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Biology Department

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The Sixteenth Annual Session

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PHYSICS DEPARTMENT

PHYSICS DEPARTMENT

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Zucchero, Peter J., Montgomery.

## THE MINUTES OF THE SIXTEENTH ANNUAL MEETING

THE SIXTEENTH ANNUAL MEETING of the West Virginia Academy of Science was called to order by the president, Professor Wallace Smith, at 10:00 a. m. on May 5, 1939, in the Ballroom, Ruffner Hotel, Charleston.

The president reported briefly on the activities of the Academy during the year just ended. His remarks also included statements concerning the policy of the Editorial Board and the News Letter sent out by the secretary. At this time the president explained that, because of the impossibility of making connections by aeroplane, Dr. F. R. Moulton, Permanent Secretary of the American Association for the Advancement of Science, could not deliver the main address of the Academy.

The treasurer stated that he was still busy with his books and would report at the Saturday morning business meeting.

The following report of the Executive Committee was read:

### THE EXECUTIVE COMMITTEE REPORT

The Executive Committee of the West Virginia Academy of Science wishes to report that:

(1) Invitations have been received from New River State, Potomac State, Salem College, Bethany College, and West Virginia Wesleyan College for the 1940 meeting on their respective campuses.

(2) The Executive Committee recommends that the 1940 meeting be held at Potomac State College on the first Friday and Saturday in May.

(3) The Executive Committee recommends that:

- (a) Miss Daisy Chapman be senior sponsor, Mr. Jack Neely be junior sponsor, and Mr. Wallace Smith be continued as treasurer for the Junior Academy of Science.
- (b) That \$20 be given to the Junior Academy by the Senior Academy for the publication of their News Letter for next year.
- (c) Names are to be submitted by the Junior Academy Awards Committee for the election of honorary members from the Junior Academy to the A. A. A. S.

(4) The Executive Committee recommends that the Legislative Committee ask the State Legislature for an appropriation of \$750 to subsidize publication of learned scientific monographs by members of the Academy of Science.

(5) Recommends that the sum of \$100 be provided to continue the work of the Biological Survey in case the W. P. A. grant

is rejected, and provided the money is available from the Academy.

(6) Recommends that members of the Academy pass on suggestions to Dr. P. D. Strausbaugh, our permanent delegate to the A. A. A. S. Conference, to give to the American Association for the Advancement of Science.

(7) Recommends that the Secretary prepare a list of the names of former guest speakers, their subjects, and the place of meetings, to be published in the Proceedings in chronological order.

(8) Recommends that it is the sense of the Executive Committee that Article 5 of the bylaws be amended so as to read:

Members who allow their dues to be unpaid for two years, having been notified of their arrearage, shall be dropped from the membership by the Executive Committee at the time of the Annual Meeting. Upon payment of arrearage they will be reinstated, or they may come in as new members by paying the initiation fee.

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The report was accepted.

The following Legislative Committee Report was read:

#### THE LEGISLATIVE COMMITTEE REPORT

At the open session of the Academy meeting on May 6, 1938, the committee received the backing of the Academy to attempt to secure a bill passed by the State Legislature making a compulsory workable sterilization law for the inmates of our state institutions for the insane and feeble-minded.

This matter was brought before the Central West Virginia Medical Association on November 22, 1938, and presented for the consideration of the State Health Commissioner, Dr. A. E. McClue. The Medical Association appointed a committee to cooperate with the West Virginia Academy of Science in drafting additional legislation concerning sterilization of mental defectives. The members of this committee, The Academy Legislative Committee, and Dr. J. J. Offner, Superintendent of the Weston State Hospital, met and drafted a bill. This bill was introduced into the House of Delegates by Mr. Ross and Mr. Powell and was passed by a majority of 62 to 14. The bill was then passed on to the Senate for their consideration at a time near the close of the session. It was hoped that a motion would be made to set aside the rules in regard to referring the bill to the Sanitation and Medicine Committee in the Senate. This was not done and the bill was referred in the regular manner to the Committee and was never presented to the Senate for a vote. The bill stirred up a large amount of comment in the State and an unexpected

amount of support was given it. The Academy Committee has on file many favorable letters from senators and representatives praising the Academy for this commendable action.

The report was accepted.

#### THE JUNIOR ACADEMY REPORT

President Smith read the report of the Junior Academy prepared by Virginia Fisher, Senior Counselor:

During the past year, eight new chapters were added, making a total of 24 active chapters with 629 students enrolled.

The Junior Academy subscribed for Science Club Service, a publication for all affiliated Junior Academies in the United States. This paper is published by the University of Illinois. The West Virginia Junior Academy received space in two issues of the paper.

In the November issue of the West Virginia School Journal, appeared a lengthy article on the activities and values of the West Virginia Junior Academy.

At the beginning of the year an emblem was selected which has appeared on all official publications. Seventy-two pins have been purchased by members since its selection.

Changes have been made in both the types of awards and the manner of judging the contestants. Two plaques will be given winners in group contests, while a key and pin will be given individual winners. A cash award will be given the chapter traveling the greatest distance and taking the largest number of members to the meeting.

Throughout the year five issues of the News Letter were published by five chapters at their own expense. The prices for publication of each issue of the News Letter ranged from \$10 to \$32.

At the beginning of the year a campaign was launched to provide funds to carry on the work of the Junior Academy. Receipts were as follows:

Northview Junior High School -----	\$ 20.00
Charleston High School -----	5.00
Kingston High School -----	10.00
South Charleston High School -----	15.00
West Virginia Academy grant -----	20.00
Dues from 8 new chapters -----	16.00
Chapter dues -----	16.00
 Total Receipts -----	 \$102.00

## Expenditures were as follows:

Stationery and letterheads -----	\$ 6.75
Postage -----	10.00
Science Club Service -----	1.50
State meeting:	
Four awards (2 plaques, key, pin) -----	24.75
Cash award -----	5.00
Printing (menu, programs, cut, tickets, place cards) -----	14.00
Twenty candles -----	2.00
Favors (mint-dollies) -----	4.60
10 guest tickets for dinner @ \$1.25 -----	12.50
Dance orchestra -----	10.00
	<hr/>
Total Expenditures -----	\$ 91.10
May 5, 1939—Balance in treasury -----	\$ 10.90

The Junior Academy wishes to make the following recommendations:

(1) that Mr. Jack Neely of Kingston High School be elected Junior Counselor for the coming year.

(2) that the Academy continue to contribute to the Junior Academy fund.

The West Virginia Junior Academy wishes to acknowledge its appreciation for the cooperation of the West Virginia Academy during the past year.

Virginia W. Fisher, Chairman.

The report was accepted.

Mr. Gerald Jenny reported concerning the present status of last year's *Proceedings* as follows:

"I regret having to report that only about one-half of the papers have been received in galley proof. These have been sent to the authors for correction. Although the printer has had the bulk of copy since January, it is impossible for him to complete the job in time for the Charleston meeting."

An invitation was read from Miss Fisher stating that the Junior Academy dinner and dance were to be held in the Daniel Boone Hotel, 6:30 p. m., at a cost of \$1.25.

President Smith was called to the hotel lobby and Vice-President Reese took charge.

Vice-President Reese then introduced the Academy A. A. A. S. permanent representative, P. D. Strausbaugh. Dr. Strausbaugh handed to each member a mimeographed eleven-page report

from the Academy Conference held in the Jefferson Hotel at Richmond, Virginia, on the afternoon of December 27, 1938. He added, in the words of Dr. Moulton, "we are not interested in what the Academies can do for the A. A. A. S. but what the Association can do for the Academies."

The report was accepted.

Chairman P. D. Strausbaugh reported for the F. E. Brooks Memorial Arboretum Committee that progress was being made in their work. He requested that he be discharged from the committee and that E. Meade McNeill be appointed as chairman for the next year.

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The report was accepted.

Dr. B. R. Weimer reported for the committee on the A. A. A. S. Grant as follows:

#### THE A. A. A. S. GRANT

The West Virginia Academy of Science Committee on Award of the A. A. A. S. Grant-in-Aid for Research Projects had presented for its consideration five projects. One project was later withdrawn. All proposed represented very worthwhile scientific investigations. On January 18, 1939, Secretary J. E. Judson received word from Mr. Sam Woodley that the A. A. A. S. Grants-in-Aid for Research allotted to the West Virginia Academy of Science for the years 1937, 1938, and 1939 were available. The sum of money for each year had been increased from \$25 to \$50. Hence your Committee had the opportunity of making three awards this year.

The Committee after careful consideration of the applications for Grants-in-Aid for Research makes the following recommendations:

That the sum of \$50 be awarded to each of the three projects herein described:

1. To: Professor J. G. Leach, Department of Plant Pathology and Bacteriology, West Virginia University, Morgantown, for continuation of the work on the problem "A Study of the Migration of the Aster Leaf Hopper (*Macrostoteles divisa* Uhl.) in Relation to the Blue-Stem Disease of Potatoes." This is an important problem to farmers in West Virginia and other potato-growing states.  
Date of application—January 9, 1939.
2. To: Professor P. J. Zucchero, Department of Biology, New River State College, Montgomery, for completion of the work on the problem

"An Investigation into the Life Cycle and Habits of a Parasitic Nematode of Poultry (*Capillaria annulata*)." This investigation was started more than two years ago, and Professor Zucchero states that with the financial assistance of a Grant-in-Aid Award he will be able to complete the final stages of experimentation on this research project.

Date of application—January 30, 1939.

3. To: Dr. Virgil G. Lilly, Agricultural Experiment Station, West Virginia University, Morgantown, for work on the problem "The Effects of Various Coals on the Growth of Green Plants." It is understood that this research will be carried on in cooperation with the West Virginia Geological Survey, Dr. Paul H. Price, Director of the Survey, having agreed to supply the different coals needed for the investigation.

Date of application—February 14, 1939.

In regard to the two other applications for Grant-in-Aid awards:

The first of these applications was one from Professor Robert C. Patterson, Department of Biology, Potomac State College, Keyser, for investigations on the problem "The Distribution of Mammals in West Virginia." A letter, date of February 13, 1939, from Professor Patterson stated that owing to his heavy teaching load and other college duties he was unable to carry on this research this year. Hence he withdrew for the present his application for a Grant-in-Aid award.

The last request for a Grant-in-Aid award received by the Committee this year was from Professor Earl L. Core on behalf of one of his students, Mr. Carroll M. Smithson, for work on the problem "A State-Wide Survey of the Trees of the Various Counties of West Virginia." The present Committee recommends this research project to the favorable consideration of the next year's Committee for the 1940 Grant-in-Aid for Research Award.

Respectfully submitted,

THE A. A. A. S. GRANT-IN-AID OF RESEARCH COMMITTEE,  
WEST VIRGINIA ACADEMY OF SCIENCE

Dean B. R. Weimer, Bethany College, Bethany;

Professor J. E. Judson, Secretary, West Virginia Academy  
of Science, West Virginia Wesleyan College, Buckhannon;

Chairman: Professor W. W. Hodge,\* Department of Chem-  
ical Engineering, West Virginia University, Morgantown.

The report was accepted.

Comments were made by Dr. Weimer in which he suggested

\*On leave of absence 1938-39 as Industrial Fellow, Mellon Institute of Industrial Research, Pittsburgh, Pa.

that qualifications for the A. A. A. S. Grant applicants should be as follows:

- (1) A member of the Academy in good standing.
- (2) Award for work where no other source is available.
- (3) Report should be made in the appropriate Academy section.

President Smith then appointed the following Committees:

*Nominations:*

P. D. Strausbaugh  
Wallace Smith  
M. L. Vest

*Resolutions:*

L. H. Taylor  
A. A. Schoolcraft  
J. H. C. Martens

*Auditing:*

J. S. V. Allen  
Peter Zucchero  
Roy C. Woods

No report came from the Activities Committee.

Since Dr. Moulton would not be present for the evening address, the presidential address was postponed until that time. President Riggelman of Morris Harvey College gave the main address of the morning session.

Beginning at 1:30 p. m. the various sections held their meetings. The papers presented are listed in the program included in these Proceedings. A Science Exhibition was held in the Ballroom of the Ruffner Hotel from 4:00 to 6:00 p. m. A Symposium of West Virginia Herpetology was held in the Rose Room of the Ruffner Hotel from 3:00 to 4:30 p. m.

At 6:15 the annual banquet took place in the Ballroom of the Ruffner Hotel.

The principal address of the evening was delivered by Wallace Smith, President of the Academy. His subject was, "The Need for Astronomical Science in West Virginia."

After his address the members and guests were entertained at an informal reception in the Rose Room of the Ruffner Hotel, sponsored by Morris Harvey College.

The second business meeting was held Saturday morning, May 6, in the Ballroom, Ruffner Hotel.

The following State Biological Survey Committee report was read by Professor Robert Patterson, secretary of the Committee:

#### THE BIOLOGICAL SURVEY REPORT

Your Committee on the West Virginia Biological Survey offers the following report:

The major item on our program for the past year has been the planning and making application for a grant of federal funds from the Works Progress Administration for the use of the West Virginia Biological Survey. As set up, the project would provide for collectors in the several counties of the State (under a trained supervisor) who would secure and preserve biological materials which would enrich the collections of the Survey and which would add materially to our knowledge of the State's biota.

Space here does not permit going into detail on the project, but Dr. A. M. Reese, Dr. Earl Core, or Dr. Leland Taylor (who, with your chairman, are co-sponsors of the project) are thoroughly acquainted with the details and will be able to give additional information. Suffice it to say here that the project has been approved by the officers of the Academy, by the State Conservation Commission, by the West Virginia Geological Survey, and by a number of members of the State Planning Board. It has passed through the local office of the W. P. A. and is awaiting action at Charleston (unless action there has been taken since this was written).

During the summer of 1938 the Survey participated (through a grant of \$100 from the funds of the Academy) in a joint collecting expedition with the Carnegie Museum, Pittsburgh, Pa. Two collectors, Mr. Neil D. Richmond and Mr. Gordon Kutchka, were in the field in West Virginia for the greater part of the summer and early fall, visiting a number of counties where relatively little biological collecting had previously been done. Dr. S. T. Brooks, of Carnegie Museum, is working up many of the results of the expedition, and Mr. M. Graham Netting and others are devoting attention to other phases of the collection. Duplicates, particularly of the amphibians, have been set aside for the Survey collections. It is worth noting that some collecting (much of it under Survey sponsorship) has now been done in every one of our 55 counties.

Following a custom instituted last year, a letter detailing biological developments within the State was recently sent to the members of the Survey. Attention was called to the recent description from West Virginia of two new species of salamanders in a number of late publications and papers dealing with phases of our biota, and to other matters of interest.

Your chairman in October 1938 attended the meetings of the West Virginia Affiliated Sportsmen's Association at Welch. He found in this organization a keen awareness of and enthusiastic

interest in the many conservation problems of the State, and respectfully suggests that our members would find a hearty welcome in the largest organized body of outdoor people in West Virginia.

Finally, your Committee desires to call special attention to the course materials in Conservation for the public schools which have been published recently. Prepared under the auspices of the State Conservation Commission and of the State Department of Schools, these courses should go far in creating and encouraging in school children a genuine sentiment for conservation.

Respectfully submitted,

Maurice Brooks, chairman

Robert C. Patterson, secretary

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The report was adopted.

Chairman Earl L. Core read the following report of the Activities Committee:

#### THE ACTIVITIES COMMITTEE REPORT

The Committee on Interim Activities of the Academy makes the following proposals:

(1) That the Academy sponsor the publication of technical monographs or popular scientific treatises prepared by members.

(2) That the Academy prepare and maintain a speaker's bureau, with especial reference to providing programs for Junior Academy chapter meetings and similar semi-popular events.

Earl L. Core, chairman

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The report was accepted.

The Auditing Committee reported:

#### THE AUDITING COMMITTEE REPORT

The accounts of the West Virginia Academy of Science were audited on May 5, 1939, and were found in order.

J. S. V. Allen

Roy C. Woods

Peter J. Zucchero

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The report was accepted.

The Resolutions Committee made the following report:

## THE RESOLUTIONS COMMITTEE REPORT

The Resolutions Committee of the West Virginia Academy of Science submits for adoption the following resolution:

Whereas the West Virginia Academy of Science has enjoyed through the efforts of various persons a pleasant and profitable meeting under the auspices of Morris Harvey College, and has received many courtesies contributing to the success of this meeting, be it

Resolved that the Academy express to Morris Harvey College and President Rigglesman, to Professor A. C. Blackwell and his local committee on arrangements, to the management of the Ruffner Hotel, and to all others who have helped to make its sixteenth annual meeting a success, its deep appreciation and thanks.

May 6, 1939

J. H. C. Martens  
A. A. Schoolcraft  
L. H. Taylor

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Professor Abreu proposed that the number of reprints of articles appearing in the Proceedings be limited by the Academy to 200 copies so as to prevent firms from buying unlimited numbers to be used for advertising purposes. Discussion by Professors Brouzas and Hall followed. It was decided to refer the matter to the Editorial Board and to request a report for the next meeting.

The names of the applicants for membership were read by A. C. Blackwell, Chairman of the Membership Committee. The list was accepted by the Academy.

Discussion was introduced by Dr. Rogers concerning the possibility of a Negro joining the Academy. Other members took part in the discussion and after considerable deliberation on the various angles of the situation, it was decided to limit membership to the White race. It was, however, clearly stated that no unfavorable reflection was meant to be cast upon the scientific work of a colored individual, or upon the race as a whole. It was further pointed out that the scientific work done by colored scientists was to be commended. It was suggested that more benefit and more suitable working conditions could be brought about with an organization made up of but one race. The secretary was instructed to convey such information to the interested parties.

The Section Committee Chairmen reported as follows:

Biology, 36 present, C. C. Fenton, chairman; for 1940, W. J. Sumpstine.

Chemistry, 46 present, W. H. Walker, chairman; for 1940, John A. Gibson.

Geology, 17 present, J. C. Lucke, chairman; for 1940, William A. Staab.

Mathematics and Physics, 15 present, J. S. V. Allen, chairman; for 1940, L. H. Chambers.

Social Science, Group I, 28 present, F. R. Gay, chairman; for 1940, M. S. Cushman.

Social Science, Group II, 35 present, A. A. Schoolcraft, chairman; for 1940, Frank S. White.

President Smith then appointed the following committees to serve for the coming year:

#### COMMITTEES FOR 1939-40

Legislative: A. J. Dadisman, J. E. Judson, Perce Ross, H. O. Van Tromp, Wallace Smith.

Junior Academy: Daisy Chapman, Senior Counselor; Jack Neely, Wallace Smith.

Membership: A. C. Blackwell, Robert C. Patterson, E. Meade McNeill, Nelle Ammons, Frank Gilbert, J. E. Judson.

Activities Committee: Earl Core, Z. R. Knotts, George R. Hunt, F. E. Brooks Garden: E. Meade McNeill, S. E. Neese, P. D. Strausbaugh.

A. A. S. Grant: B. R. Weimer, J. E. Judson, R. B. Dustman.

State Biological Survey: A. M. Reese, Maurice Brooks, Frank Gilbert, J. E. Judson, S. B. Talbot, H. D. Bond, B. R. Weimer, C. M. Roberts, E. R. Grose, E. Meade McNeill, L. M. Peairs, R. C. Patterson, A. P. Handlan, H. W. Shawhan, A. B. Brooks, Earl Core.

Preservation of Wild Life: A. B. Brooks, P. C. Bibbee, A. J. Dadisman, N. B. Green, S. B. Talbot.

Chairman P. D. Strausbaugh reported for the Nominations Committee:

"Your Committee recommends that the following men be elected to serve as officers of the Academy for the coming year: President, A. M. Reese; Vice-President, Frank S. White; Secretary, J. E. Judson; and Treasurer, C. G. Brouzas."

This report was accepted and the secretary was instructed to cast the ballot of the Academy for these men.

Retiring President Smith then introduced the new president, who spoke briefly.

The meeting adjourned and excursions were made to the following places:

Westvaco Chlorine Products Corp.  
United Carbon Co.

## THE GENERAL PROGRAM OF THE CHARLESTON MEETING

FRIDAY, MAY 5, 1939, BALLROOM, HOTEL RUFFNER

Welcome by President L. L. Riggleman of Morris Harvey College. Reply by Professor A. M. Reese, followed by the address of President Wallace Smith, "The Need for Astronomical Science in West Virginia."

### THE MEETINGS BY SECTIONS

#### *Biology*

(Botany, Zoology, Physiology, Medicine, Agriculture)

- I. A. Miles: Zoology and the pre-medical student.  
Hazel C. Cameron: Vitamin A and nightblindness. (Some studies on college students.)  
G. A. Emerson and B. E. Abreu: Studies with cannabis.  
B. E. Abreu, G. A. Emerson, and C. C. Fenton: Pathological changes in addiction to ethanol, morphine, and cocaine.  
C. C. Fenton: Lesions of the Uterus, a pathological survey. (Exhibit.)  
Leland H. Taylor: The vespinae or yellow jackets and hornets of West Virginia. (Exhibit.)  
A. M. Reese: The black widow spider. (Exhibit: male and female black widow spiders and glands of the same.)  
E. E. Myers: Anisotropic lipoids.  
W. J. Sumpstine: Plant ecology in Tomlinson Run State Park. (Illustrated with lantern slides.)  
J. E. Judson: A biology field study tour to Florida. (Illustrated with colored movies.)

#### *Chemistry*

(Chemistry, Chemical Engineering, Pharmacy)

- Friend E. Clark: William Prout, 1785-1850.  
R. L. Sibley: The Nitro plant of Monsanto Chemical Company.  
W. T. Nicholas: The Chlorinated hydrocarbons and their industrial applications.  
G. L. Roberts: Industrial carbon black.  
D. J. Beaver: Industrial applications of surface tension reducing agents.  
Dwight Williams: Quantitative measurements with the photoelectric colorimeter.  
R. B. Dustman: Retarding rancidity in stored black-walnut kernels. (A second report.)

Laurence L. Layton, A. R. Collett, and C. L. Lazzell: A new type of molecular still for research purposes.

A. H. VanLandingham: The relative value of the proteins in some feeds commonly used in poultry rations for growing chicks.

Wm. M. Hutchinson, C. L. Lazzell, and A. R. Collett: Some derivatives of p-benzaldehyde sulfonic acid.

Raymond Cyrus White and Earl C. H. Davies: A new apparatus for use with the glass electrode when pH determinations are made on unbuffered solutions.

O. W. Shannon, C. L. Lazzell, and A. R. Collett: Condensation of creatinine with certain halogen-substituted acids. Additional evidence for structure of methyl creatinine.

Virgil Greene Lilly: Fungi for thiamin (vitamin B<sub>1</sub>) assay.

John A. Gibson, Jr.: Some reactions of triethanol amine with inorganic salts.

Gordon A. Bergy: The application of the cellulose esters in the pharmaceutical arts.

#### *Geology and Mining*

(Geology, Archæology, Geophysics, Coal, Oil Engineering)

James H. C. Martens: Sulphate minerals in West Virginia. (Illustrated by lantern slides and exhibit.)

Robert B. Lafferty: Structural and depositional cross sections through the Appalachian geosyncline. (Illustrated by lantern slides.)

Paul H. Price: Cone-in-cone in coal. (Illustrated by lantern slides and exhibit.)

W. A. Staab and Carl Lamb: Research projects in the School of Mines, with special reference to chemical treatment of coal and effects of ash fusion. (Illustrated by lantern slides.)

John B. Lucke: How can geologic field experience be acquired?

J. R. Lockett: Northeastern United States basin area and the genesis of structures. (Illustrated by lantern slides.)

Dana Wells: Mastodon remains near Crum, West Virginia. (Illustrated by lantern slides.)

Edward T. Heck: Metamorphosed Devonian coal lentil in Tucker County.

C. D. Hunter: The Maxon sand Mauch Chuck outlier.

#### *Mathematics and Physics*

(Mathematics, Astronomy, Physics, Mechanical Engineering, Electrical Engineering)

R. C. Colwell and A. W. Friend: The sand figures on circular plates. Part I. The experimental equipment.

J. K. Stewart and H. Arnett: Part II. The mathematical theory.

William H. Erskine: A solution of the diophantine equation  $x^2/Ay^2 = z^2$ .

J. S. V. Allen: Spectroscopic problems.

M. L. Vest: A family of cubics associated with the orthocenter of a visible triangle.

Ernest C. White: Notes on conic construction.

Michael A. Pinto: Mechanical trisector.

*Social Sciences, Group I*

(Philosophy, Philology, Economics, History, Sociology)

James T. Laing: Trend in the drain of talent out of the Virginias.

William K. Woolery: The last public service of James Madison.

Edwin Blum: Objective methods in the social sciences.

C. E. Roth: The divisional course in the social sciences at Morris Harvey.

Harry M. Brawley: Using the federal taxing power for police regulation.

Charles C. Harper: The trend of management integration in federal administration.

T. L. Harris: Some basic conditions or factors which produce dependency in West Virginia.

A. J. Dadisman: The Chesapeake and Delaware canal.

O. M. McMillion: The Alaska coal conservation controversy.

E. W. Eckard: W. S. Jevons' contributions to statistical methods.

Henry M. Dater: The past and the present: an interrelationship.

M. S. Cushman: Huey P. Long in the lame duck Congress of 1932-1933.

C. G. Brouzas: West Virginia public and college libraries.

*Social Sciences, Group II*

(Education, Psychology)

J. Ned Bryan: Starting an evaluation program in a secondary school.

Richard E. Hyde: State aid and teacher qualifications.

Andrew Leitch: A comparison of the ranking of college freshmen on psychological examinations with their high-school academic ranking.

Andrew Leitch and Ethel Schafitz: The weekend behavior of one hundred college girls.

J. F. Marsh: Need for simplicity in textbooks in psychology.

Frank S. White: Using the ophthalmograph and metronoscope to improve the reading of college students.

Roy C. Woods: Educational development in West Virginia.

A. F. Young: A test in arithmetic terminology.

*Symposium on West Virginia herpetology*

N. Bayard Green: The four-toed salamander, *Hemidactylium scutatum*, in West Virginia.

M. Graham Netting: Reptiles killed during a "vermin" campaign.

# Papers Read at the Charleston Meeting

## *The Biology Section*

### Summary of the Findings of 100 Autopsies

C. C. FENTON

*Department of Pathology, West Virginia University*

**N**ECROPSIES are performed to determine the cause of death and to study the lesions of disease. The latter is the main purpose for which autopsies are performed by the staff of the Department of Pathology at West Virginia University. Besides fresh surgical material obtained from operations, the autopsies furnish our principal means by which gross pathology can be taught. The lesions are also studied histologically, and from the macroscopic and microscopic examinations conclusions are reached concerning the most important lesions and the most likely cause of death.

The series of 100 necropsies which is presented were performed over a period of several years. Cases of poisoning, trauma, or medico-legal interest of infants and children are not included. The ages range from 13 to 87 years. There are 70 males and 30 females. Four of each sex are colored.

The lesions are recorded according to the principal cause of death although it may not be the immediate cause of death. For example, the individual died from pneumonia but would have died at a varying interval of time from cardiac or renal disease. The causes of death are classified according to systems, such as the cardio-vascular, respiratory, etc., with the exception of malignancies, which are grouped together. The organs in which the new growths occurred are listed separately. The number of cases of each system are listed as well as the ages. The average age is given when it appears to be of significance.

The principal causes of death are listed as follows:

I. Cardio-vascular system: 20 cases, 16 males, 4 females.

A. Non-infectious heart disease, 4 cases

Cardiac failure; hypertrophy and dilatation of heart, passive hyperemia, edema, etc.; male 41, 52, female 60; male 35, clinical diagnosis of essential hypertension.

B. Infectious heart disease, 1 case; female 51; mitral stenosis, acute bacterial endocarditis, 1 case male 65; subacute bacterial endocarditis with multiple infarcts, 1 case; male 41.

C. Cardio-vascular syphilis, 7 cases. Average age: 51

Syphilitic heart disease, hypertrophy, aortic insufficiency, etc.; male 41, 43, 55, 57, 63; syphilitic aortitis with aneurysm, 2 cases; male 43, female 55.

D. Disease of coronary arteries:

Coronary sclerosis and occlusion, 6 cases. Average age 58; male 49, 63, 55, 56, 65, 70.

II. Respiratory system: 12 cases

Pulmonary apoplexy (massive hemorrhage), 2 cases; male 33, 67; pulmonary infarction, 3 cases, male 56, female 64, with ante-mortem cardiac thrombi, female 17; pneumonia, 6 cases; male 57, 61, 63, 86, 87, female 37; pulmonary tuberculosis, 1 case; female 36.

III. Gastro-intestinal system, liver and pancreas included, 12 cases; chronic gastric ulcer with pyloric stenosis, 1 case; female 63; perforated duodenal ulcer, 2 cases; male 29, 53; mesenteric thrombosis with gangrene of intestine, 1 case, female 62; acute ulcerative enteritis with perforation, 1 case, female 23; ruptured gangrenous appendicitis, 2 cases; female 13, male 53; stenosis of sigmoid colon due to bands, 1 case; female 72; obstructive biliary cirrhosis (ascites, esophageal varices) 1 case, female 51; acute pancreatitis, 2 cases; male 30, 35.

IV. Uro-genital system: 6 cases; acute suppurative nephritis (cystitis, prostatitis, etc.) male 57; chronic glomerulonephritis, 1 case, male 75; nephrosclerosis, 3 cases; male 52, 55, female 80; stricture of urethra (cystitis, ascending inflammation) 1 case, male 72.

V. Nervous System: 10 cases

Sub-dural hemorrhage, male 31, 62; subarachnoid and intraventricular hemorrhage, female, 47; intra-cerebral hemorrhage, right parietal lobe, male 52; rupture of aneurysm of anomalous and tortuous vessel, female 19; infarct of brain, male 47; chronic syphilitic meningitis, male 41; tuberculous meningitis, male 25; disseminated sclerosis, male 59.

VI. Malignancies: 29 cases; males 24 cases, females 5 cases.

Average age: 53.5 years. Lung, 6 cases, all males, 27, 49, 50, 53, 60, 76, average age 53.5; stomach, 6 cases, males 43, 47, 58, 70, 75, female 53, average age 57.6; pancreas, 4 cases, male 27, 43, 52, female 48, average age 42.5; intestines, 3 cases, male 72, 78, female 24, average age 58; testis, 1 case, 53; prostate gland, 2 cases, 52, 65; penis, 1 case, 53; ovary, 1 case, 45; hypernephroma, 1 case, male 63; sarcoma of liver, 1 case, male 72; sarcoma of prostate, 1 case, 68; lymphosarcoma, primary in lymph nodes, 1 case, male 23; primary in stomach, 1 case, female 50.

VII. Blood Dyscrasias: 3 cases, all males; pernicious anemia 44, chronic lymphatic leukemia, 53, agranulocytosis, 57.

VIII. Other Diseases, 7 cases:

Puerperal sepsis, 5 cases, 23, 25, 26, 27, 37, average age, 27.6; Hodgkin's disease, 1 case, male 44, undulant fever, (clinical diagnosis), 1 case, female, 74.

In this series of 100 post-mortem examinations, many of the usual causes of death such as cardiac, renal, pulmonary disease, etc., are observed. Malignancies accounted for 29 percent of the deaths, which is a rather large proportion. The very rare conditions which were found are sarcoma of the liver and prostate. The uncommon conditions which were seen are mesenteric thrombosis, carcinoma of the penis and testis, hypernephroma, and agranulocytosis.

## Vitamin A and Nightblindness: Some Studies on College Students (An Abstract)

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**N**IGHTBLINDNESS from too little vitamin A in the diet is not a myth, but one of the earliest signs of a lack of this vitamin and a hazard in night driving. The lights of approaching automobiles bleach out the visual purple in the eye of a driver, by which vision normally takes place, so that for a few seconds he is blind to objects on the road. With an abundant store of vitamin A, visual purple quickly regenerates after bleaching by light and vision is rapidly restored. The less vitamin A in reserve, the longer the period before vision is normal and the greater the danger of hitting unseen objects on the road. A driver with nightblindness seldom realizes that his period of recovery from a bright light is longer than normal.

With an instrument called a biophotometer it is possible in 30 minutes to measure in light units the reserve store of vitamin A by a simple visual test. By such an instrument, lack of vitamin A reserve can be detected very early and corrected before it becomes dangerous to health or hazardous in night driving.

Biophotometer tests on a group of 28 students in home economics classes showed a normal reserve store of vitamin A in 17, borderline in 5, and definitely low in 6. These six had readings low enough to indicate nightblindness and a potential hazard in night driving. One of the six was able to bring her reading up to normal in four weeks by changing her boarding house to one which gave more green and yellow vegetables and more milk, two improved theirs by increasing milk consumption to one quart daily; the other three showed rapid improvement after six weeks use of codliver oil or halibut liver oil, rich sources of vitamin A. In every case, normal readings were obtained after the vitamin A consumption was increased, whereas the readings which were normal remained so at subsequent tests.

In a group of 14 physical education girls, even more showed low reserve of vitamin A, 64% being borderline or low as against 39% in the home economics group.

While the numbers are small, it appears that education in food values is a help in avoiding deficiencies and that it needs to be extended.

By such a simple and objective test as the biophotometer, it is possible to determine when one is securing an adequate amount of vitamin A or when even a mild deficiency is present so that nightblindness occurs.

## Treatment of Decreased Blood Coagulability Following Inhalation of Fumes of Crude Sulfuric Acid

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THE OBSERVATION has been made by one of us (J.E.S.) that workers engaged in "pickling" processes in steel mills often show a prolonged bleeding time, and consequently are sometimes incapacitated by very minor injuries. The "pickling" process involves the use of crude sulfuric acid in a heated treatment bath. It appeared possible that inhalation of fumes from the treatment bath might be responsible for the blood effects.

An exposure chamber was devised in which animals could be subjected to a constant flow of vapor from crude sulfuric acid. The chamber proper was a large sealed cylinder of about 40 l. capacity, connected through one outlet to a vacuum pump and through the other to a bubbling device which could be maintained at any desired temperature. The crude sulfuric acid used was the same material as is used in commercial steel-pickling vats.

Preliminary blood coagulation studies were made on rabbits before and after treatment, by both the capillary and the pour methods. The capillary method proved to yield the most uniform results, and so most of the further work was done with this method alone.

Twenty-six rabbits were exposed to vapors from heated crude sulfuric acid for various periods of time, and the following effects were noted. Such treatment for a period of 30 minutes to 1 hour results in an increase in blood coagulation time of from 160 to 430 percent. Increase in the duration of exposure usually results in a further, relatively small, increase. Cessation of exposure is followed by a rapid fall but to a level somewhat higher than the normal level. Control experiments were run on 2 rabbits with vapor from heated C. P. sulfuric acid, for an exposure time of 1 hour. Not only was no rise in blood coagulation time noted, but a significant drop occurred. Similarly, 2 rabbits treated for 1 hour within the exposure chamber when only hot water was present in the bubbling device showed no increase in blood coagulation time. The decrease which occurred in both cases probably is due to liberation of adrenin incidental to the excitement and manipulation of the rabbits. Since an ample flow of air was maintained, and the fumes were not sufficiently irritant to produce lung damage, anoxemia could not be a factor. The experiments with crude sulfuric acid are probably less striking than they would be if the excitement factor could be eliminated.

Calcium therapy, both with calcium gluconate and calcium chloride, apparently has been tried against the condition in humans, without success. Therefore no experiments were attempted in which a rise might be produced in the level of ionized calcium in the blood of experimental animals exposed to sulfuric acid fumes. The present study was designed solely to test the effects of fibrinogen administered by mouth in doses of 3 ml. of Oral Fibrogen, Merrell.<sup>1</sup> Ten rabbits were so treated, and it was regularly noted that treatment with fibrinogen greatly reduced the increased blood coagulation time.

Two representative experiments may be quoted. In each, 2 rabbits were kept as controls while 2 were treated with fibrinogen during the course of the experiment. In the first, in which exposure was continued for 3 hours, the average blood coagulation times of the 2 control rabbits were 425 and 580 percent of their normal values at 1 and 3 hours respectively. After a rest period of 1 hour, without further exposure, the value dropped to 480 percent. The experimental rabbits showed average increases of 430 and 550 percent at 1 and 3 hours respectively; but, when treated with fibrinogen immediately after the third hour and then allowed to rest an hour, the coagulation time dropped to 250 percent of the normal. The second experiment showed more striking results. The rabbits were exposed for 2 hours, and fibrinogen was given to 2 after the first hour of exposure, the exposure then being continued. The control rabbits showed average increases of 160 and 250 percent at the end of the first and second hour, respectively; on discontinuing exposure, the average coagulation time at the end of an hour was 95 percent of normal. In those treated with fibrinogen, however, the average values were 260, 47, and 35 percent of normal at each of the 3 hours, respectively. This latter experiment demonstrates a very high activity of orally administered fibrinogen, if given in massive doses; the effect seems especially notable if the coagulation time is not first increased to too great a degree.

Variations in response to the same degree of exposure, such as may be noted between the control values in the 2 experiments quoted above, suggest that the crude sulfuric acid may lose its effect when used for extended periods. This factor was not controlled in the above experiments, because this has no effect on the significance of the results, since both the control and the fibrinogen-treated rabbits of each group were exposed at the same time. It was felt, however, that repeated exposure to the same preparation of crude sulfuric acid might show a loss of its activity, and at the same time might roughly imitate conditions of chronic exposure to which mill workers are subjected. The experimental conditions are not identical with those in mill prac-

<sup>1</sup>The authors are indebted to Dr. E. G. Gerwe and Mr. N. M. Phatak of the William S. Merrell Co. Research Laboratories for their generosity in supplying the "oral fibrogen" used in these experiments.

tice, since the workers are exposed to fumes from constantly freshened crude sulfuric acid.

Two of a number of chronic exposure experiments may be used for illustration. In the first, 2 rabbits were exposed for 2 hours a day to fumes of crude sulfuric acid. On the fifth day, the average coagulation time, taken immediately after exposure, was 260 percent of the normal, while on the seventh day it had dropped to but 120 percent of the normal. That this was not due to habituation or other compensatory mechanisms in the rabbits but to depletion of the active agent in the sulfuric acid was shown by the value of 285 percent on the ninth day, after substituting fresh sulfuric acid, and of 340 percent on the thirteenth day, again after using fresh sulfuric acid. On the following day, on which exposure was omitted, the blood coagulation time returned to 91 percent of normal. In the second experiment, 4 rabbits were exposed for 1 hour daily for 2 weeks; fresh solution was substituted every 3 days. The coagulation time remained high throughout the period, and was 40 percent above normal even after 3 days following the last exposure.

Fibrinogen was administered to several rabbits repeatedly treated with sulfuric acid fumes, and in every case it exerted a marked effect.

While the present study was designed solely to discover an agent which might be used clinically in the control of the anticoagulant action of sulfuric acid fumes in man, certain theoretical points should be pursued further to indicate the most efficient agents for treatment. A necessary preliminary step is the identification of the substance present in crude sulfuric acid and not in the C. P. sulfuric acid which is responsible for the effect. The mechanism of action is yet imperfectly known. Blood calcium depletion apparently is not a factor. Tissue fibrinogen appears to be an efficient antidote, from the present experimental study, even when given by mouth. On the other hand, Zunz and his coworkers (1, 2) have found that in the anticoagulant actions of compounds of sulfur with gold or mercury, the fibrinogen content of the blood is altered relatively little, and that their effect may be due chiefly to an interference with the formation of thrombin. It is known, however, that whatever substances, with the possible exception of calcium, are increased in the blood coagulation mechanism, mass action effects result in a speeding of the entire process. Thus, fibrinogen may be effective in relieving the decreased coagulability even though the blood fibrinogen content is not primarily affected by the inhalation of fumes of crude sulfuric acid.

Clinical application of the present results is considered justified. Further, the topical application of fibrinogen is recommended in affected patients who become injured, in preference to epinephrine or other similar local hemostatics.

## SUMMARY

Inhalation of fumes of crude sulfuric acid results in a marked decrease of coagulability of blood of rabbits, while fumes of C. P. sulfuric acid have no such action. Oral administration of massive doses of tissue fibrinogen is effective in controlling the condition.

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The Hornets and Yellow-Jackets (Vespinae)  
of West Virginia

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ONLY TWO SPECIES of Vespinae are recorded from West Virginia in Bequaert's synopsis (*Entomologica Americana*, XII, n.s., pp. 71-138, 1931 [1932]). Dr. Bequaert has urged me to add the following distributional data from the specimens that are available. These include those in my own collection and in that of the West Virginia University Department of Entomology, which I have examined through the kindness of Dr. L. M. Peairs. Although the material has not been extensive, the list is believed to be fairly complete. It is to be hoped that the great gaps in the distributional data will be filled by the more intensive collecting which I shall undertake in the near future.

The genera and species are arranged according to Bequaert's check-list (*Bull. Brooklyn Ent. Soc.*, XXX, pp. 119-124, 1935), to which the numbers refer.

SUBFAMILY VESPINAE

Genus VESPA Linnaeus

1. *Vespa crabro* var. *germana* Christ.

The great European hornet, introduced about 100 years ago into the United States, and now fairly well established in southeastern New York, southwestern Connecticut, and northern New Jersey, has also been recorded from localities in eastern Pennsylvania, eastern Maryland, Delaware, and eastern Virginia. The most recent published records I have seen place this wasp no nearer than 100 miles from the eastern end of West Virginia. I therefore doubtfully include this species, although there is a queen in the University collection, which was sent in from the eastern part of the state, presumably from a locality not far from Winchester, Virginia. The exact place of capture is not known. This seems to be rather an enormous spread for an insect which has made such slow gains in distribution over a period of 100 years. The record should be substantiated by additional specimens. It is quite within expectation that the giant hornet should appear first in the Potomac drainage system, for this seems to be one of the chief routes of dispersal of eastern species into the state.

## Genus VESPULA C. G. Thomson

## Subgenus VESPULA

1. *Vespula vulgaris* (Linnaeus)

The occurrence of this species, which, according to Bequaert (*loc. cit.*, 1932), is the more common of its subgroup in the Canadian Zone, is established through one indubitable male in the University collection, from Monongalia County. Queens, one each from Morgantown (Monongalia Co.), Ravenswood (Jackson Co.), and Berkeley Springs (Morgan Co.), also apparently belong here, though the identification of both queens and workers is always uncertain in this species.

2. *Vespula maculifrons* (R. du Buysson)

There is no male specimen to identify this species positively, and Bequaert's specimens so determined were of the other sex. This species is the Upper and Lower Austral and Transition Zone relative of *V. vulgaris*, from which it is distinguished only with difficulty in the queen and worker caste. The several queens and workers at hand are all less melanistic than those of *vulgaris*, and nearly all have yellow, often extensive, on the propodeum. I therefore tentatively place them here. Localities: Harper's Ferry (Jefferson Co.), Burlington (Mineral Co.), Summersville (Nicholas Co.), Smoke Holes (Pendleton Co.), Terra Alta and Cranesville Glades (Preston Co.), Monongalia County, and Ravenswood (Jackson Co.).

4c. *Vespula rufa* var. *vidua* (H. de Saussure)

This variety is either not very common in West Virginia, or because of its small colonies and concealed nests, not often discovered. In Massachusetts I saw one nest of this species underground; a nest in West Virginia was built in a fallen and rotted log. Queens, workers, and males have been taken in Morgantown (Monongalia Co.) and workers from a nest near Berkeley Springs (Morgan Co.)

4e. *Vespula rufa* var. *consobrina* (H. de Saussure)

The variety *consobrina*, like *vidua*, is either uncommon or seldom encountered because of concealment. I once collected a nest of this species in Massachusetts from its underground location. Specimens representing all castes are from: Thorne Creek, near Franklin (Pendleton Co.), Terra Alta and Cranesville Glades (Preston Co.), and Monongalia County.

6. *Vespula squamosa* (Drury)

I have taken only three specimens of this wasp, all queens, and all from the Potomac drainage. Locally this wasp seems to be known familiarly as the yellow "hornet," and it is said by untrained but perhaps reliable observers to have been more common

in the past. The queens apparently fly rather late in June. One, which was found evidently at home in a nest of *V. rufa* var. *vidua*, is discussed in a paper published elsewhere.<sup>1</sup> Localities: Burlington Junction (Hampshire Co.), Berkeley Springs (Morgan Co.), and Franklin (?) (Pendleton Co.).

Subgenus DOLICHOVESPULA Rohwer

8. *Vespula maculata* (Linnaeus)

The bald-faced or white-faced "hornet" is probably by far the most common and widespread species of the subfamily in the state, despite the paucity of specimens in the collection. It seems to thrive even in seasons which are unfavorable to the development of other aerially nesting species. It will probably be found all over West Virginia. Specimens in the collection are from Camp Woodbine (Nicholas Co.), Smoke Holes (Pendleton Co.), and Greer (Monongalia Co.).

9. *Vespula arenaria* (Fabricius)

This and the following form are so closely allied that Bequaert (*loc. cit.*, 1932) is not certain that they are distinct. I have arrived at the determination of the specimens here listed by a study of males and workers from several nests. The males are readily distinguishable by means of the genitalia from those of *norwegica* var. *norvegicoides*; but I have been unable to find queens or workers with the markings and the characteristic clypeus which Bequaert ascribes to the latter. I have taken and studied fourteen or more nests of this species in Massachusetts and in West Virginia. All these nests have been aerial (on trees or buildings), on low shrubs near the ground, in rock crevices, or under overhanging turf of roadsides or ditches. I have never found them underground. Males, certainly of this species, have been found in the following localities: Back Creek (Berkeley Co.), Smoke Holes (Pendleton Co.), Terra Alta (Preston Co.), Elkins (Randolph Co.), Monongalia County. Queens or workers, probably of this species, are from these additional localities: Camp Woodbine (Nicholas Co.), Thorne Creek, near Franklin (Pendleton Co.), Sleepy Creek (Morgan Co.), and Cranesville Glades (Preston Co.). This is also recorded by Bequaert.

10a. *Vespula norwegica* var. *norvegicoides* Sladen

Typically a Canadian Zone wasp, this is evidently rare in West Virginia. I have one indubitable male from Monongalia County, but have been unable to ascribe any queen or worker to this species.

11. *Vespula adulterina* var. *arctica* Rohwer

This social parasite of *V. arenaria*, without a worker caste

<sup>1</sup> Ann. Ent. Soc. America, XXXII, pp. 304-315, 1939.

and incapable of founding and rearing its own colonies, is periodically common along with its host. The habits of this species were discussed by Wheeler and me (*Psyche*, XXVIII, pp. 135-144, 1921) some years ago, and further observations of mine are published elsewhere.<sup>2</sup> Localities: Back Creek (Berkeley Co.), Camp Woodbine (Nicholas Co.), and Monongalia County.

I shall be glad to add to the distributional data by studying and identifying properly pinned and labeled specimens sent to me by interested persons. Since some of the problems of identification will be solved by the study of complete colonies, I should also like to be informed of the locations of active colonies that may be encountered, particularly in late July and in August.

<sup>2</sup> *Iâem.*

## Anisotropic Lipoid

E. E. MYERS

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TISSUES OF MANY PLANTS and animals are doubly refracting and show as bright structures against a dark background when viewed under the polarizing microscope. A very interesting group of anisotropic substances is a certain lipoid found in the human body. This occurs normally in the corpus luteum of the ovary, in the adrenal glands, and is said to be present in brain and other nerve tissue. It is apparently an ester of cholesterol and by usual microscopic examination appears as ordinary fat globules, but between crossed Nicol prisms stands out as bright "maltese" (or perhaps more properly, pattée) crosses against a black background. In disease it has been reported (2) to occur in many structures, as in cysts of the thyroid gland, and ovaries, in malignant tumors, the kidneys and urine in nephritis and nephrosis, the arteries in arteriosclerosis, and in the gall bladder in that condition known as cholesterosis.

### APPARATUS

Careful technique in setting up and manipulating the equipment is necessary properly to demonstrate this lipoid. The difficulties are comparable to the dark field examination in this respect, but the result rivals the dark field in brilliance of demonstration. A good light is essential and we have found the Spencer research model microscope lamp very satisfactory, although any used for the dark field will probably work well. Nicol prisms are much better than polaroid, although the latter is inexpensive and will give fair results. It is very convenient to have the polarizing prism in a metal tube soldered or threaded to a flange which sets in the blue glass ring on the substage of the microscope. This arrangement permits use of the condenser, which is essential for good lighting and definition. Also, the polarizer can be swung out or be removed readily for ordinary use of the microscope. A cap analyzer is preferable, as it can be removed to permit focusing, location of desirable fields, and ordinary bright field work. Examination of the optical parts of the microscope should be made for undesirable effects on polarized light (3). For testing purposes, examination of a cover-glass preparation from an egg yolk is satisfactory, as this contains lipoid showing the crosses referred to above.

### PRESENT STUDY — PRELIMINARY REPORT

The studies which we have made include examinations of

various secretions, materials, and pathological specimens received in the laboratory. Particularly, examination of bile from duodeno-biliary drainage for these lipoid bodies has been made with a view toward aiding in the diagnosis of cholesterosis of the gall bladder. Materials in which lipoid was present, in addition to those found reported, include sputum in lung abscess; endometrium in chronic endometritis; material from tuberculous salpingitis; pathological placental tissue; cyst fluid from fallopian tube; pus from tonsils; scrapings from cervical erosion; mucous membrane in an appendix showing acute and chronic inflammation; pus from prostatic tissue; and certain specimens of stomach contents, duodenal contents and bile.

#### PREPARATION OF MATERIAL

All specimens were examined in the fresh state, using scrapings, fluid, or sediment. A small amount was placed on a slide, covered with a cover glass which was pushed down to give a thin layer. (Apparently the studies on lipoid in tissues which have been reported were with frozen sections.)

#### LIPOID IN BILE

The deposits on and in the mucous membrane of the gall bladder, producing the strawberry appearance, to which the term cholesterosis has been applied, are known (1) to be doubly refracting and to show the bright "maltese" crosses under the polarizing microscope. Since these deposits are usually superficial and delicate, it might be expected that particles would be detached more or less continually and dispersed in the gall-bladder bile.

Centrifuged sediment of bile from two strawberry gall bladders removed at operation showed in each case several doubly refracting lipoid globules, occurring singly and in groups. In fourteen bile drainages, three have shown lipoid bodies in the "B" bile fractions. The patients in these instances had other findings and symptoms compatible with cholesterosis of the gall bladder. This corresponds to the published incidence of cholesterosis as being 20 to 25 percent of diseased gall bladders (4, 5), although, of course, this does not necessarily mean much because of the small number of cases studied.

Care must be exercised in evaluating possible contamination with duodenal and stomach contents which may contain lipoid, and these should be examined at the same time as the bile. There are seen, especially in gastric specimens, partly formed and irregular crosses, and the significance of these remains to be determined.

## CONCLUSION

It would appear that examination for anisotropic lipid bodies in the bile from duodeno-biliary drainage might help considerably in the diagnosis of cholesterosis of the gall bladder. There is indication for further work in this direction.

The basis for the formation of doubly refracting lipid seems to be due, in many instances, to degenerative changes. Therefore study of secretions such as gastric contents may aid in the diagnosis of chronic inflammatory processes.

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## *The Chemistry Section*

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### The Nitro Plant of the Monsanto Chemical Company

R. L. SIBLEY

*Monsanto Chemical Company, Nitro*

THE YEAR 1939 marked the centenary of the discovery of the vulcanization of rubber, a discovery identified as one of the outstanding inventions of the past century. By this invention Charles Goodyear transformed a natural product of little usefulness into such an important article of commerce that the industry manufacturing the 30,000 or more rubber articles, many of which enter into the daily life of everyone of us, has developed into one of the few billion-dollar industries of the country. In addition to showing that by heating rubber with sulfur an improved product devoid of stickiness and possessing elasticity and high tensile strength could be produced, Goodyear also showed that this so-called vulcanization process could be hastened by means of inorganic oxides, particularly litharge, lime, and magnesia. It was not until 1912 that a further important advance was made in the vulcanization process, when Oenslager, a chemist employed by The B. F. Goodrich Company in Akron, discovered that aniline as well as other organic bases were even more powerful than the inorganic bases then employed as vulcanization accelerators. This invention was operated for some time as a secret process but other rubber companies soon recognized the development and shortly after that time thiocarbanilide, or diphenyl thiourea, hexamethylenetetramine, and anhydro formaldehyde aniline were in use as accelerators. All of these products are more powerful than aniline as accelerators and offer other advantages in being less toxic and easier to handle in the plant.

In December 1921 four employees of The Goodyear Tire and Rubber Company, Mr. C. O. North, a rubber compounder, Mr. C. N. Hand, a chemical engineer, Mr. R. C. Hartong, chief chemist and, Mr. C. W. Bedford, research director, recognized that a field existed for supplying specialty chemicals to rubber companies. They incorporated The Rubber Service Laboratories Company for the manufacture of such products. The plant of this company was located at Nitro in this State early in 1922. The founders of this company with broad vision further conceived the idea of selling their products by demonstrating through laboratory tests the usefulness of their products and means of employing them. So successful was this idea that other competitors

in this and other countries have been forced to adopt the same practice. In fact one foreign company not only adopted the idea of customer service work but also very closely imitated the name of the American company. Our company at present maintains a laboratory in Akron, Ohio, engaged solely as a service laboratory for our many customers where plant problems are solved and rubber stocks developed to meet the various specifications required. Of course in such test work our own products are utilized in every manner possible. This service is carried out without charge or obligation to the customer.

From the start, Rubber Service was a success and grew rapidly. In 1927 they purchased the plant of the Southern Dye-stuffs Company at Nitro and in 1929 they sold their business to Monsanto Chemical Company of St. Louis, who have operated the Nitro plant since that time. The plant at Nitro has expanded greatly in the past ten years. It will be interesting briefly to consider the types or variety of products manufactured by Monsanto at Nitro. Incidentally all of our products commercially are employed in but small proportions, ranging for 0.1% to no more than 1.5% by weight of the total product marketed by a customer. The various products manufactured at Nitro by Monsanto may conveniently be considered as catalytic in action, some acting as positive catalysts to produce a certain desired effect, while others are negative catalysts, utilized to prevent some harmful action from taking place or materially overcoming or delaying the deleterious effect of such undesired action.

The first accelerators produced by Rubber Service were of the aldehyde-amine type, which products are described as the aldehyde derivatives of Schiff's bases and are obtained by condensing formaldehyde, acetaldehyde, and butyraldehyde with aniline, and variations thereof. Although seven such products are still produced, they are of relatively minor importance as they have been replaced for the most part by other more active products. Five other such aldehyde-amine products which were of importance only a decade ago have been entirely discontinued during the past few years. At this point it might be well to emphasize that accelerators or catalysts of the vulcanization of rubber are highly selective in effect and must be chosen by the rubber compounder to produce the desired effect depending upon the time and temperature of vulcanization as well as on other compounding ingredients that are present. Thus one accelerator may be best suited for use in tire treads, another for inner tubes, and still another for rubber shoes or battery boxes or rubber hose or rubber gloves and the like. The tendency of the rubber industry for the past decade has been to vulcanize rubber for a shorter time at a lower temperature, thereby requiring more rapidly acting accelerators than were formerly employed. As a result of this change the requirements as to specialty chemicals for the rubber industry are constantly in a

state of flux and change, and the commercial life of any one product is usually relatively short.

The most important class of accelerators at the present time, from a volume sales standpoint, in this and in foreign countries is mercaptobenzothiazole and its derivatives and reaction products. This material is readily and simply obtained by heating under pressure aniline, sulfur, and carbon disulfide. The product is weakly acid and readily forms salts. Monsanto manufactures fourteen different products which are or which contain derivatives of mercaptobenzothiazole. The more important of these are benzothiazyl 2 thio methylene hydrin, obtained by reacting mercaptobenzothiazole with formaldehyde, benzothiazyl thiobenzoate obtained by reacting the sodium salt of mercaptobenzothiazole with benzoyl chloride, dibenzo thiazyl thiol dimethyl urea, obtained by reacting dimethylol carbamide with mercaptobenzothiazole, 2-4 dinitro phenyl benzothiazyl sulfide, obtained by condensing 2-4 dinitro chlor benzene with the sodium salt of mercaptobenzothiazole, the hexamethylenetetramine salt of mercaptobenzothiazole and its crotonaldehyde condensation product, the zinc salt of mercaptobenzothiazole, and cyclohexylamino thio benzothiazole, obtained by oxidizing the cyclohexylamine salt of mercaptobenzothiazole. The products mentioned above are employed in practice with basic activating accelerators, preferably with diphenyl guanidine and diphenyl guanidine phthalate, both of which are manufactured by Monsanto.

Another class of rubber chemicals manufactured by Monsanto are the so-called ultra or very fast acting accelerators especially designed for use with rubber latex. Articles fabricated from latex are vulcanized at relatively low temperatures, usually at a range of 60 to 95°C. Such vulcanization is ordinarily carried out by means of hot air or in a hot-water bath. In addition to piperidine penta methylene dithiocarbamate for such latex stocks, Monsanto also manufactures six products which are obtained by reacting carbon disulfide on methylene dipiperidine or on methylene di(cyclohexylamine). These accelerators can also be used in the production of self-curing rubber cements used in shoe cements, tire patches, and the like.

Ranking in importance from a volume sales standpoint with the accelerators is another group of rubber specialty chemicals designated as antioxidants. Such products are employed to retard materially the deterioration of rubber articles in service, whether such impairment in desirable properties be due to oxidation, flex cracking, or deterioration by internally developed heat. The products manufactured by Monsanto for this purpose are of the ketone-amine type. By reacting acetone with aniline, the product 2-2-4 trimethyl dihydroquinoline is produced which is polymerized to different degrees to form the viscous liquid and solid products marketed. Another like product manufac-

tured is the acetone condensation product of p-amido diphenyl. The antioxidants mentioned are particularly developed as tire and tube antioxidants and are not adaptable for use in light-colored or white rubber articles. For such goods where discoloration is an important consideration, diamyl hydroquinone and p-p dioxy diphenyl cyclohexanone are available.

There are several other specialty products manufactured at Nitro by Monsanto for use in the rubber industry. Such products are of less importance to the industry than are the products previously mentioned but are required none the less for the proper processing or handling of rubber goods. Such products include two softeners used for the dispersion of pigments and to reduce power costs in the milling of rubber, a tack-producing plasticizer, a mold paste for lubricating molds to permit the ready removal of the vulcanized article therefrom, special crayons for marking rubber, and a wetting agent to facilitate the impregnation of fabric or tire cord with latex solutions.

Although our operations at Nitro have always been devoted largely to products for the rubber industry, Monsanto during the past few years has extended the scope of its research and production activities. One such group of products marketed is an ore flotation reagent employed to concentrate the value from low-grade copper ores by the froth flotation process. Products marketed for this use are diphenyl thiourea, more commonly known as thiocarbanilide, potassium ethyl xanthate, and potassium amyl xanthate.

In the cleaning or pickling of steel by dilute acid solutions to remove the film of oxide prior to galvanizing or tin plating of the steel, a so-called inhibitor is customarily employed which selectively protects the metal against the action of acid while permitting the solution of the iron oxides. Monsanto manufactures four different inhibitors for the steel industry, all including the sulfonated derivative of the reaction product of aldehyde ammonia with diphenyl thiourea as the effective inhibiting material present. The chemical nature of this product is not known with accuracy but evidence points to the presence of a triazine ring compound.

Our Nitro laboratories have investigated possibilities of extending our experience with antioxidants to industries other than rubber where oxidation of a commercial product in use develops objectionable results on products. This work has progressed to a point where Monsanto is manufacturing and marketing a product that materially extends the period in which a white toilet soap may discolor and turn rancid. Several of the better-grade toilet soaps on the market are protected against the development of rancidity by means of our soap antioxidant.

Another type of product we are marketing comprises five different materials developed as anti-skinning agents for varnishes and enamels. We are all familiar with the fact that a skin

forms over the surface of a partially filled can of paint or varnish. While this is not a serious problem in the package trade, it is a real factor in commercial painting operations where an open dip tank is used for a period of several days. The five products we suggest for such use will double the time required for skin formation when as little as one part of the anti-skinning agent is employed to two thousand parts of the varnish or enamel. We also have products available that greatly delay the development of rancidity in such fats and oils as cottonseed oil, codliver oil, olive oil and oleic acid, peanut oil, castor oil, and other edible and non-edible fats and oils.

One most interesting development from our laboratory has been our work on surface-tension reducing agents or the products more popularly known as soapless detergents. Monsanto is manufacturing at Nitro five different chemical products which are marketed in twelve different forms and which are employed in many industries as penetrants, wetting agents, and the like. These products chemically are the sodium salts of sulfonated butylated diphenyl or oxy diphenyl or are alkylated aryl sulfonates.

To summarize briefly our operations at Nitro, we are manufacturing 93 different chemical products developed for the rubber, soap, paint, steel, oil, mining, and other important industries. Our operations include all of the ordinary chemical processes from those carried out at atmospheric pressures to operations conducted at pressures of 800 lbs. to the square inch and include distillations at atmospheric pressure as well as under a vacuum of 4 mm. and additionally reactions conducted under refrigeration and up to temperatures of 250°C. Additionally we employ solvents in many operations, thereby necessitating solvent recovery operations, while in producing one product we employ a solvent extraction treatment.

Although our products are many, yet the raw materials required for their production are comparatively few in number. The more important raw materials consumed at our Nitro plant are aniline, required for 35 different products, carbon disulfide, required for thirteen products, an aldehyde such as formaldehyde, acetaldehyde, and butyraldehyde, required for sixteen products, acetone, required for six products, and an alcohol such as ethyl, amyl, or butyl alcohol, required as a solvent or reactant in nine products. Additionally chlorine, caustic soda, sulfuric, and hydrochloric acids are required as well as diphenyl, oxy diphenyl, piperidine, benzene, toluene, phthalic anhydride, sodium cyanide, and sulfur. Naturally in order to develop new products and to study the application of new developments in industries, active attention must be given to laboratory work. Our development department comprises a total of 33 employees including nineteen graduate chemists. We maintain four laboratories at Nitro, a research laboratory, an analytical laboratory,

a completely-equipped rubber-compounding laboratory, and a rubber latex laboratory. We also maintain our own patent department to protect our inventions and to be assured that our customers may be able to utilize our developments without undue interference. Since the organization of Rubber Service in 1922 our Nitro division has been granted 222 U. S. patents with many of the more important inventions patented in Canada and other foreign countries. Although our own marketing activities are confined to North and South America, we are but a single division of one of the major chemical companies of the country and our developments are naturally made available to all divisions and particularly to Monsanto's foreign subsidiary company in England, thereby assuring our products a world-wide distribution.

## Industrial Applications of Surface-Active Agents

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THE MANUFACTURE and use of synthetic compounds to increase the penetration of liquids into capillary pores and for emulsification, detergency, and kindred applications is of very recent origin. These products compete with soap in a great many uses but in addition they can be used in places where soap is entirely unsuitable because of the limited solubility of its salts, the alkalinity of the solutions, the high surface tension, or instability to acids or other chemical agents. A recent compilation (*Ind. & Eng. Chem.* 31, 66) lists by trade name 165 surface-active agents which are manufactured in America. While this list probably contains many duplications (since the same product may be sold under different trade names), still it is evident that a very large number of new synthetic products are commercially available. No attempt will be made to classify these compounds other than to say that they are composed of a water-soluble part (a hydrophilic group such as sulfate, sulfonate, phosphate, carboxyl, or hydroxyl) and a water-insoluble part (a hydrophobic group such as alkyl, aryl, or arylalkyl). By varying the type and ratio of the hydrophilic group to the hydrophobic group, very large differences in the effect of the resulting compound on the surface tension, detergency, or other property can be obtained. Consequently, the selection of the proper surface-active agent for a particular use will depend upon the kind of action desired. In the following discussion it is planned to give a summary of the uses for which different types of wetting agents are most suitable and to outline some practical methods of application.

The first use of surface-active agents in the rubber industry was to increase the penetration of rubber latex into tire cord in order to increase the resistance of the cord to heat and flex deterioration. Before the discovery of the effect of certain compounds on increasing the penetration of latex in tire cord, it was necessary to dissolve the rubber in an organic solvent such as benzene or solvent naphtha and then impregnate the cord with this solution and evaporate the solvent. This process was very expensive and dangerous because of the necessity of handling such large amounts of organic solvents, since a 10 percent solution of rubber in benzene is more viscous than glycerine, while a rubber latex solution containing 40 percent of rubber is as fluid as milk. However, if a tire cord is immersed in a latex solution which has had no treatment except stabilization with a small amount of ammonia, it is found that the rubber precipi-

tates on the surface of the cord and does not penetrate between the individual threads of the cord. This same latex treated with 1.0 percent of ARESKLENE (the neutral salt of a dibutylated disulfonated *o*-phenyl phenol) or 1.0 percent of SANTOMERSE D (the neutral salt of an alkyl-substituted aromatic sulfonic acid) will penetrate the cord completely in approximately 3 seconds and give a uniform dispersion of the rubber throughout the cord. The automobile tire manufacturers have found that tire cord treated in this way will give much better service when used in a tire because the individual threads of the cord are separated from each other by a thin film of rubber and consequently will not rub against each other when the tire is flexed.

The explanation of this very desirable effect of these wetting agents on latex is not entirely clear, since the surface tension of the solution is not lowered very appreciably as is shown by the data given in Table 1.

TABLE 1

Grams of SANTOMERSE D per liter of 20% Latex	Surface Tension dynes/cm <sup>2</sup>	Wetting out time in seconds of tire cord
20	34.0	1.6
15	34.0	1.8
10	34.1	2.7
7.5	34.4	6.6
5.0	35.0	83.3
0.0	38.2	more than 3 mins.

Since latex is an emulsion of the rubber hydrocarbon in an aqueous solution, it is possible that the beneficial effects of wetting agents might be due to their stabilizing action on the emulsion as well as lowering the surface tension of the solution. The data given in Table 2 show that small amounts of SANTOMERSE D have a very pronounced effect on the stability of the latex.

TABLE 2

A sample of 40 percent latex is stirred with a high speed stirrer (12,000 rpm) until it is coagulated.

Grams of SANTOMERSE D per liter	Coagulating time in seconds
0.0	160
1.0	400
2.5	1,560

Another very interesting use for surface-active agents is in sprays for fruit trees. Depending upon the type of spray to be used, the secondary functions of the surface-active agent will vary, although in all sprays the primary function will be to spread the toxic material evenly over the surface. For example, in sprays for use as stomach poisons the function of the surface-

active agent will be to spread the toxic solution (such as a dilute solution of nicotine sulfate) evenly over the surface of the leaves. For such uses it has been found that very low concentrations of SANTOMERSE D ( $\frac{1}{2}$  oz. per 100 gal. of spray) are effective. When using contact poison sprays, the surface-active agent serves two uses: namely, as a dispersing agent and as a spreading agent. Naturally for this use it requires larger amounts of such materials as SANTOMERSE D (8-10 oz. per 100 gal. of spray) to give satisfactory dispersions and complete spreading on the foliage. Certain types of surface-active agents are unsatisfactory for this type of spray because they form soluble arsenic or copper compounds which cause leaf burn.

The preparation of stable oil emulsions for use as larvacides has been much simplified since the advent of surface-active agents as it is necessary only to stir the oil into a dilute solution of the proper compound. This result is possible because of the greater emulsifying action of these materials as compared to soap solutions. Another advantage of these synthetic emulsifying agents is that they are effective in neutral solutions, whereas soap can be used only in slightly alkaline solutions.

The presence of residual spray on various fruits is very undesirable and at the present time most states limit the permissible amounts of lead or arsenic which can be left on the fruit. Present practice in the fruit industry is to pass the fruit through a dilute acid solution containing small amounts of surface-active agents in order to obtain better wetting of the surface and consequently greater reduction in the amount of toxic compounds. This use of surface-active agents is a recent development and is possible only because these products are stable in acid solution, whereas soap is decomposed in such media.

Sulfur has been found to be a very effective insecticide and fungicide if it is finely divided and is spread evenly on the foliage. Many different products have been used as spreading agents for sulfur and amongst the most recent have been the surface-active agents. It has been found that in some cases as little as 0.2 percent of SANTOMERSE D or similar product will be sufficient to give a satisfactory wettable sulfur which will spread evenly on the foliage and adhere well.

Probably the largest field for use of surface-active agents is in textiles as they have been found useful in most of the operations required for the preparation of the finished cloth. In the processing of cotton, the use of the proper material has given improved results in the scouring, washing, Kier-boiling, mercerizing, and dyeing operations. In the scouring and washing operations, the use of a surface-active agent gives a better feel to the yarn because these operations can be carried out in less alkaline solutions than is required with soap and because they do not form insoluble compounds with the salts present in the solution. The presence of these insoluble compounds on the yarn

not only gives a harsher feel to the finished goods but they also cause uneven dyeing of the yarn. The use of small amounts of surface-active agent in the usual scouring bath of alkali and soap will assist in the rinsing of these materials from the goods and give a better feel.

In Kier-boiling of cotton yarn, the use of a proper surface-active agent is more difficult since the higher concentration of alkali salts used in this operation precipitates out some of these compounds. The use of between 0.1 and 0.3 percent of surface-active agent which is completely soluble in the sodium hydroxide solution provides a thorough wetting of the goods, overcomes the difficulties due to channeling, carries the caustic into and through all parts of the cloth, and in many cases makes it possible to shorten the time of boil.

In mercerizing cotton cloth the use of a surface-active compound increases the rate of penetration of the strong caustic into the cloth and causes a more rapid shrinkage. Since mercerizing baths contain between 20 and 30 percent of sodium hydroxide, it is evident that the salting out effect of this bath is more pronounced than in the case with Kier-boiling solutions. In order to overcome this difficulty it has been found necessary in most cases to add other compounds to the surface-active compounds in order to increase their solubility and wetting-out action. Commercial mixtures contain such compounds as cresylic acid, higher alcohols (for example amyl or octyl) and other solvents which are soluble in the mercerizing solution and at the same time are also good solvents for the surface-active agent. In this connection it is interesting to note that some of the commercial mixtures which are excellent for use in mercerizing baths are of very limited use in neutral or slightly acid solutions. This result illustrates the advantage of being able to synthesize products to fit a particular use and not being dependent upon available natural products.

Another very important use for surface-active agents is in dyeing all kinds of yarns and cloth. By the use of these materials, rapid and even penetration of the dye into the fiber results, the formation of insoluble soap precipitates in the dye bath is prevented, more complete exhaustion of the dye is obtained, and brighter shades are produced. A complete explanation of the beneficial effects of these products on the dyeing operation has not been found for all types of dyes because the mechanism varies depending on the kind of yarn, the type of dye, and the surface-active agent. Since most commercial dyes give negatively-charged color ions in solution and most commercial surface-active agents also give negatively-charged surface-active ions, it is evident that the surface-active ions do not precipitate the color ions on the cloth by neutralizing their charge. The most recent work (Ind. & Eng. Chem. 31, 40, 1939) shows that the surface-active ions do not disperse dyes either in

the dye bath or on the textile fibers, and therefore the improvement in dyeing is not due to this action. The swelling of textile fibers by water is essential in opening the intermicellar spaces for penetration of the dyes, so it appears probable that the chief function of the surface-active agents is to increase the swelling action of the water by assisting in the rapid wetting of the fiber. In the case where positively-charged surface-active agents are used with negatively-charged color ions, the improvement in the results obtained appears to be due to the retardation of the rate of dyeing while increasing the rate of penetration of the water into the fibers.

Since surface-active agents are very valuable assistants in the dyeing operation, it was thought that they would cause more rapid bleeding of the dyes when they were used in washing. However, it was found that the removal of dyes was not very much greater than with water alone and that the hydrogen-ion concentration of the bath was a more important factor, since acid solutions retard while alkaline solutions accelerate the removal of color. It was also found that the presence of small amounts of inorganic salts such as magnesium sulfate or calcium chloride decreased the amount of color washed out by the solution of the surface-active agent. The data obtained in these various tests indicate the conclusion that the removal of water-soluble dyes is due primarily to the solubility of the dyestuff in water rather than to any peptinizing action of the surface-active agent.

The use of soap in washing soiled cloth is very unsatisfactory in hard water unless other compounds such as sodium carbonate, sodium phosphate, or other water softening agents are added. By using surface-active agents as detergents it is possible to obtain the same cleaning action in hard water as in soft water. This result is due to the fact that the magnesium and calcium salts of the synthetic detergents are soluble in water, whereas the corresponding salts of the fatty acids are insoluble. It should be emphasized at this time that all compounds which are very effective in lowering the surface tension of water are not good detergents. To be a good detergent a compound must not only be a good wetting agent in order to promote a rapid and complete wetting of the fabric but in addition it must lift the dirt from the cloth and emulsify it with the water. Another advantage of the use of synthetic detergents over soap is the fact that they can be used in neutral solution whereas soap solutions are always alkaline. Being more water-soluble than soap, they can be more easily rinsed out of the cloth and for that reason will have less deteriorating effect on the wearing qualities of washed fabric. The greater solubility of the synthetic detergents is also of considerable value in hair shampoos because they can be washed out of the hair more readily and leave the hair light and fluffy.

The very effective penetration and dispersion properties of synthetic surface-active compounds suggests the possibility of their use in many other industrial applications. For example, in the leather industry these compounds can be used in the fat-liquoring operation to promote penetration and increase the softening action; in dyeing and finishing to increase the penetration of the dye and give more level dyeing; in wetting back of chrome-tanned leathers to shorten the time required to soak the leather completely. In the manufacture of paper the use of a surface-active compound in the pulping process will aid in hydrating the raw stock, while the wet strength of certain types of paper can be increased because of increased water run-off due to lowered surface tension. In the cement trade it has been found that surface-active agents will allow the use of a lower water ratio to give the required fluidity of the mixture. This use is not developed commercially as yet because it has been found that certain of these compounds reduce the dry strength of the cement. The cause of this decreased strength is being investigated at present but no definite results have been obtained. In order to increase the penetration of glue into the pores of the wood, it has been found that small amounts of surface-active compounds were beneficial. However, it was also discovered that the glues treated with these materials tended to foam badly if too much of the surface-active agent were added. There are many other fields where these very active products will be of great use but at the present time the necessary experimental work has not been completed to the stage where commercial development is assured. However, it seems very probable that surface-active agents of either the cationic or anionic type will be used in the manufacture of ceramics, in air-purifying equipment, in fat splitting, in electro-plating, in lubrication, in non-metallic flotation, in acid treatment of oil wells, as germicides, in cosmetics, as dispersing agents in paints, and for many other uses. In many of these uses it is probable that special compounds will have to be developed in order to meet the specific requirements of the industry such as solubility of salts, odor, toxicity, and cost.

In summarizing the commercial uses of synthetic surface-active compounds it can be said that they are competitive with soap in the laundry and household washing field, but in other fields such as rubber latex, spreading and emulsification of insecticidal sprays, in Kier-boiling and mercerizing baths, and in dyeing they are superior to soap because it is possible to control the hydrogen-ion concentration of their solutions and to use them in solutions which cause a precipitate to form with soap. Since such a rapid development has taken place during the past few years it seems reasonable to believe that progress will continue, and many new and valuable uses will be found for these very interesting products of synthetic chemistry.

Retarding Rancidity in Stored Black-Walnut Kernels  
—A Second Report (Abstract)

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AT THE BETHANY MEETING of the Academy in May, 1936, the writer reported on the results of storage trials with kernels of the black walnut.

To review briefly the outline of the experiment, samples were stored under three conditions of temperature: viz., ordinary cellar storage, with variable temperature, storage in a fruit cellar where the temperature was held continuously a few degrees above freezing, and storage in a refrigerated room where the temperature was held continuously below freezing. Some of the samples were stored in screw-cap glass bottles, and others were stored in sealed glass tubes. Atmospheres within the containers were carbon dioxide, nitrogen, air, hydrogen, vacuum, and vapor of ethyl alcohol with air or nitrogen.

The experiment has been continued to the present time with results in complete harmony with the earlier report. Some of the nut meats have now been in storage for five and some for six years. The samples stored at ordinary cellar temperatures all became rancid within a period of two to four years, but those sealed in air-tight containers and stored in an atmosphere devoid of oxygen remained sweet and palatable longer than those stored in air.

Storage at lower temperatures: i.e., just above the freezing point and below freezing, aided materially in retarding the development of rancidity. In the absence of oxygen, samples stored under these conditions kept well for periods of three to five or six years. Some six-year-old samples opened in February, 1939, were altogether sweet and palatable and in fact could scarcely be distinguished by taste from kernels harvested in the fall of 1938.

Two main factors appear to be involved in the keeping quality of the nut meats: (1) exclusion of air or oxygen, and (2) storage at temperatures near or below the freezing point. On the whole, samples stored in an atmosphere of nitrogen seemed to retain a sweet nutty flavor somewhat better than those stored in carbon dioxide, hydrogen, and vacuum, although the three last-mentioned likewise kept well and were quite acceptable in flavor.

The presence of alcohol vapor, like the presence of air, invariably resulted in undesirable flavors which appeared first at the higher temperatures and grew more pronounced with lapse of time.

## A Modified Type of Micro-Molecular Still Suitable for Research Purposes

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IF THE NUMBER OF MOLECULES of a gas occupying a given space be reduced by suitable vacuum pumps to the order of  $10^{11}$  molecules per c.c., the mean free path or distance a molecule will travel before striking another molecule will be multiplied about one hundred million times. If  $n$  be the number of molecules per cubic centimeter, at  $10^{-6}$  mm. pressure  $n$  is  $.356 \times 10^{11}$  molecules per cc.

If a substance of low volatility is heated or warmed on an electrically heated plate, the pressure reduced to the order of  $10^{-4}$  to  $10^{-7}$  mm. of mercury, and a cold surface placed at a distance less than the calculated mean free path at that pressure, the molecules of the substance being heated should strike the cold surface and condense there before striking a molecule of the residual gas in the system. In this way one should be able to collect, molecule by molecule, a sample of the substance being heated; the more volatile or the lighter molecules should compose the greater part of this distillate. This is indeed found to be the case. This process, when carried out at a pressure of one micron or less, is known as molecular distillation.

Molecular distillation, as contrasted to ordinary and "vacuum" distillation, does not have to do with vapors, boiling points, nor azeotropic mixtures; in fact there are no "boiling points" in molecular distillation, nor are there azeotropic mixtures. In molecular distillation one deals not with vapors but with individual molecules; hence the designation, "molecular distillation."

A molecular still suitable for research with a multitude of organic compounds, with varying conditions of temperature and pressure, should satisfy the following qualifications:

1. The distillate and distilland should be clearly visible to the operator during the whole time of the distillation. By distilland is meant the bulk of material from which fractions are distilled. (11)
2. The total volume of the still should be a minimum, as the volume to be evacuated has a great bearing upon the time required for evacuation as well as upon the actual degree of vacuum attained.
3. The entire set-up should easily be taken apart for cleaning, inspection, or charging.
4. All parts should be replaceable (standard taper joints, standard pumps, and gauge).

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5. All joints and all glass must be vacuum-tight.
6. The distance from the distilling surface to the condensing surface should be easily adjustable without rebuilding the still; it is preferable that this distance or "gap" be adjustable under vacuum or while the still is in operation.
7. A careful control of the temperature of the distilland should be possible at all times.
8. There should be a method to permit only purified or filtered air to enter the system on releasing the vacuum. This feature is preferred because water vapor, carbon dioxide, and other gases and fumes found in an organic chemistry laboratory might be adsorbed by the pump fluid, and adsorbed by the glass walls of the system, making the evacuation of the system to extremely low pressures difficult if not impossible.
9. There should be an accurate method for measuring the pressure of the residual gases in the system.

A survey of the literature available failed to disclose a suitable still.

The first application of the principles of molecular distillation was made by Bronsted and Hevesy (1, 2) in the separation of the isotopes of mercury. Their apparatus consisted of a large outer jacket or flask and a smaller flask inserted through a stopper in the neck of the first. The space between the two flasks was evacuated to low pressure by means of the newly-invented mercury diffusion pump (13, 14). The outer flask was used as the evaporating pot; the inner flask, which could be cooled by a suitable cooling mixture placed inside, served as the condensing surface.

Using a sample of chemically pure mercury they made several fractionations of the distillate and of the residue or distilland, and found that the distillate was progressively richer in the lighter isotope; the residue was found richer in the heavy isotope.

The method of molecular distillation was not applied to organic substances until 1929, when three investigators, working independently, published almost simultaneous accounts of the distillation of various organic substances. Burch (3) reported the distillation of petroleum residues, from which he obtained hydrocarbon oils and waxes having very low vapor pressures and thus being suitable for use in vacuum systems. Hickman (10) reported the distillation of sundry phthalates, stearates, oleates, citrates, and tricresyl phosphate.

Washburn and his co-workers (16) reported the distillation of calomel, sucrose, and paraffin wax. Washburn reported that sucrose was distilled at 120° C., and that a solid, white, sweet distillate was obtained. He also obtained from commercial paraffin wax a distillate with a melting range from 48°C. to 48.6°C. and a residue with a melting range from 56.5°C. to 57.1°C. The distillation was carried out at about 58°C.

Carothers, Hill, Kirby, and Jacobson (5) were able to distill and identify pure synthetic aliphatic hydrocarbons up to hep-

tacontane,  $C_{70}H_{142}$ , which has a molecular weight of 983 and melts at  $105^{\circ}C$ .

Hill (12) stated that he and his co-workers had distilled glycine, glucose, and sorbitol at temperatures about 50 degrees below their melting points. He obtained these substances on the condenser in good yield and with no sign of decomposition.

Gurin (8) was able to distill esters of N-acyl substituted amino acids at pressures of from  $10^{-5}$  mm. to  $10^{-7}$  mm. with little or no decomposition. He observed that these esters distilled at temperatures of from 10 to 30 degrees above their melting points. Gurin found that the more complex amino-acid derivatives were very difficult to distill and showed some decomposition.

It is in connection with the concentration of vitamins A and -D, from fish-liver oils, that the molecular still has so far found its greatest usefulness.

Heilbron, Heslop, Morton, and their co-workers (9) made unsuccessful attempts to distill vitamins from halibut-liver oil at pressures they thought to be about  $10^{-4}$  mm. of mercury. Later, in cooperation with Carr and Jewell (7), they were able to distill vitamin A without decomposition at pressures stated to be below  $10^{-4}$  mm. By continuing this work, Carr and Jewell (6) were able to prepare the purest vitamin A obtained up to that date.

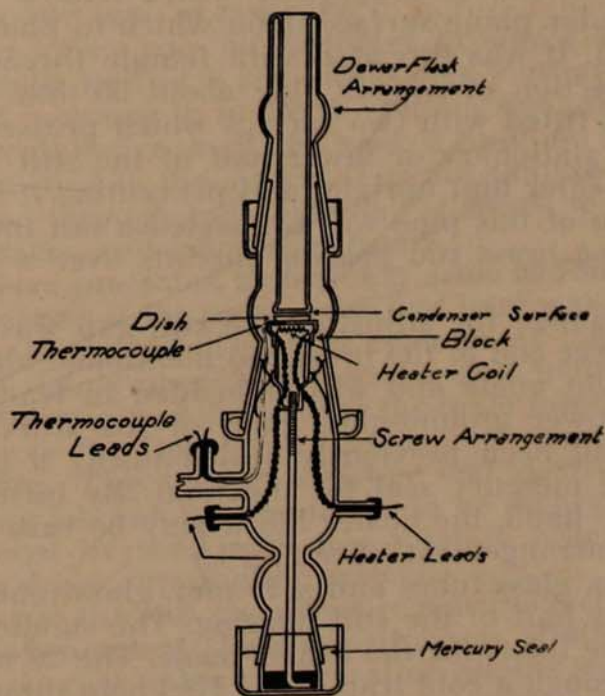


FIG. 1

#### DESCRIPTION OF MOLECULAR STILL

It was decided that a small pot type molecular still, suitable

for micro- and semi micro-analysis of organic substances, should be designed, built, and subjected to actual laboratory tests to ascertain its value as an instrument of research. The features considered desirable in such an instrument (See Introduction) were to be incorporated, if possible.

The final form of the apparatus used is shown diagrammatically in Fig. 1. The entire system was constructed of pyrex glass and only one rubber connection, that to the Cenco Hi-Vac pump, was employed.

The actual housing of the evaporator and condenser units, called the still (Fig. 1) was built from a 40 mm. standard-taper ground-glass joint to which a 30 mm. male joint was sealed at the top, and a 20 mm. female joint at the bottom.

The condenser was built as follows: A 20 mm. glass tube was sealed at one end, and the seal flattened at right angles to the length of the tube. The flat surface was to serve as the condenser surface. The other end of this glass tube was sealed by means of a ring seal into the female half of the upper or 30 mm. ground-glass joint. The condenser surface could then be cooled by placing a suitable cooling mixture inside the smaller tube. The space surrounding the condenser tube was evacuated by the pumps through the system. It was thus, in effect, a Dewar flask arrangement.

The heater block or evaporator was a hollow copper block having a circular plane surface upon which to place the sample to be distilled. It was threaded with female threads and fitted to a 3-inch section of copper pipe about 30 mm. in diameter. The pipe was fitted with two springs which pressed against the inside of the stationary or lower half of the still housing, thus holding the heater unit upright, and preventing it from turning. To the bottom of this pipe was connected a nut into which was screwed a long brass rod bearing threads over a great part of its length.

The mechanism for adjusting the still gap was built as follows: The lower end of the brass rod mentioned above was bent to form a right angle and was embedded in lead in the male half of the lower ground-glass joint of the still housing. The male joint had been previously sealed inside a beaker which served as the mercury seal for the joint. By turning the male joint with the hand, the heater block may be raised or lowered by the screw arrangement. (See Fig. 1.)

Two 5 mm. glass tubes and a 15 mm. glass tube were sealed into the lower half of the still housing. The smaller tubes were to serve as the inlets for the heater leads. The 20 mm. tube was connected through a cold trap to the Hickman dibutyl phthalate pumps. The heater coil was made from a 10-inch piece of nichrome wire and insulated from the copper block with sheet mica. The leads to the coil were insulated with small glass beads, since it was feared that organic materials might release vapors

when warmed in a vacuum. The leads were sealed into the small side tubes with picein wax. The temperature of the block was determined by means of a copper-constantan thermocouple. The thermocouple leads were also sealed in with picein wax. A Leeds and Northrup student-type potentiometer was used to measure the voltage of the thermocouple.

A glass bridge was used to connect the still to the rest of the system. To this bridge or tube were sealed four female standard-taper ground-glass joints. There was one joint each for the still, the McLeod gauge, the release valve, and the pump unit. By lifting this bridge piece the entire system could be disconnected.

The Cenco McLeod gauge was calibrated to read pressures as low as  $5 \times 10^{-6}$  mm. of mercury. It was operated by means of a threaded wooden plunger which raised or lowered the mercury. To the top of the gauge was sealed the male half of a ground-glass joint, which was connected to the system through the bridge mentioned above.

The two Hickman dibutyl phthalate condensation pumps were modified as follows: The two straight tubes on the outside of each were replaced by male standard-taper joints. Both were bent upright so that mercury cup-seals could be used to insure a vacuum tight joint. The two condensation pumps were then connected in tandem to the system. The backing pump was a Cenco Hi-Vac mechanical pump capable of producing a pressure of  $4 \times 10^{-4}$  mm. of mercury.

The release valve was an ordinary ground-glass stopcock, sealed to the male half of a standard-taper joint and immersed in a beaker of mercury to make it vacuum tight. When it was desirable to break the vacuum, the beaker could be lowered, and filtered air admitted to the system. The air admitted to the system was filtered through soda-lime and charcoal to remove carbon dioxide, water, and laboratory fumes.

All joints were protected by mercury seals as follows: A one-hole rubber stopper of the proper size and bore was fitted on the tube of the male joint, and a glass cylinder of the proper size was then fitted tightly over the stopper so as to include the joint. The female joint was then fitted over the male joint, and enough mercury to cover the lip of the female joint was then poured into the cylinder. This type of mercury seal, devised by Mr. M. D. Cross, of this laboratory, was found to be highly satisfactory. A lubricant must be used with this joint in order to prevent mercury vapor from entering the system.

In order to test the still, the pressure was reduced to less than  $5 \times 10^{-6}$  mm. of mercury. This pressure was attained about an hour after the current to the condensation pumps was turned on. The system was evacuated to .5 mm. of mercury before the condensation pumps were started. Subsequent evacuations took much less time. It was found that a slow refluxing in the condensation pumps produced the lowest pressures. The upper limit

of the temperature attained by the heater block in vacuo was about 300° C. when two six-volt storage batteries were used to heat the coil.

At temperatures above 70° C. the Cenco Vacuum wax used to lubricate the joints was found to distill out of the large joint near the heater. This wax collected on the condenser, contaminating the distillates. On cooling, the wax became very hard and held the joints so tightly that it was necessary to heat them with a Bunsen burner before they could be separated. This condition was so objectionable, that it was found necessary to discontinue the use of commercial vacuum waxes. After some experimentation, it was discovered that a stiff paste of dibutyl phthalate and finely-divided graphite was an excellent substitute for the vacuum wax, but was used very sparingly, only a thin film or polish being sufficient. When this lubricant was employed the joints were easily separated and no heating was necessary. The screw arrangement also was found to turn easily under vacuum when this preparation was used to lubricate the joint.

### RESULTS

With the apparatus described it was possible to distill various fractions from paraffin wax. The following data were obtained: (15)

	Appearance	Melting Range
Original sample -----	white, waxy	52° to 56° C. (approximately)
Distillate, 50° to 100° C. ----	white, semi-cryst.	44° C.
Residue, 50° to 100° C. ----	white, waxy	53° to 56° C.
Distillate, 100° to 130° C. ----	white	48° to 48.5° C.
Residue, 100° to 130° C. ----	white	58° to 58.5° C.
Distillate, 130° to 180° C. ----	white	56.5° C.
Residue, 130° to 180° C. ----	-----	Too little to use.

Unsuccessful efforts were made to distill sucrose. Decomposition was shown to take place. (15)

Glycine, amino acetic acid, was sublimed at a temperature of 108 degrees below the decomposition point. No sign of decomposition could be observed. This result indicates a possible use for the micro-molecular still in the separation of some of the amino acids from protein hydrolysis mixtures. (15)

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## Some Derivatives and Characteristics of Para-Benzaldehyde Sulfonic Acid

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PARA-BENZALDEHYDE SULFONIC ACID was synthesized and studied to determine whether it had any possibilities as a solubilizing influence in drugs having a primary amine group. The interest centered on the condensation of p-benzaldehyde sulfonic acid with various beta-alkoxy ethyl esters of p-amino benzoic acid. The esters of this acid are some of the best local anaesthetics. Those esters that do not have a nitrogen or other solubilizing group in the side chain are quite insoluble in water. This insolubility is a disadvantage and, in the case of the ethyl ester (Benzocaine), limits its use to a dusting powder. It was hoped that the product of the condensation would be sufficiently soluble in water to be used internally and still retain anaesthetic properties. If this be true, the compound could be administered in an aqueous solution and could then be hydrolyzed in the body to yield the original ester with a lipid-water distribution ratio favorable for anaesthesia.

The sodium salt of p-benzaldehyde sulfonic acid was reported in Friedlander's *Fortschritte der Teerfarbenfabrikation*, 7, page 108, and in *Zentralblatt für Organische Chemie*, 1904 II, page 1269, by Chemische Fabrik vorm Sandoz in 1904. It was prepared by the oxidation of p-toluene sulfonic acid with  $MnO_2$  and  $H_2SO_4$ . No analyses or melting points were given.

It was found that  $MnO_2$  oxidation yielded only the salts of p-benzaldehyde sulfonic acid. To pursue a successful investigation in this field it was thought necessary to prepare the free p-benzaldehyde sulfonic acid in order that its derivatives might have critical melting points. Since the oxidation of p-toluene sulfonic acid seemed the most promising line of attack, the compound was oxidized with an equivalent amount of  $H_2O_2$ . P-toluene sulfonic acid (51.6 grams) was dissolved in 708 cm.<sup>3</sup> of a 3 percent  $H_2O_2$  solution, and 0.5 gram of  $FeCl_3$  was added. After standing overnight, the solution was boiled to a syrup under 23 mm. pressure and dried in a vacuum desiccator over concentrated  $H_2SO_4$ . The resulting dark-brown tar could not be recrystallized but was distilled under a di-butyl phthalate pump. The resulting crystals melted at 140° C.

After preparing what was thought to be the free p-benzaldehyde sulfonic acid, the next step was to prove the structure of the product. Derivatives were prepared in order to do this and also to study the reactivity of the two substituent groups.

The phenyl hydrazone of p-benzaldehyde sulfonic acid was prepared by dissolving equal quantities of phenyl hydrazine hydrochloride and p-benzaldehyde sulfonic acid in water and heating the solution to 100° C. The purified product is a light-brown powder and decomposes at 240° C. The equation follows:

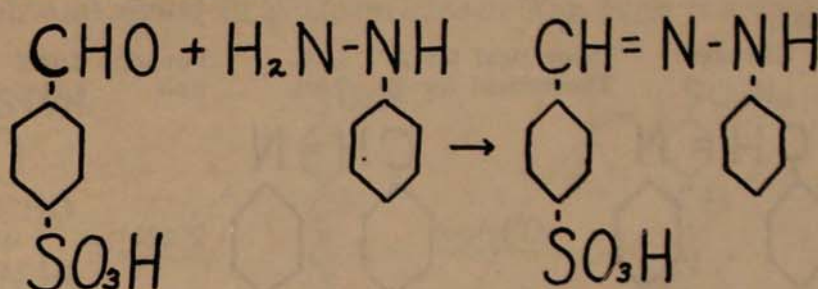


FIG. 1

Analysis:

% Nitrogen:	Theoretical	10.15%	Found and	10.1% 10.0%
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Three grams of phenyl hydrazine acetate were dissolved in water. A solution of 17 grams of p-benzaldehyde sulfonic acid in 340 cm.<sup>3</sup> of water was added and boiled to concentrate the solution. The product crystallized out in large masses of cauliflower shape. The melting point was 120° C. After three recrystallizations the color of the product had changed from dun to orange-yellow. The melting point was 172° C. The structure proposed for the above product is:

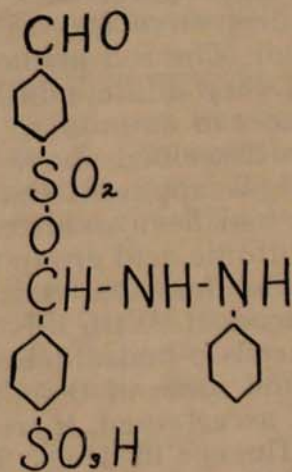


FIG. 2

Analysis:

% Nitrogen:	Theoretical	6.06%	Found and	6.10% 6.06%
% Sulfur:	Theoretical	13.9%	Found and	13.8% 13.8%

Equivalent weight from titration with NaOH using phenolphthalein as indicator:	Theoretical	462	Found	428
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The anil of p-benzaldehyde sulfonic acid was prepared by reacting excess aniline with 10 grams p-benzaldehyde sulfonic acid and steam-distilling the excess aniline. The product is very soluble in water and melts at 216° C. NaOH did not free aniline from a cold solution of the anil but did so on heating.

*Analysis:*

% Nitrogen:	Theoretical for A	5.4%	Found	6.04%
	Theoretical for B	7.9%	and	6.14%

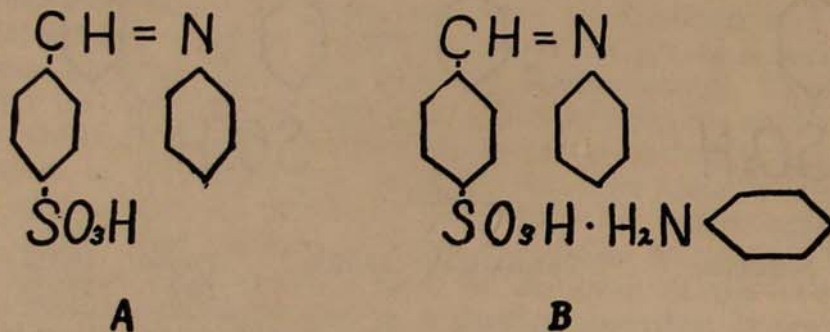


FIG. 3

Although the product could not be obtained pure, its analysis indicates that the proton from the sulfonic acid is held internally in the anil and does not form a salt with another mol of aniline.

Two tri-phenyl methane dyes were prepared from p-benzaldehyde sulfonic acid by reacting it with di-methyl aniline and with phenol using the same procedure as with benzaldehyde. The di-methyl aniline derivative is green-to-purple and shows properties of an indicator. The red phenol derivative is insensitive to pH changes, but very dilute solutions of it form a vivid burgundy color with traces of ammonia.

Since the derivatives described above depend upon an aldehyde for formation, it was apparent that the methyl group in p-toluene sulfonic acid had been oxidized by  $H_2O_2$  to an aldehyde group. Since the sulfonic acid group was para to the methyl group, it seems safe to assume that it is para to the aldehyde group in the oxidized product. With this evidence it is believed that the oxidized product is p-benzaldehyde sulfonic acid.

With the structure and some of the characteristics of p-benzaldehyde sulfonic acid ascertained, there remained its application as a solubilizing influence in drugs. The p-amino benzoates were studied. The ethyl, beta-methoxy ethyl, beta-ethoxy ethyl, and beta-propoxy ethyl esters of p-amino benzoic acid were condensed with p-benzaldehyde sulfonic acid. Four grams of the ester were added to 6 grams of the acid and heated to 100° C. for ten minutes. The melt was dissolved in 30 cm.<sup>3</sup> of methanol containing 10 percent water by volume, and the excess acid was precipitated with  $Na_2CO_3$ . The filtrate was evaporated, and the unchanged ester was separated by dissolving the product in wa-

ter, in which the original ester is insoluble. The aqueous solution, neutralized with  $\text{NaHCO}_3$ , was filtered and the filtrate boiled to concentrate to a syrup. After cooling in ice and scratching the sides of the container, the product settled out in a heavy, finely crystalline, brown mass. This was filtered, washed with methanol, and dried in a steam closet. The type reaction is as follows:

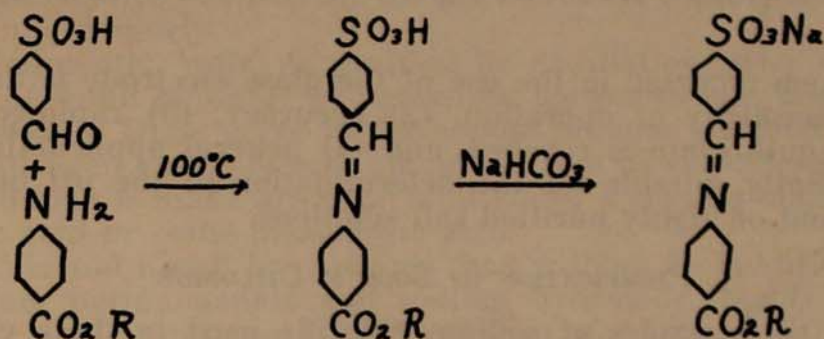


FIG. 4

Where R is the ethyl, methoxy ethyl, ethoxy ethyl, or propoxy ethyl radical.

Preliminary physiological tests conducted by Professors George A. Emerson and Benedict E. Abreu of the University School of Medicine indicate that the propoxy ethyl ester is a fairly good local anaesthetic with little toxicity. A 10 percent aqueous solution produced immediate and complete anaesthesia of a rabbit's cornea of five minutes duration. There was no sign of irritation. The same solution stopped the reflexes of a frog's legs in 2.5 minutes. One hundred, 200, 400, 800, 1200, and 1600 mg. of the propoxy ethyl ester per one kilogram body weight were administered to mice. No immediate signs were noticed except an increase in respiration. After 24 hours only the mouse receiving 800 mg./kilo body weight dose was dead, this being a case of animal variation.

From these results it appears that p-benzaldehyde sulfonic acid should find application in this type of work, since it apparently does not destroy the effect of the amino group in certain drugs and certainly increases their solubility in water.

#### SUMMARY

The following compounds have been prepared:

P-benzaldehyde sulfonic acid.

The phenyl hydrazone of p-benzaldehyde sulfonic acid.

The anil of p-benzaldehyde sulfonic acid.

A complex phenyl hydrazine derivative.

Two tri-phenyl methane dyes.

Four p-benzaldehyde sulfonic acid derivatives of p-amino benzoic esters.

## The Glass Electrode for pH Determinations on Unbuffered Solutions

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THE RAPID INCREASE in the use of the glass electrode is due to: (1) simplicity of operation, (2) accuracy, (3) rapidity with which equilibrium is reached, and (4) general applicability. It is especially suitable for the determination of the pH of pure water and of highly purified salt solutions.

### PURIFICATION OF SODIUM CHLORIDE

The two samples of sodium chloride used in these experiments gave the following analysis:

Impurities	Percentage	
	Sample A	Sample B
Insoluble matter	0.003%	0.0005%
SO <sub>4</sub>	0.000%	0.000%
Ca and Mg ppt.	0.005%	0.005%
NH <sub>4</sub> OH ppt.	0.000%	0.000%
Neut. (HCl)	0.003%	Neutral
Chlorate and nitrate (as ClO <sub>3</sub> )	0.002%	0.000%
Nitrogen comp. (as N)	0.0003%	0.000%
PO <sub>4</sub>	0.0005%	0.0000%
Ba	0.001%	0.005%
Heavy metals (as Ag, Pb)	0.000%	0.0002%
Fe	0.0003%	0.0001%
K	0.00%	0.00%

These analyses pass the usual American Chemical Society requirements of purity. However, sample A was further purified by passing dry hydrogen chloride into a saturated solution of the salt. The precipitated salt was filtered, pressed dry under suction, redissolved, again precipitated with hydrogen chloride, filtered as before, washed with a small amount of water, dried at 120° C. in an electric oven, crystallized from water, washed with small portions of water, and again dried in the oven. The salt was then heated in an open pyrex crystallizing dish over a Fisher burner to drive off any traces of hydrogen chloride. It was further purified by pouring a saturated solution of it into an equal volume of 95 percent ethyl alcohol, immersed in ice water. The finely-divided sodium chloride, precipitated from the alcohol, was separated by filtering the solution through a Büchner

\*This is part of a thesis presented by R. C. White while doing work leading to the degree of Ph.D. in chemistry.

funnel and further purified by washing with three or four portions of 95 percent alcohol, followed by three or four portions of diethyl ether.

#### PREPARATION OF PURE WATER

Due to the presence of carbon dioxide in the air, the pH of ordinary distilled water is from 5.8 to 6.0. If this distilled water is aerated with purified air the pH increases, rapidly at first and then more slowly.

Frequently, water is purified by distillation, after the addition of small amounts of potassium permanganate and sodium hydroxide. These serve to decompose organic material containing nitrogen and to release ammonia from its salts. A subsequent distillation is made after the addition of a small amount of sulfuric acid or ortho-phosphoric acid.

Ellis and Kiehl<sup>†</sup> have shown that, without the addition of potassium permanganate and sodium hydroxide, highly purified water may be produced by distillation of ordinary distilled water, which is approximately 0.025 molar with respect to ortho-phosphoric acid. The water which they collected in a receiver of silver gave a pH of 7.01, while that collected in a pyrex receiver gave a pH of 7.11 at 27° C.

Ellis and Kiehl designed a special still based on the principle that fresh air should be continuously forced through the apparatus during the distillation. We have so modified the still that salt solutions may be prepared without access to unpurified air.

#### PROCEDURE

For the determination of the pH of water and of unbuffered salt solutions, it was found desirable to design a type of refluxer (Fig. 1-B), such that the salt could be boiled without change in

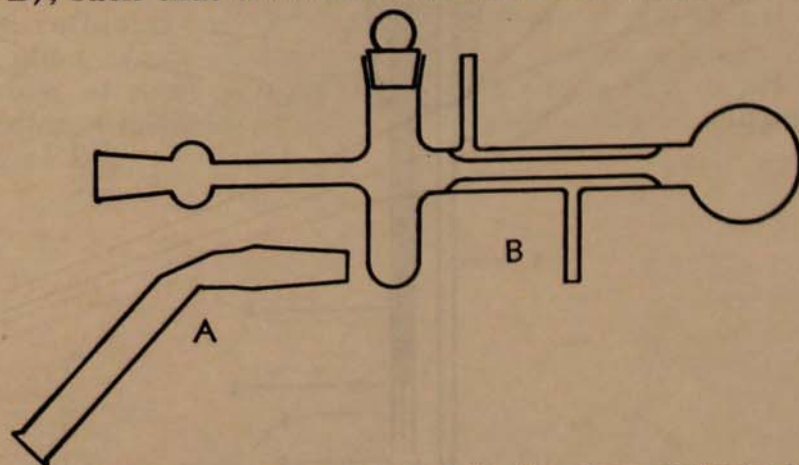


FIG. 1—Refluxing apparatus for use with the glass electrode in pH determinations  
A—Tube containing soda lime and phosphorus pentoxide  
B—Refluxer

<sup>†</sup>Ellis and Kiehl, *J. Am. Chem. Soc.*, 57, 2145 (1935).

concentration and the pH measured in the same flask. Although this was originally designed to permit heating salt solutions with samples of cellulosic material, it is suitable for pH measurements of water and unbuffered salt solutions.

In carrying out determinations the refluxer is first filled with purified air. This purified air is obtained by using an oil pump to drive air through a series of three special wash bottles containing, respectively, concentrated sulfuric acid, dilute sulfuric acid, and concentrated sodium hydroxide solution; then through an empty flask, followed by a series of five 12-inch drying towers filled with soda-lime; and, finally, through a similar tower filled with glass wool and cotton. Most of the acidic components of the air will be removed by the sodium hydroxide solution, and the basic components by the sulfuric acid. Traces of acid components, such as carbon dioxide, which pass through the wash bottles, will be completely removed by the five towers of soda-lime. The purpose of the tower containing glass wool and cotton is to prevent any soda-lime dust from being swept along with the air.

Twenty-five cc. of purified water or salt solution are siphoned through a pyrex tube extending to the bottom of the refluxer and attached to the receiving flask of the special still. The refluxer is at once protected from basic, acidic, and dust impuri-

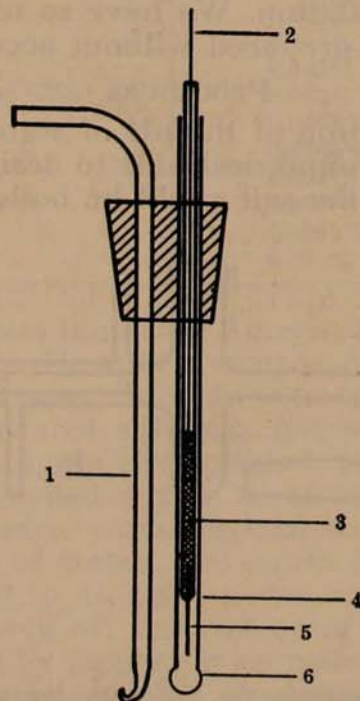


FIG. 2—Glass electrode assembly: 1. Potassium chloride bridge; 2. Lead to grid of amplifier or to ground (no. 5 in C); 3. Mercury connection; 4. Ordinary soft-glass tubing; 5. Platinum wire; 6. Corning .015 glass bulb.

ties of the air by a tube (Fig. 1-A), whose outer end is filled, as far as the bend, with alternate layers of cotton, a mixture of phosphorus pentoxide and pumice, cotton, soda-lime, and cotton.

The water or solution is brought to boiling on an electric hot plate with cold water running through the condenser. Boiling is continued for thirty minutes. This will insure complete removal of any trace of carbon dioxide, while too long boiling will slowly dissolve something from the glass.

The refluxer is removed from the heater and after cooling to room temperature, the pH is determined. This is accomplished by tilting the flask until a portion of the water or solution runs into the side tube attached to the upper portion of the refluxer. The glass stopper is removed and the glass electrode assembly (Fig. 2) quickly inserted. The rubber stopper holding the assembly fits snugly into the opening. The voltage reading should be taken as quickly as possible, since the bulb (Corning .015) of the glass electrode dissolves rather rapidly.

Wherever desirable, refluxers may be conveniently run in groups. We have heated six refluxers, simultaneously, on one electric hot plate. While these were being used, six similar refluxers were washed, dried, and assembled for use. Best results are obtained from flasks which have been previously used for similar runs.

With this apparatus an average of 27 runs on six samples of purified water gave an average pH of 7.06 at 27° C.

#### EFFECT OF GLASS SOLUBILITY ON pH

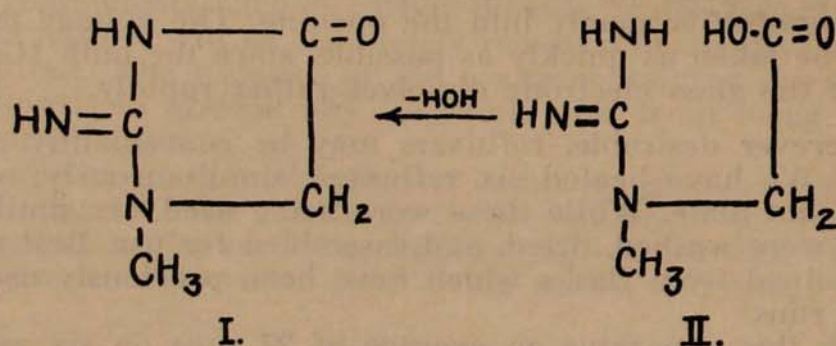
Prolonged boiling of an unbuffered solution in pyrex glass will produce an increase in pH. A 0.1 normal solution of sodium chloride, refluxed for 19.5 hours, produced a rise in pH of 1.37.

Soft glass beads in contact with 0.1 normal sodium chloride for 6.2 days at room temperature produced a rise in pH of 3.20, while water, similarly in contact with glass beads, showed a pH increase of 2.4.

## Halogen Acid Condensation Products of Creatinine

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CREATININE (I) was first reported in 1847 by Liebig (3), who had obtained its hydrochloride by heating creatine (II) with hydrochloric acid. He was able to show that creatinine could be considered the inner anhydride of creatine, since the conversion of creatine to creatinine involved the loss of only a molecule of water.



Creatinine has been shown to be a normal constituent of mammalian urine, because of its isolation from the urine of man, the dog, cat, rabbit, horse, and ox. It also is rather widely distributed in plants.

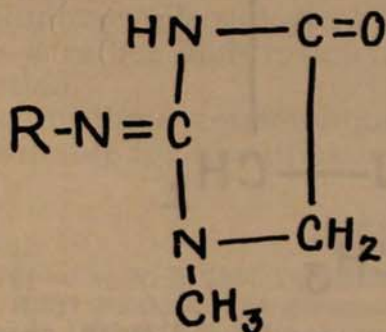
One will notice the presence of a substituted hydantoin ring in the creatinine molecule. It was wondered whether creatinine derivatives might show the physiological effects common to that ring, or whether or not the ring might prove to be a non-toxic vehicle for the introduction of substances which in themselves are too toxic or too irritating for direct administration. In order to test this matter several creatinine derivatives of aliphatic acids were synthesized.

Creatinine can be alkylated by various reagents. Neubauer (4) first employed alkyl halides in this role, preparing ethyl creatinine with ethyl iodide. Korndorfer (2), using methyl iodide, prepared methyl creatinine. Cornthwaite (1) has shown that methyl and ethyl sulfates can also be used as alkylating agents, apparently forming alkyl creatinines identical with those obtained using alkyl halides.

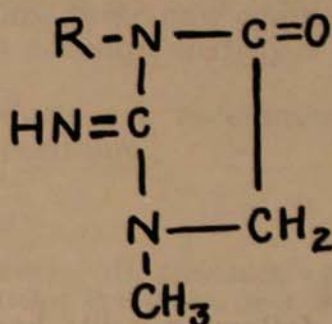
It is readily seen that the addition of an alkyl halide to a secondary nitrogen atom produces the hydrohalide of a tertiary amine. In the case of corresponding creatinine derivatives the halogen acid components are removed by judicious treatment

with potassium carbonate, sodium bicarbonate, silver oxide, or silver carbonate.

The question of the position taken by the entering group is still an unsettled one. Obviously there are two possibilities, giving rise to two possible types of derivatives, III and IV. There is evidence pointing to both the 3- and the exocyclic nitrogen atoms (1, 5, 6). Present evidence is contradictory and is much in need of clarification. Work on this phase of the alkylation problem is now in progress and we hope to be able to report conclusive evidence in the near future.



III.



IV.

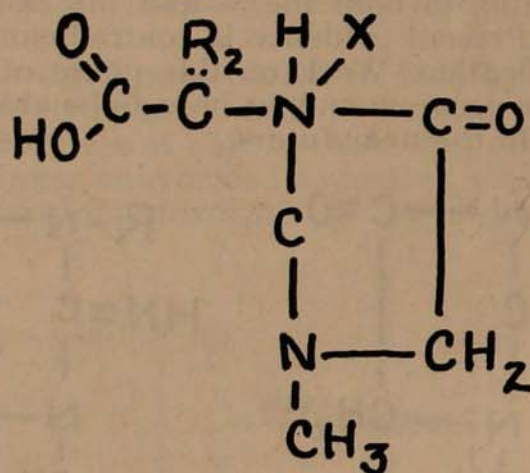
Since alkyl halides have proved effective as alkylating agents, and since but little is known concerning the chemical activity of the nitrogen atoms in creatinine, it was decided to attempt condensation of creatinine with several halogen acids. Knowing alpha-halogen-acids to be the most reactive with regard to the halogen atom, we first tried these.

The method first used to effect condensation was direct fusion at a temperature slightly above the melting points of the respective acids. After two hours the melt was dissolved in water and the excess acid extracted with ether. On concentrating the water layer the condensation product was obtained. This method has certain disadvantages. To obtain well-defined crystals, evaporation at room temperature is necessary, and this is always time-consuming. Too, there is a tendency for the condensation products to supersaturate in water solution, and if alcohol or an alcohol-ether mixture is added to hasten crystallization it is difficult to obtain nice crystals.

A second method was developed later. Though creatinine is but slightly soluble in even boiling alcohol, it was found that a boiling alcoholic solution of the appropriate acid would dissolve an equivalent amount of creatinine easily, and, on cooling, would deposit the reaction product in the form of fine needles.

Both procedures yield the same respective derivatives, though the second method mentioned is preferable both from the standpoint of time required, and the amount and purity of yield.

No formula is given for the products at this time, pending clarification of the position of various entering groups. However, on the assumption that the 3-nitrogen atom is the one affected, we may postulate a substance of this probable structure:



The following acids have been condensed with creatinine, using the methods described above. In each case one mole of the acid condenses with one mole of creatinine.

TABLE 1

Acid	Condensation Product	M.P.	Nitrogen	
			calc.	found.
$\text{ClCH}_2\text{COOH}$	Creatinine-acetic acid-HCl	161-3°	20.28	20.34
$\text{Cl}_2\text{CHCOOH}$	" -chloracetic acid-HCl	171-2°	17.46	17.35
$\text{Cl}_3\text{CCOOH}$	" -dichloracetic acid-HCl	247°wd	15.21	15.18
$\text{ICH}_2\text{COOH}$	" -acetic acid-HI	109-10°	22.28	22.07
$\text{CH}_3\text{CHBrCOOH}$	a- " -propionic acid-HBr	203-7°	15.81	15.43
$\text{BrCH}_2\text{CH}_2\text{COOH}$	b- " -propionic acid-HBr	114-5°	15.81	15.52

At this time we have not been successful in isolating the free acids. Using silver carbonate, a halogen-free water solution of what is probably the free acid has been obtained, but crystallization has not yet been accomplished.

Preliminary physiological tests on white mice show that, in general, these compounds produce high irritability, a more or less marked state of depression, and rather marked loss of control over the body, particularly in the rear legs. The mice apparently recovered to a normal state in about an hour but died, some with convulsions, in from 20 to 30 hours.

Thus it would seem that for halogen acids, attachment to the creatinine nucleus does not reduce their toxicity when administered to mice.

One unlooked-for object has been achieved while the above work was being carried out. The condensation products of cre-

atinine with di- and tri-chloroacetic acids should prove useful for the qualitative organic identification of creatinine, being characterized by slight solubility in alcohol as well as by the ease and rapidity with which they are formed in a very pure state by the solvent method.

#### SUMMARY

The reaction of creatinine with certain halogen acids has been studied. Several new condensation products have been prepared and characterized.

Preliminary physiological tests show these new compounds to possess a rather high toxicity, often accompanied by a convulsant action.

Two of these condensation products are recommended as being suitable for identification of creatinine.

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Fungi for Thiamin (Vitamin B<sub>1</sub>) Assay

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West Virginia University*

THREE GENERAL METHODS are used in assaying foods and concentrates for thiamin: First, by animal assay, which has the advantage of well-established techniques, but the disadvantage of a prolonged period required to prepare animals for the test and the relatively large amounts of thiamin required. Second, by colorimetric methods, which are very sensitive if the necessary and quite elaborate concentration of the vitamin is made beforehand. To date these methods have been used mainly for substances rich in thiamin. The limit of sensitivity of the thiochrome (3) and *p*-aminoacetophenone (4, 5, 6, 11) methods is given as 0.1 microgram of pure thiamin. These chemical methods are much more sensitive than any animal test yet devised. Undoubtedly they will be used very extensively in the future as they are refined and found reliable. Third, by the use of test fungi. The inability of certain fungi to grow in the absence of thiamin has been established in a number of laboratories (1, 7, 13). Growth of these test organisms constitutes a very delicate test for the presence of thiamin. The synthetic medium without the addendum serves as control. *Phytophthora erythroseptica* makes an appreciable growth in a suitable medium containing 0.1 microgram of thiamin to a liter. Since 10 ml. of medium suffices for a qualitative test, the limit of sensitivity is about 0.001 microgram.

All three of the foregoing methods have their place in the study of thiamin. The nature of the problem under investigation will determine the method of assay used.

The moieties of thiamin replace vitamin B<sub>1</sub> for a number of organisms. One of the thiamin moieties may replace thiamin for certain plant parts (excised tomato roots) (12). The writer is not aware of any animal or chemical assay methods available for the determination of the moieties of thiamin. By using a suitable selection of test fungi, it is possible to determine the following, semi-quantitatively at least: (a) the thiamin thiazole, (b) the thiamin pyrimidine, (c) both thiamin moieties together, and (d) thiamin *per se*. The determination of thiamin and its moieties in the same medium offers certain complications. A great deal of careful study must be devoted to this problem if it is to be solved satisfactorily.

\*Published with the approval of the Director of the West Virginia Agricultural Experiment Station as Scientific Paper No. 220.

The following list of test fungi illustrates the possibilities listed above. *Mucor ramannianus* is the only known member of the filamentous fungi that responds to thiamin thiazole *alone*; thiamin pyrimidine *alone* does not permit growth. This fungus will grow in the presence of thiamin or of cocarboxylase. It is a "lazy" organism in that it grows faster in the presence of thiazole-pyrimidine or thiamin than in the presence of thiazole alone. On solid media it has the distinctive feature of producing a pink to old-rose pigment. The amount of color produced is roughly a function of the amount of thiazole present in the medium. *Mucor ramannianus* is a slow grower. *Pythiomorpha gonapodioides*, a rapid grower, is representative of a large class of fungi that respond to thiamin pyrimidine alone. It makes no response to thiamin thiazole *alone*. Thiamin and cocarboxylase permit a good growth. *Phycomyces blakesleeanus*, another rapid grower, thrives in the presence of the two thiamin moieties *together*, neither one separately inducing any growth. Thiamin and cocarboxylase permit growth. It is a rapid grower. *Phytophthora erythroseptica* and *Pythium ascophallon* are representatives of the class of fungi that are unable to grow without thiamin or cocarboxylase. The first is a comparatively slow grower, the second more rapid.

#### QUANTITATIVE APPLICATIONS

The "Phycomyces" method for the quantitative assay of thiamin was developed by Schopfer (14, 15, 16, 17, 18). Under suitable conditions the weight of mycelium produced by *Phycomyces blakesleeanus* varies directly and linearly with the concentration of thiamin in the medium. The fungus is grown in liquid medium; at the end of 10 days the mycelium is filtered off, washed, and dried to constant weight at 100° C. A standard curve is set up from the weight of mycelium produced by known amounts of thiamin. The thiamin content of the unknown is read off from the standard curve from the weight of mycelium produced by the unknown. It is necessary to make a new standard curve for every set of determinations and to use several dilutions of the unknown, for at high concentrations the growth response is no longer linear. For a given medium there is an optimum concentration of thiamin; higher concentrations are without apparent effect on the yield.

Meiklejohn (10) has adapted Schopfer's method to determine thiamin in small volumes of blood. It is interesting that he found the thiamin content of blood from pigeons fed a vitamin B<sub>1</sub> deficient diet to be only 20 percent of that found in the blood of pigeons fed a normal diet. Villela (24, 25, 26) has made extensive use of Schopfer's method. He reported that the thiamin content of cerebrospinal fluid is higher when assayed by the Phycomyces test than by the thiochrome method. In some cases

where the chemical method gave negative results the *Phycomyces* test was positive. The question raised by these results is this: Was the higher value due to the presence of uncombined thiamin moieties in the cerebrospinal fluid (which would be reported as thiamin by the *Phycomyces* test), or was it caused by other factors? The thiochrome method measures thiamin only. Had *Phytophthora erythroseptica*, or some other organism that requires thiamin *per se*, been used instead of *Phycomyces blakesleeanus*, this uncertainty would have been removed. If *both* test organisms had been used, the question of uncombined moieties in the fluid might have been answered.

The fermentation test of Schultz, Atkin, and Frey (9, 19, 20, 21, 22, 23) offers considerable promise. This method is notable in that the time for a determination is only a few hours. This method consists of measuring the carbon dioxide evolved by a standard yeast suspension when treated with various amounts of thiamin. Thiamin stimulates the yeast to produce more carbon dioxide than the untreated control. The yeast used by these workers is stimulated to about the same extent by 2-ethyl-5-ethoxymethyl-6-amino-pyrimidine, as it is by thiamin. These authors report that no "excess" pyrimidine was found in the materials tested as shown by the agreement of the fermentation and rat assays. However, their yeast showed no stimulation in the presence of the thiazole moiety, so the question of free thiazole must be left open. Thiochrome has no influence on the rate of fermentation. When a mixture of thiamin and the pyrimidine moiety are treated with an alkaline solution of potassium ferricyanide, the thiamin is oxidized to thiochrome. This treatment did not affect the biological potency of the pyrimidine. This modification is one that should be capable of extension to the filamentous fungi. Nicotinic acid was found to have only a slight positive effect on the rate of evolution of carbon dioxide. A possible disadvantage of this method is the expensive apparatus required.

#### EXPERIMENTAL

Since *Phytophthora erythroseptica* offers a more dependable test for thiamin than *Phycomyces blakesleeanus*, it seemed worth while to determine the standard curve from the response to known concentrations of thiamin. The medium used is as follows: ammonium nitrate, magnesium sulfate, and potassium dihydrogen phosphate, 0.5 gram each, Bacto dextrose 5 gram, 0.5 gram of an amino acid mixture (*d*-glutamic acid, *l*-aspartic acid, and *d*-arginine, 2 parts each; glycine and *dl*-*a*-alanine, 1 part each), a trace of the rarer elements, 0.05% agar, water 1000 ml. The pH was adjusted to 5.5 before sterilization by the addition of sodium hydroxide. Thiamin was added to this medium in various concentrations. Five 250-ml. flasks were used

for each concentration of thiamin, with 25 ml. of medium per flask. Before inoculation the flasks were autoclaved 15 minutes at 15 pounds steam pressure. Fourteen days after inoculation the mycelium was filtered off and dried to constant weight at 100° C. The mycelium from each set of flasks was combined so that the weights in Table 1 represent the total weight of mycelium produced in five flasks.

Concentrations of thiamin greater than 1 microgram per liter increase the yield of mycelium only a little, as shown in Table 1. It cannot be too strongly stressed that these results are dependent upon the conditions employed. If the composition of the medium or other conditions are changed, the results will change also.

TABLE 1

Thiamin		Weight in mg.
Ppm.	Micrograms 125 ml.	
1/100	1.25	229
1/250	0.50	229
1/500	0.25	238
1/800	0.156	223
1/1000	0.125	206
1/2000	0.0625	174
1/5000	0.025	54
1/10,000	0.0125	9
Check	0.0	no growth

Some time ago we undertook to determine if a thiamin assay could be made using solid medium. The expected advantage of such a method was the great reduction of effort necessary to make an assay. A large number of fungi were tested in a preliminary way in test-tube slants. The habits of growth on solid media of most of the fungi tested were such that no exact comparison could be made. One organism, *Mucor ramannianus*, did show some promise. The limitations of this fungus were discussed in the introduction.

When this fungus was grown on solid medium in Erlenmeyer flasks a very good graduation in growth and color was obtained in the presence of various amounts of thiamin. The same medium was used in these experiments as in the experiments with *Phytophthora erythroseptica* with the exception that the medium was solidified with 2% agar. A concentrated solution of this medium was added to various dilutions of thiamin in 50-ml. flasks, and the volume made up to 10 ml. by the addition of distilled water. The flasks were autoclaved, inoculated, and then incubated at 25° C. Two unknowns were prepared by one of the assistants. The standards and the unknowns were treated exactly the same. The first comparison was made a week

later; growth had apparently ceased at the end of two weeks. The results of the estimation of amount of thiamin in the unknowns is given in Table 2.

TABLE 2

Observer	Unknown No. 1 Micrograms thiamin/10 ml.		Unknown No. 2 Micrograms thiamin/10 ml.	
	Estimated	Present	Estimated	Present
VGL	0.06	0.07	0.02	0.025
LHL	0.07	0.07	0.03-0.02	0.025
CRO	0.07	0.07	0.03	0.025
ASM	0.06	0.07	0.03-0.02	0.025

Further work (8) in this laboratory has shown that the growth and color produced by *Mucor ramannianus* in the presence of equivalent quantities of thiamin, cocarboxylase, and thiamin thiazole are the same.

## SUMMARY

The literature on thiamin assay by fungi has been reviewed to May, 1939. The standard curve for *Phytophthora erythroseptica* has been established, and shown suitable for thiamin assay. The possibilities of using *Mucor ramannianus* on solid media for assay have been investigated.

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## *The Geology and Mining Section*

### Mastodon Remains Near Crum, West Virginia

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THE DISTRIBUTION of Pleistocene mastodon remains in eastern North America has been confined largely to glacial deposits covering the north central and northeastern areas. An inspection of Map 5 in Oliver P. Hay's publication<sup>1</sup> proves this to be true. Numerous discoveries also have been reported from deposits on the east and west coasts of Florida, the lower Mississippi Valley, and along the Ohio River in Kentucky and Indiana. These, however, do not compare in number to similar remains which have been obtained in the more extensively glaciated regions to the north.

At the time of Hay's report, published in 1923, only two recorded finds had been made of mastodon remains within West Virginia. The first of these was a tooth found on the fifth and highest terrace along the Monongahela River near Stewartstown in Monongalia County. This discovery was reported by Dr. I. C. White<sup>2</sup> in the *American Journal of Science*. In 1902 a well-preserved mastodon tooth was recovered from river deposits on Neal Island, three miles above Parkersburg in Wood County. After examining photographs of the tooth Hay identified it as an upper left second molar.

The Department of Geology at West Virginia University was the recipient in February 1933 from Mr. William H. Boyer of an upper left hindermost molar of the mastodon *Mammot americanum* Kerr, which had been recovered from gravel-dredging operations in the Monongahela River at Point Marion, Pennsylvania. Also at this time the right tibia of the same species and probably from the same skeleton was found nearby, but its finder was reluctant to part with it. While these two specimens were not actually found within West Virginia, nevertheless their occurrence in river gravels so near the border and the considerable wear and abrasion upon them leaves little doubt that they had been washed down either the Monongahela or Cheat River to their confluence from some point in Monongalia County. This discovery was reported in a paper<sup>3</sup> presented before the West

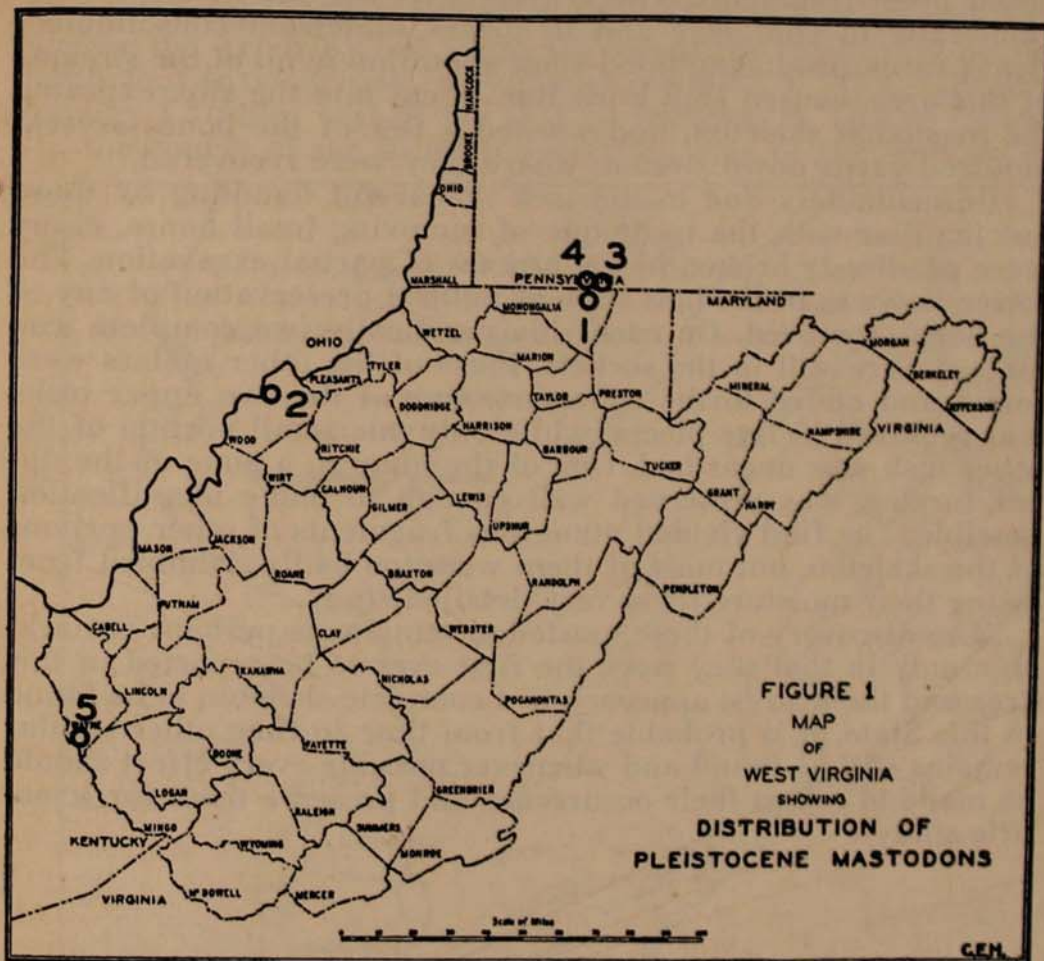
<sup>1</sup> Hay, Oliver P. 1923. *The Pleistocene of North America and its Vertebrated Animals from the States East of the Mississippi River and from the Canadian Provinces East of Longitude 95°*. Carnegie Inst. of Wash., Pub. No. 322.

<sup>2</sup> White, I. C., *Am. Jr. Sci.*, ser. 3, vol. 34, pp. 378-379.

<sup>3</sup> Price, P. H., and Wells, Dana. 1923. *Mastodon (Mammot americanum) Remains in River Gravels at Point Marion, Pennsylvania*. *Proc. W. Va. Acad. Sci.* 6: 81-83.

Virginia Academy of Science at its spring meeting of the same year.

The last and by far the most important recovery of mastodon remains in West Virginia was made the latter part of July 1938 in Wayne County near Crum. Several bones and teeth of the species *Mammot americanum* Kerr were discovered on the farm of Owen Marcum in Lincoln District, almost at the head of Bull Fork Run, a tributary of Jennies Creek, about 3½ miles north-



east of Crum. On August 3rd the writer, accompanied by Charles E. Hare, assistant geologist of the West Virginia Geological and Economic Survey, visited the site where the discovery was made and obtained permission to examine those parts of the skeleton which had been removed a short distance away to the home of Mr. Marcum.

At the time of the discovery of these skeletal remains, some of the bones were found in a deposit of terrace gravels and clays on the northeast bank, which had slumped from the hillside above down to water level in the run. Neither the exact distance of slumping nor the time of its occurrence was determinable, as

all evidence of a landslide scar above had been covered by a dense growth of vegetation. Directly opposite, on the southwest bank, a sandstone layer of the Kanawha Series was in place, as well as in the stream bed and along the bank above the slip. Numerous boulders of this sandstone member, containing characteristic Pottsville plant fossils, were scattered in the stream bed. The lenticular clays, exposed in the slump, displayed streaks of gray due to considerable organic material of partially decomposed plant fragments. The gravels were for the most part agglomeratic in character and in places somewhat consolidated. Heavy rains, producing flood-stage condition in all of the streams of this area, caused Bull Fork Run to cut into the slip, exposing the mastodon skeleton, and washed a few of the bones several hundred yards down stream, where they were recovered.

Unfortunately due to the lack of careful handling by those not familiar with the technique of removing fossil bones, many were needlessly broken in the process of partial excavation. The lower jaw was in the best state of natural preservation of any of the bones removed. On each side practically two complete true molars were still in the sockets. Parts of the other molars were found and added to the collection. One of the two upper tusks was removed in five pieces, while only one small portion of the other tusk was unearthed. One of the humeri, a bone of the upper foreleg, was preserved well enough to make identification possible. The find yielded numerous fragments of other portions of the skeleton, but most of them were too badly crumbled from losing their moisture for a very detailed study.

The discovery of these mastodon remains is perhaps remarkable only in that they were the first ever to be reported in this area and the nearest approach to a complete skeleton to be found in this State. It is probable that from time to time other similar remains will be found and whenever possible every effort should be made to report their occurrence and preserve them for scientific study.

## Devonian Coal in Tucker County, West Virginia

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IN THE EARLY SPRING of 1938 the writer had occasion to investigate the possibility of the presence of commercial coal in Pendleton County, and a summary of that investigation was read before the Academy last year.<sup>1</sup> On one of the trips in connection with that investigation, a stop was made at a WPA sandstone quarry 1.3 miles east of the City of Parsons, in Tucker County. In the course of the usual conversation, one of the workers re-

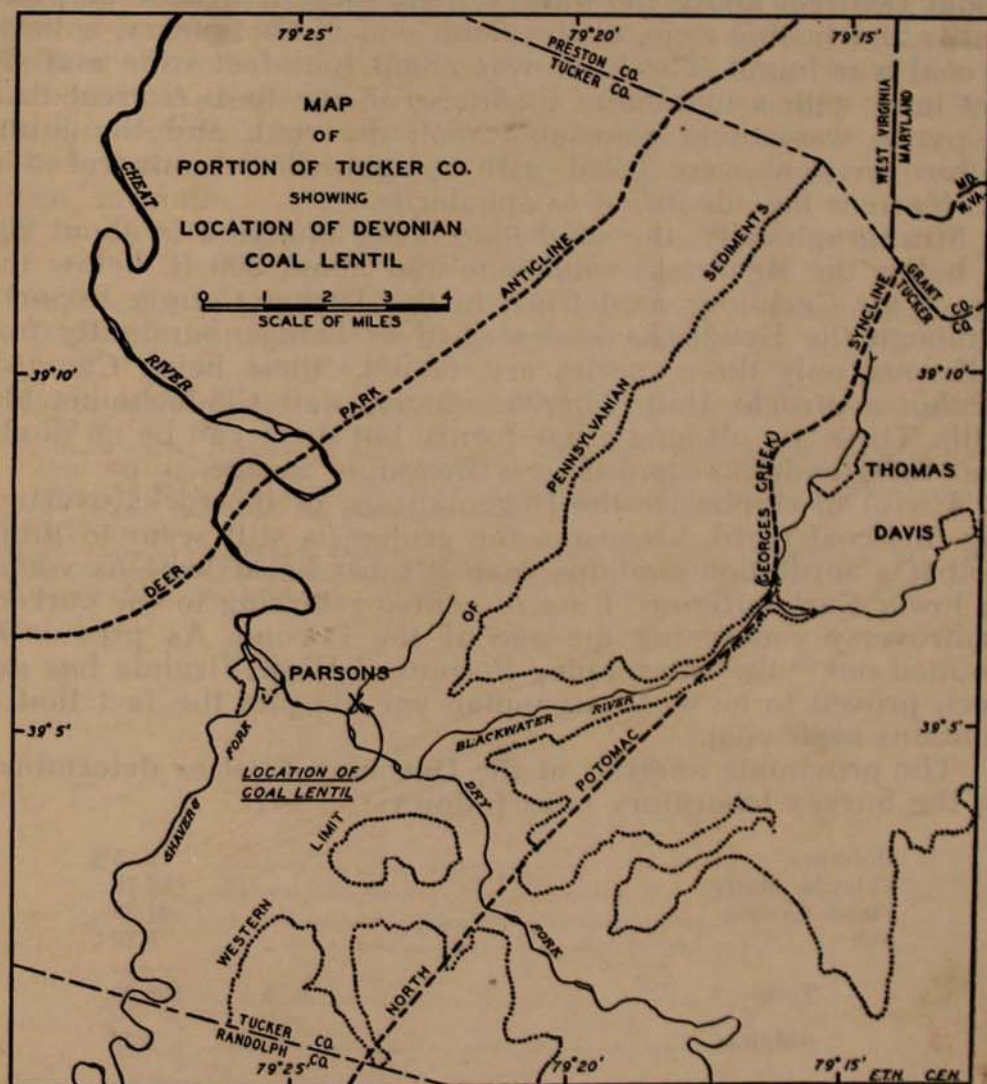


FIG. 1

<sup>1</sup> E. T. Heck. Pottsville Series of Pendleton County. Proceedings W. Va. Acad. Sci., 1938.

marked that they had struck coal. Knowing that the quarry sandstone was well down in the Devonian, the writer voiced his doubts. However, the proof of coal is coal, as the following description relates.

The quarry is located on the west side of U. S. Route 219, just above the mouth of Roaring Run (see Fig. 1). From a structural standpoint it is located between the Deer Park Anticline and the North Potomac (Georges Creek) Syncline. The rocks in the vicinity of the quarry show no evidence of intense folding, and dip to the southeast at about 800 ft. to the mile.

The quarry rock is a very massive fine-grained sandstone, with only a few of the usual vertical joints. It is pink at the top, and gradually shades into green toward the base of the quarry. About two feet above the quarry floor there is a zone of plant fossils and in this zone, at the south end of the quarry, a lense of coal was found. The lense was about four feet wide and six feet long, with a maximum thickness of one foot. A great deal of pyrite was found associated with the coal, and the joints within the coal were filled with a light-colored mineral that Dr. Martens has identified as sphalerite.

Stratigraphically, the sandstone being quarried is about 200 ft. below the Hendricks sandstone and about 300 ft. below the top of the Chemung, as defined in the Tucker County Report.<sup>2</sup> Although the Hendricks is described as being abundantly fossiliferous, only three species are named,<sup>3</sup> these being *Camartoechia contracta* Hall, *Lingula oherni*, and *Cladochonus humilis*. These are all long-range forms, but there can be no doubt that the Hendricks sandstone is Devonian in age.

I wish to emphasize the Devonian age of the rocks overlaying this coal lentil, because some geologists still seem to think that if a formation contains coal, it must be at least as young as lower Carboniferous. I am of course referring to the current controversy concerning the age of the Pocono. As previously pointed out,<sup>4</sup> the outcropping Pocono of West Virginia has not been proved to be of Mississippian age, despite the fact that it contains some coal.

The proximate analysis of the Devonian Coal as determined in the Survey laboratory is as follows:

Moisture -----	2.15%
Volatile Matter -----	17.76
Fixed Carbon -----	71.39
Ash -----	8.70
	<hr/>
Total -----	100.00
Sulphur -----	5.30

<sup>2</sup> David B. Reger, Assisted by Armstrong Price and R. C. Tucker. Tucker County Report, p. 252, 1923. Red beds have been found 500 ft. below the Hendricks. Also see p. 255.

<sup>3</sup> *Ibid.*, pp. 245 and 250.

<sup>4</sup> Paul H. Price and E. T. Heck, Greenbrier County Report. W. Va. Geol. Sur., 1939.

Reger<sup>5</sup> has published an isocarb map for Tucker County which shows a carbon ratio for the Parsons area of about 69. The above analysis gives a carbon ratio of 82.6.<sup>6</sup> These figures emphasize the importance of considering the stratigraphic position of the coal upon which carbon ratio maps are based. On Reger's map, the isocarbs for the Parsons area are controlled by analyses of Sewell Coal. According to Reger,<sup>7</sup> the interval from the Sewell Coal to the horizon of the quarry sandstone is approximately 2,150 ft. Thus we have an increase in carbon ratio of 0.6 per 100 ft. of stratigraphic depth, a figure that is identical with the 0.6 proposed by David White<sup>8</sup> and reasonably close to the 0.69 proposed by Reeves.<sup>9</sup> If these figures for increasing the carbon ratio with stratigraphic depth are valid, the so-called extinction zone of the Carbon Ratio Theory is disproved in West Virginia. There are many oil fields in this State, 2,100 or more ft. deep, that are producing in areas in which the carbon ratio of the surface coal is considerably more than 51 or 53. The significance of this point is enormous when it is remembered that the Carbon Ratio Theory was supposedly proved in West Virginia.

#### ACKNOWLEDGMENT

The writer is indebted to Mr. Charles E. Hare for the illustration and to Dr. Paul H. Price for permission to publish this paper.

<sup>5</sup> David B. Reger. Tucker County Report. W. Va. Geol. Sur., p. 261, 1923. Map by Reger and R. C. Tucker.

<sup>6</sup> Calculated on the Parr basis. See S. W. Parr. The Classification of Coal. Univ. of Illinois Eng. Exp. Sta. Bull., p. 180, 1928. See also Amer. Soc. for Test. Mat., Standards on Coal and Coke, Supplement, Oct. 1938. Converting Reger's map to the Parr basis does not change the figure for the Parsons area.

<sup>7</sup> *Ibid.*, p. 116-118.

<sup>8</sup> David White and Reinhardt Thiessen. Origin of Coal. Bur. Mines Bull. 38, p. 127, 1908.

<sup>9</sup> Frank Reeves, The Carbon-Ratio Theory in the Light of Hilt's Law. Bull. A. A. P. G., vol. 12, no. 8, p. 802, 1928.

## *The Mathematics and Physics Section*

### The Work of Amos E. Dolbear

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THE PURPOSE of this paper is to bring to Amos E. Dolbear the true recognition for the basic work which he did in the fields of electricity and sound. Professor Dolbear received his degrees from Ohio Wesleyan University and the University of Michigan and was professor of physics and natural history at Bethany College from 1867 to 1874. In 1874 he accepted a similar position at Tufts College in Boston, where he remained until his death in 1910.

In 1864, while a student at Ohio Wesleyan University, Amos Dolbear was employed to construct a large electromagnet and a large permanent magnet for demonstration purposes. While engaged in this work he devised a magneto-electric telegraph in which currents were generated by thrusting a permanent magnet into a coil; the currents in turn produced a like motion upon a permanent magnet at the other end of the line. In a paper presented in 1878 before the American Academy of Arts and Sciences Professor Dolbear stated, concerning this observation, "The device was not dissimilar to the one made by Gauss and Weber of Göttingen in 1833, but I knew nothing of their work at that time." (2)

Nine years after his first discovery Dolbear first noticed the other phenomenon which was necessary for his telephone. In his notebook, dated August 15, 1873, one finds the following entry: "Noticed the effect of the vibrating fork, which was also a permanent magnet, upon the current when one face of the mangle was heated. If the fork was moved no faster than the galvanometer needle would vibrate, once in about 4 seconds, the needle would be set swinging. If the fork vibrates its natural rate, 78 per second, the needle couldn't move, as the current was changed faster than the needle could move." (2)

This was a vibratory current in a closed circuit originating from sound vibrations. This observation was described by Professor Dolbear at the Portland meeting of the A. A. A. S. in 1873.

However, Professor Dolbear did not actually complete a model of a speaking telephone until September 20, 1876, after he had taken up his duties at Tufts. He was aided in this work by a student, Mr. Albert Stetson, from whom much of this information has been obtained. Its construction was comparatively simple. A coil of wire was wound about the pole of a permanent

magnet and a piece of iron was caused by sound to vibrate in front of it. At the other end of the circuit a similar piece of iron vibrated because of the changing attractive force of the second permanent magnet. To cause the original piece of iron to vibrate Dolbear made use of a simple device which he had invented at Bethany in 1873 and which he called an opeidoscope. The opeidoscope consisted of a membrane stretched over the end of a tube. A small mirror was glued to the membrane and a beam of light caused to fall on this mirror. As one spoke into the tube the mirror vibrated and gave off characteristic reflections.

In his first telephone Dolbear used a small piece of iron instead of the mirror and this was placed near the permanent magnet. However, he found that the iron showed a tendency to adhere to the magnet, and later a single iron diaphragm was placed across the end of the tube and much better results obtained. In his first experiment Dolbear substituted a Thomson galvanometer and a set of resistance coils in place of a receiver in order to test the possibilities of his instrument. He found that the induced current gave a deflection through an inserted resistance of 15,000 ohms, which is equal to about 900 miles of ordinary telegraph wire.

Up to this time Dolbear had been working merely to satisfy a scientific curiosity, and in 1876, when Bell gave his public demonstration and received his patent, Dolbear did not stop his work but continued on with his experiments. He devised several interesting means of attracting attention at the opposite end of the line. One was called the "Devil's Fiddle" and consisted of a piece of cat-gut string fastened to the middle of the diaphragm. The call was made by rubbing the stretched string with resin. Another type consisted of a hammer resting lightly against the diaphragm. A voice at the other end of the line caused the diaphragm to vibrate and knock the hammer down where it struck a bell or alarm.

Up to this time Dolbear had thought of varying the current by varying only the electromotive force. He next performed experiments in which he varied the resistance. Here he again tried to bring his opeidoscope into use. He fastened to the center of the vibrating membrane a wire bent at right angles. The other end of the wire was placed in contact with a globule of mercury. The results were not successful because the circuit was merely interrupted. Next he substituted a cone of iron in place of the wire with the point of the cone in contact with the mercury. The idea was that by changing the area one could cause the resistance to be changed. However, the mercury showed a tendency to bound away and only the pitch of the voice could be distinguished. In his next experiment Dolbear found that by using a single-cell battery as a sender and by touching one of the electrodes with a vibrating tuning fork, he could hear the tuning fork with an ordinary receiver. He constructed a small copper-

zinc cell about the size of a watch and was able to transmit articulate sounds of the voice through it, although they were not very loud.

His third experiment was a modification of the Reiss transmitter. A plate was made one terminal in a circuit, and an adjustable needle point the other. By using a weak battery and putting a drop of water between the point and the plate, the distinct sound of the voice could be transmitted between New York and Boston and understood at a point ten feet from the receiver. All of this work was done before or during 1877, and later experiments consisted of trials with various materials and surfaces.

In 1877 the Western Union Telegraph Company became interested in the results and records of Dolbear's work and offered to take up his interests in opposition to the Bell Company. Sometime after the suit concerning patent rights had been started, Professor Dolbear was requested to come to New York to discuss the details with the general superintendent of the Western Union, a Mr. Prescott. After reviewing what his company was doing, Prescott stated that the case looked hopeless but asked Dolbear to name a price for all of his rights in the telephone. Professor Dolbear knew that he had spent only about \$500 but he timidly asked for \$10,000. He was amazed when he was handed a check for this amount but further astounded when he learned several months later that the board of directors had voted to pay him any amount up to \$100,000.

This story was not told as an attempt to undermine the credit which has been given to Bell. Even Mr. Stetson, who worked with Dolbear, states that it was Bell who gave the telephone to the world. The essential difference between the two inventions was that in Bell's arrangement a current already on the line is varied with electromagnets, while in Dolbear's arrangement the only current on the line has permanent magnets as its origin. It is interesting to note that the permanent magnet receiver in use today is really the invention of Amos Dolbear.

In 1881 Dolbear was granted a patent for his electrostatic telephone, an invention quite different from that of Bell's. Dolbear described this telephone at a meeting of the American Association for the Advancement of Science in 1883, and in the discussion which followed Professor H. A. Rowland of Johns Hopkins University made the following statement: . . . "Scientifically this is an entirely different instrument from the Bell instrument and I am especially interested on that account." (6)

Mr. Stetson writes concerning this instrument, "In the year 1882 I spoke with the Dolbear telephone between London and Manchester, and London and Glasgow, and no other telephone in existence at that time could reach these distances. . . . The system at the transmitting station consisted of the regular microphonic transmitter controlling a primary circuit of about one-half to three-quarters of an ohm and a secondary of 2500 to

3000 ohms. . . . One end of the secondary was connected to earth at the transmitting station; the other connected at the receiving station with one plate of the Dolbear condenser telephone, the other plate being connected to earth. That articulate speech could be gotten out of a condenser was, so far as records show, unknown to any human being prior to Dolbear's wonderful discovery." (4)

In 1882 Amos E. Dolbear received, after much difficulty, a patent for perhaps his most important discovery. The difficulty lay in the fact that the patent officials declared it to be an impossibility. Considering what was known at that time it is easy to understand their incredulity when we hear the following description which Dolbear gave them. "My invention relates to establishing electrical communication between two or more places without the use of a wire or other like conductor; and it consists in connecting the transmitting instrument with a ground, the potential of which is considerably above normal, and the receiving instrument with a ground the potential of which is considerably below the normal, the result being that an impulse from the transmitter sufficient to cause the receiver to give intelligible signals is transmitted through the earth without the need of any circuit, such as has heretofore been deemed essential." (1)

He concludes his description by saying, "I have spoken only of telephone instruments, as these give the best results, but any electric instruments may be used capable of utilizing the currents passing through the earth from a point C to a point D, and the strength of such currents can be largely increased by increasing the positive potential of C and the negative potential of D." (1)

The first public exhibition of this invention was made in London, England, on April 1, 1882, at a meeting of "The Society of Telegraph Engineers and Electricians" and this is believed to be the first instance where the human voice was ever transmitted by wireless telephony. The real importance has been summed up very well by Robert Stanley in his "Text Book on Wireless Telegraphy." (3)

"In the same year, 1882, an arrangement was patented by Professor Dolbear in the United States by means of which speech communication was established over a range of more than half a mile. . . . The transmitter consists of a microphone, battery, and induction coil. One end of the induction coil was earthed, the other end was connected to a condenser. Reception was made by a telephone receiver connected at one end to earth, at the other to a condenser which was connected in series to a battery and a second condenser. . . . Speaking into the microphone caused pulses of potential to be induced in the secondary coil and therefore in the ground at A. In consequence earth currents flowed producing similar pulses of potential at B so that the speech was

reproduced in the receiver R. Instead of the microphone Dolbear wrote also of using an interrupter and a Morse key in the primary, in other words, an ordinary spark induction coil; no doubt with a large spark induction coil and a larger battery' than could be used with a microphone greater ranges could have been recorded." (3)

In another text on this subject we find the following statement in a description of Dolbear's discovery. "At times a gilt kite was employed carrying a fine wire from the secondary coil. The discharges were then nearly as strong as if there was an ordinary circuit. . . . Dolbear's idea was apparently the electrification of the ground wires and the changing of their potential from plus to minus whenever a signal was transmitted, and he showed that he was groping his way toward the real thing." (5)

It was Herz, however, who demonstrated, in 1888, the possibilities of high-frequency oscillations of which Marconi soon developed the commercial advantages as a means of signalling.

When we realize that Herz's work came six years after Dolbear's discovery, and Marconi's fifteen years after, we cannot but agree with Mr. Stetson when he described Professor Dolbear as a man in advance of his time and it can only be left to the imagination to picture what he might be doing today were he a member of the present generation.

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## The Sand Figures on Circular Plates

### PART I—THE EXPERIMENTAL EQUIPMENT

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OVER A CENTURY AGO Chladni discovered that thin glass plates, supported at the center or edge by a clamp, could be set in vibration by drawing a violin bow across the edge exactly as a violin string is vibrated. He further showed, by sprinkling sand upon the vibrating plates, that the sand would accumulate along the nodal lines. Since the plates are usually restricted to symmetrical forms such as squares, rectangles, circles, etc., the resulting nodal lines (called Chladni patterns) produce beautiful geometrical designs. Since Chladni's time, brass plates about ten inches square and varying in thickness from one-sixteenth to one sixty-fourth of an inch have become the standard plates. An elaborate theory for square plates has been developed, but so far the theory of circular plates has retained the form given it by Kirchhoff in 1850. He showed that the general solution of the differential equation gives circles and diameters in the form

$$(1) \quad J_n(kr) \cos(n\theta - a) = 0$$

However, with the electric oscillator described below, it is possible to obtain many additional symmetrical figures. Two of these are shown in Figure 1, and the theory will be discussed in Part II of this paper.

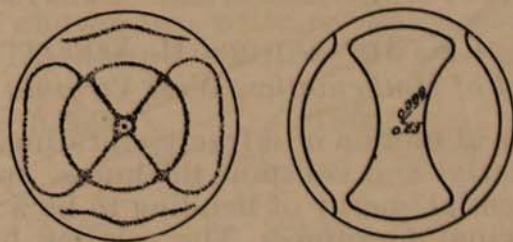


FIG. 1

Chladni always used a violin bow in vibrating his plates, but it has been found that a vacuum tube oscillator suitably applied can produce thousands of Chladni patterns, compared to the hundred odd which Chladni himself discovered. A vacuum tube circuit, unless it is carefully assembled, will not give a sinusoidal note, unaccompanied by overtones. The Western Electric Company of New York City has designed an oscillator which gives a pure sinusoidal wave at a very definite frequency. One of these oscillators has been donated to West Virginia University and with it the patterns of Figure 1 were formed.

The audio frequency signal generator, which is standard equipment for telephone testing, is arranged to be calibrated from two reeds incorporated within the unit. This calibration may also be checked by comparison with standard audio frequency signals, transmitted from the National Bureau of Standards radio station (WWV), located in Washington, D. C. These emissions are accurate to one part in one million.

The output from the signal generator is coupled into a standard high fidelity audio frequency power amplifier, from which sufficient audio frequency power is derived to operate a standard high power dynamic speaker or a magnetostriction vibrator unit. The mechanical vibrations are then transferred to the plates or membranes to be vibrated by means of suitable coupling rods, with terminating tips designed to fit the particular point of application. Figure 2 shows a block diagram of the electrical circuit.

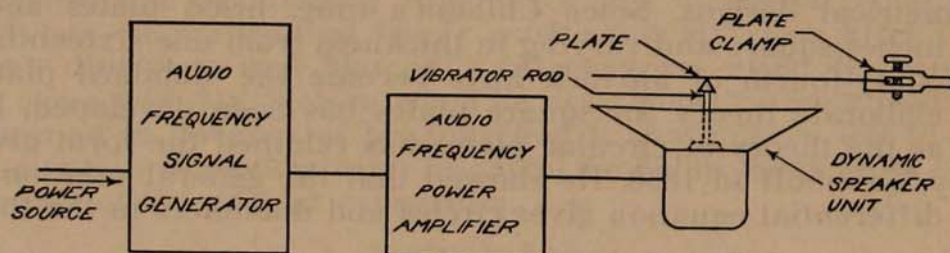


FIG. 2

## PART II—MATHEMATICAL TREATMENT

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The equations of motion of a freely vibrating, thin, solid plate of isotropic material and constant thickness, are found by considering the potential energy of bending to be a symmetric function of the principal curvatures. The solution by the method of Fobenius is

$$(2) \quad W_n = P \cos(n\theta - a) \{ J_m(kr) + \lambda J_n(ikr) \} \cos(pt - \epsilon)$$

This equation by itself would give rise to circles and diameters only. However, many other patterns appear on circular plates. Chladni attributed these to irregularities of the plate. Rayleigh suggested that the support of the plate affected the modes of vibration. Other factors such as the crystalline structure of the rolled metal, the dimensions of the central clamp, etc. have led investigators to conclude that the discrepancies were due to experimental difficulties.

The conclusion of Kirchhoff's theory that two modes cannot exist at the same time on a vibrating circular plate, is inherent in his hypothesis, and his solution is a particular one. We propose to investigate the nodal systems formed by two coexistent modes on the plate.

From the theory of Bessel functions

$$(3) \quad J_n(ikr) = i^n I_n(kr)$$

Putting (3) in (2), we have

$$(4) \quad W_n = P \cos(n\theta - a) \{J_n(kr) + \lambda i^n I_n(kr)\} \cos(pt - \epsilon)$$

For large values of  $ka$ ,  $\lambda$  becomes vanishingly small. The nodal circles are then given by  $J_n(kr) = 0$  as in the case of membranes.

When two modes exist, we have the relations

$$(5) \quad A[\cos n(\theta - a_1) \{J_n(kr) + \lambda J_n(ikr)\}] + B[\cos m(\theta - a_2) \{J_m(kr) + \lambda J_m(ikr)\}] = 0$$

Many symmetrical patterns may be plotted from equation (5). For example

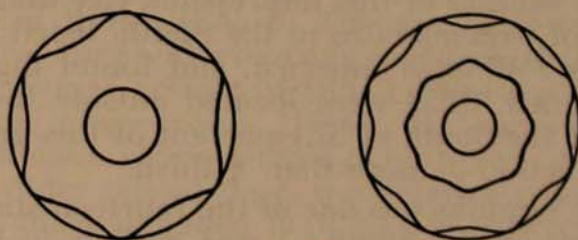


FIG. 3

in Figure 3 are shown two patterns which are neither circles nor diameters. They are plotted from the equations

$$(6) \quad \begin{cases} 8J_0\left(\frac{6.209r}{a}\right) + 5J_6\left(\frac{6.80r}{a}\right) \cos 6\theta = 0 \\ 2J_0\left(\frac{9.37r}{a}\right) + J_8\left(\frac{10.01r}{a}\right) \cos 8\theta = 0 \end{cases}$$

The original figures will be found in Chladni's "Akoustik".

## *The Social Sciences Section*

### A Further Note on the "Drain" of Talent Out of the Virginias

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A YEAR AGO I prepared a paper to be read before this group entitled, "A Note on the 'Drain' of Talent out of the Virginias." My interest in such a study was stimulated by an article written by Professor Wilson Gee, of the University of Virginia, which he called, "The 'Drag' of Talent Out of the South."<sup>1</sup> His study substantiated the more or less current impression that the South is a region which loses a considerable proportion of its talented sons and daughters to other regions. In order to test somewhat objectively the validity of this impression, Gee and his assistants made a study of persons born in the South, listed in the 1932-33 edition of *Who's Who in America*, and found that of the 6,015 persons mentioned, 2,229 were located outside the South. This meant a loss to the South of 37.1 percent of this group of Southerners of distinction — more than a third.

Since West Virginia was one of the fourteen states which Gee gave as comprising the South,<sup>2</sup> I was curious to know whether West Virginia was losing her talent to the same extent as the South in general, and my first plan was to study this question. It became apparent, however, as I contemplated such a study, that the two areas, West Virginia and the South, were not comparable. According to Gee's study a person might move all the way from Key West to Wheeling and still be in the South, whereas, a person in West Virginia may move only a small part of that distance and be outside of West Virginia. The logical thing seemed to be to compare West Virginia with another southern state of somewhat comparable area. Virginia was selected, not only because of this criterion, but also because of its geographical and historical contiguity.<sup>3</sup> Accordingly, the study was made, using the 1932-33 edition of *Who's Who in America*.<sup>4</sup> While a later edition was available at the time, the earlier one was used

<sup>1</sup> *Social Forces*, v. 15, No. 3, March 1937, pp. 343-346.

<sup>2</sup> West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee, Kentucky, Louisiana, Arkansas, Texas, and Oklahoma were the states Gee named as constituting the South.

<sup>3</sup> The area of West Virginia is 24,022 sq. mi.; that of Virginia, 40,262.

<sup>4</sup> Two of my N Y A students, Miss Dorothy Kilby and Mr. Woodard Dunlap, spent some hundreds of hours helping with the tabulations.

for purposes of comparison with Gee's study, it being then my plan to bring the study up to date for presentation at a later meeting of the Academy.

Study of the 1932-33 edition of *Who's Who in America* revealed a number of interesting comparisons. A total of 747 persons gave Virginia as their place of birth, while 249 were born in West Virginia. Similarly, a larger number of persons was found to be living in Virginia than in West Virginia, the figures being 510 and 220, respectively. Reducing these figures to a comparable basis, one finds that 14.40 persons born in West Virginia per 100,000 population in that state are listed in *Who's Who* as compared with 30.95 persons born in Virginia per 100,000 population in that state.<sup>5</sup> Likewise, there were listed 12.14 persons per 100,000 population living in West Virginia and 21.06 per 100,000 population in Virginia. In other words, in the 1932-33 edition Virginia had 2.15 times as many native sons as West Virginia and 1.73 times as many persons residing within its borders, listed in proportion to population.<sup>6</sup>

The disparity between the two states may be partially explained in a number of ways. In the first place, the older settled states generally predominate as birthplaces of people whose names appear in *Who's Who in America*.<sup>7</sup> The explanation for this fact becomes apparent when one considers that most of these persons whose names appear in *Who's Who* are likely to be included in the older age-groups. Hence, the population of a state whose development is characteristic of more recent times, as compared with an older settled state, was relatively much smaller at the time when those included in *Who's Who* were born. Thus, in 1870 West Virginia was only 36.1 percent as populous as Virginia, while in 1930 this proportion had grown to 71.4 percent.<sup>8</sup> Another factor, which may have influenced the residence figures somewhat, was the proximity of Virginia to the District of Columbia, a concentration point for talented persons from many states who are connected with the various government departments located in Washington. A number of these were found to be living in suburban places across the border in Virginia and were thus counted as living in Virginia.

While the findings with regard to residence and number of native sons listed in *Who's Who* were decidedly favorable to Virginia, the advantage shifts to West Virginia when the matter of "drain" is considered. Of the persons born in Virginia 65.9 percent were found to be living in other states, while only 53.4 percent of those born in West Virginia were living outside its borders. Likewise, in the exchanges of talented persons between the

<sup>5</sup> Based upon Birth and Residence Statistics, p. 17, of this edition.

<sup>6</sup> The population of West Virginia in 1930 was 1,729,205; that of Virginia was 2,421,851.

<sup>7</sup> See *Who's Who in America*, vol. 17; p. 18.

<sup>8</sup> Thus if we should assume an average of 50 years of age and base our rates upon the population of 1880, we find Virginia's rate to be only 1.13 times as great as that of West Virginia.

two states, only seven West Virginians cast their lot with Virginia, whereas, twenty Virginians were found in West Virginia. Numerically, West Virginia had the advantage, even though, on the qualitative side, it has given to Virginia two such native West Virginians as Senator Harry Byrd and William Jett Lauck, to whom Gee refers as an economist of national reputation.<sup>9</sup>

Upon the basis of the study last year a general hypothesis concerning the comparative loss of talented persons by Virginia and West Virginia was given. To quote: "The present study shows that in proportion to the population of the two states talented persons are found among the native sons of Virginia to a greater extent than among the native sons of West Virginia so far as this may be judged by *Who's Who* inclusion in 1932-33. West Virginia, however, is apparently better able to hold its talent within its borders than Virginia, the percentage of 'drain' for Virginia being 1.23 times as great as that of West Virginia. Furthermore, West Virginia seems better able to attract a more nearly comparable number of talented persons from other states to match the 'drain' of its own talent outward. Whether this condition, however, be temporary or more or less permanent only further research will reveal." It should be added that it was my tacit hypothesis that later editions of *Who's Who* would show a lessening of the disparity between the two states with regard to the relative numbers of natives and residents, that West Virginia would tend to reduce the early lead of Virginia, and that more and more as time passed it would tend to keep its sons of talent within its borders.

This year the study was continued, using the 1936-37 edition of *Who's Who in America*.<sup>10</sup> As a further check on the relative "drain" of talent a study of *America's Young Men*,<sup>11</sup> was included. This is the *Who's Who* among young men who have not yet passed the age of forty and who are, in the language of its editor, "the young men of promise who have not yet fully established themselves, but whose achievements to date indicate that they will be our future leaders."<sup>12</sup> It may be assumed that these younger men were born and grew to maturity at times when the population of Virginia and West Virginia was more nearly comparable than in the case of those included in *Who's Who in America*. And now we may ask what these later studies revealed concerning the validity of the hypothesis just mentioned and what changes, if any, have occurred in the four-year period between 1932-33 and 1936-37?

Both Virginia and West Virginia have a larger number of persons listed in the 1936-37 edition of *Who's Who* than they

<sup>9</sup> Lauck was one of those whose office is in Washington, D. C., and whose home is in Virginia.

<sup>10</sup> The 1938-1939 edition is now available but was not available at the time it was necessary to begin the study.

<sup>11</sup> *America's Young Men*, vol. 3, 1938-39, American Publications, Los Angeles, Cal.

<sup>12</sup> *Ibid.*, p. vii.

had four years before.<sup>13</sup> Virginia's native sons increased from 747 to 760 and West Virginia's from 249 to 259, showing a gain of 1.7 percent for Virginia and 4.7 percent for West Virginia. Likewise, both states show an increase in the number resident within their borders, Virginia showing an increase of 59 and West Virginia only three more than in the earlier edition. The relative gains in residents listed were, therefore, 10.7 percent for Virginia and 1.4 percent for West Virginia. Reducing these figures to a comparable basis, one finds that Virginia had 31.38 natives listed per 100,000 population while West Virginia had 15.61 persons per 100,000 population. Likewise, Virginia had 23.49 persons per 100,000 population listed as residents while West Virginia had 12.90 persons. In other words, in the four-year period Virginia's lead in the number of native sons listed dropped from 2.15 times as many as West Virginia to 2.01 times as many. In residents, however, her lead increased from 1.73 times as many as West Virginia to 1.82 times as many.

When one turns to the younger group of men listed in *America's Young Men* for 1938-39 the disparity between the states begins sharply to disappear. Virginia still leads but the margin of her leadership is greatly reduced. There were 3.30 West-Virginia-born young men per 100,000 population listed and 5.33 Virginia-born young men. Likewise, there were 2.96 young men living in West Virginia per 100,000 population and 3.39 young men living in Virginia. In other words, Virginia has 1.62 times as many native sons listed in proportion to population but only 1.15 times as many residents. When these figures are compared with the *Who's Who* figures of 2.01 and 1.82, respectively, the sharp decline in Virginia's lead becomes apparent.

Whatever its significance, the fact is that the "drain" of talented persons has increased during the four-year period in the case of both states. Study of the 1936-37 volume of *Who's Who* indicates that the proportion of native West Virginians living outside the State has increased from 53.4 to 59.2 percent. Native Virginians living outside the Old Dominion have likewise increased from 65.9 to 67.4 percent of the total number born there. Relatively, the "drain" of West Virginia has increased more rapidly than Virginia although the actual "drain" of Virginia is still larger by 8.2 percent. The exchange of talent between the states remained about the same as in the earlier edition, there being nine West Virginians living in Virginia and twenty-one Virginians living in West Virginia.

Four years is, of course, a relatively short time in which to expect much change to occur. It is not surprising, then, to find that the general hypothesis which was formulated concerning the earlier study holds for the most part in this one, namely, that

<sup>13</sup> The figures in the Birth and Residence Statistics given in this edition are used throughout this paragraph, or figures derived from them.

Virginia is more productive of talented natives in proportion to her population, so far as this may be judged by *Who's Who* inclusion, but that West Virginia is better able to hold her talented persons than Virginia. The further hypothesis, that as time passes this disparity between the states in the number of natives listed in *Who's Who* will tend to be lessened, was borne out by the later study. Contrary to my hypothesis, however, West Virginia did not gain in the number of residents per 100,000 population as rapidly as Virginia. The figures on the younger men listed in *America's Young Men*, however, support my hypothesis definitely by indicating little difference in the number listed per 100,000 population residing within the two states. Further, it must be stated that, contrary to my expectations, the amount of "drain" of talented persons out of both states increased.

The explanation of these changes is outside the scope of the present paper. It may be they are more or less adventitious circumstances to be corrected in a later volume. They may, on the other hand, be indicative of a definite trend. But whether it is the one or the other, we must conclude, as we did a year ago, only further research will show.

## The Chesapeake and Delaware Canal

A. J. DADISMAN

THE FIRST CANALS dug by man were probably for irrigation purposes, but they were known to be used for navigation in the days of ancient Egypt. They have been known in America but a little more than a century. The canal era in the United States dates from 1825. However, several short ones were in use before this time. During the following decade a number of artificial waterways were started, some of which have been improved and are still in use. The decade, 1850 to 1860, may be called the end of the canal-building era in the United States, and it was also the decade of greatest railroad-building up to that time. In this decade the Chesapeake and Ohio Canal reached Cumberland and was never extended; the James River and Kanawha Canal was not extended after 1851; and many others in New England, Ohio, and Pennsylvania were going out of use by the end of the decade.

A few of the early canals have been enlarged and are still serving a useful purpose. One of the most important of these is the Chesapeake and Delaware Canal connecting Chesapeake Bay with Delaware Bay. The northern end of Chesapeake Bay is 19 miles from the western shore of Delaware Bay. Baltimore, on Chesapeake Bay, is about 121 miles from Philadelphia, on Delaware Bay, by way of the canal, while the sea voyage between the two cities requires a journey of more than 400 miles. The Chesapeake Bay terminus of the canal is about 60 miles north of Baltimore and the Delaware Bay terminus is about 40 miles south of Philadelphia. The canal passes through a low-lying, almost level, agricultural country.

"As early as 1680 one Augustus Hermen, Lord of Bohemia Manor, contemplated the construction of a canal to connect the Delaware and Chesapeake Bays."<sup>1</sup> But it was not until 1764 and 1769 that private surveys were made of routes for the purpose of connecting the two bays. The Revolutionary War interrupted the venture and it lay dormant until 1799 when the Chesapeake and Delaware Canal Company was incorporated by the Maryland Legislature. Delaware and Pennsylvania soon authorized the construction of the canal. The cost was estimated at \$2,200,000 which was ultimately obtained from the three states, the Federal Government, and by popular subscriptions. By 1803 sufficient funds had been subscribed, and excavation was begun on a feeder to supply water to the canal. Funds were soon exhausted and work stopped. An appeal to Congress for funds led to a proposed bill for aid sponsored by Albert Gallatin, Secretary of the Treasury, but the bill was defeated in 1810.

In 1822 a movement was made to revive the project; a new survey was made; Pennsylvania, Delaware, Maryland, the Federal Government, and private individuals, jointly contributed \$1,000,000, and in 1824 work on the canal was begun. Success attended this attempt, and on October 17, 1829, the original canal was officially opened.

The excavation was performed by picks and shovels and the dirt was hauled away by mules and carts. At times more than 2,500 men were employed. The canal was  $13\frac{5}{8}$  miles long, had three locks, and cost \$2,250,000. This was the most expensive waterway in America at this time, having cost \$165,000 per mile. Navigation was by mule-power, and a towpath was constructed along the north side of the canal. The lock canal was 10 feet deep and had a bottom width of 36 feet. The locks were 22 feet wide and 96 feet long. In 1837 a steam pump was installed and superseded by a water-power pump in 1851, to maintain the water level in the lock canal.

In 1830 only 61,500 tons were transported on the canal but the tonnage gradually increased until 1869 to 1875 when more than 1,000,000 tons were carried each year. Since 1932 more than 1,000,000 tons of freight and several thousand passengers have been carried each year.

For 90 years the Chesapeake and Delaware Canal was operated as a privately-owned toll canal. During this time numerous improvements were made.

In 1871 interest began to develop in making the Chesapeake and Delaware Canal into a national ship canal. The stockholders of the company favored government ownership because the great construction cost was likely to render it an unprofitable investment. For nearly fifty years government engineers were engaged in making surveys of different routes. At length, in 1906, a federal commission was appointed to report on a route for a "free and open waterway to connect the Chesapeake and Delaware Bays." The following year the committee recommended the old canal as the most satisfactory location, that the waterway be purchased and improved, and estimated that to enlarge it to ship-canal size would cost approximately \$21,000,000.

Twelve years later, August 18, 1919, the Federal Government purchased the canal for \$2,514,000. A project was adopted at once for making the canal toll-free, 12 feet deep, and 90 feet wide at the bottom, at an estimated cost of \$13,000,000. The reconstruction of the canal consisted of the construction of a new entrance channel on the Delaware end, removal of 16,000,000 cubic yards of earth, removal of the old stone locks, and construction of four highway bridges and one railroad bridge. Excavation work was begun on June 27, 1921, and was completed May 31, 1927. The total cost was \$10,060,000.

The old wooden swing bridges were replaced by the vertical lift type. The vertical clearance of the bridges is about 140 feet and horizontal clearance 163 feet, with wider places for the passing of boats. All bridges are operated 24 hours daily, the lifting being done by means of electric power with gasoline emergency engines provided.

Shortly after the lock canal had been reconstructed as a sea-level canal, interest began to develop for a wider and deeper canal. In 1933 a report by the Chief of Engineers recommended to Congress that the waterway between Chesapeake Bay and Delaware Bay be modified to provide for a channel 25 feet deep and 250 feet wide at the bottom. The project was adopted in 1935, with a depth of 27 feet instead of 25 feet, as recommended in 1933. The new depth added 26 miles to the length of the canal.

One of the main purposes of the Act of 1935 was to provide employment for persons on relief; 90 percent of the workers on the project were from relief rolls.

The sea-level canal between Chesapeake Bay and Delaware Bay became a historic fact in 1927. Vessels of not more than 435 feet in length, 58-foot beam, and 18-foot draft may navigate the canal. Tows up to 800 feet in length are allowed to traverse the waterway. Emergency dolphins have been placed where needed; various signal devices have been put in place; a speed limit of 6 miles an hour has been established, the normal range of tides of 5.5 feet at the Delaware Bay end of the canal and 2 feet at the Chesapeake Bay end have been established; and this government-owned, sea-level, toll-free, 24-hour-service canal is the most modern canal in the world. The canal depth is 18 feet and 2 inches at the present time. However, two dredging boats are at work, and plans are to continue the dredging until a 27-foot channel is completed.

On January 10, 1939, the rudder of a steamship passing through the canal failed to function, and the vessel struck and destroyed one of the lift bridges. There are now three highway bridges and one railroad bridge over the main canal. All bridges are of the vertical lift type.

The commerce on this waterway consists largely of lumber and timber products, petroleum products, coal, and general merchandise. Of less importance are iron, shells and sand, acids, and fertilizers. Mine props, railroad ties, pilings, and wood are carried north in large quantities; the other products are carried both north and south. When tolls were last charged they were from \$4 to \$12 for empty steamers and fishing vessels; pig and scrap iron tolls were 15 cents per ton; coal and sand 20 cents per long ton; and lumber 38 cents per thousand board feet. Tolls averaged  $22\frac{3}{4}$  cents per ton for the year ending May 31, 1913.

The Chesapeake and Delaware Canal connects the two most important bays along the coast of the United States; it forms an

important link in a system of safe and sheltered deep waterways; it forms a link joining important bodies of water adjacent to the most important coal mining and manufacturing districts in the United States; and it provides the cheapest form of transportation for an immense volume of bulky and raw materials which are consumed some distance from their place of production.

By reducing transportation costs, this canal forms a vital link in a safe "inside transportation route" paralleling the Atlantic Seaboard from Hampton Roads to Massachusetts Bay. Army engineers have pointed out the great strategic importance of this canal for military purposes since the days of the War of 1812.

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## Huey Long and the Lame-Duck Congress

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WHEN THE Senate Democratic caucus met on December 7, 1933, it adopted the following program:

1. Priority for general appropriation bills awaiting consideration.
2. Consideration of the bill for Philippine independence.
3. Final disposition of the Glass banking bill, already considered at length in the previous session of Congress.
4. Prompt consideration of legislation for agricultural aid, tax reform, and unemployment relief.
5. Reasonably prompt action upon measures for economy and for a balanced budget.
6. Repeal of the Eighteenth Amendment, as soon as the Judiciary Committee of the Senate reported an acceptably worded measure.
7. Consideration of revision of the Volstead Act and a beer tax, as soon as these measures passed the House.
8. Attempt to get some action upon a resolution relative to American entry into the World Court.

Senator Huey P. Long of Louisiana was present at this conference, took an active part in its discussions, and joined his fellow-Democrats in giving its decisions a unanimous vote of support.<sup>1</sup> However, the 72nd Congress, in its lame-duck session, faced several difficulties. It was divided between a Republican Senate and a Democratic House; it was weakened by the presence of members recently repudiated at the polls; and it was under the discredited leadership of a President recently defeated for re-election. Such a Congress faced perplexing problems which had arisen in a highly critical period and in a time calling for cooperative planning and swift, united action.<sup>2</sup> It is not at all surprising, therefore, that only the last two items of the caucus program failed to receive any consideration from the Senate.

Amid all this confusion Senator Long repeatedly spoke in the language of a Populist. Though absent from the Senate for a full one-third of the 69 days it was in session, he delivered no less than fourteen speeches during the remaining 46 days. As in the first session of the 72nd Congress, he insistently championed the poor man against the rich, and the small independent business or business man against the gigantic corporations. Where,

<sup>1</sup> *Congressional Record*, 72d Congress, 2d session, 156. (Washington, 1933.)

<sup>2</sup> Herring, E. Pendleton: *Second Session of the Seventy-Second Congress, December 5, 1932, to March 4, 1933*, 104 (article in *American Political Science Review*, June 1933, 404-422).

in the first session of this Congress, the Standard Oil was the arch-villain, he added to it, in the second session, the banking interests and affiliated enterprises of J. P. Morgan and others. In his first session in the Senate, he claimed he had sought election to this body in order to try to "spread the wealth of the land among all the people;" for, according to his ideas, the uneven distribution of the wealth of the land was the true cause of the depression.<sup>3</sup> Share the wealth, prevent exploitation of the people by the rich, were to him what "Delenda est Carthago" was to Cato of ancient Rome.

On December 6, within a few minutes after the reading of President Hoover's last annual message, Long delivered a speech upon his favorite theme. In length, it consumed five pages of the *Congressional Record*. Here he claimed that decentralization of the wealth of America was the main issue upon which Governor Franklin D. Roosevelt had been nominated for President, and the most noticed issue upon which he had been elected. As evidence he quoted at length from the latter's address, delivered six weeks previously at the Commonwealth Club in San Francisco, wherein admission was made that the small independent business man was being forced to the wall by highly organized corporate competitors; also that American economic life was dominated by some 600 or more corporations controlling two-thirds of American industry; and that Americans were steering steadily toward economic oligarchy; that the day of the great promoter or financial titan had passed and the day of enlightened administration had come. From Roosevelt's speech of August 20, 1932, at Columbus, Ohio, Long quoted a passage showing that less than three dozen private banking houses and stock-selling affiliates in the commercial banks were directing the flow of American capital; and that a few powerful interests should not be allowed to make industrial cannon-fodder of the lives of half the people of the United States. Of several sentences quoted from Roosevelt's Atlanta speech of the preceding spring, Long played up the statement that America's basic trouble was not a capital shortage, but a buying-power shortage coupled with superabundant speculation in production. Long also quoted from President Hoover's Madison Square Garden speech and from Father Coughlin's radio address of November 27, 1932, various statements against wealth concentration. He also showed a \$23,500,000,000 increase in the annual income of all Americans from 1919 to 1928 as contrasted with a slump of \$649,000,000 in wages in 1927. He called upon Senators of both parties to act immediately by uniting in legislation to decentralize the wealth of the country and to spread it among the people. He called for a scaling up of income and inheritance taxes beyond the war-time rates of 1918, so as to

<sup>3</sup> Cushman, M. S., *Huey Long's First Session in the U. S. Senate*, 124-5 (In *Proceedings of the West Virginia Academy of Science*, 1937, vol. XI: *W. Va. Univ. Bulletin*, Series 38, No. 8-II, Feb. 1938).

prevent handing to heirs any fortune in excess of "a few million dollars"; for limiting work days so as to prevent overproduction; for the Government to take over all surplus farm produce of the nation; and for inflation of the currency.<sup>4</sup>

His hostility toward large fortunes caused him to make two long speeches upon the Hawes-Cutting Bill for Philippine independence. One consumed ten pages of the *Congressional Record*,<sup>5</sup> while the other, a part of his well-known filibuster against the Glass banking bill, consumed approximately twenty pages.<sup>6</sup> He admitted that he opposed parts of the bill, and that he would be willing to talk it to death or to have it sidetracked until after Roosevelt's inauguration.<sup>7</sup> He opposed having the Philippines wait ten, fifteen, or twenty years for their full independence, because he held that such a length of time would give the "imperialists of Wall Street", in an effort to protect \$197,000,000 of their financial investments in these islands, a chance to propagandize the native voters in favor of remaining part of American soil;<sup>8</sup> but, while he favored immediate independence,<sup>9</sup> he did support amendments for a five-year or an eight-year period of tutelage.<sup>10</sup> As he held that the absence of a tariff on Philippine sugar had brought ruin to many Louisiana cane and Colorado beet-growers, he secured adoption of an amendment limiting the imports of duty-free Philippine sugar to 615,000 tons a year;<sup>11</sup> and to protect the American growers of cotton, of vegetables, and of flax he secured another amendment, limiting to 140,000 tons a year the amount of duty-free Philippine coconut oil imports.<sup>12</sup> He asserted that the Filipinos were better off than the American farmer<sup>13</sup> and that he would free them so as to save them from the bad economic situation faced by Americans living in poverty amid plenty.<sup>14</sup>

This same hostility toward large fortunes and toward Wall Street prompted him to fight the Glass banking bill. Here he "carried through one of the most persistent filibusters in recent years."<sup>15</sup> He made no less than seven speeches occupying a total of 67 printed pages in the *Congressional Record*, all either attacking the bill or favoring certain amendments.<sup>16</sup> Here he ardently championed the small independent bank, claiming that it had not only been of valuable service to many a small farmer, but also that it had actually saved the chain banks from failure;<sup>17</sup> while the Glass bill was an entering wedge to stretch

<sup>4</sup> *Congressional Record* (Washington, 1933), 72d Congress, 2d Session, 55-59. As all other references to the *Congressional Record* will be limited to the volumes of this particular Congress and session, they will hereafter be cited only by page number.

<sup>5</sup> *Ibid.*, 555-565.

<sup>6</sup> *Ibid.*, 1800-1801 and 1835-1852.

<sup>7</sup> *Ibid.*, 555 and 1844.

<sup>8</sup> *Ibid.*, 558 and 391.

<sup>9</sup> *Ibid.*, 267 and 624.

<sup>10</sup> *Ibid.*, 434-435, 437.

<sup>11</sup> *Ibid.*, 266-269.

<sup>12</sup> *Ibid.*, 323-325.

<sup>13</sup> *Ibid.*, 563.

<sup>14</sup> *Ibid.*, 1848-1850.

<sup>15</sup> Herring, E. Pendleton., *op. cit.*, 419.

<sup>16</sup> *Congressional Record*, 72d Congress, 2d Session, 1330-1336, 1451-1467, 1573-1581, 1624-1636, 1646-1650, 2393-2399, 2493-2495.

<sup>17</sup> *Ibid.*, 1452-1453.

branch banking all over the United States;<sup>18</sup> that it allowed more concentration of wealth in the hands of a small number of men;<sup>19</sup> that it fostered monopoly;<sup>20</sup> and that President-elect Roosevelt was opposed to it.<sup>21</sup> He read an article showing that the American Bankers' Association opposed branch banking;<sup>22</sup> then he maintained that this body and the members of Congress had now changed their minds and were supporting it when J. P. Morgan ordered them to do so.<sup>23</sup> He opposed branch banking because a small farmer had more difficulty in getting a loan from a branch bank than from a small independent one; and because branch banks simply choked the small independent banks out of business.<sup>24</sup> He opposed the omission of the Secretary of the Treasury from the personnel of the Federal Reserve Board, because he believed such would only weaken the control of the Government over this organization;<sup>25</sup> and he said that no move for such omission had been made as long as Andrew Mellon or Ogden Mills was Secretary of the Treasury.<sup>26</sup> True, the Glass bill did include the Comptroller of the Currency upon the Board; but he was only a minor official, inferior to the Secretary of the Treasury,<sup>27</sup> and one who favored branch banking to such an extent as to allow its existence in defiance of adverse legislation.<sup>28</sup> He fought the abolition of the franchise tax required of the Federal Reserve Banks by the Act of 1913 and showed that these banks had cut the pay of their employees; also that the Government could use the proceeds of this tax to reduce the public debt, or as a fund for the guarantee of bank deposits.<sup>29</sup> At first he maintained that no plan of bank deposit guarantee was practicable;<sup>30</sup> but, less than two weeks later, he announced his conversion to this cause, provided the banks put up all the money for this liquidating fund, instead of the Government contributing \$125,000,000 thereto.<sup>31</sup> He condemned the bill as socialistic,<sup>32</sup> as a type of legislation not considering the sufferings of a people in a depression;<sup>33</sup> and as a measure that should be sidetracked so that much-needed relief legislation could be enacted.<sup>34</sup> He even offered to yield the floor if some Senator wished to use it for such a purpose.<sup>35</sup> On January 25, when the Senate finally voted, 54 to 9, in favor of the bill, Long, absent at that moment (though present at all roll calls up to then), was paired with Senator Reed of Pennsylvania, who transferred this pair to Senator Metcalf of Rhode Island, and voted "yea."<sup>36</sup>

A full forty pages of the *Congressional Record* were consumed in a veritable debate between Long and his fellow-Louisianian,

<sup>18</sup> *Ibid.*, 1457.

<sup>19</sup> *Ibid.*, 1333-1334.

<sup>20</sup> *Ibid.*, 1573.

<sup>21</sup> *Ibid.*, 1453 and 1407.

<sup>22</sup> *Ibid.*, 1335.

<sup>23</sup> *Ibid.*, 1457-1458.

<sup>24</sup> *Ibid.*, 1333.

<sup>25</sup> *Ibid.*, 1525-1526, 1745, 2263-2265.

<sup>26</sup> *Ibid.*, 2275.

<sup>27</sup> *Ibid.*, 2278.

<sup>28</sup> *Ibid.*, 1331.

<sup>29</sup> *Ibid.*, 1573-1574.

<sup>30</sup> *Ibid.*, 1461.

<sup>31</sup> *Ibid.*, 2289-2290.

<sup>32</sup> *Ibid.*, 2265.

<sup>33</sup> *Ibid.*, 1749.

<sup>34</sup> *Ibid.*, 1460.

<sup>35</sup> *Ibid.*, 1580.

<sup>36</sup> *Ibid.*, 2517.

Senator Edwin S. Broussard, upon the Senatorial election contest of 1932 in their home state and upon Long's own record as Governor thereof from 1928 to 1932.<sup>37</sup> This was the outcome of the decision of the Senate committee to go to New Orleans and investigate the charges; and petitions for and against such an investigation had been laid before the Senate several times.<sup>38</sup> As it amounted to an investigation of the Long regime in Louisiana, Huey called the committee a "kangaroo court"<sup>39</sup> and bitterly denounced the counsel of the committee, Brigadier-General Samuel Tilden Ansell, as "a scoundrel and a thief of the deepest dye and lowest order of crookdom."<sup>40</sup> He played up prominently the fact that, during the World War, Ansell was the attorney defending Grover Cleveland Bergdoll, wealthy draft dodger, and openly charged him with responsibility for the latter's escape to Germany under pretext to dig up a pot of gold buried somewhere in Maryland.<sup>41</sup> He played Ansell up as the arch-villain, and even promised to waive Senatorial immunity if the latter wished to sue him;<sup>42</sup> but when such a suit was filed, some time later, he refused to do so.<sup>43</sup> When Broussard replied to the charges against Ansell by inserting in the *Congressional Record* the articles of impeachment against Long as Governor of Louisiana in 1929,<sup>44</sup> the latter countered with the claim that this particular situation arose over the issue of his plan to tax the oil-refining business in Louisiana; and that the Standard Oil outfit furnished the brass band at an anti-Long meeting in Baton Rouge at that time.<sup>45</sup>

Senator Long also pleaded for inflation upon the ground that a currency shortage existed in the United States;<sup>46</sup> and that currency expansion was the remedy<sup>47</sup> and, with free silver, the only way to avoid financial disaster.<sup>48</sup> He insisted that the bankers admitted such a situation,<sup>49</sup> but that the imperialistic bankers of Wall Street opposed inflation because it would prevent their cornering all the money of the nation.<sup>50</sup> He called for a revaluation of the gold dollar<sup>51</sup> and argued that such steps were perfectly constitutional and did not constitute a violation of contract obligations.<sup>52</sup> He also averred that a slight business upturn had come in February, 1933, because of the Federal Reserve Banks' issue of \$250,000,000 in currency.<sup>53</sup>

Asserting that lack of sufficient exchange media had caused people to resort to wooden slugs,<sup>54</sup> he called for bimetallism<sup>55</sup> and backed Senator Wheeler's proposed free-silver amendment

<sup>37</sup> *Ibid.*, 2809-2819, 4658-4675, 4993-5002.

<sup>38</sup> *Ibid.*, 4279, 4377, 4456, 4560-4561, 4787, 5091, 5293.

<sup>39</sup> *Ibid.*, 4667 and 4672.

<sup>40</sup> *Ibid.*, 4659.

<sup>41</sup> *Ibid.*, 4558-4561.

<sup>42</sup> *Ibid.*, 4671.

<sup>43</sup> *Literary Digest*, Feb. 3, 1934, 7; and Feb. 17, 1934, 51.

<sup>44</sup> *Congressional Record*, 72d Congress, 2d Session, 4996-4997.

<sup>45</sup> *Ibid.*, 4999.

<sup>46</sup> *Ibid.*, 1452.

<sup>47</sup> *Ibid.*, 1464.

<sup>48</sup> *Ibid.*, 1849.

<sup>49</sup> *Ibid.*, 58.

<sup>50</sup> *Ibid.*, 1575.

<sup>51</sup> *Ibid.*, 2365, 2367, 2371.

<sup>52</sup> *Ibid.*, 2493-2494.

<sup>53</sup> *Ibid.*, 4702.

<sup>54</sup> *Ibid.*, 1847.

<sup>55</sup> *Ibid.*, 58.

to the Glass banking bill.<sup>56</sup> He held, like the Bryan Democrats of 1896, that America should not wait for the other countries to adopt bimetallism, but should lead the way;<sup>57</sup> and that the people wanted this far more than they did the Glass banking bill.<sup>58</sup> He further suggested that a remonetization of silver would furnish the necessary coverage for extra currency issues,<sup>59</sup> and that remonetization, like inflation, was the only way to avoid financial disaster.<sup>60</sup> However, he did get Senator Brookhart to agree with him that the vast concentration of large fortunes in the hands of a few persons would impede the working of any kind of American monetary system;<sup>61</sup> and near the end of the discussions upon this subject he admitted that he really knew less than nothing of American finances, and that he knew very little of monetary problems.<sup>62</sup>

As we have seen, his ardent championship of the cause of the small farmer caused him to support amendments to the Hawes-Cutting Act for Philippine independence, to restrict sugar and coconut oil imports from these islands.<sup>63</sup> He insisted that the American farmer deserved as much consideration as did the Filipino farmer 10,000 miles away;<sup>64</sup> and that as the former could not compete with the latter, the logical method of obtaining farm relief would be by freeing the Philippines.<sup>65</sup> He even claimed he could make America prosperous in 60 days by a policy of crop limitation, coupled with a public works program, plus, of course, "deconcentration" of wealth.<sup>66</sup> He favored a bill empowering the Reconstruction Finance Corporation to lend money to enable the postponement of farm mortgages; but he ridiculed one feature in this bill which enabled a farmer to use his loan to buy up depreciated bonds of a joint stock land bank and use them, at par value, to pay off his mortgage.<sup>67</sup> After quite a debate on this, in which it was disclosed that Federal land banks were using money loaned them by the Government to go out and buy up their own depreciated bonds, rather than to prevent mortgage foreclosures,<sup>68</sup> he yielded, saying if the bankers could legally do this, the farmers should be allowed to do so, too.<sup>69</sup>

Long believed that his plan of wealth "deconcentration" and of limiting work days to check overproduction would solve the problem of unemployment. He would include in this a program of public works, including flood control.<sup>70</sup> He praised his own system of unemployment relief in Louisiana, saying that the relief division of the Reconstruction Finance Corporation had

<sup>56</sup> *Ibid.*, 2294.

<sup>57</sup> *Ibid.*, 1287.

<sup>58</sup> *Ibid.*, 1581.

<sup>59</sup> *Ibid.*, 1848.

<sup>60</sup> *Ibid.*, 1849.

<sup>61</sup> *Ibid.*, 2360.

<sup>62</sup> *Ibid.*, 2393-2398.

<sup>63</sup> *Ibid.*, 266-269, 323, 555.

<sup>64</sup> *Ibid.*, 392, 555.

<sup>65</sup> *Ibid.*, 1844.

<sup>66</sup> *Ibid.*, 1845.

<sup>67</sup> *Ibid.*, 5098.

<sup>68</sup> *Ibid.*, 5473, 5479.

<sup>69</sup> *Ibid.*, 5482.

<sup>70</sup> *Ibid.*, 58, 1845, 1464.

commended it,<sup>71</sup> and even copied it,<sup>72</sup> in the Wagner bill.<sup>73</sup> In the La Follette-Costigan relief bill he would retain the provision for money for the care of transients.<sup>74</sup>

Long favored a tariff policy,<sup>75</sup> as we have seen. He held that America had no real tariff and had suffered from "dumping";<sup>76</sup> and that Congressmen would talk free trade, but vote to protect the goods of their respective home States.<sup>77</sup> As we have seen, he championed the tariff as a means of protecting or of aiding the American farmer.<sup>78</sup> Yet it is interesting to notice that he favored part payment of the Allied War debts to the United States in goods. He argued that as these debts exceeded the value of the world's total gold supply by a cool billion dollars, and that as America held about half this gold supply, no other method of settlement was practicable.<sup>79</sup>

As we have seen, Long called for higher income and inheritance taxes, as a means of heading off a capital levy. He opposed a sales tax.<sup>80</sup> He held tax refunds by the Federal Government to be natural and proper,<sup>81</sup> except where it involved refunds of amounts above \$5,000 or \$25,000 and in one case where a refund was due the estate of Andrew Mellon; and here he favored a refund only by consent of the Board of Tax Appeals;<sup>82</sup> else let this excess amount be spent for poor relief in the District of Columbia.<sup>83</sup> He also approved exempting from taxes the tickets to the Presidential inauguration, as the proceeds from such sales went to charity.<sup>84</sup>

When it came to Government spending, Long opposed any cut in aviation appropriations. He held that the cost of this service was small when compared with Army and Navy appropriations; that such a cut was not true economy but would cripple American domestic aviation industry. True, he agreed that appropriation slashes were necessary; but a ten million dollar cut in the aviation budget was too small a figure to be worth discussing.<sup>85</sup> He further argued that America's chief agency of national defense in the future would be the airplane; hence, why cripple it in its infancy? He argued that many cities had bonded themselves to raise money needed to build landing places and ports for air-mail service, and would be hard hit by such a policy of a 50 percent slash, as the bill suggested. He pleaded to give the Postmaster-General authority to fix air-mail contract rates as he saw fit;<sup>86</sup> and that if cuts in air appropriations must be made, then make cuts in railway mail contracts as well; also in the Army and Navy budgets;<sup>87</sup> for he opposed a large standing army<sup>86</sup> and held airplanes of greater importance than bat-

<sup>71</sup> *Ibid.*, 2811.

<sup>72</sup> *Ibid.*, 4479.

<sup>73</sup> *Ibid.*, 4477 and 4479.

<sup>74</sup> *Ibid.*, 4487.

<sup>75</sup> *Ibid.*, 1838.

<sup>76</sup> *Ibid.*, 1290.

<sup>77</sup> *Ibid.*, 564.

<sup>78</sup> *Ibid.*, 266-269, 323-325.

<sup>79</sup> *Ibid.*, 2477.

<sup>80</sup> *Ibid.*, 1459.

<sup>81</sup> *Ibid.*, 1554-1555.

<sup>82</sup> *Ibid.*, 1557, 1560.

<sup>83</sup> *Ibid.*, 1640.

<sup>84</sup> *Ibid.*, 2100.

<sup>85</sup> *Ibid.*, 2875-2877.

<sup>86</sup> *Ibid.*, 2878.

<sup>87</sup> *Ibid.*, 3058.

tieships.<sup>88</sup> He also opposed pay cuts of government employees as a foolish remedy,<sup>89</sup> but happened to be absent whenever the Senate voted upon any provisions limiting such pay cuts.<sup>90</sup> On the other hand, he upheld the principle of the spoils system in State politics,<sup>91</sup> including assessments for party campaign chests, on the ground that it was "done everywhere."<sup>92</sup> He even opposed a bi-partisan membership of the Farm Loan Board, as he wanted it to be all of one party or of the other.<sup>93</sup>

On the liquor question, Long showed himself openly "wet". He asserted he did not care whether the American people wanted beer or not. He would only do what they wanted, for he had ceased trying to decide this matter for them.<sup>94</sup> On January 16 he refused to cease one of his long-winded filibustering speeches, in order to yield to Senator Sheppard of Texas, who was ready to deliver his usual annual address upon the anniversary of the Eighteenth Amendment. He sarcastically suggested that if the Senator from Texas wait a few days, he would be able to deliver a funeral eulogy upon the death of this Amendment.<sup>95</sup> He also tried to make the repeal resolution the order of business for the next week, but failed.<sup>96</sup> When it did eventually come before the Senate, he, committed to repeal, was absent.<sup>97</sup> During the closing days of the Congress, he tried to bring up a medicinal beer bill "for the benefit of the suffering people of the country," as he expressed it,<sup>98</sup> and asserted that it was not a wet-and-dry issue;<sup>99</sup> and he insisted upon Senatorial consideration of it, despite the openly expressed desires of Senators Borah and Robinson (of Arkansas) to bring up a measure for emergency aid to farmers.<sup>100</sup> When Senator Brookhart of Iowa threatened a filibuster against bringing up the medicinal beer bill, Long withdrew it.<sup>101</sup>

Long also charged the Morgan banking interests and Wall Street with responsibility for bringing America into the World War.<sup>102</sup> He openly admitted he had never approved America's entry into this conflict,<sup>103</sup> and that he had never tried to enlist;<sup>104</sup> and that American gains from this struggle were illusory.<sup>105</sup>

Though at times inconsistent in his views, Senator Long showed himself a quick thinker, ready of wit, and with a good sense of humor. Often, except in discussing any phase of the liquor issue, he used Biblical quotations to illustrate a point. His pleading the cause of the small dirt farmer, of the small business man, of the small bank, his fight for currency inflation

<sup>88</sup> *Ibid.*, 2880.

<sup>89</sup> *Ibid.*, 1461-1462.

<sup>90</sup> *Ibid.*, 3086, 3167-3168, 3503-3504, 3510, 3511.

<sup>91</sup> *Ibid.*, 1183-1184.

<sup>92</sup> *Ibid.*, 2810-2811.

<sup>93</sup> *Ibid.*, 5481.

<sup>94</sup> *Ibid.*, 564.

<sup>95</sup> *Ibid.*, 1835-1849.

<sup>96</sup> *Ibid.*, 2139.

<sup>97</sup> *Ibid.*, 4058, 4138, 4169-4170, 4179, 4229-4231.

<sup>98</sup> *Ibid.*, 5228, 305, 320, 5504.

<sup>99</sup> *Ibid.*, 5320.

<sup>100</sup> *Ibid.*, 5228-5230.

<sup>101</sup> *Ibid.*, 5504-5505.

<sup>102</sup> *Ibid.*, 560, 1462.

<sup>103</sup> *Ibid.*, 4665.

<sup>104</sup> *Ibid.*, 4999.

<sup>105</sup> *Ibid.*, 559.

and for free silver, plus his insistence that the people, rather than the Standard Oil, J. P. Morgan's banking interests or any other similar gigantic enterprises, should rule the nation, justify us in classing him as a radical type of twentieth-century Southern Populist.

## West Virginia's Public and College Libraries

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FROM THE very beginning of the settlement of our country, books have been part and parcel of the educated people who came here from Europe.

Although college libraries in America began with the founding of Harvard College in 1636<sup>1</sup> and of William and Mary in 1693, public libraries were somewhat slow in inception. Even the library of William and Mary had only 5,000 volumes in 1850 and was opened for only one hour a week.<sup>2</sup> Dr. Thomas Brady, or Bray, was the first, so far as we know, to be authorized in 1700 by the Legislature of South Carolina to found a parish library.<sup>3</sup> Apparently he was successful in his task, for in 1705

<sup>1</sup> It was really in 1639 that John Harvard presented his library to Harvard College. See Savage, Ernest A., *The Story of Libraries and Book Collecting* (Routledge, 1908), p. 173. The University of Henrico was founded in 1619. To this school, the Rev. Thos. Bargo, a minister of Jamestown Colony, gave a library valued at one thousand marks, and an unnamed benefactor gave his books which were valued at 10 pounds. When the East India School was established in 1621 at Charles City, donations of books were made from England. Books were also donated to the Town House, Boston, through the will of Capt. Robert Keayne in 1635. See Myres, Clifford R. "Libraries in West Virginia Before 1863", *West Virginia School Journal* 58:16 (Dec. 1929). Lewis, Virgil A., "Early Education in West Virginia", in Miller, T. C., *History of Education in West Virginia* (1904) pp. 17-18.

<sup>2</sup> Myres, *op. cit.* 58:116.

<sup>3</sup> Savage, *op. cit.* p. 198. The name is spelled Brady by Savage, but Bray by Stephen B. Weeks in his monograph, *Libraries and Literature in North Carolina in the 18th Century* (Government Printing Office, 1896) pp. 177 and passing. Bostwick, A. E., *The American Public Library* (3rd ed., 1923) p. 5, writes "Bray". Bray was the founder and secretary of the Society for the Propagation of the Gospel. Weeks calls the library founded by Bray "the first parish or public library of which we have any account." (*Ibid.*) Bostwick (*op. cit.*) writes: "Although these libraries were primarily for the use of the clergy, they were open to the public and seem to have antedated the town libraries of New England for more than a century." Dr. Bray gave several books to libraries at different times and on one occasion in particular he gave through the Corporation for Establishing the Christian Religion, books valued at £100. (Weeks, *op. cit.*) "To Maryland alone, Dr. Bray sent thirty parish libraries, embracing 2,545 books." (Bostwick, *op. cit.* p. 5).

On the other hand, John T. Winterich, in an editorial entitled, "You Have a Book", *Saturday Review of Literature*, 20:8 (May 13, 1939) states that the first tax-supported public library in the U. S. was established at Peterborough, New Hampshire.

In the special Report of the Bureau of Education, Department of Interior, entitled, *Public Libraries in the United States* (1876), the earliest library listed is that of Peterborough as of 1833, and next that of Concord, Mass., founded in 1851, although the Boston Library had been recommended by its mayor in 1848, but actually opened in 1852. Bostwick (*op. cit.*) p. 8, states: "The town library at Salisbury, Conn., was established in 1803 by a bequest, but the town is said to have supported it for some time, although it is not now in existence. Possibly the oldest existing library of the kind is the one at Peterborough, N. H., which has been maintained by public taxation ever since its foundation in 1833." See also Conner, Martha, *Outline of the History of the Development of the American Public Library* (A. L. A. 1931) pp. 22-25.

There is no doubt that the first free public library to be supported wholly by public tax was that of Peterborough. See James F. Brennan's leaflet reprinted from the *Peterborough Transit*, July 26, 1923, which states that the claims of Dublin, N. H., to having a public library established in 1822 cannot be sustained. Says he (p.3): "A library from which all can freely get books (as was the case in Dublin) is not enough to constitute in any correct or accepted sense, a Public Library." Brennan goes on to say that Peterborough had such a library as early as 1797, and Dublin as of December 1799, "but the essential element of maintenance by public tax and control

the North Carolina Legislature voted to authorize the opening of parish libraries, and Dr. Bray was given the commission of founding 39 libraries, some of which began with more than 1,000 volumes.<sup>4</sup>

In West Virginia there was some interest in books even though some families "did not possess a single book."<sup>5</sup> Private libraries were very small, consisting of a few well-chosen or, at any rate, well-known books. The most commonly read books were the "Bible, a catechism, and a few books of a more literary character, preferably such works as Vergil's *Aeneid* and Homer's *Iliad*. These were read and reread, many of the more sagacious among the pioneer settlers being able to repeat from memory book after book of the Bible."<sup>6</sup> The following books were listed in the inventory of John Brand,<sup>7</sup> a settler of Monongalia County: "1 large family Bible, \$6.00, and 1 school Bible, 50c, 1 Dictionary, \$1.00, and 1 modron [= modern?] geography, .50c, 1 Christian Research, 1 Catichism [*sic*] and 1 *Sam Book*, 30c." However, Colonel John Baxter of Little Levels in Pocahontas, who represented in Virginia the southeastern section of what is now West Virginia, had a collection consisting of books on history, religion, and law. Many of these books were imported from Scotland. W. H. Gilmore possesses now what is left of this collection.<sup>8</sup>

*and management by vote of the town* [italics are his], was wholly lacking as was the case in Dublin in 1822 and in all the many other free libraries, wherever situated, up to the year 1833."

Accordingly, the priority of South Carolina cannot be maintained in the light of this statement. For further material on the Peterborough Library, see the pamphlet on *The Centenary of the Establishment of Public Libraries*, etc., held at Peterborough, August 22, 1933.

<sup>4</sup> Savage, *op. cit.* p. 198. See also Weeks, *op. cit.* p. 178. It may be of interest to note here that the first subscription library in America was founded by Benjamin Franklin in Philadelphia in 1732. Only subscribers could take out books, but others were welcome to read in this library. See Savage, p. 199; Bostwick, *op. cit.* p. 6.

<sup>5</sup> White, Alice Willerma, *The Public Libraries in West Virginia* (Master's thesis, Columbia School for Library Service, 1935, typewritten) p. 13. This thesis is a creditable piece of research and canvasses well the important literature on the libraries of West Virginia up to the beginning of 1935. Miss White states: "Dodridge does not even mention books in his *Notes*, and an early preacher writes, 'People were without books of any kind.'" (*Ibid.*) See also [Cross, J.], *Five Years in the Alleghenies* (1863), p. 65. Speaking of 1845, he says: "One-half of the people were without any part of the Bible. As for other books, they had none, and not one in ten could read a word." On p. 74 he writes: "Another great difficulty we had to encounter with these unlettered masses was their prejudice against education. Almost every day I had to meet this objection: 'Oh, I don't want my children learned to read; it will spoil them.'" "In many isolated communities, whole families grew up without anyone knowing the alphabet" (p. 58). On p. 72 he speaks of "the large number of families that could not read. These I found every day. When I would show my books and urge them to buy, the reply was, '*Oh none of us can't read*'" (italics his). The author cites also the testimony of the Rev. Mr. C—: "He told me the people were without books of any kind, that very few could read, and that many of them were not half civilized; that at one house, where he spent the night, they cut off the skirts of his saddle to sole their moccasins, and at another, the woman cut off the tail of his overcoat to make a pair of pants for a little boy." (p. 59).

<sup>6</sup> Ambler, Charles Henry, *A History of West Virginia* (Prentice-Hall, 1933) p. 208. He further states: "Closely associated with these small libraries were collections of Indian relics, mounted animals and birds and other curios of local origin."

<sup>7</sup> White, *op. cit.* p. 113, hereafter cited simply as White. Brand, F. M. *The Brand Family in Monongalia County, Virginia*, (1922) p. 26.

<sup>8</sup> White, p. 113.

The earliest academy in West Virginia was that at Shepherdstown<sup>9</sup> in Jefferson County, chartered in 1785. On December 31, 1787, the second oldest educational institution in this state was established, namely, the Randolph Academy, in Clarksburg. There followed in quick succession the Charlestown Academy, December, 1797; the Brooke Academy, at Wheeling, January 10, 1797; the Mount Carmel School, at West Union, in Preston County, then a part of Monongalia County, in 1801; the Lewisburg Academy in 1812; the Lancastrian Academy<sup>10</sup> in Wheeling, October 10, 1814; the Monongalia Academy at Morgantown, November 29, 1814; and following these, 45 other academies, institutes, and colleges, including the Parkersburg Classical and Scientific Institute, which opened on March 18, 1861.<sup>11</sup>

Of the above, the Randolph Academy was the first to be incorporated west of the Allegheny Mountains. Among its first board of 28 trustees were Edmund Jennings Randolph,<sup>12</sup> Benjamin Harrison, George Mason, and Patrick Henry. Its first principal was George Gowers, a graduate of Oxford, England, who for 28 years taught Latin, Greek, Hebrew, and the sciences. Among its teachers was Francis H. Pierpont, who later became Governor of Virginia under the Reorganized Government.<sup>13</sup>

Bethany College was founded in 1840, and is now the oldest collegiate institution in West Virginia<sup>14</sup> which has not changed its name or become merged with any previously existing academy. After 1843 it began to acquire a library which was fairly good for those times. In 1850 it had 1,224 volumes, 12 maps and charts, and 21 engravings.<sup>15</sup> In 1853 it had 3,500 volumes.<sup>16</sup> This library was burned in 1857.<sup>17</sup>

<sup>9</sup> This academy was later, 1871, established as Classical and Scientific Institute, which in 1872 was made State Normal. Lewis, *op. cit.* p. 118. Knuttli, J. G., "Shepherd College State Normal", in Miller, T. C., *History of Education in West Virginia* (1904) p. 85.

<sup>10</sup> This was established through a bequest of Noah Linsley. There is preserved in the University Library an undated document, written ca. 1837, which is signed by John McFerran, complaining of mismanagement. It asks that the Trustees "reorganize the board and remove what may be very properly a stigma upon the community, etc."

<sup>11</sup> Lewis, Virgil A. *West Virginia, Its History, Natural Resources, etc.* (Charleston, 1904, reprinted 1905), pp. 93-96. Myres, *op. cit.* 58:150 (January, 1930) states that within the boundaries of W. Va. there were about 65 of these schools beginning with the Shepherdstown Academy and ending with the Parkersburg Classical and Scientific Institute.

<sup>12</sup> Randolph was U. S. Secretary of State and the first Attorney General who "served without pay" because the Federal Government had very little legal business to transact. He became the 63rd governor of Virginia, 1786-1788, and was the nephew of Payton Randolph, President of the First American Congress.

<sup>13</sup> Lewis, *op. cit.* p. 96.

<sup>14</sup> *Idem*, p. 124.

<sup>15</sup> Myres, *op. cit.* p. 117.

<sup>16</sup> Lewis, *ibid.* I find, however, that Myres, *op. cit.*, gives 3,000 volumes for the year 1859, when the library burned.

<sup>17</sup> Lewis, *op. cit.* p. 182, states that this library included the private library of Alexander Campbell, "embracing the collection of himself and his father for more than 50 years. It was the greatest loss the literature of the State ever sustained, etc." Ambler, *op. cit.* p. 269, is even more emphatic, stating that fire destroyed "the entire private collection of Alexander Campbell." I think that the statements of both Ambler and Lewis concerning the private library of Alexander Campbell are quite exaggerated, if not entirely incorrect. In 1936, when I visited the library of Bethany College, I saw over 500 volumes of the original Campbell collection in the library. A search among the

Marshall College was founded on March 13, 1837, as the Marshall Academy and was a private institution.<sup>18</sup> Myres states: "The few books at the school [before 1863] could hardly be called a library, and this was the condition at most of the several hundred academies scattered throughout Virginia."<sup>19</sup>

On the ninth of January, 1866, the Board of Trustees of Monongalia Academy, which was established in 1814, passed the following resolution:

"Resolved That this Board tender to the Legislature of West Virginia, all the real estate and personal effects held as the property of 'Monongalia Academy', including the property known as 'Woodburn Female Seminary', amounting as a whole to the following estimated value, viz:

Woodburn Female Seminary-----	\$25,000.00
Monongalia Academy and dwelling-----	15,000.00
Cash, bonds, bank stock, etc.-----	10,000.00 <sup>20</sup>
Library and other personal property-----	1,000.00 <sup>21</sup>
	\$51,000.00
Amounting to-----	\$51,000.00

"To be absolutely held and used by the State of West Virginia, on the express condition that the contemplated Agricultural College be located permanently at or near Morgantown".<sup>22</sup>

documents in the University Library uncovered the last will and testament of Alexander Campbell, written on March 11, 1862. On page 6, *item* 14, we find the following: "I will and ordain that my library consisting of many rare and useful works not frequently, if now at all in the market, shall be added to the College Library as a donation from one to which my family and descendants shall always have free access. I except out of this donation only such modern or popular works as one of easy acquisition. These I wish my family to retain and to distribute amongst themselves, according to their own taste and pleasure." Miss Mary Cutlip, Assistant Librarian of Bethany College, informs me as follows in her letter of January 9, 1940:\* "I had never heard that the library of Alexander Campbell had been destroyed nor had anyone else here. All the references I can find seem to indicate that we have at least the major portion of his Library."

\*The author of this paper has brought his material up to date since delivering it before the Academy meeting in Charleston in 1939.—Ed.

Mrs. Selina Huntington Campbell in her *Home Life of Alexander Campbell* speaks of the first books which he saved from shipwreck as he came to this country: "They, with some eight hundred volumes or more, were donated to the college library. They escaped being burned, and can be seen in some two or three large oaken book cases, well secured, in the room of the board of trustees." That was in 1881 after both fires. The figure she gives, however, is considerably higher than the number of volumes we have now. I cannot explain that unless her figure was merely an estimation. We have only 416 volumes in the case in the reading room. There are others in the stacks, but not that many more.

"An article which appeared in the *Christian Evangelist* and was copied in the *Milennial Harbinger* for February 1858 may explain how the idea arose that Campbell's library was destroyed. In that article the following sentence appears: 'We have been informed that the library of Bethany College was a very valuable one, indeed—not so large, perhaps, as some other colleges have, but it contained many rare and valuable works, of difficult attainment, which the President had been collecting for a half a century or more.'"

<sup>18</sup> Teter, Dwight H., "Marshall College and Its Future," *The West Virginia Review*, 1 (no. 1, Oct. 1923) p. 41.

<sup>19</sup> Myres, *op. cit.* p. 150.

<sup>20</sup> *The Inaugural Address* of Alexander Martin, Morgantown, 1867, p. 10, lists "cash, bonds, etc., as \$87,756.00."

<sup>21</sup> President Martin's address, just cited, *ibid.*, lists "Effects surrendered as library and personal property as \$390.00."

<sup>22</sup> Quoted by Lewis, *op. cit.* p. 109. In the University Library there are preserved several documents regarding the Monongalia Academy. It has also the *Minutes* of the Monongalia Academy, beginning with April 2, 1827, and ending with February 4, 1858, and comprising 284 pages in all. On p. 97 we find an order, January 14, 1832, "for the building of the Female Academy", the dimensions of which were 32 by 20 feet.

The Legislature, after considering the claims of Point Pleasant, Bethany, Frankford, Greenwood, Harrisville, and Morgantown, decided, on the 31st of January, 1867, in favor of Morgantown by a vote of 17 to 5 in the Senate and of 32 to 21 in the House. By the Act of February 7, 1867, Governor Arthur I. Boreman was directed to appoint for this college "a Board of Regents composed of one member from each of the eleven senatorial districts." An act of Legislature, passed December 4, 1868, changed its name from "Agricultural College" to that of "West Virginia University".<sup>23</sup>

Public Libraries had a somewhat later beginning and a slower growth in the State. Apparently the first mention of a public library was made by a traveler who visited Wheeling in 1808 and wrote that "the people there were supporting a public library and a bookstore."<sup>24</sup>

In Virginia forty-one library companies were chartered before the war and of these there were 9 in what is now West Virginia. The first seems to have been the Buffalo Creek Farmer's Library Company of Monongalia County, incorporated on January 1, 1813. This was at Burnesville, near Fairmont. Other societies were the Wheeling Library Company, January 9, 1813; the Morgantown Circulating Library, November 15, 1814.<sup>25</sup>

"On the 15th of December, 1820, the Library Society of Harper's Ferry in Jefferson County was incorporated by an act of the Assembly of Virginia; two meetings were to be held annually, one of which was to be on the first Monday in May, for the election of a president, six directors, a secretary, treasurer, and librarian. On the 5th of February of the same year 'The Library Society of Romney', in Hampshire County, was incorporated, the annual meeting to be held on the first Saturday in April, ten days' notice being given thereof, when a president and four directors were to be chosen, who should from time to time appoint a librarian and such other officers as were necessary."<sup>26</sup> In 1822, Davis & McCarthy were book publishers and sellers in Wheel-

<sup>23</sup> Lewis, *ibid.*

<sup>24</sup> Lewis, *op. cit.* p. 181. Many years afterwards, the Wheeling Public Library was at first established as a subscription library in 1859. See Arnett, L. D., "Libraries in West Virginia", *The West Virginia Encyclopedia* (1929), p. 492.

<sup>25</sup> Myres, p. 150; White, p. 16.

<sup>26</sup> Myres, p. 150, states that this Society was formed January 30, 1819. See also White, p. 18, and *Historic Romney*, pp. 31-32. The last gives the following graphic account: "On a cold winter evening in 1819, nine men of Romney met in the office of Dr. John Temple for the purpose of taking into consideration the propriety of financing a Society, having for its object, the advancement [p. 32] of Literature and Science, the purchase of a Library by and for the use of its members; and their further improvement by discussing before the Society such questions as shall be selected under its directors." Among these nine men were Samuel Kercheval, Thomas Blair, and W. C. Woodrow. The constitution of the Society was adopted February 4, 1819. Membership of the Society never exceeded 52 and often as few as 15 attended the meetings." (p. 33). The Society "accumulated a splendid library beginning with the purchase of two books, 'Plutarch's Lives of Illustrious Men', and Rollins, 'Ancient History'. Within 10 years the library contained about 3,000 volumes, covering the outstanding books of the day on literature, science, history, and art, all strongly bound in calf and stamped with the seal of the Society. Minutes of the meetings listing the books purchased and the methods of acquiring them indicate that these men possessed real literary judgment and business ability." (*Ibid.* p. 33.) In 1820, the teaching of the classics was introduced into its "Romney Academy", which had just been founded and thus became the first school for higher education in this section. (*Ibid.* pp. 34.) In 1846, the Romney Classical Institute was begun which in 1870 was deeded with its grounds to the State, and the W. Va. School for the Deaf and Blind was established in the same year.

ing, and were then advertising for sale all the standard literary works of the day. On the 31st of December, 1823, 'The Lewisburg Circulating Library Company' of Greenbrier County was made a body politic with perpetual succession, its general meetings to be held on the first Mondays in May and December, four weeks' notice thereof being given, when a president, librarian, and other officers were to be chosen."<sup>27</sup>

The Martinsburg Library Society began January 9, 1826; the Charles Town Library Company, January 9, 1830.<sup>28</sup>

"In 1831, Joseph Israel was a bookmaker and bookseller in Clarksburg; and at that time, the village and country storekeepers had on their shelves a few standard books for sale as part of their stock in trade. That same year, an act of [the Virginia] Assembly provided for two State Law Libraries, one of which was to be kept at Lewisburg, in Greenbrier County, for the use of the Supreme Court of Appeals, which was to sit there ninety days in each year to hear all appeals from the inferior courts west of the Blue Ridge except those from the counties of Morgan, Berkeley, and Jefferson. Copies of all books in the library at Richmond were to be sent to that at Lewisburg, where the clerk of the court was *ex-officio* librarian. On the 28th of February, 1843, an act of Assembly incorporated 'The American Literary Institute' of Bethany College, with perpetual succession a common seal and the right to hold property to the amount of \$8,000. In 1844—January 11—"The Parkersburg Library Association' . . . was granted a charter with privilege to do any act proper to establish a lyceum,<sup>29</sup> library, and reading room, and to make laws for the government of itself. On the 12th of December, 1846, 'The Literary Society of Romney' in Hampshire County was incorporated."<sup>30</sup>

The library of this Society, however, was unfortunately plundered and scattered during the Civil War.<sup>31</sup>

"The Evansville Literary Society' . . . in Preston County, was created by an act of incorporation of March 20, 1847, and this was followed February 4 of the ensuing year by the legal establishment of the 'Martinsburg Lyceum' in Berkeley County, with a right to have and to hold property to the value of \$10,000, and it was permitted to allow its property to be used for public lectures, musical concerts, scientific, and such other exhibitions as the board of directors might deem expedient for the promotion of art, literature, taste, or

See *Historic Romney*, pp. 29-43; White, p. 18; Lewis, in Miller, *op. cit.* pp. 40-48 and in *West Virginia*, pp. 94, 120-121, who gives the date of the founding of the Romney Classical Institute as 1824, whereas *Historic Romney* gives 1846.

<sup>27</sup> Lewis, *op. cit.* p. 181.

<sup>28</sup> Myres, p. 150.

<sup>29</sup> Myres, p. 150 states: "In West Virginia, there were nine of these organized and they all were very influential in their communities. These were the Wheeling Lyceum, chartered March 17, 1836; the Kanawha Lyceum at Charleston, February 7, 1835; the Charleston Athenaeum and Female Academy, March 15, 1836; and a lyceum at each of the following: Lewisburg, April 2, 1828; Wellsburg, March 18, 1836; Martinsburg, February 4, 1848; Guyandotte, April 6, 1852; the Wheeling Athenaeum, April 3, 1848; and the Jefferson Athenaeum at Charleston, March 8, 1856. See also White, pp. 18-19.

<sup>30</sup> Lewis, p. 181. On p. 182, Lewis comments on this society: "It had the power to establish and endow a school at that place and the Potomac Seminary—now the Potomac Academy—owes its existence to this organization." Stayman, Joseph W. "Potomac State School", *The West Virginia Review*, 1: (July, 1924), p. 12, writes as follows: "On February 15, 1901, the West Virginia Legislature passed an act establishing a school of higher learning at Keyser, known as the Keyser Preparatory Branch of the West Virginia University." Friend, L. L., in "Preparatory Branch of the West Virginia University at Keyser", in Miller, *op. cit.*, p. 78, states that this school "came into existence by an act of the Legislature passed February 15, 1901. . . . Col. Thomas B. Davis of Keyser . . . donated seventeen acres of land as a site upon which to erect the buildings of the School." Lewis, therefore, must be mistaken. The Potomac Academy, however, became in 1919 the School for the Blind. See *Historic Romney*, p. 43; Lewis in Miller, *op. cit.* p. 45

<sup>31</sup> *Ibid.*, p. 42.

science. . . . 'The Guyandotte Lyceum' of Guyandotte, Cabell County, was incorporated April 16, 1852. The provisions of another act passed this year required a library of the value of \$100 to be established and maintained at every countyseat for the benefit of the Court and Bar, and the clerks of the circuit courts were made the custodians thereof. Four years later—March 8, 1856—'The Jefferson Athenaeum' at Charles Town, in Jefferson County, was made a body corporate, with authority of law to establish a library and reading room, its stock not to exceed \$10,000. At this time nearly all of the old Academies had libraries which were their boast.<sup>37</sup> Little or nothing was done in extending library work during the years of the Civil War—instead there was loss. The law library of the [Western Branch of the] Court of appeals, at Lewisburg, was scattered, as were the libraries of some of the academies. But speedily after the termination of the struggle, interest was renewed, and on the 22nd of October, 1866, 'The Fairmont Literary Association' of Marion County—the first of its kind incorporated in the new State, was 'for the mutual improvement and the diffusion of knowledge'.<sup>38</sup>

In the census of 1850 the following libraries other than private were reported:<sup>33</sup>

Name	Character	No.	No. of Vols.
Brooke <sup>34</sup>	College	2	3,000
Cabell	Public	1	300
Hampshire <sup>35</sup>	Public	1	1,000
Marshall	Church	1	100
Monongalia	School	1	150
Taylor	College	1	2,500
Wayne	Public	2	75
Wetzel	Sunday School	1	100
	Total	10	7,235

In 1851 Rector College at Pruntytown had 2,500 volumes on its shelves.<sup>36</sup> Myres speaks thus of the state college libraries: "In what is now West Virginia prior to 1863 there were only two college libraries of note, one at Bethany College and one at Pruntytown."<sup>37</sup> He gives the number of volumes at Rector College at Pruntytown as 2,000, plus the 1,000 volumes belonging to the private library of Charles Wheeler, the head of the school, for he had announced that it was accessible to all the students. Unfortunately the library, like most of the other libraries of the time, was destroyed by fire "and the institution came to an end."<sup>37</sup> A few libraries no doubt did survive total destruction in the Civil War, for in 1865 a bill was introduced in the House of Delegates regulating public printing and directing that each copy of the Acts of the Legislature be sent to each public library.<sup>38</sup>

<sup>33</sup> Lewis, pp. 181-183; Ambler, *op. cit.* pp. 269; 481.

<sup>34</sup> Callahan, James Morton, *Semi-Centennial History of West Virginia* (1913) p. 57.

<sup>35</sup> Myres, p. 150, states that of all the schools or academies "only two reported libraries in 1850; Brooke Academy at Wellsburg with 700 volumes, and Monongalia Academy with 150."

<sup>36</sup> This was the Romney Literary Society. See note 26 and 30.

<sup>37</sup> Lewis, *op. cit.* p. 182.

<sup>38</sup> *Op. cit.* p. 117.

<sup>39</sup> White, p. 31.

Lewis<sup>39</sup> gives statistics, presumably for the year 1904. These include college libraries, some school, and some public ones. The total number of volumes given by Lewis for all these miscellaneous libraries amounts to 221,647.<sup>40</sup>

The Wheeling County Library in Wheeling was the only real public library in West Virginia before 1900. As it is at present it was established in 1883 although several attempts at it had been made earlier.<sup>41</sup> The State Library (Law Book Library) was the first library of any kind within this State supported by public money beginning with 1856. "The material of a historical and general character was later transferred to the West Virginia Historical and Antiquarian Society which in time became the State Department of Archives and History."<sup>42</sup>

Apparently school men were the first to voice their interest in public libraries. The earliest recorded comment is that of Bernard L. Butcher, State Superintendent of Free Schools, who praises the Wheeling Library. James R. Trotter, State Superintendent of Free Schools, in his report of 1899 recommended public libraries and a state traveling library similar to the one which was in operation in Wisconsin.<sup>43</sup> Governor George W. Atkinson in his Biennial Message to the Legislature on January 11, 1899, made recommendations for a public-library system. *Inter alia* he recommended a non-partisan State Library Commission of five persons, and a law authorizing every legal division of the State, County, City, etc., to levy tax for the purpose of establishing and maintaining a public library; the State Treasury to subsidize each such library, the amount of the subsidy to be regulated by the size of the library and of the community.<sup>44</sup> Needless to say, the bill never passed, and a similar public-library bill had to wait until February 18, 1915, before it was passed.<sup>45</sup> As all of us know, the State Library Commission was created in 1929 after the State Library Association, which was formed October 21, 1914, at Parkersburg, had exerted all the weight of its vigorous activity.<sup>46</sup>

The public libraries of the State for 1922 showed a very small number of books, 136,290 volumes in all, partly, perhaps, be-

<sup>39</sup> *Op. cit.* pp. 183-184.

<sup>40</sup> The statistics given by Lewis are apparently incorrect, at least those pertaining to the University Library, which I have been able to check. He attributes to the University Library 27,700 as of 1904. On January 4, 1905, the official W. Va. U. L. *Accession Book* records 18,472 volumes in all. The figure of 27,701 was reached in September 30, 1911, long after Lewis' book was written.

<sup>41</sup> White, p. 33; Flint, Weston, *Statistics of Public Libraries in the United States and Canada* (1893), p. 150. For earlier attempts at forming a Wheeling public library see note 24 on page 114, and Wingerter, C. A., *History of Greater Wheeling and Vicinity*, vol. 1 (1912) pp. 478-487; White, p. 15.

<sup>42</sup> White, p. 29.

<sup>43</sup> White, p. 34-35.

<sup>44</sup> White, p. 35.

<sup>45</sup> *Idem*, p. 35-42.

<sup>46</sup> For a brief history of the struggle for the establishing of a State Library Commission see White, p. 44.

cause of the fact that some of them may not have reported their holdings to Miss Page.<sup>47</sup>

During the year 1924, statistics compiled by Miss Reed for the West Virginia Library Association showed the following condition: Questionnaires were sent to all first-class high schools, but replies from only 83 of these were received. The total number of books given is 607,802.<sup>48</sup> The other secondary schools, private, state, and denominational, numbering 7 in all, had 17,350 volumes. Among these, however, she lists the New River State School with 8,000 volumes, the Potomac State School with 3,050 volumes, as well as Greenbrier College for Women with 1,500 volumes, and the Alderson Collegiate Institute with 1,000 volumes.<sup>49</sup> Miss Reed gives statistics for 17 public libraries, of which the Charles Town Community Library was supported by membership of \$1.00 dues per year, and the Shepherdstown Public Library by charging a fee for the use of the library, the amount of which is not stated.<sup>50</sup> The total number of books for the above was 141,187 volumes, with a total state expenditure of \$70,928.17 from taxes, not counting donations and subscription contributions. Thirteen college libraries were listed by Miss Reed: Bethany, 17,000 volumes; Broaddus, 3,000; Concord, 5,100; Davis and Elkins, 5,000; Fairmont, 9,000; Glenville, 4,000; Marshall, 15,000; Morris-Harvey, 4,000; Shepherd, 6,300; West Liberty, 8,000; West Virginia University, 83,000; and West Virginia Wesleyan, for which no statistics are given.<sup>51</sup>

During the year 1926, all our elementary schools had a total of 552,773 volumes; the junior high schools 42,235; and the senior high schools 229,413—a sum total of 824,385 volumes for all the public schools exclusive of the colleges.<sup>52</sup> Just before the depression in 1929, our public-school authorities had as their goal "a million books."<sup>53</sup>

Writing in 1929 presumably from statistics for the same or the preceding year, Arnett gives<sup>54</sup> the number of books in the different college libraries as follows: Bethany College, 19,750 volumes; Broaddus, 5,200; Concord, 7,300; Davis and Elkins, 8,000; Fairmont, 9,500; Glenville, 7,500; Marshall, 20,000; Morris-Harvey, 8,000; New River State, 15,000; Potomac, 4,500; Salem, 7,000; West Virginia State, 14,000; West Virginia University, including the Agricultural Experiment Station's books, 115,000

<sup>47</sup> Page, [Sully] Scolley, whose report on the state libraries is printed in the West Virginia Federation of Women's Clubs, *Yearbook* (1933-1934) pp. 43-45, where she lists 30 libraries, a few of which did not report either for 1922 or 1932.

<sup>48</sup> Reed, Bessie Jane, *Libraries in West Virginia* (1924) p. 3. Miss Reed states that the number of volumes was for the 130 high schools of the State.

<sup>49</sup> *Ibid.* The ones enumerated are to be classed with the colleges of the State and not with the secondary schools.

<sup>50</sup> *Idem.* pp. 4-5.

<sup>51</sup> *Ibid.* pp. 6-7.

<sup>52</sup> Cf. Arnett, *op. cit.*, p. 491.

<sup>53</sup> Myres, p. 116.

<sup>54</sup> *Op. cit.* p. 492.

volumes. The books of all these colleges amounted to 273,850 volumes.

We have just seen that the trustees of the Monongalia Academy listed \$1,000 for "library and other personal property." Since in the census of 1850 there were recorded 150 volumes for Monongalia and its educational institution which was listed as "school", we may infer that the number of books in 1866 was not very much larger for the Monongalia Academy, in fact 274 in all, including 60 Government documents.<sup>55</sup> We are informed that even "in 1878, only 21 new books were accessioned" or added to the University Library, and by 1897 there were about 7,000 volumes.<sup>56</sup>

For the year 1932, the books in those public libraries which reported to Miss Page amounted to 291,678 volumes.<sup>57</sup>

The *American Library Directory*<sup>58</sup> for 1935 gives the following statistics for West Virginia college libraries: Alderson-Broadus, 5,000 volumes; Bethany, 21,223; Concord, 15,720; Davis and Elkins, 17,000; Fairmont, 16,000; Glenville, 11,300; Greenbrier College for Women, 4,000; Marshall, 32,371; Morris-Harvey, 11,000; New River, 17,000; Potomac, 6,650; Salem, 12,000; Shepherd, 15,000; Storer, 6,000; West Liberty, 9,644; West Virginia University, 182,500; West Virginia Wesleyan, 17,500.

The public libraries listed in this *Directory* are as follows: Bluefield, 9,900; Charleston (Kanawha County), 22,843; Charles Town, 5,200; Clarksburg, 15,294; Fairmont, 7,000; McMechen, 2,419; Mannington, 4,257; Martinsburg, 8,450; Morgantown (Waitman Barbe), 4,449; Moundsville, 11,182; Parkersburg, 25,000; Shepherdstown, 3,872; Sistersville, 10,018; Welch (World War Memorial), 1,700; Weston (Lewis Bennett), 10,678; Wheeling (Ohio County), 58,432; White Sulphur Springs (Greenbrier), 4,000; and Williamson, 5,400.

The 1939 edition of the *Directory* gives the following statistics for West Virginia: (I give only those libraries which show either considerable increase or considerable decrease from the previous figures.) College libraries: Bethany, 27,894; Concord, 17,200; Fairmont, 22,027; Glenville, 15,000; Greenbrier, 5,000; Marshall, 29,300; New River, 18,000; Potomac, 7,024; Salem, 14,000; Storer, 10,000; West Liberty, 15,000; University, 187,115 (including the Law Library, 30,160); West Virginia Wesleyan, 20,000.

<sup>55</sup> See note 26.

<sup>56</sup> Callahan, James Morton. *History of the Making of Morgantown* (Morgantown, 1926) p. 226, note 4. He states further that "until 1889, the librarian was some university professor who opened the room only occasionally at times to suit his convenience. In 1885, he opened it only on Fridays." The writer of this paper hopes to publish in the future a brief history of the University Library.

<sup>57</sup> *Op. cit.*, pp. 43-45.

<sup>58</sup> Weston, Bertine, editor, *The American Library Directory* (Bowker, 1935) pp. 409-410. Starred items indicate that statistics are as of 1930.

The public libraries<sup>59</sup> for 1939 are listed as follows, indicating only the ones which show large increase or decrease: Bluefield, 20,000; Charleston (Kanawha County), 40,000; Charles Town, 7,500; Clarksburg, 16,083; Huntington (Cabell County), 42,153; Martinsburg, 10,254; Morgantown (Waitman Barbe), 6,950; Shepherdstown, 5,030; Weston (Louis Bennett [Lewis County]), 14,575; Wheeling (Ohio County), 77,593.

In looking over the two editions of the *Directory*, we find the following interesting though regrettable situation: the 1935 edition lists 45 libraries; the 1939 edition 40. Only 23 libraries show any appreciable increase in volumes added. Four did not report their holdings, and no doubt if they had reported, the figures for volumes would be even smaller than they were in the earlier edition.

My own statistics, compiled from the returns of a questionnaire<sup>60</sup> sent to the librarians of the various colleges of this State, are presented below in the hope that they may be of interest. They are intended to be renewable annually by adding the figures in question no. 8 and subtracting those under nos. 9 and 10. Unless the policies of these institutions and their appropriations for books change radically, the process suggested will give fairly accurate results for each year, assuming, of course, that the figures as given by the various librarians are accurate.

As of July 1, 1938, the number of volumes in the college libraries listed below were as follows:<sup>61</sup>

(1) Alderson-Broadus, 5,500; (2) Bethany, 27,914; (3) Concord, 17,942; (4) Davis and Elkins, 17,054; (5) Fairmont, 25,740; (6) Glenville, 14,347; (7) Greenbrier, 4,503; (8) Marshall, 35,814; (9) Morris-Harvey, 8,500; (10) New River, 15,601; (11) Potomac, 8,050; (12) Salem, 13,000; (13) Shepherd, 15,000; (14) Storer, 11,000; (15) Veteran's Administration, 1,481; (16) West Liberty, 15,719; (17) West Virginia School for the Deaf and Blind, 2,000; (18) West Virginia State (Institute), 19,400; (19) West Virginia University, including the Law Library and the Agricultural Experiment Station, not counting recent duplicates, pamphlets, and government documents which are not accessioned, 189,805; (20) West Virginia Wesleyan, 21,000. These, together with the 3,000 periodicals received annually by the above institutions, make a sum total of 455,456 books, or 281,-

<sup>59</sup> Brown, Karl, editor, *The American Library Directory* (Bowker, 1939) pp. 450-451.

<sup>60</sup> *Ibid.*

<sup>61</sup> The questionnaire, asking information as of July 1, 1938, contained the following items:

1. Number of volumes possessed by your library
2. Number of duplicates among the above
3. Number of pamphlets which are not counted with the above books
4. Number of periodicals currently received
5. Number of current newspapers
6. Number of Government documents, not counted with the books
7. What items, and how many, are filed in your Library without being catalogued
8. How many volumes are added each year
9. How many volumes are lost each year
10. How many volumes a year are worn and discarded

606 more volumes than they had in 1929. This number does not include the collection of the Bureau of Archives and History, numbering over 100,000 volumes, and that of the Supreme Court Library, which contains about 85,000. These make a grand total of 601,456. If we add the 269,269 volumes possessed by the public libraries and the 824,385 books found in the public-school libraries, we have a grand total of 1,695,725 books, or nearly 1 book for each man, woman, and child in the State. This is the national average,<sup>63</sup> although the national goal for public libraries is 2 books per person.

The report by Noon and Miss Sandoe,<sup>64</sup> prepared in November 1938 for the West Virginia Federation of Women's Clubs, gives the total number of books in our public libraries as amounting to 269,269 (given above), a reduction of 22,409 volumes, to say nothing of the condition in which such books were found.

This report states:

"Of these, not more than 35% could be considered acceptable library material. Juvenile books were almost a minus quantity in public libraries. The Committee found *The Rover Boys*, *Tom Swift*, and *The Bobbsey Twins* on the shelves, but these are to be found in no accepted book selection aid. Talks with librarians brought out the fact that even these were there because children or parents had given them to the libraries. With the exception of the libraries in Wheeling, Charleston, Parkersburg, Huntington, and Clarksburg, almost every library reported that funds had been so low that no new children's books were being purchased. The board and librarian in Bluefield hesitated to have us see the juvenile collection. With no money other than rental and fine income to spend for new books, all funds had to go to buy popular fiction and non-fiction that the public would rent so that more books could be bought. In looking over the collection in Bluefield, we noticed that old, worn out copies of standard titles, particularly of juvenile non-fiction, were

<sup>63</sup> The number of volumes added each year is given for each library after the number assigned to each: e.g. (1) Alderson-Broadus 500; (2) Bethany, 1,200; etc. (last year it added 2,259 volumes); (3) 550; (4) 350; (5) 1144; (6) 699; (7) 200; (8) 1,500; (9) 225; (10) 500; (11) 125; (12) 300; (13) 700; (14) 300; (15) 100; (16) 1,000; (17) 100; (18) 400(?); (19) 9,000; (20) 1,000 volumes.

Omitting pamphlets and replacements, Government documents, and, in the case of the University Library, duplicates added in the last four years, there is noted an average number of 18,933 volumes added to our college libraries from year to year. Losses are reported as being negligent, averaging about 75 volumes annually for each library. If we subtract 1,500 volumes as lost and/or discarded, we have left 17,433 books as approximately pure gain each year.

Ralph Dunbar in "Developments in College Libraries" *School Life* 24:217, (April 1939) gives the average number of volumes in each college library of the Nation as amounting to 132,069 in 1930. He remarks: "Although in 1900 there was no university with a million volumes, in 1938, no less than nine contained a million volumes or more each. According to the latest figures compiled by the Office of Education, the libraries of our institutions of higher education at present contain over 62,000,000 bound volumes." See also *Library Journal* 64:177 (March 1939) for a statement as to the adequacy of the great libraries of our Nation; also *School Life*, 24:81 (December 1938) and 24:126 (January 1939).

<sup>64</sup> See note 31.

<sup>64</sup> Noon, A., and Sandoe, Mildred W., *West Virginia Public Libraries; A Report* (1938, typewritten), pp. 13-14. This report contains the following specific recommendations which the members of the survey committee believe practical and capable of remedying the situation (p. 19):

1. State leadership in the person of a trained executive secretary of the State Library Commission.
2. State financial support to supplement the funds available from local sources, an annual sum of \$49,100.
3. Establishing of standards for personnel and service.

still there, but that they were more than ready to be discarded. The standard titles in juvenile fiction were mostly missing. The librarian assured us that they had been there, but that even rubber bands could no longer justify placing them on the shelves. Hundreds of books had been saved to rebind, she said. When the committee suggested WPA repair for these, she explained that there was no money even for materials. This is the usual story in all libraries in West Virginia.

"Strange to relate, in library after library, the Committee came across the set of Smithsonian science books published and sold at a cost that made them seem extravagant buys to many librarians of well-supported libraries in other states.

"Fairmont, Martinsburg, Parkersburg, Shepherdstown, and Bluefield had unusually good book collections considering the amount of their yearly budgets. In every case, however, there was evidence of increasing penury. Adult non-fiction collections were much stronger in material published from 1920 to 1930, than in material published during the last three years.

"One can only say that the usable book stocks of West Virginia libraries have no more to offer than do those libraries sponsored by clubs, the WPA, or other agencies interested in such projects. The privately-supported club library in Piedmont has maintained higher standards of selection than the publicly-supported one in McMechen."<sup>65</sup>

Our books in the public libraries are so distributed that only 12%<sup>66</sup> of our people have library facilities, or 204,651 (for 1934). Our State ranked 48th in the number of population without library service. Only about one-half of one percent of the rural population had been served; that is, out of 1,237,701 only 5,777 had access to library service. It spent (1934) \$.06 per capita for the entire population, while for the actual population served, it spent \$.53. It stood 47th in the index of public-library development, while in school-library resources it ranked 19th; 33rd in the number of volumes in research libraries (1935), and in volumes per capita in public libraries, 45th, with 227,706 books, with .13 of a book per person. This compares with other states as follows: Arkansas and Mississippi, .10 of a book; South Carolina, .12 of a book. It contrasts with New York State, which has 3.51 books per capita; Vermont, 2.91; Massachusetts, 2.26; California, 2.16; Maine and Nevada, 2.11. Regarding the rental libraries, West Virginia ranked 43rd (1935) and in juvenile, 37th. The national average is 2 books per capita and the circulation 10 books per person.

The most recent comparative statistics available are those

<sup>65</sup> For a notice of this survey see Enslow, Catherine Bliss; "When Women Want Books", *The West Virginia Review*, 16;119;126-127 (January 1939).

<sup>66</sup> See A. L. A. *Bulletin* 29:249 (May 1935); White, pp. 67-69; Wachtel, Lee, "State Provisions for Public Libraries", *Library Quarterly*, 3;376 (October 1933), who states that W. Va. is among the 9 states in the Union that spent .5 or less. For comparative statistics see also Angoff, Charles, and Mencken, H. L., "The Worst American State" in *The American Mercury* 24;1-16; 176-188; 355-370 (September-November 1931), who give 85 tables comparing all the states with one another under diverse aspects. The conclusion which these authors draw is worth quoting (p.355): "The richer states on the whole, are also the most cultured, and not only the most cultured, but also the healthiest and most orderly."

More recent comparative statistics may be found in Wilson, L. R., *The Geography of Reading* (A. L. A. and University of Chicago Press, 1938), especially pp. 15, 28, 30, 45, 48, 72, 183, 210, 214, all very important regarding West Virginia. See also his review of Wm. H. Carlson's book, *The Development and Financial Support of Seven, etc.*, (1938) in *Library Quarterly* 9:218-19 (April 1939).

of the A. L. A. San Francisco Conference, June 20, 1939.<sup>67</sup> The number of people without public-library service in West Virginia is given as 1,375,230, or 79 percent, as against 88 percent in 1934, while the national average for 1934 was 36.7 and was reduced to 34.3. Of these, the rural people number 1,237,701 (same as in 1934) and the urban people, 137,829. Forty-one counties are listed without library service, and 10 places with population over 5,000 to 10,000. One place is listed with a population over 10,000 without library facilities. The expenditures for 1937-38 were \$96,702 or .05 percent, a drop of 1 cent per person from 1934. This places West Virginia with Arkansas, 47th on the list, with Mississippi, with 86 percent of its people without public-library service, having the dubious compliment of being the 48th. In 1934 the general average expenditure for the nation was .37 per person, and in 1937-38 it jumped to .42, while for West Virginia it went down from .06 to .05. The national average expenditure is \$1.00 per person. For the nation as a whole, out of 3,100 odd counties, there were 1,000 without public libraries within their boundaries in 1934, but the number was reduced to 897 in 1937-38. But only 300 counties in the nation have county-wide library service. In 20 states, more than 50 percent of the people have no public library service, and only 40 cities of over 10,000 population lack public libraries.<sup>68</sup> We have seen that West Virginia has one city over 10,000 without library facilities.

Fortunately, however, the West Virginia Commission has, for the first time, received an appropriation of \$5,000 a year for books and other necessities, and things will begin to improve materially. The last session of the State Legislature passed a bill authorizing the establishment of regional libraries between two or more counties with the approval of the county boards concerned.

This work must go on and the people of the State must be made more book-conscious. The public schools need more books, the public libraries cry for more books, and the colleges and the

<sup>67</sup> Mimeographed, consisting of 9 pages and giving the latest available statistics, especially on pp. 2, 5, 6, and 9. See also "The Library Crisis", an editorial in the *New York Times* (Sunday, April 24, 1938); "The Library Crisis", an editorial in *The Saturday Review of Literature* 15:8 (January 15, 1937); Grant, Edith, "Home Economics and the Public Library" *Journal of Home Economics*, 30:638-640 (November 1938). Smith, L. R., "Indiana and the Geography of Reading", *Library Occurrent* 12:362 (Oct.-Dec. 1938); Joeckel, Carlton, *Library Service* (Advisory Committee on Education, Washington, D. C., 1938), reviewed by Carl Vitz in *Library Quarterly* 9:213-215 (April, 1939); *Education Abstracts* 3: No. 759, p. 376 (December 1938).

<sup>68</sup> Volumes 1 and 2 of *The West Virginia Review* contain articles on 11 of the state colleges, among which, one by President Frank J. Marsh (2:308-311) deals with the University. Articles on various state schools up to 1904 are to be found in Miller, *op. cit.*, mostly by persons who were in charge of the institutions at the time they wrote the articles. Two commemorative volumes, published on the Centenary of their respective institutions, may be noticed here: *One Hundred Years of Marshall College* (1937), pp. 62; 82-92; and *West Liberty Yesterday and Today*, ed. C. C. Regier (1938), pp. 79-89. Scattered notices are to be found in *The West Virginia Review* and *The West Virginia School Journal*. Recent statistics of the State's elementary and secondary public schools, including their libraries, are found in the *Educational Bulletin*, published by the Department of Education in Charleston, since 1932.

University urgently implore for more books. Let us hope that the people in general and those in power, in particular, will heed their earnest prayers and vote more liberal allowances of money for new books and for replacements. Just as our mountains are crowned with snow in winter and clothed with verdure in summer; just as our woods are filled with wild life; just as our rivers are plied with barges carrying our coal and other materials, or are harnessed to produce hydro-electric power for our factories and our homes; just as our educational system from the kindergarten to the graduate departments of the University has soundly improved and is constantly improving — just so our libraries — school, college, and public — with generous appropriations and with wise administration, will ere long become the pride of our state and the wonderful instruments destined to feed and guide the mind and hearts of our youthful as well as our adult population for the common good of the individual, the community, the State, and the Nation.<sup>68</sup>

## Teachers' Qualifications as a Factor in the Distribution of State Aid

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A COMPANION BILL to the county unit law completely reorganized the system of school finance in West Virginia.

In 1932 the voters of the state approved the tax limitation amendment which classified property into four classifications and set maximum rates of \$.50, \$1.00, \$1.50, and \$2.00 on the respective one-hundred-dollar valuations thereof. It should be observed that the classification feature of the amendment reduced taxes as much or more than the fixed rates. For example, a county formerly levying eighty-eight thousand dollars for schools now levies only twelve thousand dollars, mostly because 90 percent of the property is in the first and second classification where very low levy rates are used.

In attempting to enact tax collection bills in accordance with the amendment, the legislature found the debt liabilities of governmental subdivisions a major handicap. These debts were not mentioned in the amendment. The first tax collection act allocated debt levies in excess of the constitutional rates, and was declared unconstitutional on this basis. The second act was obviously unconstitutional, state aid being extended for local government debt payments, a course expressly forbidden by the state constitution. In its third and successful attempt, the legislature allocated 70 percent of all levies for current expenses and 30 percent for debt. This 70-30 allotment was recently changed to 80-20. In extreme cases where allocated levies will not pay the debt service, rates sufficiently high to do so were approved by the state supreme court.

In the original law the part of the property tax distributed to boards of education was set at approximately  $9\frac{1}{3}$  million dollars instead of the  $23\frac{1}{2}$  millions usually received from this source. State aid was increased from 1 million to  $13\frac{1}{4}$  million dollars, amounting to about 55 percent of all school revenues.

The system of distributing state aid was reorganized and a correction or weight for teacher qualifications was used. Differentials between these weights for the different certificates correspond to differentials in the legal minimal salary scale. It is important to note, however, that such state aid payments are made regardless of local ability to support schools, so many counties are able to pay teachers in excess of the legal minimal scale.

In this investigation comparisons are made in terms of an

TABLE 1—Gains in index of certification by counties, 1933-38

Gains	Counties	Number of Counties
38	Calhoun	1
34	Gilmer	1
33	Pleasants	1
32	Roane	1
31	Hardy, Jackson, Lincoln	3
30	Grant, Kanawha, Pendleton, Upshur	4
29	Barbour, Hampshire, Wayne, Wirt	4
28	Wood	1
27	Monongalia, Nicholas	2
26	Cabell, Lewis, Mason, Putnam, Raleigh	5
25	Monroe, Preston, Tyler	3
24	Boone, Braxton, Randolph	3
23	Berkeley, Clay, Mineral, Wetzel	4
22	Pocahontas, Summers	2
20	Greenbrier, Wyoming	2
19	Taylor, Webster	2
18	Fayette, Mercer, Morgan, Ritchie, Tucker	5
17	Jefferson, McDowell	2
15	Doddridge	1
14	Hancock, Logan, Marion, Ohio	4
13	Harrison	1
12	Marshall	1
11	Mingo	1
10	Brooke	1
	Total	55

"Index of Certification" which was computed by assigning certain arbitrary values to certificates, the latter being classified in four types: Type I, consisting of those certificates secured by examination, the holders of which possess little or no professional training; II, certificates secured upon the completion of at least one year of college work; III, certificates requiring at least two years of college work; IV, the bachelor's degree. Type IV was assigned an arbitrary value of three; Type III, two; Type II, one; and Type I, nothing. The percentage of teachers holding each type of certificate was multiplied by the arbitrary value assigned to the type, the sum of these products being divided by three in order to reduce the scale to 100 percent, if the index were perfect, or less, if it were not. Actual computing was done more quickly by weighting Type IV certificates by three, Type II by two, adding Type I to these weighted numbers, and dividing by three times the number of teachers.

Gains in indexes of certification are particularly prevalent among the twelve thousand elementary school teachers. Comparing 1932-'33 with 1937-'38, one notes that the county school districts have made excellent progress in raising the qualifications of their elementary school teachers during this five-year period (Table No. 1). Eleven counties (Calhoun, Gilmer, Pleasants, Roane, Hardy, Jackson, Lincoln, Grant, Kanawha, Pendleton, and Upshur) increased their indexes of certification thirty

TABLE 2—*The index of certification, 1937-38*

Rank	County	Index	Rank	County	Index
1	Cabell	.768	29	Ritchie	.608
2	Brooke	.758	30.5	Nicholas	.605
3	Ohio	.752	30.5	Hardy	.605
4	Monongalia	.745	32.5	Morgan	.602
5	Mercer	.741	32.5	Braxton	.602
6	Harrison	.740	34	Tucker	.600
7	Marion	.732	35	Greenbrier	.598
8	Berkeley	.730	36	Summers	.595
9	Taylor	.725	37	Fayette	.589
10	Gilmer	.723	38	Clay	.588
11	Wood	.703	39	Monroe	.587
12	McDowell	.688	40	Hampshire	.584
13.5	Marshall	.685	41	Pleasants	.578
13.5	Jefferson	.685	42	Wyoming	.556
15	Tyler	.677	43	Webster	.535
16	Lewis	.675	44	Wayne	.520
17	Raleigh	.673	45	Calhoun	.512
18	Hancock	.672	46	Mason	.503
19	Upshur	.671	47	Boone	.498
20	Wetzel	.670	48	Wirt	.497
21	Randolph	.662	49	Logan	.494
22	Barbour	.655	50	Mingo	.479
23	Kanawha	.640	51	Roane	.474
24	Grant	.624	52	Pendleton	.469
25	Preston	.616	53	Lincoln	.461
26	Pocahontas	.613	54	Putnam	.447
27.5	Doddridge	.611	55	Jackson	.432
27.5	Mineral	.611		STATE	.629

or more points, Calhoun being the leader with thirty-eight points. Twenty-six counties registered gains of twenty-five or more points. The median gain was twenty-four; the range, ten to thirty-eight. Some county gains were comparatively small during the period, for their indexes were high at the beginning of the period. Examples of such counties are Brooke, Harrison, and Ohio.

Table II depicts the county indexes of certification for 1937-1938. The six leading counties were, in the order named, Cabell, .768; Brooke, .758; Ohio, .752; Monongalia, .745; Mercer, .741; and Harrison, .740. Twenty-three counties exceeded the state index of certification of .629, but many rural counties, such as Roane, Pendleton, Lincoln, Putnam, and Jackson, still have considerable room for improvement.

Comparisons with conditions before the enactment of the general school fund bill are in order. The state indexes for 1928-1932 were as follows: 1928-'29, thirty-five; 1929-'30, forty-two; 1930-'31, thirty-seven; and 1931-'32, thirty-nine. It is apparent that during the last four years of the old system gains of seven, two, and one were made, but in 1930-'31, five points were lost, the entire net gain for the four-year period being then only five points. On the other hand, during the first four years the state

aid weight for teacher qualifications had been in existence, gains of four, three, five, and three, totaling fifteen, were recorded, an average of 3.75 per year. In other words, since the old system of state aid has been replaced, the average rate of raising the state index of certification of elementary school teachers has tripled.

Similar improvements are shown when comparisons are made in terms of another measure of teacher qualifications. In 1932-1933 the percentage of all teachers whose qualifications consisted of two or more years of collegiate work was 56.7; 1933-'34, 61.7; 1934-'35, 66.7; 1935-'36, 73.3; 1936-'37, 78.6; 1937-'38, 82; and 1938-'39, 85, the increase being about 4 percent per year.

Doubtless, other factors are also causing the acceleration in the present rate of improving the qualifications of teachers in West Virginia. However, from information gleaned from employing executives, the writer is convinced that the state aid reward for improved teacher qualification is a powerful factor in raising the educational level of the teachers of the state.

A recent research bulletin of the National Education Association states: ". . . requirements for admission to the teaching profession in every state should be raised as rapidly as possible to include four years of college training for the work the teacher expects to do, whether it be an urban or a rural area. To facilitate the attainment of this goal, salary scales in all schools should place a salary premium on appropriate college training in excess of two years, and especially on graduation from a four-year college. Rural schoolboards will not usually obtain teachers of superior training and ability unless they are willing and able to pay more to such teachers than to those who are less well prepared." Obviously many school districts are not "able to pay" unless the state supplements local funds. Particularly is this true in states having a constitutional amendment which "hamstrings" local tax-raising initiative to such an extent that in many cases only a three-months term can be supported by property tax levies.

#### SUMMARY

In 1932 the voters of West Virginia approved a tax limitation amendment which so reduced school revenues that the state necessarily shouldered the major part of the burden of school costs. The general school fund bill was reenacted with important changes, one of which was a correction or weight for teacher certification in the different school districts.

Since the inception of this new system of distribution of state aid, improved qualifications have been particularly noticeable among the twelve thousand elementary school teachers of the state. Comparing 1932-'33 with 1937-'38, one notes eleven counties increased their indexes of certification thirty-one or more points; twenty-five counties increased their indexes of certifica-

tion twenty-five or more points, while the median gain was twenty-four. The range was ten to thirty-eight.

Comparisons of indexes of certification with conditions before the enactment of the new law favor the present formula for state aid distribution. During the last four years of the old system, gains of seven, two, and one were made, but in 1930-'31 five points were lost, the entire net gain for the four-year period being only five points. On the other hand, gains of four, three, five, and three, or an average of 3.75 per year have been recorded under the new system.

Similar progress is shown when comparisons are made in terms of the percentage of all teachers whose qualifications consisted of two or more years of collegiate work. In 1932-'33 such percentage was 56.7; in 1933-'34, 61.7; 1934-'35, 66.7; 1935-'36, 73.3; 1936-'37, 78.6; 1937-'38, 82; and 1938-'39, 85, the average increase being about 4 percent per year.

## The Ranking of College Freshmen on Psychological Examinations Compared with Their High-School Academic Ranking

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THIS STUDY WAS MADE ON the basis of freshmen entering Bethany College in the years 1934, 1935, 1936, 1937, and 1938. To be admitted to Bethany College without qualification, a student must rank in the upper half of his high-school graduating class as certified by his principal. A small number from the lower half are admitted "on probation", provided they meet certain other requirements such as their high-school principal's or counselor's certifying that in his judgment they can do college work, and their reaching a certain standard on tests administered by the college before entrance to determine whether a doubtful student ought to be admitted or not. This means that the freshman class at Bethany College is a rather highly selected group. This fact ought to be borne in mind in interpreting the following data.

The composition of the Bethany freshman classes in the period studied, with regard to their high-school academic ranking, is shown in Table 1.

TABLE 1—*High-school ranking of freshmen entering Bethany College in the years 1934-1938, inclusive*

Year	Number in high-school quarter				
	1st	2nd	3rd	4th	Unclassified
1934	6	10	29	83	20
1935	13	14	21	57	2
1936	7	13	37	88	7
1937	2	10	26	68	16
1938	14	5	46	84	8
Total 5 yrs.	42	52	159	380	53
Percentage	6%	8%	23%	55%	8%

This table shows that over the five-year period, 14 percent of the Bethany freshmen came from the lower half of their high-school graduating classes, whereas 78 percent came from the upper half, with 8 percent unclassified in the sense that their high-school principal did not report their standing.

After the freshmen have gained full college admission, each class is given two so-called intelligence tests or psychological examinations. The five classes under investigation were given the psychological examination of the American Council on Edu-

cation as well as the Ohio State University Psychological Examination of the current years. The raw scores were then transformed into percentile ratings on the basis of the national and regional norms provided with these tests. For the purposes of this investigation the freshmen were then ranked according to their percentiles and grouped into quartiles and halves. This study is based on the results of the American Council tests only. The purpose is to discover what relationship exists, if any, between their high-school academic ranking and their percentile ranking on the psychological tests. The results are summarized in the following tables:

TABLE 2—*Distribution on the American Council tests of students from the fourth high-school quarters entering Bethany College in the years 1934-1938, inclusive*

## Part I

Year	Total No.	Percentage in American Council quartiles			
		1st	2nd	3rd	4th
1934	83	11%	22%	26%	41%
1935	57	4	26	28	42
1936	88	13	18	27	42
1937	68	13	40	18	29
1938	84	20	35	20	25
5 years	380	Av. 12%	Av. 28%	Av. 24%	Av. 36%

## Part II

Year	Total No.	Percentage in American Council halves	
		Lower	Upper
1934	83	33%	67%
1935	57	30	70
1936	88	31	69
1937	68	53	47
1938	84	55	45
5 years	380	Av. 40%	Av. 60%

If we may accept high ranking on the intelligence tests as indicative of scholastic aptitude in college, Table 2 shows that the majority (60%) of those from the fourth high-school quarter are superior college material. On the other hand, 12 percent are markedly inferior. This is true for the five-year period as a whole. However, for some reason not obvious from the data, 54 percent of this group of freshmen in the years 1937 and 1938 are inferior, 20 percent of the 1938 group being markedly so, although all come from the highest high-school quarter.

Employing the same criterion as to college fitness, Table 3 shows that approximately one-third of the freshmen coming from the third high-school quarter are superior college material, while another third are distinctly inferior. Over the five-year period more than twice as many (69% versus 31%) are found

TABLE 3 — *Distribution on the American Council tests of students from the third high-school quarters entering Bethany College in the years 1934-1938, inclusive*

## Part I

Year	Total No.	Percentage in American Council quartiles			
		1st	2nd	3rd	4th
1934	29	28%	45%	17%	10%
1935	21	28	24	29	19
1936	37	22	35	30	13
1937	26	42	31	27	0
1938	46	56	33	9	2
5 years	159	Av. 35%	Av. 34%	Av. 22%	Av. 9%

## Part II

Year	Total No.	Percentage in American Council halves	
		Lower	Upper
1934	29	73%	27%
1935	21	52	48
1936	37	57	43
1937	26	73	27
1938	46	89	11
5 years	159	Av. 69%	Av. 31%

in the group inferior in college ability as are found in the superior group. Indeed, in 1937 this ratio of inferiority to superiority is approximately 4:1, and in 1938 it is 8:1, although from their high-school standing this whole group is supposedly of good college caliber. These data suggest several possibilities:

- a. The intelligence tests do not rate them accurately.
- b. Their high-school ranking is not an accurate measurement.
- c. Both (a) and (b) obtain.
- d. The high-school and the intelligence test ratings are measuring two somewhat different capacities. There is a strong presumption that the last possibility is nearest the facts.

TABLE 4 — *Distribution on the American Council tests of students from the second high-school quarters entering Bethany College in the years 1934-1938, inclusive*

## Part I

Year	Total No.	Percentage in American Council quartiles			
		1st	2nd	3rd	4th
1934	10	40%	30%	20%	10%
1935	14	22	50	21	7
1936	13	39	46	15	0
1937	10	30	30	30	10
1938	5	20	80	0	0
5 years	52	Av. 30%	Av. 47%	Av. 17%	Av. 6%

## Part II

Year	Total No.	Percentage in American Council halves	
		Lower	Upper
1934	10	70%	30%
1935	14	72	28
1936	13	85	15
1937	10	60	40
1938	5	100	0
5 years	52	Av. 77%	Av. 23%

Table 4 indicates that one-fourth of this group (23%) have higher college capacity than their high-school achievement seems to indicate, 6 percent of the group being markedly superior. On the other hand, three-fourths of this group (77%) show both poor high-school achievement and low college capacity, 30 percent of them being distinctly low on the college aptitude tests.

TABLE 5 — *Distribution on the American Council tests of students from the first high-school quarters entering Bethany College in the years 1934-1938, inclusive*

## Part I

Year	Total No.	Percentage in American Council quartiles			
		1st	2nd	3rd	4th
1934	6	50%	33%	0%	17%
1935	13	54	31	8	7
1936	7	86	0	0	14
1937	2	50	50	0	0
1938	14	36	43	14	7
5 years	42	Av. 55%	Av. 31%	Av. 4%	Av. 10%

## Part II

Year	Total No.	Percentage in American Council halves	
		Lower	Upper
1934	6	83%	17%
1935	13	85	15
1936	7	86	14
1937	2	100	0
1938	14	79	21
5 years	42	Av. 86%	Av. 14%

All of this group were very low in their high-school achievement. The intelligence tests indicate that most of them (86%) are also very low in their mental capacity. On the other hand, 14 percent of them show superior college scholastic aptitude, 10 percent of them of a very high order.

Tables 2 to 5, inclusive, show that there is a great deal of discrepancy between the high-school ranking of college freshmen and their rating on freshmen psychological examinations.

A supplementary study needs to be made of the success in college over a four-year period of those students ranked in the lower half of their high-school classes but yet admitted to college "on probation". A partial study of this sort was made by the writer and reported at the Huntington meeting of the West Virginia Academy of Science two years ago. On the basis of that study and some other scattered data the indications are that approximately 10 percent of this group make good college timber. It is a pertinent question whether the 10 percent who actually make good in college, in spite of low high-school ranking, are the same 10 percent whom we have found in this study to have distinctly superior scholastic aptitude according to our tests. If so, then we can select in advance from this group those who will make good and eliminate from the start the 90 percent who will not.

Another study needs to be made of the academic success over their four-year college course of the group ranking in the upper half of their high-school classes and admitted to college without qualification, especially of those who rank low on the psychological tests. In the present study we found that 12 percent of those from the fourth high-school quarter and 35 percent from the third are distinctly inferior in scholastic aptitude as rated by our intelligence tests. It may be that the majority of those who give our deans so many headaches come from this group, and that they do poor college work because they do not have mental capacity on the college level in spite of their relatively superior high-school rank. Similar factors may account for the high rate of college-student mortality. On these points I have not yet worked up the available data.

Finally, considering the data herewith presented as a whole, we conclude that in selecting a college freshman class, where there is selective enrollment similar to that in Bethany College, the committee on admissions ought to take into account not only the achievement of the student over a four-year high-school course, as indicated by his rank in his high-school graduating class, but, in addition, they should consider his ranking on college freshmen scholastic aptitude tests. Both criteria should be used together.

## Using the Ophthalm-O-Graph and the Metron-O-Scope

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THIS STUDY was made for the purpose of determining the value of the use of the ophthalm-o-graph and metron-o-scope in diagnosing and correcting reading defects of college students. In November 1937, ophthalm-o-graph records were made of the eye movements of 45 college students at the Fairmont State Teachers College. Each student was shown the graph of his eye movements. His attention was definitely called to the number of fixations and regressions he made per hundred words, the number of words read per minute, and his comprehension score.

If the student's graph indicated overconvergence or overdivergence, or lack of binocular control, he was advised to consult an eye specialist. In many cases this advice was heeded. However, eleven persons decided that such service was not necessary or that the cost was prohibitive.

After the students were given an interpretation of the graphs of their eye movements, they were given practice in reading on the metron-o-scope. The practice covered a period of eight weeks. During the first four weeks, there were three periods of fifteen minutes each per week. During the last four weeks, the number of practice periods was reduced to two per week, but the length of each period increased to 25 minutes. Attendance at practice was voluntary. The eleven students who needed but did not procure the services of an oculist or optometrist were irregular in practice, and neglected to have a photograph of their eye movements taken after the practice. Hence they are not taken into consideration in the remainder of this report.

A reading efficiency score was computed for each of the 34 students who practiced throughout the eight weeks. This score was determined by multiplying the number of words read per second by the score made on the true-false test. There were ten items in the test. The scoring was done by the R-W method. The statement "You will be asked some questions on what you read" was made to each student just before he began reading. As soon as he finished the reading, he was handed a mimeographed sheet containing the true-false exercise, and was requested to fill it out. It is clear from the nature of the test and its administration that the main intellectual quality measured was ability of immediate recall.

The selection read, while the ophthalm-o-graph records were being made before practice on the metron-o-scope, was:

"In 1910 Captain Amundsen, leader of an expedition from Norway, started for the regions of the South Pole. After establishing a base station, he traveled eleven months, covering more than eight hundred miles before he reached the South Pole. With dog teams and skis he planted sixty-six tons of seal meat for food in stations along the way. Amundsen claimed these vast lands for Norway."

The true-false exercise used after the reading was:

(Ring the correct answer. Hand this sheet to the attendant.)

- |   |     |    |
|---|-----|----|
| 1. Amundsen was leader of an expedition from Sweden.....              | Yes | No |
| 2. He started for the regions of the North Pole.....                  | Yes | No |
| 3. Amundsen started on the expedition in 1910.....                    | Yes | No |
| 4. He traveled eleven months before reaching the pole.....            | Yes | No |
| 5. Amundsen claimed this new territory for Sweden.....                | Yes | No |
| 6. His journey to the pole covered more than a thousand miles....     | Yes | No |
| 7. He established a base station from which to begin his operations.. | Yes | No |
| 8. Sixty-six tons of food were stored at different stations.....      | Yes | No |
| 9. This food consisted of fish.....                                   | Yes | No |
| 10. On the trip he used dog teams and skis.....                       | Yes | No |

The selection read, while the eye movements were being photographed, after the metron-o-scope practice was:

"There are nearly one hundred known species of the maple tree. The most important variety is the upright, gray-barked, sugar maple which sometimes reaches a height of 120 feet. Its broad flat leaf is the emblem of Canada. Maple syrup and sugar are obtained from this tree. The lumber it produces is also valuable because it is heavy, hard, strong, and takes a fine polish."

The test given after the reading of the preceding selection was:

(Ring the correct answer. Hand this sheet to the attendant.)

- |  |   |   |
|--|---|---|
| 1. There are nearly one hundred fifty varieties of the maple tree..... | T | F |
| 2. The most important variety is the yellow-barked.....                | T | F |
| 3. The gray-barked sugar maple leaf is the emblem of Canada.....       | T | F |
| 4. The maple tree sometimes reaches a heighth of 150 feet.....         | T | F |
| 5. Sugar is obtained from this tree.....                               | T | F |
| 6. The lumber produced from this tree is soft.....                     | T | F |
| 7. The lumber from this tree takes a fine polish.....                  | T | F |
| 8. The leaves are narrow and long.....                                 | T | F |
| 9. The lumber is heavy and strong.....                                 | T | F |
| 10. The drooping maple is found in nearly every country of the world.. | T | F |

The number of fixations and regressions per 100 words, the efficiency score before and after practice, and the percentage of increase in reading efficiency is shown in Table 1.

TABLE 1—*Ophthalm-o-graph records and reading comprehension score of 34 college students*

Student	Before practicing on the metron-o-scope					After practicing on the metron-o-scope					
	Fixations per 100 words	Regressions per 100 words	Words read per minute	Retention score	Reading efficiency score	Fixations per 100 words	Regressions per 100 words	Words read per minute	Retention score	Reading efficiency score	Percentage of gain or loss in reading efficiency
1	108	36	109	2	3.6	86	14	267	6	26.7	642
2	80	26	292	4	19.5	80	14	300	7	35.0	79
3	102	34	210	6	21.0	54	8	600	8	80.0	280
4	72	18	316	8	42.1	70	10	347	10	57.8	37
5	96	40	257	2	8.6	72	26	387	4	24.1	176
6	106	24	214	4	14.3	70	10	340	4	22.7	59
7	72	26	261	4	17.0	72	14	312	3	15.6	-8
8	84	28	267	4	18.7	64	8	340	6	34.0	91
9	80	26	240	4	16.0	72	10	369	8	49.1	206
10	112	34	218	0	00.0	80	20	261	10	43.5	---
11	114	48	171	6	17.1	92	30	214	6	21.4	25
12	126	34	218	0	00.0	89	16	279	6	27.9	30
13	120	20	218	4	14.5	80	16	316	6	21.4	54
14	110	34	237	4	15.8	98	26	250	4	16.7	5
15	108	30	214	6	21.4	80	12	273	8	39.7	86
16	130	30	218	4	14.2	68	16	375	8	50.0	214
17	110	30	226	0	00.0	108	20	292	10	48.7	---
18	106	40	240	6	24.0	66	14	400	10	00.0	---
19	98	26	234	4	15.6	78	8	324	4	21.5	38
20	110	46	231	2	7.7	110	40	286	8	38.1	395
21	90	28	188	0	00.0	90	20	176	10	29.3	---
22	138	40	160	4	10.7	84	10	240	8	32.0	204
23	122	52	231	0	00.0	92	14	222	6	22.2	---
24	128	50	174	2	6.0	84	18	250	2	8.3	39
25	90	32	324	8	43.2	58	12	461	8	61.5	42
26	112	48	197	4	13.1	98	24	267	6	26.7	104
27	102	20	261	10	43.5	86	8	334	10	55.7	28
28	116	60	207	6	20.7	90	20	234	10	23.6	14
29	96	32	231	2	7.7	92	16	240	4	16.0	108
30	80	22	387	8	51.6	56	4	400	8	53.3	3
31	116	32	250	0	00.0	72	14	308	6	30.8	---
32	104	44	267	4	17.8	64	6	308	6	30.8	73
33	96	34	267	0	00.0	64	12	334	8	44.5	---
34	102	52	292	2	9.7	70	18	387	6	38.7	300
Mean					16.36					35.58	

## INTERPRETATION

A large number of fixations and regressions in proportion to the number of words read in a given time indicates a proportionately great expenditure of energy. That is, the person who make 100 fixations with 40 regressions in reading 100 words

is, theoretically, expending twice as much energy as the individual who makes 50 fixations with only 20 regressions in reading the same number. But this comparison is not sufficient, because the reader who makes a large number of fixations in proportion to the number of words read will very frequently make longer ones than the person who makes a small number. It is evident that, if a person can decrease the number of fixations and regressions and at the same time keep up his comprehension, he is increasing his reading efficiency. It is said that the college student of today is required to do five times as much reading as was required of the college student at the turn of the century. There is no available evidence to indicate that the student today is meeting this new requirement by devoting five times as much time to reading as the student of 40 years ago devoted to it. Certainly there is no evidence that would indicate that the college student of today has any greater capacity than the one of a generation ago. It would seem that the most reasonable means of meeting this new reading demand lies in the increasing of the reading rate. It should be remembered that each individual has his limitations, and that it is necessary for him to keep his rate adjusted to his comprehension.

Table 1 shows a range in the efficiency from 0 to 51.6 before practice on the metron-o-scope. The mean of the efficiency score 16.36.

The Standard Deviation is 12.45. The reliability of the mean is 3.625. The observed difference between the mean of the efficiency score before and after practice is 19.44. The reliability is 4.21. Therefore we know that the true difference will be between 15.21 and 23.65. The chances are 480,000 to 1 that the true difference would not be 4.21 reliability difference units below 19.44.<sup>1</sup>

#### CONCLUSIONS

After making allowance for the fact that mere retention for a short time is not a complete measure of reading efficiency, and that certain emotional and other uncontrolled factors may have affected the results both before and after the practice, and making further allowance for the fact that the results were not checked against any other criteria, we are justified in concluding that the use of ophthalm-o-graph and metron-o-scope is a great aid in diagnosing and correcting the reading defects of many college students.

<sup>1</sup> Tieggs, Ernest W., and Crawford, Claud C., *Statistics for Teachers*, ch. ix.

## Educational Development in West Virginia

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## EARLY HISTORY

SOME WRITERS start their account of educational development in our state with the ill-fated University of Henrico and its East India (preparatory) School. By doing so they link with the "mother state" of Virginia. Had it not been for the Indian Massacre which "stayed the progress of education in the Colony" we could claim a history of education starting "fifteen years before Harvard, seventy-two years before William and Mary had opened its doors to students and eighty years before Yale had an existence." It is extremely doubtful, however, if either of these schools reached the instructional stage. If they were not "still-born" they at least "died in infancy." Neither was within the boundaries of the present state of West Virginia.

In 1727 Morgan ap Morgan built a cabin home near what is now Bunker Hill in Berkeley County and in the same year a group of Germans from Pennsylvania settled New Mecklenberg (Shepherdstown) in Jefferson County. If these colonists or the many others who followed brought educational facilities with them they must have been meager and of the parental tutorial type.

Virgil A. Lewis, former state historian and archivist, states that "little can be known of the first schools in West Virginia in the early years of its settlement, for from the year 1727 . . . until General Wayne in 1794 broke the savage power at the battle of Fallen Timbers on the Maumee River . . . there was little else than savage warfare . . ." He asserts that the earliest reference to a school house he had been able to discover was found in "an entry in the journal of George Washington, when in 1747 he surveyed lands for Lord Fairfax on the Upper Potomac, and in the South Branch, Cacapon and Patterson Creek Valleys. . . . On the 18th of August of that year, he surveyed a tract by beginning at a station in 'the School House Old Field'. But no stream or other object is mentioned by which this location can be determined, nor can this be done by any contemporary surveys. It is believed to be far up the South Branch Valley at what is known as the 'Indian Old Field' in Hardy County."

## THE ACADEMY MOVEMENT

It is definitely known that a man named Shrock began teaching a school in his "cabin at Romney in 1753, two years before the French and Indian Wars." Although parishes were organized in this state it seems doubtful that any great development

of parish schools resulted. Some of course may have been organized. During the time when academies were popular many were organized within our state.

Virgil Lewis<sup>1</sup> states that "By far the most important, the most potent factors in early educational work in West Virginia were the many academies which, as chartered institutions, were scattered over the State, and whose management and control were in the hands of the foremost men of the community. . . ."

A year before the first newspaper made its appearance west of the Blue Ridge, the Alexandria "Advertiser", of June 22, 1786, carried an advertisement stating that the trustees of the "Winchester Latin, Greek, and English Schools having elected Mr. Armstrong and Mr. Potter, two gentlemen of character and ability, to take charge of the institution, we do hereby give notice that the schools will open on the first Monday in July." They also indicated that the "climate is healthful, the country plentiful, and the town growing." Lewis calls this the "first classical school of the Lower Shenandoah Valley which opened its doors to the young men and women of what is now the eastern part of West Virginia."

There must have been many such schools which failed to leave any record and were operating without the formality of incorporation because on the third of December 1787 the Reverend Mr. Robert Stubbs made affidavit that he witnessed the test trial of James Rumsey's steamboat on the Potomac. He subscribed himself as "teacher of the Academy at Shepherdstown". The articles of incorporation for the Shepherdstown Academy were dated January 3, 1814. This of course may have been a second school operated there, or the first school may have been tardy in incorporating, but it gives evidence that academies in this state were founded much earlier than the articles of incorporation indicate. Brooke Academy at Wellsburg in Brooke County was incorporated on January 10, 1797, twenty years after it had begun active educational work. Academies in West Virginia probably antedate the Revolutionary War; this places them early in the history of the academy movement. Brooke Academy was the earliest institution of higher learning on the Ohio River south of Pittsburgh. The Shepherdstown Academy did excellent educational work for nearly a hundred years.

The first institution of higher learning west of the Allegheny Mountains for which records are available was the Randolph Academy, located at Clarksville in Harrison County, incorporated on December 11, 1797. Its first board of trustees consisted of 28 people among whom were such men as Edmund Randolph, Benjamin Harrison, George Mason, and Patrick Henry. Its establishment resulted in a diversion of one-eighth of the surveyors' fees for Harrison, Monongalia, Ohio, and Randolph

<sup>1</sup> The History of Education in West Virginia. 1907. State Department of Education, p. 36.

Counties from William and Mary College to this school. The act declared that the school was established for the benefit of the people of these four counties, which at that time was all of (West) Virginia north of the Little Kanawha River. A graduate of Oxford, England, George Gowers, served as its first principal and taught Latin, Greek, Hebrew, and sciences for twenty years. In 1830-1840 one of its teachers was Francis H. Pierpont, who later became Governor of Virginia under the Reorganized Government.

After a varied and useful career many of these schools merged with others until their identity became lost in records and tradition. After serving the state for over half a century, Brooke Academy in 1852 merged with Meade Collegiate Institute, which had been originally incorporated "at or near Parkersburg" on March 21, 1851. The Mount Carmel School, which had been established at West Union in Monongalia (now Preston) County after serving the state for 48 years, lost its building by fire and moved to an unknown locality. The Lancasterian Academy at Wheeling, Ohio County, was incorporated on October 10, 1814, but later became the Linsly Institute. The Monongalia Academy, which was incorporated at Morgantown in Monongalia County on November 29, 1814, was considered the most flourishing institution of learning in this section. In 1867 it joined with Woodburn Female Seminary, which had been incorporated in Morgantown on January 4, 1858, in transferring its property, valued at \$51,000, to the state and became the modest beginning of West Virginia's State University.

Under the leadership of Superintendent White the Normal School was established for the training of teachers. He said to the Legislature that "it would be better to suspend the schools of the State for two years and donate the entire school revenues for that time to the establishment and endowment of a State Normal School than to have none." His efforts were rewarded by the conversion of the old Marshall Academy, founded in 1837, into a training institution.

Marshall Academy was incorporated in 1838 in Guyandotte (now Huntington), Cabell County. For many years it "was the most famous institution of higher learning in Western Virginia." In 1858 the name was changed to Marshall College. In 1867 the authorities of Cabell County gave its property, valued at \$10,000, to the state for a location for a state Normal School. The name Marshall College was retained by legislative enactment. Between 1867 and 1871 five branches of this school were formed at Fairmont, Shepherdstown, Concord Church, (now Athens), West Liberty, and Glenville. Some of these Branches of Marshall College represent former academies. Fairmont was the seat of a private normal school founded in the summer of 1865 by J. N. Boyd and Dr. Dennis B. Dorsey which later became the Fairmont branch. In 1838 the Reverend Mr. Nathan

Shotwell established a school at West Liberty called West Liberty Academy, which in 1870 became a branch normal. A classical and scientific school called Shepherd College was incorporated on January 12, 1872, which on February 27, 1872, was taken over by the state under the name of State Normal School. Each of these five Branches have since been organized as State Teachers Colleges and are no longer considered branches of Marshall College.

The transfer and merger of these older schools often favored the less fortunate people. This is true especially of Romney Classical Institute, which was incorporated in Romney, Hampshire County, in 1824 and was transferred in 1870 to state operation as a school for the Deaf and Blind.

That the academies became the model for other schools is evident. Storer College, an institution of learning for Negroes in the state, probably should be listed as an academy although its founding follows the dates of expansion of the academy movement. The Reverend Mr. Nathan C. Brackett, graduate of Dartmouth and attached to Sheridan's Army, became interested in the Freedmen in the Shenandoah Valley. With the help of many people, among whom was John Storer of Sanford, Maine, who gave \$10,000 for the founding of a school for colored people; and with the cooperation of Congress through the influence of General James A. Garfield in the House and William Pitt Fessenden in the Senate the work of Storer College began on October 2, 1867. It has done a notable work among the colored people of the state.

Many of these academies remained private institutions until they disappeared under the onslaught of the high-school movement or were elevated to college of full or junior standing. Among these is Bethany College, which was incorporated as such in 1840 by John C. Campbell, of Wheeling, founder of the Christian Church. The first session of the college opened in the fall of 1841. But before this, as early as 1818, there had been operated a school called Buffalo Seminary, which had served to sharpen the cherished purpose and desire of Campbell.

Through an unhappy and regrettable misunderstanding in 1844 a division among Methodists developed and the Methodist Academy at Clarksburg failed. After 40 years a revival of interest in higher education among the Methodists led to the founding of West Virginia Wesleyan College at Buckhannon, which received its first students on September 3, 1890. Morris Harvey, operated by the Methodist Episcopal Church South, opened its doors for students in September 1888 at Barboursville. After years of service it moved to Charleston. Greenbrier College, West Virginia's only college strictly for women, was founded as Lewisburg Female Seminary in 1812.

While the writer is unaware of any official recorded connections, one is naturally inclined to believe that the pioneer

urge for learning which caused academies to spring up in a wilderness would transfer itself naturally to higher forms of education as the public high-school movement gained headway at the expense of the former. If this is true Salem, Davis and Elkins, and Broaddus, as well as numerous colleges which have ceased to operate, were an outgrowth of the academy movement.

A complete history of West Virginia Academies will never be written because many are lost among the vagaries of pioneer records and traditions. A partial list of West Virginia academies with their place and date of founding is given by Lewis<sup>2</sup> and is attached here as evidence of the widespread interest in this movement:

1. The Academy of Shepherdstown, at Shepherdstown, in Jefferson County, incorporated in 17—.
2. The Randolph Academy, at Clarksburg, in Harrison County, incorporated December 11, 1797.
3. The Charles Town Academy, at Charles Town, in Jefferson County, incorporated December 25, 1797.
4. The Brooke Academy, at Wellsburg, in Brooke County, incorporated January 10, 1797.
5. The Mount Carmel School, at West Union, in Preston County (then Monongalia), established in 1801.
6. The Lewisburg Academy, at Lewisburg, in Greenbrier County, incorporated in 1812.
7. The Shepherdstown Academy, at Shepherdstown, in Jefferson County, incorporated January 3, 1814.
8. The Romney Academy, at Romney, in Hampshire County, incorporated February 11, 1814.
9. The Lancasterian Academy, at Wheeling, in Ohio County, incorporated October 10, 1814.
10. The Monongalia Academy, at Morgantown, in Monongalia County, incorporated November 29, 1814.
11. The Mercer Academy, in Charleston, Kanawha County, incorporated November 29, 1818.
12. The Union Academy, at Union, in Monroe County, incorporated January 27, 1820.
13. The Martinsburg Academy, at Martinsburg, in Berkeley County, incorporated January 28, 1822.
14. The Romney Classical Institute, at Romney, in Hampshire County, established in 1824.
15. The Tyler Academy, at Middlebourne, in Tyler County, incorporated in January 30, 1827.
16. The Wheeling Academy, at Wheeling, in Ohio County, incorporated February 21, 1827.
17. The Romney Academy, at Romney, in Hampshire County, incorporated March 25, 1829.
18. The Morgantown Female Seminary, at Morgantown, in Monongalia County, incorporated March 23, 1831.
19. The Seymour Academy, at Moorefield, in Hardy County, incorporated February 16, 1832.
20. The Bolivar Academy, at Bolivar, in Jefferson County, incorporated February 16, 1832.
21. The Red Sulphur Seminary, at Red Sulphur Springs, in Monroe County, opened April 15, 1832.

<sup>2</sup> *Op. cit.*, pp. 37 ff.

22. The Charles Town Female Academy, at Charles Town, in Jefferson County, incorporated March 15, 1836.
23. The Brickhead and Wells Academy, at Sistersville, in Tyler County, incorporated January 18, 1837.
24. The West Liberty Academy, at West Liberty, in Ohio County, incorporated March 20, 1837.
25. The Marshall Academy, at Guyandotte (now Huntington) in Cabell County, incorporated March 13, 1838.
26. The Western Virginia Education Society, at Pruntytown, in Taylor County (then Harrison), incorporated March 28, 1838.
27. The Parkersburg Academy Association, at Parkersburg, in Wood County, incorporated April 5, 1838.
28. The Morgantown Female Academy, at Morgantown, in Monongalia County, incorporated January 30, 1839.
29. The Cove Academy, at Holliday's Cove, in Hancock County (then Brooke), incorporated April 6, 1839.
30. The Bethany College, at Bethany, in Brooke County, incorporated in the autumn of 1840.
31. The Preston Academy, at Kingwood, in Preston County, incorporated January 2, 1841.
32. The Huntersville Academy, at Huntersville, in Pocahontas County, incorporated January 18, 1842.
33. The Asbury Academy, at Parkersburg, in Wood County, incorporated February 8, 1842.
34. The Little Levels Academy, at Hillsboro, in Pocahontas County, incorporated February 14, 1842.
35. The Rector College, at Pruntytown, in Taylor County, incorporated February 14, 1842.
36. The Greenbank Academy, at Greenbank, in Pocahontas County, incorporated March 26, 1842.
37. The Northwestern Academy, at Clarksburg, in Harrison County, incorporated March 26, 1842.
38. The Brandon Academy, at Brandonville, in Preston County, incorporated March 27, 1843.
39. The Weston Academy, at Weston, in Lewis County, incorporated January 18, 1844.
40. The Potomac Seminary, at Romney, in Hampshire County, incorporated December 12, 1846.
41. The Male and Female Academy at Buckhannon, in Upshur County (then Lewis), incorporated February 1, 1847.
42. The Lewis County Seminary, at Weston, in Lewis County, incorporated March 20, 1847.
43. The Marshall Academy, at Moundsville, in Marshall County, incorporated March 19, 1847.
44. The Wheeling Female Seminary, at Wheeling, in Ohio County, incorporated January 24, 1848.
45. The Buffalo Academy, at Buffalo, in Putnam County, incorporated March 16, 1849.
46. The Academy of the Visitation, at Wheeling, in Ohio County, incorporated March 14, 1850.
47. The Jane Lew Academy, at Jane Lew, in Lewis County, incorporated March 16, 1850.
48. The Wellsburg Female Academy, at Wellsburg, in Brooke County, incorporated March 17, 1851.
49. The Meade Collegiate Institute, at or near Parkersburg, incorporated March 21, 1851.
50. The South Branch Academical Institute, at Moorefield, in Hardy County, incorporated March 31, 1851.
51. The Fairmont Academy, at Fairmont, in Marion County, incorporated February 17, 1852.

52. The Wheeling Female Seminary, at Wheeling, in Ohio County, incorporated January 10, 1853.
53. The West Union Academy, at West Union, in Doddridge County, incorporated April 16, 1852.
54. The Morgan Academy, at Berkeley Springs, in Morgan County, incorporated January 10, 1853.
55. The Logan Institute, at Logan Court House, in Logan County, incorporated February 21, 1853.
56. The Ashton Academy, at Mercer's Bottom, in Mason County, incorporated January 7, 1856.
57. The Point Pleasant Academy, at Point Pleasant, in Mason County, incorporated February 26, 1856.
58. The Polytechnic College, at Aracoma, in Logan County, incorporated February 28, 1856.
59. The Fairmont Male and Female Seminary, at Fairmont, in Marion County, incorporated March 12, 1856.
60. The Harper's Ferry Female Institute, at Harper's Ferry, in Jefferson County, incorporated March 18, 1856.
61. The Woodburn Female Seminary, at Morgantown, in Monongalia County, incorporated January 4, 1858.
62. The Lewisburg Female Institute, at Lewisburg, in Greenbrier County, incorporated April 7, 1858.
63. The Levelton Male and Female College, at Hillsboro, in Pocahontas County, incorporated February 27, 1860.
64. The Union College, at Union, in Monroe County, incorporated March 28, 1860.
65. The Parkersburg Classical and Scientific Institute, at Parkersburg, in Wood County, incorporated March 18, 1861.

Truly West Virginia was a land of academies. Its distance from the English influence of Old Virginia made inaccessible the benefits of the Latin grammar schools of Old England and William and Mary of Old Virginia. The mountains settled the question of education. If the pioneer was to secure for his children the benefits of schooling he must found his own schools. A lackadaisical attitude among the residents of Old Virginia and the presence in our midst of settlers from Pennsylvania led the mountaineer to copy the academy movement inaugurated by Franklin in 1751. West Virginia should be definitely classed among the Middle Atlantic states in this matter.

#### RISE OF PUBLIC EDUCATION

It seems doubtful that "the charity schools" had scarcely any existence west of the Blue Ridge. A few, however, appear to have been opened in Berkeley, Hampshire, and some of the more western counties as they were then called. Private and select schools did gain a foothold in the state and "did good work," in the education of "all the children of all the people who were able and willing to pay tuition." The common primary schools seemed to gain the ascendancy among the mountaineer pioneer. Under the name of "old field schools" they had an illustrious history extending back nearly a hundred years.

Although the Virginia Assembly lacked Constitutional authority, it passed what is known as the Aldermanic School Law on December 26, 1796. Since its preamble voices current educational ideals we quote in part:

“. . . The great advantages which civilized and polished nations appear to enjoy, beyond the savage and barbarous nations of the world, are principally derived from the invention and use of letters, by means whereof the knowledge and experience of past days are recorded and transmitted, so that man, availing himself in succession of the accumulated wisdom and discoveries of his predecessors, is enabled more successfully to pursue and improve not only those acts which contribute to the support, convenience and ornament of life, but to those also which tend to illumine and ennoble his understanding and his nature. . . . If the minds of the citizens be not rendered liberal and humane, and be not fully impressed with the importance of the principles from which these blessings proceed, there can be no real stability or lasting permanency of the liberty, justice and order of a republican government.”

By this law “three of their most honest and able men” in each county were to be designated or appointed as aldermen. They were to choose a site, erect a school house, select the teacher, and “visit the school once every year at least.” They were to examine the pupils, superintend the teacher’s conduct, and see that “there shall be taught reading, writing, and common arithmetic; and all free children, male and female . . . shall be entitled to receive *tuition gratis*, for the term of three years; and as much longer at private expense, as their parents, guardians, or friends shall think proper.” It is interesting to note that the expenses were to be collected by the sheriff as other public taxes are collected and from each inhabitant in proportion to their public assessments and county levies. The law went into effect in January, 1797, and was the first school law operative in the ten counties then organized in what is now West Virginia. It is not known how many of these counties obeyed the law but it is fair to assume that some did.

The Acts of 1809 provided “that all escheats, confiscations, forfeitures, and all personal property accruing to the Commonwealth as derelict and having no rightful owner . . . and all militia fines . . . are hereby appropriated to the encouragement of learning.” This was the “Literary Fund” around which clusters much educational history of the two states. The Assembly even went so far as to register a solemn “protest against any other application of the said fund by any succeeding General Assembly to any other object than the education of the poor.” This fund was later increased by the addition of other monies among which were the re-payment by the Federal Government of the loans made by Virginia during the War of 1812. The Court in each county was empowered to appoint from five to

fifteen "descreet" persons who served as "school commissioners" and were to administer the part of the funds designated for their county. They determined the number, selected the children who were to be recipients of this benefit, and could draw from this fund for all expenses including tuition, proper books, and materials.

J. E. Norris, "the historian of the Shenandoah Valley", says: "There was a certain stigma attached to these lower schools, not alone for the contact with poor children, whose rude manners may have been entailed on them by an idle and dissolute father, or worthless mother, but from the innate Virginia idea of independence; the sense of not being dependent upon their fellow men or the State, for material support or assistance, especially in the matter of the education of their children."

Lewis feels that this stigma "produced much of the illiteracy of the Commonwealth. But a large part of the people patronized these schools and when the three years' *tuition gratis* were passed, paid tuition and kept their children in school. Very many . . . were unable to do this . . . and the three years of free school afforded, gave but scant opportunity for the education of their children who thus grew up in ignorance if not illiteracy. It was to meet these conditions that the Literary Fund was created, and it became a mighty educational factor despite the refusal to accept its opportunities by so many of those for whom it was intended."

Presaging a "Free School System for the Commonwealth in which all children should be educated without distinction", the Clarksburg Convention was called in September, 1841. It was attended by delegates from nineteen counties of Virginia, of which sixteen were in the present boundaries of West Virginia. Lewis states that "never did a more earnest body of men assemble in West Virginia than this, nor has the work of any one yielded more abundant fruit." They published a pamphlet of proceedings entitled "A Memorial to the General Assembly of the State, Requesting that Body to Establish a More Liberal and Efficient Primary or Common School System." Lewis calls this "the most remarkable publication to be found in the educational literature of the Virginias."

From 1833 to 1846 educational matters remained largely in a static condition while operating under the Aldermanic Act. An attempt was made in March, 1846, to remedy the situation, but the resulting act was merely a continuance of the old system in a new cloak. The clouds of Civil War were gathering, and no effectual progress was made until after the new state had been formed.

Lewis describes "the West Virginia Schoolhouse of olden times" and the "Schoolmaster" as follows:

"Down on the broad river bottoms, in the valleys of smaller streams, or among the hills by a bubbling spring or rippling

brook, a spot, in juxtaposition to a half dozen or more cabin homes was agreed upon by the heads of the families as a suitable place for a schoolhouse. It was an old 'clearing' which tradition said was made by a man who was killed by the Indians, lost in the woods and never afterward heard of, or, tired of the wilderness, had gone back over 'the Ridge' — the Blue Ridge.

"There, on the margin of that 'improvement' — an 'old field' — where a half dozen paths bisected, with primitive forests in the rear and the plant of wild grass and tangled weeds in front, these men — advance guard of civilization — reared the schoolhouse. Rude structure it was; in size, perhaps 16x18 feet; the walls built of logs, sometimes hewn, but usually round, and from eight to twelve inches in diameter — the interstices chinked with sticks and stones and daubed with clay; the roof of clapboards held in place by heavy weight poles; the door of slabs hung on wooden hinges; the floor, if any, was made of puncheons split from the body of a large tree and hewn so as to have somewhat the quality of smoothness; a fire-place, ample as that of an ancient baron, spanned over half of one end of the building and was surmounted by a 'cat-and-clay' chimney not unlike a tall partridge trap, ever tottering to its fall. Logs ten inches in diameter, split in halves, and pins or legs inserted in the oval sides, answered for seats. Along the side of the wall pins were inserted and on them rested a slab, sloping downward, used as a writing desk; just above it, a log was chopped out and in its place a long frame-work resembling sash for holding a single row of panes of glass in the absence of which, greased paper was sometimes pasted to admit the light. . . .

"Autumn came. A stranger appeared upon the scene and the report went from cabin to cabin that there was a schoolmaster in the neighborhood. Look at him. He is clad in the garb of the border. Whence he came, none knew. He brings no credentials or diploma from a college faculty, for none is required. It is only necessary that he teach the three "R's — reading, 'riting, and 'rithmetic. He binds himself to do this in his 'article' which he carries from house to house, soliciting subscriptions to the school which he is to 'keep' for so much a 'quarter' and 'board 'round' — that is with his pupils. Then he goes to the school commissioner of the section of the district, who, in compliance with the law of '96 (1796) or '46 (1846) enters into contract to pay from his quota of the Literary Fund, Tuition of the indigent children of the neighborhood. Then the day is announced for school to begin and it is understood that the 'master' will board the first week at John Smith's but none can divine where he will stay the next.

"Monday morning comes. The 'master' goes early and with the aid of one of Smith's boys, puts on a 'back-log' and soon a fire is roaring on the hearth. Then the boys and girls for a half dozen miles around begin to arrive. . . ."

West Virginia was admitted to the Union on June 20, 1863. Its first Constitution carried provision for "a thorough and efficient system of free schools . . . (and) for the support of such schools by appropriating thereto the interest of the invested school fund, the net proceeds of all forfeitures, confiscations, and fines accruing to this State under the laws thereto; and by general taxation on persons and property or otherwise." It also provided for the "raising in each township, by authority of the people thereof, such a proportion of the amount required for the support of the free schools therein as shall be prescribed by general law." In December, 1863, the Legislature of the State passed the act establishing the free school system. Rev. W. R. White was named state superintendent in 1864. His vigorous campaign for good schools won for him the title, "The Horace Mann of West Virginia." Since that time progress has been made steadily in the improvement of our elementary schools. The academies gradually gave way to high schools, normal schools, or colleges.

No material alteration in the "district system" of schools occurred until 1933, when the old district lines were abolished and a "county-unit plan" instituted. The urbanization and industrialization of the state had so stimulated the flow of wealth to the cities that with the recent financial crises it became necessary, if efficient schools were to be maintained, to broaden the area of administration and support and to increase materially the few cents per dollar in state aid. The new plan is much too young to evaluate adequately. If it raises the level of education in rural and backward areas to that of the cities it will be conceded a success.

If space permitted, much could be said of the illustrious old school men who have given their services to the cause of education, and of the numbers who have come up through our schools to give valuable services in other chosen fields. West Virginia has had her "Century of Progress" in educational affairs, and a few statistics may not be amiss. While as a state we do not rank high in the many surveys and indexes that have been published, the following data indicate that we are making progress.

In 1833 there were only 678 common free primary schools in the state with only about 63 percent of the 9,000 poor children attending them. Today we have approximately 6,000 schools of elementary level attended by approximately 75 percent of the 530,000 children. In 1833 the total number of pupil days aggregated only 221,000, whereas today it exceeds 55,000,000. In 1833 each pupil averaged less than 40 days per year in school whereas now he averages in excess of 149. In 1833 the state assumed 4.7 cents per day per pupil in educational costs and is now assuming 15.1 cents. At that time there were only 45

academies offering for tuition an education on the secondary level as contrasted with our present 430 free high schools.

The curricula of these academies were described in such terms as "language, painting, and drawing"; "Greek and Latin"; "the necessary branches of an English education"; and the "ordinary branches of English education". The common schools were properly called "Schools of the Three R's". The schools of secondary level were primarily college preparatory schools offering only one limited curriculum. A very few schools on the secondary levels offered an English education designed for college preparation. Today the curricula compare favorably with that of the colleges in 1833. Our elementary schools have expanded their curricula until they are equal in many ways to the better academies and some colleges in 1833. The forward look of the mountaineer is still the chief characteristic of the West Virginian.

## A Test in Arithmetic Terminology

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VARIOUS MOTIVES may instigate a problem in research. This particular study was brought about by a desire for a more efficient course of study in arithmetic for our elementary schools. Our immediate concern is arithmetic terminology and some of its apparent relationships.

About four years ago we observed a class of eighth-grade pupils working on a problem in proportion. The problem written on the board in the form of an equation when I entered the room was " $3:6 = 4:x$ ". The teacher told the children to solve the problem. Instead of solving the problem the children looked at the teacher. Finally the teacher asked the pupils for the rule in solving such problems. A boy said, "The product of the means is equal to the product of the extremes." The teacher then remarked, "You now have the rule, solve the problem." Still the problem offered insurmountable difficulties. It was evident by this time that the children did not understand the meaning of the terms extremes and means as used in the rule. To them there was no connection with the terms in the rule and their position in the equation.

The meaning of the terms extremes and means was worked out with the pupils. When this had been done, the solution of the equation gave the pupils no difficulty. From this experience arose the question, "How important is the meaning of arithmetic terms in the solution of a problem?" We desired an answer to this question, but not being able to secure a standard test of the desired type to give us an answer, we began the construction of one which we hoped would give the information wanted.

The original test consisted of 110 terms. The original was given to 3400 pupils from grades three to eight inclusive. Of grades six, seven, and eight, 400 were eighth-grade pupils, 450 were seventh-grade pupils, and 500 were sixth-grade pupils.

Six words of the original test were eliminated. This left 104 terms. These terms were tabulated for percentage of correct responses. Two forms of the test A and B, of 52 terms each, were arranged in order of ascending difficulty. The split-half method<sup>1</sup> was used to find a coefficient of reliability between the two forms. It was found to be,  $r, .93$ .

<sup>1</sup>Garret, Henry E. *Statistics in Education and Psychology*. Longmans, Green & Co., New York.

The following sampling of terms is taken from Form A.

6. Add is:
- To take away
  - To put together
  - To buy
  - To multiply

22. In the example,

$$\begin{array}{r} 2 \\ 4 \overline{) 8} \\ \underline{8} \end{array}$$

the dividend is:

- /
- 2
- 4
- 8

24. Tax is:
- Money paid to support a government
  - One's income
  - What one spends
  - The cost of a public building

25. A common denominator of  $\frac{1}{3}$ ,  $\frac{1}{4}$ ,  $\frac{1}{2}$ ,  $\frac{1}{6}$  is:
- 15
  - 12
  - 14
  - 18

The Stanford Achievement Test Form V<sup>2</sup> in paragraph meaning, in word meaning, in arithmetic reasoning, and in arithmetic computation; the Henmon-Nelson Intelligence Test;<sup>3</sup> and Arithmetic Terminology Test Form A were given to 100 sixth-, seventh-, and eighth-grade pupils respectively. The results of 50 pupils from each grade were selected at random for computational purposes. These results are given in Table 1.

TABLE 1

Grade	I.Q.	S.A.T.	T.A.T.	D.A.T.	Reading					Arithmetic			
					Paragraph meaning			Word meaning		Arithmetic reasoning		Arithmetic computation	
					S.C.	T.S.	D.	T.S.	D.	T.S.	D.	T.S.	D.
6	102	33	34	+1	6.4	6.2	-0.2	6.2	-0.2	6.1	-0.3	6.3	-0.1
7	98	37	33	-4	7.4	6.4	-1.0	6.7	-0.7	6.2	-1.2	6.2	-1.2
8	98	42	42	0	8.4	7.8	-0.6	7.5	-0.9	7.4	-1.0	7.4	-1.0

Table 1 gives the results of 50 pupils selected at random from grades six, seven, and eight respectively. Grade indicates the school grade; I.Q., the mean intelligence quotient; S.A.T., the mean score secured previously by administering the Arithmetic Terminology Test to 500 sixth-grade pupils, to 450 seventh-grade pupils, and to 400 eighth-grade pupils; T.A.T., the mean score

<sup>2</sup> Stanford Achievement Test Form V. World Book Co., New York.

<sup>3</sup> Henmon-Nelson Intelligence Test. Houghton Mifflin Co., New York.

of the 50 sixth-, seventh-, and eighth-grade pupils respectively; D.A.T., the difference between the present test and the original Arithmetic Terminology Test; S.C., the mean standard score of the Stanford Achievement Test Form V in paragraph meaning, word meaning, arithmetic reasoning, and arithmetic computation; T.S., in paragraph meaning, word meaning, and arithmetic computation is the mean score of the present test; D. is the difference between the Stanford Achievement Test scores in reading and arithmetic and the present test. In the test scores of reading and arithmetic in the Stanford Achievement Test, the whole numbers refer to years and decimals to months. Hence, the number 6.2 means six years and two months. Table 1 is given primarily as a background upon which the following calculations are based.

Our major concern is the importance of arithmetic terminology and its relationship to problem solving. If a relationship exists between arithmetic terminology and problem solving, how great is it? If it is related to arithmetic problem solving, is there a relationship also to arithmetic computation? Does it end in a relationship between arithmetic problem solving and arithmetic computation, or are there similar relationships existing between arithmetic terminology, paragraph interpretation, and general word meaning?

Table 1 gives no answer to any of these questions. Table 2 gives the number of cases in each of grades six, seven, and eight, I.Q., the mean intelligence quotient, and the following correlations:

Correlation between A.T. and P.M., arithmetic terminology and paragraph meaning;

Correlation between A.T. and I.Q., arithmetic terminology and intelligence quotient;

Correlation between P.M. and I.Q., paragraph meaning and intelligence quotient;

Correlation between A.T. and W.M., arithmetic terminology and word meaning;

Correlation between W.M. and P.M., word meaning and paragraph meaning;

Correlation between A.T. and A.R., arithmetic terminology and arithmetic reasoning;

Correlation between A.R. and I.Q., arithmetic terminology and intelligence quotient;

Correlation between A.T. and A.C., arithmetic terminology and arithmetic computation;

Correlation between A.C. and I.Q., arithmetic computation and intelligence quotient.

The product-moment method<sup>4</sup> of finding correlations was used. The  $r$ 's were not corrected for attenuation.

TABLE 2

Grade	Cases	M.I.Q.	Reading						Arithmetic			
			Paragraph meaning			Word meaning			Arithmetic reasoning		Arithmetic computation	
			r	r	r	r	r	r	r	r	r	r
			A.T. P.M.	A.T. I.Q.	P.M. I.Q.	A.T. W.M.	W.M. I.Q.	W.M. P.M.	A.T. A.R.	A.R. I.Q.	A.T. A.C.	A.C. I.Q.
6.	50	102	.68	.64	.78	.73	.77	.84	.59	.47	.55	.52
7.	50	98	.75	.79	.87	.86	.82	.87	.66	.79	.77	.77
8.	50	98	.70	.80	.80	.75	.69	.61	.77	.65	.69	.76
Mean		r	.71	.75	.82	.78	.76	.78	.68	.59	.68	.69

Generally speaking, the correlated abilities show a marked relationship with the possible exception of  $r$  .47 between arithmetic reasoning and intelligence, when one considers  $r$  .50 or above as marked.

We appreciate the danger of averaging correlations, but the proximity of the  $r$  values in each grade of the several abilities correlated, we feel, make the mean  $r$  permissible. We found the mean  $r$  by squaring each  $r$ , averaging these squares, and extracting the square root of the average thus obtained.<sup>5</sup> The mean  $r$ 's vary from a low  $r$  .59 between arithmetic reasoning and intelligence to a high  $r$  .82 between paragraph meaning and intelligence.

Table 2 gives evidence of marked relationship between arithmetic terminology and the several abilities enumerated. But, are there other factors which may be influential in these relationships? For instance, the correlation between arithmetic terminology and paragraph meaning in grade six is  $r$  .68, and the correlation between arithmetic terminology and intelligence is  $r$  .64. Perhaps there is no relationship between arithmetic terminology and paragraph meaning. It may be a matter of intelligence. That is, those who are intelligent may do better in arithmetic terminology and paragraph meaning because of their intelligence, not because of any existing relationship between arithmetic terminology and paragraph meaning. We shall further refine the data given in Table 2 by partialing out the factor of intelligence.

Table 2 gives the intercorrelations between arithmetic terminology and paragraph meaning, between arithmetic terminology and intelligence, and between paragraph meaning and in-

<sup>4</sup> Garrett, Henry E., *Statistics in Psychology and Education*. Longmans, Green & Co., New York, p. 284.

<sup>5</sup> Garrett, *op. cit.*

telligence. Likewise similar intercorrelations are given in Table 2 under the general headings of word meaning, arithmetic reasoning, and arithmetic computation. The correlation between (1) paragraph meaning and (2) arithmetic terminology, written  $r_{12}$ , is .68; the correlation between (2) arithmetic terminology and (3) intelligence quotient, written  $r_{23}$ , is .64; and the correlation between (1) paragraph meaning and (3) intelligence quotient, written  $r_{13}$ , is .78.

When the intercorrelations had been calculated the following formula was used to partial out the influence of intelligence

$$r_{12.3} = \frac{r_{12} - r_{13} r_{23}}{\sqrt{1-r_{13}^2} \sqrt{1-r_{23}^2}}$$

Substitution of the values of  $r_{12}$  .68;  $r_{13}$  .78; and  $r_{23}$  .64 gives a net or partial correlation of  $r_{12.3}$  .37. Therefore, the correlation between paragraph meaning and arithmetic terminology with **the influence of intelligence eliminated** is  $r_{12.3}$  .37.

Having applied a similar treatment to general word meaning and arithmetic terminology, arithmetic reasoning and arithmetic terminology, arithmetic computation and arithmetic terminology, the net or partial correlations between these abilities in grades six, seven, and eight were calculated.

Grade 6	Paragraph Meaning and Arithmetic Terminology,	$r_{12.3}$ .37
Grade 7	“ “ “ “ “	$r_{12.3}$ .21
Grade 8	“ “ “ “ “	$r_{12.3}$ .35
MEAN	“ “ “ “ “	$r_{12.3}$ .31
Grade 6	General Word Meaning and Arithmetic Terminology,	$r_{12.3}$ .48
Grade 7	“ “ “ “ “	$r_{12.3}$ .60
Grade 8	“ “ “ “ “	$r_{12.3}$ .45
MEAN	“ “ “ “ “	$r_{12.3}$ .51
Grade 6	Arithmetic Reasoning and Arithmetic Terminology,	$r_{12.3}$ .42
Grade 7	“ “ “ “ “	$r_{12.3}$ .31
Grade 8	“ “ “ “ “	$r_{12.3}$ .50
MEAN	“ “ “ “ “	$r_{12.3}$ .42
Grade 6	Arithmetic Computation and Arithmetic Terminology,	$r_{12.3}$ .33
Grade 7	“ “ “ “ “	$r_{12.3}$ .40
Grade 8	“ “ “ “ “	$r_{12.3}$ .42
MEAN	“ “ “ “ “	$r_{12.3}$ .39

The same method was used in finding the mean partial correlations as was used in finding the mean correlations in Table 2.

These partial correlations, though not marked, are sufficient to show an existing relationship between arithmetic terminology and the several abilities enumerated. The greatest mean net or partial correlation is  $r_{12.3}$  .51, found between general word meaning and arithmetic terminology. This may not be surprising

when one considers that words standing alone may have a more pronounced relationship than when influenced by other factors which are associated with them in paragraph or arithmetic problem context. The least net or partial correlation,  $r_{12.3}$  .32, is found between paragraph meaning and arithmetic terminology, while the second largest,  $r_{12.3}$  .42, is found between arithmetic reasoning and arithmetic terminology. This is not surprising when one considers that general paragraph reading does not demand the same unit factors of meaning for successful interpretation as the arithmetic problem demands for successful solution. Arithmetic terminology as a unit factor of meaning is more closely associated with arithmetic problem solving than with general paragraph reading. Such word meanings as add, tax, area, discount, etc., are quite frequently associated with problem solving but may not be with general paragraph reading.

Next in importance of relationship to the net or partial correlation between arithmetic terminology and arithmetic reasoning is the net or partial correlation,  $r_{12.3}$  .39, between arithmetic terminology and arithmetic computation.

The low correlations between the Arithmetic Terminology Test and the other tests indicate that the other tests are measuring factors which the Arithmetic Terminology Test does not measure.

## The Validity of the Pintner General Ability Test, Advanced Form

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### INTRODUCTION

THE PINTNER GENERAL ABILITY TESTS, both the Intermediate Test and the Advanced Test, are published in two equivalent forms.<sup>1</sup> These tests measure assumedly different aspects of general mental ability through the following eight subtests: vocabulary, logical selection, number sequence, best answer, classification, opposites, analogies, and arithmetic reasoning. The tests are partially self-administering in that all instructions concerning the method of response are given prior to the pupil's beginning the test.

Those tests follow the generally accepted ideas of exercises which should constitute a test of academic aptitude. Apparently no factor analysis of the components of academic aptitude, such as that proposed by Thurstone, has been applied to these tests. The manual of directions did not supply any correlation of these tests with other tests of academic aptitude at the college level, or with any measures of academic achievement, and that is what first prompted our study. Under the section on "Standardization" in the manual of directions there is this explanation:

"An unusually thorough experimental program has been conducted in connection with the standardization of the Pintner Intermediate and Advanced Tests. Although the Intermediate Test had been previously standardized (before its earlier publication as the Pintner Intelligence Test), a completely new determination of norms has been made for it as well as for the Advanced Test. The present norms are based on approximately 60,000 cases drawn from seven communities representative of varying economic levels of the country. In most of these communities the standardization group included the entire public school enrollment in Grades 4 through 12. The norms thus determined have been checked by equating to the national norms of other intelligence tests."

\* \* \* \*

"The wide sampling of the traits or factors which comprise general mental ability insures a high degree of validity for the Pintner Tests. Study of the correlations between forms of the Pintner Tests and of correlations between odd and even items indicates satisfactory reliability."

While it may be presumed that in both validity and reliability the Pintner tests are as good as most currently available

<sup>1</sup> Pintner General Ability Tests, Verbal Series. Pintner Intermediate Test, Form A, Grades V to VIII; Pintner Advanced Test, Form A, Grades IX to XII, by Rudolf Pintner. Yonkers-on-Hudson; World Book Co. 1938 (The Pintner tests are mentioned without comment or appraisal in the JOURNAL OF EDUCATIONAL RESEARCH, vol. 32, no. 6, p. 469, February 1939.)

tests of "verbal intelligence", we were interested in checking on the validity and usefulness of the advanced form of the test at the college level.

### PROCEDURE

As the first step in making some check on the validity and usefulness of the advanced form of the Pintner test we administered Form A to all of the freshmen at Bethany College on October 31, 1938. We already had scores on the 1937 edition of the American Council on Education's Psychological Examination<sup>2</sup> and the Ohio State University Psychological Test<sup>3</sup> for this same class. These tests were administered on September 19, 1938, and September 22, 1938, respectively. In February 1939 the final academic grades for the first semester were made available and in April 1939 the mid-semester grades for the second semester were made available. These were put into point averages for each student (i.e., credit hours divided by quality points). The 1938 edition of the A.C.E. Psychological Examination was administered to this same class on January 25, 1939. Thus we were able to determine the relationship of the Pintner test with three other tests of mental ability and with academic achievement as measured by the grades. We also had scores on an achievement test in English<sup>4</sup> which was administered on September 19, 1938. These relationships were determined by the coefficient of correlation (Pearson product method).

### RESULTS

The correlation coefficients determined between the Pintner scores and the other test scores are all in the seventies and eighties. These are listed in Table 1.

TABLE 1 — *Coefficients of Correlation between Pintner Scores and Other Test Scores — Freshmen at Bethany College*

Test	r	P.E. <sub>r</sub>
American Council (1937 ed.)	.819	.0178
Ohio State University (Form 20)	.773	.0225
American Council (1938 ed.)	.766	.0221
English	.719	.0269

In a further analysis of the Pintner test the relationship was determined between the total score on the test and the scores on separate parts of the American Council examination and the Ohio State test. The Pintner test scores correlated high with

<sup>2</sup> American Council on Education Psychological Examination, L. L. and T. G. Thurstone. Published by American Council on Education.

<sup>3</sup> Ohio State University Psychological Examination, Form 20, H. A. Toops. Published by the Ohio College Association.

<sup>4</sup> Cooperative English Test, Form O, Leonard, Willing, Henmon, Carpenter, Lindquist, Cook, Patterson, Beers, Spaulding. Published by Cooperative Test Service.

the "completion" and "opposites" parts of the American Council examination, with coefficients in the seventies. The lowest correlation was with the part on "artificial language". The scores on the separate sections of the Ohio State test and the Pintner scores showed correlations rather evenly with all coefficients at about 70. A detailed report of these correlations is listed in Tables 2 and 3.

TABLE 2—*Coefficients of Correlation between Pintner Scores and Scores on Parts of American Council Examination, 1937 edition—Freshmen at Bethany College*

Parts of American Council Examination	r	P.E.
I—Analogies	.494	.0413
II—Arithmetic	.607	.0343
III—Artificial language	.357	.0472
IV—Completion	.719	.0262
V—Opposites	.741	.0245

TABLE 3—*Coefficients of Correlation between Pintner Scores and Scores on Parts of Ohio State Test, Form 20—Freshmen at Bethany College*

Parts of Ohio State University Test	r	P.E.
I—Same—Opposites	.732	.0254
II—Analogies	.693	.0285
III—Reading comprehension	.702	.0278

In addition to checking the validity of the Pintner tests by correlation with other tests of mental ability which are used at the college level, the relationship was determined with the academic attainments of the students. The point average (i.e., credit hours divided by quality points earned) for each freshman at Bethany College was calculated at the end of the first semester, and these were correlated with the scores on each of four tests of mental ability. The coefficients were all in the fifties, and

TABLE 4—*Coefficients of Correlation between First Semester Point Averages and Mental Test Scores—Freshmen at Bethany College*

Test	r	P.E.
Pintner	.592	.0360
American Council (1937 ed.)	.523	.0396
American Council (1938 ed.)	.569	.0374
Ohio State Test (Form 20)	.581	.0360

these are about what one would expect from similar studies.<sup>5</sup> Table 4 gives a report of these correlations.

It is probably fair to say that the mid-semester grades at Bethany College do not represent an accurate appraisal of a student's achievement; hence the report of these grades and the point averages determined from them are not very useful for checking on the validity and usefulness of a mental test. The correlations determined for the four tests with the mid-semester grades for the second semester are listed in Table 5. The coefficients here are all lower than those with final semester grades.

TABLE 5—*Coefficients of Correlation between Point Averages of Mid-Semester Grades, April 1939, and Mental Test Scores—Freshmen at Bethany College*

Test	r	P.E.
Pintner	.462	.0441
American Council (1937 ed.)	.348	.0480
American Council (1938 ed.)	.531	.0390
Ohio State University (Form 20)	.427	.0444

In addition to determining the mathematical correlation between academic grades and mental test scores, it is important to know how well the test scores actually predict the academic success of a student in terms of his standing in the class. To check the usefulness of the Pintner test on this point, the freshmen were ranked according to their point average at the end of the semester and the range was divided by quintile points. This set the class into five different groups according to their final semester grades. The same kind of distribution was made for the scores on the Pintner test. The scores for students in each group (divided in terms of grades) were checked to determine whether

TABLE 6—*Percentage of Cases Where Standing in Academic Grades (Point Average) is checked by Standing in Mental Test Score—Range Divided into Quintiles—Freshmen at Bethany College*

Quintile academic standing	Pintner	A.C. 1937	A.C. 1938	O.S. 20
5	58.62%	58.62	58.62	55.17
4	37.93	24.13	27.58	34.48
3	27.58	24.13	27.58	34.48
2	20.00	20.00	33.33	33.33
1	36.66	40.00	46.66	43.33

the interval in the range of scores matched. For instance, a check was made to see whether a student who stood in the top fifth of the class in terms of grades also stood in the top fifth in terms

<sup>5</sup> Such studies as MacPhail, A.H., *The Intelligence of College Students*. 1924. Warwick and York, Baltimore.

of the Pintner score. This kind of check gave us an idea as to the prognostic value of the Pintner test at the college level.

It was found that 58.62 percent of the students who stood at the top fifth of the class in academic grades stood in the top fifth in Pintner scores and that 36 percent who stood in the lower fifth in grades were in the lower fifth of the scores. The same kind of check was made with the other three mental ability tests. There is very little difference in the prognostic value of these tests as checked by this kind of analysis. A detailed report of this may be seen in Table 6.

#### CONCLUSION

From the results obtained in this study we would conclude that the Pintner General Ability Tests, Verbal Series—Advanced Form is a valid and useful instrument for use at the college level. It has checked well with other tests of mental ability as to correlation with total scores and with part scores and it has checked well with academic grades both as to simple correlation and prognosis of standing. It has several merits, such as ease of administration and scoring, that may commend it to wide use at the college level.

## Reptiles Killed on a "Vermin" Campaign in Mercer County, West Virginia

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FOR SOME YEARS the State of West Virginia has had the unenviable reputation of condoning, if not encouraging, the most ill-advised "vermin" campaigns of any northeastern state. Dr. Reese<sup>1</sup> has published a quantitative report on the destructiveness of these campaigns to the vertebrate fauna of West Virginia. I have long wished to examine qualitatively some of the reptiles probated for bounties, and in 1938, thanks to the kindness of Mr. P. C. Bibbee of Concord State Teachers College, I received a few of the specimens upon which bounties were paid in Mercer County. This collection, which consisted of 35 snake heads, one entire snake, and one entire lizard, cannot be taken as indicative of the results of all "vermin" contests, because of its small size. It is of intrinsic interest, however, since no herpetologist has had the opportunity previously to check the identifications of snakes classed as "vermin" in West Virginia. I hope, also, that this brief account may stimulate similar analyses of other collections.

### LIZARDS

#### *Eumeces fasciatus* (L.) — Blue-tailed Skink

A complete juvenile specimen was received. This lizard feeds almost exclusively upon insects, although upon rare occasions it may eat newly-born mice, birds' eggs, and small lizards. There can be no question that economically it is beneficial.

### SNAKES

#### *Carphophis amoena amoena* (Say) — Eastern Ground Snake

The head of an adult specimen was received. This tiny snake, which rarely exceeds one foot in length, feeds upon earthworms, grubs, and other soft-bodied insects. Its feeding habits are incompletely known, but it can be considered of about neutral value, since its good work in eating insects is partially negated by its consumption of earthworms.

#### *Elaphe obsoleta obsoleta* (Say) — Pilot Blacksnake

One complete young specimen, the head of a partly-grown specimen, and the heads of ten large adults were received. Although most reptile "vermin" campaigns are directed at water

<sup>1</sup> Science, vol. 82 :pp.593-594. Dec. 20, 1935.

snakes, it must be emphasized that in this small collection more Pilot Blacksnakes were killed than any other species! There has been much argument about the economic status of this snake. Studies have shown that half of the food of Pennsylvania specimens during June and July was comprised of birds and their eggs, whereas in August and September 75 percent of the food consisted of mammals — principally mice. Rats, weasels, shrews, red squirrels, opossums, insects, and hen's eggs are eaten also. On an annual basis, the Pilot eats more mammals and insects than birds.

From his extensive studies of rodents and the predators which help to control them, and from his experience with captive Pilot Blacksnakes, Dr. William J. Hamilton, Jr., of Cornell University states (letter of May 3, 1939) "I suspect a large blacksnake will eat *at least* a dozen field mice (about a pound) in a week." In captivity snakes have notoriously poor appetites; but even under such abnormal conditions a Pilot will eat a dozen mice per month. By combining these two figures, an adult Pilot Blacksnake may be credited with a possible consumption of two dozen mice for each of the six months of the year in which it is active. Probably 100 mice per year, in addition to other food, is a conservative annual average for a five- or six-foot specimen. In other words, a single Pilot Blacksnake eats about as many field mice annually as inhabit an acre of alfalfa. Dr. Hamilton writes, in the letter mentioned above, "I should judge that in a good stand of alfalfa each mouse is capable of 25 cents per year damage, possibly much more, and in an average year there might be 50 to 100 mice per acre. But probably the loss would not exceed \$10 per acre." Hamilton's "Field-Mouse and Rabbit Control in New York Orchards"<sup>2</sup> contains pertinent estimates of damage done to timothy fields and orchards by mice. According to a Government report,<sup>3</sup> over 1000 trees, all over 18 years old, were killed by pine mice in a single large orchard near Charleston, West Virginia. On the basis of available information, then, the farmer or orchardist is justified in placing a monetary value of no less than five dollars, and possibly as much as ten dollars, upon each Pilot Blacksnake!

Pilot Blacksnakes should never be killed in orchards, grain fields, or in the woods, but specimens found in hen houses or where quail are being reared should be killed. Each snake has a circumscribed territory which it inhabits, and a Pilot found in a hen house is more likely to have come from a nearby barn than from a woodlot a half mile away.

*Lampropeltis triangulum triangulum* (Lacépède)—House Snake

The head of one large specimen was received. This species is definitely beneficial, since 83 percent of its food consists of

<sup>2</sup> Cornell Extension Bull. no. 338, Sept. 1935.

<sup>3</sup> Farmer's Bull. no. 1397: p. 5.

mammals, principally field mice; 6 percent, snakes, both harmless and poisonous; and 3 percent, slugs. At all times of the year mice comprise more than two-thirds of its food.

*Natrix septemvittata* (Say) — Queen Water Snake

Heads of eleven adult specimens were received. This species, although a "water snake", feeds principally upon crayfish (80 percent) and toads (20 percent). Crayfish are very destructive to earth dams, and they are known to eat fish and tadpoles, but they do serve as food for bass. Occasionally small fish and frogs are consumed, but the fish are usually carrion. The Queen Snake is too small to eat large fish, and probably too slow-swimming to catch game species.

*Natrix sipedon sipedon* (L.) — Banded Water Snake

The heads of five young, three half-grown, and one adult specimen were received. Experiments have shown that this snake prefers slow-swimming, non-game fishes to game species, when given its choice. It does eat trout, but it more than compensates for this crime against fishermen by eating White Suckers, Catfish, and Star Gazers, which destroy trout eggs and fry. It protects healthy fish by eating diseased individuals which are easy to catch and by taking dead specimens which otherwise would serve as fly-breeding sites. In addition it feeds upon shrews, mice, insects, toads, frogs, and salamanders.

Dr. J. Clark Salyer, II, who has made the most complete study in recent years of the stomach contents of water snakes, stated in a letter to the writer, under date of April 7, 1936, "To date, I have found that the water snake (*N. sipedon*) has an astonishingly varied diet in which fishes do not loom disproportionately large. On the Michigan trout streams, undoubtedly the two species of *Cottus* [sculpins] occurring there form the bulk of its diet. Naturally, around hatcheries it can feed upon but one thing and should, in a measure, be controlled in such situations. However, it does not have a tendency to linger in these places due to human frequency of the area." If water snakes are actually so detrimental as the "vermin" campaigners would have us believe, there would have been no trout left when man first reached the streams of North America. Stream pollution by White men has been infinitely more destructive of fish life than have all of the reptilian predators.

*Thamnophis sirtalis sirtalis* (L.) — Common Garter Snake

Two heads were received. This species is economically harmful since it consumes large quantities of toads and earthworms, but it is an interesting and friendly snake and should not be persecuted too severely. After all, the robin is economically detrimental when cherries are ripening, yet the first robins to

arrive each spring are greeted with sincere pleasure rather than with shotguns.

Animals, under natural conditions, reach a delicate balance between predators and prey. This balance must be maintained, or allowed to re-establish itself, if any region is to continue to be fit for human habitation over a long period of time. The results of interference are often not apparent immediately, but the penalties are visited upon succeeding generations, even as with other sins. Sportsmen slaughter eagles, hawks, and owls, encourage the payment of bounties upon weasel scalps, and then write to me in the hope that I can recommend a poison which will destroy the rattlesnakes which infest regions in which their summer cabins are located. Reptile "vermin" campaigns are predicated upon the thesis that any animal which dares to eat fish or game birds should be exterminated. I believe that good hunting and good fishing are important to man's enjoyment of life, and that once in a while some control of predators is necessary. I maintain, however, that a sportsman dying from a rodent-borne disease, such as tularemia, is in no condition to enjoy a teeming trout stream; that a farmer whose orchard or clover fields have been seriously injured by field mice cannot afford shotgun shells; and that good enemies are required to maintain the virility of game animals, since they eradicate weaklings and prevent the overcrowding which spreads disease and leads to semi-starvation. It is wholly selfish and short-sighted to persecute unendingly the rodent-eating snakes, hawks, and owls to improve our sport, when the inevitable result will be a plague of rats and mice which will bring famine and pestilence unless halted by widespread rodent control measures and resultant increased taxation. Personally, I would rather have a live Blacksnake as a rat-trap than a paid exterminator who scatters poison.

Insects and rodents are generally conceded to be the groups of animals which make the greatest inroads upon human food supplies. These groups are also of extreme importance as vectors of human diseases. All matters of sentiment aside, I earnestly call upon the "vermin" campaigners to stay their hands from those species of animals that serve as insect and rodent controls, regardless of occasional sins for the sake of dietetic variation. To those who consider me a rodent alarmist I commend the following computation. Dr. Reese's figures,<sup>4</sup> taken from the Biennial Report of the Conservation Commission of West Virginia, included 79,481 snakes destroyed in 26 counties in the fiscal year 1933-34. For 1934-35 the Commission proudly reported that 40 counties conducted vermin contests!

Of the 36 snakes received from the Mercer County contest, twelve, or exactly one-third of the entire lot, were Pilot Blacksnakes. The same relative proportion applied to the 79,481 snakes

<sup>4</sup> *Op. cit.*, p. 594.

killed in 26 counties in the fiscal year 1933-34 results in the amazing figure of 26,493 Pilot Blacksnakes destroyed. On this assumption, the sponsors of the "vermin" contests, in dooming so many mouse-catchers, enabled 2,649,300 destructive mice to continue their prolific existences. On a monetary basis, using the minimum evaluation of five dollars on each Pilot, the loss in rodent damage, in a single year, to the agriculturalists of 26 West Virginia counties may have been over \$132,000 as a result of the slaughter of Pilot Blacksnakes alone!

