

PROCEEDINGS
of the
NORTH DAKOTA
ACADEMY OF SCIENCE

Founded December, 1908

VOLUME IX
1955

PUBLICATION COMMITTEE

Rae H. Harris (*Chairman*)
G. A. Abbott
Ernest D. Coon
Ralph E. Dunbar
J. Donald Henderson

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

July, 1955
GRAND FORKS, NORTH DAKOTA

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OFFICERS

President - - - - - Harry B. Hart, Jamestown College
Vice President - - - - - W. E. Cornatzer, University
Secretary-Treasurer - - - J. Donald Henderson, University
Historian - - - - - G. A. Abbott, University
Additional Members of Executive Committee:
 J. Frank Cassel, Agricultural College
 Warren Whitman, Agricultural College

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NORTH DAKOTA ACADEMY OF SCIENCE**ACTIVE MEMBERS**

- Abbott, G. A. (Chemistry), University, Charter Member.
- Aho, Donald T. (Conservation), U. S. Soil Conservation Service, Bismarck. 1954.
- Anderson, Robert N. (Agronomy), Agricultural College. 1954.
- Anderson, Sidney B. (Geology), North Dakota Geological Survey. 1953.
- Arnason, A. F. (Forestry), Commissioner, State Board of Higher Education, Bismarck. 1939.
- Bale, Harold D. (Physics), University. 1954.
- Banasik, Orville J. (Cereal Chemistry), Agricultural College. 1947.
- Bell, Gordon L. (Geology), University. 1954
- Bitzen, Edward F. (Chemistry), U. S. Bureau of Mines. 1952.
- Bliss, Harald N. (Ornithology), Grafton. 1951.
- Bo, Walter J. (Anatomy), University. 1954.
- Bolin, Donald W. (Biochemistry), Agricultural College. 1946.
- Bolin, F. M. (Veterinary Science), Agricultural College. 1948.
- Bonneville, David C. (Chemistry), N. D. Research Foundation. 1951.
- Bosch, Wouter. (Chemistry), Agricultural College. 1948.
- Bosch, Mrs. Wouter. (Chemistry), Agricultural College. 1949.
- Bothun, Robert E. (Plant Genetics), Agricultural College. 1954.
- Brezden, William. (Chemistry), State Mill and Elevator, Grand Forks. 1945.
- Briggle, Leland W. (Agronomy), Agricultural College. 1950.
- Broberg, Joel W. (Chemistry), Agricultural College. 1948.
- Brody, Harold. (Anatomy), University. 1954.
- Brown, Leonard W. (Chemistry), Armour and Company, Fargo. 1952.
- Bryant, Reece L. (Poultry Genetics), Agricultural College. 1948.
- Buchanan, M. L. (Animal Husbandry), Agricultural College. 1950.
- Burr, Alex C. (Chemical Engineering), N. D. Research Foundation, Bismarck. 1940.
- Callenbach, John A. (Entomology), Agricultural College. 1954.
- Cardy, James D. (Pathology), University. 1950.
- Carter, Jack F. (Agronomy), Agricultural College. 1950.
- Cassel, J. Frank. (Vertebrate Ecology), Agricultural College. 1954.
- Challey, John R. (Vertebrate Ecology), Agricultural College. 1954.
- Christoferson, Lee A. (Neurological Surgery), Fargo. 1952.
- Clagett, Carl O. (Biochemistry), Agricultural College. 1949.
- Comita, Gabriel W. (Zoology), Agricultural College. 1954.
- Conlon, Thomas J. (Agronomy), Dickinson. 1950.
- Cooley, A. M. (Chemical Engineering), University. 1938.
- Coon, Ernest D. (Chemistry), University. 1923.
- Corbus, Jr., Budd C. (Urological Surgery), Fargo. 1952.
- Cornatzer, William E. (Biochemistry), University. 1952.
- Davis, Mildred L. (Nutrition), University. 1951.

- DeBoer, Benjamin. (Pharmacology), University. 1952.
- Delphia, John M. (Embryology), Agricultural College. 1954.
- Dillard, J. R. (Gynecology), Fargo. 1954.
- Dinusson, William E. (Animal Nutrition), Agricultural College. 1950.
- Donat, Theodore L. (Medicine), Fargo. 1954.
- Doubly, Mrs. Elma K. (Bacteriology), Agricultural College. 1950.
- Doubly, John A. (Bacteriology), Agricultural College. 1950.
- Douglas, Raymond J. (Animal Husbandry), Agricultural College. 1950.
- Downing, William L. (Biology), Jamestown College. 1952.
- Dunbar, Ralph E. (Chemistry), Agricultural College. 1938.
- Ederstrom, Helge E. (Physiology), University. 1953.
- Erickson Roland I. (Mining), University. 1953.
- Estensen, Ernest V. (Psychology), Agricultural College. 1951.
- Eveleth, D. F. (Veterinary Science), Agricultural College. 1944.
- Facey, Vera. (Botany), University. 1948.
- Ferris, Leslie M. (Chemistry), Agricultural College. 1954.
- Fischer, Robert G. (Bacteriology), University. 1948.
- Fleetwood, Charles W. (Chemistry), Agricultural College. 1948.
- Flor, Harold H. (Plant Pathology), Agricultural College. 1943.
- Folsom, Clarence B. (Petroleum Engineering), University. 1954.
- Fordyce, Ira V. (Chemistry), AGSCO, Grand Forks. 1947.
- Forster, Theodore L. (Dairy Technology), Agricultural College. 1950.
- Fox, Adrian C. (Conservation), Soil Conservation Service, Bismarck, 1954.
- 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.
- Giles, Ray (Petroleum Chemistry), Standard Oil Co., Mandan. 1954.
- Graham, Charles M. (Internal Medicine), Grand Forks. 1951.
- Grimes, Ruby. (Mathematics), Agricultural College. 1946.
- Gustafson, A. A. (Bacteriology), Public Health Lab., University. 1950.
- Gustafson, Ben G. (Chemistry), University. 1939.
- Hamre, Christopher J. (Anatomy), University. 1950.
- Hanson, Dan E. (Geology), University. 1954.
- Hansen, Miller. (Geology), N. D. Geological Survey. 1952.
- Haraldson, Harold C. (Geology), University. 1952.
- Harris, Rae H. (Agricultural Biochemistry), Agricultural College. 1938.
- Hart, Harry B. (Chemistry), Jamestown College.
- Harwood, Theodore H. (Internal Medicine), University. 1954.
- Haugen, Kenneth. (Geology), University. 1954.
- Haunz, Edgar A. (Internal Medicine), Grand Forks. 1951.

- Hazen, Arlon. (Agricultural Engineering), Agricultural College. 1950.
- 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.
- 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.
- Horner, Oscar. (Vertebrate Ecology), Agricultural College. 1954.
- 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.
- 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.
- Kruschwitz, Earl H. (Physics), Valley City. 1947.
- 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.
- Lebsock, Kenneth L. (Agronomy), Agricultural College. 1954.
- Lium, Elder L. (Civil Engineering), University. 1953.
- Loomis, Fred H. (Cereal Chemistry), Loomis Laboratories, Grand Forks. 1947.
- Lundy, John S. (Anesthesiology), Mayo Clinic, Rochester, Minn. 1940.
- Luper, Miltza (Medical Technology), Deaconess Hospital, Grand Forks. 1951.
- McCauley, Howard W. (Civil Engineering), Agricultural College. 1954.
- McMillan, William W. (Chemistry), N. D. Research Foundation, Fordville. 1947.
- MacDonald, John H. (Biology), Teachers College, Dickinson. 1951.

- Magnusson, Adeyynn 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.
- Minnear, F. L. (Chemistry), Agricultural College. 1954.
- Mohberg, Joyce. (Vertebrate Morphology), Agricultural College. 1954.
- Moir, David R. (Botany), Agricultural College. 1954.
- 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.
- Norum, E. B. (Soils), Agricultural College. 1948.
- Nungesser, William C. (Physiology), University. 1954.
- Oakey, John A. (Civil Engineering), Agricultural College. 1954.
- Oehler, Mrs. Alma. (Nutrition), State Mill and Elevator, Grand Forks. 1945.
- Oppelt, Walter H. (Fuels), Bureau of Mines, University. 1949.
- Ovrebø, 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, Harvey J. (Veterinary Medicine), Grand Forks. 1954.
- Peterson, Robert H. (Chemistry), Agricultural College. 1951.
- Porter, Charles B. (Surgery), Grand Forks. 1951.
- Posin, Daniel Q. (Physics), Agricultural College. 1948.
- Potter, Loren. (Botany), Agricultural College. 1948.
- Randall, Robert N. (Wildlife Management), U. S. Fish and Wildlife Service, Bismarck. 1954.
- Reid, Neil J. (Mammalogy), Mount Rushmore Memorial, Keystone, South Dakota. 1953.
- Reid, Russell (Natural Science), State Museum, Bismarck. 1940.
- Richards, Stephen H. (Wildlife Management), Agricultural College. 1954.
- 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.
- Saiki, Arthur K. (Pathology), University. 1949.
- Sands, F. H. (Chemistry), Agricultural College. 1946.
- Saugstad, Stanley. (Entomology), Minot. 1939.
- Schmitz, Emmett R. (Geology), University. 1954.
- 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.
- Shoesmith, Lloyd (Soils), Agricultural College. 1950.
- Shrader, Ruth. (Anatomy), University. 1951.
- Shumard, Raymond F. (Parasitology), Agricultural College. 1954.
- Sibbitt, L. D. (Cereal Technology), Agricultural College. 1946.
- Sleeper, Bayard P. (Bacteriology), Agricultural College. 1952.
- Smith, Glenn S. (Plant Breeding), Agricultural College. 1930.
- Snook, Theodore. (Anatomy), University. 1954.
- Spier, Jack J. (Pathology), St. John's Hospital, Fargo. 1952.
- Staley, Raymond C. (Mathematics), University. 1946.
- Stallings, H. Dean. (Library), Agricultural College. 1951.
- Starcher, George W. (Mathematics), President, University. 1954.
- 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.
- Stockdale, Thomas E. (Petroleum Refining), Standard Oil Co., Mandan. 1954.
- Sudro, W. F. (Pharmacy), Agricultural College. 1911.
- Sullivan, John W. (Biochemistry), Agricultural College. 1954.
- 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.
- Timian, Roland G. (Plant Pathology), Agricultural College. 1954.
- Towse, Donald F. (Geology), Dickinson. 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.
- Turelle, Joseph W. (Agronomy), U. S. Soil Conservation Service, Bismarck. 1954.
- Van Heuvelen, W. (Chemistry), State Health Dept., Bismarck. 1945.
- Vergeer, Teunis. (Physiology), University. 1954.
- Walster, H. L. (Director of Experiment Station), Agricultural College. 1920.
- Watkins, John B. (Veterinary Medicine), Grand Forks. 1954.
- Weers, Walter A. (Civil Engineering), Agricultural College. 1954.
- Welte, Arden F. (Biology), Grafton. 1954.
- 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.
Wills, Bernt L. (Geography), University. 1949.
Witmer, Robert B. (Physics), University. 1925.
Young, Ralph A. (Agronomy), Agricultural College. 1954.

MEMBERS ELECTED IN 1955

- Adams, A. Paul. (Bacteriology), Agricultural College. 1955.
Anderegg, L. T. (Chemistry), Agricultural College. 1955.
Aulsebrook, Kenneth A. (Physiology), Agricultural College. 1955.
Bauer, Armand. (Soils), Agricultural College. 1955.
Bruner, Gilbert H. (Cereal Technology), Agricultural College. 1955.
Buegel, Hermann F. (Psychology), University. 1955.
Dixon, John D. (Electrical Engineering), University. 1955.
Ebeltoft, David (Plant Breeding), Agricultural College. 1955.
Freeman, Andrew L. (Electrical Engineering), Grand Forks, 1955.
Fromm, Herbert J. (Biochemistry), University. 1955.
Jacobs, Francis A. (Biochemistry), University. 1955.
Jensen, Ivan R. (Civil Engineering), University. 1955.
Krong, Norman L. (Psychology), Agricultural College. 1955.
Lawson, Edward C. (Mechanical Engineering), University. 1955.
McClelland, John E. (Soils), Agricultural College. 1955.
McMurtrie, Robert. (Chemical Engineering), Bureau of Mines, Grand
Forks. 1955.
Mogen, Clinton A. (Soils), Soil Conservation Service, Fargo. 1955.
Moreng, Robert E. (Poultry Physiology), Agricultural College. 1955.
Nelson, Edward O. (Mathematics), University. 1955.
Olson, Ordell P. (Agronomy), Agricultural College. 1955.
Redmond, Charles E. (Soils), Agricultural College. 1955.
Riedesel, Mildred (Home Economics), University. 1955.
Sandal, Paul C. (Plant Breeding), Agricultural College. 1955.
Simonson, Gerald H. (Soils), Agricultural College. 1955.
Sommerfeldt, Theron G. (Soils), Agricultural College. 1955.
Whalin, Edwin A. (Physics), University. 1955.
Zubriski, J. C. (Soil Physics), Agricultural College. 1955.

NORTH DAKOTA ACADEMY OF SCIENCE

Minutes of the Forty-Seventh Annual Meeting

FRIDAY, MAY 6, 1955

President G. A. Abbott called the meeting to order at 9:00 a. m. in the Medical School Auditorium on the campus of the University of North Dakota. After brief introductory remarks by the president, the nine papers listed on the morning program were read and discussed.

At 11:10 a. m. the Nominating Committee composed of C. O. Claggett, chairman; L. D. Sibbitt, Cyril Moore, John L. Hundley and William Downing presented the following slate of candidates:

President:	Harry B. Hart* H. E. Murphy
Vice President:	W. E. Cornatzer* Cyril Moore
Secretary-Treasurer:	J. Donald Henderson* Vera Facey
Historian:	George A. Abbott*
Executive Committee:	J. Frank Cassel* Jerome H. Svore Warren Whitman*

There were no additional nominations from the floor and the report was accepted. Members were instructed to cast their ballots between 2:00 and 4:00 p. m. at the registration table. The candidates whose names are marked* in the above slate were elected.

The morning session adjourned at 11:20 a. m. and was followed immediately by luncheon in the Student Union Cafeteria. Forty-two visiting members were guests of the University.

The Academy reconvened at 1:34 p. m. in the Medical School Auditorium. Paper No. 10 was not read because urgent duties prevented its author, Dr. Glenn Smith, from attending the meeting. The other nine papers listed on the afternoon program were read and discussed. The meeting adjourned at 4:00 p. m. and the members were invited to examine the equipment exhibited by the Chicago Apparatus Company in the laboratory next door to the auditorium.

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 chapter of Sigma

Xi. The dinner was held at 6:15 p. m. in the Student Union Ballroom with 104 members and guests present. Following the dinner, Dr. E. D. Coon, President of Sigma Xi, presented the following program: Vocal solos by M. Earl Ness and Gail Jahnke accompanied by Miss Silvia Bagley. Greeting from George W. Starcher, President of the University. Introduction of new officers of the Red River Valley Section of ACS by Professor Ben Gustafson. Introduction of the new officers of the Academy by Dr. Carl Clagett. Presentation of the AAAS Research Grant of \$100.00 to Dr. Vera Facey by Dr. G. A. Abbott. Dr. Rae Harris announced the results of the Student Research Prize Contest as follows: **First Place**—Ann Holmes, **Second Place**—George Hildre, **Third Place**—Donald McMasters and Vernon Feil. Dr. Abbott introduced the guest speaker, Dr. John S. Lundy, who spoke on "Recent Progress in the Conquest of Pain." The audience was fascinated by Doctor Lundy's description of the work being done in his Department of Anesthesiology at the Mayo Clinic in Rochester.

SATURDAY, MAY 7, 1955

The meeting was called to order at 9:02 a.m. by President Abbott in the Medical School Auditorium. The eight papers scheduled for the morning were read and discussed.

The ANNUAL BUSINESS SESSION was called to order at 10:51 a.m. with 29 members present. The minutes of the 1954 meeting were approved as printed in the 1954 **Proceedings**. The treasurer's report was presented and accepted.

Dr. E. A. Helgeson presented his report as representative to the AAAS.

The Committee on Resolutions presented the following report.

1. We express our appreciation to the University for extending its facilities to the Academy, and for the luncheons provided; and to the Press for giving excellent publicity to our meetings.
2. We thank the Red River Valley Section of the American Chemical Society for its joint participation in our meetings, and making it possible to share their guest speaker.
3. Our thanks are extended to the local Sigma Xi chapter for sponsoring the Academy Dinner.
4. We are especially grateful to the Administration of the Agricultural College and of the University for continuing the policy of financing the publication of the Proceedings of the Academy and to the members of the Committee on Publication for the excellent work they have done.
5. We record with deep sorrow the passing of L. R. Waldron, one of our members.
6. To the Officers and Committees of the Academy, we express our thanks for providing the excellent program of papers,

the comfortable arrangements, and for the successful conduct of this highly interesting and profitable meeting of the Academy, especially to President Abbott and Secretary Henderson who were called upon to assume the extra load.

7. We urge all members to encourage the participation in the Academy activities by other institutions of higher learning in the State that are not represented at this meeting.
8. We express our appreciation to A. Rodger Denison, Vice President of the Amerada Petroleum Corporation, for repeating his gift of \$90.00 for student research prizes.

Orville Banasik

Jerome Svore

Wilson M. Laird, Chairman

The report was adopted.

Dr. Abbott gave the progress report for the Special Committee on Support and Recognition of the Academy.

In the absence of the chairman, Loren Potter, Dr. W. E. Cornatzer gave the report of the Membership Committee. Other members of the committee were Harold Klosterman, Harry Mason and Donald Towse. Following the report, new members were elected and their names are given immediately following the list of active members in the **Proceedings**.

In the absence of the chairman, O. A. Stevens, Dean H. E. French reported for the Necrology Committee. Other members of the committee were Russell Reid, H. E. Murphy, and H. L. Walster. Dean French read a special tribute to Dr. L. R. Waldron who passed away since our previous meeting. The report was referred to the Executive and Publication Committees for further action.

The possibility of amending the constitution to provide for a president-elect in place of the vice president and to make the retiring president a member of the Executive Committee was briefly discussed and it was suggested that such action be taken next year.

An invitation to meet at Jamestown in 1956 was discussed. Dr. R. E. Dunbar moved that the group recommend that the Executive Committee give serious consideration to the invitation to meet at Jamestown on the first weekend in May, 1956. Motion was seconded by Dr. Laird and carried.

Dr. C. O. Claggett moved that the annual dues be raised to two dollars (\$2.00). Motion was seconded and after brief discussion the motion was passed unanimously.

The Academy adjourned at 11:55 a.m. and following adjournment luncheon was held in the Student Union Cafeteria. Fifteen visiting members were guests of the University.

J. Donald Henderson
Secretary-Treasurer.

NECROLOGY COMMITTEE REPORT

Lawrence Root Waldron 1875-1954

Lawrence Root Waldron was born at Ionia, Michigan, October 20, 1875 and died at Fargo, August 22, 1955. He received his B.S. from the North Dakota Agricultural College in 1899, M.S. at the University of Michigan in 1902 and Ph.D. from Cornell University in 1928. From 1899 to 1905 he was an assistant in Botany and Zoology at the North Dakota Agricultural College; 1905 to 1916 Superintendent of the Dickinson Branch Experiment Station and 1916 to 1954 Plant Breeder at the Experiment Station at Fargo.

At Dickinson his work was especially with alfalfa and other forage crops. Since 1916 the need for new varieties of wheat more resistant to stem rust became more and more intense and his varieties Ceres, Rival and Mida in turn became those largely grown in the State.

Dr. Waldron was known to his associates as an inveterate reader and prodigious worker. He was known throughout the world for his work in wheat breeding and was a member of the Linnaean Society of London in addition to American scientific organizations.

Bulletin No. 46, a list of the vascular plants of North Dakota, was published by Bolley and Waldron in 1900. It contained names of about 775 species. Dr. Waldron continued to maintain an interest in additions to the list although not actively engaged in such studies.

PHYSIOGRAPHY OF NORTH DAKOTA*Fritz J. Roth and J. T. Zimmerman**Department of Geology**University of North Dakota, Grand Forks, North Dakota***ABSTRACT**

North Dakota, before Pleistocene time, was typified by badland topography which exists today in the south-western part of the state. Pleistocene glaciation greatly modified its surface and deposition by the glacier exceeded erosion. As a result of glaciation, isostatic rebound, and structural effects, five escarpments trending northwest partition the state into six major physiographic divisions. These are, Agassiz Lake Plain, Drift Prairie, Turtle Mountains, Souris and Devils Lake Plain, Couteau du Missouri, and Missouri Plateau.

THE ROLE OF THREONINE ON THE LIPOTROPIC ACTION OF METHIONINE

W. E. Cornatzer and Fred Snyder

Department of Biochemistry

University of North Dakota, Grand Forks, North Dakota

ABSTRACT

The lipotropic effect of methionine has been compared following the administration of two doses, 100 and 300 mg. per rat per day, in male albino rats maintained on two different diets, 5% casein-5% fat and 5% casein-32% fat. After two to three weeks on the diets, the animals were injected with P³², and six hours later the acid-soluble P, phospholipide P and the total lipides were determined in the liver. It is of interest that the administration of 100 mg. of methionine per rat per day failed to produce a lipotropic effect. Additional animals were maintained on low-protein diets, one supplemented with 0.3% methionine and the other a mixture of 0.36% threonine and 0.3% methionine. A lipotropic effect was observed in those animals to which the threonine was incorporated in the diet along with methionine. It is postulated that methionine stimulates protein metabolism in animals maintained on a low-protein diet supplemented with small amounts of this amino acid and therefore methionine fails to exert its lipotropic effect. The supplementation of a diet low in methionine with threonine will prevent the deposition of fat in the liver. (Aided by grants from American Cyanamid, U.S. Vitamin Corporation and U.S. Public Health.)

YEARLY SOIL TEMPERATURES AT FARGO, N. DAK.

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ABSTRACT

Soil temperatures at depths of 1", 6", 1', 2', 3', 4', 5', and 6' were determined at five different sites, varying in cultural practice and snow cover at Fargo, N. Dak. from July 1952 to August 1954. These were based on potentiometer readings of iron-constantan thermocouples.

Field crops or grass sod had little effect on maximum temperatures, however, the insulating effect of grass sod resulted in higher minimum temperatures.

Thawing was observed to occur both from below and above with the last level to thaw being somewhat intermediate between top and bottom of the originally frozen soil.

The total frost-free period under grass sod was as much as 4½ weeks longer than under other cultural practices.

Comparisons between open field conditions and deep snow showed frozen surface layers thawing out under deep snow and mean annual temperatures 3°F. warmer.

Fall and spring the soil reaches a uniform temperature throughout, comparable to the spring and fall overturn in lakes. The average spring overturn of soil temperature was on May 5 with an average variation of 2.1°F. from 39.9-42.0°F. The average fall overturn was on Oct. 3 with an average variation of 2.4°F. from 57.1-59.5°F. These results include soil levels from 6"-6'.

The mean annual temperature of the various levels from 1"-6' were remarkably uniform at each site. Those under grass sod were the most uniform.

Wheat is seeded at a time close to the spring overturn when the soil temperatures are nearly uniform at 40°F. which is also a minimum temperature for wheat germination. Because of the early season, wheat roots apparently develop at less than optimum soil temperatures.

Corn planting is of necessity delayed until the soil warms up and the penetration of the working level of the root system corresponds to soil temperatures of about 60°F.

LINSEED OIL EMULSION PAINTS

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For the past decade synthetic latex paints that contain little or no vegetable oils have become a great competitor of the important North Dakota flax crop. These latex paints are made from oil in water emulsion vehicles and have many advantages; they are easy to apply, dry fast, and the equipment can be cleaned with water. Next to an application of latex paints on interior surfaces, new latices are coming on the market that can be used for exterior decorative and protective purposes. In order to compete with these film forming synthetic materials, research has been carried out on modifications of linseed oil in order to speed up its drying properties and to prepare oil in water emulsions of modified linseed oil. It has been found that a copolymer of linseed oil and vinyltoluene, prepared in a ratio of about 1:1 by heating for 3 hours at 180°C, dried much faster and hardened much quicker than linseed oil. A 70% solution of this copolymer in mineral spirits dried after the addition of appropriate driers in fifteen minutes to the dust free state and was tack free within two hours.

This varnish was rather easily made into a stable oil in water emulsion of a non-volatile content of 45% by using either ammonium

or morpholine soaps as emulsifying agents. The inversion method was found to be best for the preparation of emulsions. A dilute soap solution was slowly added to the varnish resulting in water in oil emulsions. Upon further addition of emulsifier and water an inversion to an oil in water emulsion took place as evidenced by a sudden decrease in viscosity. These emulsions, where water is the external phase could be thinned with water. Pigmentation of these emulsions with water dispersible pigments yielded white paints that compared very favorably with latex paints, either prepared for this research or purchased.

In a second series of experiments the pigments, both white and colored, were ground in the varnish, prepared from the linseed oil vinyltoluene copolymer, and then the pigment paste was emulsified. Good emulsion paints were made in this way also and this method had the advantage that any oil-dispersible pigment could be used.

PRELIMINARY INVESTIGATION OF CONODONTS IN THE WINNIPEG FORMATION (ORDOVICIAN) OF NORTH DAKOTA

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ABSTRACT

During 1954 Morton D. Strassberg, formerly of the North Dakota Geological Survey, reported the first occurrence of conodonts in the Winnipeg formation of North Dakota. These were from the Stanolind Oil and Gas Company, Walter and Ingeborg Waswick No. 1, in Ward County. The purpose of this investigation is to study these specimens. They were removed from the matrix by crushing, boiling in weak sodium hydroxide and by gravity separation using bromoform. The specimens are predominately simple cones and include the following genera: **Paltodus**, **Uistodus** and **Microcoelodus**. The occurrence of conodonts in the Winnipeg formation is undoubtedly more widespread in the state than has been reported. The conodont fauna will be an aid in establishing the exact age of the Winnipeg formation in this area.

COLORIMETRIC DETERMINATION OF THE POLAROGRAPHIC PURITY OF DIOXANE

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Introduction

Several qualitative and quantitative methods are known for the determination of peroxides in organic liquids. (12, 13). However, most of these are not applicable for the detection of the very small amounts of peroxides present in dioxane which is polarographically pure or very slightly impure. (9, 10). It was the purpose of this research to find a quantitative method for determining the concentration of small amounts of peroxides which make dioxane polarographically impure. This new method will be used primarily to save time in testing the purity of dioxane.

It has been reported that organic peroxides liberate iodine immediately when a neutral solution of potassium iodide is added to impure dioxane (8). Dioxane which is taken directly from the distillation step of the purification process does not liberate iodine, indicating that the dioxane is quite pure. This dioxane when tested with the polarograph is polarographically pure. However, when the dioxane is exposed to the air, the formation of peroxides starts immediately. Dioxane which is exposed in this way quickly becomes polarographically impure and releases iodine when treated with a neutral potassium iodide solution. The iodine forms a complex with the dioxane in the molar ratio of 1:1 and has a light yellow color when very dilute. (1, 2, 5, 6). It was thought that the intensity of this color might be used as a means of determining the polarographic purity of dioxane.

Experimental

APPARATUS. The iodine color was measured with a Klett-Sumerson photoelectric colorimeter, Model 900-3, using the blue (#42) filter. (7).

The polarographic reductions were performed with a Sargent Model XXI Polarograph. (11). A semi-micro H-cell was used.

REAGENT. The potassium iodide, sodium thiosulfate, iodine, glacial acetic acid, and nitrogen were all C. P. grade chemicals. The tetraethylammonium bromide was white-label Eastman-Kodak. The dioxane was white-label Eastman-Kodak, purified according to Fieser (3), refluxed again with sodium and distilled. The nitrogen was passed through Fieser solution (4), concentrated sulfuric acid, soda lime and drierite.

TECHNIQUES

To determine whether or not the intensity of the iodine-dioxane color could be used to predict the polarographic purity or dioxane, the following procedures were carried out with dioxane of varying purity.

Six milliliters of the dioxane were placed into the standard colorimeter test tube and the instrument was adjusted to read zero. One drop of potassium iodide solution (3 g./100 ml. water) was added and the colorimeter reading was recorded.

All polarograms were recorded under these conditions: voltage span -0.0 to -2.0 volts (50 to 70 per cent of the span was actually recorded vs. the saturated calomel electrode), a constant temperature of $25 \pm 0.05^\circ\text{C}$ and a sensitivity of 0.030 microamps per millimeter. The solutions were 60 per cent dioxane, 40 per cent water (pretreated with purified nitrogen for 30 minutes) and a supporting electrolyte concentration of 0.1 M in tetraethylammonium bromide. The solutions were treated with nitrogen for 10 minutes before the polarogram was recorded.

To obtain the different degrees of purity of dioxane, the dioxane was exposed to the air to hasten the formation of peroxides. Colorimeter readings and polarograms were recorded as the dioxane became more impure.

DISCUSSION OF RESULTS

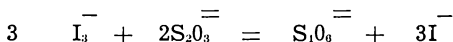
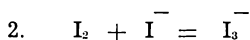
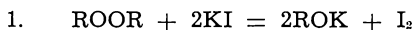
All dioxane which gave a colorimeter reading of 72 or less was polarographically pure. This was indicated from the polarogram by a minimum amount of residual current. All dioxane which had a colorimeter reading of 80 or more was found to be polarographically impure. This was indicated from the polarogram by a noticeable increase in the residual current. This is evidence that impurities are present which are being reduced. These impurities interfere in precise work in polarography.

As stated earlier in this paper, organic peroxides liberate iodine immediately when a neutral solution of potassium iodide is added to impure dioxane. This was confirmed in our experiments. The intensity did not fade nor increase upon standing which would indicate that the reaction was reasonably complete. It was also established that the amount of iodine evolved is reproducible as evidenced by the fact that the colorimeter readings were the same for a series of trials using the standard technique as described above.

This evidence induced us to see if we could establish whether the reaction is quantitative with the neutral potassium iodide.

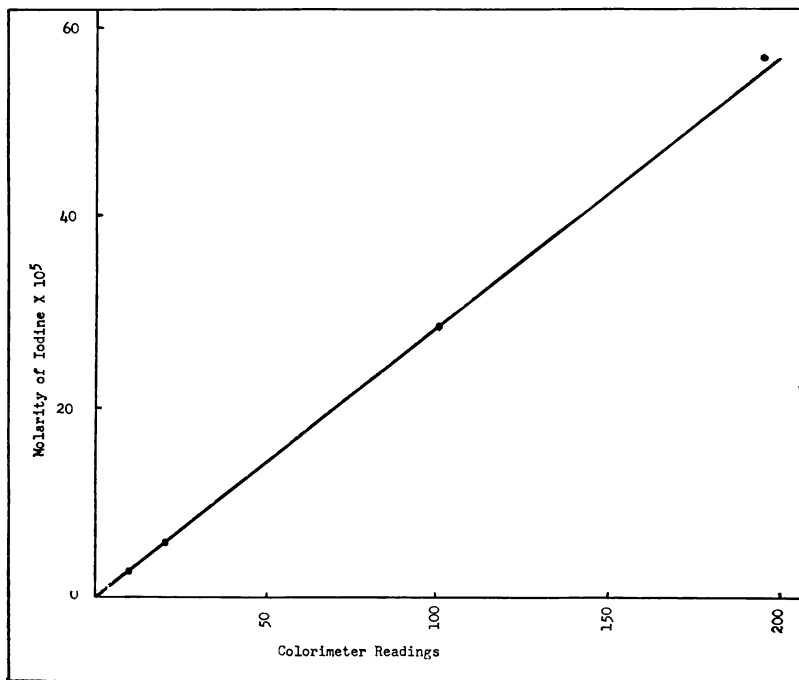
Eastman-Kodak white-label dioxane which had been in stock for approximately one year was standardized for peroxide content with standard sodium thiosulfate. This standardized solution was then diluted 500 times with freshly purified dioxane which had no

peroxides. This solution gave a colorimeter reading of 71 and had a calculated concentration of 2.4×10^{-5} M in peroxide content. The calculations are based on these equations:



Dioxane which had a colorimeter reading of 284 was standardized with sodium thiosulfate by the procedure as employed by Swain *et al* (14). When converted to a basis of colorimeter reading of 71, this peroxide concentration was 7.5×10^{-5} M.

To see how much iodine was actually present, a solution containing 0.0716 g. of iodine per 100 ml. of dioxane was diluted with



(Figure 1)

dioxane to various concentrations to determine the relationship between colorimeter readings and concentration of iodine. The following data were obtained:

Colorimeter Readings	Molarity of the Iodine solutions
196	$5.68 \times 10_{-4}$
102	$2.84 \times 10_{-4}$
20.5	$5.68 \times 10_{-5}$
10.5	$2.84 \times 10_{-5}$

The graph of the above data (Fig. 1 on page 18) shows clearly that the intensity of the iodine color follows the Beer-Lambert law.

For a colorimeter reading of 71, the concentration of iodine is $20 \times 10_{-5}$ and if equation 1 above is used again this would also be the initial concentration of peroxide. This evidence then indicated that the reaction is more complete using neutral potassium iodide than by either of the two standard methods above.

Another experimental fact of interest is that the intensity of the iodine color is not changed by making the test solution acidic with glacial acetic acid.

We therefore conclude that the reaction of neutral potassium iodide is probably quantitative as based on this experimental evidence:

1. The reaction is very rapid.
2. The reaction is reproducible.
3. The quantity of iodine produced is larger than is predicted by two standardization procedures.
4. The reaction is not affected by acetic acid.

CONCLUSION

A quick, efficient method has been developed for determining the polarographic purity of dioxane by a colorimetric procedure based on the color produced by the reaction of the peroxides in dioxane with neutral potassium iodide. A colorimeter reading of 75 indicates the break between the polarographically pure and the polarographically impure dioxane.

The reaction of neutral potassium iodide with dioxane is thought to be quantitative according to our experimental evidence. The amount of peroxides present can be determined approximately from a graph of colorimeter readings vs. concentration of iodine, which is also the concentration of peroxide.

ACKNOWLEDGEMENT

Acknowledge is made to Dr. R. E. Frank and Dr. E. D. Coon, Chemistry Department, University of North Dakota for valuable suggestions through this investigation.

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THE EFFECT OF SIMULATED SWEETCLOVER WEEVIL DAMAGE TO SWEETCLOVER SEEDLINGS IN THE GREENHOUSE

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INTRODUCTION

The sweetclover weevil has caused considerable damage to new seedlings of sweetclover during recent years in North Dakota as well as other areas in the north central area of the United States. The weevil feeds on the leaves of the young seedling shortly after emergence and observations indicate that stands are often greatly reduced. A number of chemicals are available as dusts or sprays to control this pest at a high cost with considerable doubt at what stage of plant growth to apply the treatments. This study was conducted to determine the effect of simulated weevil injury on seedlings grown under wet and dry conditions with stands established from small and large seed in the greenhouse. Information of this nature should be helpful in determining the stage of seedling growth at which chemical control of the weevil would be the most practical. It would also provide data to determine the degree of plant weevil resistance which would be desirable in a breeding program attempting to develop weevil resistant or tolerant varieties.

REVIEW OF LITERATURE

No research information is available on the effect of varying degrees of defoliation of sweetclover seedlings or other forage legumes on seedling tolerance or vigor. Smith and Graber (3), however, have shown that early cutting of sweetclover the first year of establishment reduces root reserves and vigor appreciably. Experimental results reported by Rogler (2) show that large seed of crested wheatgrass produce more vigorous seedlings than small seed. Miller and Pammel (1) also reported that large seed of several legumes exhibited much greater seedling vigor than seedlings derived from small seed. These data concerning forage crops indicate that planting of large seed of sweetclover may result in rapid early growth of the plants such that considerable weevil damage could be evaded.

MATERIALS AND METHODS

All seedings were made in flats in the greenhouse with half the flats relatively dry and the other half maintained in a favorable moist condition. Large seed used weighed 3.33 milligrams per seed and the small seed averaged 1.69 milligrams per seed. The variety used was common white biennial sweetclover. Five degrees of defoliation treatments (simulated weevil damage) were applied to the young seedlings along with a check treatment. The treatments were:

1. Removal of both cotyledons and unifoliolate leaf.
2. Removal of both cotyledons.
3. Removal of one cotyledon and unifoliolate leaf.
4. Removal of one cotyledon.
5. Removal of unifoliolate leaf.
6. Check. no leaves removed.

All treatments were made on fully established seedlings with the cotyledons removed when the bud for the unifoliolate leaf was well developed. The unifoliolate leaf was removed when the bud for the first trifoliolate leaf was visible. All leaves were completely removed by cutting their respective petioles with a small scissor. Although the removal of the entire leaf is likely not identical to the feeding habits of the sweetclover weevil, it was anticipated that this simulated weevil damage would be similar to a severe weevil infestation. Each treatment included twelve plants with four replications at each moisture level. When the seedlings were four weeks old data were collected on height of plants and weight separately for tops and roots, respectively. The data were summarized and analyzed by appropriate statistical procedures.

RESULTS

The effects of varying degrees of simulated weevil damage on the height of four week old sweetclover seedlings are shown in Table 1 and the respective plant weight responses shown in Table 2. Highly

Table I. Height of four-week old sweetclover seedlings following varying degrees of defoliation.

Treatment	Height in m. m.			% of check		
	Dry	Wet	Ave.	Dry	Wet	Ave.
1	9.00	14.50	11.75	59	57	58
2	11.00	19.25	14.13	72	75	74
3	12.25	19.12	15.69	80	75	78
4	14.88	23.85	19.37	97	93	95
5	14.38	23.12	18.75	93	90	92
6	15.38	25.62	20.50	100	100	100
Mean	12.82	-20.91				

L. S. D. 5% level

water = 3.69

treat = 1.63

t × w = 2.30 within either moisture level

3.31 any other comparison

Table II. Total weight of four-week old sweetclover seedlings following varying degrees of defoliation.

Treatment	Small Seed		Large Seed		Ave.
	Dry	Wet	Dry	Wet	
	Grams per 100 plants				
1	1.50	4.06	3.49	8.97	
2	3.47	8.22	3.87	12.93	
3	1.99	7.60	3.78	12.09	
4	4.14	11.49	5.98	19.24	
5	3.24	10.11	5.43	15.78	
6	4.86	13.77	4.93	20.02	
Means	3.20	9.21	4.58	14.84	9.71

L. S. D. 5%

Seed size — 1.15

SS × W — 1.62 within either water level.

1.61 any other comparison

significant differences were found among the treatments for plant height under wet and dry conditions. The removal of both cotyledons and the unifoliolate leaf reduced the height of the plants by about 40%, whereas the treatments involving the removal of only one cotyledon and the unifoliolate leaf reduced height approximately 25%. Less severe treatments reduced plant height from 8% to 25%.

The removal of both cotyledons and the unifoliolate leaf reduced

the weight of the whole plant by over 50%. Less severe removal of leaf tissue reduced plant weight by 10% to 40%.

In general, since the removal of cotyledons and the unifoliolate leaf of sweetclover seedlings in varying degrees in the greenhouse reduced vigor appreciably, it appears likely that considerable damage to new seedlings in the field would result from weevil infestations. Too, the data show that complete resistance to weevil damage would be desirable in a breeding program, since the least severe defoliation imposed on the plants still reduced vigor appreciably.

Correlation coefficients calculated between plant height and weight of whole plants and weight of tops were + .974 and + .978, respectively. The magnitude of these correlations indicate that plant height measurements alone would be fairly accurate in estimating the effects of defoliation on vigor of seedlings.

SUMMARY

1. Treatment means were found to differ significantly. The removal of the unifoliolate leaf alone, or in combination with the removal of the cotyledons, produced the greatest decrease in plant growth and vigor.

2. Positive correlations of .974 were found between the height of plants and the weight of the whole plant, and .978 between the height of plants and the weight of tops.

3. Low soil moisture decreased plant vigor and growth significantly and a significant interaction was found in the various defoliation treatments and moisture levels.

4. Large seed produced significantly more vigorous plants than small seed.

5. The seed size—moisture level interaction was found to be highly significant.

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THE PREPARATION OF 11-PHENYL-UNDECANOL-1

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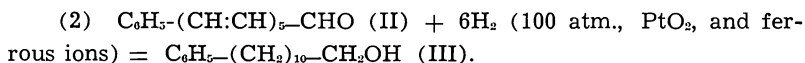
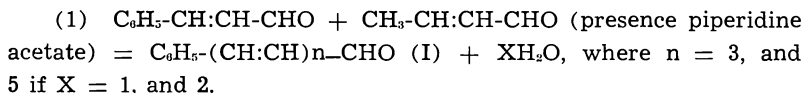
INTRODUCTION

The synthesis of long chain omega-phenyl alkanols has been difficult and not successful beyond that with eight carbon atoms in the side chain. The development of an improved synthesis for phenyl polyene aldehydes by Schmitt (1) has led to the present investigation of the catalytic reduction of these aldehydes with formation of the desired phenyl saturated alcohols. The process is not as simple as it seems because the first-formed reduction products retain conjugated unsaturation with high reactivity; these appear to polymerize rather rapidly under the conditions, thus reducing the yield of the phenyl alkanols.

Kuhn and Wallenfels (2) hydrogenated 11-phenyl-2,4,8,10-undeca-pentaenal on a micro scale but did not isolate the saturated product. They reported that mole uptake of hydrogen was nearly theoretical. It is doubtful however that they obtained pure 11-phenyl-undecanol-1 because of the great sensitivity of the starting material to air oxidation (3). It should be pointed out that even if air oxidation of these polyenes occurred (with likely formation of oxirane rings) the uptake of hydrogen would not necessarily differ from that of un-oxidized starting material.

In our work the reduction of 11-phenyl-2,4,6,8,10-undeca-pentaenal was carried out at high pressure and room temperature using anhydrous dioxane as the solvent, platinum oxide catalyst, and a tarce of ferrous chloride to promote reduction of the aldehyde group (4). It was necessary to isolate the high boiling alcohol from polymeric by-products formed during the reduction by high vacuum distillation using the Hickman molecular still. The final product was identified on the basis of molar refraction, molecular weight determination, and specific dispersion (values greater than 100 in conjunction with ultra violet absorption in the region of 260 millimicrons, indicates the presence of an aromatic ring).

The following reactions were studied:



PROCEDURE

A mixture of 7g. (0.03 moles) of freshly prepared 11-phenyl-2,4,6,8,10-undeca-pentaenal (II)², 130 ml. of anhydrous dioxane, 0.2 g. platinum oxide, and a trace of ferrous chloride was placed in a "Magna-Dash" hydrogenation bomb equipped with a plunger type stirrer and having a capacity of 250 ml. After flushing to remove air, the hydrogen pressure was raised to 95-100 atm. and the electric stirrer turned on at room temperature. There was an immediate drop in pressure. Agitation was continued until no further drop in pressure was detected, whereupon the bomb was opened and the contents filtered through a sintered glass funnel.

The resulting pale yellow solution was vacuum distilled to remove dioxane. A viscous dark colored residue remained (7 g.). The residue was transferred to a Hickman molecular still and slowly distilled at 200°/0.5mm., yielding 4.7g. of crude alcohol, which upon redistillation gave 3.5g. of pure 11-phenyl-undecanol-1, (III). (45% of theory.)

Properties of compound III:

$n_D^{25} = 1.5019$; density (25°) = 0.9215 g./ml.; m. p. = 23 - 24° C.; molecular refraction: calc. for $C_{17}H_{28}O = 79.9$, Found = 77.9; molecular weight: calc. For $C_{17}H_{28}O = 248$, Found = 243, using boiling point elevation of benzene in the Swietoslawski apparatus; analysis: calc., Carbon = 82.2, Hydrogen = 11.3, Found, Carbon = 81.2, Hydrogen = 11.1.

SUMMARY

11-phenyl-2,4,6,8,10-undeca-pentaenal has been successfully hydrogenated to 11-phenyl-undecanol-1 and the latter isolated and identified for the first time.

ACKNOWLEDGEMENT

We wish to express thanks to the Research Corporation of New York for support of this work. This will also be included in the M. S. thesis to be submitted by F. M. Young to the graduate school of North Dakota Agricultural College.

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² This compound was prepared according to the Schmitt method (1): it is very sensitive to air oxidation and must be stored under nitrogen or in a good vacuum desiccator or oven.

REACTION OF CARBON MONOXIDE AND HYDROGEN ON SODIUM SULFATE

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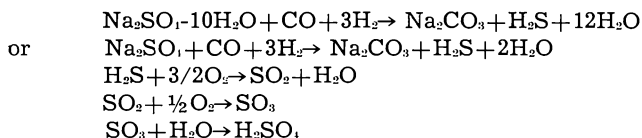
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The extensive deposits of sodium sulfate found in northwestern North Dakota have been, since their discovery in 1804, practically untouched. Some sodium sulfate is shipped to plants elsewhere for use in the production paper pulp but practically none is utilized in this state.

When oil 'became of age' and a refinery grew on the plains, a market for sulfuric acid was opened. All the sulfuric acid used at the present time must be shipped in from other states. Why, it was postulated, would it not be possible to take our sodium sulfate and treat it with a mixture of carbon monoxide and hydrogen gases to produce hydrogen sulfide which could be converted to sulfur dioxide which in turn could be converted to sulfuric acid by the contact process. The carbon monoxide and hydrogen could be obtained economically from the gasification of lignite, North Dakota's most abundant resource.

It has been reported by Kuno¹ that sodium sulfate reacted with carbon monoxide according to the equation: $2 \text{Na}_2\text{SO}_4 + 6 \text{CO} \rightarrow 2\text{Na}_2\text{CO}_3 + 4\text{CO} + \text{S}_2 + 141,140 \text{ cal}$. Loser² reported that sodium sulfate reacted with hydrogen to form hydrogen sulfide and sodium hydroxide, which on further heating were converted to sodium sulfide. Laubi³ reported that sodium sulfate treated with chlorine, sulfur dioxide and hydrochloric acid results in pure sulfuric acid. No record of a reaction between sodium sulfate, carbon monoxide and hydrogen was found.

The theory underlying this investigation was based on the following equations:



Thermodynamic calculations showed that the first two reactions were exothermic up to approximately 100°. Above this temperature they were mildly endothermic.

EXPERIMENTAL

Preparation of the sample: The raw Glauber's salt, $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$, was easily purified by crystallization. The raw material was dissolved in warm water, filtered warm and cooled below 32.0°. The long, clear

needles were removed and the remaining solution evaporated to approximately one-half its volume and again cooled. The recrystallized Glauber's salt was dried at room temperature until it became white and powdery. It was then ground and placed in a drying oven at 100° for several days. After this treatment the sodium sulfate was 99% pure.

Treatment of the reaction gases: Hydrogen was used as received. Carbon monoxide was passed through two bubblers each containing 200 ml. of 50% potassium hydroxide. This was to remove sulfur impurities, SO₃ and SO₂. Nitrogen, used to sweep out the apparatus, was also used as received. The reaction gases were mixed in a glass tower, loosely packed with glass wool, before being admitted to the reaction chamber. This tower also served as an expansion chamber in case of explosion.

Procedure: A 0.2000 gram sample was weighed in a combustion tube heated by a multiple unit combustion furnace. The samples were held in glazed porcelain combustion boats.

Procedure: A 0.2000 gram sample was weighed in a combustion boat and placed in the reaction tube. The temperature was raised to 927-983°. Nitrogen was then run through the entire apparatus for 10-15 min., to remove any oxygen that might be present. A 1:3 mixture of carbon monoxide and hydrogen was then admitted. The rate of flow of gases was generally 0.0090 cu. ft./min. for hydrogen and 0.0030 cu. ft./min. for carbon monoxide. Two hours was the average length of time the reaction gases were passed over the sodium sulfate.

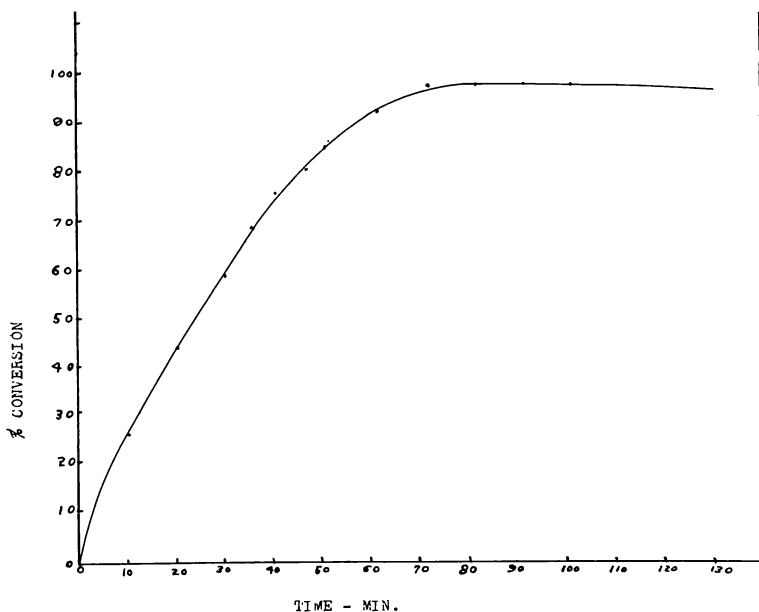
The outlet gases were passed through a neutral solution of cadmium sulfate, to absorb the evolved hydrogen sulfide. Every half hour a sample of the gases passing through the cadmium sulfate solution was taken and analyzed for CO₂, CO, and H₂.

After two hours the reaction gases were shut off and nitrogen again blown through the entire apparatus. This final flushing out with an inert gas was necessary to prevent combustion of the residual hydrogen.

The CdS, from the reaction $\text{CdSO}_4 + \text{H}_2\text{S} \rightarrow \text{CdS} + \text{H}_2\text{SO}_4$, was analyzed either gravimetrically or by iodine-thiosulfate titration. The free acid formed was titrated with standard base.

RESULTS

Although thermodynamic calculations had shown the reactions to be exothermic up to 100° no conversion could be realized below the melting point of sodium sulfate 884°. At 927-983° the percent conversion of sodium sulfate to hydrogen sulfide ranged from 62-98%. The percentage conversion was directly related to the length of time the reaction gases were in contact with the sample. The percent conversion was not dependent on temperature in the range from 927-983°.



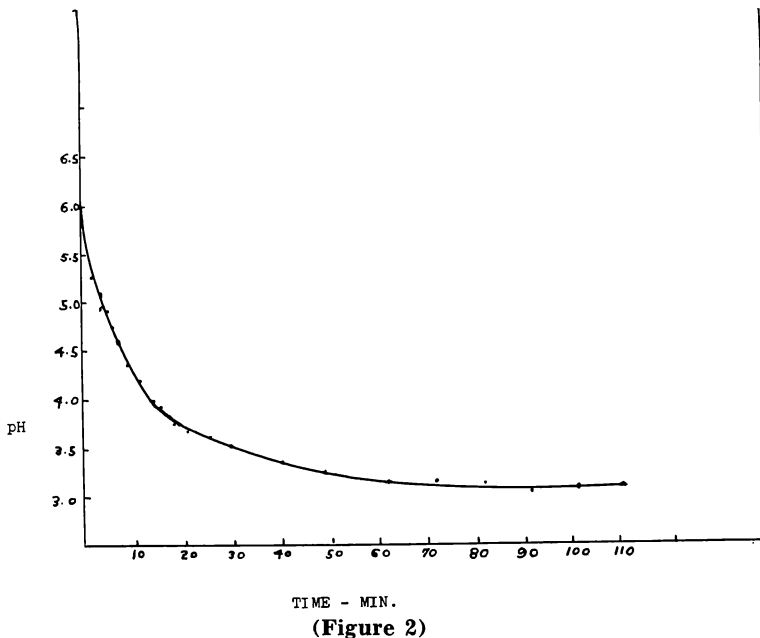
(Figure 1)

Gravimetric analysis of the CdS precipitate gave results 1% higher than either the titration of the free acid or the iodine—thiosulfate titration of the CdS. This was found to be due to the formation of the free sulfur according to the equation: $\text{Na}_2\text{SO}_4 + 3\text{CO} \rightarrow \text{Na}_2\text{CO}_3 + \frac{1}{2}\text{S}_2$. This free sulfur would be weighed as CdS but would not be titrated by iodine and would contribute nothing to the formation of the free acid.

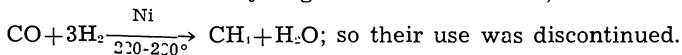
Since there was free acid formed by the action of hydrogen sulfide on the cadmium sulfate it was possible to follow the course of the reaction with a pH meter. The pH of the cadmium sulfate solution fell very rapidly for approximately the first ten minutes after the evolution of hydrogen sulfide began. After sixty minutes the pH had leveled off at 3.1-3.3. Analysis showed that 95% of the hydrogen sulfide was evolved during the first hour but to obtain maximum conversion the gases were passed through the reaction chamber for a total of two hours.

In an attempt to obtain conversion below the ignition point of hydrogen, 648° , which is below the melting point of anhydrous sodium sulfate, a variety of nickel catalysts were tried. Nickel oxide, nickel nitrate, and nickel sulfate were used with no results.

At the end of a two hour run no residue remained in the com-



bustion boat. The color of the boat had changed from the white of the glazed porcelain to a shiny, deep brown color. Apparently any residue formed reacted with the glaze forming a new glaze that could not be removed and analyzed. In an attempt to recover some of the residue nickel boats were used. Nothing was left in these boats after a run and unfortunately they were attached by the carbon monoxide and hydrogen to form methane,



SUMMARY

It was proved by this series of experiments that hydrogen sulfide could be obtained in good yields from molten sodium sulfate treated with carbon monoxide and hydrogen gases. It has not yet been determined if this process could be carried out industrially to yield pure sulfuric acid that could compete economically with the manufacturing process now used.

ACKNOWLEDGEMENTS

The writer is indebted to Dr A. C. Burr, Director of the North Dakota Research Foundation, who first proposed these experiments and who later gave consent that this paper be written and to D. C. Bonneville, now of Dow Chemical, who worked with the author on this project.

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**NEUROLOGICAL AND CHEMICAL FACTORS
REGULATING BLOOD FLOW IN THE FOOT**

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ABSTRACT

The volume of blood flowing through the body tissues of any area is regulated primarily by nervous impulses and by the chemical substances contained in the blood. The understanding of the factors involved in blood flow are of significance in determining the causes and treatment of hypertension and other diseases of the circulatory system.

Unilateral lumbar sympathectomy was performed on a group of dogs, and the change in blood flow determined by measuring the amount of outflow from the saphenous veins under deep anesthesia. Temperature changes of the feet were also recorded, since this is an indirect indication of directional change of blood flow. About one hour after the removal of one lumbar sympathetic chain, the blood flow of the operated leg was found to be about double that of the normal. Temperatures were found to be about 2 degrees centigrade higher on the operated leg, further indicating greater blood flow on that side.

If surgery was done under sterile conditions, and the animals allowed to recover, it was found that blood flows on the operated side diminished after 2 or 3 days, and thereafter were only about half as great as on the normal side. The same condition has been found in human subjects who have undergone sympathectomy for relief of hypertension or peripheral vascular disease.

One explanation for the change in blood flow following sympathectomy was set forth by W. Cannon, who found that blood vessels became hypersensitive to circulating adrenaline when deprived of their nerve supply. In an attempt to test this hypothesis, the dogs described above were given intra-arterial infusions of dilute adrenaline and nor-adrenaline solutions and the blood flows measured simultaneously on the normal and operated legs. These drugs gave slightly greater reductions in blood flow on the sympathectomized foot.

In addition to the above studies, one group of animals were given Priscoline or Dibenzylene, which neutralize the effects of adrenaline in the body, and also block the action of the sympathetic nervous system. The operated foot showed a larger increase in blood flow than the normal foot when Priscoline was given, but slightly less than the normal with Dibenzylene.

The blood flow changes following sympathectomy were considered to be brought about by chemical substances in the blood, rather than by the nervous system.

A COMPARISON OF FLOUR VOLUME FROM VARIOUS WHEATS GROWN IN NORTH DAKOTA

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ABSTRACT

The apparatus and the method used for determining specific flour volume are described. The results of a series of tests, using semi-commercially and experimentally milled flours are presented and analyzed statistically. The greater part of the work was concerned with 10 varieties grown at Fargo and five branch stations in North Dakota. The results showed significant differences between varieties as well as between stations. Two wheat hybrids which were promising in rust resistance had particularly large flour volume. The industrial significance of these tests is discussed with reference to the influence of flour volume on freedom of flour flow through the mill and packing problems. The method of milling had no effect on the relative volume. No correlation was found between flour volume and any of the usual control tests used in a flour mill laboratory.

THE EFFECT OF DIET ON THE LENGTH OF THIRD STAGE LARVAE PRODUCED BY ADULT HAEMONCHUS CONTORTUS HARBORED BY LAMBS

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ABSTRACT

Previous work by the author and others had shown that lambs infected with the stomach worm, *Haemonchus contortus*, and receiving additions of cobalt and steamed bone meal to nutritionally adequate diets could better withstand the effects of the infection. The

worms matured at an earlier date and the female worms produced more eggs when their hosts were given this dietary addition. There was also an increase of vitamin B₁₂ in the feces of these lambs.

It seemed logical that differences in the nutritional components of the feces of infected lambs would produce differences in the free-living larvae hatched from eggs found in these faces.

Sixteen lambs, parasite free except for a few **Strongyloides papillosus**, were placed in four lots, four lambs to a lot. All lots received a basal ration consisting of alfalfa-grass hay, oat straw, and ground yellow corn. In addition Lot I received iodized salt; Lot II, cobaltized salt, Lot III, manganized salt, and Lot IV, trace-mineralized salt. Three of the four lambs in each lot were given approximately 50,000 infective **H. contortus** larvae each *per os*. The fourth lamb served as a control.

Twenty-seven to thirty days following infection feces were collected from all the lambs. The fecal material from each of the control lambs was crushed and mixed with powdered bone charcoal, and placed in equal amounts in 12 Petri dishes. Fecal material from each of the infected lambs was crushed and placed in saturated sodium chloride solution. The material was centrifuged at low speed and the eggs gathered from the top. Approximately 8,000 fertilized eggs from each sample were placed in the fecal material from each of the control lambs. This resulted in a total of 48 samples.

At the end of seven days the larvae were gathered and measured after killing with heat. Differences obtained in the measurements of the larvae were not due to differences in the nutritional constituents of the feces but were due to differences in nutrition of the host lambs. Analyses of variance showed a highly significant difference in the length of the larvae. Those larvae from parents residing in lambs receiving cobalt or trace mineralized salt (containing cobalt) were significantly longer.

EXFOLIATION ON GLACIAL BOULDERS

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ABSTRACT

Exfoliation is a structural term used to designate all masses made up of rock separated by definite, smoothly curved partings. Exfoliation is considered with specific reference to the various processes as they affect glacial boulders. Examples are given.

Of the many causes postulated to explain exfoliation of rocks in nature, most attention has been given to the following four causes;

(1) insolation, (2) forest fires, (3) chemical disintegration, and (4) dilation.

Insolation has been discarded by most geologists, as a possible cause of great importance, and has been replaced somewhat by hydration and similar chemical processes, plus a force due to the release of the internal stresses by removing the overload.

EOSINOPHIL RESPONSE IN "NON-STRESS" SITUATIONS*

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In the course of a series of pharmacological studies an attempt was made to determine the eosinophil response to an imposed stress situation. It was observed that the non-stress control demonstrated a contrary response to the generally accepted eosinophil changes. This change consisted of a rise in the eosinophil count instead of the anticipated fall. It was assumed that an error in the technique or some unknown mechanism was responsible for this aberrant response. Therefore a series of studies were undertaken in which saline, a supposed non-stressing agent, was administered. Physiological saline, prepared in our laboratories, was then compared to a saline solution of physiological concentration, prepared for the commercial market. A series of animals were observed with only the technique for the collection of blood samples imposed upon these animals as a further control. Other means of eliminating possible sources of error were utilized in order to rule out a technical error. Despite these precautions, the administration of saline, either that prepared in this laboratory or that purchased commercially, resulted in changes in the eosinophil count which were comparable to those originally observed in the experimental series in which saline was used as a "non-stressing" agent. Subjection of the animals to collection of blood samples only, resulted in the production of the classically described change in the eosinophil count. These observations give rise to questions which can readily be answered with simple techniques and is of interest in the field of comparative physiology as well as in the fields of human physiology and pharmacology.

* This study was aided by U.S.P.H.S. Grant B645.

SOME EXPERIMENTAL EVIDENCE OF BILATERAL TRANSFER (PSYCHOLOGY)

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INTRODUCTION

In its more general meaning, the term "transfer" is used by psychologists to describe the carrying over of a way of acting from one situation to another. Whether the skill acquired through practice in one learning-activity spreads to other performances is regarded as a fundamental (often very practical) question in psychology. Conceivably, the learning of one act may facilitate, hinder, or have no effect upon the acquisition of another skill. The term "bilateral transfer" is delimited to the transfer of a skill from one bodily member to an opposite bodily member (dextral to sinistral, or vice versa); sometimes also referred to as "cross-education."

Woodworth (2) cites various experiments dealing with bilateral transfer, and points out some of the pitfalls. He notes that Weber (1844) and Fechner (1858), German psychophysicists, reported casual observations dealing with children's ability to write with opposite hands, also experimentation in which increase in the two-point threshold (i.e., increase in sensitivity in a practiced skin-area) showed an almost equal improvement in the corresponding area on the opposite arm or hand. Woodworth cites Scripture and Davis who in the '90's studied bilateral transfer in connection with hand steadiness, gripping a dynamometer, lifting a dumbbell to the point of fatigue, foot-tapping, and lunging at a target, and found that the opposite member showed some improvement in most cases, but lack of proper controls "left the evidence insecure." Ewert (1926), according to Woodworth, found older claims concerning transfer in mirror-tracing to be excessive "because of failure to allow for the practice afforded in the fore-test." According to Woodworth, Munn (1932) employed a ball-and-cup device and found evidence of transfer, but his groups were not matched for initial ability.

Three types of apparatus were used in the present study, viz., a peg board; a mirror-drawing apparatus, an old-time favorite in studying various aspects of learning, including transfer; and Munn's ball-and-cup device. In a naive or common-sense approach, it would seem that practice with one hand would have no effect upon (neither improve nor reduce) the skill of the opposite, unpracticed member; in other words, at the outset, a null hypothesis is suggested. Data are presented and interpreted in the above order.

Peg Board

The peg boards used in this experiment were home-made, of oak,

with 100 machine-bored holes in each, and 156 Ss were scored for time-in-seconds in each of six trials for removing and placing 50 pegs. The LRRRRL sequence of trials was used, in which L represents the non-preferred hand, with R (the preferred hand) receiving the benefit of four practices. The mean of each of six trials by 156 Ss and the standard deviations of the L performances were computed, as shown in Table I.

TABLE I
Time-in-Seconds of Trials in Peg Board Test

	L-1	R-1	R-2	R-3	R-4	L-2
Mean	81.1	71.3	68.0	66.8	66.1	74.3
S. D.	12.7					11.1

The mean performance of the 156 Ss was computed, of course, by summing the scores and dividing by N. The standard deviation was calculated around an arbitrary mean of zero; square the scores, sum them, divide by N, subtract M^2 (the correction from zero—squared), extract the square root, to find the standard deviation.

It is clear that, although the practices were done RRRR, the difference between L-1 and L-2 (81.1 minus 74.3), or 6.8, represents a change in the L performance, and that therefore the hypothesis of a true difference of zero is at least questionable. It will be noted, however, that the difference of 6.8 included the benefit of the L-1 trial. Since the difference revealed from R-1 to R-2 was 3.3, one may suspect the presence of a similar practice effect in the L-1 fore-test, which, if deducted, would show a net improvement of 3.5. It may be noted at this point that the standard deviations of 12.7 and 11.1 were employed in computing the standard error of the difference between the two means of 81.1 and 74.3. According to the formula "D/sigma D," if the quotient is 3, there is virtual certainty of a difference; in this case, the net difference of 3.5 yields a quotient of 2.6 which, by the Table of Probabilities (1), indicates virtual certainty in 995 case out of 1000, or highly significant.

Mirror-Drawing

The mirror-drawing experiment yielded two sets of scores, one for errors, the other for time-in-seconds. Each of 151 Ss traced six star-patterns, again using the LRRRRL sequence of trials. The mean performance of each trial, and the standard deviation (sigma) of the L trials appear in Table II.

TABLE II
Errors and Time-in-Seconds in Mirror-Drawing Test

	L-1	R-1	R-2	R-3	R-4	L-2
Mean Errors	33.9	25.4	21.1	18.8	17.2	22.6
S. D.	19.2					12.1
Mean Time	157.2	134.4	109.8	93.7	83.5	97.1
S. D.	59.3					38.7

Following the R trials, the mean reduction in errors in the L performance was found to be 11.3 (33.9 minus 22.6), as revealed in Table II.

As further indicated in Table II, the time-in-seconds of the L performance, with intervening RRRR trials, showed a reduction of 60.1 (157.2 minus 97.1).

On the basis of large improvement in both the error and time factors, the hypothesis of a true difference of zero again appears to be untenable; put differently, the true difference is substantially greater than zero. The large differences, however, are likely not fully ascribable to transfer alone since, by reference to R-1 and R-2 performances, the practice effect showed reduction of 4.3 errors and 24.6 seconds, respectively. Deducting 4.3 from the obtained difference (11.3 minus 4.3), the net reduction in errors in L performance was 8.0; similarly, the net time-in-seconds (60.1 minus 24.6) was 35.5, assuming of course that the practice effect is equal in R and L fore-tests.

The standard error of the difference between two obtained means may now be computed. Deducting the suspected practice-effect of the fore-tests, the net transfer would be 8.0 for errors and 35.5 for time-in-seconds. The standard deviations, as shown in Table II, were 19.2 and 12.1 for the L performance as to errors; 59.3 and 38.7 for time-in-seconds, which were employed in computing the standard error of the difference between the means. Virtual certainty of a difference is assured if " $D/\sigma D$ " yields a quotient of 3 or more. For errors, the quotient is 4.4; for time-in-seconds, 8.7, both well beyond the marginal 3 to establish virtual certainty; that is, net bilateral transfer (errors and time-in-seconds).

Ball-and-Cup

In the ball-and-cup experiment, 152 Ss were scored for 50 throws with the non-preferred hand, after which two equivalent groups were chosen on the basis of the L-1 fore-test. The procedure was modified from the peg board and the mirror-drawing experiments because the improvement in L-2 performances in those experiments included both the transfer factor and the probable practice-effect of the previous L-1 trials. Equivalence of Control and Experimental groups was determined on a rank-order sequence (1-4-5-8, etc., versus 2-3-6-7, etc.) of the L-1 scores. The mean of the Control group of 75 Ss was found to be 53.1; of the Experimental group of 77 Ss, 54.3. The control Ss were limited to L-trials only, while the experimental Ss were scored for 500 R-throws, sufficient to reach or pass the point of fatigue, with 50 throws constituting a datum in the series of R performances, as indicated in the captions of Table III.

TABLE III
Scores of Experimental Control Groups in
Ball-and-Cup Experiment

L-50	R-50	R-100	R-150	R-200	R-250	R-300	R-350	R-400	R-450	R-500	L-100
54.3	70.5	76.3	79.3	83.4	87.6	88.5	90.8	92.4	91.9	96.0	71.4
S. D.											S. D.
18.3											17.7
L-50				(Control Group: no R trials)							L-100
53.1											61.8
<hr/>											
S. D.—											S. D.
19.6											19.3

As revealed in Table III, the Experimental group showed a mean gain in L-scores of 17.1 (from 54.3 to 71.4), while the Control group, without benefit of 500 R-throws, revealed a gain of only 8.7 (from 53.1 to 61.8), which logically is attributable to the practice-effect of the L-1 fore-test. Deducting the practice-effect, 8.7 from the improvement shown by the Experimental group, i. e., 17.1 minus 8.7, the net improvement of 8.4 is ascribable to transfer.

Omitting at this point the peg board and mirror-drawing findings as merely but fairly indicative of transfer, the ball-and-cup data may now be tested for reliability and significance.

If all that we have in the ball-and-cup experiment is the obtained difference, even this conclusion may not be strictly warranted. Before we can be sure, it is important that we have some way of estimating the reliability of the obtained difference; that is, some way of telling whether one group is sufficiently superior to the other to enable us to say with confidence or virtual certainty that the experimental group will nearly always excel the control group; moreover, if the obtained difference is not significant, we should know, if possible, how near it approaches significance.

Garrett's formula (1) for determining the significance of the difference between two obtained means when we are dealing with different groups takes into account the standard error of the mean of the first group, the standard error of the mean of the second group, and the standard error of the difference between the two means. Again, if " $D/\sigma D$ " equals or exceeds 3, virtual certainty of a difference is indicated, since there is only about one chance in a 1000 that a difference greater than 3 sigmas removed from zero will arise. In the ball-and-cup data, the quotient was found to be 2.8, which, interpreted according to the Table of Probabilities (1), indicates that the chances of virtual certainty are 997 of 1000 cases; in other words, the conclusion warranted by the ball-and-cup experiment is that odds are 997-3 against a null hypothesis. And what we really wanted to know was whether the true difference between

the mean scores of the L performances was greater than zero.

Thus, in all three experiments, the hypothesis of a true difference of zero was found untenable; put differently, the true differences were substantially greater than zero, yielding reliable evidence of bilateral transfer in these experiments.

OBSERVATIONS

Woodworth (2) reports the use of control groups "in a small way by Thorndike and Woodworth" as far back as 1901 in transfer experiments, and comments that it is justified to assume equal gains for the two groups except for the transfer effect.

Aside from the experimental data, it is interesting to consider how transfer probably takes place. Concerning Lashley's latch-box experiments with a monkey (1924), Woodworth comments: "The locus of such learning, from all we know of the brain, may extend widely over the cortex, into the premotor, parietal and occipital regions." And further: "Instances of transfer . . . belong at a relatively high level of cerebral function . . . Either hand is available for the use of the same cerebral mechanism; for the core of the act corresponds to the cerebral mechanism and not the muscles or receptors employed." In other words, while partly peripheral, the dominant role is central; that is, cerebral.

Paralleling the accumulation of data in the study of transfer was the opportunity for study of the learning curve in the acquisition of skill by the preferred hand, the plateau in the ball-and-cup trials arising likely from fatigue followed by the last-round spurt; also slight sex differences not shown in the tabulated data; retro-active inhibition and almost complete frustration in mirror-tracing; and similar incidental factors in learning.

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RECOVERY OF A LYMPHOCYTIC CHORIOMENINGITIS-LIKE VIRUS FROM THE BRAIN TISSUE OF A STEER

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ABSTRACT

During a routine diagnosis for the presence of rabies the apparent recovery of a lymphocytic-choriomeningitis like virus was

made from the brain of a steer. Upon microscopic examination inclusion bodies differing somewhat from Negri bodies, a typical characteristic of rabies, were observed. Two different types of inocula; fluid taken from the ventricles of the brain and homogenized tissue from the cerebellum and Ammons horn were injected intracerebrally into groups of six mice each.

The mice receiving homogenized brain tissue were negative for rabies after a 30 day observation period. These animals were normal until they were destroyed.

The resulting symptoms and lesions in those mice receiving the brain fluid were typical for choriomeningitis as has been described by previous investigators in the literature.

Passage of the infected mouse brain and visceral tissue to two guinea pigs by the sole pad route produced symptoms of choriomeningitis in 13 and 22 days respectively.

Tests are continuing for the isolation and identification of this virus.

PROCEDURE FOR ESTIMATING THE SUPPLY OF LABOR

William R. Waind

Reports and Analysis

North Dakota State Employment Service, Bismarck, North Dakota

Since two of the basic objectives of the North Dakota State Employment Service and the North Dakota Unemployment Compensation Division are the promotion of economic stability and the maximization of employment, we are keenly interested in the industrial development of our State.

Since one of the prerequisites to the industrial development of an area is that the area have available an adequate supply of labor, we feel that the field in which we can be of most service, in promoting industrial expansion, is by providing up-to-date information regarding the supply of labor currently and potentially available.

The current supply of labor available may be defined as the number of workers expected to be available for employment in a specified period of time. Another definition would be current unemployment less an allowance for minimum unemployment. Minimum unemployment refers to the level below which unemployment cannot be expected to drop even under the most favorable employment conditions. It results, in part, from turnover resulting in some workers always being between jobs, even though their duration of unemployment may be very brief; and partly, to mismatching of workers and jobs, either in terms of physical skill or other requirements. Congested area surveys made during World War II showed

that unemployment did not drop below 1.0 to 1.5 percent of labor force.

One of the primary functions of your State Employment Service is the filling of employer orders for workers and the placement of applicants on jobs. Each job applicant registering with the local Employment Service office is classified occupationally according to his experience and training.

To determine whether the job applicant information accumulated by the Employment Service corresponded to the information obtained regarding the characteristics of the unemployed, as obtained in the last census, several special studies were conducted. It was found that, with a few minor exceptions, the occupational, sex and age distribution of the job applicants registered at the local Employment Service offices, agrees fairly well with the distribution of the unemployed as reported to the census. This means that local Employment Service application files can provide a valuable measure of the characteristics of the unemployed at any selected time and in any selected area.

The estimate of unemployment, or the current supply of labor available, is based largely on unemployment insurance records. If coverage under this program were truly universal, our records could yield all the information necessary, both as to the number and the characteristics of the unemployed. Unfortunately, in North Dakota, coverage is currently limited to nonagricultural employers of eight or more employees. Nevertheless, it must be recognized that unemployment insurance data yields a wealth of information since it currently covers approximately 60% of those employed in nonagricultural activities and 22% of the total employment in the State.

In estimating unemployment, we have to consider three groups, these being (1) Unemployed wage and salary workers from covered industries, (2) Unemployed wage and salary workers from non-covered industries, and (3) Unemployed new entrants, re-entrants, self-employed and unpaid family workers.

To understand the procedures we use, it is necessary to keep in mind the difference between covered industries and covered employment. In North Dakota, the law specifically exempts from coverage, such industries as agriculture, interstate railroads, domestic service, government and nonprofit organizations. With these exceptions, all other industries in North Dakota come under the Unemployment Insurance Act and are referred to as covered industries.

As previously stated, however, in North Dakota only those firms having eight or more employees come under the provisions of the Unemployment Insurance Act. Therefore, not all employment in covered industries is covered employment and estimates have to be

made for the noncovered segment as well as for those who have exhausted their benefit rights.

In estimating unemployment in covered industries, we relate the number of persons filing claims during a given week to covered employment to obtain the rate of insured unemployment. Since the incidence of unemployment varies from industry to industry; for example, it is much greater in the construction industry than in the finance, insurance and real estate field, the unemployment ratio is computed on an industry basis. Once the rate of unemployment is found for the covered segment of an industry, it is applied to total wage and salary employment in that industry to obtain an estimate of total unemployment.

Post-exhaustion unemployment is estimated on the basis of several studies showing that an average of eight weeks elapses between the time a claimant exhausts his benefits and the time he obtains re-employment. Post-exhaustion unemployment is, therefore, estimated to equal the number of claimants exhausting their benefits during the preceding two months, converted to a weekly basis.

The combination of these two estimates gives us the number of unemployed wage and salary workers in industries covered by Unemployment Insurance.

In estimating unemployment in noncovered industries it has been necessary to rely to a certain extent on national experience with these groups.

Examination of data available indicates that, nationally, unemployment among government workers has been about one-half as heavy as among non-government workers. Data available in North Dakota, would indicate that this rate would only be one-fourth that of non-government workers. The difference stems from the high degree of seasonality in unemployment among Non-government workers, plus the fact that our government employment is relatively stable.

Normally, unemployment among workers from nonprofit institutions is generally quite small, not only because employment in these institutions is usually slight, but also because it is steady. Unemployment among this group, is estimated at the same rate as for non-agricultural workers in covered industries, excluding construction. Construction is excluded because of its high degree of seasonality.

Interstate railroad workers are insured under the provisions of the Railroad Retirement Act. Data relating to unemployment among this group of workers is obtained from the Railroad Retirement Board.

Available data, indicates that during the summer months, unemployment among agricultural hired workers will equal the rate found for nonagricultural workers. However, during the winter months, when agricultural activities are at a low level, this rate increases to about twice the rate for nonagricultural wage and salary workers.

Self-employed and unpaid family workers are quite significant

in North Dakota in terms of employment, accounting for approximately 44% of the total employment in this State in 1954. While employment of this class of workers is high, it is also relatively stable. Available data indicates that unemployment among self-employed and unpaid family workers in agriculture is almost nonexistent during most of the year, while unemployment among non-agricultural self-employed and unpaid family workers is only about one-fourth as heavy as among nonagricultural hired workers. Unemployment for this group as a whole is estimated at one-fifth the rate obtained for nonagricultural wage and salary workers.

Unemployed new entrants and re-entrants are those individuals who joined the ranks of the unemployed upon their initial entry into the labor market or after a period of retirement from the labor force. Unemployment in this group is quite significant in all months of the year, but particularly in June when school graduations take place. The number of unemployed new entrants and re-entrants is dependent not only upon the month of the year, but also upon the number of unemployed workers in the area at that time. Except in June and July, an estimate of unemployment among new entrants and re-entrants should not exceed 15% of the entire unemployment group or 1% of the total labor force, whichever gives the smaller number. During June, unemployed new entrants and re-entrants account for approximately one-third of the total unemployed group (or 1.5% of the labor force). This tapers off gradually, and by the middle of September, the number of unemployed has generally reverted to the usual pattern. In actual practice, we have developed a seasonal index to estimate unemployment for this group.

The total of all these groups provides us with an estimate of the supply of labor currently in the labor market. However, we still have available to us a significant number of potential workers, not in the labor force.

Experience has indicated that increased labor demand of a non-seasonal nature brings into the labor force additional workers and that the labor force has a considerable degree of flexibility which is significant to an analysis of labor supply. Experience has also shown that the actual supply of labor that becomes available to meet specific demands may be significantly greater than the apparent supply. In attempting to analyze this potential supply of labor, it is necessary to examine the labor force participation rate. This rate may be defined as the proportion of the population, 14 years of age and over, that is in the labor force.

One characteristic which has an important influence on this rate is the employment of women. Nationally, the participation rate for women averaged 28.6% in 1950, while in North Dakota, this rate amounted to only 22.8%. This difference is almost entirely due to the large rural population in the State and to the limited number

of job possibilities for unmarried women in these areas. This conclusion is borne out by the fact that the female labor force participation rate ranges from 34.9% for urban areas in the State to 22.1% for rural non-farm areas, and down as low as 13.1% in rural farm areas.

In estimating the number of women which could be brought into the labor force in North Dakota, we have made use of a labor force participation study conducted by the United States Bureau of Employment Security. In this study, it has been concluded that a "saturation point" for female labor force participation would appear to be in the range of from 40% to 45%.

Census figures for 1950 show that Bismarck had a female labor force participation rate of 37%, Fargo 38.7% and Grand Forks 31.4%. When you take into consideration the fact that the female labor force participation rate for such industrialized areas as Los Angeles was 33%, Chicago 34% and Washington, D. C., with all its government establishments, 42%, we concluded that the maximum female participation rate we could hope for would be 40%. The number of women that could be brought into the labor force is estimated as the difference between those currently in the labor force and the number arrived at by applying the 40% ratio.

As far as male labor force participation rates are concerned, it appears probable that very minor changes in participation can be expected over short periods of time in a peacetime economy. Even during wartime, in centers of defence activity, the local additions to the civilian male labor force are not apt to be such as to increase the male participation rate beyond 5 percent. In view of our relatively large proportion of males over 65 years of age, it is believed that we would do well if we could increase our male labor force participation rate by 2 percent, and that is the ratio used in estimating this part of our potential supply.

We have one final source of potential supply to be considered and that is new entrants into the labor market. The Bureau of the Census, in its study on projected labor force growth, anticipated an annual net increase, in the total labor force, of 1.2 percent per year. This represents, in a large measure, the annual excess of young workers entering the labor force over deaths and old age retirements. Since we have not developed any State data relating to this group, we have been using the national average to estimate this source of supply.

Using the methods I have just outlined, we have estimated that there would be available for plant expansion in the city of Fargo, approximately 1900 workers, 800 in Bismarck, and 1900 in Grand Forks, or approximately 4600 workers in these cities alone.

We realize that many of the procedures used are quite rough. However, we feel that they give us the most realistic picture obtainable at the present time.

OIL AND NORTH DAKOTA

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INTRODUCTION

It is indeed a pleasure to be speaking to you today in view of the many years of pleasant association I have had with this group. It is also a great honor to have been asked to address you on the subject of oil and its affect in North Dakota.

HISTORY OF OIL DEVELOPMENT IN NORTH DAKOTA

In looking over the data at hand, it would appear that the history of the oil development in North Dakota can be divided into several major groupings. The first of these might be classified as the Heroic Age which would include the years prior to 1938. During this period, there were a number of significant, but at that time, rather unappreciated wells drilled largely by groups of promoters. In this category is found the famous well promoted by A. C. Townley and associates near Robinson, the Glenfield well in Foster County, the Big Viking well in Williams County, and the early-day gas and oil drilling that was done in Bottineau County. All of these were shallow attempts and relatively few of them penetrated the entire sedimentary section above the granite. The others were too shallow to reach any real commercial objectives that are now known to be present in many of these areas.

This was the day rather largely of the cable tool or percussion-type rig which was limited in its ability to drill deeply. Furthermore, there were psychological as well as mechanical difficulties in the way because most of the geologists and others felt that there was very little chance of oil occurring below the Dakota sandstone. This belief existed because of the great depth of the lower beds and because of the fact that rocks older than these of the Dakota were not then known to be particularly productive in this or in the immediate adjacent areas.

The second period could be classified as the beginning of the Modern period which extended from 1938 to 1951. The first modern well drilled in North Dakota was the California Company Nels Kamp No. 1 well drilled in the same quarter section as the Big Viking well in Williams County, North Dakota. The location of this well was NW NE Sec. 3, T. 154 N., R. 96 W., Williams County. This well was drilled to a total depth of 10,281 feet and was abandoned in August of 1938. This well was a very considerable mechanical accomplishment at that time and it is interesting to note that it was drilled only one mile from present day production in the Beaver Lodge and Capa oil fields. There is still some doubt in the minds of many as to whether

or not it actually did encounter oil in non-commercial quantities at the time the well had to be abandoned due to mechanical difficulties.

Following the drilling of the California Kamp well, there was a period of relative quiescence in which only a few wells were drilled in the state, notably the Carter Oil Company's E. L. Semling No. 1 in Oliver County and the Carter Oil Company's Franklin Investment Company No. 1 in Emmons County, North Dakota. Subsequent to the drilling of this last-named well, World War II was in full swing and so therefore steel and personnel were not available to do wild-cattling in as rank a wildcat province as the Williston Basin was at that time. Therefore, from 1943 until approximately 1951, practically no wells were drilled in North Dakota except a few stratigraphic ventures which were primarily drilled to gather geologic information.

The third age of North Dakota oil development should probably be classified as the Age of Discovery. The period started with the bringing in of the Clarence Iverson No. 1 well in Williams County on April 4, 1951. Since that time, there have been drilled in the State of North Dakota 765 wells up to April 15 of this year. Of these wells, 494 have been producers and 271 have been dry holes. Practically all of these wells, with but one or two exceptions, have been drilled by rotary tools. This enabled not only greater depth of drilling, but more adequate control of the high pressures encountered at greater depths.

In view of the fact that this is a scientific group, perhaps it would be of interest to see what part scientific endeavors played in the oil business in North Dakota. Originally, oil in North Dakota existed only in the minds of a group of geologists. These men studied all available information which was admittedly scanty, and came to the conclusion that the conditions were right for the occurrence of oil in the Williston Basin.

While the regional studies of the geologists were continuing, they called upon another phase of geology, namely geophysics, to do more detailed geophysical study of an area selected by the geologists. Included in the geophysical group were geologists, physicists, and electrical engineers as well as surveyors and other similar personnel.

After the area was detailed by the geophysicists and the final decision to drill made, a new group of personnel moved into the picture. We still have the geologist watching the samples obtained by drilling, but we now have the petroleum engineer supervising the actual drilling operation.

After the well was completed and the discovery made, another group of petroleum engineers ultimately entered the picture. These are the men who make the studies of the reservoir and who evaluate the field. They also plan development, recommend rates of withdrawal from the reservoir and suggest proper spacing development.

After the oil and gas leaves the field, a new set of technically-trained scientists take over. Now the raw product enters the hands

of chemical engineers and chemists who will transform these raw hydrocarbons to useful products. These workers will take sulfur, propane, and butane from the gas and make gasoline and many other products from the oil. Many other products can be made from these raw materials and it is hoped that sometime in the near future other industries will be attracted to North Dakota because of the abundance of this raw material.

Thus, it can be seen that this new raw material has provided employment for geologists, physicists, electrical engineers, petroleum engineers, chemical engineers and chemists as well as many other scientific workers in lesser capacities. North Dakota furnished practically none of these trained personnel in the beginning, but since the discovery of oil, an increasing number of these scientifically—trained people are being furnished by our own educational institutions in the state.

Perhaps it would be well to consider what our greatest successes have been and also what our greatest failures have been.

Taking into consideration our successes first which is, of course, the most pleasant thing to do, it would appear that the greatest success, as far as drilling is concerned thus far in North Dakota, has been associated with structural conditions, notably anticlines. It will be noted by looking at the map that practically all of the large oil fields in North Dakota are located in one general area. This is the area of the Nesson anticline and all of the larger fields are associated with that structure. It is true that some of the fields such as White Earth and East Tioga as well as McGregor appear to be off this major structure, but undoubtedly are associated with it on subsidiary and closely allied structures.

The finding of the fields on these large structures was due in no small way to successful geophysical exploration on the part of the Amerada Petroleum Corporation as well as many other operators in the state. In other words, here in finding structural traps, the geophysical type of exploration has been most successful.

We also have had some small successes in finding oil accumulations of a stratigraphic type in Bottineau County, North Dakota. However, these are not as large nor have they been as significant as it would appear that they should be from the standpoint of the regional geology of the area.

The rapid development of the gasoline plants, refineries and pipelines has been one of the great successes of the oil business in North Dakota.

In a field more or less divorced from that of the geology of the area, we have had great success in the field of state conservation laws and regulations promulgated under these laws. These laws and regulations are probably among the most advanced laws in the United States.

Where then have our greatest failures been? It would appear to

me that the greatest failures that we have had are due to the fact that we have failed to locate large stratigraphic accumulations of oil such as those found in Saskatchewan and particularly Manitoba immediately to the north of us. Note the map of the fields in Saskatchewan and Manitoba immediately north of us. Along with this failure, it would appear that one of the main difficulties has been that geophysical methods of exploration, which have been so successful in locating structural conditions in the western part of the state and the western part of the Williston Basin, have not been particularly successful in this area. This is due, no doubt, largely to lack of knowledge concerning certain aspects of the formations which the geophysicists are attempting to measure. Very likely, this failure can be corrected as soon as more information is gathered in this and immediately adjacent areas.

Probably one of our other greatest failures has been the inadequate testing of potential shows in the formations which might possibly be oil bearing. Many of the wells have been drilled simply with the view in mind apparently of getting the hole down in the shortest possible time. This fact combined with inadequate supervision and with inadequate study of the samples and other information obtained in the drilling may have meant some overlooked oil field.

In looking back over the history and finding out where our successes and failures have been, it makes one wonder what the oil potential of North Dakota actually is. In my opinion, there is no question about the fact that numerous oil fields, and probably large ones, may well lie as yet undiscovered on the east flank of the Basin. This reasoning would appear to be in line with the successes that have been obtained immediately to the north and northwest of us in Saskatchewan and Manitoba where geologic conditions are very similar, if not identical, with those found on the east side of the Williston Basin in North Dakota. It seems almost impossible to believe that geologic conditions would be such that they would be terminated by a political boundary.

I feel certain also that greater amounts of oil will be found on structures, particularly in the western part of the State and in a deeper part of the Basin. This would be in line with the discoveries which have been made not only in western North Dakota, but also in eastern Montana.

Furthermore, I feel certain that more horizons will prove productive than have been the case up to this time. This is particularly true of some of the shallower sands particularly those in the Dakota group and associated sandstone formations. To date, nothing but water and a few non-commercial gas shows have been found in these formations. However, this does not mean that provided the conditions are favorable that oil will not sometime be found in them somewhere.

Recently, interesting theories have been suggested by Dr. M. K. Hubbard which would indicate that under certain proper conditions the hydrodynamics of certain reservoirs similar to those of the sands of the Dakota group, would be such that oil and gas could be accumulated without structural closure. This is a very important and potent fact to be considered relative to the accumulation of oil and gas in the Newcastle or Muddy, and Dakota sandstone formations in eastern North Dakota.

I think also that improved methods for finding oil will be discovered. Just what these methods will be, I do not know. Undoubtedly, the methods may in part be refinements of methods which are already in use. In addition, new methods may very well be discovered and perfected. One of the most recent tools being used is the scintillometer. Whether this will prove successful is simply not known. Much more work must be done on it. Furthermore, more work may well be done on geochemical prospecting for oil. This is a geologic tool upon which little work has yet been done in North Dakota.

One of the great problems of the oil business is adequate recovery of the oil which is in the ground. It is a well known fact that under the most optimum conditions at the present time, only 75% of the oil in place is actually ever removed. This is, as you all know, due to the physical bond between the oil in one hand and the enclosing rock in the other. Perhaps new methods can be discovered to break this bond or to at least make it less effective.

What has been the effect of oil in North Dakota? Needless to say, it has been profound. It has changed our way of thinking and in some areas, our way of living. It has increased our industrial potential and it has taken its place second only to agriculture as our leading industry. It has increased our tax base in the oil areas and added to our tax revenues. In fact, in the 18 months from July 1, 1953 to January 1, 1955, the state and counties have collected directly \$728,302.24 from the gross production tax on oil and gas and since the beginning of the oil development, over \$6,000,000 from leases, bonuses and royalties. These latter revenues went to the Board of University and School Lands and the Bank of North Dakota.

However, the inception of this new industry has not been without birth pains, particularly in the oil area itself. Many problems were immediately created in housing, schools, streets, sewers, police and fire protection as well as other areas. Then too, the state had to set up machinery to handle the regulation of the industry.

As noted previously, North Dakota has made excellent progress in the field of oil conservation practice. We have tried to apply the best scientific principles known in the industry to the problems of conservation. However, any conservation program dealing with natural resources to be successful must of necessity be a compromise between scientific principles on one hand and economics on the

other. What is being attempted is a balance between the needs of the present with the anticipated demands of the future. It is to be earnestly hoped we are successfully accomplishing this balance.

Now there will be, undoubtedly, some new industries attracted to North Dakota because of the abundance of this new raw material. I refer specifically to the petrochemical industry. Needless to say, these new industries are not going to come in right away. There will be a problem of time, there will be the problem of venture capital, there will be the general economic situation, the tax situation, etc., all of which must be considered at great length.

In summary then, the state of North Dakota has benefited in a very material way from the introduction of oil and gas industry in North Dakota. Our development has been orderly. It has not been a boom and bust type. It is my feeling that it is an industry to be welcomed and already has taken a very favorite place in our economy.

THE EFFECT OF COLD EXPOSURE ON RENAL FUNCTION IN DOGS

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The effect of cold environment on the circulation and on the function of the kidneys is of interest to people living in cold climates or to those exposed to cold as a result of their occupation, for example farmers and military and flying personnel.

This study utilized unanesthetized female mongrel dogs which had a metal cannula implanted inside the bladder opposite the ureteral orifices and through which urine drains to the outside of the ventral body wall. Control observations were made for forty-five minutes at ordinary room temperatures 21-24 degrees Centigrade. The dog was then taken to a refrigerated room at temperatures which fell to 4.0-1.8 degrees Centigrade during an experimental period of one hour's duration.

Observations included skin temperatures of back and feet, and rectal temperatures. Renal clearances of exogenous creatinine and para amino hippurate were used to measure glomerular filtration rate and effective renal plasma flow, respectively. Water and chloride excretion were measured.

Cold room exposure resulted in a sharp decrease in foot temperatures and smaller decreases in the temperature of the skin of the back, suggesting a constriction and reduced blood flow in these skin areas. These changes usually preceded shivering. Rectal temperatures showed little or no change.

Usually renal plasma flow decreased during cold exposure, sug-

gesting that efferent renal arterioles shared in the constriction occurring in skin blood vessels. Glomerular filtration rate did not show changes which were consistent when comparing one experiment to another or one dog to another. In experiments in which there was a change in water or chloride excretion, there was usually a decrease in excretion of both, which reflected an increase in tubular reabsorption of water and chloride.

THIOACETATES FROM MERCAPTANS AND KETENE

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Thiolic esters represent one of the three types of sulfur containing esters that have received intermittent theoretical consideration in attempts to elucidate analogous oxygen type organic reactions. Except for their odoriferous and frequently offensive aroma, they perhaps would have received far more consideration for practical and synthetic purposes, such as the preparation of aldehydes(1).

Thiolic esters were first prepared by Michler (2) by the action of an acid chloride and mercaptan: $\text{RCOCl} + \text{HSR}^1 = \text{RCOSR}^1 + \text{HCl}$. In their preparation with acetic acid the reaction reaches equilibrium when about 15% of the products have been formed, so it is apparent that the esters hydrolyze considerably. The first and apparently only reference to the preparation of thioacetates from ketene were by Hurd and Williams (3) in 1936 who reported the preparation of ethyl thioacetate in 92.6% yield by allowing liquid ketene and ethanethiol to stand for 3 days at -80° . Apparently no catalyst was used and no attempt was made to acetylate other mercaptans. Since typical esters can be readily produced in good yields by the action of ketene on alcohols, it seemed highly probable that the corresponding sulfur containing thiolic esters could be produced by analogous treatment of mercaptans with ketene.

Methanethiol, ethanethiol, 1-propanethiol, 2-propanethiol, 2-butanethiol, and 2-methyl-2-propanethiol were each in turn acetylated with ketene using various conditions, and sulfuric acid as a catalyst. The thiols having sufficiently high boiling points were treated with ketene in a carbon tetrachloride solution at room temperature. Others were acetylated with liquid ketene at a temperature of -68 to -72° again using sulfuric acid as a catalyst. Solid carbon dioxide and chloroform were used in the cooling baths to obtain these low temperatures. The 2-methyl-2-propanethiol did not acetylate appreciably at room temperature in a carbon tetrachloride solution, but the reaction proceeded satisfactorily at the lower temperature with liquid ketene. Some difficulty was again experienced in acetylating tertiary mercaptans with ketene (3). Tertiary butyl, amyl and

TABLE I
Physical Constants of Thioacetates

Compound Acetylated	Yield %	b. p.		30 c ₄	30 n _D	M _D
		Obs.	Lit (7)			
Methanethiol ¹⁰	22.5	97.5-8.8	95-6	1.013 ²⁵	1.4572 ²⁵ ^o	24.30 24.035
Ethanethiol ⁹	23.4	113-14.5	116-17	.971 .975 ²⁵ ^o (8)	1.4473 1.4503 (8)	28.30 28.653
1-Propanethiol	46.0	137-39.5	135-37	.955	1.4533	33.6 33.27
2-Propanethiol	22.5	124-26	124-27	.952	1.4445	33.2 33.27
2-Butanethiol ¹⁰	59.0	148-51.5	—	.933	1.4528	38.25 37.889
2-Methyl -2-propanethiol ¹¹	17.5	130-33	—	.918	1.4435	38.4 37.889

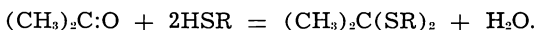
⁹ These compounds were acetylated with liquid ketene at a temperature of -68° to -72° and sulfuric acid for catalyst.

¹⁰ The sulfur content was found to be 23.8%, theoretical 24.24%.

¹¹ The sulfur content was found to be 24.40%, theoretical 24.24%.

dodecyl mercaptans in carbon tetrachloride did not appreciably acetylate at room temperature.

The yields of thiolic esters are frequently low by this procedure. This may be due in part to numerous side reactions that consume appreciable quantities of ketene or mercaptans. Acetone was present in appreciable quantities in the reaction gases and probably reacted with a portion of mercaptans forming the thio acetal (4):



The mercaptans are likewise easily oxidized to the disulfides or under more drastic conditions to the sulfonic acids. Additional unsaturated gases, other than ketene, produced in the generator, may also react with the mercaptans.

EXPERIMENTAL

The ketene used was generated by the pyrolysis of acetone using the lamp previously described by Dunbar and Bolstad (5). The six mercaptans were each individually placed in the gas absorption apparatus designed by Dunbar and Bolstad (6). Each mercaptan was then individually treated with a theoretical excess of ketene. The resulting products were carefully fractionated at atmospheric pressure and several physical constants determined. The findings are recorded in Table I. The preparation of, and physical constants of 2-butyl thioacetate, 2-methyl-2-propylthioacetate are reported for the first time. Attempts to acetylate tertiary butyl mercaptan, tertiary amyl mercaptan, and tertiary dodecyl mercaptan respectively, each at room temperature, with a theoretical excess of ketene in a solution of carbon tetrachloride containing two drops of sulfuric acid, gave in each case negative results.

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PRESERVATION OF POTATO VIRUSES X AND Y BY FREEZING

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ABSTRACT

It is customary to maintain certain potato viruses in suitable hosts in order to have inoculum available when needed. Although this is a fairly satisfactory method, there is always the possibility that insect vectors may infect the hosts with other viruses. It is also necessary to transfer the viruses occasionally to virus-free hosts. It would be much more convenient if the viruses could be maintained in some other manner. A virulent strain of potato virus X was expressed from *Nicotiana glutinosa* leaves in November 1951 and frozen. Another virulent strain was expressed from *N. glutinosa* in August 1954 and frozen. The juices of two less virulent strains of X were obtained from potato leaves and frozen in September 1954. Three strains of virus Y, one virulent and two moderately virulent, were expressed from *N. glutinosa* and frozen in August 1954. Portions of all these frozen juices were melted and tested at various times during 1955. In all instances, they produced the characteristic symptoms on the indicator plants. One virulent strain of virus X has been frozen for 39 months and it was still viable when tested in February.

STUDIES ON RESPIRATION AS A HEAT LOSS MECHANISM IN DOGS

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ABSTRACT

A series of experiments have been conducted in which the effects of hyperthermia on conscious dogs, which have had their respiratory heat loss mechanism by-passed, were studied and compared to control observations obtained on the same animal. Skin and rectal temperatures, respiratory air water content, respiratory rate, and blood chemical and water alterations were measured. The results of these experiments indicate that in spite of the impairment of the respiratory heat loss system, the dog is able to compensate for the increased stress and rather efficiently maintain deep body tempera-

ture within physiological limits. The respiratory rate and respiratory water loss generally follow the degree of hyperthermic stress as is indicated by rising and falling rectal temperatures. No marked variations from normal have been observed in the plasma water content oserom bicarbonate when the dogs are permitted adequate drinking water. While the exact compensatory mechanism has not been determined by these experiments it suggests the great importance of the lungs in temperature regulation in hyperthermic environment. (This investigation was supported in part by research grant G-3772 from the Public Health Service, National Institute of Health).

CHICK GROWTH RESPONSES WITH THE ADDITION OF AMINO ACIDS TO WHEAT PROTEINS

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A recent report made by the Feed Survey Committee, sponsored by the American Feed Manufacture Association show that there is not enough protein available to permit all farm animals and poultry to be fed according to the recognized standard. Any information that will have a tendency to increase the protein or better the protein quality with the addition of a synthetic amino acid may have an important economic value in the near future.

Pure amino acids, when available offer excellent opportunities to balance the amino acids in rations. At present only methionine is available in quantity and at a price which will permit its use in poultry rations. Methionine is beng used extensively to supplement the protein in broiler rations.

Lysine is not available at this time for commercial use in poultry rations, when it becomes available it will have numerous applications in the supplementation of protein in poultry rations.

The results presented here will tend to substantiate this statement.

Experimental Procedure

One week old uniformly selected chicks were placed in a electrical controlled temperature brooder. Ten chicks were allotted to each lot. Each lot of chicks was placed on an all basal wheat protein rations. The only ingredients added to this basal ration were vitamins and minerals to meet the nutritive requirements of the young growing chick.

To some of the basal rations were added the amino acid, methio-

nine, tryptophane and lysine as shown in the table. All lots were run in duplicates for each amino acid or combination of amino acids. The chicks were weighed individually at the beginning and at the end of the two week feeding period. All lots of chicks were weighed in groups daily. The feed consumption was determined weekly and weekly collections of the feces were made. The feces were then dried in a ventilated hood at approximately 70° centigrade. After drying the feces were weighed, ground in a Wiley mill and a nitrogen determination was made by the Kjeldahl method on both the feed and feces.

The result of these determinations were used to calculate the protein efficiency and the percent nitrogen retention as shown in the table.

Result and Discussion

The results obtained from these feeding trials using wheat proteins as the sole source indicate that these proteins are deficient in lysine in meeting the nutritive requirements of the one to three week old chicks.

Chick Growth Response to a Wheat Protein Ration With the Additions of Certain Amino Acids

Ration	Protein	Ave. Grain	Feed Efficiency	Protein Efficiency	Nitrogen Retention
Wheat	11.1	24	4.06	2.20	30.7
Wheat Methionine	11.1	38	3.64	2.48	35.5
Wheat Methionine Tryptophane	11.1	35	3.13	2.89	35.0
Wheat Tryptophane	11.1	38	3.79	2.38	35.0
Wheat Lysine	11.1	66	2.62	3.44	44.6
Wheat	16.1	19	6.97	.89	42.8
Wheat Lysine	16.1	115	2.17	2.94	48.5
Commercial Chick Starter	20.3	173	1.67	2.96	52.0

The addition of lysine to a wheat protein ration increased the feed efficiency which is the amount of feed required per unit of gain. Protein efficiency is expressed as the amount of gain made by one unit of protein. It is also indicated in the table, that the amount of proteins in the ration has an effect on the lysine requirement. For the wheat ration containing 16.1 percent protein the chick made a lesser gain on this basal, than those chicks on 11.1 percent protein basal. Thus the lysine deficiency was greater in the 16.1 percent basal wheat rations. With the addition of lysine a greater growth response was obtained from 16.1 percent wheat basal. Chicks on the methionine and tryptophane rations made less gains than those receiving lysine, but slightly greater than the chicks on the basal. From the data presented it would be difficult to state whether a

methionine or tryptophane deficiency existed in these rations.

When methionine and tryptophane were added to a ration to which lysine has been added there was no increase in growth response. This would indicate that under these feeding conditions, no deficiency in methionine and tryptophane existed.

The percent nitrogen retention was better in those chicks receiving the lysine but there was little difference in percent nitrogen retention, for chicks on 16.1 percent protein. The reason is this discrepancy is not known.

A commercial chick starter was used for comparative purposes in these feeding trials. The rate of gain, feed efficiency, protein efficiency and percent nitrogen retention were better for birds on the commercial starter ration than for any of the wheat rations with added amino acids. This would indicate that there are some other limiting factors in the wheat protein rations. Protein deficiency may be partially the cause of the lesser gains in the wheat rations.

Summary

The first limiting amino acid in wheat protein for chick growth is lysine as measured by rate of gain, feed efficiency, protein efficiency and percent nitrogen retention. Methionine, tryptophane were not indicated to be lacking in wheat proteins for chick growth.

COMPARISON OF THE CHICK GROWTH INHIBITION OF UNHEATED LINSEED HULL AND COTYLEDON FRACTIONS

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ABSTRACT

The growth depressing effect resulting from the incorporation of linseed meal in the chick diet has been known for the past 25 years. In 1946 several workers (McGinnis and Polis, Poultry Sci. **25**, 408, 1946, and Kratzer, Poultry Sci. **25**, 541, 1946) showed that water treatment at room temperature decreased the growth depressing effect considerably. The inhibitor could also be overcome by the addition of a synthetic vitamin mix, and specifically by the addition of the B vitamin, pyridoxin. In one report (Mani et al., Sci. Ag. **29**, 86-90, 1949) mucilage was indicated as the inhibitory factor for chick growth. We have developed a practical method for separating experimental quantities of flaxseed into hulls and cotyledons. Lots of chicks were fed the standard ration and rations with a portion of the soybean meal replaced with heated linseed meal, unheated linseed meal, linseed hull and linseed cotyledon. The hull supplement

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produced less growth than the control but much better growth than either the heated linseed meal, unheated linseed meal or the cotyledon fractions. This series of experiments eliminates the possibility of musilage being the pyrdoxin-binding factor in linsed meal toxicity.

Table 1. — Comparisons of the rates of gain and feed efficiencies of the various linseed fractions.

	Total Gain (grams)			Feed Efficiency		
	Trial			Trial		
	1	2	3	1	2	3
Control	143	191	150	2.12	1.90	1.81
Heated linseed meal	111*	93	102	2.13*	2.43	2.06
Unheated linseed meal	45	59	41	2.86	3.00	3.64
Linseed hull	127	121	114	2.16	2.39	2.50
Linseed embryo	78	62	67	2.85	2.75	2.80

*Commercial linseed meal

The total gain (Table 1) and feed efficiency were in the same order in all experiments, with the control showing the greatest gain and greatest efficiency and the cold extracted linseed meal the lowest gain and the poorest feed efficiency. The gain on linseed cotyledon was only slightly better than the cold extracted meal in all cases.

AN ACTINOMYCETE AMYLASE

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ABSTRACT

The characteristics of an extra-cellular amylase secreted by a starch-grown *Actinomyces* sp. isolated from Edgley loam have been studied. Varying amounts of the enzyme are produced when the organism is grown on different substrates. Concentration and purification have been accomplished by acetone or alcohol precipitation followed by ammonium sulfate precipitation. Chromatographic and electrophoretic studies on the purity and homogeneity of the enzyme have been made.

The amylase is destroyed in about 15 minutes at 60° C. The optimum pH for activity is 6.0; the pH activity and stability curves are very closely parallel in the acid range. No marked stimulation occurs in the presence of metallic ions that activate amylases from some

other sources. Inhibition and reactivation studies indicate strong dependence on sulfhydryl groups for enzymatic activity.

Several lines of evidence indicate the mechanism of attack on the starch molecule by this amylase is that of a typical α -amylase.

LEAF, STEM, AND HEAD PROPORTIONS IN GRASS HAYS¹

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ABSTRACT

Quality in grass hay is commonly associated with the relative degree of leafiness of the hay. The leaves are not only more palatable to livestock, but are lower in fiber and higher in nutritive value, particularly in protein content, than are the stems. Greater leafiness in hay can be obtained by early cutting before the stems are fully developed. However, early cutting results in a considerable decrease in weight of the hay produced from any given acre of ground. In the drier areas, where the production of hay is normally rather low, it frequently becomes necessary to compromise between quality and quantity and to cut at a stage where the grass has produced a sufficient volume of material to provide a satisfactory yield.

The quality of grass hay can be improved by using grasses which contain a relatively large proportion of leaves in relation to stems, even though the grasses have reached an advanced stage of development with stem growth at or near completion. In order to determine the relative proportions of leaves, stems, and heads in different grass varieties when cut at a late hay stage, physical separation of these components have been made from hay samples taken from pure stands of nine grass varieties at the Dickinson Experiment Station.

Over the four year period, 1951-1954, the physical composition of all varieties taken together has averaged: leaves, 45.3 percent of the total yield, stems 44.6 percent, and heads 10.1 percent. The average percentage of leaves for the different varieties has been: Russian wildrye 92.4 percent, green stipagrass 62.2, Lincoln brome 58.4, pubescent wheatgrass 55.1 intermediate wheatgrass 52.3, northern brome 42.9, Fairway crested wheatgrass 31.4, standard crested 25.8, and Nordan crested 25.4.

The ratio of stems and heads to leaves is not a constant factor with species but varies widely from season to season. However, all the species seem to respond in the same general way to seasonal influences, although the magnitude of the response is different between

different species. Thus the ratio of stems and heads to leaves was high for all species in 1951, considerably lower in 1952, high again in 1953, and relatively low again in 1954. The favorableness of the seasonal growing conditions for the production of stems and heads apparently has greater influence on the relative proportions of leaves, stems, and heads than does the favorableness of the season for leaf growth.

Nitrogen analyses of the leaf, stem, and head fractions of the 1954 samples showed that the crude protein content of the leaves averaged twice that of the stems, 9.0 percent for leaves—4.5 percent for stems. Protein was highest in the head fraction, 12.5 percent. For all varieties taken together the average protein yields were 75.0 lbs. per acre for the leaves, 18.0 lbs. per acre for the stems, and 17.3 lbs. per acre for the heads.

Some of the grass varieties which are low in proportion of leaves, such as standard crested wheatgrass, actually produce a greater total yield of protein than do some of the more leafy varieties, such as Lincoln brome grass. Much of the value of the hay from grasses such as these depends on the relative degree of palatability of the stems. Fortunately the stems of the crested wheatgrass varieties have fair palatability to livestock. Otherwise these grasses would be of little value as hay. The results of this study indicate, however, that probably a greater use for hay of the more leafy grasses, such as pubescent wheatgrass and intermediate wheatgrass, should be made in the drier sections of the state.

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