PROCEEDINGS

of the

NORTH DAKOTA ACADEMY OF SCIENCE

Founded December, 1908

VOLUME VIII

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Published jointly by the University of North Dakota and the North Dakota Agricultural College

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July, 1954

GRAND FORKS, NORTH DAKOTA

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GRAND FORKS, NORTH DAKOTA

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Banasik, Orville J. (Cereal Chemistry), Agricultural College. 1947.
Bitzen, Edward F. (Chemistry), U. S. Bureau of Mines. 1952.
Bliss, Harold N. (Ornithology), Grafton. 1951.
Bolin, Donald W. (Biochemistry), Agricultural College. 1946.
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Bonneville, David C. (Chemistry), N. D. Research Foundation. 1951.
Bosch, Wouter. (Chemistry), Agricultural College. 1948.
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Brezden, William. (Chemistry), State Mill and Elevator, Grand Forks. 1945.
Briggle, Leland W. (Agronomy), Agricultural College. 1950.
Broberg, Joel W. (Chemistry), Agricultural College. 1948.
Brown, Leonard W. (Chemistry), Armour and Company, Fargo. 1952.
Bryant, Reece L. (Poultry Genetics), Agricurtural College. 1948.
Buchanan, M. L. (Animal Husbandry), Agricultural College. 1950.
Burr, Alex C. (Chemical Engineering), Bureau of Mines, Grand Forks, 1940.
Cardy, James D. (Pathology), University. 1950.
Carter, Jack F. (Agronomy), Agricultural College. 1950.
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Coon, Ernest D. (Chemistry), University. 1923.
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Ederstrom, Helge E. (Physiology), University. 1953.

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Ellman, Robert. (Fuels), Bureau of Mines, University. 1949.
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Fisher, Stanley P., Jr. (Petroleum Geology), N. D. Geological Survey. 1952.
Fleetwood, Charles W. (Chemistry), Agricultural College. 1948.
Flor, Harold H. (Plant Pathology), Agricultural College. 1943.
Fordyce, Ira V. (Chemistry), AGSCO, Grand Forks. 1947.
Forster, Theodore L. (Dairy Technology), Agricultural College. 1950.
Frank, Richard E. (Chemistry), University. 1949.
Fredrickson, Ronald L. (Chemistry), Abbott Laboratories, North Chicago, Ill. 1951.
French, Harley E. (Anatomy), Dean Emeritus, University. 1911.
Gault, Alta R. (Physiology), University. 1949.
Geiszler, Gustav N. (Agronomy), Agricultural Experiment Station, Minot, 1950.
Goldsby, Alice. (Veterinary Science), Agricultural College. 1946.
Golob, Edward F. (Chemical Engineering), Minneapolis, Minn. 1952
Gorz, Herman J. (Plant Breeding), Agricultural College. 1951.
Graham, Charles M. (Internal Medicine), Grand Forks. 1951
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Gustafson, A. A. (Bacteriology), Public Health Lab., University. 1950.
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Hamre, Christopher J. (Anatomy), University. 1950.
Hansen, Miller. (Geology), N. D. Geological Survey. 1952.
Haraldson, Harald C. (Geology), University. 1952.
Harris, Rae H. (Agricultural Biochemistry), Agricultural College. 1938.
Hart, Harry B. (Chemistry), Jamestown College.
Haunz, Edgar A. (Internal Medicine), Grand Forks. 1951.
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Heermann, Ruben M. (Agronomy), U. S. Dept. of Agriculture, Fargo. 1950.
Helgeson, E. A. (Botany), Agricultural College. 1936.
Henderson, J. Donald. (Physics), University. 1945.
Higgins, Edith C. (State Seed Department), Agricultural College. 1950.
Hill, A. Glenn. (Mathematics), Agricultural College. 1946.
Hoag, Donald G. (Botany), Agricultural College. 1950.
Hoeppner, Jerome J. (Chemistry), Bureau of Mines, University. 1949.
Hoffman, Glenn L. (Parasitology), University. 1951.
Holm, Glenn C. (Veterinary Science), Agricultural College. 1950.
Holmes, Richard R. (Chemistry), University. 1953.

Hoyer, Horst W. (Chemistry), University. 1953.
Hoyman, William G. (Phytopathology), Agricultural College. 1950.
Hultz, Fred S. (Agriculture), President, Agricultural College. 1950.
Hundley, John L. (Physics), University. 1930.
Jensen, C. (Dairy Husbandry), Agricultural College. 1927.
Kaufman, Victor. (Physics), University. 1951.
Keefer, Daryle E. (Psychology), University. 1953.
Keith, Eaden F., Jr. (Pharmacology), University. 1953.
Kelly, Eunice. (Nutrition), Agricultural College. 1944.
King, Richard P. (Animal Nutrition), Agricultural College. 1952.
Kingsley, Allan F. (Agricultural Chemistry), Agricultural College. 1950.
Kjerstad, C. L. (Philosophy and Psychology), University. 1937.
Klosterman, Harold J. (Agricultural Chemistry), Agricultural College. 1948.
Knudson, Walter L. (Biology), School of Forestry, Bottineau. 1950.
Kohanowski, Nicholas. (Geology), University. 1949.
Koons, Melvin E. (Bacteriology), Public Health Lab., University. 1943.
Koth, Arthur W. (Metallurgy) University. 1939.
Kratochvil, Donald E. (Botany), Agricultural College. 1952.
Kube, Wayne R. (Chemical Engineering), Bureau of Mines, University. 1949.
Laird, Wilson M. (Geology), University. 1941.
Langford, Larkin H. (Animal Husbandry), Agricultural College. 1950.
Larson, Edith E. (Biology), University. 1947.
Lium, Elder L. (Civil Engineering), University. 1953.
Loomis, Fred H. (Cereal Chemistry), Loomis Laboratories, Grand Forks, 1947.
Lundy, John L. (Anesthesiology), Mayo Clinic, Rochester, Minn. 1940.
Luper, Miltza (Medical Technology), Deaconess Hospital, Grand Forks. 1951.
McMillan, William W. (Chemistry), N. D. Research Foundation, Fordville, 1947.
MacDonald, John H. (Biology), Teachers College, Dickinson. 1951.
Magnusson, Adelynn M. (Chemistry), University. 1951.
Manz, Oscar E. (Ceramic Engineering), University. 1953.
Marwin, Richard M. (Bacteriology), University. 1949.
Mason, Harry. (Physics), Jamestown College. 1951.
Miller, Clifton E. (Pharmaceutical Chemistry), Agricultural College. 1947.
Miller, Leonard E. (Chemistry), University. 1951.
Milligan, Edward A. (Anthropology), School of Forestry, Battineau. 1951.
Moore, Cyril C. (Chemistry), Teachers College, Minot. 1948.
Moran, Walter H. (Chemistry), University. 1931.

Munro, J. A. (Entomology), c/o American Embassy, La Paz, Bolivia, S. A. 1927.
Murphy, H. E. (Chemistry), Teachers College, Dickinson.
Nelson, Casper I. (Bacteriology), Agricultural College. 1915.
Norum, E. B. (Soils), Agricultural College. 1948.
Oehler, Mrs. Alma. (Nutrition), State Mill and Elevator, Grand Forks. 1945.
Ongstad, Orvin C. (Fuels), Bureau of Mines, University. 1949.
Oppelt, Walter H. (Fuels), Bureau of Mines, University. 1949.
Ovrebo, Gerhard O. (Physics), Teachers College, Valley City. 1947.
Owens, Paul R. (Floriculture), Owens Floral Co., Grand Forks. 1945.
Parsons, Jesse L. (Bacteriology), Agricultural College. 1950.
Peterson, Robert H. (Chemistry), Agricultural College. 1951.
Porter, Charles B. (Surgery), Grand Forks. 1951.
Posin, Daniel Q. (Physics), Agricultural College. 1948.
Post, R. L. (Entomology), Agricultural College. 1948.
Potter, Loren. (Botany), Agricultural College. 1948.
Reid, Neil J. (Mammalogy), Mount Rushmore Memorial, Keystone, South Dakota. 1953.
Reid, Russell (Natural Science), State Museum, Bismarck. 1940.
Riley, Kenneth W. (Chemistry), Marietta, Ohio.
Robinson, Hugh M. (Botany), Teachers College, Valley City.
Robinson, Roy N. (Physics), Public Schools, Minot. 1951.
Rognlie, Philip A. (Mathematics), University. 1946.
Rolzinski, Julian J. (Biology), Junior College, Devils Lake. 1950.
Ryan, Floyd T. (Forestry), School of Forestry, Bottineau. 1950.
Saiki, Arthur K. (Pathology), University. 1949.
Sands, F. H. (Chemistry), Agricultural College. 1946.
Saugstad, Stanley. (Entomology), Minot. 1939.
Saumur, Mrs. William G. (Pathology), Grand Forks. 1951.
Schultz, J. H. (Horticulture), Agricultural College. 1948.
Scott, George M. (Cereal Chemistry), Agricultural College. 1952.
Sebens, William P. (Agriculture), Greater North Dakota Association, Fargo. 1948.
Severson, Donald E. (Chemical Engineering), University. 1949.
Severson, Roland G. (Chemistry), University. 1951.
Shoesmith, Lloyd (Soils), Agricultural College. 1950.
Shrader, Ruth. (Anatomy). University. 1951.
Sibbitt, L. D. (Cereal Technology), Agricultural College. 1946.
Sleeper, Bayard P. (Bacteriology), Agricultural College. 1952.
Smith, Glenn S. (Plant Breeding), Agricultural College. 1930.
Spier, Jack J. (Pathology), St. John's Hospital, Fargo. 1952.
Staley, Raymond C. (Mathematics), University. 1946.
Stallings, H. Dean (Library), Agricultural College. 1951.
Stevens, O. A. (Botany), Agricultural College. 1910.
Stewart, Donald L. (Chemistry), American Crystal Sugar Co., East Grand Forks, Minn. 1943.

Stoa, Theodore E. (Agronomy), Agricultural College. 1950.

Sudro, W. F. (Pharmacy), Agricultural College. 1911.

Summers, Lawrence. (Chemistry), University. 1951.

Svore, Jerome H. (Sanitary Engineering), State Health Dept., Bismarck. 1943.

Taintor, E. J. (Agriculture), Taintor Seed House, Grand Forks. 1945.

Thompson, John C. (Mathematics), Teachers College, Dickinson. 1948.

Thompson, Matilda. (Mathematics), Agricultural College. 1947.

Towse, Donald F. (Geology), University. 1952.

Traverse, Alfred. (Plant Paleontology), U. S. Bureau of Mines. 1952.

Treumann, William B. (Chemistry), Agricultural College. 1946.

Tsumagari, Yukio. (Pathology), University. 1951.

Tuneberg, Everett O. D. (Chemistry), School of Forestry, Bottineau. 1949.

Van Heuvelen, W. (Chemistry), State Health Dept., Bismarck. 1945.

Waldron, L. R. (Agronomy), Agricultural College. 1910.

Walster, H. L. (Director of Experiment Station), Agricultural College. 1920.

Wendland, Ray T. (Chemistry), Agricultural College. 1948.

Whedon, Arthur D. (Zoology), Danbury, Connecticut. 1924.

Wheeler, George C. (Biology), University. 1924.

Whitman, Warren (Botany), Agricultural College. 1950.

Wiidakas, William (Agronomy), Agricultural College. 1946.

Wild, Robert L. (Physics), University. 1951.

Willamson, Arthur E. (Sanitary Engineering), State Health Department, Bismarck. 1953.

Wills, Bernt L. (Geography), University. 1949.

Witmer, Robert B. (Physics), University. 1925.

MEMBERS ELECTED IN 1954

Aho, Donald T. (Conservation), U. S. Soil Conservation Service, Bismarck. 1954.

Andersen, Robert N. (Agronomy), Agricultural College. 1954.

Bale, Harold D. (Physics), University. 1954.

Bell, Gordon L. (Geology), University. 1954.

Bo, Walter J. (Anatomy), University. 1954.

Bothun, Robert E. (Plant Genetics), Agricultural College. 1954.

Brody, Harold. (Anatomy), University. 1954.

Callenbach, John A. (Entomology), Agricultural College. 1954.

Cassel, J. Frank.; (Vertebrate Ecology), Agricultural College. 1954.

Challey, John R. (Vertebrate Ecology), Agricultural College. 1954.

Comita, Gabriel W. (Zoology), Agricultural College. 1954.

Delphia, John M. (Embryology) Agricultural College. 1954.

Dillard, J. R. (Gynecology), Fargo. 1954.

Donat, Theodore L. (Medicine), Fargo. 1954.

Ferris, Leslie M. (Chemistry), Agricultural College. 1954.

Folsom, Clarence B. (Petroleum Engineering), University. 1954.

Fox, Adrian C. (Conservation), Soil Conservation Service, Bismarck. 1954.

Giles, Ray. (Petroleum Chemistry), Standard Oil Co., Mandan. 1954.

Hanson, Dane E. (Geology), University. 1954.

Harwood, Theodore H. (Internal Medicine), University. 1954.

Haugen, Kenneth. (Geology), University. 1954.

Horner, Oscar. (Vertebrate Ecology), Agricultural College. 1954.

Lebsock, Kenneth L. (Agronomy), Agricultural College. 1954.

Lloyd, Lyness. (Soil Conservation), Bismarck. 1954.

McCauley, Howard W. (Civil Engineering), Agricultural College. 1954.

Minnear, F. L. (Chemistry), Agricultural College. 1954.

Mohberg, Joyce. (Vertebrate Morphology), Agricultural College. 1954.

Moir, David R. (Botany), Agricultural College. 1954.

Nungessor, William C. (Physiology, University. 1954.

Oakey, John A. (Civil Engineering). Agricultural College. 1954.

Peterson, Harvey J. (Veterinary Medicine), Grand Forks. 1954.

Randall, Robert N. (Wildlife Management), U. S. Fish and Wildlife Service, Bismarck. 1954.

Richards, Stephen H. (Wildlife Management), Agricultural College. 1954.

Schmitz, Emmett R. (Geology), University. 1954.

Shumard, Raymond F. (Parasitology), Agricultural College. 1954.

Snook, Theodore. (Anatomy), University. 1954.

Starcher, George W. (Mathematics), President, University. 1954.

Stockdale, Thomas E. (Petroleum Refining), Standard Oil Co., Mandan. 1954.

Sullivan, John W. (Biochemistry), Agricultural College. 1954.

Timian, Roland G. (Plant Pathology), Agricultural College. 1954.

Turelle, Joseph W. (Agronomy), U. S. Soil Conservation Service, Bismarck. 1954.

Vennes, John W. (Bacteriology), University. 1954.

Vergeer, Teunis. (Physiology), University. 1954.

Watkins, John B. (Veterinary Medicine), Grand Forks. 1954.

Welte, Arden F. (Biology), Grafton. 1954.

Weers, Walter A. (Civil Engineering), Agricultural College. 1954.

Young, Ralph A. (Agronomy), Agricultural College. 1954.

NORTH DAKOTA ACADEMY OF SCIENCE

Minutes of the Forty-Sixth Annual Meeting

FRIDAY, MAY 7, 1954

President Carl O. Clagett called the meeting to order at 9:05 a.m. in Room 207 of Ladd Hall on the Campus of the North Dakota Agricultural College. After brief introductory remarks by the president, the eight papers listed on the morning program were read and discussed.

The following committees were announced. MEMBERSHIP: Dean Glenn C. Holm, Chairman; Richard E. Frank, Alex C. Burr, Cyril Moore, and W. Van Heuvelen. NECROLOGY: O. A. Stevens, Chairman; H. E. French, Harry B. Hart, H. E. Murphy, Everett O. D. Tuneberg. COMMITTEE ON SUPPORT AND RECOGNITION OF THE ACADEMY: G. A. Abbott, Chairman; Wilson Laird, and Dean H. L. Walster. NOMINATING COMMITTEE: Dr. E. D. Coon, Chairman; G. S. Smith, C. I. Nelson, H. E Murphy, Cyril C. Moore. RESOLUTIONS COMMITTEE: Dr. Ray Wendland, Chairman; Alex C. Burr and Allan F. Kingsley.

The morning session adjourned at 11:30 a.m. and was followed immediately by luncheon in Ceres Hall Cafeteria. Visiting members were guests of the Agricultural College.

The Academy reconvened at 1:30 p.m. in Room 207 of Ladd Hall. The ten papers listed on the afternoon program were read and discussed. Meeting adjourned at 5:03 p.m.

Following the custom of recent years the Academy Dinner was a joint meeting with the Red River Valley Section of the American Chemical Society and was sponsored by the local Sigma Xi Club. The dinner was held in the Memorial Union Ballroom with 128 members and guests present. After the dinner Dr. Wouter Bosch presented the following program: Vocal duet by Carole and Jocelyn Kirkus with Delores Mithun as accompanist. Greeting from President Fred S. Hultz. Introduction of new Sigma Xi officers. Introduction of new officers of Red River Section of American Chemical Society by Dr. W. B. Treumann. Announcement of winners of Student Research Prize Contest by Dr. Rae H. Harris; *First Place* to William E. Streib and Maurice L. Zweigle, *Second Place* to John Sullivan and *Third Place* to Freeman Young.

For the address of the evening the group moved to the Memorial Union Lounge. Dr. Laurence H. Snyder, Dean of the Graduate College of the University of Oklahoma spoke on "Human Heredity and Its Modern Applications". Dean Snyder's masterful presentation of this topic did much to stimulate our interest in this subject of vital concern to all of us.

SATURDAY, MAY 8, 1954

The meeting was called to order at 9:05 a.m. by President Clagett in Room 207 of Ladd Hall. The six papers scheduled for the morning were read and discussed.

The ANNUAL BUSINESS SESSION was called to order at 10:45 a.m. The minutes of the 1953 meeting were approved as printed in the 1953 **Proceedings.** The treasurer's report was read and approved as read.

Dr. E. A. Helgeson, Representative to the AAAS, reported on our relation to the AAAS and especially on the activities of the Academy Conference. His report was adopted.

Chairman Rae H. Harris gave the report of the Publication Committee. The report was adopted.

Dr. O. A. Stevens, Chairman of the Necrology Committee, in his report noted that there had been no deaths in the membership during the past year. The report was accepted.

Dr. Ray Wendland, Chairman of the Committee on Resolutions, presented their report. After some discussion the report as given below, except for Item 2 relative to the nomination of officers, was adopted. Item 2 was to be considered in a subsequent vote.

The Committee recommends to the Academy the Resolutions stated below:

1. In accordance with the purposes of this Academy, namely "to promote and conduct scientific research and to diffuse scientific knowledge", we urge the members of the State Board of Higher Education and the Superintendent of Public Instruction to strengthen the instruction in the laboratory sciences and mathematics at all educational levels by provision of adequate facilities and competent experienced teachers.(*)
2. Nominations for officers of the Academy should be sent to the members in advance of the annual meeting, and the nominating committee should be instructed to nominate at least two candidates for each office. Accordingly, we ask that the president call for action at this meeting to amend the by-laws to include this provision.
3. For the splendid encouragement of creative work in science throughout the high schools of the State, we offer congratulations and thanks to the directors of the State Science Fair, and particularly to its recent and present chairmen, Messrs. J. Rolzinski, H. N. Bliss, and R. Voth.

(*) The Committee asks that the Secretary forward letters containing this resolution to all members of the State Board of Higher Education (7), to the Superintendent of Public Instruction, to the Presidents of all the Colleges and University, and to Deans and Department Heads in the field of **Education.**

4. The Academy notes with approval and supports the program of the National Science Foundation as described recently by Dr. Raymond Seeger.
5. To draw upon the special experience of certain Academy members and to integrate information in a chosen field we believe that one (at least) invitational address be included as a feature of the regular program of research reports.
6. We urge the Executive Committee to broaden the base of research reports by extending special invitation to the variety of scientific groups in the State outside the University and State College.
7. We extend special thanks to our distinguished guest speaker, Dean Laurence Snyder, of the University of Oklahoma for his masterful presentation of the topic "Human Heredity and Its Modern Applications".
8. We extend thanks and appreciation to the Red River Valley section of the American Chemical Society and the Society of Sigma Xi for their support of the Academy program.
9. We extend thanks and appreciation to the Administrations of the State College and University for continuing the policy of financing the publication of the Proceedings of the Academy, and the Committee on Publications for their excellent service in preparing the Proceedings.
10. We extend thanks and appreciation to the Officers of the Academy for providing the program of research papers, pleasant accommodations, and management of Academy business under excellent supervision.
11. Our special thanks go to Miss Carolyn Cofell for kindly assistance with programs, tickets, and general information to visitors.

Dr. Alex Burr moved that along with the above report the Academy include

1. An expression of appreciation to the Fargo Forum and their staff writers for the excellent publicity they have given the oil development in North Dakota.
2. An expression of appreciation to Dr. A. Rodger Denison for supplying the money for the Student Research Prizes.

Motion was seconded and carried.

In the absence of the chairman, Dean Holm, Dr. Richard Frank reported for the Membership Committee. Mr. Ben Gustafson moved that three names be added to the list of nominees for membership. Motion was seconded by Dr. Wendland and carried. The proposed new members were unanimously elected and their names are given immediately following the list of active members in the first section of the **Proceedings.**

As chairman, Dr. Abbott reported for the Special Committee on

Support and Recognition of the Academy. This was in the nature of a progress report and Dr. Abbott moved that the committee be continued for another year to enable it to complete its present plans. Motion seconded and carried.

Dr. Wendland moved that the by-laws be changed as explained in Item 2 of the Report of the Resolutions Committee. The motion was seconded. After some discussion a vote was taken and the chairman declared the motion lost since it failed to receive a two-thirds vote.

Dr. E. D. Coon moved that the following by-law be adopted.

"The nominating committee shall bring in two nominations for each office. Other nominations may be made from the floor. The officers shall be elected by ballot at the Annual Meeting."

The motion was seconded and carried.

Dr. E. D. Coon as chairman of the Nominating Committee submitted the following slate of candidates: President—G. A. Abbott, Vice President—Warren Whitman, Secretary-Treasurer—J. Donald Henderson, Historian—G. A. Abbott, Additional Members of the Executive Committee—Everett O. D. Tuneberg and Cyril Moore. Additional nominations from the floor were for vice president—Loren Potter, H. E. Murphy, and Harry B. Hart; for member of the executive committee—Walter Knudson.

Dean Dunbar moved that the secretary cast an unanimous ballot for the president and secertary since there was only one candidate for each of these offices. Motion seconded and carried. Dr. W. B. Treumann moved that a plurality vote decide the election of the other officers. Motion seconded and carried.

The results of the election were as follows:

President - - - - G. A. Abbott, University
Vice President - Harry B. Hart, Jamestown College
Secretary-Treasurer - J. Donald Henderson, University
Historian - - -- - - - - - G. A. Abbott, University
Additional Members of Executive Committee—
Cyril Moore, Minot State Teachers College
Walter Knudson, Bottineau School of Forestry

Dr. W. B. Treumann described the events leading to the apparent termination of the Department of Geology and Geography at the North Dakota Agricultural College. After considerable discussion Dr. Treumann moved that the following resolution be forwarded to each member of the Board of Higher Education.

"The North Dakota Academy of Science expresses its grave concern regarding the recent action taken by the State Board of Higher Education leading to the termination of the Department of Geology and Geography at the North Dakota Agricultural College and the dismissal of the two professors of this department, effective at the close of the current academic year.

"This action represents a sudden reversal of policy inasmuch as the Department was only last spring authorized to expand its staff.

"This action involves the dismissal of one professor who has full tenure status.

"In the view of the Academy, if this action actually takes effect it may be expected to seriously damage the future of science and education in North Dakota

"In the interest of the future of the State of North Dakota, we strongly urge that the State Board of Higher Education carefully review this action, and that the Board take appropriate steps to restore the confidence of the academic world in our state."

Motion was seconded.

Dr. Alex Burr moved a substitute motion that the Executive Committee interrogate the Board of Higher Education with regard to a change in attitude with regard to science and report to the membership of the Academy. Seconded by Dr. Coon. Motion was lost.

Because of the comparatively small group present at the Business Session it seemed desirable to give the entire membership of the Academy an opportunity to express its opinion. Dr. Treumann changed his motion to the effect that the resolution be separated into Part A including the first four paragraphs and Part B including the last paragraph; each part to be voted on separately. If both parts were adopted, the secretary must send a copy of the entire resolution to each member of the Board of Higher Education. If the first part was adopted and the second part rejected, the adopted portion of the resolution would not be transmitted to the Board. The motion as modified was seconded and carried.

President Clagett appointed a committee to prepare and mail this resolution to the members of the Academy. The committee members were Dr. Earl Helgeson, Chairman; W. B. Treumann and D. Q. Posin.

(The result of the vote on sending the resolution to the Board of Higher Education was 54 for, 39 against, and 92 not voting. Thus it became the duty of the secretary to forward the resolution to the Board of Higher Education.)

The Academy adjourned at 1:05 p.m. and following adjournment lucheon was held in Ceres Hall Cafeteria with the visiting members as guests of the Agricultural College.

J. Donald Henderson
Secretary-Treasurer

YIELD CHARACTERISTICS OF NATIVE GRASS RANGES[1]

Warren C. Whitman

Department of Botany
North Dakota Agricultural College, Fargo, North Dakota

Introduction

The quantitative characterization of the forage yield of our western North Dakota native grass ranges is essential to a more complete understanding of their present productivity status and their potential productivity under improved management. The value of the native grass forage crop is dependent both on the quantity of its production and on the quality of its production. The proper evaluation of its yield characteristics therefore requires a more complex analysis than can be obtained from the establishment and maintenance of a long time record of total forage production.

Some aspects of the quality of the native grass forage crop of western North Dakota ranges have been considered by Whitman et. al. (4) (1951). Sarvis (3) 1941), in a classic experiment conducted at the Mandan Field Station, has evaluated the factors of both quantity and quality of forage production by means of cattle weights and and gains under different intensities of grazing. A complete quantitative analysis of the yield characteristics of the native grass forage crop has not yet been made..

This paper considers some of the quantitative aspects of native grass forage production based on studies begun by the North Dakota Agricultural Experiment Station as early as 1946. Those characteristics of yield which can be determined by cover analysis and clipping techniques are emphasized. These include species composition of the cover, species composition of the yield, total yield, seasonal variability in yield, and the periods of production within the season both on the basis of the vegetation as a whole and on the basis of the production of individual species.

Methods

Forage yields of grazed native grass ranges in southwestern North Dakota at and in the vicinity of the Dickinson Experiment Station have been determined by means of the cage-clipping technique. Portable steel-mesh cages are used to exclude livestock from small areas of vegetation in selected portions of representative vegetation sub-types. Ten such cages have been placed on each area of the selected vegetation sub-type. In all, 200 such cages are now in use involving approximately 17 different vegetation sub-types.

At the end of each growing season the forage within the areas protected by the cages is harvested with a hand-shears. The species

[1] Published with the approval of the Director, North Dakota Agricultural Experiment Station.

composition of the yield has been evaluated by estimation, supplemented by physical separation of a portion of the samples.

Vegetation cover analyses have been made on all sub-types where yield studies are being made, using the point-quadrat method.

Detailed studies of the seasonal increment of forage production for the vegetation as a whole and for individual species have been made by means of clipped quadrat technique on native grass areas at the Dickinson Station. All livestock grazing is excluded from these areas.

Records of precipitation, evaporation, wind movement, and air temperatures are obtained at the weather observation station maintained at the Dickinson Experiment Station.

Results

Table 1 gives the average yield by species and plant groups from 17 native grass range types for the four-year period 1950-1953. The special composition of the yield and of the vegetative cover are also given. It is apparent that on the average two of the grasses, western wheatgrass and needle-and-thread have provided about 60 percent of the total yield, even though they made up together less than 16 percent of the ground cover. These two grasses are of medium height and are referred to as mid-grasses. Blue grama grass is considered a short grass, and the upland sedges, of which there are three common species, are the ecological equivalents of shortgrasses. Blue grama and the sedges together have provided another 23 percent of the yield, but they made up almost 68 percent of the ground cover. The grasses which make up the bulk of the ground cover, therefore provide less than one-fourth of the total yield.

Miscellaneous grasses, while fairly numerous and of frequent occurrence produced only about 11 percent of the yield on the average, and made up about the same percentage of the total ground cover.

The data of the table show that for the most part the native grass ranges of western North Dakota are not weedy. The forbs produced only about seven percent of the yield and made up less than six percent of the ground cover.

Total production on these ranges can be expected to vary greatly from year to year. Such variations of course are related to varying weather conditions from season to season, especially to variations in precipitation and temperature conditions. The data of Table 2 show that the coefficient of variability for seasonal yield is very high, 56 percent, and is appreciably higher than the coefficients of variability for precipitation expressed either as average annual precipitation, seasonal precipitation, or potentially effective precipitation. Rogler and Haas (1947) (2) have shown that the amount of moisture in the soil in the fall plus the current season precipitation correlates very well with seasonal forage production. Clarke, Tisdale, and Skoglund (1) (1943) have found a close relationship between the seasonal Precipitation/Evaporation ratio and seasonal forage production. In all probability the same relationships apply in this area.

Table 3 shows something of the practical importance of the great variability in forage yield which occurs from season to season on these ranges. Maximum yields for the eight year period (1946-53) occurred in 1953 and minimum yields occurred in 1951, only one growing season apart. Serious consideration must be given to grazing management problems when a pasture which will provide 44 animal unit days grazing per acre in one season may provide only 11 days grazing per acre a season or two later. Probably an extreme case is represented by the low bench type where the forage was adequate to provide only 8 animal unit days of grazing per acre in 1951, but would have provided 70 days grazing per acre in 1953.

Most of the forage produced by these ranges in any one season is produced by the end of June. Table 4 gives the average increment of forage production for the 1951, 1952, and 1953 seasons. The data of this table show that the proportion of the total forage yield which will be produced by any given date in the season will vary considerably from year to year. The three year average shows about 30 percent of the total yield of forage to have been produced from the time growth began in April up to May 20. By the end of June approximately 80 percent of the forage had been produced. By the end of July forage production for the season is practically complete, with the three-year average indicating that about 93 percent of the total production will have been made by July 31.

Apparently late season precipitation has only a slight effect in stimulating further forage production, although it may have important effects on quality. Rainfall in August and September of 1951 totalled 4.78", and for the same period in 1952, 3.72", yet very little forage was produced on the clipped plots in either of these years after the end of July.

Some indication of the part that the important individual species play in influencing forage production of the vegetation as a whole at different periods during the season is shown by the data of Table 5. Western wheatgrass, needle-and-thread, and green needlegrass produce about one-third of their yield in the early growth period up to May. 20. Blue grama grass makes only a small portion of its yield in this early period, while the upland sedges produce almost half of their total yield during this period.

All of the species considered, with the exception of the sedges, make the bulk of their production in the period between May 20 and June 30. On the basis of the three-year average only blue grama grass makes a significant portion of its total production in July—27 percent. In 1951 this species produced over 50 percent of its total yield in the period between June 30 and July 31.

Discussion

Evaluated from the practical grazing standpoint the results of these studies indicate that the native grass ranges of western North Dakota produce on the average sufficient forage to provide 20 to 25 animal unit days of grazing per acre when utilized on the basis of a five-months summer grazing period. However forage production on these ranges is highly variable from season to season and grazing capacity may be four to five or more times greater in one season than in the next.

With over 80 percent of the yield from these ranges being produced by western wheatgrass, needle-and-thread, blue grama grass and the upland sedges, grazing management of the native grass should logically be centered around the maintenance of the proper proportional balance of these species. Special attention should be given to the maintenance of the highest possible proportion of the mid-grasses, western wheatgrasses and needle-and-thread, in the cover. These grasses provide the bulk of the forage yield and their growth extends for the longest period of time over the season. Deferment of grazing in the spring period plus moderate utilization tend to aid in maintaining a relatively high proportion of mid-grasses in the vegetative cover.

Since practically all the forage on these ranges is produced prior to the first of July, grazing animals must subsist for at least half of the grazing season on forage which is at or near complete maturity. As the livestock industry of the state swings more toward a program of finishing cattle for market, the problem of proper supplementation to secure the greatest good out of this mature forage can be expected to assume increasing importance.

Summary

A study of the yield characteristics of native grass ranges in the vicinity of the Dickinson Experiment Station in southwestern North Dakota has shown that almost 60 percent of the total yield is produced by western wheatgrass and needle-and-thread. These two grasses comprise slightly less than 16 percent of the vegetative cover. The upland sedges and blue grama grass produce about 23 percent of the total yield, but together make up over 67 percent of the vegetative cover.

Weeds during the period of the study have been relatively unimportant in terms of forage production and ground cover.

Variability in forage production is high from year to year on these native grass ranges. The coefficient of variability for yield based on eight years observation is 56 percent. Forage production shows greater variability than would be anticipated on the basis of variability in amount and distribution of precipitation.

Detailed clipping studies have shown that on the average about 80 percent of the forage yield is produced by June 30. Only one

species, blue grama grass had made a substantial part of its production after July 1. Precipitation in August and September has had only a slight effect in stimulating additional forage production during the latter part of the season.

TABLE 1.
Average Yield and Percentage Composition of Yield From 17 Native Grass Range Types—1950-1953.
Dickinson Area

Species	Ave. Yield-Lbs/Acre Dry wt.	Percentage composition of yield	Percentage composition of Vegetation-Basal Area
Westen wheatgrass	472	39.1	7.7
Needle-and-thread	248	20.5	8.0
Upland sedges	149	12.4	18.6
Blue grama grass	126	10.4	48.9
Green needlegrass	36	3.0	2.0
Prairie Junegrass	18	1.5	0.2
All other grasses[1]	73	6.0	8.9
Forbs	86	7.1	5.7
Total	1208	100.0	100.0

Average density — 27.1%

[1] Principally plains reedgrass, sandgrass, and Sandberg's bluegrass.

TABLE 2.
Variability in Yield of Native Grass Ranges and in Precipitation at the Dickinson Station
1946-1953

	Eight-Year Average	Standard Deviation	Coefficient of Variability
Yield—(6 types)	1128	630	56%
Annual ppt.	15.42"	3.03	20%
Seasonal ppt.	11.43	3.31	29%
Potential eff. ppt.	13.91	3.73	27%

TABLE 3.
Ratios of Maximum Yield to Minimum Yield on Six Range Types at the Dickinson Station — 1946-53.

Range Type	Ratio Max. Yield / Min. Yield	Days Grazing/Acre[1] Maximum	Days Grazing/Acre[1] Minimum
Rolling Uplands	4.1	44	11
Upland Draws	3.5	75	22
Lower Draws	5.3	79	15
Bench Type	5.1	40	8
Upland slopes	5.2	45	9
Low Benches	8.3	70	9

[1] At 50% Utilization

TABLE 4.

Increment of Forage Production on Native Grass Range at the Dickinson Experiment Station — 1951-1953

Year	Percentage of yield produced at intervals				
	May 20	June 30	July 31	Aug. 31	Sept. 30
1951	34.5	33.4	21.9	1.4	8.8
1952	42.9	43.7	7.2	5.0	1.2
1953	10.4	74.4	11.3	3.9	0.0
3-yr. Average	29.3	50.5	13.5	3.4	3.3
Cum. total	29.3	79.8	93.3	96.7	100.0

TABLE 5.

Increment of Yield of Individual Species and Plant Groups in Native Grass Vegetation at the Dickinson Experiment Station 3-Year Average — 1951-53.

Species	Percentage of yield produced at intervals				
	May 20	June 30	July 31	Aug. 31	Sept. 30
Western wheatgrass	36.5	40.5	9.1	3.4	10.1
Needle-and-thread	30.9	44.1	13.4	4.9	6.7
Blue grama grass	15.5	53.9	27.0	3.6	0.0
Upland sedges	49.3	35.1	12.5	3.1	0.0
Prairie Junegrass	28.0	57.3	10.5	4.2	0.0
Green needlegrass	33.1	49.5	8.8	0.5	0.0
Forbs	24.8	58.3	13.0	3.6	0.3

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A NEW CARBOHYDRATE FROM FLAXSEED

Harold J. Klosterman and C. O. Clagett
Department of Agricultural Chemistry
North Dakota Agricultural College, Fargo, North Dakota

ABSTRACT

A new type of carbohydrate has been isolated from fat-free linseed meal by extraction with a cold alcohol-dioxane mixture. The tan-colored product constitutes from two to four per cent of the meal. It is a high polymer and is faintly acidic. Dilute acid hydrolysis yields glucose, a dicarboxylic acid and a large amount of resinous material. Treatment of a methanol-dioxane solution with a small quantity of sodium methoxide affords an excellent degradation of the polymer and yields products which may be readily separated.

By partition chromatography on a cellulose column, using butanol ethanol water two fractions are obtained. The slower moving portion is glucosidic but so far has not been studied in great detail. The faster moving portion is a mixture and may be further resolved into four components by partition chromatography using a chloroform, acetic acid, tert-butyl alcohol water mixture. Two of these have been identified. One of them, dimethyl-**B**-hydroxy-**B**-methylglutarate has been described elsewhere. The second is the **B**-glucoside of **p**-hydroxycinnamic acid methyl ester. Both are new compounds and have been synthesized.

DEVELOPMENT OF TEMPERATURE REGULATION IN THE DOG

C. E. Jensen and H. E. Ederstrom
University of North Dakota Medical School, Grand Forks, N. D.

ABSTRACT

Dogs of various ages were exposed to cold and hot environments, without anesthesia, in an attempt to determine the age at which homeothermy developed. Adult animals maintained relatively constant rectal temperatures without apparent discomfort in the 2 air temperature ranges used (0-2 ° C.) and (39-41 ° C.). In the cold environment shivering was conspicuous in the adult animals, and core and surface temperature differences revealed marked vasoconstriction. In the newborn the shivering response was absent or ineffective for the first week or ten days after birth and core, surface temperature differences revealed poor vasconstriction. A rapid drop in rectal temperature was observed the first few days after birth but the rate of decline became progressively slower with age, until at 2 to 3 weeks after birth the rectal temperature remained fairly constant in the cold environment. In the hot environment the

rectal temperature increased rapidly in the newborn animals despite the appearance of a distinct panting response as early as 3 days after birth. Resistance to heat was poor until the animals were 3-4 weeks of age, when the ability to maintain a relatively constant rectal temperature under the conditions described was acquired.

(This investigation was supported in part by research grant G-3772 from the Public Health Service, National Institute of Health.)

FLOUR PARTICLE SIZE DISTRIBUTION IN HARD SPRING WHEATS

R. H. Harris and L. D. Sibbitt

Department of Cereal Technology

North Dakota Agricultural College, Fargo, North Dakota

ABSTRACT

Hard red spring wheat flour was separated into six fractions of varying particle size by sieving with Tyler Standard steel sieves on a Ro-Tap shaker equipped with an automatic tapping device to simulate hand sieving. The action is uniform and yields dependable and reproducible results. Protein content of the six fractions increased as particle size decreased, except for the finest size fraction, which was markedly lower. Loaf volume and mixing properties were directly related to the protein content. Flour ash content varied inversely with the particle size.

Particle size distribution, as ascertained by eight sieves of different opening size, was significantly affected by variety for six wheats of acceptable milling quality. The response of the varieties varied with location of growth in North Dakota, and sieve opening. The effect of location of growth was markedly greater than that of varieties, and varied for the different sieve sizes. For varieties of unsatisfactory milling quality flour particle size distribution was quite different from that of varieties possessing acceptable milling properties.

VIABILITY OF POTATO POLLEN AS DETERMINED BY STAINING

Eugene Schober and Shelby Lund

Department of Horticulture

North Dakota Agricultural College, Fargo, North Dakota

Potato breeding involves the use of many varieties and clonal selections as pollen parents. Many of these varieties and selections have varying amounts of non-viable pollen and are difficult to use as pollen parents in making crosses. This paper deals with rapid tests for pollen viability by use of an acetocarmine staining technique.

There are several ways in which potato pollen may be easily and quickly stained to determine the relative viability. Each major method has variations which are largely for the convenience and preference of the investigator. The quickest and most commonly used method of determining viability involves the use of acetocarmine (1). The stain was prepared by boiling an excess of carmine in forty-five per cent acetic acid for four minutes and then filtering.

The procedure used in staining and counting the pollen grains was as follows:

Fresh anthers were collected from the blossoms shortly before the time for examination. The anthers were tapped lightly against the slide to insure an even, not too dense, film of pollen for easier counting. With the pollen in place, the cover slip was placed gently on the pollen and the stain inserted from the side of the cover glass. The slide was then heated slightly to hasten the staining and to make the stain deeper on the viable grains. After about sixty seconds, the slide was placed on the microscope under low power, and with the aid of the ocular divider and two automatic counters, the stained and non-stained grains were counted and recorded.

All potato plants grown for winter crossing in 1953 and 1954 and having sufficient pollen were tested. In most cases this involved five plants of each variety. Samples were taken from different plants and different flowers on different dates, when this proved possible and practical. Pollen viability determinations were conducted from February 23 to April 1 and February 19 to March 12 in 1953 and 1954 respectively.

Individual anthers were tested for viability. These were selected one from a flower, and the flowers were chosen on different stems and different plants whenever this practice was possible. A representative area on the slide was selected for counting. With the aid of the ocular divider, the four areas of the field were counted as to the number stainable and non-stainable pollen grains. These four sample areas were totaled and the percentage figure for the individual anther was determined from them. In most cases percentages from five individual anthers of each variety were averaged to give the mean percentage of viability for the variety. In all cases, at least one hundred fifty pollen grains were counted from each anther. In cases where there appeared to be considerable variation between anthers of a variety, larger numbers of pollen grains were counted. Those pollen grains that did not stain or those that were larger and mal-formed were counted as non-viable.

The varieties and selections which were tested in both years are listed in Table I. With few exception, the results are quite comparable.

Discussion of Results

The viability of its pollen determines whether or not a given potato variety can be used as a pollen parent in making crosses.

Stainability of pollen is here used as an indication of viability. Krantz, et al, (2) have reported that most of the stainable pollen was probably viable and capable of effecting fertilization even in selections having five per cent or less stainable pollen. Under field conditions, various environmental factors may also affect fruit set in potatoes(2).

The results reported in Tables I and II have been used as a guide in making potato crosses in the greenhouse.[1] Based on these crosses, it was found that varieties with fifty percent and above stainable pollen produced excellent seed set, thirty to fifty per cent stainable pollen fairly low seed set, and less than thirty per cent stainable pollen very low seed set.

TABLE I. Comparison of Pollen Viability in 1953 and 1954

	Percent viable				Percent viable		
Variety	1953	1954	Ave.	Variety	1953	1954	Ave.
B922-3	86	89	88	S108	64	70	67
NDI9-100-3	78	83	80	Osage	65	66	66
ND457-1	78	77	78	ND457-1-4	61	63	62
ND2387-1	78	76	77	W1301	70	30[1]	50
ND2098-1	80	73	76	$B313N_3$	38	58	48
ND2780-6R	73	78	76	$B313N_1$	64	63	64
Redkote	68	77	72	Early Gem	47	48	48
ND1255-1	69	74	70	ND2910-1R	32	44	39
Manota	78	63	70	ND2569-4R	24	47	36
ND457-1-10	64	74	69	ND457-1-36	0	0	0

[1] Virus infection of plants may have affected pollen viability in 1954.

TABLE II.

Pollen Viability of Potato Varieties Tested in Only One Year

1953		1954	
Variety	Percent Viable	Variety	Percent Viable
I811-1	92	3028-6	88
B1290-2	90	2976-2R	87
ND92.49-2L	85	457-1-16	84
ND2231-2	79	2124-2R	84
B927.3	78	2555-6R	83
Mich R77-29	78	2200-1R	82
Cherokee	78	3045-7R	82
ND475-M2	76	3070-5R	82
ND2018-3R	72	1225-4	81
B2368-4R	72	30995-3R	81
NDB3074-2	70	2972-2R	78
Minn 113-8	69	2994-1R	76
NDB3074-3	68	3047-1	75
ND2104-3R	64	B922-6	75
ND2124-10R	64	M1546-2-48	74
Minn 32-80	61	W804	73
Neb 49.40-1	60	Taccona	72
Minn 147-90	60	3026-3	71
ND2470-3	60	2728-20R	70
ND2855-2	59	2475-8	69
Neb 26.44-1	59	I1049-3	69

TABLE II (Continued)

1953		1954	
Variety	Percent Viable	Variety	Percent Viable
Minn 147-24	56	3021-1R	68
B874-24R	52	B2876-1	68
B2102-11R	49	LD82-69	68
Kennebec	48	2987-2	67
B515-2	47	3185-1R	67
B2368-10R	47	M358	67
Triumph	44	B2368-11	66
B2872-1R	42	B1359N_2	64
ND2531-RR	42	3247-2R	64
I8168-26	41	B2067-133	63
B313N_1	37	B2368	63
B799-1	36	B3255N_1	63
ND2226-2	33	3203-6R	62
I972-1R	30	B31-37-13	62
ND2839-2	28	CS9947	62
I8168-28	27	M1363	62
ND2746-2	26	NDB3072-1	62
B2331-5R	19	2876-1	61
ND2090-2	16	3218-2R	61
ND457-1-22	12	3297-2	60
ND457-1-30	11	NDI906-1	58
B41956	10	B3159-1	57
Minn 15.46-2-48	3	B2162	56
Neb 209.43-1	3	3144-1	55
Neb 213.43-2	2	3168-1R	51
ND2080-2	1	B2067-1	51
		3022-17	50
		Early Gem	48
		888-8-1R	47
		B3131N_2	46
		2853-3R	45
		I801-10	44
		3255-1	42
		B595-76	42
		2851-4	38
		2774-3RR	36
		3203-1	36
		2780-8R	32
		3022-69	32
		B962-9	32
		3987-2	28
		I803-3	28
		B31-31-8	27
		M24-48-4-50	24
		3296-3	19
		2124-16	18
		3291-5	17
		3295-6	12
		3203-7	0
		3268-1	0
		41956	0
		457-1-35	0
		B2329-11R	0
		B3333N_1	0
		B606-67	0

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[1] Appreciation is expressed to the Department of Horticulture, North Dakota Agricultural Experiment Station, Fargo for the use of facilities and plant material used in these studies and to Mr. Robert Johansen of that department for the information on crossability referred to in this paragraph.

ADSORPTION OF AMMONIA ON LEONARDITE, NORIT AND LIGNITE

William E. Streib and Maurice L. Sweigle

Department of Chemistry
University of North Dakota, Grand Forks, North Dakota

INTRODUCTION

It has been well established that finely divided charcoal is a good adsorbant for many gases. In 1911, Titov (4) carefully meausured the adsorption of H_2, N_2, CO_2 and NH_3 on charcoal. He found that adsorption followed the following relationship

$$\log a = \log a_0 - (C_1 - C_2 \log p)\ t$$

where "a" is the amount of gas adsorbed, C_1 and C_2 are constants, p is pressure, t is temperature, and a_0 is a constant quantity multiplied by pressure. The adsorptive properties of brown coal, lignite, and some related materials have been studied. Vandracek and Hlavica (5) (1925) studied the adsorption of N_2, H_2, air and CO_2 on lignite and found that there was almost no adsorption of N_2 or H_2 and less than one percent of air or CO_2. The lignite sample here contained water. Later, D. Casavola (1949) (1) and B. Tanzi (1934) (3) studied the effect of prior sulfuric acid acidification on the adsorption of ammonia on lignite. Winzer (1935) (6) found that up to 15.1% NH_3 was adsorbed by brown coal when it was treated with ammonia. The temperature at which this was carried out was not given. Winzer also found that the water content of the brown coal had pronounced effect on its adsorptive properties. Kagan and Proshchin (1937) (2) found that pretreatment of lignite with chlorine gas or oxygen at 100°C increased its adsorption of ammonia.

No information could be found in the literature on the adsorptive properties of leonardite (a weathered form of lignite found in North Dakota). In this study, Norit (a commercially prepared charcoal), known to be 97-98% carbon and 2-3% ash, was used as a reference for comparative purposes. Lignite, known to contain groups which do influence the adsorptive properties of carbon, was included in these studies.

It will be the purpose of this investigation to ascertain the adsorption extent of ammonia on leonardite as compared to Norit and lignite and to determine whether this adsorption is chemical, physical or both.

Experimental

PREPARATION OF SAMPLE. The Norit (manufactured by Pfanstiehl Chemical Co., Waukegan, Illinois) used was in powdered from. The lignite and loanardite were ground and screened through a forty mesh screen. The lignite sample was mined at Columbia, North Dakota; the leonardite sample was obtained at Gascoyne, North Dakota.

Each sample was heated to 400-450°C for one and one half hour and stored in a dessicator, over calcium chloride.

APPARATUS FOR AMMONIATION. The sample tube was made using 15x200 mm. pyrex tubing fitted at each end with a male ground glass joint. A female ground glass joint was used between one end and an ammonia source, while the other end was similarly connected to an air trap and an acid trap in turn. This sample tube was heated to the desired temperature in an electric tube-furnace, the temperature of which was controlled by a variac and measured with a mercury thermometer.

DETERMINATION OF AMMONIA ADSORPTION. The sample tube containing a known amount of sample (determined by weighing on an analytical balance) and an asbestos filter plug at each end was connected to the ammonia source, heated to the desired temperature and exposed to a gentle flow of ammonia (25 ml. per minute) for 180-200 minutes. The sample tube is then reweighed and the percent of ammonia adsorbed determined directly. The sample was then exposed to air at 110°C to determine the extent of chemical adsorption.

Discussion

Several successive trials were run to determine the relationship between adsorption and time. Table 1 indicates that, beyond 180 minutes, the amount of adsorption was not a function of time.

TABLE 1

Exposure time (min.)	% NH_3 adsorption on Norit
35	8.26
70	9.66
140	10.11
200	10.13

The largest percentage adsorption for each of the three materials (Norit, leonardite, and lignite) occured at the lower temperatures.

TABLE 2

% Total Adsorption of Ammonia

Temp.	Norit	Leonardite	Lignite
23°C	10.33	7.22	7.64
45°C	6.63	5.52	5.51
85°C	1.52	3.63	3.19
115°C	.79	2.42	1.93

The data shows further that Norit had the highest percent adsorption at the lower temperature and it also had the lowest percent adsorption at the higher temperature. Lignite had the next highest percent adsorption at the lower temperature and the next higher percent adsorption at the higher temperature, while the leonardite had the lowest adsorption at the lower temperature, but it also had the highest adsorption percent at the higher temperature. This indicates that the adsorptive properties of leonardite were least affected by temperature change.

If ammonia is adsorbed chemically to form a stable adsorption product, it is to be expected that such ammonia would be retained in the material upon exposure to air at an elevated temperature. It is possible that some of the adsorption products formed are not stable above 110°C. These would not be reflected in any adsorption labelled chemical adsorption if the sample were exposed to air at 100°C to remove physically adsorbed ammonia without adsorbing water from the air. If, however, adsorption is physical (i. e. similar to condensation) it is to be expected that such ammonia will be lost by the material on exposure to air. This is particularly true at slightly elevated temperatures because the boiling point of ammonia is -33.4°C.

TABLE 3

Exposure of Ammoniated Norit To Air At 110°C

Ammoniation	% of total NH_3 remaining after following time intervals				
temperature	30 min.	5 hours	24 hours	1 week	1 week
23°C	28.15			16.94	8.13
45°C	62.10	27.01	22.81		
85°C	38.81	0.00	0.00		
115°C	0.00	0.00	0.00	0.00	0.00

TABLE 4

Exposure of Ammoniated Lignite to Air at 110°C

Ammoniation	% of total NH_3 remaining after following time intervals		
temperature	30 min	5 hours	24 hours
23°C	70.28	53.93	53.93
45°C	50.99	49.23	49.23
85°C	66.85	66.85	66.85
115°C	100.00	100.00	100.00

TABLE 5

Exposure of Ammoniated Leonardite to Air at 110°C

Ammoniation temperature	% of total NH_3 remaining after following time intervals 30 min	5 hours	24 hours
23°C	75.14	60.89	60.89
45°C	100.00	100.00	94.64
85°C	100.00	100.00	100.00
115°C	100.00	100.00	100.00

All samples run were exposed to air at 100°C for the length of time indicated in tables 3, 4, and 5. Some of the samples reached a maximum loss of weight within the above exposure time, indicating that all the physically adsorbed ammonia had been lost and that any remaining ammonia was chemically adsorbed. The rest of the samples were still losing ammonia at the end of the exposure period. However, the rate of loss had decreased to the point which clearly indicates that, after all the physically adsorbed ammonia had been lost, there will remain some chemically adsorbed ammonia. The exception to this occurs in the Norit samples run at 85°C and 115°C which had lost all of the adsorbed ammonia, indicating that there was no chemical adsorption in these cases. Tables 3, 4, and 5 summarize the effect of the exposure on all of the samples. The data indicates that in only one case (ammoniation at 45°C) does chemical adsorption of ammonia on Norit exceed nine percent of the total ammonia adsorption. Chemical adsorption of ammonia on lignite is at least 49% of the total adsorption while it is at least 60% of the total adsorption on leonardite. Data of Tables 3, 4, and 5 interpreted in the light of Table 2 indicate that, while the adsorption of lignite and leonardite can all be chemically adsorbed, at such a point the total adsorption is as low as 1.93%. The data further indicates that ammoniation at 23°C gives greatest chemical adsorption on lignite (about 4%) while ammoniation at 45°C gives greatest chemical adsorption on leonardite (about 5%). We are at this point in the investigation not prepared to say just what groups are responsible for the chemical adsorption herein discussed.

Acknowledgment

Acknowledgment is made to Dr. H. W. Hoyer, Chemistry Dept., University of North Dakota for valuable suggestions throughout this investigation.

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EVALUATING THE QUALITY OF NORTH DAKOTA WHEATS BY PHYSICAL DOUGH TESTING EQUIPMENT[1]

John Sullivan, L. D. Sibbitt and Rae H. Harris

Department of Cereal Technology

North Dakota Agricultural College, Fargo, North Dakota

INTRODUCTION

Since the production of bread wheat is very important to North Dakota agriculture the utilization value of this crop is of interest, and worthy of investigation. Any criteria which may be useful in arriving at a decision on the advisability of releasing a new variety for general farm growth affords additional insurance against the possibility of a wheat of poor milling and baking quality being approved. This is especially pertinent when every effort is being made to develop new varieties of satisfactory quality which are resistant to the attacks of the 15 B rust complex.

In addition to information about other flour attributes, a knowledge of the physical properties of a dough is essential to the baker. These physical properties indicate the adaptability of a flour to the processes used in bread production.

Many diverse methods have been used by investigators to evaluate a flour for these properties. The use of the Brabender Farinograph for determining several physical properties has been heavily relied upon. The Farinograph measures changes occurring in a dough during mixing. This instrument represents a dynamic type of measurement (the results of which are readily interpreted). In contrast to this dynamic type, the Brabender Extensograph represents a static type of measurement. The Extensograph measures the changes that occur in a dough during fermentation or resting. Merritt and Bailey (2) contributed to some of the preliminary studies involving the most desirable techniques to be used in this measurement. Harris, Sibbitt, and Mundinger (1) developed a procedure best suited to differentiate hard red spring wheats. The following study used this procedure in differentiating hard red spring wheats grown in North Dakota.

This study was made in an attempt to differentiate hard red spring wheats grown in 1953 with both the Farinograph and Extensograph. All wheats were milled in an Allis-Chalmers experimental mill. Six field plot varieties grown at six stations in North Dakota and one additional variety grown only at the Fargo station were included in this study. The six varieties and stations are identified in Table I, and the extra variety in Figure 1.

[1] Published with the approval of the Director, North Dakota Agricultural Experiment Station.

METHODS

Both instruments and materials used are maintained at a temperature of 30°C. The Farinograph measures the relative baking absorption and mixing requirements of a flour. This is done by producing a curve on a graph which represents the resistance to mixing of a flour-water mixture during dough formation. The instrument is composed of three main parts: the bowl and mixing device, the dynometer, and the recorder. The baking absorption is obtained by measuring the quantity of water necessary to obtain a dough that has a maximum consistency at the 540 Brabender unit line on the kymograph. The mixing time and mixing stability are obtained from the curve dimensions. The mixing time is the time from commencement of mixing until the curve's maximum height is reached. Mixing stability is the distance through which the maximum height remains relatively stable. A medium mixing time and a long mixing stability signify superior mixing requirements. The curves are classified as strong, medium, or weak depending on the width of the curve and the amount of mixing stability.

Resistance, in gms., to extension and extensibility, in cm., of a dough are obtained by Extensograph measurements. The Extensograph has three main parts: the molding equipment, the stretching mechanism, and the recording device. The operation and formula used have been described previously (1). Both extensibility and resistance are obtained directly from the curve. Extensibility is the length of the curve while resistance is the height of the curve. Much work has been done to find correlations between extensogram measurement and baking data (1, 3).

RESULTS

In observing some of the abnormal characteristics shown by many of the new varieties the need for knowing their physical properties has become self evident. Figure I shows farinograms and extensograms of three flours. Thatcher is an accepted standard variety while Selkirk and Minn. 2855 are new varieties. Selkirk has recently been approved for release in Canada and Minn. 2855 is a variety being increased under contract for possible release by the Minnesota station. Thatcher and Selkirk both yield farinograms and extensograms which are satisfactory and superior to those produced by Minn. 2855. Neither the farinogram nor the extensogram of Minn. 2855 is desirable. The 180 minute extensogram has a larger resistance than the 45 minute curve in all instances. This is a result of the presence of potassium bromate and is termed the "bromate effect". No appreciable increase in resistance occurs with the unbromated 180-minute doughs or between the bromated and unbromated 45-minute doughs (1). Bromate is extensively used as an improver in bread formulas to obtain a more desirable loaf. Thus the increase in resistance may be used as an indication of the capability of a flour to be improved by oxidizing or maturing agents.

Table I shows the wheat protein content and farinogram properties of the six varieties. The protein content of the wheats grown at Fargo were lower than normal for North Dakota. It has been shown that a high correlation (+.97) exists between mixing time and mixing tolerance and that mixing requirements tend to be varietal in character (4). Because of this it is necessary to show only the mean values for the mixing stability of the six varieties. Thatcher, Rival, Mida, Lee, and Selkirk all have large desirable mixing stability, while 3880 has a relatively low, undesirable value. This variety has been judged as unacceptable for quality because of its mixing requirements, and therefore has been replaced in our field plot trials by a selection which produces a more desirable type of farinogram and extensogram.

Table II shows the mean Extensograph data for the varieties. Thatcher possesses the highest resistance to extension while Mida represents probably the lower level in acceptable extensograph requirements. No. 3880 is unsatisfactory in this respect with markedly lower resistance than Mida, the second lowest, particularly following 180 minutes of rest. There appears to be a relation between resistance and extensibility. No. 3880 has the lowest value for extensibility as well as for resistance.

The lower section of the table provides values for resistance and extensibility for the six stations. Dickinson produced wheats of the greatest resistance, while Fargo and Edgeley gave lower results. The range between stations, 165 gms., was much less than between varieties, 384 gms. The relative magnitude of this difference is the same for dough extensibility. These differences are evaluated statistically in an analyses of variance, Table III.

The analysis of variance given in Table III shows the relative importance of varieties, stations, and rest periods in regard to the extensibility and resistance values obtained by the Extensograph. For extensibility the varieties are by far the most important, as shown by the relative magnitudes of the variances. However, both station and periods do have a significant effect on extensibility. None of the interactions show any significance for extensibility. Resistance also is affected much more by varieties than by station, but rest periods are the most important single contributing factor. This would be suspected because of the manner in which the bromate affects the resistance of the 180 minute rest period curve. The interactions all are significant for resistance.

It is evident from the data that mixing requirements and dough handling properties, as assayed by the Extensograph, differed significantly between wheat varieties, and to a lesser, though still significant, degree among stations where the wheats were grown. Potassium bromate appeared to aid in characterizing varieties from a standpoint of oxidation requirements. Differentiation between varieties was best after 180 minutes rest.

One or two new hybrid wheats were particularly different in these properties from varieties which have been found satisfactory by the milling and baking industries, and are likely to cause dissatisfaction to the consumer if grown extensively.

TABLE I

Mean Dough Stability Values for Varieties and Stations
(Arranged in order of decreasing dough stability)

VARIETIES	Wheat Protein %	Dough Stability cm.	STATIONS	Wheat Protein %	Dough Stability cm.
Lee	13.2	14.7	Dickinson	14.0	16.6
Thatcher	12.4	12.1	Minot	12.6	11.2
Mida	12.0	12.1	Williston	13.1	10.0
Selkirk (C.T. 186)	13.9	9.8	Langdon	13.2	9.8
Rival	11.9	8.8	Edgeley	13.2	9.1
3880	14.1	6.1	Fargo	11.3	6.9

TABLE II

Mean Values for Dough Resistance and Extensibility for the Six Varieties and Stations
(Arranged in order of decreasing resistance at 180 minutes)

	Resistance		Extensibility	
	45 minute	180 minute	45 minute	180 minute
VARIETIES				
	gms.	gms.	cm.	cm.
Thatcher	460	640	26.2	25.7
Lee	403	592	25.8	24.9
Rival	389	582	25.5	23.1
Selkirk	370	533	21.4	19.7
Mida	369	522	21.2	19.3
3880	202	266	21.2	18.9
STATIONS				
Dickinson	428	607	26.1	25.2
Williston	398	561	23.6	21.4
Langdon	354	535	22.5	20.5
Minot	371	524	23.4	22.1
Fargo	322	467	21.4	19.2
Edgeley	322	442	24.2	23.1

TABLE III

Analysis of Variance of Extensograph Data

Source of Variation	Degrees of Freedom	Resistance Variance	Resistance F Value	Extensibility Variance	Extensibility F Value
Between Varieties	5	143,787.50	58,724.7**	88.32	33.58**
Between Stations	5	30,878.33	12,611.1**	41.22	15.67**
Between Periods	1	443,381.90	181,083.1**	46.72	17.76**
INTERACTIONS:					
Varieties x Stations	25	1,112.83	454.5**	3.85	1.46
Varieties x Periods	5	7,622.78	3,113.2**	4.42	1.68
Stations x Periods	5	1,548.61	632.5**	1.12	.43
Varieties x Stations x Periods	25	2,448.50		2.63	
TOTAL	71				

** Denotes 1% level of significance.

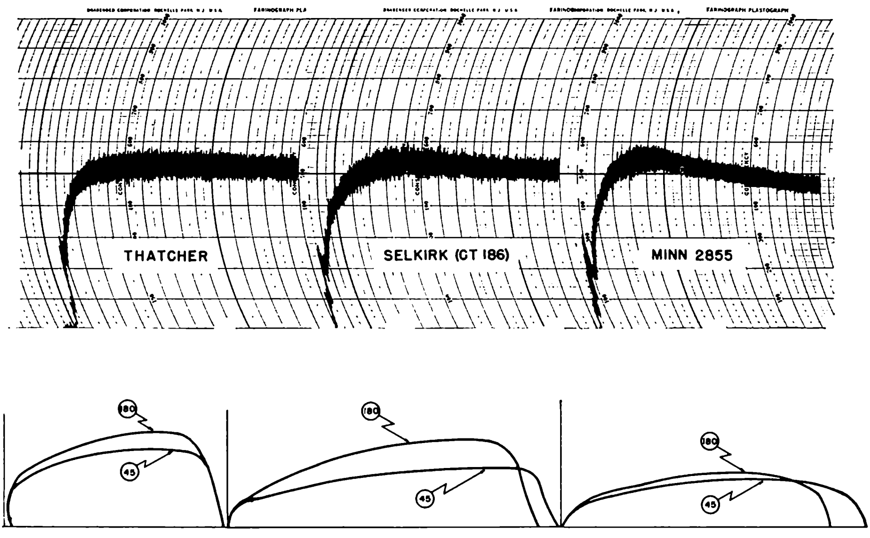

Figure 1. Farinograms and extensograms for Thatcher, Selkirk and Minn. 2855. The extensograms show curves for both the 45 minute and the 180 minute rest periods.

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AN INVESTIGATION OF CYCLOHEXENE PEROXIDES

F. M. Young and W. B. Treumann

School of Chemical Technology
North Dakota Agricultural College, Fargo, North Dakota

INTRODUCTION

Cyclohexene confined in the presence of air slowly absorbs oxygen, with the formation of products of relatively low volatility. Stephens (5) has shown that the major substances formed are peroxides of cyclohexene, but reported evidence pointing to polymerization on distillation. Criegee, Pilz and Flygare (3) identified the major component of the oxidation product as 3-cyclohexenyl hydroperoxide.

Stephens (5) obtained samples of cyclohexene peroxide by recycling oxygen at barometric pressure through cyclohexene at room temperature for periods of from one to four months, followed by fractional distillation. Yields of less than one *per cent* were obtained. Criegee, Pilz and Flygare (3) evidently obtained better yields, probably of the order of five *per cent,* by confining cyclohexene and oxygen in a quartz vessel, and subjecting the mixture to ultraviolet radiation for 14 hours followed by agitation in the dark for ten hours. They reported a rate of oxidation with agitation of about two-thirds that obtained with radiation. Insufficient information is given to rule out the possibility that the relative rates would be reversed if the order of the conditions had been reversed. In any case, their results suggest that the use of oxygen under much higher pressures may allow the preparation of cyclohexene peroxide in good yield.

The object of the present investigation was to explore the possibility of preparing cyclohexene peroxides in satisfactory yields by the use of oxygen under rather high pressure in reasonably short periods of time, and to investigate certain aspects of the properties of the product.

EXPERIMENTAL AND RESULTS

The reaction vessel used was a Parr combustion bomb which had been modified by covering the rubber gaskets with aluminum foil gaskets to prevent contamination of the liquid.

In the first run, to 21 grams of freshly distilled cyclohexene, refractive index* 1.4451, oxygen was admitted until a pressure of 16

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* All refractive indices were measured at 23°C. using sodium light.

atmospheres was reached. The bomb was shaken every 15 minutes during the first two and one-half hours and then allowed to stand for three days at room temperature. The resulting liquid was yellow in color and had a penetrating odor very different from that of cyclohexene. The refractive index of this solution was 1.4471, 0.0020 greater than that of pure cyclohexene.

In the second run the same mass of cyclohexene was used, but oxygen was admitted until a pressure of 30 atmospheres was reached. The bomb was shaken vigorously for a few minutes, then set aside, and was opened two days later. The liquid was found to be similar in color and odor to the one previously obtained, but its refractive index was 1.4511, 0.0060 larger than that of cyclohexene. The refractive index of cyclohexene peroxide is 1.4830 (4), thus in this run the increment in the refractive index is 16 *per cent* of that to be expected for complete conversion, and three times as large as for the first run.

Christensen (2) observed that a sample of cyclohexene, which had been confined for several years in the presence of air, separated into two phases on addition of silver nitrate. In the present investigation, silver nitrate was added, with shaking, to a large portion of the richer mixture until further additions of silver nitrate failed to dissolve. The mixture separated into two phases. The upper phase, somewhat larger in volume than the lower, had a refractive index of 1.4451, identical to that of cyclohexene (1). No attempt was made to distill the organic material from the viscous phase because of the explosion hazard reported by Christensen (2). A few small crystals of sodium chloride were added but they neither dissolved nor formed any precipitate.

A few small crystals of sodium chloride were dropped into the remaining portion of the oxidation product, but in marked contrast to the results obtained with silver nitrate, no visible loss of salt occurred.

DISCUSSION OF RESULTS

Cyclohexene in contact with oxygen at 30 atmospheres of pressure evidently undergoes considerable oxidation in a two day period. On the basis of the increase in the refractive index, it appears that roughly one-sixth of the cyclohexene was converted into the peroxide.

The correspondence between the results obtained on adding silver nitrate to the oxidation product and those observed by Christensen on treating aged cyclohexene in the same manner suggest the similarity, if not the identity, of the reaction product formed by the two processes. It is interesting to note that the upper phase has a refractive index identical to that of pure cyclohexene. Evidently the peroxides are almost quantitatively removed from the oxidation product by the addition of silver nitrate.

The high solubility of silver nitrate in the oxidation product and the negligible solubility of sodium chloride suggest that the reaction product interacts in some specific manner with silver nitrate. This probably involves complex formation between silver ion and the double bond of the cyclohexene peroxide molecule in a manner similar to that which occurs betwen silver ion and allyl alcohol (2, 6).

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RADIATION STUDIES

T. Vergeer

Department of Physiology and Pharmacology

University of North Dakota, Grand Forks, North Dakota

ABSTRACTS

1. EFFECTS OF NEUTRON IRRADIATION ON PLANT GROWTH*

Tulips irradiated sixteen and eight minutes with neutrons developed poorly, nearly all failed to bloom, many failed to develop roots and none reproduced.

Five lots of forty bulbs belonging to two cultivated varieties and three wild species were exposed to two minute neutron irradiation. One hundred ninety-four were planted and one hundred five produced a small crop but in only five was there a small gain, the others lost 34-79%.

The following year one species, T. acuminata, died out. Another, T. tarda, the only species which bloomed the first year and which lost the least in weight, was lost. The survivors of the three other groups consisting of 25, 17, and 30 bulbs were planted, together with controls. Now 17, 12, and 27, respectively produced a crop. Only six of these failed to replace their own weight. The other clones gained up to 232% . The average gain of irradiated Mr. Van der Hoef was

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* Neutron irradiation courtesy Dr. Norbert J. Scully, Argonne National Laboratory Investigation aided by grant from the Joseph Henry Fund, administered by the National Academy of Science.

43%, of Blue Ribbon 60%, and of T. praestans 116%. Individual controls gained up to 194% and averaged 33% in Mr. Van der Hoef, 87% in Blue Ribbon and 110% in T. praestans. Preliminary tests have shown that leaves of eight minute irradiated plants form no starch and that starch synthesis is materially reduced in parts of 2 minute irradiated plants.

2. IRRADIATION OF NORMAL PLANT MATERIAL BY RADIOACTIVE BULBS*

Previous experience had suggested that certain elements in bulbs can be rendered radioactive and that such bulbs may emit gamma and beta rays. To test their effect on other bulbs two hundred eight minute neutron irradiated bulbs were packed with one hundred normal tulip bulbs and left in the same container for one month. In general, exposure proved too severe. However, because of differences in position, it varied considerably. There was marked evidence of burning, typical delay in development, and only one variety produced a few flowers. As with gamma irradiation from cobalt 60 (Vergeer: Gamma radiation and plant growth. Fed Proc. 13 (1):157, 1954), these also showed marked development of internal buds into secondary plants and increased multiplication in many. Ninety-five secondarily irradiated tulips were planted, sixty-five survived. The average weight of the crop of two lots of the five gained a little the first year after exposure. However, some individual specimens lost but others made gains up to 104% in one variety and in another up to 107%

The following year five additional clones died out and all the bulbs of one variety were lost. However, the four remaining varieties ganed 101-158% and individual clones gained up to 266%. The controls gained 33-110% and their individual clones gained up to 194%.

The number of bulbs produced by the irradiated lots far exceeded the number produced by the controls.

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* Irradiation courtesy Dr. Norbert J. Scully, Argonne National Laboratory Investigation aided by grant from the Joseph Henry Fund, administered by the National Academy of Science.

3. RADIATION INDUCED PARTHENOCARPY*

In an experiment to test the effects of neutron irradiation on tulip bulbs control bulbs appeared to be affected by secondary irradiation from the exposed bulbs. (Vergeer: Mich. Acad. Sc., Arts, & Lett. 36:53-61, 1950). Ten of twenty pistils enlarged markedly, seven produced no seed and the seed of the other three did not germinate.

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* Radiation courtesy Dr. Lester Wolterink, Michigan State College. Investigation aided by grant from the Joseph Henry Fund, administered by the National Academy of Science.

To repeat the experiment thirty-seven tulips were irradiated* with pure gamma rays from Cobalt 60 and the same general systemic effects observed. Normally dormant internal buds enlarged to produce whole new additional plants from the same bulb, many overies enlarged to normal sized fruits but were often abnormally shaped. One fruit developed with the carpels completely separated and produced a quantity of large seeds, others produced only a few or none. The unripe seeds were red and decidedly biconvex instead of white and flat. None of the controls produced fruit or seed. Only one of several hundred seeds grew. The plant was half the size of those raised from control seed produced by hand pollination. The seed appears to have been parthenogenetic.

CONDUCTOMETRIC EVIDENCE ON THE EXISTENCE AND COMPOSITION OF A COMPLEX BETWEEN ALLYL ALCOHOL AND SILVER ION

W. L. Krueger and W. B. Treumann

School of Chemical Technology
North Dakota Agricultural College, Fargo, North Dakota

INTRODUCTION

On the basis of measurements of the equilibrium distribution of allyl alcohol between carbon tetrachloride and aqueous silver nitrate, Winstein and Lucas (2) postulated that allyl alcohol and silver ion have some tendency to unite in a one-to-one ratio, forming complex ions. It should be of interest to examine this hypothesis in terms of phenomena of a very different type.

THEORY

Solutions containing ionic solutes are electrical conductors. Under fixed conditions of concentration, temperature and potential gradient, the specific conductances of various electrolytes in a given solvent are proportional to the average migration speeds of the ion constituents. When an ion becomes heavier through coordination with a molecule more work is required to transport it through the solution, thus the ion travels more slowly and the conductance of the solution is correspondingly reduced. Since it is possible to measure the conductance of an electrolyte both in the presence and in the absence of a suspected complexing agent, it is often possible to demonstrate the existence of complexes from appropriate conductance data.

METHOD

Each set of solutions studied contained an inorganic electrolyte at one certain concentration of approximately tenth molar, and an organic compound at concentrations varying from zero to several times the molarity of the electrolyte. Plots of the specific resistances* of these solutions versus the concentration of the organic materials may be expected to exhibit a rapid change in slope approximately at the stoichiometric point if a complex of high stability is formed, a gradual change in slope for a complex of moderate stability, and an essentially constant slope if no complex is formed.

EXPERIMENTAL

The liquid materials used were of high initial purity and were redistilled. Conductivity water was used as the solvent. The solid materials, of C. P. or of analytical grade, were used without further purification.

The resistances of the solutions were measured at 30.2°C. using a Wheatstone bridge and an alternating current of 1000 cycles per second. The capacitance of the cell containing the solutions was balanced by a variable capacitor across the matching resistance.

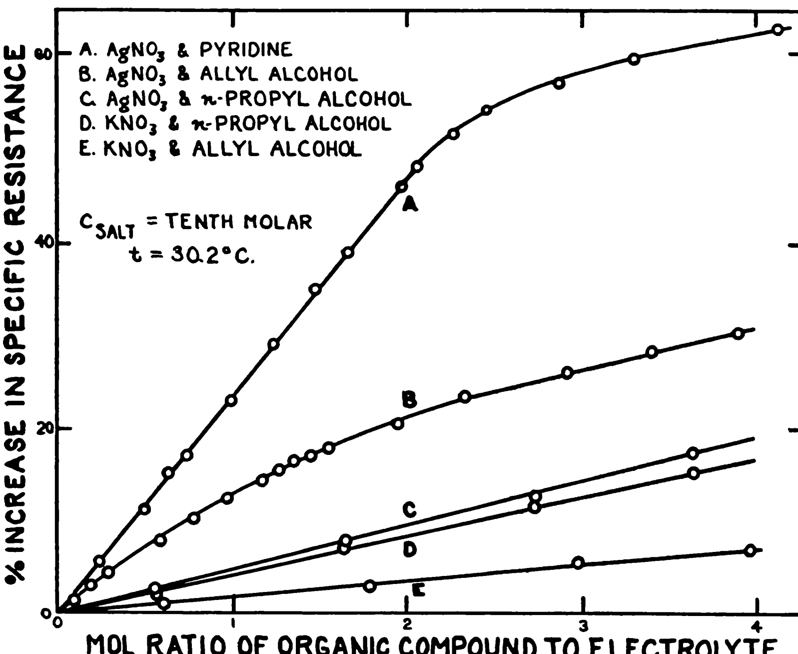

FIG. 1. EFFECT OF ADDED ORGANIC SOLUTE ON RESISTANCE

* For certain theoretical reasons, results obtained in studies of the resistances of solutions are usually stated on a conductance basis. However, in the present study specific resistance is the more convenient quantity because it is a simpler function of the compositional variable employed.

RESULTS AND CONCLUSIONS

The data obtained are not amenable to compact tabulation but are represented graphically in Fig 1.

Pyridine and silver ion are known to form a 2:1 complex of rather high stability (1). This may be deduced from Curve A. At constant concentration of $AgNO_3$, increasing concentration of pyridine is accompanied by a marked increase in resistance up to or somewhat beyond a molarity of pyridine twice as large as that of $AgNO_3$. Further increases in the pyridine concentration result in relatively little increase in the resistance. The change in slope indicates complex formation; the abruptnes of the change shows that the complex has a rather high stability, and the location of the "break" implies a 2:1 composition. This system is included as an aid in the interpretation of the other results.

Certain comparisons and contrasts among the Curves B, C, D and E are worthy of preliminary notice. Allyl alcohol is much more effective than *n*-propyl alcohol in creasing the resistance of $AgNO_3$ solutions (cf. Curves B and C.) although the reverse is the case for KNO_3 solutions (cf. Curves D and E). Solutions of $AgNO_3$ undergo much greater increases in resistance on addition of allyl alcohol than do solutions of KNO_3 (cf. Curves B and E) although solutions of $AgNO_3$ and of KNO_3 exhibit rather similar behavior if *n*-propyl alcohol is added instead (cf. Curves C and D). Thus solutions containing silver nitrate and allyl alcohol are in marked contrast to solutions of the other pairs of solutes.

The marked non-linearity of Curve B indicates that $AgNO_3$ and allyl alcohol tend to form a complex. The gradual decline in the slope, with increasing concentration of the alcohol, shows that the complex is of moderate stability. The curve is essentially linear at mol-ratios larger than approximately 2.2, suggesting that most of the $AgNO_3$ is complexed in this region. Because the complex is only moderately stable, only a small fraction of the material can be in the form of the complex at the stoichiometric ratio, therefore the slope must continue to decline considerably beyond this point as more and more of the minor constituent is complexed. Hence the mol ratio composition of the complex must be less than two. A 1:1 composition is the most probable, although complexes of other compositions may also exist.

Inspection of Curve E reveals that KNO_3 shows no tendency to complex with allyl alcohol, hence the active component of $AgNO_3$ must be the silver ion.

The results represented by Curve C show that the silver ion does not complex appreciably with *n*-propyl alcohol, the saturated analogue of allyl alcohol. Therefore the double bond is a structural feature essential to the formation of a complex between silver ion and allyl alcohol.

SUMMARY

Evidence is presented for the formation of a moderately stable complex ion from silver ion and allyl alcohol. The double bond of the allyl alcohol molecule is shown to be an essential structural feature. A 1:1 composition is probable, although complexes of other compositions may also exist.

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EPIDEMIC OF SCALP RINGWORM (TAENIA CAPITIS) IN GRAND FORKS, NORTH DAKOTA THE DISTRIBUTION OF SCALP RINGWORM

Henry Y. Tsumagari

Department of Pathology
University of North Dakota, Grand Forks, North Dakota

ABSTRACT

A severe epidemic of Taenia capitis due to the fungi, Microsporon Audouini, appeared in Grand Forks, North Dakota in the spring of 1952. At the height of the epidemic, a total of 372 children, principally of school age, were found to have scalp ringworm. All cases were proven by cultural methods by the North Dakota Public Health Laboratory.

A total of 4564 students were periodically examined under the Wood's lamp revealing an incidence of 8.2% infected with rigworm. The magnitude of the epidemic may be illustrated by saying that in the peak incident age group of ten years, one of every 5.4 boys had ringworm of the scalp. The ratio of boys to girls having ringworm was 12:1. The peak incidence of girls infected was in the four and five year old group with a sharp decline in the number of cases as the age increased. Within the four and five year old group, almost one half of the cases were comprised of girls, and it is of interest that 42% of the girls infected had a brother with scalp ringworm.

The geographic distribution of the known cases in the city showed a higher incidence of infection in the low income and rental districts where a greater degree of crowding and congestion was noted.

A study of the location of the lesion on the scalp showed the region of the occiput to contain the highest incidence of infection: here, a circular area of 5.0 cm. in diameter included 124 or 33.6% of the cases. The entire scalp was involved in 48 or 13% of the cases. The lesions localized in the region of the hair line are pointed out, for

it has been stated that the barbers are the chief vectors of transmission by the use of contaminated clippers. In this epidemic, the hair line areas comprised only 5% of the total cases, thus little support of this hypothesis was found. By further dividing the scalp into the anterior and the posterior one half, the latter one half was found to contain 89.5% of the cases. This figure is significant for it shows that the dstribution is not random for the probability of such an occurrence on chance alone would be, for all practical purposes, zero. (one times ten to the forty first power)

In clinical experiments, not all indivduals become infected by the introduction of the infective spores on the scalp. In the successful innoculation of ringworm in the susceptible individual, minor trauma, short of exudation as a prerequisite, is required, presumably because of the need to introduce the infective sport into the scalp or hair follicle, thus favoring germination.

This study would indicate that the distribution of ringworm in the city or on the scalp is not random and that the presence of spores alone is not adequate to initiate the lesion. It would appear that the distribution of ringworm of Microsporon Audouini origin is related directly to contact of the infective material on susceptible individuals.

COCCIDIOMYCOSIS IN A NORTH DAKOTA COTTONTAIL RABBIT (Sylvitagus floridaurus)

Jenny Turn and D. F. Eveleth

Department of Veterinary Science

North Dakota Agricultural College, Fargo, North Dakota

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Coccidiomycosis has been considered a disease of animals and man, confined largely to the southwestern part of the United States, Mexico and Argentina. A case of coccidiomycosis in the dog, reported from the province of Quebec in Canada and described by Radmore (9) and Plummer (8), is interesting in that this animal had been mated to a bitch that had been brought from California.

Coccidiomycosis of man was first described by Posadas and Wernicke in Buenos Aires in 1892 (6). In 1894, Rixford and Gilchrist (7) reported the disease in human cases in California. Reports in the literature record more cases of human coccidiomycosis than those of the lower animals.

Giltner (5) and Beck, Traum and Harrington (1) all have reported on bovine coccidiomycosis and Beck has also reported a case in a sheep. Davis, Stiles and McGregor (2) have found the disease in calves. Emmons (3) has summarized the investigations made by him and his associates who have found the infective organism in soil and diagnosed the disease in rodents in the southwestern part of the United States. Farness (4) in Arizona and Plummer (8) in Canada, have published case reports on coccidiomycosis in dogs.

The diagnosis of coccidiomycosis in a wild cottontail rabbit from North Dakota is of interest because this is the first diagnosis of coccidial granuloma in the state, and it appears to be the first case of natural infection reported for the cottontail rabbit.

Case history: A resident of Fargo, North Dakota killed ten cottontail rabbits in a small area located about ten miles south of the city. While skinning them, he noticed a large cyst on the shoulder of one of the rabbits. The rabbit was submitted to this laboratory for an opinion as to its fitness for human food.

The cyst was located in the suprascapular fossa and contained about 5 ml. of fluid. It was semi-transparent and was at first considered to be a tapeworm cyst. When it was opened, however, a milky fluid drained out and at the base of the cyst was a small mat of granulatomous tissue. A smear of the fluid showed many mycelia, indicating a fungus infection. Smears from the tissue showed many typical spherules. A tentative diagnosis of coccidiomycosis was made.

The fluid was inoculated onto tryptose agar slants and incubatted at 37°C. A few small colonies were visible after 48 hours of incubation. The organism was also grown in tryptose broth which was used as an inoculum for chick embryos. Most embryos died in from 2-8 days. The organism was not usually recovered from the allantoic-amniotic fluid, but could readily be recovered from the tissue of the embryo.

Rats and guinea pigs were inoculated but only minor lesions developed. A cyst in the leg muscle of a guinea pig and a pneumonic lesion in a rat both yielded pure cultures of C. *immitis*.

There does not appear to be any plausible explanation of the source of infection for the rabbit. There is, of course, the possibility of the infection having been introduced into this area by infected people or their pets who may have originally come from the southwestern part of the United States or Mexico. There is also a possibility that the spores were blown into this area on dust particles.

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PETROLOGY OF THE BEAVER LODGE MADISON RESERVOIR, NORTH DAKOTA

Donald Towse

Department of Geology
University of North Dakota, Grand Forks, North Dakota

ABSTRACT

The Mississippian Madison formation produces oil and gas in several fields on the Nesson anticline in northwestern North Dakota. This report is a summary of results of a study of the Madison reservoir in the Beaver Ladge field. Electric logs, thin sections, and etched, stained, and polished sections of cores were used to analyze the lithologic character of the reservoir rock and the distribution of the porous zones. The environment of deposition and the effect of post- depositional changes on original rock fabric and pore distribution are described.

The Madison reservoir is a fine to coarse fragmental limestone. Grains include fossil fragments, oolites, and some possible algal and fecal pellets. Original porosity was intergranular, and it has been modified by solution, dolomitization, and recrystallization. There are three major vertically separate porous zones, and each zone is made of individually lenticular streaks of porous rock that make a pattern like that found in reservoirs of interbedded sandstone and shale. Porosity appears to be directly related to original variations in texture.

The rock is compared to modern lime sand deposits on the Bahama banks.

BEACH RIDGES AND VEGETATION IN THE HUDSON BAY REGION[1]

D. R. Moir

Department of Botany
North Dakota Agricultural College, Fargo, North Dakota

Between the Laurentian Upland Province and the present shore of Hudson Bay there is a low-lying zone of glacier-worked marine clays, the Hudson Bay Coastal Plain. This does not extend around the entire coast of Hudson Bay, but begins at Cape Jones on the east side of the Bay and extends west and north as far as exporation has been conducted, probably passing without interruption into the Arctic Ocean. It has a maximum width of 150 miles and is very well developed on the Paleozoic limestones along the south coast of the Bay. In this region it is very flat, broken locally by hills of drift material, and dissected only by post-glacial stream channels. The slope towards the Bay approximates three to four feet per mile over most of the area.

The Hudson Bay Coastal Plain is characterized over much of its extent by a series of conspicuous beach ridges paralleling the coast and extending inland in recognizable form from 60 to 100 miles. These beach ridges are especially well developed along the south coast of Hudson Bay. Their origin and the nature of their vegetative cover is the subject of this discussion.

As is true of most areas in the northern latitudes of this continent, biological and geomorphological investigations in the Hudson Bay region must be interpreted in terms of the effect of the last glaciation and the changes occurring since the recession of the continental ice sheet. Reviewed briefly, the ice sheet that caused the last, or Wisconsin glaciation, had its origin in the highlands of eastern Quebec. Valley glaciers coalesced to form a piedmont glacier, and as this ice sheet increased in size, the cold air mass above it accelerated accumulation from the moisture-laden winds from the south and south-west. This caused greater enrichment from the south and west with resulting westward shift of the center of ice accumulation. The evidence provided by gravity anomaly studies, along with directional evidences such as erratics, glacial striae and drumlin fields, suggests that the Hudson Bay area became the center of ice accumulation. Previous to glaciation, this area was not a bay nor inland sea, but rather a low-lying area with a dendritic drainage pattern leading out through what is now Hudson Strait. The entire area was in pre-glacial times a great depositional basin surrounded by the Laurentian Upland Province.

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[1] Field expenses for this project were provided by a Grant-in-aid from the Arctic Institute of North America.

The maximum thickness of ice during the Wisconsin glaciation is estimated to have been between 5,000 and 10,000 feet. The weight of this ice mass was sufficient to cause a crustal downwarping contering in the Hudson Bay area and extending as far south as the Great Lakes region. Maximum depression at the center of the ice mass was approximately 1800 feet. With the removal of the ice mass, crustal recoil and recovery were initiated, and the uplift since deglaciation is about 900 feet, with half of the total yet to be recovered. (Flint, 1947 (1)).

Many types of evidence point to the continuing uplift of the area e. g., the observed northward uptilting of beach lines of Glacial Lake Agassiz; gravity anomaly studies; the observed shoaling of harbors along the north shores of Lake Superior; the increasing distance of separation from the water's edge of accurately surveyed points along the coast of Hudson Bay; the study of tidal tables, as well as the evidence provided by the beach series described in this paper. The rate of uplift is approximately three feet per century, and the evidence suggests that the rate is decreasing rather than increasing. This means that Hudson Bay was once much larger than its present size, and if full crustal recovery occurs, it will probably be once more a lowland area with a dendritic drainage pattern.

The short-forming processes of a gently sloping coastal plain are strikingly different from those occurring where the slope to the water is abrupt. Several factors operate in this area, and these may be listed as follows:

1. An average bottom slope of about three feet per mile.
2. Bottom materials consisting of fine silt, clay and sand.
3. Long stretches of relatively straight shoreline.
4. High frequency of onshore winds during the period when the coastal waters are free of ice.
5. The slow uplift caused by crustal recoil.
6. Occasional exceptionally high spring and fall tides, sometimes accompanied by storms.
7. Ice shove during the spring and early summer.

The combination of gentle slope, onshore winds, abundance of fine material and long, straight or only gently curved shoreline is responsible for the building up of beach ridges which may be several miles in length. The mechanics of the process are as follows. Because of the thermal absorption of the interior forested land surface is greater than the water surface of the bay, local low pressure areas develop inland due to the heating of the air mass above the land. This results in a movement of air from over the water into the low pressure areas, in the form of onshore winds. Wind action over the water results in waves of oscillation, moving shoreward in harmonic motion in the deeper water. As each successive wave approaches the shallower inshore water, the symmetry of the wave form is disturbed by shoaling. Each wave now "breaks," becoming a a wave of translation and as such is capable of mechanical transport of bottom materials. The silt, clay, sand and pebbles of the bottom are carried forward to form a beach ridge, consisting mainly of the coarser materials due to the sorting action of the water. (Johnson, 1919 (2)). Because the bottom shows little change in relief and the slope is quite uniform, these beach ridges may extend in length for several miles. Superimposed on this beach formation process is the gradual uplift and emergence of the beach ridges so that they are removed from the zone of wave action and consequently preserved in parallel series extending into the interior. While this as a rythmic process and the beach ridges are essentially parallel, certain irregularities due to major storms, ice shove, local minor differences in relief, variation in sediments, and drainage from the interior, etc., might be expected. This is evidenced in the aerial photographs and aerial reconnaissance by some crowding of beaches, anastomoses, and short discontinuous ridges, all of which are superimposed on the basically parallel arrangement.

Due to the variability outlined above, only average figures on width and height of the beach ridges may be advanced, with allowance for extremes in either direction. In a fairly typical beach area 8 miles east of the mouth of the Severn River, and the same distance inland from the coast, the ridges are 50-100 yards in width, separated by shallow lagoons of similar width. The height of the ridges above the lagoon water level is approximately three feet, with lagoon depth of the same order. The ridges are generally quite flat on top with no apparent difference in slope between the landward and seaward slopes. The texture of the beach material varies from fine sand to coarse pebbles. In section, bedding planes of contrasting texture are apparent.

This series of beach ridges, progressively older from the coast to the interior, presents an interesting sequence of emergent land forms of similar physiographic origin, differing only in age. The development of vegetation along a north-south transect from the present coastline to the forested interior may be described briefly as follows.

The most recently formed beach ridges along the coast are sparsely vegetated by scattered colonies of *Mertensia maritima, Elymus arenarius var. villosus* and *Arenaria peploides*. The matted growth form of these species tends to collect sand particles moving along the beach surface, so that the colonies may be raised several inches above the general level. Localized areas of small sand dunes are not uncommon where the vegetation is insufficient to stabilize the surface.

Between these costal beaches and the forested beaches of the interior there is a zone characterized by a surface stabilized by low-growing woody shrubs such as *salix spp., Shepherdia canadensis, Ledum groenlandicum, Empetrum, nigrum, Rhododendron lapponicum, Vaccinium uliginosum,* along with *Dryas integrifolia, Saxifraga tricuspedata* and lichens such as *Cladonia spp.* On the slopes of the ridges about two miles inland a stunted and sparse growth of *Picea glauca* and *Larix laricina* is present.

Several miles inland the beach ridges support open stands of mature spruce forests. The trees are typically grouped and layering is common. The undercover species in the spruce clumps is largely *Empetrum nigrum* and *Vaccinium vitis-idaea*. The open areas of the interior ridges are covered by a dense lichen mat of reindeer moss, *Cladonia spp*. The only other tree species found on the crest of the ridge, and this very infrequently, is the aspen, *Populus tremuloides*. Shrub species characteristic of the openings are *Juniperus communis, Salix spp., Potentilla fruticosa, Vaccinium uliginosum* and *Ledum groenlandicum*. On the slopes of the ridges the lichen cover is replaced by moss cover, and the tree-shrub complex consists mainly of *Picea, Larix, Salix, Alnus* and *Ledum*. This grades into the open water lagoons aften characterized by *Sphagnum* hummocks and numerous emergent aquatics such as *Carex spp., Triglochin maritima, Scheuchzeria palustris* and *Menyanthes trifoliate*.

The foregoing account of the more conspicuous elements of the vegetation of three stages of vegetative development gives a general picture of the cover present on the beach ridges. A more detailed account of the vegetation and the underlying soils awaits a complete analysis of the data now available from this area.

Summary

1. The glacial and post-glacial history of the Hudson Bay Coastal Plain has been reviewed.
2. A combination of physical factors unique to this area has resulted in the formation of long beach ridges, which have been preserved in a parallel series due to post-glacial uplift of the coastal plain.
3. Three stages in the establishment of vegetation on beaches of successively longer emergence have been described briefly.

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DIETARY EFFECT ON THE LIPIDE COMPOSITION OF LIVER MITOCHONDRIA

D. G. Gallo and W. E. Cornatzer

School of Medicine

University of North Dakota, Grand Forks, North Dakota

ABSTRACT

Phospholipide synthesis is a primary function of cell processes. Mitochondria and large granules are very rich in phospholipides.

Male rats (100-110 gm.) were maintained at various intervals on a 25 or 5% casein diet. The composition of the total lipide P, lecithin P, Sphingomyelin P, cephalin P and cholesterol was determined on homogenates and mitochondria preparations of the liver. There was a decrease in the total phospholipide P and choline-containing phospholipides (lecithins) of homogenates in animals maintained on a low protein-fat diet, as compared to the adequate diet. A progressive drop occurred in the lecithin P in mitochondria and homogenates from liver of choline-deficient animals. The choline deficiency was produced by supplementation of the diet with a methyl acceptor (guanidoacetic acid). Administration of a single dose of choline 6 hours before removal of the liver of a choline-deficient animal produced a significant increase in the lecithin P of both mitochondria and homogenates. (This study was aided by grants from the Division of Research Grants and Fellowships of the National Institutes of Health, U. S. Public Health Service, the Lipotropic Research Fund and the American Cyanamide Company.)

TRACHEAL CANNULATION AS A MEANS OF STUDYING THE ROLE OF RESPIRATION IN THERMAL EXPERIMENTS

J. A. Linfoot and H. E. Ederstrom

Department of Physiology and Pharmacology
University of North Dakota, Grand Forks, North Dakota

ABSTRACT

A stainless steel cannula has been devised which permits respiratory studies in conscious dogs. The cannula is designed so that the animal may carry on normal respiration via the buccal cavity, or by the introduction of a specially designed tube, the air may be shunted from a side arm in the trachea and, in this manner, by-pass the buccal cavity. The construction of the cannula, the technique of surgical instillation, and the problems of post-surgical management will be described. The use of these techniques and the other apparatus employed in these experiments will also be described. Information concerning the effects of hyperthermia on these animals, which have had their normal heat loss mechanism, the tongue and buccal cavity, by-passed through this method will be represented.

(This investigation was supported in part by research grant G-3772 from the Public Health Service, National Institute of Health.)

AMYL AND HEXYL URETHANS*

Donald Krook and C. E. Miller

School of Pharmacy

North Dakota Agricultural College, Fargo, North Dakota

In the course of our study of analogues of the drug Urethan (Ethyl Urethan) as anti-carcinogenic agents we had need for considerable quantities of several amyl and hexyl urethans. The unavailability of the necessary alkyl chloroformates (4) as intermediates prompted a search for other methods of preparation. A survey of the literature (3, 1) disclosed that in certain instances urethans have been prepared by the direct heating of urea with an excess of the alcohol. Alcohols with boiling points greater than 140°C. allowed the reaction to proceed at atmospheric pressure. We wish to report in this paper our preparation of n-amyl; iso-amyl; n-hexyl and 2-ethylbutyl urethans in yields of about 40 per cent by the direct reaction between the appropriate alcohol and urea. The procedure used in the preparation of n-amyl urethan is typical for the other alcohols.

EXPERIMENTAL

n-Amyl Urethan. A mixture of 90 g. (1.5 mole) of urea and 500 g. (5.6 mole) of n-amyl alcohol was placed in a 1-L. two-necked flask fitted with a condenser and thermometer. The mixture was gradually brought to the melting point of urea by a variac controlling heating mantle. At this temperature a spontaneous reaction was observed with copious amounts of ammonia being evolved and a temperature rise of from 30 to 40°. The reaction proceeded for about six hours after which the ammonia evolution diminished. At this point the excess alcohol was removed by distillation and the solid residue remaining was worked up in the usual manner. The resulting urethan was recrystallized to constant melting point from ether and dried under vacuum. The analytical data for these several urethans is given in table I and the LD/50 (2) values are given in table II.

CONCLUSIONS

1. Four analogues of Ethyl Urethan have been prepared by the direct reaction of urea wtih the following alcohols: n-amyl; iso-amyl; n-hexyl and 2-ethylbutyl.
2. The LD/50 values for these urethans has been determined under the supervision of Dr. Ralph Banziger, Department of Pharmacology, School of Pharmacy.

* Acknowledgement is given to the North Dakota Cancer Society, Inc. for financial assistance which made this study possible.

TABLE I

Alkyl Urethans $R\text{-}O\text{-}\overset{\displaystyle O}{\overset{\|}{C}}\text{-}NH_2$

R	Formula	M.P.°C.[a]	Analysis % Carbon Calcd	Carbon Found	Hydrogen Calcd	Hydrogen Found	Nitrogen[b] Calcd	Nitrogen[b] Found
n-Amyl	$C_6H_{13}NO_2$	54	54.91	54.62	9.98	10.07	9.29	9.18
iso-Amyl	$C_6H_{13}NO_2$	50	54.91	54.90	9.98	10.05	9.29	9.54
n-Hexyl	$C_7H_{15}NO_2$	59-61	57.90	57.61	10.41	10.51	9.64	9.65
2-ethyl n-butyl	$C_7H_{15}NO_2$	76-8	57.90	57.78	10.41	10.52	9.64	9.92

Dumas method
Uncorrected

TABLE II

LD/50 Values for Amyl and Hexyl Urethans

Compond	LD/50[a]
n-Amyl	370 mg./Kg. with limits of error of 95-106 per cent.
iso-Amyl	500.5 mg./Kg. with limits of error of 95-105 per cent
n-Hexyl	420 mg./Kg. with limits of error of 96-104 per cent
2-Ethylbutyl	435 mg./Kg. with limits of error of 95-105 per cent.

a) Administered subcutaneously in propylene glycol on 10 day old chicks

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BREEDING RUST RESISTANT WHEATS

Glenn S . Smith

Department of Agronomy
North Dakota Agricultural College, Fargo, North Dakota

ABSTRACT*

Race 15B of wheat stem rust first appeared in the spring wheat region in 1950, causing considerable loss in yield and test weight. All wheats grown commercially in the U.S. are susceptible to this

race and thus it is very serious. The damage in 1953 was even more serious. The U.S.D.A. crop forecast for 1953 fell from 150,000,000 bushels as of July 1 to something like 100,000,000 for the final total return, a large part of the reduction being attributable to stem rust. Durums are more susceptible than the bread wheats.

A multiple attack on the rust problem is being conducted by the North Dakota Agricultural Experiment Station, in cooperation with the U.S.D.A. and other wheat states and Canada. Our pathologists are testing chemicals which might control the rust by sprays or dusts, and they are searching the world wheat collection for new sources of inherent resistance. The plant breeders are crossing these best resistant varieties with our standard susceptible wheats to combine desired agronomic and quality charcteristics with rust resistance. The cereal technologists are testing larger numbers of new wheats from the plant breeders for their milling and baking qualities. The agronomists are testing the new strains along-side of the older varieties in nursery and plot tests, and increasing the best in greenhouse and in California. The biochemists and plant physiologists are studying basic nutritional aspects of the rust-wheat complex to discover the nature of resistance to disease.

Since the natural occurrence of 15B, these projects have been intensified and expanded. Chemicals are now known which reduce rust severity, but they have some injurious effects so cannot yet be recommended commercially. The first 15B rust resistant variety is Selkirk from Manitoba, and it is being released this season. Other wheats and durums are in the advanced stages of testing from North Dakota, South Dakota and Minnesota.

* Motion pictures accompanied this paper.

EPOXIDIZED LINSEED OIL

Wouter Bosch

Department of Paints, Varnishes and Lacquers
North Dakota Agricultural College, Fargo, North Dakota

ABSTRACT

Various methods are used to improve the drying of linseed oil. Heat bodying, catalytic polmerization, blowing, and co-polymerization are some of these. The speed of drying of a vegetable oil depends on the degree and type of unsaturation of the fatty acids and consists of oxidation, polymerization and gel formation.

Epoxidation or the formation of oxirane rings decreases the degree of unsaturation, but increases the reactivity of an oil with respect to polymerization. Epoxidation is achieved by the reaction of an organic peracid with carbon to carbon double bonds. In our ex-

periments performic acid, prepared in situ by mixing formic acid with linseed oil and adding hydrogen peroxide to the mixture was employed.

By changing the ratio of formic acid to hydrogen peroxide the degree of epoxidation of linseed oil was varied and samples with different percentages of oxirane oxygen were prepared. As expected it was found that the iodine number of the oil decreased with an in-crase of epoxy groups and that the viscosity of the oil increased. with regard to the speed of polymerization it was found that the viscosity of an epoxidized linseed oil increases upon heating much faster than that of the unmodified oil.

Interesting also are the results of an acid polymerization of epoxidized linseed oil. Linseed oil with a content of 6.7% oxirane oxygen, for instance, formed a gel after heating for one hour at 70°C with small amounts of sulfuric acid and no darkening of the material occurred. Similarly a sample with 4.9% oxirane oxygen increased in viscosity from 2 to 148 poises after a heating for 5 hours at 70°C with small amounts of sulfuric acid. Again the color had not changed, contrary to linseed oil that had turned into a black gel after 3 hours under the same conditions. The results obtained are promising and might lead to a new type of modified vegetable oils with fast polymerization properties.

BREEDING RUST-RESISTANT FLAX

H. H. Flor

U. S. Department of Agriculture and
North Dakota Agricultural College, Fargo, North Dakota

The succumbing of varieties of small grains and flax to rust, often within a few years after their release as rust-resistant varieties, shows the need for a new approach to breding for rust resistance. Rust reaction and infection type are terms signifying the same phenomenon, i.e., the interaction of the gene complex of the host with that of the parasite under a particular environment. The genetics of pathogenicity in flax rust, *Melampsora lini* (Pers.) Lev., and the genetics of rust reaction in cultivated flax, *Linum usitatissium* L., have been studied. A gene-for-gene relationship has been established between each of 30 genes conditioning reaction to rust in the host and corresponding genes conditioning pathogenicity in the parasite. Lines of flax apparently pure for each rust-conditioning gene have been developed. Fifteen of these lines have been resistant to all races found in North Dakota. The genes for rust reaction appear to lie in 4 allelic series and no flax variety is known to possess more than 4 genes for rust reaction. By using hybrid races of rust fungus to identify specific genes for rust reaction in the host, varieties may be developed possessing any desired combination of resistant genes, within the limits of allelism.

GEOLOGY OF THE MCVILLE QUADRANGLE, NORTH DAKOTA

Gordon L. Bell

Department of Geology
University of North Dakota, Grand Forks, North Dakota

ABSTRACT

This sector of glacial drift, of Wisconsin age, is characterized by complex readvance features, interpreted to be the products of the Mankato substage of glaciation. Broad end moraines that accumulated in front of the glacial ice indicate lobation from the northeast and the northwest.

One glacial lobe advanced from the northeast, and two glacial lobes advanced from the northwest. The smaller first lobe, herein caled the McVille lobe, developed a terminal moraine and recessional moraines north of the town of McVille. The larger second lobe drumlinized and otherwise reworked the recessional moraines of the McVille lobe.

Two kettle chains were developed in the north central part of the area and these with the related spillways and outwash plains contain comercial deposits of gravel. Silver Creek spillway along the west margin of the quadrangle develcped a preglacial valley tributary to Sheyenne River.

Cretaceous Pierre shale is exposed along Silver Creek spillway and along Sheyenne Valley in the southwest corner of the quadrangle. The pierre shale is partly covered by weathered boulder till that is interpreted to be the product of the first Wisconsin substage, known as the Iowan substage of glaciation.

CHEMICAL OXIDATION OF MESITYLENE[1]

Earl C. Hutchins, Keith M. Nelson, Charles H. Smith[2], and R. E. Dunbar

School of Chemical Technology
North Dakota Agricultural College, Fargo, North Dakota

The chemical oxidation of mesitylene to trimesic acid by sunlight and air (3), aqueous potassium permanganate (4), or strong nitric or chromic acid (5) have consistently given extremely low yields varying from 0.76 to 34.8%. These erractic results have been in part due to the relatively high solubility of trimesic acid in water, the tendency of the acid to decarboxylate under the experimental conditions used, and likewise the failure of the oxidizing agent to adequately oxidize the three side-chain methyl groups present in the original hydrocarbon. Methods and procedures have now been developed that provide a 75 to 85% conversion of mesitylene to trimesic acid. Several variables in the reaction procedure have been further investigated.

Chemical oxidation, with 30% nitric acid and mild heating and stirring, gave noticeable decarboxylation and the only isolated prodduct was m-teluic acid. A cold 30% nitric acid solution failed to react. A 50% solution of nitric acid gave even greater decarboxylation than hot 30% nitric acid and no trimesic acid could be isolated. Aqueous potassium dichromate gave no reaction; with 10% sulfuric acid noticeable decarboxylation occurred; and with more concentrated sulfuric acid almost complete decomposition took place. Potassum permanganate in water appeared to give satisfactory oxidation, but during the subsequent liberation of the trimesic acid from its salt with hydrochloric acid, again excessive decarboxylation occurred. Low temperatures used during this acid addition greatly increased the yield. However, the use of a minimum amount of water and portion-wise addition of the potassium permanganate and subsequent addition of hydrochloric acid at low temperature failed to produce a satisfactory yield. As the concentration of the acid was increased the yields were proportionately decreased.

From the foregoing observations a satisfactory procedure has been evolved for the chemical oxidation of mesitylene to trimesic acid. Twenty g. of mesitylene and 500 ml. of water were placed in a 1 l. three necked round-bottomed flask, equipped with a heating mantle, thermometer, reflux condenser, and vigorous mechanical stirrer. The contents of the flask were heated to 95° for 6 hrs. during which time 170 g. of potassium permanganate was added in four equal portions. Each additional portion of potassium permanganate was added only after the major part of the previous portion of oxidizing agent had been visibly consumed. Each addition was accompanied by an approximate 6° rise in temperature. After completion of the 6 hr. period, the residual manganses dioxide was filtered off from the hot solution and washed with 300 ml. of hot water. In case the oxidation has been incomplete the precipitate will appear as an oily residue rather than crystalline mass. After filtration 6 g. of sodium bisulfite was added to the filtrate to reduce any remaining potassium permanganate or manganese dioxide to the soluble manganese sulfate. The elimination of the manganese dioxide apparently minimizes the subsequent decarboxylation of the trimesic acid upon acidification. The solution was then cooled in an ice-water bath to 0.5° and 300 to 350 ml. of 1.5 N hydrochloric acid, also previously cooled to 0-5°, was added dropwise, again with vigorous stirring. Complete precipitation is essential in order to obtain a maximum yield, but excess acid should be avoided. The point of maximum precipitation is reached when the trimesic acid forms a heavy milky collodial suspension, which does not produce noticeable additional precipitation upon the addition of a few more drops of hydrochloric acid. The mixture was allowed to stand overnight at room temperature in order to induce agglomeration. The mixture was then cooled to 0-5° and filtered. The white product was air dried and is now ready for subsequent use. Yields, by this procedure ranged from 75 to 85%. The neutralization equivalent was 74.5 (Theoretical 70.0), after recrystallization from glacial acetic acid.

Current research involves the use of the trimesic acid in the preparation of several new polyester resins.

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POSTGLACIAL WARPING IN NORTH DAKOTA

Emmett R. Schmitz and Ronald J. Kresl

Department of Geology

University of North Dakota, Grand Forks, North Dakota

ABSTRACT

The physical data concerning postglacial warping in North Dakota are presented and all published data relating to this subject are coordinated. In addition to the published data the report includes information concerning the Nesson anticlinal system from the files of the North Dakota Geological Survey.

It was found that the amount of tilting recorded by Upham on the Herman beach of glacial Lake Agassiz corresponds to those observations and calculations of A. G. Leonard along the Little Missouri River in western North Dakota. Using these data it is possible to extend the isobases, or isotilt lines, across North Dakota.

The trend of the Nession anticlinal system lies essentially parallel to the direction of maximum tilting. The possible effect of tilt-

ing within the Nession anticline, as well as the surface, is considered. A cross-section was constructed to show the present surface features along the trend of the Nesson anticlinal system, as well as those horizons of commercial importance within the oil bearing Nesson anticline. These same features are restored to their positions during maximum glacial load as indicated by the amount of rebound, which is 175 feet from the hinge line in southeastern North Dakota to the Canadian border, and 160 feet from the hinge line in the vicinity of the Little Badlands area, north of the Shollsmade to McGregor, North Dakota.

This amount of tilting within the Nesson anticlinal system has possibly influenced fluid migration by changing the equilibrium.

THE CERCARIA AND DEVELOPMENT OF GASSIPHIALA (NEASCUS) BULBOGLOSSA (TREMATODA: STRIGEIDA)

Glenn L. Hoffman

School of Medicine
University of North Dakota, Grand Forks, North Dakota

ABSTRACT

In an attempt to infect fish experimentally with the cercaria of black spot Neascus, *Uvulifer ambloplitis* (described as *Varcaria bessiae* Cort and Brooks, 1928), the resulting metacercaria turned out to be *Crassiphiala (Neascus) bulboglossa* Hughes, 1928, instead of *U. ambloplitis*. In other words the author could not differentiate the two cercariae. The experimentally infected fish were examined and the development of the metacercaria was studied.

Twenty *Neascus*-free individuals of three species of fish, *Pimephales p. promelas* (fathead), *Fundulus diaphanus menona* (top-minnow), and *Eucalia inconstans* (stickleback) were exposed to moderate numbers of cercariae obtained from three naturally infected snails, *Heliosoma anceps* (Menke) from Turtle River, Arvilla, North Dakota. All three of the fatheads became infected; nine of ten topminnows became infected; and six of the seven sticklebacks became infected.

Development in the fathead and topminnow appeared to be identical and probably normal. At four days the larvae were found free in the skin and were 86 to 140 gamma long. At 11 days the larvae were enclosed in a non-pigmented host cyst in the skin, but the inner cyst of parasite origin was not yet present. The metacercariae measured about 270 gamma in length. At 28 days they appeared fully developed and did not differ greatly from the original description of the metacercaria by Hughes (1928). The only peculiarities were the complete lack of pigmentation of the cyst in the topminnow and the

presence of a previously undescribed yellow-golden pigment about most of the cysts in the fathead. In the latter there were also a moderate number of typical melanophores surrounding the cyst.

The sticklebacks became infected, but the larvae never became fully developed metacercariae although they remained alive in the fish for at least 24 days. The larvae had grown to 225 gamma in length by the strigeid constriction, holdfast, and cyst of parasite origin had not developed. At 49 days all larvae examined were dead and disintegrating, the parasite cyst had not been formed, but the host cyst was still intact.