West Virginia University
Bulletin

SERIES 33 No. 15

PROCEEDINGS
OF THE WEST VIRGINIA ACADEMY OF SCIENCE

Volume 6 March, 1933

March Fifteenth, Nineteen Hundred Thirty-three
Published by THE UNIVERSITY
MORGANTOWN, WEST VIRGINIA

Entered as second-class matter, July 15, 1929, at the postoffice at Morgantown, W. Va., under act of August 24, 1912.

Issued twice in October, November, December, January, February, and March, and once in July, August, September, April, and May.

PROCEEDINGS
OF THE WEST VIRGINIA ACADEMY OF SCIENCE

Volume 6 March, 1933

Ninth Annual Session
Athens, W. Va. April 29-30, 1932

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MEMBERS OF THE WEST VIRGINIA ACADEMY OF SCIENCE

*Akers, Bernice, Teacher, Ramsey Junior High School, Bluefield.
Albert, C. E., Dean, Davis & Elkins College, Elkins.
†Ammons, Nellie, Instructor in Botany, W. V. U., Morgantown.
Anderson, Newton, Social Science Teacher, Upshur Co. High School, Buckhannon.
Archer, C. H., Registrar, Concord St. College, Athens.
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†Bretnall, George H., Prof. Biology, Shepherd College, Shepherdstown.
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†Brooks, A. B., Park Naturalist, Oglebay Park, Wheeling.
†Brooks, Fred E., Entomologist, French Creek.
†Brooks, Maurice, Upshur Co. High School, Buckhannon.
*Brouzas, C. G., Assoc. Prof. of Classics, W. V. U., Morgantown.
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Brown, Russell G., University of Maryland, College Park, Md.
*Burdette, Curtis, Teacher, Hinton.
*†Burke, Stephen P., Dean Graduate School, W. V. U., Morgantown.
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†Campbell, Carl G., Prof. Chemistry, George Peabody College, Nashville, Tenn.
Chapman, Daisy V., Biology Teacher, Williamson.
†Chidester, Floyd E., Prof. Zoology, W. V. U., Morgantown.
†Clark, Friend E., Prof. Chemistry, W. V. U., Morgantown.
*Coffindaffer, Fred S., Teacher Biology, Spanishburg High School, Princeton.
Collins, Berenice, 1215 Quarrier St., Charleston.
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†Colwell, Robert C., Prof. Physics, W. V. U., Morgantown.
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*Cook, James, Science Teacher, Oceana.
†Cook, Rolla V., Prof. Physics, Bethany College, Bethany.

*Cook, T. A., Prof. Mathematics, Concord State Teachers College, Athens.
†Core, Earl L., Instructor in Botany, W. V. U., Morgantown.
*Cushman, M. S., Head, History Dept., Concord State Teachers College, Athens.
†Cutright, Frank, Prof. Biology, Concord St. College, Athens.
Cutright, Paul R., Dept. of Zoology, University of Pittsburgh, Pittsburgh, Pa.
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Davis, Lida L., Prof. Geography, Concord St. College, Athens.
†Davis, Hannibal A., Prof. Mathematics, W. V. U., Morgantown.
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*†Fridley, Harry M., Assoc. Prof. of Geology, W. V. U., Morgantown.
†Fromme, Fred Denton, Dean College Agriculture, W. V. U., Morgantown.
†Frye, Wilbert M., Teacher, Hanging Rock.
*Furbee, Charles W., Geology Student, W. V. U., Morgantown.
*Gabbert, Carl, Science Teacher, Talcott High School, Talcott.
†Goldbraith, Freeman Dent, Prof. Chemistry, Potomac State School, Keyser.
†Galpin, S. L., Prof. Geology, W. V. U., Morgantown.
†Garber, R. J., Prof. Agronomy, W. V. U., Morgantown.
Gardner, S. O., Teacher, Blacksville.
*Gatherum, Robert S., Dean, Concord State Teachers College, Athens.
Gilbert, Frank A., Prof. Botany, Marshall College, Huntington.
*†Gould, Arthur B., Prof. Biology, Salem College, Salem.
*Graybeal, L. B., Prof. Education, Concord State Teachers College, Athens.
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*Hance, Robert T., Head, Zoology Dept., University of Pittsburgh, Pittsburgh, Pa.
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†Harris, T. L., Prof. Sociology, W. V. U., Morgantown.
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*Haught, O. L., Geology Student, W. V. U., Morgantown.
*Haught, Thomas W., Prof. Geology, W. Va. Wesleyan, Buckhannon.
Haught, C. D., Prof. Physics, Fairmont State Teachers College, Fairmont.
†Haught, Oscar, Littleton.
*Heck, Edward T., Geology Student, W. V. U., Morgantown.
*†Herndon, L. K., State Dept. of Health, Charleston.
Hill, Canton N., Biology Teacher, East Side High School, Fairmont.
Hill, George H., Road Engineer, Charleston.
Hodge, W. W., Prof. Chemical Engineering, W. V. U., Morgantown.
Hornor, Carl L., Mining Engineer and Coal Operator, Clarksburg.
†Hornor, Roy R., Norwood Gas Company, P. O. Box 6, Clarksburg.
†Hron, Ralph P., Prof. Physics, Marshall College, Huntington.
*Hunt, George R., Prof. Zoology, Fairmont State Teachers College, Fairmont.
*†Hyma, Nicholas, Prof. Chemistry, W. Va. Wesleyan, Buckhannon.
Irvine, Carmen E., Graduate Student, W. V. U., Morgantown.
†Jacobson, Carl A., Prof. Chemistry, W. V. U., Morgantown.
*James G. Claire, Glenville.
†Jones, C. R., Dean College of Engineering, W. V. U., Morgantown.
†Jones, Harris A., Meteorologist, Elkins.
†Judson, J. E., Prof. Botany, W. Va. Wesleyan College, Buckhannon.
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Kelly, Matthew J., Machinist, Elkins.
*King, Genevive, Hundred.
†Knight, H. G., Chief, Bureau of Soils and Chemistry, Washington, D. C.
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Largent, R. J., Dean, Marshall College, Huntington.
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Lawall, Charles E., Prof. Mining Engineering, W. V. U., Morgantown.
*Layne, Mabelle A., Science Teacher, Burch High School, Delbarton.
*Leach, Stuart, Biology Teacher, Matewan High School, Matewan.
Lively, E. L., State Teachers College, Fairmont.
*Lord, Paul, Science Teacher, Marlinton.
Loy, Melvin P., Prof. Zoology, Marshall College, Huntington.
*Ludwig, Ross, Teacher, Union District High School, Dunbar.
McClure, Iris, Teacher Mathematics and Physics, High School, Romney.
McGuire, A. E., Prof. Education, Concord State Teachers College, Athens.

*McLaughlin, J. B., Member State Board of Educ., Charleston.
†McNeill, E. Meade, Prof. Biology, Concord State College, Athens.
*Marsh, J. F., President Concord State College, Athens.
Martens, J. H. C., Prof. Geology, W. V. U., Morgantown.
*Martin, C. H., President, New River State College, Montgomery.
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*Meier, Albin, Science Teacher, Charleston High School, Charleston.
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Moore, Laura B., Teacher, High School, Parkersburg.
*Moore, Theodore, Game Warden, Marlinton.
*Morris, Lee, Assistant Geologist, W. Va. Geol. Survey, Morgantown.
*Morris, Samuel, Prof. Chemistry, W. V. U., Morgantown.
*Musser, Biology Teacher, High School, Charleston.
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†Newins, Harold S., Asst. Prof. of Forestry, Michigan State College, East Lansing, Mich.
*†Orton, C. R., Dept. of Plant Pathology, W. V. U., Morgantown.
*Packard, Russel L., Prof. Geography, Concord State Teachers College, Athens.
Palmer, John, Rock Ledge, Wheeling.
*Parry, V. Frank, W. V. U., Morgantown.
*Patterson, Robert C., Graduate Ass't Zoology, W. V. U., Morgantown.
†Phelps, Edward P., Prof. Chemistry, Marshall College, Huntington.
*Perry, T. J., Science Teacher, Athens High School, Athens.
*Phillips, D. E., Prof. Mathematics, Shepherdstown.
*Poe, J. Alfred, Teacher, 120 Shepherd Ave., S. Charleston.
*†Porter, C. Clyde, Sureshot Torpedo Company, Huntington.
*Price, Calvin W., Editor, Marlinton.
Price, Paul H., Instructor in Geology, W. V. U., Morgantown.
†Pardum, R. B., Prof. Physics, Davis & Elkins College, Elkins.
Raub, Leo. G., Prof. Physics, New River State College, Montgomery.
†Reese, A. M., Prof. Zoology, W. V. U., Morgantown.
†Reger, David B., Consulting Geologist, P. O. Box 816, Morgantown.
*Reiger, C. C., Prof. History, New River State College, Montgomery.
†Reynolds, Clarence N., Jr., Prof. Mathematics, W. V. U., Morgantown.
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*Roach, John, Teacher of Chemistry and Biology, Union District High School, Dunbar.
*Robb, Clarence C., Teacher, Social Science and Industrial Arts, Union Dist. High School, Dunbar.
†Rogers, H. F., Prof. Chemistry, Fairmont St. Teachers College, Fairmont.
Rohr, H. D., Principal Weston High School, Weston.
*Rufener, L. A., Prof. Economics, W. V. U., Morgantown.
Saleski, R. E., Prof. German, Bethany College, Bethany.
*†Schneiderhan, F. J., Assoc. Plant Pathologist, Kearneysville.

Scott, R. Ray, Prof. Education, W. Va. Wesleyan College, Buckhannon.
Scott, S. A., Vice Pres. New River Coal Company, McDowell.
*Seyster, E. W., Assoc. Prof. of Biology, New River State College, Montgomery.
Sharp, Ward M., Dept. Botany, W. V. U., Morgantown.
Shaw, D. A., Principal High School, Gilbert.
*Shearer, M. L., Prof. Physical Education, Concord State Teachers College, Athens.
Shouse, J. B., Dean, Teachers College, Marshall College, Huntington.
*Shuffleberger, Earl, Science Teacher, Princeton.
*Shutts, H. A., Dept. Mathematics, Fairmont State Teachers College, Fairmont.
Skuce, Thomas W., Extension Forester, W. V. U., Morgantown.
Smith, Wallace, Prof. Mathematics, New River St. College, Montgomery.
†Spangler, R. C., Prof. Botany, W. V. U., Morgantown.
Stathers, Allan, Teacher Mathematics, Weston High School, Weston.
Stayman, Joseph W., Pres. Potomac State School, Keyser.
Stout, Wilbur, Geological Survey, Columbus, Ohio.
†Straley, H. W., III, Stralehurst, Princeton.
†Strausbaugh, Perry D., Prof. Botany, W. V. U., Morgantown.
Sumpstine, Wilbur J., Prof. Biology, Bethany College, Bethany.
Talbott, S. Benton, Prof. Biology, Davis & Elkins College, Elkins.
†Taylor, Leland H., Prof. Zoology, W. V. U., Morgantown.
*Taylor, Mary Louise, Teacher, 1005 Quincy Street, Parkersburg.
Terrill, T. E., Prof. English, Bethany College, Bethany.
*Todd, Leslie J., Prof. Chemistry, Marshall College, Huntington.
*Toler, Jesse Lee, District Supervisor, Slab Fork Dist., Besoco.
*Tracy, C. H., District Forester, Box 617, Bluefield.
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†Turner, B. M., Prof. Mathematics, W. V. U., Morgantown.
Turner, John Roscoe, Pres. W. V. U., Morgantown.
†Utterback, W. I., Prof. Zoology, Marshall College, Huntington.
Vachon, Joe, Chemistry Teacher, High School, Athens.
Van Tromp, H. O., Physician, French Creek.
Vehse, C. H., Prof. Mathematics, W. V. U., Morgantown.
†Vest, Lewis, Dept, Mathematics, W. V. U., Morgantown.
*Walker, W. T., Teacher Mathematics, War.
Ward, J. B., Coal Prospector, Morgantown.
Weakley, Charles E., Jr., Chemist Agr. Exp. Sta., W. V. U., Morgantown.
†Weaver, J. B., Mono. West Penn, Clarksburg.
Webb, William G., 801 Nat'l City Bank Bldg., Los Angeles, California.
†Weimer, B. R., Prof. Biology, Bethany College, Bethany.
Weimer, Frederick G., 42 Heiskell St., Wheeling.
White, Frank S., Prof. Psychology and Education, Fairmont State Teachers College, Fairmont.
White, Ryland, Fairmont State Teachers College, Fairmont.
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*Williams, S. H., Prof. Zoology, University of Pittsburgh, Pittsburgh, Pa.

†Wilson, Dorothy, Prof. Mathematics, Potomac State School, Keyser.
†Wingerter, Charles A., Physician, Birch Lynn, Wheeling.
†Winter, John E., Prof. Psychology, W. V. U., Morgantown.
*Woddel, S., Science Teacher, Mullens High School, Mullens.
†Woods, Roy C., 1640 Sixth Avenue, Huntington.
*Yager, Eugene F., Teacher, Route No. 1, Bluefield.

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†Members of the American Association for the Advancement of Science.
*New members elected at the Athens meeting.

2. That Article IV of the Constitution be amended to read:

Fees. Each member shall pay in advance an annual fee of one dollar ($1.00) to the Treasurer of the Academy, due at each annual meeting; and in addition, each new member shall pay an initiation fee of one dollar ($1.00) due at the time of his election to membership.

3. That this Academy favor the presentation of a half day program of papers by the National Academy Conference at the next annual meeting of that body.

4. That this Academy favor the publication of its annual program in **Science** at the expense of the Academy.

5. That joint meetings with the academies of neighboring states does not seem advisable at present; but the Academy favors sending representatives to the neighboring state meetings.

6. The appointment of a Committee on Activities to investigate the activities of other academies and report their findings to the Executive Committee of this Academy.

7. That the Legislative Committee be made a standing committee.

8. That the following persons be elected to membership in the Academy:

(See list of members, page 6, for the seventy-three new names presented at this time).

Signed:

P. D. STRAUSBAUGH
CARL G. CAMPBELL
H. A. DAVIS
C. E. ALBERT
A. B. BROOKS

The report was adopted, except that the time of the next meeting was referred back to the Committee for investigation and discussion.

Maurice Brooks read the following report of the Committee on Junior Academies:

REPORT OF COMMITTEE ON FORMATION OF WEST VIRGINIA JUNIOR ACADEMY OF SCIENCE

To the Senior Academy:

Your committee on the formation of a Junior Academy of Science in West Virginia wishes to make the following report:

Pursuant to the action taken by the Senior Academy at the 1931 meeting, your chairman began to get in touch with high school teachers of science in the state, and found a definite interest in, and desire for, the organization of a Junior Academy, to be built largely on Science Clubs already in existence.

Miss Laura B. Moore, teacher of biology in Parkersburg High School, and Mr. H. C. Rohr, principal of Weston High School, consented to serve on the state committee on organization.

Letters were sent out to teachers of science and high school principals of the state outlining some of the plans and purposes of the organization. Copies of these letters are appended. A very good response to these letters was received.

The committee now wishes to offer the following specific recommendations:

1. That the Senior Academy authorize the immediate formation of a Junior Academy organization.

2. That each individual branch, located in a secondary school of the state, shall be affiliated with the Senior Academy.

3. That branches be placed in secondary schools only where an active membership and leadership can be assured. We recommend that local branch leaders should themselves be members of the Senior Academy.

4. That, as soon as practicable, the various branches of the Junior Academy hold an annual state meeting in connection with the meeting of the Senior Academy. Papers prepared by Junior members should form a part of the program of such meetings, and speakers on popular scientific subjects should be supplied from the Senior Academy.

5. From time to time outstanding work done by Junior members should be accorded a place on the sectional or general programs of the Senior Academy.

6. That an affiliation fee of two dollars ($2.00) be assessed each branch, said fee to be used for costs of postage, printing of programs, etc., and to be administered by the state committee hereinafter provided for.

7. That matters of local dues, assessments, etc., be left to the discretion of the local branches, with the understanding that such dues should, in no case exceed ten cents per month, per member.

8. That each branch endeavor to have at least one representative at every state meeting, with the suggestion that any dues collected be applied, in part at least, to meeting the expense of such delegate or delegates.

9. That some form of installation ceremony be prepared, such ceremony to include a scientific address by a member of the Senior Academy.

10. That the Senior Academy formulate and publish a list of volunteer speakers, drawn from its own ranks, who are located in the various parts of the state, and who will address meetings of local Junior Academies.

11. That the Senior Academy organize a bureau of its members, representing all the sciences, who will answer questions and give information requested by Junior Academy members. Names of those volunteering such information, with the field of their interests to be published and distributed to the branches of the Junior Academy.

12. That the scholarship fund of the Senior Academy, provided by the Academy at its 1930 meeting, and now accruing, be restricted to outstanding members who come up through the Junior Academies.

13. That every effort be made to make paramount the conservation of West Virginia's natural resources and beauties in the program of the Junior Academies.

14. That a permanent committee of three members from the Senior Academy shall be appointed at this meeting, charged with the organization, administration and helpful guidance of the Junior Academies. One of these members to hold office for three years, one for two years, and one for one year, the president of the Senior Academy to make the appointments for the current year, and to appoint one new member for 1933, and each succeeding year.

Respectfully submitted,
LAURA B. MOORE
H. C. ROHR
MAURICE BROOKS, Chairman

This report was referred to the Executive Committee for recommendation.

The following committees were appointed by President Strausbaugh:

Membership Committee	E. M. McNeill, Chairman H. F. Rogers Wallace Smith
Resolutions Committee	J. E. Judson, Chairman Jennie Harshbarger R. B. Purdum
Nominating Committee	W. W. Hodge, Chairman S. Benton Talbot R. J. Largent
Auditing Committee	Frank Cutright, Chairman Jno. A. Eiesland Frank A. Gilbert
Legislative Committee	Claude Maxwell, Chairman Jno. Palmer Phil Conley
Committee on Activities	Wallace Smith, Chairman J. E. Judson T. L. Harris

The President's Address, which appears in full elsewhere, was given, followed by the general program of papers.

The next general session convened at 8:30 a. m. April 30.

The report of the Committee on Junior Academies was accepted, following such recommendation by the Executive Committee.

It was moved, seconded, and passed that the general program be continued.

It was moved and passed that the Secretary be empowered to send out news letters; and that he be allowed a sum not to exceed one hundred dollars for expenses.

A. M. Reese spoke of the possibility of the Academy publishing Bibbee's "Check List of West Virginia Birds." It was moved and passed that the Executive Committee be directed to investigate the cost of publishing the Check List, and be empowered to act.

The retiring sectional chairmen reported attendance and new chairmen as follows:

Biology Section, Attendance 100. Nellie Ammons.
Chemistry Section, Attendance 20. L. K. Herndon.
Geology and Mining Section, Attendance 15. R. C. Tucker.
Mathematics and Physics Section, Attendance 16. H. A. Shutts.
Social Science Section, Attendance 32. I. F. Boughter.

Frank A. Gilbert read the following report of the Auditing Committee, which was accepted:

This is to certify that we, the Auditing Committee of the West Virginia Academy of Science have examined the accounts of the Treasurer, C. E. Albert, for the year, May 1, 1931, to April 1, 1932, and find them to be correct.

Signed:

FRANK CUTRIGHT, Chairman
JOHN A. EIESLAND
FRANK A. GILBERT

Athens, W. Va., April 29, 1932.

The following report of the Resolutions Committee was accepted:

The 1932 meeting of the West Virginia Academy of Science has been adjudged a decided success; hence it is most fitting that some recognition be given to all who have contributed to its success, Therefore, Be it resolved:

That we extend our thanks to President P. D. Strausbaugh and to the other officers and chairmen of the sections for the excellent program and for their work toward the advancement of science in our state;

That we extend our sincere thanks to President J. F. Marsh of Concord State Teachers' College and to the local committees for the part they have had in cintributing toward our comfort and entertainment;

That we are grateful to the management of the cafeteria staff for their part in contributing toward our comfort;

That we recommend the membership and Junior Academy committees for their outstanding work for the Academy.

Be it further resolved, that the Academy feels most keenly the severe loss it has sustained in the death of Dr. H. T. McKinney. Dr.

McKinney has been a member of the Academy since its organization and has worked, faithfully and willingly, for the advancement of the Academy. He has contributed papers for programs, has been a most valuable adviser, has served as an efficient treasurer for three years.

Signed:

J. E. JUDSON
R. B. PURDUM
JENNIE HARSHBARGER

The following report of the Committee on Nominations was given:

For President ..... Carl G. Campbell
For Vice-President ..... David B. Reger
For Secretary ..... H. A. Davis
For Treasurer ..... C. E. Albert
For Curator ..... John E. Winter

Signed:

W. W. HODGE
R. J. LARGENT
S. B. TALBOT

The persons nominated were elected.

President elect Campbell was called upon, after which the meeting adjourned.

H. A. DAVIS, Secretary.

PROGRAM FOR THE ATHENS MEETING

Friday, April 29, 1932.

9:00 A. M.—Greeting, President J. F. Marsh, Concord State College. Reply, P. D. Strausbaugh, President of the West Virginia Academy of Science.

Business of the Academy, Open Session:

Reports of Officers.
Report of Executive Committee.
Reports of Standing Committees.
Election of Members.
Appointment of Special Committees.
Other Business.

10:00 A. M.—President's Address: The Function of the West Virginia Academy of Science.

L. A. Rufener: Monopolies and Business Depression.

Paul R. Cutright: The Monuments of the Moundbuilders.

Carl G. Campbell: Three Major Activities of the State Academies of Science.

PAPERS

Meetings by Sections:

Biology

(Botany, Zoology, Physiology, Medicine, Agriculture)

J. E. JUDSON, Chairman.

Samuel H. Williams: The Animal Ecology of Presque Isle, Lake Erie. 15 min.

A. M. Reese: Life of West Virginia Caves. 10 min.

F. D. Fromme: Current Research in the Plant Sciences at the West Virginia Agricultural Experiment Station. 20 min.

Frank A. Gilbert: Some Additions to the Cryptogamic Flora of West Virginia. 10 min.

Ward M. Sharp: Pore Fungi of Monongalia County. 8 min.

Nellie Ammons: Bryophytes in McKinney's Cave. 5 min.

W. I. Utterback: New Glochidia. 10 min.

G. H. Bretnall: Is Man Homoithermal? 8 min.

Robert C. Patterson: Notes on Neotoma Pennsylvania with Special Reference to the Genital Organization. 10 min.

O. L. Haught: Notes on the Vegetation of Eastern Wetzel County, West Virginia. 10 min.

H. H. Collins: The Vermillion-spotted Newt as a Laboratory Animal. 10 min.

H. H. Collins: Organization and Content of a Course in Vertebrate Morphology. 10 min.

Robert T. Hance: Requirements for Graduate Degrees. 10 min.

Robert T. Hance: Speaking the Speech. 10 min.

J. E. Judson and J. E. Westfall: The Killing Power of Certain Modern Antiseptics. 8 min.

Chemistry

(Chemistry, Chemical Engineering, Pharmacy)

SAMUEL MORRIS, Chairman.

Carl G. Campbell: Developing Quantitative Technique by Analysis of Osage Orange.

Leslie J. Todd: Complex Ions in Inorganic Chemistry.

R. B. Purdum and H. A. Rutherford: The Solvent Effect of Raegents on Glass Bottles.

R. B. Purdum and H. A. Rutherford: The Solubilities of Sparingly Soluble Salts Using Large Volumes of Solvents.

L. Kermit Herndon: A Pollution Survey of the Elk River Basin.

A. C. Blackwell: A West Virginia Self-Glazing Clay.

Geology and Mining

(Geology, Archaeology, Coal and Oil Engineering, Road Commission, Building Material)

DAVID B. REGER, Chairman.

James H. C. Martens: The Mineralogy of the Sandstones of Northern West Virginia.

Dana Wells: The Examination of the Monongahela Clays for Characteristic Spores.
Paul H. Price, C. W. Furbee, and G. C. Bailey: Clay Dikes in the Redstone Coal.
H. M. Fridley: Drainage Divisions of the Upper Cheat Valley.
S. L. Galpin: An Unusual Structural Feature in the Bakerstown Coal.
William S. Downs: Highway Financing.
H. W. Straley III: Some Confused Terms in Fault Nomenclature.
Wm. C. Darrah: Some Paleontological Finds in the Conemaugh Formation.
Wm. C. Darrah: Paleozoic Cones and Seeds.

Mathematics and Physics

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

WALLACE SMITH, Chairman.

John A. Eiesland: A Certain Cremona Transformation in S_5. 20 min.
D. E. Phillips: The Why's and How's of Studying Mathematics. 20 min.
H. A. Davis: A Cremona Transformation Associated with a (1,3) Congruence. 15 min.
L. G. Raub: The Training of Science Teachers for High School. 20 min.
M. J. Kelly: Irregularities in the Moon's Motion. 20 min.
Dan H. Perdue: Teaching Science and Mathematics in the High Schools and Colleges. 25 min.
R. P. Hron: Gyroscopic Action and Some of Its Applications. 20 min.

Social Sciences

(Philosophy, Psychology, Education Economics, Sociology, History)

T. L. HARRIS, Chairman.

Roy C. Wood: Graduation Requirements in Hours and Quality Credits. 20 min.
C. C. Regier: An Immigrant Family of 1876. 20 min.
Calvert L. Estill: The Organization and Activities of the West Virginia State Department of Public Welfare. 15 min.
M. S. Cushman: Rise of the Pilsudski Dictatorship in Poland. 20 min.
Elizabeth M. Stalnaker: A study of Certain Phases of the Nursery School Child (With Motion Pictures). 25 min.
A. E. McGuire: Some Objectives in the Teaching of Economics and Sociology. 20 min.
Robert J. Largent: Attempted Reforms of the U. S. Civil Service, 1865-1881. 15 min.

(20)

R. Ray Scott. A Reinterpretation of the Stimulus-Response Concept. 20 min.
Jacob Saposnekow: The Independence of Sociology. 15 min.
W. F. Statts: Teaching Sixth Grade Youngsters How to Save Tax Payers' Money. 15 min.
Frank S. White: The Techniques for Making Case Studies in the Field of Character Education. 20 min.

R. D. Myers: Super Power in West Virginia. 15 min.
T. L. Harris: The Trend Toward Dictatorships and Greater Social Control. 15 min.

Evening Program

6:15 P. M.—Dinner, College Dining Room, $0.75. Tickets must be purchased at the time of registration to insure reservation.

8:15 P. M.—Address, Professor H. P. Robertson, Princeton University. The Expanding Universe.*

Saturday, April 30, 1932.

8:00 A. M.—Business Meeting:
Unfinished Business.
New Business.
Reports of Committees:
Auditing Committee.
Committee on Resolutions.
Committee on Nominations.
Election of Officers.

9:00 A. M.—Excursions, under the management of a local committee. A trip to New River of interest to geologists, a visit to the power plant at Glen Lyn, Va., and a trip of special interest to biologists to Brush Creek on Shawnee Lake are being arranged.

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*Published in full, Science, Sept. 9, 1932, Vol. 76, No. 1967, pp. 221-226.

CURRENT RESEARCH IN THE PLANT SCIENCES AT THE WEST VIRGINIA AGRICULTURAL EXPERIMENT STATION

By
F. D. FROMME,
Dean, College of Agriculture, West Virginia University.

The plant science research of the West Virginia Agricultural Experiment Station is conducted primarily through three departments, Agronomy and Genetics, Horticulture and Plant Pathology. Approximately 40 projects are now active, and the personnel includes 15 regular staff members and 9 graduate assistants and fellows. This would appear to be a fairly liberal allotment of man-power, but almost everyone divides time with instruction or extension work. In reality we have the equivalent of 8¾ full-time men for plant scientific research, and when we consider that they cover the fields of agronomy, bacteriology, genetics, horticulture, mycology, pathology, physiology and vegetable gardening it will be apparent that we are not over-staffed. Our staff is small compared with many other experiment stations but despite this handicap the output of research will compare favorably with any, save perhaps a few of the wealthier ones.

Cooperation has been an important factor in achieving this result. If each worker and each department were isolated we could not hope to realize either the volume or the quality of data that we now obtain. The history of early research is largely that of the solitary worker whose secrets were revealed to his fellows only when the problem had been completed. Modern research has few if any secrets. It enlists the team-work of the group and attempts to focus the services of correlated sciences toward the solution of the problem in hand. And so in our own work we have attempted and have largely succeeded in breaking down the barriers between departments and individuals. The project is the important thing and all possible agencies are enlisted in common cause to further it.

It will obviously be impossible for me to discuss each of our 40 projects in the plant science field. I shall not even list them by title, but will discuss briefly a few that may be considered representative of the program as a whole.

One of the major contributions of the Experiment Station in recent years is the discovery of the parasitic nature of apple measles. It has been one of the obscure diseases, first recognized and described in 1912, and the subject of considerable study by a number of workers. Our experience began in 1915 when the first occurrence was noted in West Virginia. It has culminated within the past two years in the successful isolation of a fungus from the pustules of the disease and the repeated proof that it is the causative factor.

Measles causes dwarfing and ultimate death of the host. It is especially virulent on the varieties, Red Astrachan, Maiden's Blush, Rome Beauty and Grimes Golden. Although distributed to some extent in practically all sections of the state, the most destructive case in our

experience has occurred in an orchard near Charleston. In 1915 the disease was observed in a few trees and by 1929, when the orchard was finally abandoned by the owners, practically all of the 16,000 trees were infected.

The successful outcome of this project is to be credited to Anthony Berg, associate plant pathologist. He obtained convincing evidence of the infectious character of the disease in 1929 and 1930 by exposing young trees to the drip of rainfall from infected trees. Having this circumstantial evidence he concentrated on the isolation of an organism and finally succeeded where he and others had previously failed. Berg has now observed the pathogen on natural lesions, has isolated it many times from both natural and induced lesions, and has established abundant proof that it is the causative agent in the production of the measles disease.

The fungus is a Hyphomycete, but its identity with any described genus has not been clearly established.

Satisfactory control measures remain to be developed, but our work can now be directed with an intelligence that could not obtain when complete knowledge of the cause was lacking.

Another important contribution in the field of plant pathology is the discovery and study by C. R. Orton and J. M. Ashcroft of black walnut canker. Although there is now abundant evidence that the disease is not new to West Virginia in the sense that it is of recent origin, it was new to science when Orton announced his discovery two years ago. Our studies to date indicate its occurrence in 29 counties of West Virginia, also Rhode Island, Pennsylvania, Virginia, Wisconsin and Ontario. The disease not only presents a problem of considerable scientific interest, but one of great practical significance to the timber owner and nut grower. Severely infected trees are worthless for timber purposes and because of the highly infectious nature of the disease are a menace to healthy trees. In some stands as many as 80 per cent of the trees are infected.

The cankers are quite typical in appearance due to the concentric, annual rings of callus tissue. The perithecia of a species of Nectria commonly occur on the bark and heartwood of the canker. The fungus grows readily on media and produces conidia in abundance. These have been used as inoculum in an extended series of trials and infection has resulted in nearly 90 per cent of inoculations. The induced lesions are typical of those found in nature and the fungus is readily recovered in culture.

Although the fungus grows readily in artificial media at an optimum temperature range of 18° to 24° centigrade all attempts to reproduce the perithecial stage have failed, save one. Only one of a considerable number of isolants or strains has formed perithecia.

The identity of the fungus with species of Nectria described from other hosts, is as yet uncertain due in part to the confusion of names in European literature. Studies now in progress will attempt to clarify nomenclature and to determine the possible relationship of the walnut canker with similar cankers on tulip poplar, the oaks, butternut and red maple.

Attempts to arrest the progress of the disease by the removal of

discolored wood have not been successful. Apparently the only likelihood of control lies in the complete removal of infected parts and this in many instances is synonymous with the eradication of the entire tree.

The department of Agronomy and Genetics, in addition to its rather extensive studies of agronomic science and practice which will not be discussed at this time, has for a number of years featured investigations in the field of plant genetics with particular emphasis on breeding for disease resistance. R. J. Garber and M. M. Hoover have been primarily responsible for the very satisfying progress that has been made. They have been assisted from time to time by other members of the staff.

Among the interesting results of a fundamental character are: (a) evidence that disease resistance is an expression of definite chromosomal factors which are linked with certain factors controlling morphological characters, and (b) evidence of transgressive segregation for susceptibility to disease, i. e. some of the segregates of a cross may be more susceptible than the most susceptible parent.

These principals have been established in connection with inbreeding studies with corn in relation to the smut disease, and also with hybridization studies with oat varieties in relation to oat smut.

The corn studies have included more than 100 strains derived originally through the selfing of 12 varieties. Through continual selfing each strain has become quite fixed with respect to morphology and disease resistance. The extreme range of variability exhibited by these strain sis most striking. Two strains from the same parent may be more unlike than any two of the the original varieties. The fixity of these strains respecting smut resistance and the complete immunity of some of them lends encouragement to the belief that ultimate solution of the smut problem may result. As is generally known, inbred strains of corn are inferior in yield. Our immune strains are no exception to the rule. None of them has sufficient vigor and yield to recommend it to the farmer even though it is free from smut. The immediate problem, therefore, is to reinvigorate these immune strains without loss of immunity. We are attempting this by resynthesis, that is we are attempting to mix a number of the better strains into a genetic complex which we hope will result in the vigorous, high-yielding, smut-resistant corn that we are seeking.

Self-fertilization in sweet clover has likewise produced a wide variation in types, many of which are quite unlike the parent type; so very unlike in fact that they are scarcely recognizable as sweet clover. The original objective of this study, which involves some 150 strains, was the search for a strain that would resist acid soil conditions and be low in cumarin content. This phase of the study is still active but it has been supplanted to a degree by the still greater promise of producing better types of plants for general farm purposes, especially as cover crops. Some of the new types are prostrate, others are taller than the original parents. One type which we call "box-wood" because it resembles the dwarf box is particularly striking and may have value due to the fineness of the stems and the abundance of leaves. Evidence to date indicates that these variations can be fixed and maintained through continued selfing, and if the problem of maintaining them under conditions of

open-pollination can be solved they should have considerable value in the agriculture of the State.

Other work in the breeding of watermelons for resistance to Fusarium wilt and in tobacco for resistance to root rot might also be cited.

One of our major problems in the field of horticulture lies in the study and possible improvement of root stocks for fruit trees. As yet we have little of tangible accomplishment to report except that material for such studies is being assembled and located in experimental plantings. Naturally one does not anticipate results from studies of this type within a year or two. The study is based on the theory, for which there is considerable experimental proof, that the stock has considerable to do with the growth, productivity and longevity of the scion. It is also readily apparent that different stocks may exhibit striking differences in tolerance to low temperatures, drought, physical and chemical characteristics of soils, and the attacks of root parasites. Because of the variation that exists in seedlings, particular attention is given to clonal stocks but the possibility of improvement in seedling material is not overlooked.

Considerable popular interest has been attached to trials of paper mulches for vegetable crops conducted during several seasons by K. C. Westover and others in the department of horticulture. This interest has been stimulated by the claims of paper manufacturers and the quite natural inclination of gardeners to grow more with less effort. Our results indicate that considerable increases are obtained with certain crops grown under mulch paper, notably tomatoes, egg-plants and peppers, on certain soil types, while on other soils little or no increases are obtained. Seasonal conditions also influence the character of the responses. Mulch paper has given marked increases on a clay-loam soil and no consistent increases on a sandy soil. These soils differ markedly in their moisture-holding-capacity. The effect of the mulch, as measured by moisture determinations at plow depth, has been to conserve moisture supply in the heavy soil. It has had no effect on moisture content in the sandy soil. A further effect of the mulch, as shown by definite measurements, has been to increase soil temperature. Determinations of nitrates and soil acidity have shown no consistent differences.

The fact that apple trees are unable to use nitrogen in the form of ammonia until it has been converted into nitrates explains certain results obtained by H. E. Knowlton in his studies of orchard fertilization. When sodium nitrate and ammonium sulfate are applied at blooming time the former has much greater value in stimulating fruit production. If, however, the applications are made two or three weeks before bloom they are equal in value. In the case of ammonium sulfate the early application provides sufficient time for conversion into nitrates which are then available for the use of the tree at the time of greatest need. Having this definite understanding the orchardist may substitute ammonium sulfate for sodium nitrate since on the basis of nitrogen units the cost is only half as much as the latter. Continued use of ammonium sulfate may result in an acid soil reaction unfavorable to the growth of cover crops and necessitating the use of lime to restore neutrality.

LIFE OF WEST VIRGINIA CAVES

(Preliminary report)

By
ALBERT M. REESE
Professor of Zoology, West Virgina University.

In the limestone regions of West Virginia are many caves, some of them of very considerable size.

Up to the time of this report, nineteen of these caves have been at least partially explored in search for the animals they may contain.

The caves so far examined lie in the following counties: Monongalia, Preston, Jefferson, Randolph, Pocahontas, Greenbrier and Monroe.

The most common animals so far found are several species of bats; two or three species of salamanders; one species of fish; and several species of insects, arachnids and myriapods.

No blind fish have yet been found.

It is planned to continue this work, at least duing the summer and fall of 1932, by aid of a grant for this purpose from the American Association for the Advancement of Science.

ADDITIONS TO THE CRYPTOGAMIC FLORA OF WEST VIRGINIA*

By

FRANK A. GILBERT,

Professor of Botany, Marshall College.

Since the publication of the Millspaugh check list in 1913[1], few additions have been made to the cryptogamic flora of West Virginia, although in 1930, the list of spermatophytes was considerably augmented through the efforts of the Botany Department of West Virginia University.[2] Cryptogams, especially the smaller forms, are naturally more difficult to classify than Phanerogams, not only because most of their points of identification are based on microscopic characteristics but also because the monographs of the various families and genera are scattered through the literature and many are available only at the larger institutions. Indeed, some genera and even families yet await a monographer. At best a collector can be familiar with only a few groups, have a working knowledge of a number of others, and must send the rest to various specialists. All this naturally dampens the ardor of the amateur and although there are a number of mycological clubs scattered throughout the country, their membership is very limited.

During the past few years the writer has sporadically, because of pressure of other interests, collected fungi as he came across them in the field, and after their identification, added them to his herbarium, although it is his intention to place them permanently in a Marshall College herbarium when conditions allow the maintenance of such an important adjunct to botanical teaching and research. Practically all of the fungi are common, but a perusal of the 1913 check list shows that so far as can be found out, many have not yet been reported as being found within the borders of the state. It is the purpose of this paper therefore to make a slight contribution to the state's cryptogamic flora as yet so little known. A great deal of thanks is extended to Professor L. O. Overholts of Pennsylvania State College for his identification of Polyporus fissilis. The following list includes, by families, only the species which so far as is known have never before been collected in the state, and omits the many species new to Cabell county but reported by Millspaugh as being collected in other parts of the state.

AGARICACEÆ

Amanita cothurnata Atk. Cabell co. near Huntington, 24, July, 1930.

Coprinus atramentarius Fr. manured flower bed, Huntington, Cabell Co. 30, Sept., 1929.

Coprinus comatus Fr. Cabell Co., near Huntington, 23, Sept. 1930.

Mycena leajana Berk. Cabell Co., near Huntington, 2, Oct., 1931.

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*Contribution No. 3 from the Botany Department of Marshall College.

[1]Millspaugh, C. E. The Living Flora of West Virginia, West Virginia Geological Survey, Wheeling 1913.

[2]Strausbaugh & Core. Some Additions to the Millspaugh Check List of West Virginia Spermatophytes. Pro. W. Va. Acad. Sci., 4: 38-48, Oct. 1930.

Pleurotus ostreatus Fr. Wayne Co. near Buffalo Creek, 9, Oct., 1931. Coll. Drexell Plymale.

Russula foetens Fr. Cabell Co. near Huntington, 2, Oct. 1931.

Panus rudis Fr. On fallen Beech, Cabell Co. near Huntington, 1, Oct., 1931.

Psalliota (Agaricus) haemorrhodaria Fr. Marshall College Campus, Huntington, Cabell Co., 20, Oct., 1931.

BOLETACEÆ

Boletus felleus Bull. Cabell Co., near Huntington, 6, Sept., 1931.

Boletus ornatipes Pk. Cabell Co., near Huntington, 15, July, 1931.

Boletinus porosus (Berk) Peck. Buffalo Creek, Wayne Co., 2, Oct., 1931. Coll. Drexell Playmale.

POLYPORACEÆ

Fomes Everhartii Ellis & Gall. On fallen Oak, Wayne Co. near Ceredo, 24, Oct., 1931.

Polyporus picipes Fr. On fallen Beech, Cabell Co. near Huntington, 4, Nov., 1931.

Polyporus hirsutulus Schw. Cabell near Huntington, 7, Jan., 1932.

Polyporus fissilis. B. & C. Cabell Co., near Huntington, Nov. 1931.

LYCOPERDACEÆ

Geaster velutinus Morg. Mason Co., near Mercer's bottom. 25, Sept., 1931. Coll. Robert Campbell.

Geaster rufescens Pers. Cabell Co., near Huntington, 5, Sept., 1930.

NIDULARIACEÆ

Cyathus vernicosus DeC. On sawdust, Cabell Co., near Huntington. 24, July, 1931.

Cyathus striatus Willd. Nicholas Co., near Gauley River, 18, Oct., 1931. Coll. Robert Campbell.

THE POLYPORACEÆ OF MONONGALIA COUNTY, WEST VIRGINIA

By
WARD M. SHARP,
Instructor in Botany, West Virginia University.

The object of this paper is to give a preliminary list of the Polyporaceæ (commonly called the pore fungi) known to occur in Monongalia County, West Virginia. This group of fungi is a relatively small family of the Basidiomycetes, characterized by having the pores borne on the inner surfaces of the tubes or lamella which make up the hymenium of the fungus. The Boletaceæ, a family very closely related to the "pore fungi" are not included in this paper. The Boletaceæ are separated from the Polyporaceæ by the more fleshy sporophores, and by the fact that the spores separate rather easily from the flesh of the pileus in a smooth layer. The sporophores of the Polyporaceæ are woody, leathery, corky or sometimes of a spongy, succulent texture when fresh.

The Polyporaceæ are saprophytes, semiparasites, and a few may be classed as true parasites. These fungi depend entirely upon wood for their supply of food; the wood may be that of either dead or living plants according to the particular fungus involved. From the economic standpoint, we are interested most in the timber and the tree-decaying forms. The parasitic forms enter the tissues of trees through wounds inflicted by man, birds, insects, wind, or other external agencies. Brown and white rots are the types generally caused by these fungi. Those species that cause the brown rot, are said to do so, by destroying the cellulose of the xylem, thus leaving the lignin. On the other hand, the species that cause the white rot are supposed to destroy the lignin, and leave the cellulose which then gives rise to the white or whitish appearance.

It is not the purpose of this brief paper to present a complete list of all the species occurring within the county, but rather to report those Polyporaceæ that have been collected repeatedly by the author during the years 1930-32. -Similar collections may be observed in the herbarium of the Department of Plant Pathology at West Virginia University Most of these collections were made by Dr. C R. Orton and other members of the staff of this department.

At present the only monographic work available for the accurate indentification of species of Polyporaceæ occurring in our region is "Overholt's Polyporaceæ of Ohio." This manual has been followed in making the preliminary determinations of the species studied, and all of the identifications have been checked by Dr. L. O. Overholts, the author of this monograph.

In Monongalia County, the Polyporaceæ are represented by six genera. The most common of these are Polyporus, Daedalea, and Fomes; the remaining genera Lenzites, Favalus, and Poria are less common. The genus Poria is quite difficult since it differs from Polyporus chiefly in its resupinate habit of growth; however, Polyporus is also often resupinate in the earlier stages of development.

A LIST OF THE SPECIES OF THE POLYPORACEÆ

(Scientific name)	(Host)	(Frequency)
Daedalea confragosa Bolt	Common on living Salix, Betula and other deciduous trees	Common
Daedalea quercina L.	Found on dead wood of **Quercus** (the oaks)	Frequent
Daedalea unicolor Bull.	Found on dead deciduous trees	Uncommon
Favolus canadensis Klotzsch.	Frequent on dead branches of Fagus; however occurs on other deciduous trees	Uncommon
Fomes appalantus Pers.	Living on deciduous trees of various genera	Common
Fomes connatus Weinm.	At bases of living deciduous trees	Uncommon
Fomes fraxinophilus Peck	Only on living Fraxinus	Uncommon
Fromes lobatus Schw.	On living **Quercus velutina**	Rare
Fomes rimosus Berk.	On living Robinia	Common
Lenzites betulina L.	On Quercus and similar genera	Common
Polyporus adustus Willd.	On dead wood of deciduous trees	Uncommon
Polyporus arcularis Bolsch.	On logs of Betula and other deciduous trees	Uncommon
Polyporus biformis Klotsch.	On dead deciduous trees	Common
Polyporus brumalis Pers.	On dead deciduous trees	Frequent
Polyporus chioneus Fries.	On dead deciduous trees	Frequent
Polyporus cinnabarinus Jacq.	On dead wood of Quercus and other genera	Frequent
Polyporus cristatus (Pers.) Fr.	On dead deciduous trees	Uncommon
Polyporus cuticularis Bull.	On dead or living Fagus	Frequent
Polyporus dichorous Fries.	On dead deciduous trees	Frequent
Polyporus dryodeus Pers.	On living Quercus	Uncommon
Polyporus galactinus Berk.	On dead deciduous trees	Uncommon
Polyporus giluus Schw.	On dead deciduous trees	Common
Polyporus hispidus Bull.	On living Quercus prunus	Frequent
Polyporus hirsutus Wulfen.	On dead wood of deciduous trees	Common
Polyporus lucidus Leyss.	On dead wood of deciduous trees	Uncommon

Polyporus nidulans Fries.	On dead wood of Betula	Uncommon
Polyporus pargamenus Fries.	On dead wood of Quercus or Castanea	Common
Polyporus pecepes Fries.	On dead wood of deciduous trees	Frequent
Polyporus pubescens Schum.	On dead deciduous trees	Uncommon
Polyporus resinosus Schrad.	On dead deciduous trees	Frequent
Polyporus sulphureus Bull.	On dead or living deciduous trees	Very common
Polyporus versicolor L.	On dead wood of deciduous trees	Very common
Poria ferruginosa.	On dead wood of deciduous trees	Uncommon
Poria tsugina Murr.	On dead wood of **Tsuga**	Uncommon

NEW GLOCHIDIA

By
W. I. UTTERBACK,
Professor of Zoology, Marshall College.

While employed some years ago as a Scientific Investigator under the U. S. Bureau of Fisheries I worked on the problem of the Breeding Record for the Freshwater Mussels (Nāiades). From this investigation a long report was made to the government and afterward a published record was made.[1] It was during this period of research under the government and also as a graduate student in the University of Missouri that I had the pleasure of discovering a few larvae,—technically known as GLOCHIDIA,—of the Nāiades.

Before taking up the description and illustration of these new Glochidia allow me to present an account of the reproductive characters among this interesting group of mollusks, the Freshwater Mussels, a descriptive and illustrated catalogue of which I had produced as a graduate thesis some years ago.[2]

In the first place I would define the Glochidium of the mussel as its larva, or post-embryo, which, like the mature form, is provided with two shells, or valves, but, unlike the adult, is parasitic on fish-hosts,—and occasionally on salamanders,—until the independent life of the juvenile is reached. The origin of the name, "Glochidium," is interesting in the fact that, when this larva was discovered encysted on the gill arches of a fish many years ago by a research worker, it was thought to be a distinct species of mollusk at that time and was given the name of "Glochidium parasiticum." The name, "Glochidium," however, was retained after it was found that this parasite was only a phase, or so-called generation, in the metagenesis of the mussel's ontogeny, just as the caterpillar is only a phase in the complete metamorphosis of an insect's life history.

In the attempts of fish-hosts to consume as food the glochidial masses discharged by gravid mussels the snapping valves of the glochidia fasten upon the gill arches,—and even the fins,—where they become encysted for about six weeks or two months when they drop off as juveniles, usually about the size of a wheat kernel, and then develop byssal threads which aid them in clinging to sticks and stones and thus avoiding rough handling of the water currents.

Recent research work among the Naiades has definitely solved the problem of parasitism among a few species,—notably that of Utterbackia ohiensis and Strophitus edentulus,—in that they are no longer to be considered non-parasitic and thus all species of this molluscan group are, without exception, parasitic in the glochidial life.[3] The chief purpose of parasitism, as a matter of survival among this group of mollusks,

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[1]"Breeding Record of Missouri Mussels," (The Nautilus, Vol. XXX, No. 2, June, 1916).

[2]"The Naiades of Missouri," (American Midland Naturalist, Vol. IV, Nos. 1-10, with plates I-XXIX, 1916b).

[3]Tucker, "On Normal Development of the Glochidium on Fish-Host for **Utterbackia ohiensis,**" (Transactions of the American Microscopic Society, Vol. XLVI, p. 286, 1927).

is more concerning geographic distribution than that of nutrition since the independent life of any Naiad species is not capable of any extensive locomotion. Thus active fish-hosts bear their unwelcome guests for many miles,—especially during the spawning season,—over barriers which the sluggish mussel could not overcome.

Different kinds of fish are attracted to the different kinds of egg masses discharged by mussels. These masses are borne in the gills of of the female mussel and as they are usually conglutinated in the gill chambers adapted as brood pouches, or marsupia, they are discharged in the glochidial stage as separate club-like masses known as conglutinates, or placentulæ. Thus you may note that as soon as the fertilization of the ova takes place,—which is supposed to be at the time of the ovulation from the ovaries into the marsupia,—then the cleavage, blastula and gastrula stages are developed in the marsupia. Under normal conditions the late embryos,—that is, the Glochidia,—will be discharged out through the dorsal openings of the marsupia of the lower forms of mussels and out through the ventral edges by actual ruptures from the brood pouches of the higher forms. The conglutinates, then, appear in such forms as they may be moulded by the peculiar shapes of the marsupial chambers.

It is interesting to note that the periods of gravidity for the Naiades are different for the lower and higher forms. The primitive mussels, for the most part, have **short** periods of breeding and are said to be **Summer Breeders,** or **tachytictic** forms, and the more modern types have **long** periods of breeding and are known as the **Winter Breeders,** or **bradytictic** forms. On account of the greater accessibility of mussel beds during the summer months workers have been enabled to secure more data concerning the Summer Breeders and thus have solved most problems relating to the tachytictic forms. It was my determination, when I took up the breeding phase of the Freshwater Mussel Studies, to make more intensive studies of the breeding habits during the winter months. In so doing I was rewarded with some discoveries after four winters of aggressive field work when the rigorous winter weather conditions made the research difficult and dangerous. Thus the eight new glochidia mentioned in this report are mostly those of winter, or long period, breeding types.

It is also interesting to observe that each of the three major groups of Naiades have different provisions for their marsupia as per following:—

1.—Lower Group, (Unioninae),—all four gills marsupial.
2.—Middle Group, (Anodontinae),—only outer gills marsupial.
3.—Higher Group, **(Lampsilinae),**—only posterior part of outer gill marsupial, but with greater advantage for aeration of embryos and thus one of the best bases for the highest classification since no agency contributes so much to survival as this adaptation of reducing mortality.

In general all Glochidia may be grouped under the following characterization:—

1.—**Anodonta** types, the non-conglutinated Glochidia, triangle-form spined at ventral edges.

2.—**Proptera** types, the conglutinated Glochidia, ax-head forms, spined or spineless.

3.—**Unio-Lampsilis** types, conglutinated Glochidia, apron-forms, spineless.

In an atavistic way, the last named glochidial group represents both primitive and modern forms of mussels and hence includes most of the **Naiades,**—especially the fluviatile forms. The **Proptera** forms of Glochidia are only modifications of the **Unio-Lampsilis** types and are only found in one genus of mussels. The **Anodonta** types are **also few in numbers** and are mostly represented in the lacustrine species of **Naiades;** however, these forms are well provided for survival in possessing roughened tooth-like spines at the ventral edges of their unusually largs valves so they are specially adapted to hook on the gill arches of feeding fish and also they have a greater advantage than the spineless forms in encysting on the caudal and lateral fins of passing fish. While this spineless character of these intermediate to modern types may mean some disadvantage yet the mortality of the late embryos is cut down by those compensatory organs, such as tentacles, mantle flaps, etc., situated on the post-ventral mantle edge for the purpose of furnishing a richer supply of oxygen through the thin distended walls of the marsupia gravid with early and late embryos.

The following are the **eight Glochidia,** which have been my good fortune to **bring to light,** as representing five species and three sub-species arranged in the taxonomic sequence of the parent forms:—

1.—**Amblema perplicata Quintardii,** (Cragin); common and trade name, "Blue-Point," "Multiplicate."
—The new Glochidium of this parent sub-species is of the **Unio-Lampsilis** type, is of medium size measuring .205 mm. in length, (i. e., from the greater convexity of the anterior end to that of the posterior), and .215 mm. in width, (i. e., from the hinge line to the extreme ventral edge), is suboval in general outline, spineless on the ventral margin and has a straight hinge line. Except for size the larva of this sub-species is much like that of its species, **Amblema perplicata** (Conrad).

2.—**Rotundaria tuberculata,** (Rafinesque); common name, "Purple Warty Back."
—This newly discovered Glochidium of this species is of the Unio-Lampsilis type, is rather large measuring .267 mm. in length by .325 mm. in width, is subelliptic in general outline, is spineless, and has a straight hinge line. From the accompanying illustration (Fig. A-[a—c]) it will be noted that the hinge line is very short while the ventral margin is rounded.

3.—**Pleurobema obliquum solidum,** (Lea); common name, "Solid Pigtoe"
—The Glochidium of this sub-species is also of the Unio-Lampsilis type, is rather small measuring .170 mm. by .180 mm., is sub-oval in outline, spineless, and has a straight hinge line.

4.—**Uniomerus tetralasma,** (Say); common name, "Pond Horn Shell"
—The Glochidium of this species is of the Unio-Lampsilis type, is rather small measuring .160 mm. by .210 mm., is subelliptic in

general outline, spineless, and has a straight hinge line. Note in Fig. B-(a—c) the few modifications of the general form shown in Fig. A-(a—c).

5.—**Utterbackia**[4] **suborbiculata,** (Say); common name, "Suborb," 'Heel-Splitter"

—This new Glochidium is of the **Anodonta** type, and is unusually large measuring .325 mm. by 320 mm. and being easily seen with the naked eye, is subtriangular in general outline, spined, and with hinge slightly undulated. Its beautiful golden color makes it an attractive form to study. The camera lucida sketch, Fig. C-(a—c), shows its special characters of peculiar shape, size and presence of a serrated spine recurved on the ventral tip of each valve with a byssus protruding between the two spines in the center.

6.—**Carunculina parva,** (Barnes); common name, "Liliput Shell"

—This Glochidium is of the **Unio-Lampsilis** type, measures .175 mm. by .220 mm., is semi-circular in general outline, spineless, and hinge line evenly curved. Although the shell of the adult is among the tiniest of the **Naiades** its Glochidium, as you may note, is of medium size.

7.—**Eurynia brevicula Brittsii,** (Simpson); common name, "Britts' Shell"

—This Glochidium is one of the **Unio-Lampsilis** type, measures .25 mm. by .305 mm., is semi-elliptic in outline, spineless, and hinge line undulated. This is another very small shelled form for the adult, but with a moderately large Glochidium.

8.—**Eurynia (Micromya) brevicula** (Call); common name, "Broken Rays," "Soul-Of-Wit"

—This Glochidium is of the **Unio-Lampsilis** type, measures .215 mm. by .270 mm., is subelliptic, spineless, and straight hinge line. Since the publication of my illustrated and descriptive catalogue of the Missouri mussels I discovered this glochidium while making a government survey of the White River for the benefit of the Pearl Button Industry. In my mussel surveys in West Virginia I have been able to verify many findings of other workers among the Naiades, especially those pertaining to the Glochidia concerning which there is much yet to be discovered.

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[4]Proceedings of the West Virginia Academy of Science, Vol. IV, pp. 66-69.—Paper entitled "A New Genus of Freshwater Mussels," Illustrated, (Fig's. 1-3).

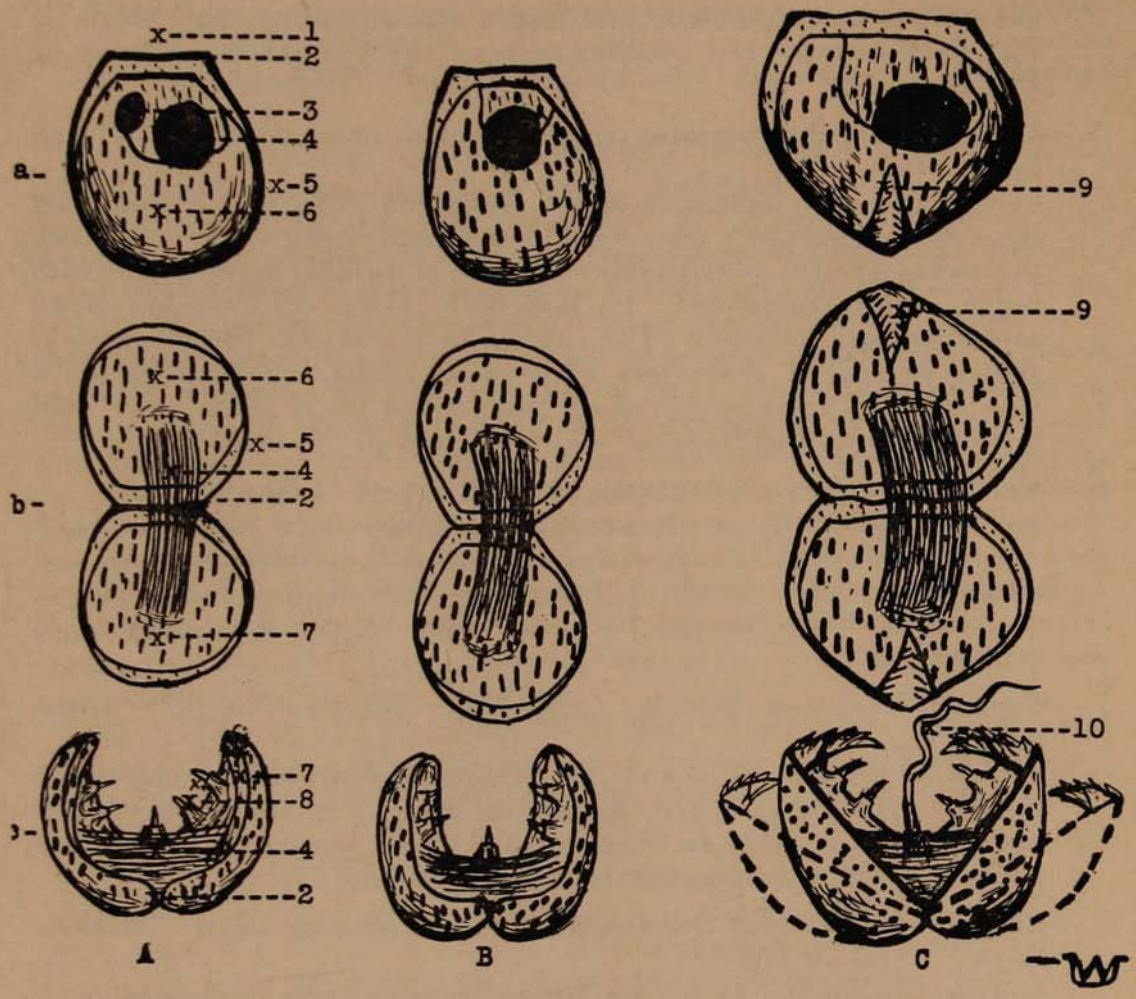

Figure A (a—c),—Glochidium of **Rotundaria tuberculata,** (Rafinesque); figure B (a—c),—**Uniomerus tetralasma,** (Say); figure C (a—c),—**Utterbackia suborbiculata,** (Say).

a,—closed Glochidium showing right valve; b,—active open Glochidium from a ventral view; c,—active open Glochidium from the anterior view.—1, dorsal view; 2, hinge line; 3, pericardium; 4, adductor muscle; 5, anterior end; 6, right valve; 7, left valve; 8, seta; 9, coarse tooth-like spine; 10, byssus, controlling organ in parasitizing fish.

The coarse stippling indicates the thin limy shell. The dotted outlines of Fig. C—c show the valves open to the fullest extent. All figures are projection drawings through use of the camera lucida, (X87), thus giving proper proportion from this low power magnification.

IS MAN HOMOIOTHERMAL?

By
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Great changes are found in the temperatures of the lower mammals with changing environmental temperatures and also during hibernation. Man shows extreme changes of body temperature under pathological conditions but even under normal conditions large changes occur. With normal subjects under high temperatures our experiments show great changes in body temperatures. These running as high as 104 degrees Fahrenheit. With lower temperatures we have found decided changes in body temperatures from cool mornings to warm afternoons. A daily variation was also seen when the body temperatures were taken daily for a month.

NOTES ON NEOTOMA PENNSYLVANICA WITH SPECIAL REFERENCE TO THE GENITAL ORGANIZATION

By
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The small fur bearing animals of West Virginia seem to invite the study of those interested in mammalogy and finding a particularly interesting animal in Neotoma pennsylvanica while a member of the West Virginia University Biological Expedition in the summer of 1931, I decided to investigate its habits.

The expedition was camping on Hermit Island in the famous Smoke Hole country of Pendleton County and while stationed there I had the opportunity to explore the Smoke Hole Cave in company of Dr. W. J. Hamilton, Jr., of Cornell University and others. Along the ledges of rock about ten feet from the floor of the cave we noticed a few nests of some animals which were supposed to be Neotoma. We decided to trap for them and met with success taking three large female animals which will be mentioned more fully later in this paper.

In October 1931 I decided to investigate the breeding habits of these animals and wrote to Mr. A. W. Alt of the Smoke Hole to enlist his aid in trapping these creatures. I wanted them alive if possible, but they proved to be wary of Mr. Alt's attempts to lure them with varied bait into the wire cage traps. He did succeed in catching two; Nos. 4 and 5 in steel traps, later in the year.

In the meantime I got in touch with the Pell brothers of near Masonown, Preston County, West Virginia, and they shot six rats in the Cornwall Cave on Cheat River (Preston County), Nos. 1, 2, 3, 6, 7 and 8.

I had the extreme good fortune of trapping one alive near Dellslow on State Route No. 7 in February, Number 9 of my series. This animal was taken at the mouth of a small cave in a wire trap set over night, baited with apple and potato. Many subsequent attempts to trap animals in this vicinity have proved fruitless.

Since the animals except the last one were dead when received here in the laboratory, I was forced to approach my problem somewhat from the histological angle. With the small amount of material at hand and the limited time represented, I realize that it is almost impossible to draw any conclusions of value, it is my desire to continue this work to such a point that I can offer the complete story of this animal's habits and life history.

David Starr Jordan (1929) gives the following classification for this animal: Neotoma pennsylvanica, a member of the order Glires, the rodents, and of the family Muridae, the mice, is generally differentiated from the round, baretailed rats and mice by its hairy tail, which in this species is by-colored and quite long.

Say and Ord in 1825 published a diagnosis of Neotoma from the peculiar dental character of the species using as type Mus floridans, an

eastern Florida resident, and described by Ord and published in the bulletin of the Philomatique Society of Paris in December 1818.

Neotoma has a terete tail, not bushy. The maxillary tooth row is narrower posteriorly than anteriorly. The middle lobe of the last upper molar is not divided by inner reentrant angle. (Howell, after Goldman).

Goldman makes Neotoma a subgeneric name and recognizes separate groups of 26 species and 35 subspecies. There have been 97 forms of Neotoma described.

Neotoma build nests of wood fibres which are seemingly added to from generation to generation (English 1923). In the caves of Pendleton County, Eagle Rock Cave and Smoke Hole Cave, the writer saw several of these nests in good repair altho unoccupied at the time. Several attempts were made to photograph these nests but failed. They were built for the most part on elevated ledges or shelves of rock as high as twelve feet from the floor proper, and in two cases in locations which looked to be inaccessible to these creatures. It is known that these animals have well developed powers of climbing, some forms are quite at home in the trees. I have seen Rhododendron twigs cut five feet from the ground, which cutting looked like the work of these animals. The size of the nests varies from those measuring approximately 35 cm. in diameter to the larger ones of near 60 cm. The nests seem to have been made from the fibres of conifers for the most part.

In the vicinity of Dellslow a sheltered shelf of rock offered quite a collection of cuttings chief of which were:

1. Aspidium marginale—Marginal shield fern.
2. Polystichum acrostichoides—Christmas fern.
3. Rhododendron maximum, twigs and leaves.
4. Tsuga canadensis, twigs and cones—Hemlock.

Most of this material was folded in pieces measuring generally 10 cm. The whole being so intertwined that it is quite a task to unravel it.

The female rat in captivity shows a marked fondness for English walnuts, black walnuts, pecans, raw peanuts, hard corn, and seedless raisins. The chief items of diet are apples which it preferred cut into manageable pieces. It also ate the leaves of Rhododendron and gnawed the bark of the twigs of this plant. It ate very sparingly of cabbage leaves and lettuce and would not touch onions. When a piece of onion was dropped into its nest, it would pick it up and drop it outside the nest immediately. The rat showed a considerable liking for Irish potatoes. These last two items are at variance with the findings of Newcombe (1929). The rat consumes between two hundred and two hundred and fifty c. c. of water each forty-eigh hours or twice the amount used by Newcombe's rats.

The rat shows no marked inclination to form a nest by placing the excelsior supplied in any particular arrangement but by turning around in a corner of the mass finally wears a hole in it which places the excelsior around the sides in a cup shaped nest with the wire floor of the cage exposed in the bottom.

When given raw peanuts in quantities the rat would take them from the fingers through the wire mesh of the cage and hold them in its mouth until it had accumulated as high as eight medium sized ker-

nels at a time. When the mouth was full it would scurry away to some part of the excelsior and hide the nuts in the edge of the nest and return for more. No such attempt to store food such as apple or potato was noticed at any time.

The rat showed marked signs of nervousness when first taken. These symptoms were manifest in striking or drumming on the bottom of the cage with its hind feet. It was shy but later would take pieces of apple or nuts from the fingers as has been mentioned. In the three months this animal has been under observation, I have never seen it drink water or void waste. The fecal waste was habitually deposited in the water container and usually there would be leaves of Rhododendron and pieces of excelsior in the water.

In an attempt to secure some method of determining the probable number of these animals in a given locality I followed the suggestion of other workers and made a count of the fecal pellets. The number per twenty-four hours varied from three to eighty-four over a period of three weeks with an average of about fifty. The inconsistence of this method due to the wide difference of numbers makes it seem almost useless in determining the number. The animals' deposits of waste as seen in the caves visited and in their haunts around cliffs indicates that they have regular locations for these deposits. The Pack rat of the western United States, Neotoma albigula albigula, is said to deposit its waste without regard to regular habits as to place.

The first time the animal was taken from the cage for an examination it micturated, the fluid being a yellowish color and about the consistency of pus. Slides were made and stained with Wright's stain for leucocytes, but none were found. A Gram's stain was made for bacteria yielding negative results as the stain crystalized. Second attempts to collect urine failed.

The animal is very active in captivity and is quite interesting to observe. The attitudes it assumes are interesting. It eats sitting on its hind feet and holding the food in its fore feet after the manner of the squirrel, an animal which it resembles somewhat in appearance.

They are known by many names in this vicinity, but to most people they are just rats. They are referred to variously as:

Cliff rats
Wood rats
Allegheny Cliff Rats
Allegheny Wood Rats
Cave rats, and
Pack rats

The term "rat" seems to be an unfortunate one since the connotation is bad. There is no evidence that these animals are of negative importance and they are certainly interesting, lively little creatures.

Very few people are acquainted with them as they are nocturnal in habits and spend the daylight hours in rock crevices or in the caves. They are not at all plentiful as is indicated by the difficulty in trapping them. They seem to live in colonies.

They will bite if cornered, but do not seem to put much power in it. I have always worn light leather gloves in handling them, and have

never felt more than a pinch from their bite. It is not doubted that they could puncture the skin of the bare hand if the opportunity presented. The incisor teeth are sharp and long, the masseter muscles well developed.

The testicles of the Neotoma pennsylvanica are partly abdominal. More abdominal during periods of sexual quiescence than when active. In animal No. 1 taken in December the testicles were small, polar length 11 m.m., diameter 7 m. m. In animals taken in February 8 and 25, which were sexually active, the average of three specimens was 18.5 mm. polar and 11mm. in diameter. The scrotal sac is shallow and encloses approximately the caudal third of the testicle and the cauda epididymis. The testicle is marked by the testicular vessels on its surface. Sections thru the testicles of the animal taken in December show some sperm in the tubules and epiddymis, but compared with sections of males taken in February the number of these sperms is very small.

From the anterior end of the testicle the greatly coiled epididymis emerges and forms, pendant from the caudal pole, a mass which lies wholly within the scrotal sac. From this cauda epididymis arises the vas deferens accompanied by the spermatic vessels and passes anteriorly as the spermatic cord through the inguinal canal. The vas deferens then passes above and over the ureter and enters the urethra laterally just anterior to the prostrate gland.

The spermatic arteries arise opposite each other from the dorsal aorta caudal to the renal arteries. The spermatic vein on the left side joins the left renal vein while the right spermatic vein joins the abdominal vena cave at a point near the origin of the spermatic artery of the corresponding side.

The penis presents two sharp angles one approximately about 5 m. m. from its origin, another 12 m. m. from the first. The first angle is directed anteriorly and the second distally. The glands is somewhat blunt tapering back into the body of the penis in which is situated a pointed os penis. The prepuce is practically devoid of hair except on the extreme end where a few hairs persist.

A well defined prostrate is present and Cowper's glands lie caudal to the isvhio-cavernosus muscle and crus of the corpus cavernosum and dorsal to the bulb of the corpus spongiosum. Around the neck of the bladder and anterior to it is a spongy tissue the coagulating glands which are well developed in the sexually active animal and almost wanting in the inactive state.

The superior poles of the testicles are capped with large flat bodies of fat. Howell says these seem to be glandular in structure and possible in action as well. I find in sectioning this body that there is some glandular arrangement to be seen. The fat seems to be proportionately large in the inactive animal as compared with the sexually active ones. As these animals are collected early in their breeding season the size of these fatty areas may not be indicative. Later in the breeding season there may be a distinct decrease of this material.

The ovaries of the specimens studied were small and well covered by fat and the folds of the oviduct. The left ovary was in all cases more

anterior than the right one. The oviducts are much coiled and occupy a small space between the ovary and the uterine horn.

The uterus is bi cornus the two horns converge in a broad and definite "U" shape. The horns are supported by the broad ligament whose most anterior attachment is opposite the center of the kidney of the respective side and lateral to it. The left horn averaged 4.3 m. m. longer than the right. The body of the uterus lies just ventral to the rectum as does the vagina and urogenital sinus. The clitoris is anterior to the vaginal opening and partly covers it. The urethra terminates in this structure.

The left ovarian vein empties into the left renal while the right ovarian empties into the post caval vein between the renal and illiolumbar veins. The ovarian arteries arise below the renals and pursue a course direct to the ovaries.

ECOLOGICAL NOTES ON THE VEGETATION OF EASTERN WETZEL COUNTY, W. VA.

By
O. L. HAUGHT.

Wetzel County is situated between Monongalia County and the Ohio River, and adjoins on the north Marshall County, West Virginia, and Green County, Pennsylvania. On the south, it is bounded by Marion and Tyler Counties, West Virginia. The boundary between Wetzel and Monongalia Counties coincides with a portion of the divide between the Ohio and Monongahela drainage areas, the entire surface of the former county draining into the Ohio through Fish, Proctor, and Fishing Creeks.

The topography of Wetzel County is quite rugged, though the relief is nowhere sufficient to justify the application of the term "mountain" to any of the innumerable hills, the elevation of the highest of which is not quite 1600 feet. Throughout the county the rocks exposed are the sandstones and shales of the Dunkard Series, which, as is well known, contains hardly any limestone. Consequently, the soils are acid nearly everywhere, and by no means fertile, especially where formed through disintegration of the many massive sandstones of the Dunkard Series. Some of the shales contain sufficiently high proportions of lime to produce somewhat basic residual soils.

The more conspicuous ecological distinctions within the area under consideration depend upon character of soil, and upon the steepness and the direction of slope of the surface. As the surface of the county is at the mature stage of the erosion cycle, practically the entire area is very well drained. Only small spots of swampy ground are found here and there along some of the streams.

As has been stated, acid soils predominate in Wetzel County. The vegetation of the small areas of actual limestone soil is characterized by the presence of Oenothera muricata, O. biennis, and species of Crataegus. Around Littleton for example, luxuriant colonies of Oenothera mark the positions of outcrops of the Upper Washington and of the Ninevah Limestones.

The best agricultural soils of Wetzel County, with the exception of the small areas of alluvium, are the residual soils formed from shales, which are basic in many places. Hence, most areas covered by these soils have been under cultivation for so long a period that their natural vegetative cover is rather uncertain; though Juglans nigra, J. cinerea, Liriodendron, and Castanea dentata were certainly abundant and conspicuous trees. Where abandoned after cultivation, such areas, after a few years during which they are occupied by a rank growth of Rubus, Vernonia, Solidago, and grasses, revert to second growth forest, the shade of the young trees of which rapidly destroys the intermediate association of perennial herbs. In this second growth forest the predominant trees are Juglans nigra, J. cinerea, Liriodendron, Sassafras, species of Carya, Robinia pseudo-acacia, and Pyrus Malus. As these trees—with the exception of Pyrus Malus of course—were probably dominant in the original forest-cover of this shale soil, it appears that

the climax association is here restored rapidly through natural processes as soon as cultivation ceases. In fact, the ease with which such areas become reforested renders it difficult to keep them in pasture land for any considerable number of consecutive years.

Acid soils residual from underlying sandstones, occupy probably half the area of Wetzel County. In their natural state these soils were rather fertile, as is evident from the luxuriance of the vegetation covering them wherever they have not been cultivated. In consequence of their porosity, both leaching and oxidation are rapid while such soils are under cultivation, a few years of which not only ruins them for agricultural purposes but also renders reforestation difficult. The climax association, composed largely of species of Quercus, with undergrowth of Kalmia latifolia, Rhododendron nudiflorum, and species of Vaccinium, reappears very slowly, especially when cultivation has been continued long enough to result in the complete destruction of the natural vegetation. Abandoned areas are occupied at first by a group of plants characteristic of poor soil, of which the more conspicuous are trailing species of Rubus, Smilax, Lespedeza, Desmodium, Solidago, and thickets of stunted Rhus. As the fertility of the soil slowly increases, taller species of Rubus (blackberries and raspberries) appear, as well as seedlings of Quercus, Carya, and Pyrus coronaria. At about this stage the land is usually cleared again, the new formed soil completely destroyed within two or three years, and the area abandoned for another effort on the part of nature to reclothe it in forest.

Residual soils of the two types mentioned, formed respectively from shale and from sandstone, occupy at least nine-tenths of the area of Wetzel County. Differences between their vegetative covers are due mainly to the acidity and greater porosity of the soils from the sandstones, the acidophile plants characteristic of which are never found on the more basic soils derived from shales. The more conspicuous of these acidophile plants are Vaccinium stamineum, V. vacillans, Kalmia latifolia, Rhododendron nudiflorum, and species of Desmodium and of Lespedeza. The predominant forest trees on the sandstone soils are species of Quercus; on the shale soils, Juglans, Fagus, and Liriodendron.

I have seen Oxydendrum arboreum and Tephrosia virginiana at only a few stations, in small areas of sterile, extremely sandy soil, otherwise characterized by the presence of Quercus coccinea, Sassafras officinalis, Kalmia latifolia, Vaccinium vacillans, Smilax species, and Pteris aquilina. This association is usually found in narrow strips along the crests of ridges, as for example along that crossed by the road between Hundred and Earnshaw, in Church District.

The scattered bits of marsh along the streams are occupied by our usual association of moisture-loving plants—Juncus, Carex, Scirpus, Typha latifolia, Acorus calamus, Lobelia syphilitica and, rather rarely, Lobelia cardinalis and Arisaema Dracontium. Dianthera americana, the only plant of the acanthus family I have seen in Wetzel County, though Ruellia strepens might be expected, occupies the beds of the streams in many places. As there is no permanent pond or lake of natural origin in the county, such hydrophydes as Castalia and Lemna do not occur.

In consequence of the east to west course of many of the streams,

and of the roughness of the general topography, there are many steep hillsides facing north in the eastern part of Wetzel County. Some of the plants growing on these form as clearly marked an association as is found in the area under consideration. So far as I have seen, Betula lenta, Taxus canadensis, Solidago squarrosa and Gentiana andrewsii are found only on such slopes, where they are associated with Tsuga canadensis, Rubus odoratus, Ribes Cynosbati, and Senecio aureus. The only station at which I have been able to find Maianthemum canadense is on a northern hillside between Hundred and Littleton. As is seen, the characteristic plants of this association are distinctly northern species, typical rather of New England and of the high altitude regions of our own state.

The vegetation of steep south-facing hillsides does not, however, include more typically southern forms than that of the more gently sloping areas. Indeed, those hillsides are rather unfavorable for southern species, on account of the frequency of alternate freezing and thawing during winter.

STATIONS OF PLANTS LOCALLY RARE

The stations at which a few plants which are somewhat rare, locally at least, have been found, are as follows:

Arisaema dracontium—In a small swamp on the eastern side of the B. & O. track, just south of the mouth of Burner's Run, immediately above Hundred. Also in a bit of marshy land at the foot of the steep hillside below U. S. Highway 250, near the western portal of Marshall tunnel, about halfway between Hundred and Littleton.

Polygonatum commutatum—Roadside on Rocky Run, Center District. Only station and only clump seen there.

Cypripedium acaule—Formerly abundant in a forest of Tsuga canadensis on a northern hillside to the west of the southern portal of Marshall tunnel. The hemlocks were cut several years ago, and an effort was made to persuade grass to grow on the sandy hillside soil. Neither Cypripediums nor grass found there now. C. acaule may be found also on the ridge between Hundred and Earnshaw, but last summer I was unable to find the colony I had seen there previously.

Maianthemum canadense—On the northern hillside, west of the southern portal of Marshall tunnel. This species, by virtue of growing on nearly vertical cliffs, escaped the extermination that overtook the Cypripediums there.

Chamaelirium luteum, and **Polygala sanguinea**—On the terrace of sandy soil overlooking the site of the old Sugar Grove schoolhouse, about one mile south of Littleton. The Chamaelirium grows along the roadside; the Polygala, farther beck on the terrace.

Asplenium pinnatifidum—In crevices of sandstone cliffs on the hillside north of Littleton. The only station.

Habenaria ciliaris—On a terrace of rather sandy soil on the hillside north of Littleton.

Liparis liliifolia—In the open oak forest on a ridge south of the

B. &. O. track, just east of Littleton. This plant is very nearly epiphytic. It possesses an actual pseudobulb, which is found, not in the soil, but in cushions of moss, usually at least an inch above the soil. The roots, too, ramify through the moss and hardly reach the soil. Corresponding to its epiphytic habit, Liparis liliifolia is about as easy to dry as a cactus.

STUDIES ON THE DECOMPOSITION BACTERIA OF THE HUMAN BODY

By

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Introduction—This investigation has been made to throw light on the characteristics of a composite culture of organisms taken from many dead human bodies. The problem has been divided into three parts: First, the growth of the composite culture on gelatin media of different hydrogen ion concentrations. Second, the killing power of five-tenths of one, percent, two, four, six and eight percent of formalin on the composite culture. Third, the effect of carbon dioxide on the composite culture. This information is of interest in the study of bacteria and important in the preparation of embalming fluids.

Methods and Observations—The composite culture of organisms collected from many dead human bodies was obtained from Dr. Hilton Ira Jones, research director of National Selected Morticians. The customary bacteriological technique necessary to prevent contamination was exercised during all of the experiments. For the first part of the problem the composite culture was grown on ordinary gelatine media of 5.8, 7.4, and 8.6 hydrogen ion concentrations. Tubes of the media of the different hydrogen ion concentrations were inoculated with the composite culture and incubated at 37C. for forty-eight hours. Inoccu-lations were made from each of these tubes at the end of the incubation period on gelatine media with a hydrogen ion concentration of 7.4.

The following table indicates the results obtained from inocculating gelatine media of different hydrogen ion concentrations with the composite culture:

Date	Number of Tubes	Hydrogen ion Concentration of Media		
		5.8	7.4	8.6
Jan. 14, 1931	6	no growth	growth	growth
Jan. 17, 1931	6	no growth	growth	growth
Jan. 19, 1931	6	no growth	growth	growth
Feb. 10, 1931	6	no growth	growth	growth

Inoculations were made from each of the test tubes containing inoculated geletine of 5.8 PH and 8.6 PH in the above table on gelatine of 7.4 PH. The results were that on an average of four out of six cultures grown on gelatine with a 5.8 PH did not grow when inoculated back on gelatine with a 7.4 PH. All of the cultures grown on a gelatine media of 7.4 PH grew when inoculated on gelatine with a 7.4 PH. Since two out of six cultures from the 5.8 PH gelatine did grow when inoculated on a media of 7.4 PH, we may say that the 5.8 PH media does not necessarily kill the organisms.

The live human body is alkaline and the common opinion is that it depends upon this condition to a certain extent as a defense against disease. The average dead body has a hydrogen ion concentration of six. Our culture taken from dead bodies does not grow on gelatine of

5.8 PH but grows well on a gelatine media of 7.4 PH and 8.6 PH. These facts seem contradictory and further work is necessary along this line. The organisms of putrefaction break down substances which cause alkalinity. Our composite culture after standing for several months has a PH of 8.6. This hydrogen ion concentration change is due probably to the activities of the organisms in the culture. The results of our experiments show clearly that some organisms found in a culture taken from many dead bodies grow well in an alkaline media. If an embalming fluid depends on a hydrogen ion concentration of eight alone to inhibit the growth of germs found in a culture.

Results using four percent of formalin:

70 hrs.	24 hrs.	12 hrs.	6 hrs.	5 hrs.	4 hrs.	3 hrs.	2 hrs.	1 hr.							
–	–	–	–	*	x	x	x	x							
–	–	–	–	x	x	x	x	x							
–	–	–	–	x	x	x	x	x							
–	–	–	–	x	x	x	x	x							

10 min.	15 min.	30 min.	1 hr.	1¼ hrs.	1½ hrs.	2 hrs.	2½ hrs.	3 hrs.	3½ hrs.	4 hrs.	4¼ hrs.	4½ hrs.	4¾ hrs.	5 hrs.	5½ hrs.
x	x	x	x	x	x	x	x	x	*	–	x	x	x	*	–
x	x	x	x	x	x	x	x	x	x	x	x	X	*	*	–
x	x	x	x	x	x	x	–	–	*	x	*	–	*	–	–
x	x	x	x	x	x	–	x	x	x	x	x	x	X	*	–

Conclusion for four percent of formalin: All the germs were killed in five hours and fifteen minutes to five hours and thirty minutes.

Results using two percent of forty percent formalin:

70 hrs.	24 hrs.	12 hrs.	6 hrs.	5 hrs.	4 hrs.	3 hrs.	2 hrs.	1 hr.							
–	–	–	x	x	x	x	x	x							
–	–	–	x	x	x	x	x	x							
–	–	–	x	x	x	x	x	x							
–	–	–	x	x	x	x	x	x							

6½ hrs.	7 hrs.	7¼ hrs.	7½ hrs.	8 hrs.	8½ hrs.	8¾ hrs.	9 hrs.	9¼ hrs.	9½ hrs.	9¾ hrs.	10 hrs.	10¼ hrs.	10½ hrs.	10¾ hrs.	11 hrs.
x	x	x	x	*	*	x	x	*	–	–	–	–	–	–	–
x	x	x	*	x	x	x	x	x	*	*	–	–	–	–	–
x	x	–	x	*	x	*	x	*	x	–	*	–	–	–	–
x	x	x	x	x	x	x	x	x	–	*	x	*	–	–	–

Conclusion for two percent formalin: All the germs of the composite culture were killed in from ten to ten and one-half hours.

Five-tenths of a one percent solution of formalin was exposed with the composite culture for eighty hours and the germs grew strongly at the end of that time when inoculated into beef broth. This indicates that a solution of one-half of one percent formalin does not kill the germs in the composite culture at the end of eighty hours.

For the third part of the problem test tubes of beef broth containing growing cultures of the composite culture were filled with carbon dioxide by means of a sterile glass tube. These cultures were placed in ordinary glass fruit jars filled with carbon dioxide and then incubated for forty-

eight hours. Inoculations were made from these into other test tubes of beef broth. The air was likewise displaced in these tubes by carbon dioxide. They were in turn placed in glass jars filled with carbon dioxide and incubated for forty-eight hours. Gelatin tubes were inoculated from the first beef broth culture which had been inoculated for forty-eight hours in an atmosphere of carbon dioxide. A culture taken from the beef broth culture which was grown in a carbon dioxide atmosphere for forty-eight hours was inoculated into beef broth and gelatine and grown in aerobic conditions for forty-eight hours.

		Culture A	Culture B	Culture C	Culture D	Culture E
		Inoculated from culture A. atmosphere with beef broth media.	Grown in beef broth in air. Inoculated from culture A after 24 hours.	Grown in carbon dioxide. Grown in carbon dioxide atmosphere in beef broth media.	Inoculated from culture A. Grown in carbon dioxide atmosphere in gelatine.	Inoculated from culture A. Grown in air gelatine media.
Number of tubes	Growth	x x x x x x	x x x x x x			
	No growth			— — — — — —	— — — — — —	— — — — — —
PH of media after organisms had grown in it forty - eight hours		5.5	7.	4.5	4.5	7.4

Growth of composite culture in beef broth of different hydrogen ion concentrations.

PH of media	8.	6.7	5.5	4.5	4.
	Growth	Growth	Growth	No growth	No growth

CONCLUSIONS

We may conclude from the facts in the preceding table that carbon dioxide kills the bacteria. When they are first exposed to the gas, however, some growth takes place—best shown by culture A. No growth

appeared in culture C which was inoculated from culture A, and grown in beef broth media in an atmosphere of carbon dioxide. Culture D was inoculated from culture A, and grown in gelatine media in an atmosphere of carbon dioxide. Growth did not take place on the media. No growth took place in culture E which shows that the bacteria were attenuated to such an extent by the carbon dioxide that they did not grow on the gelatine media in air. Some growth took place in culture A before the carbon dioxide affected the bacteria present. After twenty-four hours inoculations were made into beef broth and growth took place, however, there was a marked decrease in the amount of growth which showed that the carbon dioxide affected the bacteria. After forty-eight hours inoculations were made into gelatine from A and no growth took place. Many of these organisms of the composite culture grow well without oxygen, but our experiments show that some of them will not grow in an atmosphere of carbon dioxide.

THE HYDROGEN CONCENTRATION

The slight growth in culture B, and no growth in cultures C, D, and E show that carbon dioxide not only inhibits the growth of the bacteria but if given time will kill it.

The hydrogen ion concentration of the media is changed by the action of the atmosphere of carbon dioxide. The substances formed by the composite culture make the media in which they are growing more alkaline, however, when carbon dioxide is added, the media becomes more acid. After the media has been exposed to the carbon dioxide until the PH becomes 4.5, no growthe takes place in either beef broth or gelatine media. These facts were shown by the experiments in the first part of the problem.

SUMMARY

A composite culture of organisms taken from many dead bodies will not grow in a gelatine media with a hydrogen ion concentration of 5.8. Considerable growth takes place in media of 8.6 hydrogen ion concentration, and therefore media of this concentration will not inhibit the growth of the decomposition germs.

An eight percent solution of formalin kills the germs of decomposition in three hours and a half; a six percent solution of formalin kills them in three hours and a half to four hours; a four percent solution kills all the organisms in five hours and thirty minutes; and a two percent solution kills the germs in ten to ten and a half hours. One-half of one percent formalin solution will not kill the germs of decomposition of the human body at the end of eighty hours.

The germs of decomposition will not grow in beef broth media in an atmosphere of carbon dioxide after forty-eight hours exposure and incubation. The presence of the carbon dioxide atmosphere changes the hydrogen ion concentration of the media until it becomes too acid for the growth of the organisms. A lack of oxygen does not affect to a noticeable degree the growth of the composite culture.

We wish to acknowledge our indebtedness to Dr. Hilton Ira Jones for suggesting this investigation, and for his help during the progress of the work.

DEVELOPING QUANTITATIVE TECHNIQUE BY ANALYSIS OF OSAGE ORANGE

By
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In advanced quantitative analysis there are two quite similar "end-points" which must be considered and evaluated. No defense need be made of that which has generally been the chief goal—a high degree of accuracy. To shift the deviation from the correct analysis from the first decimal point to the second, is worthy of the best efforts of the analytical chemist. Indeed,if he can be reasonably sure of his result to the third decimal, he has achieved something of the utmost importance. In the development of this accuracy he may well make use of the time-honored problems, such as soda ash, oxalic acid, limonite, pyrolusite, stibnite, soluble chloride, ferrous ammonium sulfate, apatite, and dear old limestone. If he can make his analyses of these sufficiently accurate, he may consider that he has completed a satisfactory course in advanced quantitative analysis, both volumetric and gravimetric. But he is likely to become extremely "weary in well doing." It is not unknown for a student to become so exceedingly tired of doing the same old thing over and over again that he quits in disgust. He has even been known to throw the "Beaker and Contents," as the manual puts it, out of the window.

Well, what are we going to do about it? Nothing, that I can suggest, except to give the student something new to work on and a new goal to strive for. Let us consider these in inverse order. What other goal is there to strive for, except extreme accuracy? How about versatility? Perhaps it is worth while to learn more methods than one of doing the same thing. Take an instance. The analysis of manganese has usually been made volumetrically, with sodium oxalate as the standard. Let us try other methods, such as precipitation with bromine water and ammonium hydroxide and later ignition to manganomanganic oxide, or titration against a standard solution of potassium periodate. These are sufficiently different from the usual method to hold the interest of the worker, and he may be willing now to go back to the old method and check results as obtained by the three different methods, thus obtaining our goal of accuracy by means of diversification.

Now, if your minds are open to conviction, let us consider a specific problem by means of which both accuracy and diversification may be achieved. This involves the analysis of the fruit of the Maclura pomiferum, which is our old friend Osage orange or hedge apple. Some time during 1914 or early in 1915, Dr. J. S. McHargue of the University of Kentucky Experiment Station worked out some of the important constituents of this fruit and published his findings in the Journal of Industrial and Engineering Chemistry, Vol. 7, No. 7, page 612. July, 1915. You may use this for reference, although the analysis you will now do with me is outlined in the book of "Official and Tentative Methods of

Analysis" as published by the Association of Official Agricultural Chemists, 1925.

Let us turn to Part IV. Plants. This begins on page 39 and extends through page 45, with references to other pages. We shall use two other procedures for specific purposes, which will be mentioned later. Just now, let us learn how to prepare the material for analysis. The text states, "Thoroughly remove all foreign matter from the material, especially adhering soil; air-dry; grind; and preserve in tightly stoppered bottles." This takes only two weeks, so we refer to it briefly. If you pick the fruit from the tree by hand you will obviate much of the necessary cleaning; rinsing with water is sufficient. McHargue advises that the outside milky cells be pared off to the seeds; that the part containing the seeds be pared off to the core, and each portion dried and kept separately. We split the fruit, separated each seed pod and its milk sac by hand, and cut up the core with a cleaver. These were green fruits, just ready to drop from the trees. While the material is drying at room temperature, prepare the reagents needed for the analysis. A list of these is presented herewith, consisting of eleven acids, nine bases, eight solid salts, and twenty-two salts in solution. This gives good practice in the art of preparing solutions and keeps the analyst busy while the material is drying. All these reagents should be of the highest purity possible, therefore it might be well to analyze those about which there must be absolutely no doubt, according to the standards listed by Murray. Additional technique is acquired if these analyses are made, and some of them should be made, particularly where phosphorus—free reagents have been specified.

The first analysis is for sand and silica, and the method of ashing is by plain ignition in a flat-bottomed platinum dish in a muffle, at a temperature not exceeding dull redness. This ash is dissolved in dilute hydrochloric acid. The sand residue is ignited on a Gooch crucible, while the soluble silica is obtained on an ashless filter and ignited. Here we have practice in ignition by two different methods. The filtrate from this ashing is used for several different determinations, such as ferric and aluminum oxides, manganese, calcium. and magnesium. In determining iron the phosphorus must be removed as the phospho-molybdate, and you will agree that this is excellent practice in procedure. Then the mixed oxides must be fused with potassium hydrogen sulfate, the iron reduced with zinc, and the final determination made with permanganate solution. Calcium is precipitated with hot solution of ammonium oxalate, as is customary, and ignited to the oxide or converted into oxalic acid with dilute sulfuric and titrated with permanganate. Magnesium is, as usual, precipitated as the ammonium phosphate and ignited to the pyrophosphate. Manganese has been mentioned.

To determine sodium and potassium, ignition is accomplished by saturation with concentrated sulfuric acid and ignition in a muffler at a low red heat. This ash is treated first with strong hydrochloric acid and then with water. After appropriate precipitations of all other possible ingredients, the sodium and potassium are finally ignited as the sulfates,

and the potassium is determined by the use of the platinum solution.

For chlorine, the material is moistened with a 5% sodium carbonate solution, dried, and ignited at full redness. This ash is first extracted with water, re-ignited, and dissolved in dilute nitric acid. The chlorine is then determined gravimetrically by precipitation with silver, or volumetrically by titration of nitric acid filtrate with excess silver nitrate, this excess being calculated with thiocyanate in the presence of ferric indicator.

Analysis for sulfur calls for two different methods of ashing. One is by mixture with anhydrous sodium carbonate, moistening with water, and drying with sodium peroxide. This mixture is fused over a sulfur-free flame (alcohol), with stirring. It must not ignite. Careful solution in water and precipitation with the usual barium chloride follow this procedure. The other method is to mix with a special magnesium nitrate solution and heat on the hot plate at 180°C., then transfer to the muffle and complete oxidation at less than red heat. Water is added, then strong hydrochloric acid in excess. The final estimate is made as above, but half of the solution may be reserved for phosphorus determination.

Instead of using an aliquot from the sulfur filtrate, Howk and DeTurk, of the University of Illinois (Analytic Edition of Industrial and Engineering Chemistry, Vol. 4, No. 1, Jan. 1932), advise mixing with twice as much pure precipitated calcium carbonate, covering with a like amount of the same material, heating gently over the Meker burner until fumes are no longer evolved, and then heating at the full heat of the burner. The ash is moistened with water and dissolved in dilute nitric acid. The phosphorus is separated from the other minerals by precipitation as the phosphomolybdate and then re-precipitated as the ammonium phosphate with magnesia mixture and ignited to the pyrophosphate.

These six methods of ashing, each followed by a specific way of getting the ash into solution, offer good practice in this part of analytical procedure. It is a feature not much stressed in the earlier courses. In addition, the determinations of silica, sand, iron, aluminum, calcium, manganese, potassium, sodium, chlorine, sulfur, and phosphorus, give as great variety of methods as you are likely to find in any one problem. Iron and sodium are present in such small amounts that spectroscopic examination is necessary to prove them present. They are not reported separately in the table below, which gives percentage as found:

Silica, insoluble and soluble (whole fruit)	0.075%
Iron and Aluminum Oxides (seedless material)	0.040%
Manganomanganic Oxide (seedless material)	0.075%
Calcium Oxide (whole fruit)	0.674%
Magnesium Oxide (whole fruit)	0.361%
Sodium and Potassium Sulfate (whole fruit)	3.741%
Chlorine (whole fruit)	0.107%
Sulfur (whole fruit)	0.150%
Phosphorus Pentoxide (whole fruit)	0.648%
Total solids	5.871%

LIST OF REAGENTS NEEDED FOR ANALYSIS OF THE FRUIT OF THE OSAGE ORANGE

Acids, conc. and dil.

1. Acetic, conc.
2. Hydrochloric, conc.
3. Hydrochloric, 1 and 4.
4. Hydrogen peroxide, 3%.
5. Nitric, conc.
6. Nitric, 4 and 1, boiled.
7. Nitric, 1 and 4.
8. Oxalic, 2.5%.
9. Phosphoric, conc.
10. Sulfuric, conc.
11. Sulfuric, 1 and 1.

Bases, conc. and dil.

1. Ammonium carbonate, 10%.
2. Ammonium hydroxide, 28%.
3. Ammonium hydroxide, 1 & 1.
4. Ammonium hydroxide, 1 & 4.
5. Ammonium hydroxide, 1 & 9.
6. Barium hydroxide, sat.
7. Sodium carbonate, sat.
8. Sodium carbonate, 10%.
9. Sodium hydroxide, 10%.

Salts, solid.

1. Ammonium carbonate, anhyd.
2. Ammonium nitrate, cryst.
3. Ferric nitrate, P free.
4. Potassium bisulfate, fused.
5. Potassium periodate.
6. Sodium acetate.
7. Sodium carbonate, anhyd.
8. Sodium peroxide.

Salts, in solution

1. Ammonium nitrate, P free, 50%.
2. Ammonium nitrate, P free, 2.5%.
3. Ammonium oxalate, saturated.
4. Ammonium sulfate, 75 g per L.
5. Ammonium sulfate, 3.5 & 50.
6. Ammonium thiocyanate, 0.1-N
7. Barium chloride, 10%.
8. Bromine, liquid, free.
9. Bromine water, sat.
10. Ferric ammonium sulfate, sat.
11. Ferric chloride, P free, 10%.
12. Ferrous ammonium sulfate, sat.
13. Magnesia mixture (12 g. MgO in HCl, boil and filter, add 140g. NH_4Cl, 130 ml. conc. NH_4OH, dil. to 1 L.).
14. Magnesium nitrate (160 g. MgO in HNO_3, boil & filter, dil. to 1 L.).
15. Molybdate solution (100 g. MoO_3 in dil. NH_4OH, 144 & 271, pour it into dil. HNO_3, 489 & 1148, keep warm).
16. K_2PtCl_6, 0.042 g. per ml.
17. Potassium permanganate, O. 1-N.
18. Potassium permanganate, alkaline, equivalent to 0.1 mg. per ml.
19. Silver nitrate, 10%.
20. Silver nitrate, 0.1-N.
21. Sodium acetate, 20%.
22. Sodium citrate, 10%.

XX. Distilled water, hot and cold, and as free as possible from CO_2.

N. B. Where figures are given, such as 1 & 4, the first figure refers to the reagent, the second to the amount of water used.

COMPLEX IONS IN INORGANIC CHEMISTRY

By

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With most of us the question of complex ions in inorganic chemistry is discussed very slightly in teaching general chemistry to college students. Some chemists, especially interested in complex ions, believe that the entire attitude of the teaching of general chemistry could be and should be changed. Less time should be used in discussing the physical laws, which could be left to physical chemistry, and more time could be spent on what is essentially inorganic chemistry. This of course includes a wider knowledge of the properties and reactions of complex ions.

How much we should teach a beginning student about complex ions when we discuss radicals is a very difficult problem to determine. Being interested in these ions myself, I explained a little more fully to my class in general chemistry this year, the various valences an element can assume in different radicals and in the very next written lesson I found a large percent of the students had a very hazy idea of the valence of the radical.

Many years ago Kekulé brought forth the idea of valence and that every element had one fixed valence. He used carbon with a valence of four as the foundation of his theory and explained lower valences of carbon and many other elements as unsaturated valences. Further research in science led many men away from this theory and some elements were accepted as having several valences depending on the elements with which they combined. In 1896 Werner came forth with a theory of the constitution of complex compounds which up to the present time does not need to be altered in any essential detail. Quoting Werner, who states: "Even when, to judge by the valence number, the combining power of certain atoms is exhausted, they still posses in most cases the power of participating further in the construction of complex molecule with the formation of very definite atomic linkage. The possibility of this action is to be traced back to the fact that, besides the affinity bonds designated as principal valences, still other bonds on the atoms called auxiliary valences, may be called into action." The maximum number of these bonds, called auxiliary valences or secondary valences, or the maximum number of ions or neutral molecules which apparently every metallic element can hold, is its "co-ordination number." For the greatest number of elements this number is six but it varies for different elements and may vary for the same element at different oxidation levels.

Beginning with the simplest complex ions, of which the complexity may be debatable, sulphate and carbon ions for example, we have all degrees of complexity until we reach the typical compounds such as copper or silver ammonia chlorides or nitrates, the chloroplatinates, and the cobaltinitrites. We find all degrees of stability in our complex compounds from those which are so unstable that their existence may be questioned to those whose stability is so great that they are easily

prepared, can be kept for a long time and their properties have been studied in great detail.

Time will allow a discussion of only a very few of these complex compounds. The cobalt ammonia chloride complexes have been prepared and studied in detail. Four compounds beginning with $Co(NH_3)_6Cl_3$ and going to $Co(NH_3)_3Cl_3$ are known, the difference being the loss of one molecule of ammonia in each case. The conductivity of the first is the greatest. The last is not an electrolyte. If the first compound is treated with an excess of silver nitrate solution, three chloride ions are precipitated as silver chloride but if the last compound is treated with an excess of silver nitrate solution no precipitate is formed. Cobalt ammonia nitrates are known and it is possible to replace ammonia molecules with nitrate groups. Beginning with $Co(NH_3)_3(NO_2)_3$ which is a non-electrolyte as we increase the nitrite groups by replacing the ammonia molecules with them, the conductivity of the compounds in solution increases until we reach $K_3Co(NO_2)_6$. In the two examples given above of non-electrolytes the combination must be non-ionogen. The compounds $Co(NH_3)_6Cl_3$ and $K_3Co(NO_2)_6$ each form four ions in solution. As these two series of compounds come nearer to the non-eiectrolytes by substituting chloride ion for NH_3 in the first case and NH_3 for NO_2 in the second the number of ions in solution decrease. The properties of the solutions change accordingly. There must be some change in the composition of the complex that will explain these changes in properties. We believe that this change in properties is caused by the chloride ion (in the case of $Co(NH_3)_6Cl_3$ changing to $Co(NH_3)Cl_3$) replacing the NH_3 molecule in the complex ion $Co(NH_3)_6^{+++}$ until all three chloride ions have replaced three ammonia molecules and are attached to the cobalt atom by non-ionogen linkage.

For many years hydrates were not considered separate definite compounds and the water of crystallization scarcely considered at all. I like to think of these hydrates as complex compounds, entirely similar to the cobalt ammonia complexes in many of their properties. Both H_2O and NH_3 are neutral molecules and their presence attached to the central cobalt atom does not change the ionogen valence of the cobalt atom. The maximum number of each, six, is the same. The properties of the complex is changed when either of these molecules are replaced by chloride ion for example $CoCl_2.6H_2O$ gives a pink or rose red solution when dissolved in water but if concentrated hydrochloric acid is added to the solution the color changes to deep blue. A simple explanation of this reaction is one of dehydration in the complex ion. The $Co(H_2O)_6^{+++}$ becomes $Co(H_2O)_xCl_y$, x and y together totaling six. Copper sulphate crystals are blue in color and anhydrous copper sulphate is white. If concentrated sulphuric acid is added to copper sulphate crystals the blue color begins to fade and in time becomes almost white. Again I like to think of this reaction being one of dehydration of the complex ion $Cu(H_2O)_4^{++}$.

To discuss the question of primary valence and secondary valence is beyond the scope of this paper. There is much controversy on the subject at the present time and no definite conclusions have been reached. This much can be said. Using platinic chloride as an example we can

add two potassium chloride molecules in solution and have the complex compound potassium chloroplatinate, K_2PtCl_6. Chemical reactions can detect no difference between the four chloride atoms that were attached to the platinum atom in the first compound and the last two that completed the complex ion $PtCl_6''$.

My attitude in this paper is somewhat practical. I have already mentioned the trouble encountered when the valences of elements in radicals were explained to classes in general chemistry. In spite of this I believe that making this explanation only to the better students in our classes is well worth the time and makes a definite contribution to their knowledge of chemistry. In general chemistry a discussion of the complex ions of several metals with ammonia can be presented and the fact explained that some of the metals, cobalt and nickel for example, have different complexes with ammonia depending upon the number of molecules held, the limit being six. Hydrates could be emphasized as definite compounds and even in solution the ions may be complex ones with the water molecules attached. All of this material should be taken up in detail the second year in qualitative analysis and the theory discussed much more fully. Special emphasis should be given to complex ions in qualitative analysis. Many of our separations of these ions are due to complex ion formation, silver from mercurous, the polysulphides, copper from cadmium, aluminum from zinc, and several others. If we discuss the theories of analytical separations we must discuss the complex ion formations. In beginning quantitative analysis we use complex ions very slightly but I like to explain some of the difficulties an analyst may meet in determining chloride ion for example, in a chromic chloride solution, in which some of the chloride ion may be found in the complex and a few of the methods by which these difficulties may be overcome.

THE SOLVENT EFFECT OF REAGENTS ON GLASS BOTTLES

By
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INTRODUCTION

It is a fact of common knowledge that any liquid reagent will attack the glass container in which it is placed. It is also obvious that for any fixed environment the rate of attack of any particular reagent will be dependent upon the composition of the glass of the container. A number of investigators[2] have studied the effect of various reagents on different makes of laboratory glassware. The majority of these investigations have been carried out by allowing a given quantity of the reagent to remain in contact with a particular container for a given period of time (usually short) and subsequently determining either the loss in weight of the container or the amount of solids dissolved in the reagent analytically. In most instances a given quantity of some reagent was simply boiled for a short time in a beaker or flask.

The writers have observed in particular the pronounced effect of strong alkali solutions on the common type of laboratory reagent bottle. It seemed desirable, therefore, to study the solvent effect of various reagents on different kinds of glass bottles over long periods of time under conditions as nearly as possible to those ordinarily prevailing in the laboratory. Such a study should enable us to determine approximately how long a reagent could be left in a particular make of bottle before being rendered unfit for use for a given purpose. The results reported in this paper were obtained with three makes of bottles using approximately 6 N NH_4OH as the reagent.

MATERIALS

5.53 N NH_4OH was prepared by diluting commercial C. P. ammonia with freshly distilled water.

Twelve 16-oz. flint glass reagent bottles and an equal number of ordinary green glass acid bottles and of pyrex bottles of the same capacity and shape, all of which had never been used, were cleaned by using only soap and water. They were cleaned in this manner in order that the inside surface might be entirely new and unblemished by brushing or by the action of any cleaning solution or scouring powder. They were then thoroughly rinsed with freshly distilled water and allowed to drain. An examination of the various bottles showed practically no difference in the available surface exposed to the reagent.

EXPERIMENTAL METHOD

The initial solid content of the ammonium hydroxide was determined by evaporating a definite volume in a platinum dish and igniting to a

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[1]An abstract of a thesis presented to the faculty of Davis and Elkins College by Henry A. Rutherford in partial fulfillment of the requirements for the B. S. Degree.

[2]A. G. Barladean, Schweiz. Apoth. Ztg., 52, 469-72 and 485-7 (1914); P. Nicolardt, Compt. Rend., 163, 355-7 (1916); Walker & Smither, Jou. Ind. Eng. Chem., 9, 1090 (1917); Walker & Smither, Bur. of Standards Tech. Paper No. 107 (1918).

constant weight. The new bottles were then filled with the 5.53 N NH_4OH and stoppered. In order that the experiments might be carried out as nearly as possible under conditions which exist in the laboratory, the bottles were allowed to stand undisturbed on a shelf, which was at no time exposed to direct sunlight, at approximately constant temperature (18.5°) until time for analysis.

After a period of one week the solid content of the ammonium hydroxide in the first bottle was determined. The bottle was shaken vigorously in order to mechanically break up any crystals which had formed so that they would pass through the tip of a pipette. The 25 ml. pipette employed was specially prepared with a large tip and calibrated. 200 ml. of the NH_4OH solution in 25 ml. portions were evaporated on a steam bath in a weighted platiunm dish. The bottle was shaken just before the withdrawal of each portion in order to obtain a uniform suspension of crystals in the solution. The dish was then ignited to a constant weight over a Fisher Burner, and the solid matter dissolved in the reagent determined by deducting the initial solid content of the NH_4OH from the weight of the residue in the dish. The analyses were done in duplicate. Subsequent analyses were done in the same manner as just described.

EXPERIMENTAL RESULTS

The results obtained in the various experiments are presented in Table I, and illustrated graphically in Figure 1.

TABLE I.

SOLVENT EFFECT OF 5.53 N NH_4OH ON GLASS BOTTLES

Average temperature 18.5°C.

Bottle No.	Time in Weeks	Dissolved Solids, Mg./L. in: Flint	Green	Pyrex
1	1	6.9	3.9	6.4
2	2	13.4	10.4	9.5
3	3	24.7	15.9	11.9
4	4	46.9	21.9	11.9
5	8	97.9	41.9	24.4
6	12	123.9	58.9	29.4
7	16	136.4	70.4	30.9
8	20	161.4	82.0	32.4
9	24	161.4	82.9	36.9
10	32	174.6	103.9	
11	36	181.4		

DISCUSSION OF RESULTS

Inspection of the curves in Figure 1 will reveal that the solvent effect of ammonium hydroxide on the three glasses increases in the order Pyrex, Green, Flint. It is particularly interesting to not the much greater solvent effect of the alkali on the flint glass as compared to the green glass or Pyrex. It would obviously be quite instructive to have comparative analyses of the three glasses as well as the analyses of the solid residues obtained from the solutions. The authors hope to present in a later paper the results of such analyses and also the results of the solvent actions of other reagents.

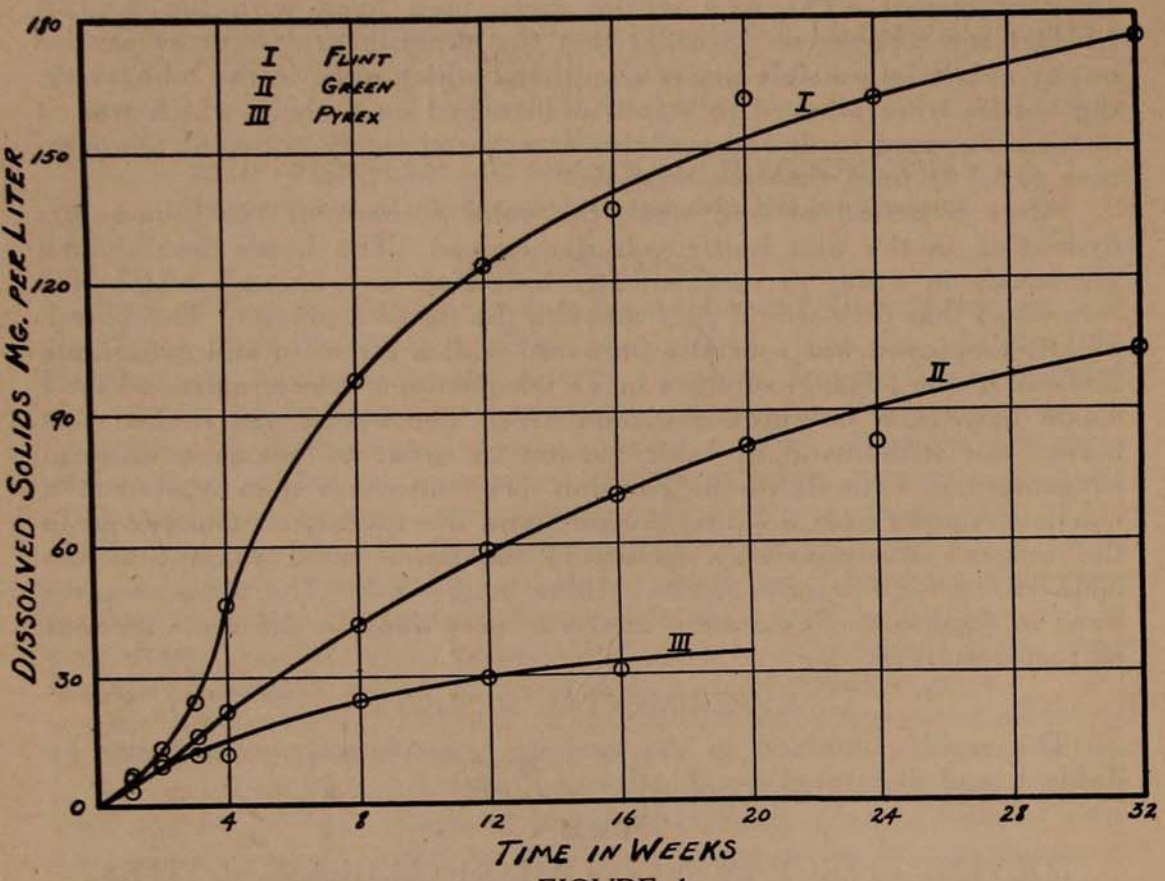

FIGURE 1.

Attention should be called to the fact that the solid matter in the flint glass bottles scales off the walls of the bottles and appears in the form of crystals suspended in the solution. However, no crystals or solid matter of any kind can be detected with the eye in either the green glass or Pyrex bottles. The appearance of crystals was first noticed in the flint glass at the end of eight weeks, whereas even at the end of the twenty-fourth week no visible solids are present in the green glass or Pyrex.

SUMMARY

1. A study has been made of the solvent effect of ammonium hydroxide on Pyrex, Green, and Flint glass bottles.

2. The solvent effect of the NH_4OH increases in the order: Pyrex, Green, Flint.

3. It would appear that the common green glass acid bottles might advantageously be used for making molded-label reagent bottles instead of the present flint glass.

THE SOLUBILITIES OF SPARINGLY SOLUBLE SALTS USING LARGE VOLUMES OF SOLVENTS

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(ABSTRACT)

THE SOLUBILITY OF LEAD SULPHATE AT 20°.

A large percentage of the data on solubilities of sparingly soluble salts have been obtained by conductivity methods, and more data by direct measurement of solution equlibrium seemed in order. Furthermore, most of the data secured by analytical methods have been obtained by using rather small volumes of solvents, and the degree of accuracy has been limited as examination of the literature reveals. It also appeared desirable to have data on a particular substance prepared by different methods.

Two samples of lead sulphate were prepared by different methods and saturation effected in a specially constructed apparatus illustrated in Figs. 1 and 2. Fig. 1 shows a general view of the apparatus comprising a 225 gallon constant temperature bath having suspended in it 4 5-gallon Pyrex bottles. In Fig. 2, A represents a top view of one of the bottle supports, and B a cross-section view through the center. C is a cross-section of one of the stirer units employed, lying on its side.

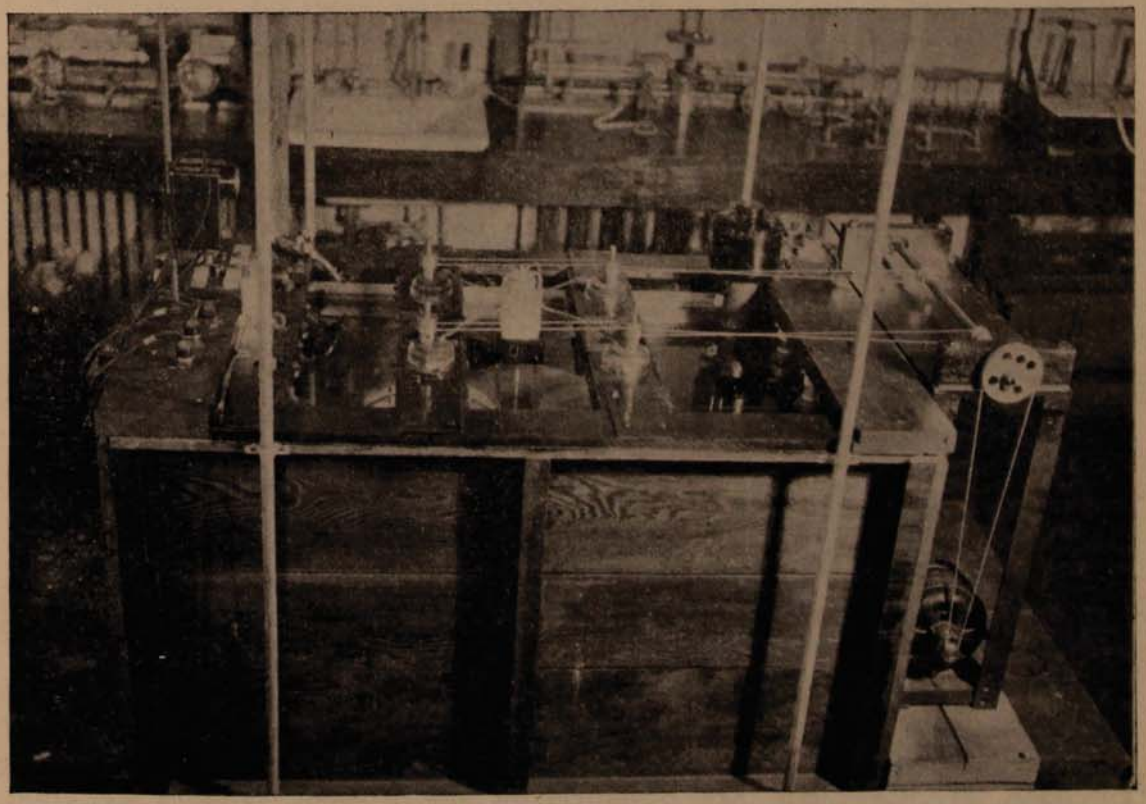

Fig. 1.

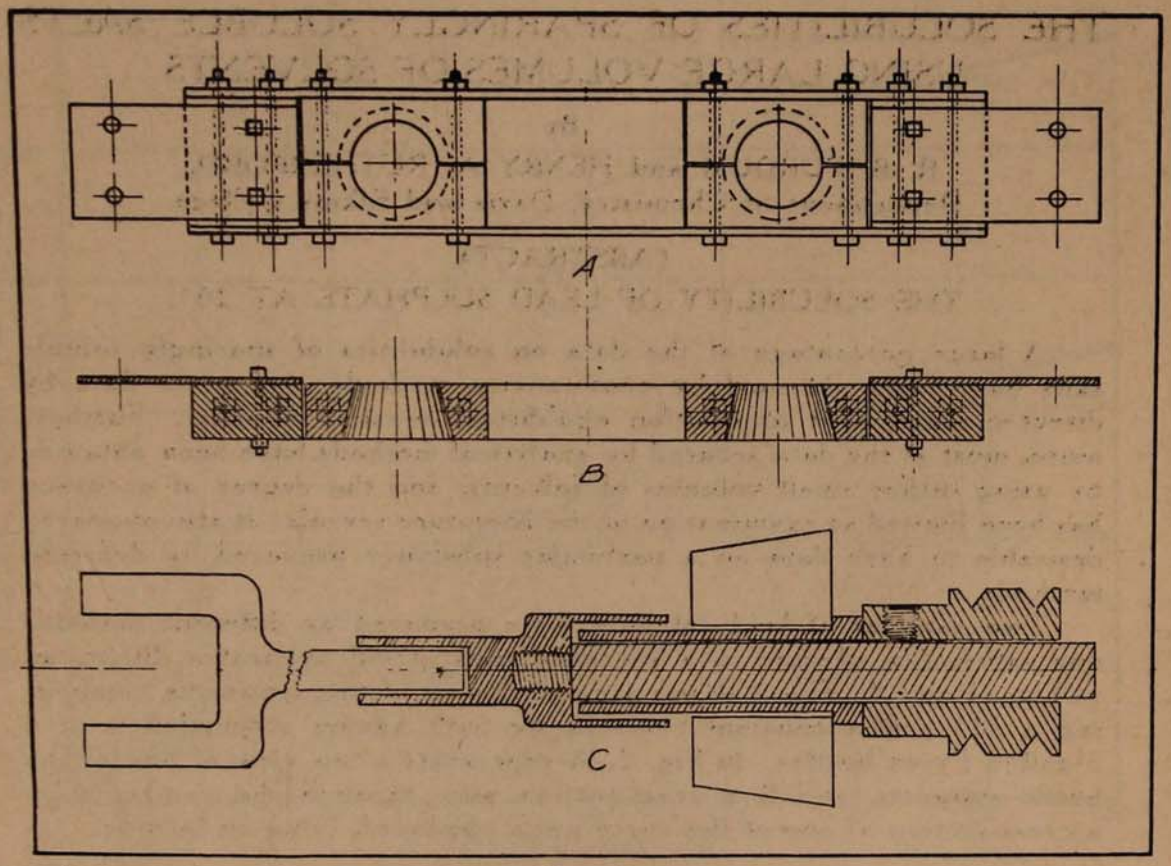

Fig. 2.

Two 6000 ml. samples of the saturated solution were siphoned from each bottle, ammonium acetate added, and the volume concentrated to about 400 ml. The solutions were acidified with acetic acid, and the lead precipitated by slow addition of potassium bichromate to excess. The mixtures were heated to boiling for 15 minutes, allowed to stand at room temperature for 12 hours, filtered through Gooch crucibles, and dried to constant weight at 110°C. The following results were obtained:

SOLUBILITY OF $PbSO_4$ IN G/LITER AT 20°.

Sample No. 1	Sample No. 2
0.0421	0.0423
0.0422	0.0424
0.0422	0.0427
0.0421 mean 0.0422	0.0422
	0.0427
	0.0422 mean 0.0424

The method apparently is capable of a high degree of accuracy and would seem to merit further work. Recently four other samples of lead sulphate have been prepared and work on these will go forward as soon as more data are obtained on the present samples at other temperatures.

A WEST VIRGINIA SELF-GLAZING CLAY

By
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INTRODUCTION

This paper is based on investigations conducted by the H. R. Wylie China Co., Huntington, W. Va., the Harshaw Chemical Co., Cleveland, Ohio, and Morris Harvey College, Barboursville, W. Va. The physical tests were run in the industrial plants, and the qualitative and quantitative analyses were carried out in the department of Chemistry of Morris Harvey College. The qualitative analysis was conducted by the writer, aided by Ralph S. Bird, a student assistant, and the quantitative determinations were made by Dr. P. E. Roller, professor of Mathematics and Physics in Morris Harvey College.

OCCURRENCE AND PHYSICAL CHARACTERISTICS

In Cabell County, West Virginia, along Little Seven Mile Creek, there is a considerable deposit of a very unique type of clay. This material, though cropping out at several points, is usually found about eight to ten feet below the surface. A continuous deposit has been located extending to a depth of 40 feet, which point, in this instance, was the bottom of a well.

The clay is light gray in color, and it is very soft and almost greasy to the touch. To some extent it is soluble in water. It is fairly plastic. It casts well, and releases quickly from the mould. Its air shrinkage and fire shrinkage are slight. Perhaps the most interesting characteristic of the clay is its self-glazing property. When heated to a temperature of 1200 to 1400°F, the clay assumes a reddish-brown color and glazes beautifully. Examination of a plane of fracture indicates that the tiny air bubbles in the mass are also completely glazed. When fired at a slightly higher temperature, the color becomes a deeper brownish-red. At 2100°F the clay melts to a black mass. Careful examination of the clay by the Harshaw Chemical Co. leads its investigators to the conclusion that this material is a slip clay possessing physical characteristics which are about the same as those of Albany Slip Clay—found in the east central part of New York near Albany—and Michigan Slip Clay—found in Ontonagon County, Michigan. A slip clay will fuse and melt to a translucent glaze at a comparatively low temperature, and such a clay is used for glazing ware made of cheaper materials. There are many low melting clays native to the United States, but they do not melt to good glazes. The clay under discussion will not stand the high heat required in regular firing, for its melting point is too low, but it does glaze other ware quite well, giving a bright finish to the product.

CHEMICAL COMPOSITION

I. Qualitative Analysis

A. Method

The analysis of silicates, as outlined by Curtman,[1] was followed. The

[1]Curtman, Qualitative Chemical Analysis, Macmillan (1931), pp. 392-397.

finely powdered clay was fused with $NaKCO_3$ in a nickel crucible. The melt was treated with boiling water, and the solution was divided into two parts. Part 1 was acidified with HNO_3 and evaporated to dryness to dehydrate the silicic acid. The residue was treated with concentrated HCl and evaporated to dryness on a steam bath. This residue was treated with concentrated HCl, heated, diluted with five times its volume of water, and filtered from the silicic acid. The filtrate was examined for the common metallic ions with the exception of sodium, potassium, and ammonium. Part 2 was tested for chloride, sulfate, phosphate, borate, silicate and fluoride. Carbonate and sulfide tests were carried out with the use of a fresh sample of the original clay in each case.

The water insoluble portion of the melt was treated with hot, dilute HNO_3 until no further action took place. No dark brown residue remained, indicating the possible absence of manganese, but the practically white residue was treated with H_2O_2 to oxidize traces of manganese, heated to boiling, and filtered. The small residue from this operation was discarded. According to Curtman, a small residue at this point generally consists of coarse particles of the original silicate which have resisted the decomposing action of the flux, and it, therefore, may be safely discarded. The HNO_3 filtrate was analysed for the common metallic ions with the exception of sodium, potassium, and ammonium.

In the detection of sodium and potassium, the J. Lawrence Smith[2] method was used. A fresh sample of clay was heated with freshly sublimed NH_4Cl and alkali-free $CaCO_3$. The sintered product was extracted with boiling water and filtered. The calcium was removed as oxalate, the filtrate was evaporated to dryness, and the residue was ignited until all ammonium salts had been volatilized. The product was extracted with water, and the solution was examined for potassium ion by the $HClO_4$ method and for sodium ion by the H_2SiF_6 method.

The test for ammonia was carried out in the usual manner by treatment of a fresh sample of clay with sodium hydroxide and heat.

B. **Results:**

The following ions were found to be present:—

Calcium	Nickel	Chloride
Aluminum	Potassium	Sulfate
Iron	Sodium	Phosphate
Magnesium	Ammonium	Carbonate
	Silicate	

II. Quantitative Analysis

A. Method

The procedures followed were chiefly those outlined as the [3]Tentaative Methods of the Association of Official Agricultural Chemists, prescribed for the analysis of soils.

The clay was fused with $NaKCO_3$, and the melt was extracted with HCl. The solution was filtered from the undissolved silica, and treated

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[2]Curtman, Qualitative Chemical Analysis, Macmillan (1931), p. 397.
[3]Griffin, Technical Methods of Analysis, McGraw-Hill (1927), pp. 729-730; 732-734.

with NH_4OH to precipitate the iron, aluminum, manganese, etc. The calcium was removed as oxalate by treatment with ammonium oxalate solution in the presence of ammonia. The filtrate was evaporated to dryness with HNO_3, dissolved in HCl, and diluted. The magnesium was precipitated from ammoniacal solution as phosphate by $(NH_4)_2HPO_4$.

For the determination of manganese a fresh sample of clay was treated in a nickel crucible with hydrofluoric acid, and equal volumes of water and dilute H_2SO_4 (1:3), and evaporated to dryness. From this point the [4]chlorate method for manganese was used. The residue from the acid evaporation was fused with $NaKCO_3$. The product was treated with concentrated HNO_3, heated to boiling, and filtered from a residue believed to be nickel sulfate. The filtrate was boiled with $KClO_3$, but no precipitate of MnO_2 was obtained, indicating the absence of manganese.

A fresh sample of the clay was heated strongly to constant weight, and the loss was calculated as moisture and organic matter.

B. **Results of Analysis and Comparison of Same with [5]Analyses of Albany Slip Clay and Michigan Slip Clay**

	Cabell County Clay	Albany Slip Clay	Michigan Slip Clay
SiO_3	72.69%	57.65%	62.21%
Fe_2O_3	13.86%	4.92%	6.58%
Al_2O_3		15.75%	10.24%
CaO	3.46%	6.28%	8.24%
MgO	1.12%	3.20%	0.30%
K_2O	Undetermined	3.10%	4.20%
Na_2O	Undetermined	1.80%	1.00%
Ignition Loss	2.48%	7.30%	7.23%
Undetermined	6.39%	0.00%	0.00%
	100.00%	100.00%	100.00%

A Comparison of Usual Glaze Mixtures and the Cabell County Clay

Glazes are glossy coatings used to cover clay bodies for ornamentation, or for rendering the body impervious to moisture, or for both purposes. They are silicates or solid solutions of silicates and desired oxide or oxides. To prevent "crazing," they must have the same coefficient of expansion and the same shrinkage as the ware on which they are used. They vary greatly in hardness, transparency, color, gloss, and solubility. Glazes are classified as hard and soft glazes. The hard glazes fuse at high temperatures, and, therefore, contain a smaller percent of fluxing materials than the soft glazes. The latter are fusible at lower temperature, and they ordinarily contain a considerable amount of lead oxide. Glazes are also classified as matt glazes and bright glazes. The matt glazes give a dull finish to the ware, and the bright glazes impart a glossy finish.

[4]Griffin, Technical Methods of Analysis, McGraw-Hill (1927), p. 147.
[5]Ceramic Products Cyclopedia, Industrial Publications, Inc., Chicago (1930-31), p. 429.

According to W. A. Koehler,[6] professor of Ceramic Engineering, West Virginia University, the chemical composition of glazes is divided into three groups, namely, the bases (R_2O and RO); the sesquioxides (R_2O_3); and the acids (RO_2). A glaze may, therefore, have the following compositions:

0.20 Na_2O		
0.05 K_2O	0.28 Al_2O_3	2.86 SiO_2
0.25 PbO	0.38 B_2O_3	
0.50 CaO		

Our analysis indicates that the clay under examination contains no borates or lead oxide. In these respects it does not meet the requirements of the usual glazes, particularly the low melting glazes, for these generally contain borates at least. The Na_2O, K_2O, and CO_2 present may account for the low fusion point. The nickel found in the analytical tests doubtless came from the nickel crucible used during the fusion, and probably should not be considered as a constituent of the clay.

As indicated above, the composition of this clay is about the same as that of Albany Slip Clay and Michigan Slip Clay. The Albany Slip and the Michigan Slip are used satisfactorily for glazing stoneware and electric porcelain. The burning behavior is similar to that of the Cabell County clay. It is interesting to note that, according to Ceramic Products Cyclopedia,[7] an artificial clay of exactly similar composition to that of the Albany Slip or the Michigan Slip will not give the excellent results as to gloss or color that are attained by use of the natural clays.

The author and his co-workers can offer no satisfactory explanation for the glazing property. We feel that we have insufficient information to enable us to reach a definite conclusion as to the cause of this phenomenon. We, therefore, submit our results with the hope that interest in this material may be aroused and that other work may be done on this unusual type of clay.

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[6]Rogers, Manual of Industrial Chemistry, Vol. I, p. 352, D. Van Nostrand Co. (1926).

[7]Ceramic Products Cyclopedia, Industrial Publications, Inc., Chicago (1930-31), p. 440.

THE MONUMENTS OF THE MOUNDBUILDERS

By
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The present paper is the outcome of a very delightful and interesting ten-day trip made through that part of the Indian mound area lying between the Ohio and Mississippi Rivers. The largest and most interesting of the mounds in the United States are to be found in this section which includes the states of Ohio, Indiana, Illinois, and Wisconsin.

A lecture by Dr. Warren K. Moorehead, one of the outstanding authorities on the prehistory of this country, inspired in me the desire to visit the Indian mounds, a desire which was strengthened by reading Dr. Shetrone's scholarly and enjoyable book, "The Moundbuilders."

There are said to be approximately 100,000 mounds in the United States. Outside of a few anomalous earthenworks these may be divided into four groups:—first, **burial mounds,** which are as a rule conical in shape and constructed for mortuary purposes; second, **effigy mounds,** which are constructed in the form of birds, mammals, serpents, and humans. These are thought to have had their origin in sacred or religious observances and appear to be totemic in character; third, **fortifications,** embankments which enclose the tops of hills and other strategic positions and appear to have been purely defensive in character and; fourth,**geometric enclosures,** squares, circles, rectangles, and octagons, the purposes of which were apparently sacred or social, or perhaps a combination of both.

At Moundsville, West Virginia is found one of the best examples of a conical burial mound. It is 70 feet in height and a little over 250 feet in diameter at its base but it is not the largest Indian mound in the United States as it is commonly believed to be. This was one of the first mounds discovered after the early settlers had made their way across the Alleghenies and on into the Ohio valley, the heart of the great mound area. It was excavated by tunneling many years ago. Three skeletons were found in timbered burial vaults; two at the base and the other one twenty-five feet directly above. Ornaments of copper and mica and many shelled beads had been entombed with the bodies.

Marietta, Ohio, was the first capitol of the Northwest Territory and from the time of the arrival of the Ohio Company in 1788 until the present day the Marietta group of prehistoric earthworks has been a subject of much admiration and discussion. The works at Marietta represent an admiral example of what we have already defined as geometric enclosures. In 1788, and for many years afterward, they consisted of two huge rectangles, the larger one enclosing 50 acres and the smaller one enclosing 27 acres. The walls at that time were 6-10 feet high. In the larger enclosure were three truncated pyramids. At the eastern end of the smaller rectangle was a conical mound 30 feet in height around which was a moat and an embankment four feet high. All that remains of these extensive earthworks today is the conical mound and two of the pyramids. The mound is located in the Marietta

cemetery; the city library is built on one of the pyramids and the other is beautifully preserved in a small park.

As was said previously these geometric enclosures were constructed for some social or sacred purpose; no burials have ever been found in them. The pyramids may have been used as platforms upon which the tribal chieftains or medicine-men conducted ritualistic ceremonies.

The most extensive and impressive of the geometric earthworks are those to be found at Newark, Ohio, a two hours drive northwest from Marietta. Formerly these works covered an area approximately two miles square. The city has obliterated the eastern portion but the western part is remarkably preserved. A giant circle about 1200 feet in diameter, with earthen walls 10-14 feet in height, is situated in what is now the county fair grounds. This circle is of such proportions that a half-mile race track is concentrically located on the inside.

A circle almost as large, connected by two parallel walls to a huge octagon, lies on the grounds of the country club. The wall of the octagon is interrupted at regular intervals and just on the inside of each break, built with a surprising regard for symmetry, is a rectangular flat-topped mound. If the prehistoric walls that were originally constructed by the Indians at this site could be placed end-to-end they would reach a length of ten miles, or more.

The structure of the earthworks, coupled with the nature of the contents revealed through excavation, prove to the archaeologist that there were different tribes, or cultures, among the moundbuilders. For example, the Indians who were responsible for the Newark and Marietta works were probably of the same culture but, beyond question, a different culture entirely built the mound at Moundsville. There are three outstanding cultures in Ohio alone. The geometric works at Newark and elsewhere were designed and constructed by Indians of the **Hopewell** culture; the Moundsville mound and many of a similar nature were fashioned by Indians belonging to the **Adena** culture; while the defensive works at Fort Ancient, to be described later, were created by Indians of the **Fort Ancient** culture.

Of these three cultures the Hopewell stands head and shoulders above the others. Given certain environmental stimuli or a certain amount of coercive leadership and the Hopewell people might easily have rivaled the Aztecs of Mexico or the Mayas of Yucatan. Perhaps their mental attributes were on a par with their kin farther south and they lacked only the suitable building materials necessary for the construction of a Chichen Itza or a Temple of the Warriors somewhere in the Ohio basin. Even though their architectural attainments do not measure up to those of the Aztecs and Mayas the large numbers in which they occur, and their extensive distribution, are to be marveled at.

When the Hopewell Indians were in their heyday all roads led to the Scioto River valley in the neighborhood of what is now Chillicothe. Here was the very heart of the moundbuilder activity of Ohio. Within a radius of a few miles from Chillicothe are the Hopewell works, which gave the name to the culture, the Cedar Bank Works, Hopeton, Junction City, High Bank, Harness, and several others. Most of these works are alike in that they consist of a large circle and an adjacent

rectangle, both of huge proportions. There is also at the edge of the city the well-known Mound City group composed of 23 small conical mounds surrounded by a rectangular embankment.

Burials are not to be found in the walls that make up the circles and rectangles but there are frequently conical burial mounds nearby. The contents of these reveal a skill in the manufacture of weapons, ornaments, tobacco pipes, and other artifacts that furnishes conclusive evidence that the culture of the Hopewell people was on a very high plane and much superior to that of the other Ohio cultures. Outstanding among the artifacts exhumed were the remarkable effigy tobacco pipes designed in the form of the eagle, squirrel, frog, raccoon, dog, and other animals; the copper breastplates; and an infinite variety of flint and obsidian implements.

There was a great abundance of valuable pearls found in practically all of the burial mounds; in one instance 60,000 of them were unearthed. They were used for ornamentation, as is proved by the discovery of a necklace containing 332 well matched pearls, but they were also, most likely, used as a means of exchange.

The only mound in Ohio known definitely to be an effigy mound is the great Serpent Mound found in the southwestern part of the state. The serpent, 1330 feet in length and 2-3 feet in height, extends sinuously along the backbone of a ridge that overlooks a small valley. The head is on the edge of a bluff one hundred feet in height. Since there are no burials in this mound it is generally believed by archaeologists to be religious in origin. The serpent has always figured prominently in primitive religion, especially in those days of development in which nature and natural phenomena were endowed with animistic and spiritual attributes.

Strangely enough the Great Serpent has been identified as the very site of the Garden of the Fall. Some 20-25 years ago a certain minister of Ohio broadcast the theory that the Great Serpent was built by the hand of the Creator himself on the site of the original Eden to mark the first "Sad event."

This mound is better known than any of the others and is visited by thousands of people annually. Is this due to the great size of the snake or is it due to the singular fascination which serpents have always exerted over human beings?

Just a few miles west of the Great Serpent is Fort Ancient, the most outstanding example of prehistoric defensive works in the United States. The Fort occupies a promontory that overlooks the Little Miami River from a height of almost 300 feet. The location is eminently strategic since there is only one easily accessible approach, that from the north-east. Along the rim of the promontory is a wall 6-10 feet in height. It is highest at the north-east where approach is easy and lowest at the opposite end of the fort where the declivity is greatest. The embankment is over three and a half miles in length. The natural scenic beauty of Fort Ancient, enhanced by the care taken of the grounds and approaches, make it the most charming of all the prehistoric sites.

Several small burial mounds within the fort have yielded skeletons

and artifacts. The latter are different from those found in the Hopewell and Adena earthworks and are therefore believed to be of a different culture. Four or five other forts of a similar nature, although smaller, are found in southwestern Ohio.

It is a good days drive from Fort Ancient to East St. Louis but a sight of the great Cahokia mounds located there is adequate compensation for the time and effort expended.

The Cahokia group bears the distinction of possessing the largest individual mound, the greatest group of mounds, and the most extensive prehistoric village site of the entire mound area. At the present time there are said to be some 85 mounds in the group but Dr. Moorhead states that there were at an earlier date between two and three hundred, erosion and cultivation having destroyed the majority of the smaller ones.

In the center of the group stands the great Monk's mound, so-called from the fact that some Trappist monks resided either on or near it about the year 1810. This mound is the most remarkable prehistoric monument north of Mexico. It is a flat-topped rectangular pyramid 100 feet in height; the dimensions at its base are from north to south 1080 feet and from east to west 780 feet. The area of the base is a little over 16 acres, a greater area than that covered by the pyramid of Cheops, the greatest of the Egyptians tombs. To give some idea of the construction of this wonderful pyramid it has been estimated that the physical act of carrying every foot of earth in the mound, the cubical contents of which approximate 1,076,000 cubic yards, would occupy 150 moundbuilders 39 years. In all probability some great ceremonial structure was at one time located on the top. In addition to the Monk's mound there are several others near its base that range in height from 30-60 feet.

Only a motive impelled by a religious fervor could have been responsible for the stupendous amount of labor required to build the great number of smaller mounds and the huge Monk's mound, centrally located, which dominates over all the rest. We can only conjecture as to the reason underlying the particular design of the mounds.

In the region of Lewiston, Illinois, literally hundreds of Indian mounds are to be found. Five miles south of Lewiston is situated what is known as the Dickson's Moundbuilder Tomb. A few years ago Dr. Don F. Dickson and members of his family conceived the idea of uncovering a particular mound, leaving the burials and artifacts in place and erecting over them a building designed to serve as a museum. More than 200 skeletons have been uncovered and perhaps several hundred more await discovery. Considering the huge number of skeletons one rushes to the the conclusion that these Indians had died wholesale as the result of either pestilence or warfare and had been thrown indiscriminately into a common burial pit. A close examination reveals that this was not the case. The skeletons as they are now seen were placed in various positions and at different levels. Pottery vessels, in which are mussel-shell spoons, tobacco pipes, bone needles, stone axes, and many other objects were buried with them. Of particular interest was a group burial consisting of an adult male and an adult

female with a child between them. The skeletons were well preserved due to the alkaline nature of the soil. As evidence of this the remains of an embryonic child were discovered, the undeveloped bones of which were practically intact. One seeks in vain for an explanation of why so many Indians were buried together in this fashion. Visitors from all over the United States come to this tomb, as worshipers come to a shrine, and so much interest has been manifested that an attempt has been made by the World's Fair Committee to have it removed to Chicago for the 1933 exhibition.

Wisconsin is the home of effigy mounds. There are close to 12,000 mounds in Wisconsin alone and a large percentage of these are effigy mounds. They are constructed in the form of such animals as the bear, deer, panther, wolf, fox, buffalo, and turtle. Many birds are represented such as the eagle, swallow, and goose. Two or three examples represent the human form. They vary in size, naturally, and occur mainly in groups together with conical and many linear mounds. Some of the latter are several hundred feet in length. While the origin of effigy mounds is associated with ceremonial or totemic ideas, many of them contain burials. Whenever burials are found they are usually definitely located—centrally, within the head, midway between the shoulder and hip or in the position of the heart. Some of the effigies are startling in their proportions. A bird effigy at Mendota has a height of six feet with a wing spread of 624 feet while a panther effigy at the same place has a body length of 90 feet with a tail curving up over the back well over 100 feet in length.

MINERALOGY OF SANDSTONES OF NORTHERN WEST VIRGINIA[1]

By

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Contribution No. 93 of the Division of Industrial Sciences, West Virginia University.

INTRODUCTION

In this paper I shall give part of the results of the petrographic work which I have done on the sandstones of northern West Virginia. During the academic year 1930-31 financial assistance in this work was given by the West Virginia Geological Survey, and the well samples examined were also obtained by the Survey. The investigation was started with special reference to the problems of correlation of oil and gas sands and their relation to associated rocks. The petrographic descriptions of some thin sections by S. L. Powell[2] constitute the principal work of this type previously done on the sandstones of this region.

The sandstones examined by the writer range from Upper Devonian to Pennsylvania in age, and the aggregate thickness of the rock column in which they occur is estimated at about 3500 feet, from the top of the Conemaugh series down to the lowest horizon sampled in the Chemung. The number of samples examined is far from sufficient to determine the lateral and vertical variations of the many sandstones in this interval.

About sixty samples of oil and gas sands from twelve wells in Marion, Monongalia, Tyler and Wetzel counties were examined. There are large intervals between the samples from any one well and the horizons sampled in the different wells are not the same, so these samples are of little value for correlation purposes, although they are useful in determining the general character of the sub-surface formations.

The producing formations outcrop east of the area productive of oil and gas owing to the general westward dip and the large uplift among some of the anticlines. Specimens representing as nearly as possible the sandstones in stratigraphic positions corresponding to the productive sands were collected in Preston and eastern Monongalia county, West Virginia, and Fayette county, Pennsylvania. About one hundred outcrop specimens have been examined in detail.

Aside from some general observations as to kind of rock, color, degree of consolidation, structure and texture, the major part of the laboratory work on both well samples and outcrop material consisted of microscopic examination after suitable preparation. The preparation of outcrop specimens consists of crushing, sieving, cleaning of grains with acid, washing out clay and fine silt, drying and separation of heavy and light minerals with bromoform of specific gravity 2.85. Only the portion passing a sieve of ½ mm. circular opening was used in the bromoform separation. Slides for microscopic examination were pre-

[1]Detailed descriptions, localities and stratigraphic positions for the samples on which conclusions in this paper are based will be given in a report to be published by the West Virginia Geological Survey.

[2]In Vol. IV of West Virginia Geological Survey, Iron Ores, Salt and Sandstone, by G. P. Grimsley, 1909.

pared by mounting grains of the light minerals in Canada balsam (refractive index 1.54) and grains of the heavy minerals in piperine (refractive index 1.68). Preparation of the well samples was similar except that little crushing was necessary. The coarser fractions were examined with a low power binocular and the slides of the finer heavy and light portions were examined with a petrographic microscope. Most of the minerals mentioned in the following paragraphs occur in such small grains that they can be recognized only with the aid of the microscope.

Forty thin sections of sandstone from outcrops were examined for information as to texture and presence of minerals which might have been destroyed by the acid treatment.

CLASSIFICATION OF MINERALS AS TO ORIGIN

All minerals of sedimentary rocks may be considered under two headings according to their origin:—(1) **authigenic** minerals, or those formed **in place** in the rock in which they occur; (2) **detrital** or transported minerals which have been derived from some preexisting rock and carried to where they are now found. A mineral is classified as authigenic or detrital in any particular occurrence partly by the physical and chemical nature of the mineral itself and the shape of its grains or crystals, and partly by its relation to the other minerals in the rock. The minerals found thus far in the sandstones of northern West Virginia include the following:

Detrital minerals:—quartz, feldspars, muscovite, biotite, chlorite, tourmaline, zircon, rutile, leucoxene, anatase, brookite, ilmenite, magnetite, garnet, xenotime, monazite, apatite.

Authigenic minerals:—pyrite, quartz, calcite, siderite, dolomite, limonite, hematite, kaolinite, sericite, chlorite, leucoxene, barite, sphalerite, galena, anatase, brookite.

A few minerals are listed as both detrital and authigenic. The most common example of a mineral occurring in these two ways is quartz. **Detrital** quartz forms the greater part of the grains of most sand and sandstone; secondary or **authigenic** quartz is the principal cementing material in many siliceous sandstones. It is obvious that detrital minerals and mineral associations have a different significance from authigenic ones. Similar detrital minerals may be the result of derivation from the same or like sources, while similar authigenic minerals in two rocks may be the result of similar conditions during or since deposition.

Detrital minerals in sediments are likely to be those constituents of igneous and metamorphic rocks which are most resistant to weathering and to wear and tear during transportation by wind or water.

Authigenic minerals may be formed in several different ways. Some are precipitated from water at the same time that the sediment is being deposited; others are formed by the action of ground water in the pores of the rock at a considerable depth beneath the surface; others are the result of surface weathering of minerals which may be either detrital or authigenic in origin.

OCCURRENCE AND PROPERTIES OF INDIVIDUAL MINERALS[3]

Anatase (TiO_2) was observed in about half the specimens examined and seems to be generally present in small amount throughout the entire geologic section. It occurs both as worn grains and as very perfect crystals and groups of crystals which are undoubtedly authigenic. Square flat grains are most common; there are also some in the shape of a tetragonal bipyramid resembling the octahedron. The smallest crystals are nearly colorless and the larger ones yellow, blue or gray.

Apatite ($Ca_5F[PO_4]_3$) in detrital grains was found in about one third of the forty thin sections examined. These represent sandstones of the Chemung, Catskill, Allegheny and Conemaugh series. Apatite was not found in the heavy separates from crushed sandstones on account of its solubility in hydrochloric acid. According to Milner[4] apatite is more likely to survive in sediments not very pervious to water and its presence is somewhat of an indication of continental origin for the beds in which it occurs.

Barite ($BaSO_4$) in sediments is generally authigenic and occurs as a cementing material, in concretions, or in veins. In the well samples it has a stratigraphic range from about the horizon of the Speechley sand of the Chemung up to the salt sands of the Pottsville. It was found in outcrop specimens of the Pocono sandstone from near Friends Gap, Preston county, but since it was seen only as angular fragments in the crushed material, its relation to the quartz grains is not definitely known.

Biotite, the dark colored variety of mica, is much less common in sediments than muscovite, and is always detrital. It occurs in the less weathered portions of the Buffalo and Mahoning sandstones in the vicinity of Morgantown and in the Devonian sandstones of Preston county, being associated with larger amounts of muscovite.

Brookite (TiO_2), the least common of the three titanium dioxide minerals, occurs both as worn detrital grains and as distinct crystals of authigenic origin. In the Upper Conoquenessing sandstone near Cascade there are groups of thin flat brookite crystals which must be authigenic because it is difficult to see how they counld have been transported from any possible source in igneous or metamorphic rocks without being worn or broken. Not only are the crystal faces intact and free from wear but the connections between the crystals in the groups is so slight that the wonder is that they could even survive the disintegration of the rock preparatory to microscopic examination. A few worn grains of detrital brookite were found in various sandstones from the Chemung series upward in the geological column. In every case it is very scarce and it is perhaps largely a matter of chance whether or not a few grains are observed in the preparation. The grains of both the detrital and authigenic brookite are small, being rarely more than 0.10 mm. and usually only a few hundredths of a

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[3]For more complete description of the chemical composition and physical properties of these minerals and the characteristics which they show in sediments the reader may refer to,

N. H. and A. N. Winchell, Elements of Optical Mineralogy, 2nd edition, Part II, 1927.

H. B. Milner, Sedimentary Petrography, 2nd edition, 1929.

[4]H. B. Milner, Sedimentary Petrography, 2nd edition, 1929, p. 439.

millimeter in diameter. Brookite grains with surfaces rough from wear are difficult to recognize with certainty because scarcely enough light comes through to give a useful interference figure.

Calcite ($CaCO_3$) is widely distributed in these sandstones in small amount, as shown by effervescence of many samples with acid. As far as known, the calcareous sandstone in the lower part of the Greenbrier is the only one where the cement is calcite throughout any considerable mass of rock. No thorough study was made of the calcite and other carbonate minerals but there is no doubt that they are mainly authigenic.

Chlorite, a complex and variable hydrous silicate of aluminum, magnesium and iron is the cause of the greenish color of many sandstones throughout the section under consideration. It is present in well over half the specimens examined. The relation to other minerals shows both detrital and authigenic forms to be present. Chlorite occurs as distinct flakes up to a millimeter or so in diameter and in very fine aggregates with quartz and sericite. Flakes of biotite were seen which had altered to chlorite on the outside. Its shape, specific gravity close to that of bromoform, and the fact that chlorite is often attached to other minerals results in it being found frequently in both the heavy and light fractions.

Dolomite ($CaMg[CO_3]_2$) was found in a sandstone of the Allegheny series at Dellslow, Monongalia county, where it fills small cavities lined with secondary quartz. It is probably present in other samples since the regular laboratory procedure was not suitable for certain detection of dolomite in small amount.

Galena (PbS) occurs sparingly in small grains in the basal portion of the Buffalo sandstone at Albright, Preston county. It is of authigenic origin, as is also sphalerite, which was found in one outcrop specimen of the Buffalo and one of the Mahoning sandstones, and in a few well samples from the Greenbrier limestones and Pocono sandstones.

Garnet is one of the less common detrital minerals of the sandstones outcropping in northern West Virginia. More was found in the Pine Creek ,Buffalo and Mahoning members of the Conemaugh than in any of the other sandstones examined. The garnet grains are pale pink to nearly colorless, and generally irregular in shape, often showing conchoidal fracture. Some have shapes suggesting dodecahedral cleavage fragments, like the garnets described by Hedberg[5], but these shapes are probably the result of solution rather than breaking of crystals. Garnet is generally formed in metamorphic rocks, and rocks of this class are likely to be the principal source of the garnet in these sandstones.

Gypsum ($CaSO_4.2H_2O$) is not known to occur as a normal constituent of the sandstones of this region, but develops on weathered outcrops as a whitish coating or as small scattered crystals. It is likely to indicate the presence of pyrite in the less weathered materials, **Epsomite** ($MgSO_4.7H_2O$) is like gypsum in its origin and occurrence, but is so easily soluble that it is less likely to be found after prolonged rains. It

[5]Hedberg, Hollis . Some aspects of sedimentary petrography in relation to stratigraphy in the Bolivar coast fields of the Maracaibo Basin, Venezuela, Journal of Palentology, Vol. 2, p. 41, 1928.

was abundant beneath overhanging sandstone cliffs after the dry summer of 1930.

Hematite (Fe_2O_3) is responsible for the red color of the Catskill sandstones. It is an authigenic mineral, occurring as a coating on the grains and as a cementing material between them. It is dissolved by acid much more slowly than limonite.

Feldspars considered as a mineral group are, next after quartz, the most abundant constituent of the sandstones of this region. The feldspars observed are potash feldspar (orthoclase and microcline) and acid plagioclase, approximating albite. All of these, when in grains, are readily distinguished from quartz by lower refractive index. They are entirely detrital, and there was probably more feldspar, which in the more permeable sandstones has weathered to such hydrous silicates as kaolinite.

Feldspar is very abundant in most of the sandstones of the Chemung, Catskill and Pocono and in the calcareous sandstone of the Greenbrier; it is somewhat scarcer in the Conemaugh series and comparatively rare in the Allegheny and Pottsville sandstones. The fine sandstones are likely to contain more feldspar than the medium to coarse ones.

Ilmenite ($FeTiO_3$) is one of the less common of the heavy detrital minerals of various sandstones from the Chemung series up to the Grafton sandstone of the Conemaugh. It is probable that it was more common in the sands as originally deposited, but has largely altered to leucoxene and anatase.

Kaolinite ($H_4Al_2Si_2O_9$) occurs as soft, dull, white specks visible without a microscope in some of the medium to fairly coarse light colored sandstones of the Conemaugh, Pottsville and Pocono. It is probably formed from the alteration of feldspar, and is undoubtedly authigenic.

Leucoxene, a titanium mineral of not very well known composition, is universally present in the sandstones examined, and in some of them it is the most abundant heavy mineral. In the light portion it appears to some extent adhering to the quartz grains. Many of the grains tentatively classed with leucoxene have a rougher and less compact appearance and more of a yellow or brown color than those which are considered typical. There appears to be every gradation from groups of light yellow anatase crystals on which the characteristic shapes can be plainly seen, to the cryptocrystalline leucoxene. It is therefore suggested that much of the so-called leucoxene is really anatase. Leucoxene is formed by the alteration of ilmenite and other titanium minerals, but it is impossible to say how much of this alteration took place in these sandstones, and how much previous to their deposition.

Limonite, the poorly crystallized form of hydrous ferric oxide, is a nearly opaque brown mineral which gives most of the brown, orange and yellow colors to sandstones. In the sandstones under consideration it is mainly the result of recent surface weathering, involving oxidation of other iron minerals, such as pyrite and siderite. It occurs generally as a coating on grains, rather than as distinct grains in itself, and it is the removal of this coating which is one of the main objects of the acid treatment.

Magnetite (Fe_3O_4) occurs rarely as small black octahedrons in a few of the sandstones studied. Methods of preparation of the materials were not always favorable for detecting small amounts of it but it is certain that it is not common nor abundant.

Muscovite ($H_2KAl_3Si_3O_{12}$) or white mica occurs in distinct flakes of detrital origin in every sandstone member of every formation or series and in nearly every specimen examined. In many of the sandstones it is abundant enough to be an important factor in determining the composition of the rock as a whole and some of its smaller structural features. The coarser sandstones, especially those of the Conemaugh and Pottsville series, contain little mica because a current strong enough to move coarse quartz sand and pebbles would carry away the flat flakes of mica entirely. Most of the mica flakes come to rest with the flat sides parallel to the bedding planes of the rock and wave or current action has often sorted out the mica into thin streaks, along which the rock breaks more easily than elsewhere. The Buffalo sandstone at Morgantown and the Mahoning sandstone at Uffington and Little Falls are examples of sandstones containing enough mica to be readily seen without a microscope. Specimens can be obtained which on some surfaces show as much mica as a mica schist.

Muscovite is so little heavier than bromoform that often some of it remains in the light portion which floats in making the bromoform separation.

Pyrite (FeS_2) of authigenic origin was observed in about half of the heavy separates from outcropping sandstones and in nearly all of those from well samples. It occurs as small disseminated cubic or octahedral crystals and as aggregates of such crystals. Compound grains containing quartz and pyrite are common in some of the heavy separates. In some specimens pyrite is so abundant that it is difficult to see the other heavy minerals without removing it with nitric acid. Since small scattered particles of pyrite make a rock gray to nearly black, we do not find much of it either in red rocks or in nearly white ones. Marcasite, the other form of FeS_2, may be present, but no attempt was made to distinguish it from pyrite.

Quartz (SiO_2) is the principal mineral of sandstones generally, as well as in those of this region, where the percentage of it varies from 60 or 70 to very nearly 100. It makes up practically all of the light portions of the purer sandstones. Quartz occurs both as sand grains and as a secondary deposit around and between the grains. The quartz contains inclusions of many other minerals, which are mostly in the detrital grains rather than in the secondary quartz. In addition to dustlike material too fine for identification the following minerals were observed as inclusions: rutile, muscovite, chlorite, tourmaline, zircon, potash-feldspar, sillimanite and apatite.

In sandstones of the Pottsville, Allegheny and Conemaugh series secondary quartz has frequently formed about the original sand grains, in optical continuity with them. Where the pore space has not been completely filled crystal faces are frequently developed on the quartz, forming a **crystal sandstone,** recognized by bright reflections from faces of quartz crystals. Finely granular quartz occurs to some extent in

the cement of many of the sandstones, but fibrous quartz, or chalcedomy is so rare as to be practically absent.

Rutile (TiO_2) is one of the most persistent of the heavy detrital minerals and occurs in all of the sandstone members and in nearly every slide examined. In the few specimens where it was not seen it was probably present but obscured by larger than usual amounts of pyrite and muscovite. The actual proportion of rutile is small, since it usually amounts to less than one percent of the heavy fraction. Rutile usually occurs in grains composed of a single crystal, showing some indication of prism faces but worn or broken on the ends. The larger ones show considerable rounding.

Sericite is the name applied to the poorly crystallized muscovite which occurs in the form of fine aggregates, sometimes nearly pure but more often mixed with quartz, chlorite, pyrite, leucoxene, etc. It occurs in sandstones of all the formations examined and in nearly every specimen although it is rather scarce in some which are nearly pure quartz. Sericite is one of the principal cementing materials. Probably it is both detrital and authigenic. On account of its specific gravity near that of bromoform and its mixture with other minerals it may be found in both the heavy and light portions.

Siderite is one of the fairly common authigenic minerals in the rocks of the Pottsville, Allegheny and Conemaugh series. It occurs as concretions in shale and in disseminated form in sandstones where it acts to some extent as a cementing material. The rusty weathering of the Pennsylvania sandstones is due in part to oxidation of siderite. Siderite is usually considered as an indication of continental rather than marine origin for the beds in which it occurs.

Tourmaline occurs as detrital grains in every well sample and every outcrop sandstone examined, although the amount is so small that it cannot usually be found without separating the heavy minerals from the rock. Although almost universally present in sandstones, tourmaline is too scarce to have any significance in determining the physical properties of the rock. In the sandstones of Monongalia and Preston counties there are brown, blue and green tourmalines, and also grains with zonal structure showing every combination of two of these colors in the same crystal. Brown is the most common color and probably blue next. The tourmaline grains are as varied in shape as in color, the larger ones usually being rounded and the smaller ones either irregular chips or distinct crystals. All of the varieties of tourmaline are widely distributed but the Big Injun sand of the upper part of the Pocono shows an unusually large amount of tourmaline in proportion to the other heavy minerals and also an unusually large ratio of blue and green tourmaline to total tourmaline.

Xenotime (YPO_4) in sediments is always of detrital origin. It resembles zircon but is distinguished by lower refractive index. It occurs sparingly in the sandstones of the Conemaugh, Pottsville, Mauch Chunk, Pocono, Catskill and Chemung series, being most easily found where zircon makes up the largest part of the heavy saparate.

Zircon ($ZrSiO_4$) occupies a place among the heavy detrital minerals similar to that of quartz among the light ones, in that it is universally

present. Generally the more quartz in the light fraction, the higher the percentage of zircon in the heavy. In a fine to medium grained sand or sandstone most of the zircons are generally only a few hundredths of a millimeter in diameter, while in a very coarse sandstone there may be a few as large as 0.2 or 0.3 mm. in diameter. They are always much smaller than the associated quartz grains. Many of the zircon grains are distinct crystals, but the larger ones tend to be rounded. Possibly with more detailed study some of the formations might be distinguished by the particular variety of zircon which they contain. On account of its extreme resistance to alteration, which permits it to be carried through many cycles of erosion without change, zircon is of little or no help in indicating the immediate source of sediments.

RELATION OF MINERAL COMPOSITION TO COLOR

The principal colors of the sandstones examined are gray caused by pyrite and carbon, red caused by hematite, yellow and orange caused by limonite, and green caused by chlorite. Most of the unweathered sandstones would be called gray by a casual observer, but comparison with a color chart shows that few of these are really neutral gray but rather a yellow or yellowish green with a considerable amount of gray.

CEMENTING MINERALS

Quartz is the principal cementing material in the coarser Pennsylvanian and Mississippian sandstones and the greater part of it occurs as a secondary enlargement of the sand grains, the secondary quartz being in optical continuity with the original grain. Calcite is the cement in the calcareous sandstone of the lower part of the Greenbrier. Although often present elsewhere in small quantity it seems not to be important. The carbonates, dolomite and siderite also form part of the cement in some of the Pennsylvania sandstones. Muscovite, of the variety sericite, and chlorite in crystals of similarly small size form the cement in most of the Chemung and Catskill, and generally of the finer and less pure sandstones of the Pocono, Mauch Chunk, Pottsville, Alleghely and Conemaugh series. It is probable that there is usually some secondary quartz associated with them. Hematite forms part of the cement in the red sandstones of the Catskill in Preston county.

GEOLOGIC SIGNIFICANCE OF MINERALS

Indications as to Source of Sediments

The mineral composition of these sandstones shows clearly that a large proportion of the sediment composing them was derived directly from igneous and metamorphic rocks. Evidence of this is the occurrence of detrital apatite and biotite which are too easily weathered to survive more than one erosion cycle since their original formation in igneous and metamorphic rocks. Detrital feldspar and its alteration products occur more abundantly in many of the sandstones than would be likely in sediments which had been derived mostly from other sedimentary rocks. Although muscovite is very resistant to weathering, and might occur as detrital grains which had been subjected to weathering and erosion two or three times, its persistent and abundant presence strongly suggests direct derivation from muscovite schists and gneisses. Monazite

and xenotime are derived chiefly from granite and related rocks, but are so resistant to alteration that they might have survived a second erosion cycle.

The very high quartz content of some of the Pottsville sandstones and their corresponding lack of feldspar suggests that they were derived more from reworking of other sediments than were some of the other sandstone members in the series examined.

Correlation

The sandstones of the Upper Devonian, Mississippian and Pennsylvanian in this region seldom contain any fossils useful and convenient for correlation purposes. Where fossils are present they are likely to be fairly large plant fossils that could never be found in well cuttings. There are often no obvious lithologic differences between sandstones, and sandstone members must be identified more often by position in relation to known coal beds, limestones, fossil horizons in shale, etc. This procedure applies well in most of the Pennsylvanian, at least where there are good outcrops or where the coals have been opened up in many mines. In the Pocono, Catskill and Chemung series, where coal beds and persistent limestones are lacking and where many of the sandstones are lenses rather than continuous layers it becomes increasingly difficult to divide these thick series of alternating shales and sandstones into members. From favorable results which have been obtained in other regions, in correlating sediments by petrographic methods it seems to be at least a possibility that some of the fairly well defined sandstone members of the Pennsylvanian and Mississippian may be characterized by the presence of certain minerals or by the relative proportions of certain minerals. Moreover there is also a possibility that on the same basis the Upper Devonian rocks may be divided into members or zones corresponding to different periods of deposition, but not necessarily showing any simple relation to the gross lithology.

In Venezuela and California, to mention only two regions, correlation of Tertiary sediments by means of mineral composition determined microscopically has been successful from both the practical and the scientific point of view. The Paleozoic sandstones of the Mid-Continent and Appalachian regions do not show such clearly defined differences in detrital minerals and the variety of such minerals present is less. Preparation of material is frequently more difficult on account of more thorough cementation of the older rocks. The number of samples from any one formation which I have analyzed in connection with this project is too small to allow any definite conclusion as to the possibility of certainly recognizing any of the sandstone members on the basis of mineral composition alone, or as to the possibility of dividing the Upper Devonian into zones. However it seems likely that if any mineralogical distinction can be made between any part of the Catskill and Chemung series it will be by careful study of varieties of some of the common minerals and estimates of their relative amounts.

MASTODON (Mammut americanum) REMAINS IN RIVER GRAVELS AT POINT MARION, PA.

By

PAUL H. PRICE and DANA WELLS.

During the month of February of this year members of the Division of Tests of the State Road Commission brought to the authors a tooth for identification that had been recovered in the dredging operations of the McClain Sand Company at Point Marion, Pennsylvania, at the same time calling attention to the fact that a large bone had also been recovered, but the bone had been taken to the home of Mr. William H. Boyer, one of the workmen. A trip to Mr. Boyer's home, accompanied by Mr. Fred Jennewine, a few days later revealed a large leg-bone in fair state of preservation and supposedly belonging to a mastodon. The tooth was loaned the authors for identification, but Mr. Boyer being somewhat of a collector was unwilling to part with the bone, but had no objections to studying it there. On later trips measurements and photographs were made.

Location

Both the tooth and the bone were recovered from the Monongahela River but a considerable distance apart, the tooth coming from near the middle of the river about a thousand feet below the present mouth of Cheat River. It was picked off the "dumping table" before entering the crusher, but was estimated to have been unearthed from beneath some twelve feet of gravel. The bone was dredged from near the middle of the Monongahela but above the present mouth of Cheat River, or just above the present new bridge. As the mouth of the Cheat has migrated down-stream, the bone was found at a point that would have been formerly opposite the mouth of the river. It was estimated that the bone had been buried to a depth of some eighteen feet.

Geologic Age

The geologic age of these remains must of necessity be somewhat uncertain as it is most unlikely that the animal or animals died where the remains were found. The fact that the tips of the cusps of the tooth have been broken off, with the more prominent portions of the cone being somewhat rounded, suggests that they were transported by stream action. It is possible then that the remains may have been carried to the point of recovery either by the Monongahela or the Cheat. It is interesting to note that Dr. I. C. White is credited with reporting the finding of a Mastodon tooth that had been dug up on the fifth and highest terrace along the Monongahela River near Stewartstown, Monongalia county, West Virginia, the latter place being only three miles due south of Point Marion. The article of White's is quoted as saying "in the region of Morgantown the high-terrace deposits are about 275 feet above low-water mark in the Monongahela and 1,065 feet above tide. It is probable that the mastodon lived there during the early Pleistocene."

The history of the Monongahela drainage, which is pertinent to a discussion of the Pleistocene deposits over this area, has been discussed by Leverett (The Glacial Formations and Drainage Features of the Erie and Ohio Basins)[1] to which the reader is referred. It might be mentioned that the upper part of the Ohio River, the Allegheny, and the Monongahela with its branches at one time emptied into the St. Lawrence drainage basin. An advance of the continental ice sheet blocked this northern outlet, causing the drainage south of it to pond and eventually reverse its flow. After the ice finally retreated, the new drainage lines had been so well established that most of the streams of western Pennsylvania and West Virgina continued to flow down the Ohio.

Mammut americanum reached its greatest development during the Pleistocene and was quite common in North America. It is therefore assumed that this animal lived in this area during the early Pleistocene and probably died on what is now the high terrace, to be carried later by a stream into the gravel deposits at the mouth of Cheat River.

Upper Left Hindermost Molar, MAMMUT AMERICANUM (Kerr)

The crown is crossed by five transverse ridges, four of which are quite prominent but the fifth with the cones broken off is much lower than the rest. Behind the fifth crest there is a small heel composed of three tiny tubercules. All the intervening valleys (Fig. 1) are conspicuous except the last which is only moderately deep near the middle. A shallow median cleft traversing the long axis of the crown bisects each ridge into an inner and outer cone. The outer end of each transverse ridge is more nearly perpendicular to the grinding surface of the tooth, while the inner end exhibits a more gentle slope from the crest to the base. Each inner cone is buttressed by two ridges, one extending from the apex to the base on the front face, the other on the rear face. The buttresses on the inner cones of the third and fourth ridges are thicker and heavier than those of the first and second ridges. Those of the latter show considerable wear and polishing by mastication The two islands of dentine (Fig. 2) on the cones of the front ridge are due more to a breaking away of the apices than to natural wear. Smaller islands of dentine on some of the hinder cones appear from a wearing down of the thick enamel. The layer of enamel varies in thickness. At a point along the base of the front ridge it shows a maximum thickness of 5 mm. The cingulum is strongly developed along the front of the inner cone of the first ridge and back to the inner cone of the third ridge. It is also distinct at the ends of the two remaining valleys on the same side and blocks the ends of the valleys between the outer cones of the tooth. The extremities of all the roots have been broken off exposing a shallow pulp cavity extending from above the first ridge to the fourth. The longest portion of any of the roots rises from above the middle of the third ridge and measures 38 mm. This tooth has a length of 187 mm. along the crown; a width of 101 mm.

Right Tibia, MAMMUT AMERICANUM (Kerr)?

The bone (Fig. 3) has been tentatively identified as the right tibia

[1]Monograph—U. S. G. S., Vol. XLI, 1902, pp. 88-158.

from a skeleton of Mammut americanum (Kerr). Final identification will be withheld until perhaps this summer when a comparative study can be made with similar bones in the United States National Museum. If the correct identification has been made, a comparison of measurements with the tibia[2] belonging to a mounted skeleton of the same species in the Museum at Washington, shows our specimen to be much larger in every respect. The total length of our fossil bone checks more nearly with the tibia[3] of a skeleton of Elephas primigenius Blumenbach, found in Grant county, Indiana, and and now in the American Museum of Natural History, New York. The length of that tibia measures 735 mm.; greater by 43 mm. than our specimen. One striking feature, of the bone herein described, is the length being shorter by 58 mm. than the circumference of the upper end. Our specimen presents the following measurements:

Total length	692 mm.
Circumference of shaft, where smallest	343 mm.
Circumference of shaft at upper end	750 mm.
Circumference of shaft at lower end	557 mm.
Diameter from front to back at upper end	273 mm.

1.

2.

3.

PLATE I.

[2]Iowa Geological Survey, Vol. XXIII, 1912, p. 331.
[3]Iowa Geological Survey, Vol. XXIII. 1912, p. 398.

Fig. 1. Mammut americanum. Upper left hindermost molar, seen from outside. X1/3.

Fig. 2. Mammut americanum. Crown view of upper left hindermost molar. X1/3.

Fig. 3. Right Tibia, Mammut americanum? X1/5.

(Photographs by G. C. Bailey)

DRAINAGE DIVERSIONS OF THE CHEAT RIVER

By
H. M. FRIDLEY.

The peculiar pattern of drainage of the Cheat River has long attracted the interest of geologists. The present system drains an area of 1,418 square miles. Over 90% of this area is east of Chestnut Ridge through which Cheat River is entrenched in a canyon-like gorge.

Stream Piracy at the Headwaters of Cheat River

The amount of diversion which has taken place is the subject of much discussion. It is certain that recently the Cheat River system has lost a considerable amount of its drainage at its headwaters. There can be but little question that Greenbrier River has extended its tributaries northward and has captured most of the drainage which formerly went into Shaver's Fork, Laurel Fork and Gandy Creek. It has been pointed out by Price[1], and Wright[2], that Leatherbark Creek, Pocahontas County, a branch of Greenbrier River, is now robbing upper Shaver's Fork. At the time of the completion of the Upland (Kittatinny-Schooley) Peneplain the fact that the Greenbrier was located on an anticlinal structure, whereas Shaver's Fork was a synclinal stream, explains the much more rapid downcutting of the former stream. The added volume of water gained by the capture of the tributaries of Shaver's Fork gave the Greenbrier an added advantage in downcutting over the north-flowing branches of Cheat River which are located on structure similar to that in the Greenbrier Valley. Subterranean drainage through limestone has played an important part in stream diversion.

Reger[3] has mentioned the finding of stream boulders on the divide between the south-flowing Greenbrier and the north-flowing Glady Fork.

In connection with his study of the "Physiography of the Upper James River Basin in Virginia," Wright prepared a map showing the reconstructed Upland Peneplain. If Wright's conclusions are correct, the Greenbrier has eaten back through a distinct dome. From a study of the present drainage conditions and a study of the the slopes of the Upland Peneplain, it is apparent that the region north of Marlinton was an ancient drainage divide. Here rise the headwaters of the James, Greenbrier, Gauley, Cheat, and South Branch Potomac rivers.

Wright has indicated many domes on the old peneplain surface which, he contends, are due to subsequent warping rather than to monadnock areas. He offers as proof to his theory the fact that a tributary of Williams River extends entirely across Spruce Dome. If the theory of such extensive warping be accepted, then many of the drainage anomalies in West Virginia can be readily explained.

Back Creek, in Virginia, has apparently extended its drainage several miles to the northward since the uplift of the Upland Peneplain. It is in the process now of robbing the head waters of Laurel Fork, a tribu-

[1]Paul H. Price, "Pocahontas County," W. Va. Geol. Surv. (1929), p. 62.
[2]Frank J. Wright, "The Physiography of the Upper James River Basin," Va. Geol. Surv. (1925), p. 55.
[3]David B. Reger, "Randolph County," W. Va. Geol. Surv.(1931), p. 790.

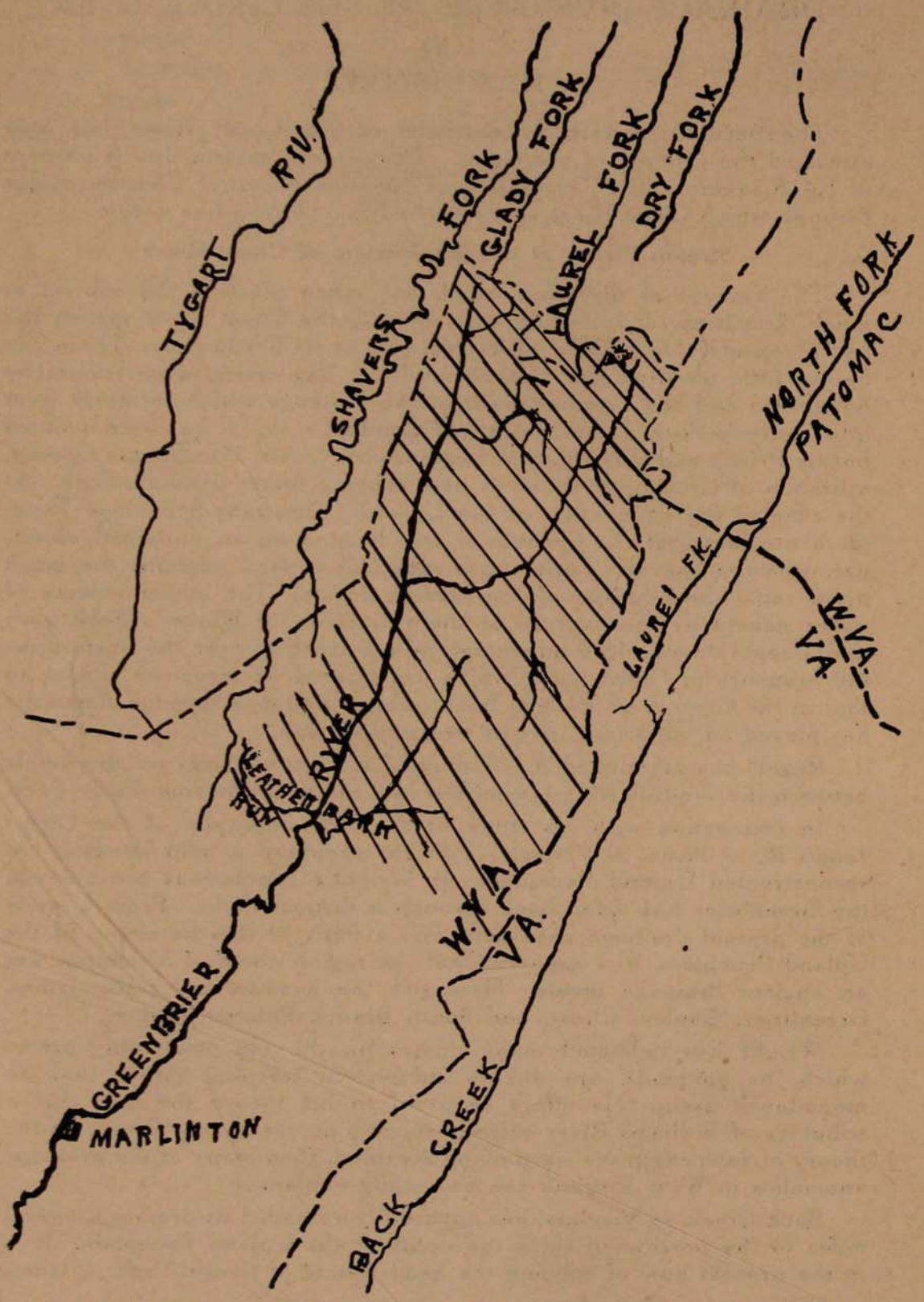

Fig. 1. Map showing the former drainage area of the Cheat River system which has been diverted by Greenbrier River.

tary of the Potomac system. The divide area on the ancient Upland Peneplain was probably in the area shown in Figure I, an area which is now drained principally by the Greenbrier River.

Evidence of Diversion of Lower Cheat River

Water gaps or deep gorge-like valleys can be accounted for in three ways: (1) to the entrenching of an antecedent stream; (2) to superimposition; and (3) to headwater erosion. It has generally been considered that Cheat River cut through Chestnut Ridge as fast as this anticlinal ridge rose in its path. Accepting this as true, then Cheat River is an antecedent stream. The unwarping of Chestnut Ridge must have occurred in late Tertiary or early Pleistocene time.

In 1931 Nőlting[4], in his paper entitled "Drainage Changes in the Headwaters of Deckers Creek," offered evidence that Deckers Creek had cut back to Chestnut Ridge and had captured the headwaters of Three Fork Creek, a south-flowing branch of the Tygart River. The author of the present paper offers evidence that Cheat River likewise is a pirate stream.

The basin between Chestnut Ridge and Briary Mountain in Preston County has a general slope toward the south. Many of the tributary streams, especially those coming in from the east and north, empty into Cheat River either at right angles or actually with acute angles pointing upstream (Fig. 2).

North-south profiles were drawn across the western part of the Kingwood quadrangle and also across the Thornton quadrangle. These profiles show a depression extending from the west bank of Cheat River, a few miles east of Tunnelton, westward and southward toward the Tygart River. This depression follows a branch of Three Fork Creek for two or three miles west of Tunnelton and then swings southward toward the Northwestern Turnpike, thence in a more westerly direction to the Tygart River.

If this depression is really the site of the ancient Cheat River it means that a pirate stream has eaten back through Chestnut Ridge, following, for the most part, the weak Mauch Chunk shales and Greenbrier limestone, and then has extended its drainage southward to a place where the capturing of the ancient Cheat River was effected.

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[4]John P. Nölting, Jr., "Drainage Changes in the Headwater Region of Deckers Creek," Proc. W. Va. Acad. Sc., Vol. V (1931), pp. 149-152.

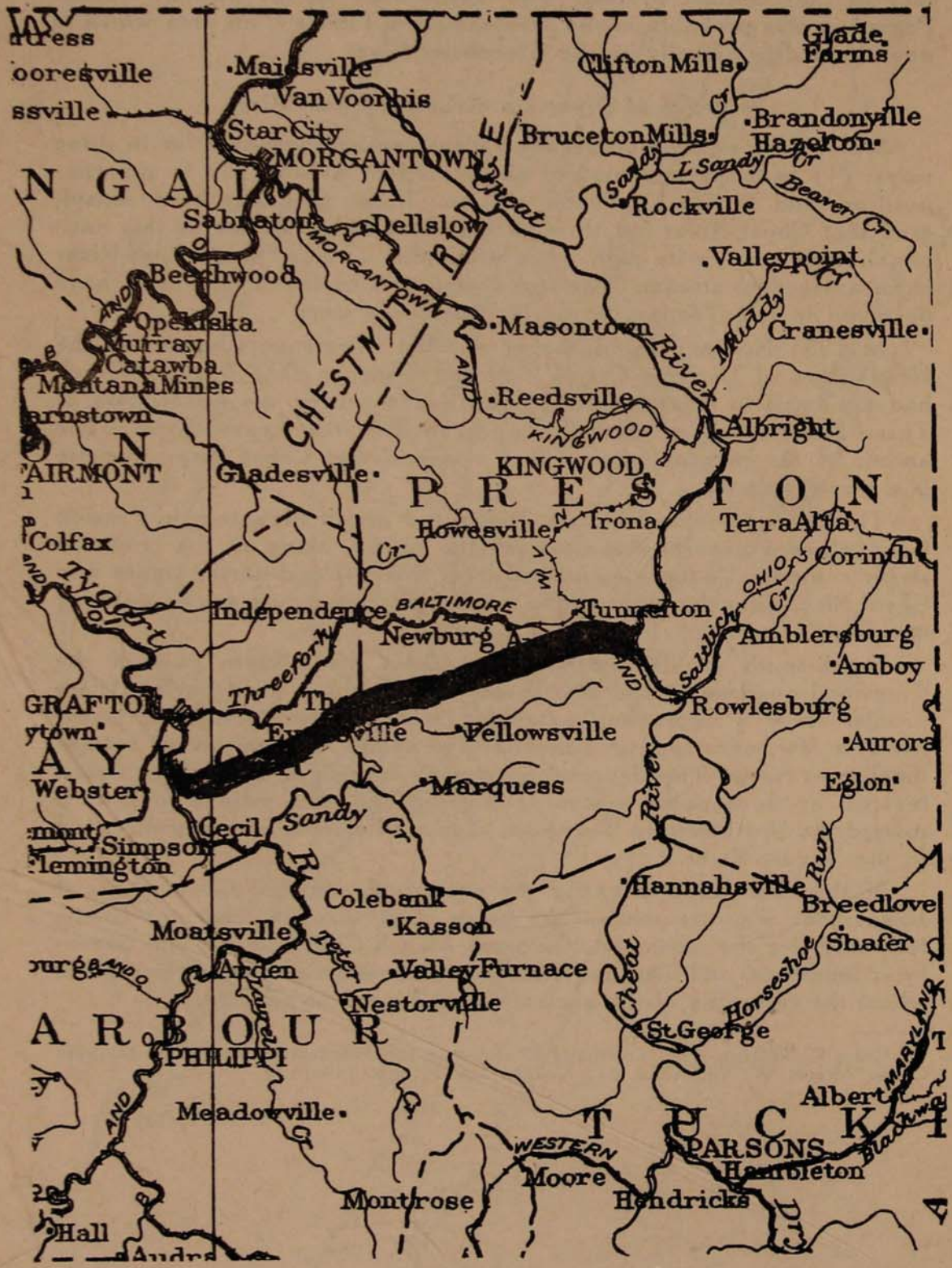

Fig. 2. Map showing the probable former course of the Cheat River.

THE TRAINING OF SCIENCE TEACHERS FOR HIGH SCHOOL

By
L. G. RAUB,
Professor of Physics, New River State College.

The purpose of this paper is to bring before the minds of the science teachers in the state of West Virginia conditions which all know exist but regarding which the Scientists of the state have been largely passive. However it seems to the writer that all science teachers in our colleges should be interested whether training future teachers or future scientists.

Hassler and Smith in The Teaching of Secondary Mathematics make the following statement regarding the teachers of secondary mathematics:

"Suppose that a party of tourists is setting out for a long trip into a comparatively unknown and unsettled region. Suppose that no guide is at the time available for more than the first day's journey. Suppose that of two guides under consideration one has never been farther than one days journey on this particular tour while the other has been over the whole route. Certainly the tourist would prefer the services of the guide who knows all about the trip ahead of them beyond the point to which he can take them. They need to be guided in their preparations for the journey by one who knows just what their future needs will be. Similarly if a class of pupils is to enter through the gates of algebra and geometry into the domain of the oldest, most used, and most perfectly developed science known to the human race, they should have for a guide one who knows what is inside, far beyond the point to which he expects to lead his class.

"We should not think much of a teacher of a class reading in the third reader who had never read beyond the fourth reader herself and knew nothing of literature.

"It is strange, then, to find a prevalent misconception that, if anyone has had as much as one course in mathematics beyond what he teaches, he is a satisfactory teacher. Until this diseased state of mind is healed we shall continue to have indifferent teaching of mathematics. Every teacher of mathematics who expects to continue as such should feel obligated to make further (and then further) acquaintance with the subject."

What has been said above regarding mathematics could be said of any or all of the sciences. No teacher is prepared to teach a science in High School who does not know more about that science than he expects to teach his pupils. The teacher should have a sufficient knowledge and grasp of his subject that he may bring in interesting ideas and examples to stimulate the interest of his pupils. This is possible only with a wide and thorough knowledge of the subject being taught.

Before going further the writer wishes to make it clear that he believes a really good teacher must have an adequate cultural background in addition to his knowledge of the subject being taught. There

is nothing more pitiful than to see a man or woman who can think and talk only about physics or chemistry.

It has been in the writer's mind while thinking about this paper to give a few of the requirements for the First Class Certificate and then give some criticisms thereof.

The following data is taken from Teacher Training Bulletin No. 3, 1931, and Teacher Training Bulletin No. 7, 1928:

Subject Groups	Semester Hours
English	34
Social Science	34
Physical Sciences (Chemistry, 16, Physics 16)	32
Biology and General Science (Biology 20, Chemistry 8, Physics 8)	36
Mathematics	16
Home Economics	40

The writer has no criticism to make of requiring 34 semester hours in English and the Social Sciences. Probably there should be more required if we are to approach the ideals of thoroughly competent highschool teachers for our boys and girls.

But the writer does wish to criticise the requirements in the next three subject groups. In the Physical Sciences there are required; Chemistry 16 semester hours, Physics 16 semester hours. These requirements are woefully inadequate if our guide is to stimulate sufficient interest in our high school students for these subjects so that students will want to pursue them further in college and University. Indeed it seems to the writer justifiable to say that 16 hours of Physics or Chemistry will barely enable the average man or woman to take a class of high school students through a good high school text.

The next two groups appear to be even more inadequate, particularly when one realizes that a teacher in the Biology and General Science group may be called upon to teach either physics or chemistry. The inadequacy of the training in this group becomes even more apparent when we consider the four year curriculum as given in Bulletin No. 7. No mathematics is required and how anyone is to learn or teach physics and chemistry without some mathematical background is beyond the understanding of the writer.

It might be well to consider the four year curriculum for teachers of Physical Sciences and for teachers of mathematics:

TEACHER TRAINING BULLETIN No. 7, 1928.

Four-year Curriculum for Teachers of Physical Science.

	Sem. Hours	Sem. Hours Required
1. Physical Sciences		
(a) Chemistry	16	
(b) Physics	16	
Total		32
2. Mathematics		6
3. English and Public Speaking		12
4. Social Studies		12

5. Geography and Geology		6
6. Health and Physical Education		6
7. Education		
(a) Constant for all teachers	11	
(b) Materials and Methods in Teaching Sciences	2	
(c) Directed Teaching	3	
(d) Electives in Education	4	
Total in Education		20
8. Second Teaching Subject and Electives		34
Total required for certificate		128

The mathematics requirement is not sufficient for a student to take the required 16 hours of physics. This difficulty might be alleviated by making mathematics the second teaching subject. However there is a more serious objection. Our high schools are beginning to give the preference to candidates who have obtained their master's degree. The amount of physics or chemistry required in the above curriculum is not sufficient for a major for the baccaulaureate degree and is not sufficient for graduate work in either field. Therefore when our students come up for their A. B. degree they suddenly find themselves confronted with a Faculty ruling "Not a sufficient number of hours for a major and therefore not eligible for graduation."

Sometimes however our Faculties may be lenient and grant the degree with a major as combined physics and chemistry. Are John Jones' difficulties ended? Not so you would notice it. In about two or three years his principal suggests the advisability of doing some graduate work. So the registrar is asked to send his credits to the University and he makes his application for entrance to the Graduate School in one of his subjects. Then comes the bitterest blow of all; not sufficient work in his subject to begin graduate work and therefore he must give up a couple of summers to doing undergraduate work for which he will receive no credit toward any degree.

It is always easy to make destructive criticisms but in a paper of this kind there should be something that could possibly be interpreted as constructive. Therefore the writer will make two or three suggestions that seem to him to be of a constructive nature.

First it does not seem reasonable to have required a greater number of hours in education than in the teaching subjects. Therefore eliminate the 4 hours of elective education and add them to the physics and chemistry.

Next cut twelve hours from the elective group and add them to the physics and chemistry, making a total of chemistry 24 semester hours, physics 24 semester hours. This could be counted as a bare minimum requirement for a major in either subject.

This leaves only 22 hours electives which seems rather low, so let us make an alternative suggestion. Instead of taking 12 hours from the electives take 8 hours and add them to either the physics or chemistry, depending on which the student prefers, making a total of 26 hours in

one and 18 in the other. This leaves one of his teaching subjects still weak but some stronger than at present. It does give a legitimate major and would enable the student to begin graduate work in his main interest.

However the mathematics is altogether too weak and the only solution seems to be to either make mathematics the second teaching field or take mathematics as electives.

Four-year Curriculum for Teachers of Mathematice

	Sem. Hours Required
1. Mathematics	16
2. English and Public Speaking	12
3. Social Studies	12
4. Science	6
5. Health and Physical Education	6
6. Education (Same distribution as above)	20
7. Second Teaching Subject and Electives	56
Total required for Certification	128

The above curriculum is if anything worse than for the physical sciences because it is needlessly so. Again the writer suggests taking four of elective education credits and 8 hours of electives and adding them to the mathematics requirements, making a total of 28 hours for the mathematics which would seem a reasonable requirement.

These criticisms and suggestions are not offered with any idea that these changes would make a perfect curriculum. They are given with a feeling that such changes would be an improvement and with the hope that it may stimulate thought and action looking towards an improvement in our present curriculum.

In closing permit me to quote one more passage from Hassler and Smith, The Teaching of Secondary Mathematics.

"A young man who ranked very high in mathematical ability had almost completed the work for a Master's degree, majoring in mathematics, when he secured a position as teacher of mathematics in high school. His general attitude, manner of speech, and reactions towards educational methods were such that it seemed as if he might be a failure as a teacher of boys and girls. He had a minimum preparation along the lines of psychology and education. At the end of the first year his superintendent was asked for a confidential statement concerning the young man's work as a teacher. He wrote as follows:

" 'His only weakness in high school is the problem of discipline. He gets so interested in the development of the subject matter that he does not notice slight disturbances at all. It is a fact that he can get more mathematics across to the students in spite of trivial disturbances from time to time than I have ever been able to do and I have been regarded as a strict disciplinarian.' "

IRREGULARITIES IN THE MOON'S MOTION

By
M. J. KELLY,
Elkins.

The exact calculation of the Moon's motion in it's orbit is one of the most difficult tasks of Astronomy. Professor Brown spent about twenty years on his, "Tables of the Moon," which are the latest and mosa accurate. He found 155 periodic terms for the Moon's longitude with coefficients exceeding one-tenth of a second, and 500 smaller ones whose sum would have to be considered if we wish to compute the longitude to one-tenth of a second. The number of terms in the latitude is about half as great, and in computing the parallax about 150 have to be considered. The Sun, being the main disturbing force, most of the perturbations are due to it's attraction. At new moon, the sun attracts the moon and the earth in the same direction, but the moon more than the earth, since it is nearest and tends to pull the moon away from the earth. The result is that of a disturbing force acting on the moon and directed away from the earth. At the first quarter, the forces are acting along converging lines, and the earth and moon tend to approach one another. In this case the disturbing force is directed toward the earth. At full moon, the earth is nearer the sun and therefore pulled away from the moon, and the disturbing force is directed away from the earth. While we have been speaking of the forces acting between the bodies, it is not the forces we have to deal with, but the accelerations due to the forces. The force of the sun's attraction on the earth is about eighty times as great as that on the moon, owing to the idfference of mass, but at the same distance the accelerations are equal. The attraction of the sun on the moon is more than twice the earth's, so that if the earth could be held stationary, the sun would pull the moon right away from it. Since the earth and moon are both free to move, the difference in their accelerations is all we have to deal with. At the time the sun crosses the line of apsides of the moon's orbit, a period about 31.8 days, the eccentricity of the orbit is increased about 20 percent. When the sun is 90 degrees from perigee, the eccentricity is diminished about the same amount. While the eccentricity on the average remains the same the line of apsides advances and completes a revolution in 8.8503 years. The inclination of the moon's orbit is nine minutes less than it's average when the sun is at the node, and nine minutes greater when it is 90 degrees from it. The inclination is subject to periodic changes only, but the line of nodes regress at an average rate of once in 18.5995 years. The attraction of the sun on the earth and the moon acts on the average as a disturbing force directed away from the earth. The result of this, is a diminishing of the earth's attraction on the moon and the month is about 53 minutes longer than it would be if the moon's motion were undisturbed. So far, only the sun has been considered as the disturbing force, but the planets directly and indirectly cause a multitude of periodic perturbations. Directly by their own attraction and indirectly by altering the earth's motion around

the sun. There is also an important though small influence on the length of the month due to the indirect action of the planets. Owing tosecular planetary perturbations the eccentricity of the earth's orbit is slowly decreasing. Since the major axis of the orbit is unaffected, a slight increase of the minor axis takes place and this increases the average distance of the earth from the sun during a year. This increase average distance lessens the sun's disturbing action on the moon and the sideral month is therefore slowly becoming shorter. This will continue for about 24,000 years or until the eccentricity has diminished to zero, when the action will then be reversed.

As a result of this the moon slowly moves ahead of the position calculated with a uniform period. Theoretically this change amounts to only 6.01 seconds every one hundred years, but this amounts to 40 minutes in 2000 years, an amount great enough to be detected from the records of ancient observations. This acceleration of the moon was found by Halley more than 200 years ago, by comparing ancient with modern eclipses. Recently, from a check of all the records of ancient observations, astronomers find an acceleration of 10.3 seconds per century. The difference between this and the theoretical value must be real, and can be accounted for only by a gradual slowing of the earth's rotation and lengthening of the day. They also found an apparent acceleration of the sun of 1.5 seconds per century, which can be explained only by an increase in the length of the day. By a lengthening of the day at the rate of $\frac{1}{1000}$ of a second per century the moon would be set ahead about 5.8 seconds and the sun about 0.75 seconds. This agrees with the observed values well enough, due to the uncertainty of the data. The cause of the slowing of the earth's rotation is due to friction of the lunar and solar tides. In the oceans where the water is deep the motion of the tides are slow and there is little friction, but near the land where it is shallow great masses of water flow in and out with a large amount of friction, and this necessarily involves the expenditure of considerable energy. This energy is derived mainly from the rotational energy of the earth, and the effect is to slow the earth's rotation and lengthen the day. If the slowing of the earth's rotation is due to tidal friction, the power expended in lengthening the day by $\frac{1}{1000}$ of a second per century, would require the continuous dissipation of energy at the rate of 2100 million horsepower. Jefferys and Taylor have calculated the dissipation of energy by tidal friction for all the regions where tides are strong, and find on the average the total rate of dissipation is 1500 million horse power. They found about two-thirds of all the friction occurs in Bering Sea, where the currents are strong and the water shallow. While the information on which the calculations are based is rather rough, it is probable that better information would lead to a closer agreement with the value of 2100 million horse power. As the rotation of the earth gradually grows slower the angular momentum associated with it diminishes. While angular momentum is indistructible it may be transferred from one body to another in a system. In this case the angular momentum lost by the earth is gained by the moon, and as the moon gains angular momentum it's orbit will expand, and the moon will move

farther away from the earth. The farther the moon is from the earth the slower it moves in its orbit and thus the month must grow longer. These influences acting through almost countless ages of time must have altered the earth-moon system to a marked extent. In remote times the earth must have rotated faster, the moon nearer, and the month shorter. The limiting state can be shown to be that in which the day was a little less than five hours long, the moon about nine thousand miles from the earth, and the month about the same length as the day. Jefferys estimates the time required to bring the earth-moon system to its present state to be about four thousand million years.

In the future, the earth will gradually slow down, the moon will recede from the earth, until at last the earth keeps the same face toward the moon, and the day and month are equal to forty-seven of our present days. This, however, is not the final state. The solar tides will still be at work and will continue to slow the earth's rotation until the day is longer than the month. The lunar tides will then oppose the solar tides and tend to accelerate the earth's rotation. The angular momentum will then be very slowly transferred to the orbital motion of the system around the sun. The moon will gradually come back to the earth and may at the last be torn to pieces by the tidal forces and form a ring system around the earth like that of Saturn. This, however, will take an exceedingly long time, and the sun may have ceased to shine before it is accomplished. After allowing the influence of all known bodies, there remain disagreements between the computed and observed longitudes of the moon which are unexplainable. These sometimes exceed ten seconds and may change by several seconds in a few years. The greater part of these appear to be of a periodic nature. One with a period of about 260 years, with a range of about 14 seconds on each side of the mean, and another, the period of which is about 60 years, ranging about 3 seconds each way. Newcomb and Brown agree that the law of these fluctuations is unknown, and that their future course cannot be predicted. The observed positions of the sun and the inner planets also show deviations which are remarkably similar. All these deviations could be explained by supposing that the earth, considered as a clock, gets sometimes fast by as much as twenty seconds, and at other times slow by the same amount. Brown has suggested that these changes of rotation are real, and arise from the alternate expansion and contraction of the earth, due to internal causes, and amounting at most to a few feet.

MONOPOLIES AND BUSINESS DEPRESSION

By
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It is a commonplace of economic theory that business depressions are the results of various kinds of maladjustments. But the maladjustments and the causes of the maladjustments which have produced our numerous depressions have not always been the same. Each successive depression has been marked by some peculiarity of its own; and it seems that the peculiarity of the present business depression, not only in the United States, but in the world at large, is a variety of serious maladjustments growing out of the deliberate restraint of the free flow of trade by tariff barriers between one country and another and by monopolistic control of prices and production within the national boundaries. The limitation of time requires that the present discussion be confined to a consideration of one phase of this broad subject, namely, the relation of monopolistic control over prices to the depression in the United States.

Monopolistic devices used for the purpose of price control are not new in the United States. Fifty years ago John D. Rockefeller and his associates invented a monopolistic device—the combination trust—which worked so well that the word trust soon became the most common term used to designate industrial monopoly. The trust, in its technical sense is, however, merely one of numerous forms of business organizations which have been used to control price, including gentlemen's agreements, pools, holding companies, mergers, amalgamations, outright consolidations, and trade associations.

The multiplication of these various types of monopolies many years ago frightened our legislators into enacting a great many laws against monopoly and restraint of trade, including more than a score of state anti-trust laws and the federal Sherman Anti-trust Act; and, before the war, some of these laws were occasionally enforced, sometimes to to the surprise, sometimes to the detriment, and sometimes to the profit, of the offenders.

Then came the world war, which, like the flood in an earlier epoch, interrupted the continuity of history. After the war Warren G. Harding, entirely surrounded by the best minds and dedicated to "normalcy," came into power, and the anti-trust laws, along with some other pre-war antiques, were relegated to the administration attic. There they have remained ever since, undisturbed except for an occasional perfunctory inspection and light dusting. During the post war decade it became sound political gospel that business competition is ruinous and that peaceful cooperation should supersede the ancient and barbarous economic warfare. The experience of the dollar a year men in price fixing in Washington during the war no doubt suggested to many of them that the war to end war might well be made the occasion for ending price wars, a belief that apparently was held by one of them who later became Secretary of Commerce and then stepped up one more rung on the ladder of political success to an even higher office.

At any rate since 1920 monopolistic devices for maintenance of prices have flourished in the United States as never before, and foremost among them that wolf in sheep's clothing, the trade association. The avowed purpose of the trade association is not restraint of trade or monopoly, but helpful cooperation among its members—its membership being as large a proportion of the producers in a given industry as can be induced to join. The nice distinction between the adjustment of supply to demand so that the product may be sold at a price covering cost plus a fair profit, and monopolistic control of output and of prices should be carefully observed. It is on the basis of this altruistic control over production exercised by the trade association as contrasted with the grasping and selfish policies of the old pre-war types of monopolies, that the argument is advanced from many quarters that the Sherman Anti-trust Act should be no longer retained in the attic, but be hauled down and burned up, lest it fall into the hands of the enemies of peaceful and cooperative price-fixers.

It will not here be contended that there is no persuasive argument favoring repeal of the anti-trust laws, and favoring the monopolistic control of prices by private business interests. It will, in fact, be admitted that as industry is now organized, with heavy investment in fixed plant and equipment and heavy overhead costs, competition may indeed prove to be ruinous to the competitors and detrimental to the general public. But it must be pointed out that however ruinous and detrimental competition under present conditions may be, deductive reasoning leads to the conclusion that monopolistic practices on the scale practiced in the United States since the war are more ruinous and must lead inevitably to economic disaster. And, unfortunately, this is not all. Economic history of the past ten years confirms the soundness of this economic theorizing—monopoly has actually brought us to economic disaster.

Let us consider briefly the theory of monopoly price. The purely selfish monopolist fixes the price of his product at the point which will yield him the greatest aggregate net return—that is, at such a level that his profit per unit times the number of units sold will be at the maximum. He applies the elementary principle of economics that the smaller the supply of any commodity, other things remaining the same, the higher will be the price at which it can be sold. Generally speaking then, under monopoly output is restricted below, and price raised above, the level that would prevail under competition. Under certain very favorable conditions, not likely to be realized in practice, this result would not follow.

Consider next the interdependence of industries. All business is merely buying and selling. The manufacturer, for example, buys raw materials, supplies, machinery and labor. He sells his product. Generally speaking, industries buy from one another and buy labor, and they sell to one another or to the general public. Note, then, the result when one industry becomes monopolized, and raises the price of its product. We need not assume that it is a vicious monopoly, such as existed before the war, which aims at raising the price so high as to obtain the maximum net gain; it may be a nice altruistic monopoly merely adjusting

supply to demand with the idea of getting a price equal to cost plus a fair profit; yet some increase in price undoubtedly we must assume, if the previously existing competition has been ruinous and forced the price too low for prosperity. And if we assume that increase in price, we must assume also some restriction of output. The two are inseparable.

We come now to a very important point, the significance of which has apparently escaped the attention of the monopolists and of all who advocate monopoly as a panacea for economic ills. **When any industry restricts the supply of its own product in order to obtain a better price, it restrains the demand for labor and for the products of other industries.** If it produces less than it would otherwise produce it presumably employs less labor; it discharges some men it otherwise would retain, or fails to hire some it otherwise would hire. It thereby contributes to the problem of unemployment, to the problem of a shrinking national payroll, and shrinking purchasing power of the workers. Likewise, if it produces less than it would otherwise produce, it buys fewer raw materials, fewer supplies, and fewer machines—less, in fact, of everything than it otherwise would buy. To this extent, then, it destroys the demand for the products of all industries from which it buys. And this is not all. If other producers and the general public continue buying from this industry its product at the higher price, they thereby impair their buying power in respect to other commodities and services. Indirectly as well as directly, then, the monopolist injures practically every one in the economic community.

When the monopolists are relatively few in numbers, the direct and the indirect damage they inflict upon industry in general may be serious but need not be calamitous. Suppose, however, that as the result of governmental encouragement and public approbation monopoly becomes widespread. Suppose the country becomes, let us say, half monopolistic and half competitive, what then?

Why then we develop those serious maladjustments which have been the outstanding cause of the present depression. The first maladjustment that occurs is the spread between the prices of the monopolized products and the non-monopolized products—between the price, let us say, of copper and cotton; between cement and wheat; between steel rails and bituminous coal. There will inevitably be non-monopolized industries—those industries in which units of production are small and numerous, in which sufficient degree of cooperation to restrict output and maintain price cannot be achieved; those industries which produce a surplus which must be sold at world market prices, and which are not protected from world competition by national tariff walls; such industries for example, as the wheat, corn, and cotton industries, and the bituminous coal industry. It has been shown that when the monopolists restrict output they directly and indirectly reduce the demand for the products of other industries, including the products of non-monopolized as well as the monopolized industries. The competitive industries, not restricting output, suffer a decline in the prices of their products, since it is elementary economics that a decline in demand, other things remaining the same, causes a fall in price. Thus with the prices of non-monopolized products falling and the prices of the monop-

olized products rising, a substantial spread develops. This means that in so far as competitive industries or producers buy the products of monopolists, their costs are rising while their prices are falling. It means also that consumers dependent upon the competitive industries for a living either as wage earners or as proprietors, find their money incomes reduced while their cost of living in so far as reflected in the prices of monopolized products is rising.

But this is only the beginning of maladjustments. Things are bound to grow worse if the monopolies persist in their policy of adjusting supply to demand in order to sell at cost plus a fair profit. With their money incomes declining, and cost of production and the cost of living rising, remaining stationary, or at any rate not declining in proportion to their money incomes, the proprietors and the wage earners in the competitive industries cannot buy as many goods as before, either of monopolists or any one else. Moreover, the wage earners even in the monopolized industries, unless their money wages have been increased, and they are not likely to be increased unless they are organized into strong trade unions, cannot buy as many monopolized goods at high prices as at low prices, and those who have been discharged as a result of restriction of output cannot buy at all unless out of savings or until they find employment elsewhere; and finding employment elsewhere is difficult if a large proportion of all industries are engaged in the process of adjusting supply to demand. Finally, the monopolistic industries are among themselves engaged in the pleasant task of economically cutting one another's throats, since, to some extent they must buy from and sell to one another, and as a result of their policies, they ask one another higher prices for what they sell, and buy in smaller quantities the things they buy. In short, the monopolist chicken named restriction of output, comes home to roost. The monopolists find their costs increased in some quarters, and the demand for their products eventually seriously curtailed. And now we come to the really brilliant performance of the monopolists. They proceed to cure their wound with the hair of the dog that bit them. The demand for their products having declined as an indirect but inevitable result of their restriction of output, they now proceed to restrict output further—to adjust supply once more to demand, to discharge more workers, to buy fewer raw materials, supplies and machines, to depress further the competing industries and the purchasing power of the wage earners and consumers in general, and figuratively speaking, to cut even deeper gashes into one another's throats. And when the vicious circle of restriction of supply bringing restriction in demand has made its round, they must proceed to adjust and readjust production downward, even to the point of zero. If during this process a considerable proportion of the monopolistic organizations would break up under the strain, would dissolve, or make price concessions, the progressive restriction of output, growing unemployment of labor, and general financial disorganization might be halted short of complete disaster. If on the other hand, most of them hold to their course and insist upon maintaining high prices even at the cost of closing down their plants entirely, it is difficult to see how eventual complete collapse is to be avoided.

It need now hardly be added that this theoretical description of the result of widespread monopolistic price control through restriction of output is also a fairly accurate description of what has actually been taking place in the United States during the past few years. Even though our monopolistic industries did not in all cases raise prices and in some cases actually reduced prices of their products, they nevertheless invariably maintained prices above the competitive level and relatively higher than the prices of products sold under competitive conditions; and they did this by restricting output. In the early stages of the process the monopolized industries prospered, and on the basis of this artificial prosperity, aided by reckless expansion of bank credit on an unprecedented scale, the great stock market inflation of 1924-1929 was built. When the persistent spread between the prices of the monopolized products and the non-monopolized products brought increasing depression to the competitive industries, and when the growing unemployment resulting from restricted output reduced the purchasing power of the wage earning class, the monopolists were able for a time to escape a decline in the demand for their products by means of the installment plan which enabled consumers to spend more than twelve months' income in a year; and by the flotation of foreign loans, which enabled foreigners to buy our products without cost; and by paper profits gained by the rank and file in the great stock market spree, which they spent, as the saying goes, like drunken sailors. It was only after these three artificial props to monopolistic prosperity had collapsed that the monopolists began to feel the pinch of decline in demand, and to restrict output with a vengeance. But once started on their program of progressive restriction of output, they proceeded with great vigor. With the general index of business activity down to about 60% of normal, and with the steel industry and others as low as 20% of capacity, the question naturally arises, how much worse may things get. If the monopolists can only hold out, there is no natural stopping point short of zero.

The foregoing analysis seems to suggest an easy way out of the depression. If the depression has been caused by progressive restiction of output by monopolistic industries, bringing as a result progressive restriction of demand and growing unemployment, then a reversal of the monopolistic procedure—a stepping up of production all around and a cut in monopolistic prices would bring a progressive increase in employment and in demand.

But there are complications. Other causes beside monopolistic restriction of output have operated, including international tariff barriers, the international debt problem, the rapid introduction of labor saving devices in recent years, the mounting public expenditures and public debts; and these other causes alone might have brought on a severe depression even in the absence of monopolistic restriction of output. And there is now the tremendous degree of financial demoralization and the destruction of confidence to deal with. While the shortsighted and grasping monopolistic policies of a large group of our industries represent the chief contributing factor in bringing on, deepening and prolonging the depression, a sudden reversal of these policies cannot at once undo the harm they have done.

GRADUATION REQUIREMENTS IN HOURS AND QUALITY CREDITS

By
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Recently the writer was asked to conduct an investigation to discover the present situation in American Colleges and Universities relative to the number of hours required for graduation and to find out how many and to what extent quality credits were prescribed. Feeling that this would be of interest to others he submits the following rather brief report:

The study limited itself to the catalogue statement concerning graduation requirements. Where the statement apparently meant the same as; "an average of C," or "an average of one point" where C as a grade received the quality credit of one point, both were treated under the same head. After the data was tabulated it was found that there were 237 institutions in 40 states in which data were found sufficiently complete to be used. The data are grouped under three heads i. e., Teachers College, Other Colleges, and Universities. They are also grouped according to size as shown by the enrollment reported in the same catalogue.

Any attempt to solve for a mean or medium to indicate averages must obviously give a fictittious result. While in ordinary cases the mode is the least serviceable, it appears in this case to be a more accurate indication of the present facts. It gives the "most used" measure.

The results are to be seen in the following tables:

Semester Hours Required for Graduation

TYPE OF INSTITUTION

	Univ.	No. cases	College	No. cases	Teachers College	No. cases	Total cases	No. cases
1st	120	20	120	23	128	18	120	61
2nd	124	13	124	15	120	12	124	40
3rd	128	6	128	4	124	8	128	18
Total cases		39		42		38		119

SIZE OF SCHOOL

	Under 1,000	No. cases	1,000 2,499	No. cases	2,500 3,999	No. cases	Over 4,000	No. cases	Total	No. cases
1st	124	10	124	9	120	5	120	4	124	28
2nd	120	8	120	5	128	5	124	2	120	20
3rd	128	6	128	3	124	2	128	1	128	12
Total		24		17		12		7		60

Quality of Credits Required for Graduation

TYPE OF INSTITUTION

	University No. cases	% cases	College No. cases	% cases	Teach. Coll. No. cases	% cases	Total No. cases	% cases
Yes	25	29.7	31	38.2	39	54.1	95	40.0
No	59	70.2	50	61.7	33	45.9	142	59.9
(or no entry in catalogue to that effect)								
Total	84	99.9	81	99.9	72	100.0	237	99.9

	SIZE OF SCHOOL									
	Under 1,000		1,000 2,499		2,500 3,999		Above 4,000		Total	
	No. cases	% cases	No. cases	% cases	No cases	% cases	No. cases	% cases	No. cases	% cases
Yes	32	50.8	18	42.8	11	61.1	9	52.9	70	50.0
No	31	49.2	24	57.1	7	38.8	8	47.0	70	50.0
(see note above)										
Total	63	100.0	42	99.9	18	99.9	17	99.9	140	100.0

The Value of the Grade Points Where Used

Value of Letters	Number of Cases
A—3; B—2; C—1; Rest 0	72
A—3; B—2; C—1; D—0; E and F minus 1	15
A—4; B—3; C—2; D—1; E and F—0	12

(Only the three highest systems were listed. There were four other systems with a frequency of 6 or less making a total of 112 cases available for this part of the study.)

Grading Systems Found

System	Number of Cases
A—B—C—D—E—F—I.	40
A—B—C—D—E.	36
A—B—C—D—F—I.	33

(Only the three highest were listed. There were three other systems found with a frequency of 5 or less.)

In so far as the number of cases studied represent a valid sampling of the total situation the writer ventures to present the following list of conclusions by way of summary:—

1. In colleges and universities, the most frequent requirement for graduation was 120 semester hours with 124 coming second and 128 third. There were more using 120 hours than both of the other two. Teachers' colleges were more frequently found to require 128 semester hours or its equivalent for graduation.

2. The question of quality "credits" was obscured by insufficient data. For instance, does the fact that we found no statement concerning "quality credits" indicate that none existed? Or that it was not in the catalogue? Or that we failed to find it? Without doubt some of it is accounted for as errors in the collection of data. If we assume that the absence of such an item meant that the institution in question maintained no such requirement, (and it would seem to be a valid assumption) the results are decidedly against any point system for allowing "quality credits" to be a determining factor in graduation. Stated another way there seems to be no evidence, that outside of Teachers' Colleges, there is more than one-third of the institutions of higher learning attempting such a standard.

3. When grouped according to size of school as shown by the enrollment there was found no deciding conclusion favoring either. Cases were few and quite evenly scattered, indicating that chance was probably the deciding factor, and not the size of the institution.

4. In the schools using the point system there was a decided

majority in favor of the scheme in which the following values prevailed: A—3; B—2; C—1; other grades to receive none. This scheme was used in almost as many cases as all others combined and almost five times its nearest competitor.

5. There was no distinct advantage in the count for any one system of grading. The three highest almost tied in this respect. In the order of frequencies they were: A, B, C, D, E, F, I; A, B, C, D, E; and A, B, C, D, F, I. There seemed to be a tendency to feel that a grade, known as "condition," was needed. This was to be different from the "incomplete" or "failure."

6. Finally, may the writer caution against reading into these figures more than they deserve. At its best this study can only show the present status and is in no way to be interpreted to indicate trends. A similar study using cataogues from the same or approximately the same list of institutions that were ten years old would give an interesting study in the trends of these questions. They would give some light upon the future possibilities.

THE ORGANIZATION AND ACTIVITIES OF THE WEST VIRGINIA DEPARTMENT OF PUBLIC WELFARE

By
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In the enactment of humanitarian and public welfare legislation, West Virginia has been in the front rank of the most progressive states of the Union. This was one of the first states toput into operation a workman's compensation plan, to provide hospitals for those injured in industry, to make what was at that time adequate provision for its mentally afflicted, and to adopt a modern and an improved attitude toward its criminal classes, and to provide adequate eleemosynary, charitable and hospital facilities for its negro citizens.

In keeping with this record of progressiveness, West Virginia, at the 1931 session of the Legislature, enacted a law creating the West Virginia Department of Public Welfare by coordinating and consolidating the personnel, resources and activities of three small bureaus which had theretofore functioned independently. That the bill creating the Department was meritorius is attested by the fact that it was approved by the Senate with only one dissenting vote, and by the House of Delegates unanimously, and this in spite of the fact that the House was overwhelmingly Democratic while the Senate had a Republican majority. A further proof of the merit of the legislation is found in the fact that the bill was sponsored in the Senate by the Republican President thereof, and in the House ofDelegates by the Democratic Speaker thereof.

This legislation, which is found in Chapter 2, of the Acts of the West Virginia Legislature of 1931, is the outgrowth of a study of conditions in the state made under Governor William G, Conley, who recommended to the Legislature that a Department of Public Welfare be established to make more effective, and thereby more economical, the administration of state welfare funds.

Prior to the establishment of the Department of Public Welfare, the duties which the State of West Virginia had assumed relative to dependent and neglected children were performed by the State Board of Children's Guardians, which was established in 1919, at which time it succeeded to the responsibilities, powers and duties of the West Virginia Humane Society, with respect to children; and in addition to these, was granted wider powers and given further duties.

The State Board of Children's Guardians was composed of a Board of three citizens, one of whom was a woman, appointed by the Governor. This Board employed a full-time staff and intrusted the administration of its affairs to a secretary. The staff consisted of district agents, placed in various points in the state, whose duties were to make necessary investigations prior to commitment of children to the state for dependency or neglect, to find foster homes for such children, and to supervise children in their foster homes. Naturally these agents found their duties and responsibilities which were collateral with those assigned to them by law.

In 1925, the Legislature authorized the creation of the West Virginia Crippled Children's Council, consisting of seven members, three of whom were appointed by the Governor and four of whom were state officials, who were members ex officio. This council was required to find, treat, train and educate the crippled children of the state. Although the Council was authorized to be established in 1925, however, no funds were made available for its work until the legislative session of 1929, at which time an annual appropriation of $40,000 was provided.

This Council selected orthopedic surgeons to whom was entrusted the treatment of crippled children, and designated certain hospitals, of required standards, as the institutions in which such treatment should be given. By reason of the work carried on by this Council in 1929 and 1930, and more especially by reason of the activity of the West Virginia Society for Crippled Children, the Legislature of 1931 was persuaded to appropriate $85,000 a year for crippled children.

In 1919, following the close of the World War, the Legislature of West Virginia appropriated $50,000 annually for the direct relief of indigent veterans. This fund was at first disbursed by a sub-committee of the State Board of Public Works; but in 1927, at request of the American Legion, the post of Veterans' Service Officer was created by the Legislature, and this officer, under rules and regulations prescribed by the State Board of Public Works, was empowered to disburse relief funds. This appropriation was discontinued at the legislative session of 1931 and there is no provision today for financial aid by the state to any veteran.

Prior to the creation of the Department of Public Welfare, which officially came into being on June 8, 1931, each of the three bureaus just mentioned,—the State Board of Children's Guardians, the Crippled Children's Council and the Veterans' Service Officer,—was engaged in one phase of public welfare work. With public welfare work as the common denominator, the three agencies were merged into one, with the chief administrative officer a Director, appointed, with the advice and concent of the the Senate, by the Governor, and serving concurrently with him.

The statute establishing the Department provides for the continuation in a general way of the work formerly done by three independent agencies, and consequently the Department of Public Welfare is made up of a Division of Crippled Children, a Division of Dependent Children, and a Division of Veterans' Affairs, each under the direction of a chief and each coordinating its activities with the other two through the Director. The field staff, which was inherited from the State Board of Chldren's Guardians, is now responsible not only for children in cases of dependency or neglect, but also for activities connected with the State's work with crippled children and with the State's work with veterans.

The Department of Public Welfare, by virtue of Chapter 2, of the Acts of 1931, succeeds to all the rights, powers, privileges, duties and responsibilities theretofore vested in the State Board of Children's Guardians, the Crippled Children's Council and the Veterans' Service Officer.

Whereas two of these agencies were under the jurisdiction of the State Board of Control, while the third was under the jurisdiction of the is directly under the Governor and responsible to him.
State Board of Public Works, the Department of Public Welfare today

The welfare work of West Virginia has been raised from a bureau to a departmental status; and, by reason of this fact alone, the state is able to wield a more effective influence with welfare agencies and officials in other states,—an influence that has resulted in a greater economy in administration of the social laws.

The Department, from the day of its creation, has sought to establish a firm foundation on which to build by securing in usable form essential facts relating to dependency and neglect, to the care and treatment of crippled children and to the rendering of service to veterans of the Spanish-American and World Wars and their dependents.

In the field of dependency, the Department is having approved records completed for every child admitted to a county infirmary or to a private child-caring institution. These records are so prepared as to show, when the information is available, a fairly complete family history, social background, cause of dependency and the physical, mental, social and educational status of the child to be committed and his immediate family. The records are not elaborate because this work is just beginning in West Virginia and it is impossible to put complicated forms into use at the present time. But the state has greater knowledge in both volume and detail relative to dependency than ever before.

The Department expects to be able at the next session of the Legisture to outline, to some extent at least, the size of the problem of dependency in this state and to endeavor to secure an appropriation sufficient to care adequately for children committed to the state. In its legislative program, the Department will seek to clarify existing laws on dependency and neglect, adoption and commitment, supervision, care and training, and to secure other modifications and revisions of existing statutes to simplify and make more effective procedures and practices now in use. This program will have the major objective of keeping administrative and other expenses to the lowest level possible consistent with efficient, effective and adequate care and supervision of the Department's wards.

Work with crippled children of the state, by the state itself, is in its infancy. Owing to lack of records and experience in West Virginia, it has been necessary to adopt as an administrative principle a rather flexible policy with regard to the hospitalization, treatment, and training of children who are accepted for rehabiltation on state funds. In the beginning of the state's work in this field, only definitely orthopedic cases were accepted for treatment, and then only when the child was below the age of sixteen. The age limit has been raised to twenty-one years to harmonize with state statutes defining "a child," and at the same time the division of cases into "orthopedic" and "non-orthopedic" classes, with the exclusion from treatment on state funds of the latter class, has been abolished in view of the fact that the law definitely declares that any child with a physical handicap can be accepted by the Department for treatment.

Preferential classes for treatment on state funds are being established. It is the present policy of the Department to give first preference to those classes of handicap which can be most quickly, completely and inexpensively rehabilitated and which are not hereditarily transmissible. The Department assumes the position that it is better to endeavor to rehabilitate completely ten children who are ten per cent handicapped rather than attempt to rehabilitate one child who is ninety per cent handicapped and whom the utmost in care and treatment would raise only to a twenty or thirty per cent level of physical ability. A careful effort is made to exclude from treatment on state funds children who are not mentally normal.

During the current school year an education unit was established at Huntington, in which city are three hospitals wherein state cases are taken for treatment. Two teachers are employed by the Department and one volunteer has given much of her time to carrying out a very effective program. Equipment and supplies have been furnished by the Department. A dozen or more children who were illiterate have been taught to read and write while they were under the care of the surgeon; and scores of other children have not only carried on their regular school work while they were in the hospital, but have learned many practical things in the nature of handcraft. This educational work will be continued during the next school year.

It is generally conceded that success in work with crippled children can be secured only through an effective follow-up program in the field. In recognition of this fact, the Department has, since last July, employed an outstanding orthopedic nurse who has visited hundreds of the crippled children of West Virginia in their own homes; not only those who were hospitalized on state funds, but as well those hospitalized by civic and fraternal organizations, women's clubs and individual citizens. In the home, this nurse trains the mother in physiotherapy and in the home-care and treatment of her child, checks braces and shoes to see that they fit and function properly, and, when she finds it necessary, brings back to the hospital those children who are in need of further attention by the surgeon. The Department plan is now to employ an additional nurse for field work during the coming year.

Prior to 1927 little, if any, general effort was made to secure contact with veterans of the Spanish-American and World Wars, to see what their economic and physiceal condition was and secure for them such available assistance as might be needed. Following the creation of the post of Veterans' Service Officer in 1927, however, the service to the veterans was somewhat expanded and upon the establishment of the Department of Public Welfare in 1921, a broad program was formulated and effectuated which has for its major purpose the rendering of the greatest possible service by the state to the veteran and his dependents.

The Division of Veterans' Affairs does not wait for a veteran in need of assistance to come to Department headquarters in Charleston. The Division is going into every section of West Virginia and contacting former soldiers, appraising them of their rights under state and federal legislation, and endeavoring to confirm them in those rights. Through

the cooperation of the State Compensation Commission, every workman above the age of thirty, injured in industry, is reported to the Department of Public Welfare so that his claim may be presented for certain benefits which the federal government allows him. Through the several posts of the American Legion and other veterans' organizations, the Department maintains close contact with the veterans and is prompt to act upon and assist in the presentation of every legitimate claim made by them. Through the cooperation of the American Legion of West Virginia and the American Legion Auxiliary, with funds provided by these two organizations, by National Headquarters of the American Legion and by the Department of Public Welfare, an assistant has been secured for the Division of Veterans' Affairs whose primary duty is the furtherance of the welfare of the children and dependents of veterans. The work that this Division is doing is of inestimable value, financially and socially, to the State of West Virginia and its people.

By means of legitimate publicity in the newspapers, in the Public Welfare Bulletin published by the Department, and through addresses made before civic and fraternal organizations by staff members throughout the state, the Department of Public Welfare is endeavoring to acquaint the people of West Virginia with its work, with its problems and with its programs. An encouraging interest on the part of the public is becoming manifest and it is hoped that at the next session of the Legislature the legislative plans of the Department looking to its more effective functioning and firm establishment will be written into the law.

THE RISE OF THE PILSUDSKI DICTATORSHIP IN POLAND

By
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(Abstract of paper read before the Social Sciences section of the West Virginia Academy of Science at their annual session, Athens, West Virginia, 1932).

Poland is practically the geographic center of Europe, where Greek Catholic, Slavonic, rural Europe of the East meets Roman Catholic and Protestant, Teutonic and urban Europe of the West. At the close of the World War, it had the following problems to face:—

1.—Creation of a single people out of Prussian, Russian, and Austrian Poles, whose mental outlook has been greatly affected by the regimes under which they had lived since the eighteenth century.

2.—Creation of a single educational system for a people who had been under three systems, varying from the progressive German to the backward Russian.

3.—Creation of a single legal system for a people who had lived under no less than five legal systems for nearly a century.

4.—Bad economic situation, due to the primitive Russian methods in one area, and progressive German and Austrian elsewhere, and different railway gauges. Also, during the war, the Germans systematically destroyed factories in Russian Poland, so as to make the land economically dependent upon Germany. Where but one-seventh of France was devastated by the war, six-sevenths of Poland was devastated; and she had neither a well-organized national treasury nor reparations to aid her in rehabilitation.

5.—Three tax systems, three currency systems (later five), all to make into one.

6.—Need of a national army, to be created out of the Russian, German, and Austrian Polish contingents, plus volunteer contingents raised during the war (Haller's for example). This need was all the more urgent, with such powerful neighbors as Germany and Russia to fear.

7.—Her many-party system. Due to her existence under separate flags in past years, no less than eight political parties arose, exclusive of the Communists.

Pilsudski was a native of Zulow, in Russian Poland, coming from old Polish and Lithuanian stock, strongly opposed to Russian rule. This attitude led to his arrest and exile to Siberia in 1887, from which he was released by amnesty in 1893. His activities led to his escape to Cracrow, where he lived until the Russo-Japanese war. He was more of a nationalist than a Socialist in his outlook. In the World War, he organized and led troops under the German flag until the Russians were driven out of Poland. His refusal to swear allegiance to the Central

Powers led to his arrest and imprisonment in Magdeburg until the close of the war in 1918.

The collapse of the German power in Poland left the way clear for Pilsudski to become head of the Polish state after the German revolution of 1918 freed him from prison. Under his administration, Paderewski represented Poland at the Congress of Versailles in 1919.

As chief of State, Pilsudski stood for the formation of a powerful army, also for the principles of a democratic regime. The Polish constitution, accepted March 17, 1921, copied much of the French constitution, with the idea of a parliamentary republic, interpellation of the ministers, and proportional representation in choice of members of the Sejm or lower house of the parliament. Failure to fix definitely the right of dissolving parliament either upon this body or upon the President, and the French system of parliamentary procedure with its many parties threatened trouble for later days. In the three years of the first Pilsudski regime, no less than nine Cabinets ran the government. With the installation of the new government, under the presidency first of Narutowicz, then (after his assassination) of Wocjiechowski, Pilsudski retired to a country residence just outside Warsaw, holding aloof from politics until the crisis of 1926.

The reasons for the crisis of 1926 may be briefly listed as follows:—

1.—The currency situation. The Polish mark had depreciated, due to inability of the Government to balance the budget, the German economic war against Poland to keep the mark low thus force Silesians to vote in favor of remaining German instead of becoming Polish, the general reluctance to pay taxes, the irresistible growth of bureaucratic machinery, the desire for State credits to finance private enterprises, and large army expenses. Poland also had a debt of $1,365,000,000, or one larger than that of Japan. Grabski as finance minister, seeing the collapse of the Polish mark in December 1923, managed to stabalize it at 9,300,000 to the dollar, and accepted the premiership on condition of being granted dictatorial powers in finance. He ended unlimited paper money printing, and introduced a gold unit, the zloty, worth about twenty cents. His new taxes and new coinage, while they balanced the budget, also caused a money shortage, and resultant depression which in turn caused many bankruptcies. A bad harvest for 1924 made large imports necessary which in turn caused a heavy drain upon the gold reserve and resultant depreciation of the zloty. The nation lost the patriotic fervor which had saved it from the Russians in 1920 and were in no mood for further sacrifices.

2.—The military situation. Under the Witos ministry, the Government began shifting Pilsudski's officers to minor and distant posts, and the Skrzynski ministry began to introduce bills to reduce the size of the army. This aroused Pilsudski who feared Russia.

3.—The many cabinet changes under the Wocjiechowski administration. No less than four cabinets served, and in the early spring of 1926, there was a deadlock in which several men were tried and none succeeded in forming a ministry acceptable to the Sejm. Finally

Witos, a shrewd little Galician village mayor, of the Peasants' Party, a man opposed by Pilsudski, succeeded. His Cabinet was decidedly unpopular.

4.—The overthrow was but an expression of the old anarchic spirit which had cost Poland her independence in the eighteenth century.

5.—A clash between the Polish army leaders. Pilsudski and his followers were Russian Poles, while Haller, Sikorski, and Szeptycki, with the Galician politician Witos, were Austrian Poles.

6.—Disgust of Pilsudski over the political situation, which was now being ridiculed in the press, especially by the Cracow Czas.

7.—There was a call among many for a dictator, in imitation of the Italian Fascists.

8.—Wocjiechowski and Witos underestimated Pilsudski's strength and popularity.

The attempt of the Witos ministry to stop a paper which printed Pilsudski's attack upon his cabinet led to the open break which culminated in the march of Pilsudski and his followers upon Warsaw, the resignation of both Wocjiechowski and Witos and the seizure of power by Pilsudski. He refused election as President, as this post did not give him any power. At his recommendation, Ignaczy Mascicki, a man of culture, refinement, and dignity, was elected. He also felt that the regime he had destroyed was corrupt and dangerous to the safety of the state. He next sought and obtained a revision of the constitution giving the President greater powers, and obtained a Cabinet with the posts of foreign affairs and of war free from parliamentary intrigues. His dictatorship has given the government more actual power than any other Polish government has ever enjoyed. According to one American writer, he has used the powers of a dictator to prevent the recurrence of such conditions which led to the coup d'etat of 1926.

ATTEMPTED REFORMS OF THE CIVIL SERVICE OF THE UNITED STATES, 1865-1881

By
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The first earnest and determined effort to arrest the progress of the political patronage evil through effective national legislation was sponsored by Representative Jenckes of Rhode Island. "A conscientious statesman, a painstaking and industrious scholar, he had entered Congress in 1863 and had been profoundly impressed by the marked difference between the civil service and that of the army and navy." After an exhaustive study of the systems of the nations of Western Europe, he became convinced that the abuses could be remedied in the United States just as they had been in England, France, Belgium, and Prussia. Accordingly, on December 20, 1865, he introduced in Congress a bill embodying the results of his investigations, and aiming "to secure efficiency in the civil service by substituting for the public and private auction of government offices the system of competitive examinations." Few recruits rallied to his standard, and after a year's delay, due to obstacles of one kind or another, the bill was tabled by a vote of 72 to 66.[1]

In 1867, Mr. Jenckes introduced a second bill providing for the appointment of a commission to classify the Federal civil service under the examination and merit system. A comprehensive report based on results secured abroad along similar lines accompanied the measure.[2] As Chairman of a joint committee on retrenchment, Mr. Jenckes made a report on January 29, 1867, in which the following points were stressed in behalf of civil service reform:

First. People have a right to demand that the time and talents of their chief public servants should be employed in performing the duties of the office to which they are elected or appointed.

Second. All positions in the initial grades of the service should be thrown open to all.

Third. Only the most worthy should receive appointments.

Fourth. Best talent obtainable should be secured.

Fifth. Patronage should be entirely eliminated.

Sixth. Many young people would be encouraged to prepare themselves for governmental service.[3]

The closing paragraph of Mr. Jenckes' speech on the Report and in favor of the proposed reform bill runs as follows: "Thus, while this proposed system will stimulate education and bring the best attainable talent into the public service, it will place that service above all considerations of locality, favoritism, patronage, or party, and will give it permanence and the character of nationality as distinct from its present qualities of insecurity and of centralized power. A career will be opened to all who wish to serve the Republic; and although its range is limited,

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[1]Salmon, Appointing Power of the President, 90.
[2]McAneny, Reform of the Civil Service, 7.
[3]The Civil Service, 4-13.

yet success in it will be an admitted qualification for that higher and more laborious and uncertain competition before the people, if any one should be tempted to enter upon it. The nation will be better served; the Government will be more stable and better administered; property will be more secure; personal rights more sacred; and the Republic more respected and powerful. The great experiment of self-government, which our fathers initiated will have another of its alien elements of discord removed from it, and in its administration, in peace as well as in war, will have become a grand success."[4]

Despite the valiant efforts of its champion, this bill, like its predecessor went down to defeat. Congress was not yet ready for such a drastic change in the direction of purer government, but the measure had gained a few warm friends even among congressmen, and independent publications, such as The Nation, were actively and unqualifiedly enlisted in its support. A movement had been launched that was destined to advance slowly but steadily until final success would be won.[5]

The attitude of the politicians was exactly the same as it always is on questions of reform. They denounced the bill as bad,* wrong, contrary to the spirit of American institutions, unconstitutional,—in fact used every argument that would likely influence the vote of a single congressman. Later, when the reformers were gaining the day, the politicians hopped on the band-wagon and vociferously claimed the lion's share of the credit for the victory.[6]

Anent the situation in 1869, J. D. Cox, Secretary of the Interior, wrote as follows: "During Mr. Johnson's Administration * * * * a condition of things existed which rivals the most corrupt era that can be found in the history of any nation. Men were known to offer $5,000. for the influence which might secure them an appointment to a gauger's situation in the revenue service; there $1,500. was the limit of the pay that could be honestly earned, and when it was morally certain that the advent of a new administration would terminate the employment within a year. This is simply a type of similar transactions extending through many grades of the public service."[7]

By 1870, the spoils system had become so notoriously revolting that President Grant declared in his annual message to Congress that, "the present system does not secure the best men and often not even fit now for public places. The elevation and purification of the civil service of the government will be hailed with approval by the whole people of

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[4]The Civil Service, 14.

[5]Globe, 3rd. Session, 40th. Congress, 262; also, Salmon, op. cit., 91.

*A good exampl of the bi-lingual charasteristics of the shifty politician is the case of John A. Logan of Illinois. On January 8, 1869, he paid his respects to the "Jenckes civil service bill" in the following terms: "I think that this bill is bad in theory, wrong in principle, opposed to the genius and spirit of our institutions and our people, and probably unconstitutional in its legal aspect. I regard the introduction of a bill like this, and the favor with which it has been thus far receivd by both parties and the press of the country, as one of the most positive, and, therefore, one of the most alarming signs of the inauguration of a policy which if persisted in will end in the obliteration of all that is republican in this Govrnment and the substitution of that which is monarchical instead." Sixteen years later, in an after-dinner speech following a reception given in his honor in Boston, Mr. Logan enthusiastically proclaimed civil service reform as "the child of the Republican party."

[7]Annual Report of the United States Civil Service Commission, XIV, 39.

the United States." This appeal to Congress secured the law of March 3, 1871, which authorized the President to appoint a Civil Service Commission. A body of civil service rules was formulated by the Commission and approved by the President, whereupon the open competitive examinations provided for went into effect January 1, 1872. The enforcement of the new system quickly made inroads on congressional and partisan patronage, thus creating among party leaders hostility which led to action on the part of Congress whereby the $25,000. annually appropriated for the support of the work of the Commission was cut off. This was done without the formality either of debate or a record of votes.[8]

President Grant repeatedly urged Congress to restore the lost appropriation. He represented to the national legislature that the new system had "given persons of superior character and capacity to the service" in Washington, "developed more energy in the discharge of duty, diminished unreasonable solicitation and preference, and allowed the heads of departments more time for their duties and more libertyfor dismissing unworthy officials." In April, 1874, he sent a special message setting forth the salutary effects of the new system and declaring that the rules could "be so improved and enforced as to still more materially benefit the public service, and relieve the Executive, members of Congress, and the heads of departments from influences prejudicial to good administration." But Congress was contrary-minded and ignored the President's appeal.[9] Any policy or course of action that threatened to interfere with their favorite mode of building up their political fences or the maintenance of partisan esprit de corps was naturally and inevitably bitterly opposed by all politicians.[10]

Offices and positions in the public service were treated not as forming a legitimate class of honorable employment, but as the property of the party in power, to be filled by those who had rendered party services or who through any other means could gain the favor of party leaders. Fitness for the work to be performed was considered as secondary, if considered at all. Promotions were secured through influence also, and very rarely because of the ability or worth of the employee. Removals were made as soon as the positions were wanted at another change of party, or even of factional control. This plan was followed in the filling of offices from the highest to the lowest,—chairmen of party committees or friendly editors, for instance, securing Diplomatic or Consular commissions, while at the other extreme, the "runners" and "heelers" of local machines rewarded with low grade clerkships and positions on the labor force. There were conspicuous and honorable exceptions to this practice, of course, especially among the higher posts, but in the great majority of cases the spoils rule prevailed. The inevitable consequence was, as it always will be under similar circumstances, that anything approaching an efficiency of even average private service was entirely out of the question. As a natural corollary, the cost of administration increased in inverse ratio, a greater number of employees being required to do

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[8]Eaton, The Spoils System, 28.
[9]Eaton, The Spoils System, 30.
[10]McAneny, Reform of the Civil Service, 7.

the necessary work of the Government, while to meet the constant demand for place for political adherents, a vast number of employees for whom there could be no real need were added to the lists. The result of a system so utterly unbusinesslike could have but one effect upon the conduct of public administration. It is not strange that incompetence and extravagance* became accepted as the distinguishing characteristics of the various departments of our National Government.[11]

According to an estimate made by the New York Chamber of Commerce in 1874, it cost the United States about $7,000,000 to collect the duties on imports of the value of $642,000,000, while in the same year it cost Great Britain only $5,000,000 to collect the duties on imports of the value of $1,800,000,000.[12]

The ill effects of the system were not confined to any particular branch of the service. Incorporated in a report of a Congressional Committee appointed to investigate conditions in the Bureau of Engraving and Printing, we find these observations: "The whole system seems to have resolved itself into a vicious circle. Appropriations have been secured by making appointments for Congressmen, without regard to the fitness of the appointees or the necessities of the work; and when secured they have been expended in such manner as to retain the good will of those already friendly or to secure that of others. * * *

"We cannot condemn too strongly the system of patronage, which is chiefly responsible for the extravagance and irregularities that have heretofore marked the management of the Bureau, and which, it is safe to say, has cost the people millions of dollars in this branch of the service alone."[13]

The civil service of Great Britain had been rescued from similar conditions by reform acts passed in 1855 and 1870, the distinctive features of which were the admission to the service only those whose fitness had been proved by searching examinations and probationary trial; advancement for merit only; tenure of office dependent on faithfulness and continued ability, and the exclusion of political considerations throughout.[14]

Some Americans objected to our adoption of the merit system on the ground that it would be a mere aping of the British system which was adapted to a monarchical form of government but totally unsuited for use in a democracy like ours. Many questions of a more or less direct nature were propounded. Had the new system been adequately tested? Was it adapted to the social life and institutions of America? Was it republican in spirit and consistent with the practical administration of our governmental affairs? Did we possess sufficient public intelligence to institute such a reform?[15] Proponents of the reform felt that these

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"New York, December 30, 1873.

*"Gentlemen:—Please give bearer one gallon of brandy and one gallon of gin for me. I am sorry to trouble you; but this is New Year, and I hope you will honor my order. I will reciprocate on some other occasion.

"Yours respectfully,

Gauger."

[11]McAneny, Reform of the Civil Service, 5.
[12]Eaton, The Spoils System, 45.
[13]McAneny, Reform of the Civil Service. 5.
[14]Ibid., 7.
[15]Eaton, Civil Service in Great Britain, 362.

queries could best be answered from a study of the principles and conclusions that had been accepted in the later experiences of Great Britain. These may be summarized thus:

"1. Public office creates a relation of trust and duty of a kind which requires all authority and influence pertaining to it to be exercised with the same absolute conformity to moral standards, to the spirit of the constitution and the laws, and to the common interests of the people, which may be insisted upon in the use of public money or any other common property of the people; and therefore, whatever difficulty may attend the practical application of the rule of duty, it is identically the same whether it be applied to property or to official discretion.

"2. So far as any right is involved, in filling offices, it is the right of the people to have the worthiest citizens in the public service for the general welfare; and the privilege of sharing the honors and profits of holding office appertains to every citizen, in proportion to his measure of character and capacity which qualify him for such service.

"3. The ability, attainments, and character requisite for the fit discharge of official duties of any kind,—in other words, the personal merits of the candidate—are in themselves the highest claim upon an office.

"4. Party government and the salutary activity of parties are not superseded, but are made purer and more efficient, by the merit system of office, which brings larger capacity and higher character to their support.

"5. Government by parties is enfeebled and debased by reliance upon a partisan system of appointments and removals; and, for its most vigorous life and salutary influence, it is only needful for the party majority to select, as the representatives of its views and the executors of its policy, the few high officers with whom rests the power to direct the national affairs, and to instruct and keep in the line of their duty the whole body of their subordinates through whose administrative work that policy is to be carried into effect.

"6. Patronage in the hands of members of the legislature, which originated in a usurpation of executive functions, increases the expenses of the administration, is degrading and demoralizing to those who possess it, is disastrous to legislation, tends to impair the counterpoise and stability of the government; and it cannot withstand the criticism of an intelligent people when they fairly comprehend its character and consequences.

"7. Examinations may be so conducted as to ascertain, with far greater certainty than by any other means, the persons who are the most fit for public service; and the worthiest thus disclosed may be selected for the public service by a just and non-partisan method, which the most enlightened public opinion will heartily approve.

"8. Open competition presents at once the most just and practicable means of supplying fit persons for appointment. It is proved to have given the best public servants; it makes an end of patronage; and, besides being based on equal rights and common justice, it has been found to be the surest safeguard against both partisan coercion and official favoritism.

"9. Such methods, which leave to parties and party government their true functions in unimpaired vigor, tend to reduce manipulation, intrigue, and every form of corruption in politics to their smallest proportion. They also reward learning, give more importance to character and principles and make political life more attractive to all worthy citizens.

"10. Regarded as a whole, the new system has raised the ambition and advanced both the self-respect and the popular estimation of those in the public service, while it has encouraged general education, arrested demoralizing solicitation for office, and promoted economy, efficiency, and fidelity in public affairs.

"11. A system is entirely practicable under which official salaries shall increase during the most active years of life, and through which a retiring allowance is retained to be paid upon the officer leaving the public service; and such a system appears to contribute to economy and fidelity in administration.

"12. Open competition is as fatal to all the conditions of a bureaucracy, as it is to patronage, nepotism and every form of favoritism in the public service.

"13. The merit system, by raising the character and capacity of the subordinate service, and by accustoming the people to consider personal worth and sound principles, rather than selfish interest and adroit management, as the controlling elements of success in politics, has also invigorated national patriotism, raised the standard of statesmanship, and caused political leaders to look more to the better sentiments and the higher intelligence for support."[16]

Such evidence and reasoning as this would go a long way toward convincing those who were open to conviction but a vast number of party leaders did not want to be convinced. The situation was discouraging but not without hope. For instance, Chester A. Arthur, a product of the patronage system of New York, and a holder of the office of Collector of the New York Custom House by virtue of that system, in his annual report in 1874, made the following observation regarding the working of civil service reform in his office: "There can be no doubt that the increased strictness required by the new system has in this respect been beneficial. It has excluded many unfit persons and deterred a much larger number from applying."[17] Again, on November 23, 1877, he wrote to Secretary Sherman: "Permanence in office, which, of course prevents removal except for cause, and promotion based upon good conduct and efficiency, are essential elements of correct civil service." The fact that Mr. Arthur made only 144 removals in a period of five years as Collector is fairly conclusive evidence that he tried to practice what the moderate reformers were preaching.[18]

President Hayes came to high office pledged to the duty of reforming the civil service. He determined to give the merit system the fairest and most thorough trial possible in the New York offices of the Federal Government. Consequently he appointed head men who were sympa-

[16]Eaton, Civil Service in Great Britain, 363.
[18]Eaton, Term and Tenure of Office, 38.
[17]Eaton, The Spoils System, 32.

thetically inclined towards the new system and would likely make an honest effort to carry out his purposes.[19] In 1877, the President appointed the Jay Commission to investigate the conduct of the New York Custom House in order to get at the facts from a source independent of party bias and without commitments to patronage. The report of the commission constituted a real contribution on the subject and was regarded as the rendition of a valuable public service.[20]

Mere pass examinations were ineffectual in bringing a true remedy to the conditions that prevail. Open competitive examinations, based on common justice and the equal rights of all competent persons to share the honors and salaries of the government, offered the only solution to the problem of getting rid of the unfit and corrupt and filling the positions from the number of those who were fitted by character and prepared by training to do the work efficiently and honestly.[21]

"Every patronage-monger,—every caucus manipulator,—every shiftless office-seeker of the land,—every aspiring demagogue longing for more offices to pledge,—evry unscrupulous chieftain seeking more officials to tax and more places to give as bribes,—every intense partisan believing that spoils are the strength of parties, and that rotation in office is a vital principle of republics,"—was not only favorable to the old four-year tenure but insistent on the application of Jacksonian proscription during that term.[22] Referring to the unfortunate effects of the four-year term, James A. Garfield, future President of the United States, wrote in 1877, as follows: "It degrades the civil service itself; * * * * * it repels from the service those high and manly qualities which are so necessary to a firm and efficient administration; it debauches the public mind by holding up public office as the mere reward of party zeal."[23]

Other effects injurious to the administration and policies of the country, caused or greatly aggravated by those four years' term statutes, are the extended use of Congressional patronage and the usurpation of the executive power by the Senate in connection with confirmations. A great proportion of all the appointments and removals in the public service speedily became a part of the perquisites and spoils of Congressmen, a situation tending to produce the degradation of official manhood, and corruption and coercion at elections in manifold forms. A single appointment which a Congressman could control could be vaguely promised in such a way as to influence a score or more of voters.

The greatest evil, however, was in confirmations by the Senate. According to the spirit of the Constitution and the usages of its framers, the Senate was to consider only the personal fitness of the nominee for the particular position he was expected to fill. But after the short-term tenure laws facilitated a rotation of party henchmen and supreme regard for partisan consideration, confirmations began to depend more and more on the State politics and Senatorial favoritism.

The great test on confirmation developed rapidly into the question

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[19]Eaton, The Spoils System, 37.
[20]Ibid., 36.
[21]Ibid., 56-58.
[22]Eaton, Term and Tenure of Office, 55.
[23]Eaton, Term and Tenure of Office, 37-38.

as to what bearing the proposed appointment would have on local politics in the place where the nominee was to serve, or upon the next Senatorial election. In brief, the confirmation very generally disregarded the only factors which the Senate was supposed to consider. As all Senators were similarly situated, and each could have his own ends served only by conceding to his fellow-Senators the same autocracy which he desired for himself, there was a common interest and opportunity for self-aggrandizement in usurping the executive powers of appointment and removal. Out of this grew "senatorial courtesy," another baneful influence in American political administration. This is utterly repugnant to the spirit of the Constitution, to the early practice under it, to the duty of the President to see that the laws are faithfully executed, to the independence of the Senators themselves for the proper discharge of their functions, to the counterpoise and strength of our institutions, and is in every way demoralizing and pernicious.[24]

In his last message to Congress, President Hayes took occasion to endorse once again the principle of civil service reform. It was his belief that the competitive system "secures for the position applied for the best qualifications attainable among the competing applicants; * * * is an effectual protection from importunity, preventing the abuse of the service for the mere furtherance of private and party purposes and leaving the employee of the government, freed from the obligations imposed by patronage, to depend solely upon merit for retention and advancement, and with this constant incentive to exertion and improvement. These invaluable results have been attained in a high degree in the officces where the rules of appointment by competitive examinations have been applied."[25]

In 1877, the first Civil Service Reform Association was formed—that of New York— and in August, 1881, the National League, composed of various local associations, came into being under the Presidency and leadership of George William Curtis.[26] It sought to show that there were really two classes of offices in the Federal Government, one class subject to change whenever the opposite political party came into power, the other non-political in nature, and therefore limited as to tenure. It described the situation thus: "The Civil Service of the United States includes all public employments which are not military or naval. It may be divided into two parts—the political and the non-political. The political comprises the positions which are essential to carrying out the policy of administration which has been approved by the people at the polls; and the non-political part embraces the positions which are subordinate and ministerial. This last part is strictly a business agency, with no representative political character or significance whatever. It has charge of the clerical and other details; of the collection and disbursement of the national revenue, external and internal, in all its branches; of the Post-Office Department, or the distribution by mail of letters, newspapers, and merchandise; of the management of the

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[24]Eaton, Term and Tenure of Office, 39.
[25]Eaton, The Spoils System, 65-66.
[26]McAneny, Reform of the Civil Service, 7.

public lands, patents, and Indian affairs; of the subordinate work of all departments of the Government."[27]

For the President to interview prospective candidates for all these positions and use discriminatory judgment in his selections was, manifestly, an impossibility. Nevertheless, much of the time of the Chief Executive was consumed in listening to appeals for office. A very good illustration is furnished by the experiences of Presidnt Garfield. The New York Tribune declared that applications for office had occupied one-third of his time; a clerk asserted that fully one-half of his time had been thus spent; while another clerk affirmed that out of 750 callers upon the President during his three months in office, 710 were office-seekers. Offices had precious little opportunity to seek the man.[28]

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[28]Eaton, Term and Tenure of Office, 20.
[27]Purposes of the Civil Service Reform Association, 3.

SUPERPOWER IN WEST VIRGINIA

By
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With the rapid expansion in the use of electricity for industrial, commercial, and domestic purposes the importance of Superpower in the economic welfare of the country has become apparent to all. Particularly has the subject of electrification interested the railroads which face operating difficulties of the first magnitude. Many railroads today are facing a financial crisis in their history. Economies must be effected on every side and one source of suggested economy has been to electrify those steam railroads which face the greatest operating difficulties. Electrification in mountainous sections and terminals has received the greatest amount of attention.

Superpower as the term is used in this study, means electric power regionally distributed by electric supply systems in which electricity is generated with high economy in fuel power or by water power. Voltage is not a governing element but rather economical distribution.

The territory composing the states of Ohio, West Virginia, Kentucky, and Western Pennsylvania is referred to from time to time as the Region. This territory is grouped together for it represents a common economic entity.

STEAM RAILWAY ELECTRIFICATION

This study of railway electrification is undertaken for the purpose of criticizing steam railway electrification in this Region. This analysis will consider the reasons for and the results of such electrification. Since the physical characteristics of the Region are diversified, the two main types of steam railway electrification are exemplified. These two types are mountain and terminal electrification. In order to simplify the treatment of the subject a representative example of each type of electrification will be examined. In treating mountain electrification the Virginian Railway will be examined. Terminal electrification will be represented by the Cleveland Terminal project.

Numerous articles have been written on problems of power plant, substation, overhead construction and electric locomotives. For information on any of these subjects reference is made to Circular No. D. V. 463, issued by the Mechanical Section of the American Railway Association, covering report of Committee on Electric Rolling Stock, dated May 9, 1926; also to Circular No. D. V. 536 of the American Railway Association, report of Committee on Electric Rooling Stock, dated May 7, 1927.

a. Mountain Electrification. The Virginian Railway.

The Virginian Railway is primarily a coal carrying road. Most of the tonnage is east bound, west bound cars being in most instances empties. The road runs from Deepwater, W. Va., to Norfolk, Va., on the seaboard. Of this line the division between Mullens, W. Va., and Roanoke, Va., is electrified. This electrified division is 134 miles long.

All the difficulties incident to mountain operation are existent on this division. It has no counterpart in the United States except in the iron ore movements of the Great Northern Railway. The difficulty of operation can be seen in a survey of the physical obstacles which must be overcome in the operation of trains in this territory. Clark's Gap with an elevation of 2500 feet is the highest point crossed. The maximum grade is 2.07%, maximum curves of 12 degrees are encountered and 5.6 miles of tunneling was done to eliminate difficult grades. These facts have made it necessary for the Virginian to operate at low cost, high capacity equipment in the largest units possible commensurate with safe operation. Steam units necessitated high costs at a time when operating economies were necessary. As the only apparent solution to the problem, electrification was proposed and adopted for the more difficult operating secion of the road. It was decided to build a power station to be operated by the railway company.

This was necessary for no power lines paralleled the railway. A modern Superpower station was constructed and power units located at various points on the electrified section. While the cost of the electrified section was approximately $15,000,000.00, if electrification had not been undertaken it would have been necessray to spend large sums for additional heavy motive power and for additional second track in a territory where construction costs are very high, due to physical conditions necessitating heavy fills, deep rock cuts, and tunneling through mountains. After the electrified section was placed in operation a committee of the American Railway Association surveyed the road for the purpose of determining the advantages which had resulted from electrification. Prior to electrification, five helpers and one main locomotive were used to haul one train of coal. Since electrification one main locomotive and one helper are used to haul the same amount of traffic. During the year 1924, which was the last full year preceding electrification, the Virginian hauled 7,444,832 net tons of coal. The first full year after electrification (1927) 11,825,101 net tons of coal were handled. The ton miles per train hour had increased from 9,112 in 1924 to 70,666 in 1929. Some specific advantages which resulted from this electrification are:

a. Increase in train load.

b. Increase of capacity by a saving of time for each haul.

c. Seven more trains could be moved every twenty-four hours.

d. Elimination of congestion which would undoubtedly have increased operating costs.

e. Decreased cost of maintenance of equipment—reduced accidents and derailments.

Of course with this increase in efficiency came a decrease in operating costs per ton of coal handled. Reduced fuel and operaing costs have been helped by the use of regenerative braking. The locomotives of the Virginian Railway returned 13% of the energy used in motoring which resulted in a savings of about $80,000.00 a year. The results of electrification, as a whole, are best understood by a glance at the following figures:

In 1924 the Virginian Railway's cost of conducting transportation was 16.94 cents per hundred net ton miles, with total operating cost of 40.24 cents, while in 1927 the cost of conducting transportation was 13.63 cents, with a total operating cost of 35.74 cents. This shows a decrease in operating costs of 4.50 cents per hundred net ton miles, or 11.2 per cent. The net tons moved one mile by the Virginian Railway in 1924 was 3,034,366,000, while in 1927 the net tons moved one mile was 3,246,964,000.

Applying the difference in operating costs of 4.50 cents per hundred net ton miles to the tonnage moved in 1927 indicates a savings of $1,461,133.00. The figures quoted cannot be totally attributed to electrification as other economies may have affected the results, such as bureau consolidations and like economies.

Few railroads with normal traffic conditions would be warranted in electrifying on the scale of the Virginian Railway. It is apparent that electrification was economical for the Virginian. The Norfolk and Western Railway operating in the Region has successfully electrified 56 miles on main route line. This railway is a coal carrier handling lake cargo coal and confronted by problems similar to those of the Virginian Railway.

It is doubtful if any other roads operating in the mountain territory of the Region would seriously consider electrification. This conclusion is arrived at after a survey of other railroads which operate in this Region. Those railroads operating some lines in the mountain region are:

a. New York Central.
b. Pennsylvania.
c. Baltomore and Ohio.
d. Chesapeake and Ohio.
e. Louisvile and Nashville.
f. Southern Railway.
g. Illinois Central.

Each of these lines haul a diversified traffic under normal mountain conditions and railway electrification would not seem advisable at present for their mountain sections.

b. **Terminal Electrification. The Cleveland Union Terminal Co.**

The growth of large cities with their attendant railroads has created a number of serious traffic problems. In the case of the larger terminals steam opertion has not proved successful. In many cases terminal electrification is required by city ordinance for the purpose of eliminating smoke. Terminal electrification is undertaken also for the purpose of increasing capacity without increasing the physical properties of the railway. Where tunnels are operated electric operation is almost a necessity. Where a great amount of through traffic is handled, electric operation facilitates the handling of peak traffic. Many terminals are now being electrified or have been electrified for one of the aforenamed purposes. Among those terminals with electrified services are, New York, Philadelphia, Washington, Detroit, Chicago, Boston, and Cleveland.

In the Region only the Cleveland terminal has been electrified, although it seems that it is only the matter of a short time until the terminals at Pittsburgh, Cincinnati, Louisville, and Columbus will follow suit. All of these terminals are experiencing some or all of the difficulties which have caused terminal electrification in other cities.

The Cleveland Union Terminals Company has constructed a new terminal adjacent to the Public Square at Cleveland, Ohio, and has also proceeded to develop the air rights above the terminal by means of extensive building construction. The terminal went into service in 1930 and is now being used by the New York Central, Big Four, and Nickel Plate trains.

For two reasons, in particular, it was necessary to electrify this terminal. First, the new station is centrally located so as to bring the trains into the heart of the business and banking districts; hence it is doubtful if the necessary city ordinances could have been obtained without the promise of electrical operation. Second, the station tracks and near approaches are covered with structures, making electric power quite necessary for visibility and comfort.

In addition to the Terminal Company's tracks, there are certain adjoining sections of tenant company's tracks which are electrified. The through trains of the New York Central Railroad making station stops at Cleveland operate over the full length of the electrification from Linndale on the west to Collingwood on the east, a distance of about 17 miles. The Nickel Plate enters and leaves this line at intermediate points. The total trackage equipped with overhead contact line is 56 miles.

All power for operation of the new terminal is purchased from the Cleveland Electric Illuminating Company. The Illuminating Company has an extensive system with several generating stations totaling about 550,000 kilowatt hours capacity, and is also connected with other the other large power companies in northern Ohio. It is a giant Superpower system. The annual consumption of power for this electrification is 31,000,000 kilowatt hours of which 21,000,000 kilowatt hours are propulsion power.

It will be noted that throughout this discussion little mention has been made of electrification of main passenger railroads. This has been purposely omitted as electrification of such lines is generally not a matter of economy but rather of city ordinances for the purpose of eliminating smoke and other nuisances attendant on steam railroad operation. While in the case of freight carrying roads the main consideration in electrification has been economy. Since the railroads receive all of their net income from freight activities, by far the greatest attention should be given to this problem. In case of interest in this special problem, attention is called to the reference material contained in footnote (4) this chapter. It is only in this phase of the subject that proponents of steam train propulsion clash with proponents of electric

However, as this discussion is not for the purpose of guessing into the future of train propulsion. and since authentic facts as yet are unpublished, the author does not feel warranted in coming to any conclusions on this subject.

It does seem that Superpower will play a noteworthy part in the evolution of our transportration systems. In many cases power will be utilized directly from electric company lines, while in other cases railways will be required to build their own superpower stations. In all cases it will be found more profitable for railways engaged in terminal electrification to utilize the services of already established power companies. In this way great economies will result, and duplication will be reduced to a minimum.

THE TREND TOWARD DICTATORSHIPS AND GREATER SOCIAL CONTROL

By
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This subject, as I intend to deal with it, naturally falls into three divisions: (1) A statement of some of the evidences that a trend toward dictatorships and greater social control exists at the present time; (2) An analysis and discussion of the causes or conditions which have helped to create this trend; (3) Comment on the effects of the trend.

Perhaps we need to go to Europe to find the most obvious and outstanding examples of actual functioning dictatorships, and trends in that direction.

Italy, with a population of 40,000,000, lives under probably the most stable dictatorship. Perhaps we may call the regime of Mussolini a benevolent despotism. There is no question that Italy has made great progress economically and as an international force of first or second rank, since Mussolini's strong hand took the reins of control and relegated the king to the position of an obedient, acquiescent figurehead. To be sure, there are rumblings of discontent heard now and then in Italy, but not as many or as loud or frequent as are heard in the South American Republics, or several other nations. Personal observation in Italy in 1926 convinced the writer of this paper that law and order, smooth functioning of railroads and other great industries, patriotic enthusiasm, loyalty of the people to their government, and other evidences of a busy, growing, ambitious, united nation, suggested strongly that Mussolini's dictatorship was as generally accepted by the Italians as our own American government is by our people. There has been no substantial change in this respect in Italy during the six years which have elapsed since my observations in 1926.

The 160,000,000 people of Soviet Russia, since 1921, have been living under another type of dictatorship. For, as we all know, Mussolini became the dictator of Italy in order to prevent a revolution; while the Russian dictatorship came into existence because of and as a direct result of, the most drastic and thoroughgoing revolution in recorded history. Also the Russian dictatorship continues to rest upon a proletarian basis, having turned Russian social and economic classes upside down in their relations to one another. It is a unique and significant fact that although these two dictatorships are directly opposite each other, so far as the nature of their bases or fundamental objectives are concerned, nevertheless, the international political and trade relations between the two are exceedingly friendly and mutually profitable, and are growing rapidly more so through adoption of trade treaties, etc. This rather paradoxical situation may be explained partly by the exceedingly realistic nature of all dictatorships. They do not fritter away time or words or golden trade opportunities by bickerings and arguments about whether Russian goods are produced by forced labor or whether the present Russian regime will recognize and pay the international

obligations of the old Czarist regime. While the United States refuses to recognize Russia on these and similar grounds and loses enormously in badly needed export trade, Italy and Russia cut the gordian knot of what are **to them** meaningless words and ideals of government by, for, and of the people, go right ahead and build up flourishing and friendly business and political intercourse. Whatever criticism may be made of dictatorships or whatever arguments may be developed over relative merits or different **types** of dictators, it seems they are **all** agreed that the way to get things done is to do them.

Two other notable European dictators are Horthy in Hungary and Pilsudski in Poland. The first of these has no doubt been bolstered up by the League of Nations, the second directly supported by France. A study of the Polish dictatorship is the subject matter of another paper being presented at our session today.

A military dictatorship is a strong possibility in Japan. Time, in its issue of March 28, reports, in substance: Japan, by her recent adventures in Manchuria and at Shanghi, seems wavering on the brink of a decision to overthrow her parliamentary government. This parliamentary government was imported forty-two years ago from the west. Japan now seems much inclined to give over her destinies to the strong military clique which has been decidedly dominant the last few months.

Even in Germany the present government is often referred to as the Bruening-Hindenburg dictatorship, to say nothing of the threatened Hitler dictatorship. While the drastic governmental decrees recently issued in Germany are nominally allowed by the constitution of the Reich in emergencies, they border strongly on a dictatorship policy, are so thought of and generally submitted to by the German people.

What about the United States? While no doubt we are still relatively safe from such a complete form of dictatorship as we find in Italy and Russia today, there are undoubtedly small stirrings here and there that, under certain conditions, **might** become strong enough to move the American people in the direction of a friendly attitude toward more drastic and more nation-wide forms of social control. We shall discuss this point more fully in the second part of this paper. Suffice it to say here that it is no secret that some of the critics of our president have not hesitated to say that he attempted to play the role of dictator in proclaiming the moratorium on German reparations payments last June, without calling a special session of Congress to authorize this very significant step. When Congress met in December, it showed plainly by its reluctant and conditional approval of this act by President Hoover that it would not condone further dictatorial procedure on the part of the president. Our American Congress, at least, is very definitely **not** ready to turn over its power and authority to the executive, as the Italian Parliament did several years ago to Moussolini, who is **still** nominally the prime minister of the Italian parliament. For all practical purposes of control, however, the representative parliament in Italy is non-existent.

Many of us have heard some of our neighbors say now and then in regard to our crime problem, in regard to our slow moving policies of correction of economic evils such as unemployment and bank failures,

"We need a Mussolini to straighten us out." Perhaps such comments are not to be taken very seriously; for no doubt those who make them would be very sorry indeed to have to give up our free press, free speech, etc., even if we thereby secured at least temporary relief from some of the ills that now press hard upon us. Such remarks do indicate, however, that some Americans are now thinking in new terms.

When we come to analyze the **causes** and **conditions** that have created the widespread trend toward greater social control (the chief drastic **example** of which is **national** dictatorship), we are at once in a field of complexity and difficulty. All we can appropriately attempt in this short paper is to present, in a **suggestive** and **not** in an **exhaustive** way, two or three of what seem to the writer to be **among** the most significant factors involved.

1. One set of conditions which certainly helped prepare the soil for the growth of dictatorships grew directly out of the World War. Not only did the war wreak its havoc on human lives and in the destruction of valuable property. It inevitably, because of severity, extent and long duration of its destructive processes, wrought havoc with institutions, traditions and time-honored concepts, attitudes and emotions. No wonder the people roughly concluded that those groups or persons who had controlled them up to and **during most** of the war, were responsible for the tragedies and gruesome and ghastly sufferings borne by the people. Therefore, great and powerful dynasties—the Romanoffs in Russia, the Hohenzollerns in Germany, the Hapsburgs in Austria—were toppled from their thrones and warned never to attempt to return. In their more or less blind and vengeful mood, the returned soldiers and a large part of the civil population struck right and left. Human life, cherished inherited values, material and spiritual, were in real danger. In Russia and in Italy, for special reasons which we do not have time here to discuss, disorder and revolutionary tendencies became especially dangerous. Mussolini was able, by a narrow margin, to head off a communistic revolution in Italy. In Russia, perhaps largely of well laid plans over a period of fifteen or twenty years, the revolutionary party of the Bolsheviki, after a bloody civil war of three years' duration, managed to seize the reins of power, and has held them ever since. The tremendous dissatisfaction of the Russian people with their very inefficient and corrupt leadership in their hopeless fight against the Germans, made them almost willing to turn to **any** new leader that promised them a degree of stability and **some** improvement over the old conditions under the Czar. The aggressive, enthusiastic leaders of the Bolsheviki saw their opportunity and made the most of it.

Every great war leaves a trail of lowered moral standards and shattered illusions; thousands of people battered in mind and emotions, as well as in body. Granted the existence of strong and dramatic leaders and groups ready to take advantage of the situation, revolutions, dictatorships, new and strange social and political forms and processes are sure to crop up and some of them will more or less permanently survive. In a sense, these phenomena are a part of the never ending process of social evolution—at least this particular aspect of the evolutionary

process or revolutionary process will survive as long as wars continue to afflict mankind.

2. Another group of factors or conditions which underlie and support (and even make **necessary**) an increasing amount of social control, is connected with the fact that we live in a machine age. In the last two decades we have progressed so rapidly in this direction that we may with a large degree of accuracy say that we are now passing through a new or second industrial revolution. We all know the facts, but we are not able yet to fathom their full significance. The almost unbelievable efficiency of mass production, the new range of communication and propaganda made possible by the radio, the airplane, the talkie and television, the world-wide use of motor vehicles, have all combined to project us into a social and economic life of tremendous dynamic power. We may not know **where** we are going, but we do know that we are going somewhere and at a hitherto undreamed of speed.

The gap which has always existed between generations has been much widened by this greatly speeded up process of social change. Unless the adult and older persons make it a special point to constantly be intelligent and sympathetic toward the newer developments and inventions, their influence over their own children and especially over the adolescent groups in the population will move and is moving toward the vanishing point. It is a striking fact that revolutionary societies like Russia and dictators like Mussolini make it a most vital element in their program to inculcate and drill the youth; for they well know that their new tradition destroying campaign has a most fertile soil in the minds and emotions of those who are just coming into action and who find so many new tools to work with that they take hold of life with a creative enthusiasm and vigor rarely seen up to this time. Most any kind of dictatorship can survive and flourish if it makes a constant, persistent, intelligent and organized appeal to the naturally dynamic life of youth. Perhaps it has been a weakness of our older and more stable civilizations that they have too much assumed that men must be forty or fifty or sixty before they can be expected to have the ability and willingness to assume definite individual and group responsibilities. Whatever may have been the reason, there is no doubt that we have permitted a huge waste of energy and enthusiasm among our adolescent groups. They have been far too much allowed to let their surplus energy drift aimlessly, without constructive purposes or worthy goals, and inevitably they have become to a large extent a prey to vicious personal habits, crooked politicians, and selfish business leaders. We have largely neglected to tie up this great fund of youthful energy to an appealing motive or program. The dictators in the world today, for good or for ill, have at least been wise enough to welcome eagerly into their folds the young men and women who naturally are the leaders in taking hold of the new machines and inventions, and mastering them. No doubt many of our boys and girls have a real feeling of **kindship** for the new inventions and machines, for they all came into the world together and are mutually interdependent. What boy is not delighted to tinker with a radio or a miniature airplane in the family attic? What modern girl is not intrigued and fascinated by the newest fashions in dress, household

appliances or racy literature? It matters not that in **some,** perhaps **many** cases, the new is really inferior to the old. We live in an age when the new irresistibly attracts. What girl **or** boy is not interested in the new **social** inventions, actual or proposed, like companionate marriage, birth control, etc.?

Is it not reasonable to suppose that much of this hankering of modern youth for the new and untried (or at least not fully developed), whether it be **machine** or **scientific process** or **social practice** or **program,** could not just as easily be harnessed to a dynamic yet **constructive,** forward looking social, economic, or political movement as to be allowed to drift in chaotic fashion? The middleaged and older people who hold the reins of political, business and social power have a real obligation, in this respect, to the younger generation now coming on the scene of action. To make a sincere and intelligent attempt to understand the conditions which face our young men and women in these days of rapid change, and the challenge to old and accepted ways of doing things and of thinking and feeling, is the least which the fairminded middle-aged and older person can do.

I am not here arguing either for or against these new and dynamic inventions, machines, ideas, and customs; I am simply stating that they are here to be dealt with and to be understood. Some of them are no doubt foolish, or useless or positively dangerous; but they are full of dynamite and they are, so far as we can see ahead, coming to the modern world in increasing numbers. Our modern dictatorships have seized upon them with avidity and use them to the limit. The Russian dictatorship would, in all probability, have already been a thing of the past, if they had not been able to use propaganda, military control, etc.,with the high degree of efficiency made possible by the radio, the moving picture, the automobile, etc. No wonder the Soviets plan to double the number of their motion picture theatres in the very near future.

3. A third group of factors which cause many persons to begin to have more tolerance for dictators is associated with what may be called a gradual disillusionment as to the merits of democracy. Some of the influential critics go so far as to say that there never has been and never can be a genuine democracy in the case of large nations, with non-homogeneous populations. Where there are many races, religions, and languages, social and economic classes are played off one against another, to the advantage of political leaders and groups who are chiefly after the spoils of office. It is, at best, extremely difficult under such conditions to maintain a genuinely democratic form of government or of economic and social life.

We sometimes long for the good old days of Jacksonian or Jeffersonian democracy and simplicity; but may it not be that this period of American history was one of great economic and social freedom based upon the great abundance of land and other natural resources, in relation to the population? Was not the spirit of American life in the early nineteenth century one of "sturdy individualism" in a very real sense, and **not** an actuality of a genuine, consciously developed, coordinated, **functioning** democracy? The latter may be what we need now, but we all know that we are far from having it.

There are certain questions that may be appropriate at this point. The first is from Harper's Magazine, April 1932, page 579; and is a statement by a former member of the British Parliament:

"Elected representatives of the people, whether Members of Parliament, Congressmen, Senators, Deputies, or even ministers, are in the pillory at the present hour. We have failed at our job. The universe is in a mess, and we are held responsible. We provide obvious targets, and the missiles fly. Bankers, business men, industrialists, writers, philosophers vie with one another in saying that they see no solution, and then turn from congenial denunciation of the politician to demand that he save them from themselves. We are a democracy, and as such, doubly damned. "Things' have, somehow, got too big for us; it is time for us to clear out and hand over the fate of the citizens we try to represent to some undefined dictator."

We quote again from a statement made by Mr. W. M. Kiplinger in Nation's Business for April, 1932, page 23. As is well known, Nation's Business is the ably edited official organ of the United States Chamber of Commerce. Mr. Kiplinger is, at presnt, the chief Washington correspondent of this journal. Referring to the confusion and the friction now existing in Washington political circles, and to the well developed practice of "passing the buck," among business men and politicians, Mr. Kiplinger says, in the course of his discussion on the possibility of reducing government expenditures:

"Our Government is dominated by politics—regional politics, sectional politics, group politics, trade politics, conservative-vs-liberal politics, and, incidentally, party politics. Government policies are not determined by logic, or clean efficiency, or clear merit. You must accept these limitations as unavoidable and inevitable in our system of government. Only a dictator could get around them, and we are not willing to accept a dictator."

Last, but not least, because it comes home to us in West Virginia, we quote part of an editorial in the Morgantown (West Virginia) Post of March 23, 1932: (Inasmuch as we are not concerned primarily with personalities, the names of the two men referred to by the editor of the Post, as well as the names of the companies which they represent, are here omitted. Suffice it to say that both men and the companies are recognized as leaders in the West Virginia coal industry, and the personal and other details if desired can be obtained by direct reference to the editorial itself.)

"In their testimony at Washington yesterday before the senate subcommittee investigating the Davis-Kelly coal regulation bill, Mr.——— of the ——— Coal Company and Mr.———of the ———Coal Company testified they were convinced of the operators' inability to help themselves and of the necessity for government regulation and control.

"The operators are unable to cope with the evils of actual and potential overproduction without some form of government control, said Mr.——— , while Mr.——— admitted the operators have tried fruitlessly for 25 years to perfect a stabilization plan and now must turn to government regulation for the solution of their problems."

We shall now deal briefly with the **effects** of dictatorships. Modern types of dictatorships have too brief a history for us to make any conclusions except of a tentative nature. The two most effective and significant dictatorships, the one in Italy and one in Russia, have, however, been in existence since shortly after the World War. Ten years is an extremely short period in the life of a nation, but it is long enough to reveal significant tendencies and possibilities.

First, what is the effect of a dictatorship upon the nation as a whole? In both Russia and Italy, economic and national efficiency have increased tremendously in the last decade. The **rate** of this increase of efficiency has been so great, in comparison with preceding equivalent periods in the respective nations' history, **and** in comparison with the rate of increase of productive efficiency of **neighboring** countries, that we can hardly avoid the conclusion that the methods and processes of dictatorship have been a **large** if not the **chief** cause of this greater efficiency. Moussolini uses drastic methods when necessary, to produce discipline and order and regularity in work. Railroads, factories, foreign trade, even the birth of babies, are all speeded up, encouraged and rewarded by any method which will produce results; and methods are changed, quickly and ruthlessly, if need arises. The army and navy, especially, have been stimulated, prodded and persuaded into a state of potential efficiency that might make the old Roman military leaders green with envy. Indeed, Mussolini has as one of his slogans, "Italy is the inheritor of old Roman power and bravery." Under this vigorous dictatorship, the previous supremacy of France in the Mediterranean is sharply and effectively challenged. The World Disarmament Conference at London in February, 1931, was brought to a dead stop because France and Italy would not come to an agreement on naval parity.

The situation in Russia is almost identical, so far as economic efficiency and military preparedness goes. Enormous water-power and other industrial developments have sprung up almost as by magic and the Russians have sought engineering and technical leadership wherever they could find it, chiefly in Germany and the United States. Russia's Red Army is the largest and perhaps the most effective in the world today. The soldier in Russia ranks along with the industrial worker, at the top of the whole social strata. In pay and in prestige the high value of his job is recognized. No wonder Japan becomes fearful when Soviet Russia begins to concentrate her army along the Manchurian border.

But what about the individual, the person, free press, free speech, and free religion, under dictatorship? Here the story is different. While the **theory** of dictators is that the added efficiency, order and stability which they produce is for the good of **all,** even the most humble worker and his family, the **facts** are decidedly different. While it **may** be that the ruthless methods which have so far seemed inseparable from dictatorships will be only temporary (as the dictators say), until the old regime and its dangers have been completely wiped out, it remains true that the daily and weekly record so far is a rather dark and bloody one. Whether dictators will tone down and humanize their control processes as they win complete victory (if they do) over their enemies, time alone will tell. A rough balancing, however, of all the factors

involved, makes many of us cling more strongly to the values of a representative democracy. If we can rid our present democracies of some of their most glaring weaknesses, it would seem that it is the part of human wisdom to hold on to those forms of government and of economic and social life which have been painstakingly worked out by our western European ancestors during the past 1000 years.

How long this trend toward dictatorships will continue or to what lengths it will go cannot now be predicted. That we are in the midst of such a trend seems quite certain. An attempt to understand it will bring rich returns in human welfare. To an unusual and possibly to an unjustifiable degree the old landmarks and signposts are being relegated to the dump heap. The present world situation, in business, in government, in religion, in race and international affairs, and in the family and sex relations, calls for resourcefulness, initiative, a sane perspective, if we would conserve **old** values and not deny experimentation with alleged **new** values.

The chief responsibility for increasing our **understanding** of these trends toward greater social control lies with the social scientists, especially the economists, the political scientists, and the sociologists; and these three groups will not work most effectively unless they constantly keep in mind the **correlation** and **interdependence** of the phenomena of the three fields. Even the border-lands which reach over into psychology, history, etc., must not be neglected. One interesting bit of evidence that **some** social scientists sense this responsibility is to be found in the character of the papers presented at the December, 1930, meetings at Cleveland and at the 1931 meetings at Washington. Certain of the economists at the Washington session, especially, struck out into these new problems with scientific boldness and made outstanding contributions; such as Professor Tugwell's analysis of the significance of the endorsement by the United States Chamber of Commerce of a national economic advisory council.

The chief responsibility, on the other hand, for **applying** the increasing knowledge of the processes of drastic change found all about us, lies with certain other groups. Is not this part of the responsibility largely with the leaders of business, the professional social workers and those men and women entrusted with governmental authority?