

TENTH BIENNIAL REPORT

[No. 22 IN SERIES.]

OF

THE BOARD OF REGENTS

OF THE

University of Minnesota

TO THE GOVERNOR,

FOR THE

FISCAL YEARS 1897 AND 1898 ENDING JULY 31ST.

*Transmitted to the Legislature at the Thirty-first (Tenth Biennial)
Session, 1899.*

DELANO, MINN.
THE EAGLE PRINTING COMPANY,
PRINTERS.
1899.

ADMINISTRATIVE OFFICERS.

BOARD OF REGENTS.

	Term Expires.
The HON. JOHN S. PILLSBURY, Minneapolis, - - -	Regent for Life
The HON. DAVID M. CLOUGH, Minneapolis, - - -	Ex-Officio
The Governor of the State.	
CYRUS NORTROP, LL. D., Minneapolis, - - -	Ex-Officio
The President of the University.	
The HON. W. W. PENDERGAST, M. A., Hutchinson, - - -	Ex-Officio
The State Superintendent of Public Instruction.	
The HON. STEPHEN MAHONEY, B. A., Minneapolis, - - -	1901
The HON. SIDNEY M. OWEN, Minneapolis, - - -	1901
The HON. ALPHONSO BARTO, St. Cloud, - - -	1902
The HON. M. R. TODD, Preston, - - -	1902
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The HON. ELMER E. ADAMS, B. A., Fergus Falls, - - -	1903
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The REV. SAMUEL G. SMITH, D. D., St. Paul, - - -	1904

OFFICERS OF THE BOARD.

The HON. JOHN S. PILLSBURY, - - - - -	President
The HON. STEPHEN MAHONEY, - - - - -	Recording Secretary
PRESIDENT CYRUS NORTROP, - - - - -	Corresponding Secretary
JOSEPH E. WARE, (Address care St. Anthony Falls Bank) -	Treasurer

STANDING COMMITTEES.

EXECUTIVE—Regents Pillsbury, Liggett and Northrop.
AGRICULTURE—Regents Liggett, Owen, Pillsbury, Barto and Pendergast.
MEDICAL DEPARTMENT—Regents Mahoney, Clark and Todd.
LAW DEPARTMENT—Regents, Clark, Mahoney, Rice and Davis.
COURSE OF STUDY—Regents Northrop, Pendergast and Adams.
LEGISLATION—Regents Rice, Adams and Owen.
LIBRARY—Regents Todd, Clough and Northrop.
AUDITING ACCOUNTS—Regents Adams, Todd and Rice.
GEOLOGICAL AND NATURAL HISTORY SURVEY—Regents Clark, Adams, Liggett, Pillsbury and Rice.
SALARIES—Regents Mahoney, Clark and Barto.

EXECUTIVE OFFICERS.

WILLIAM M. LIGGETT, Dean of Department of Agriculture.
WILLIAM S. PATTEE, LL. D., Dean of the College of Law.
PARKS RITCHIE, M. D., Dean of the College of Medicine and Surgery.
ALONZO P. WILLIAMSON, M. D., Dean of the College of Homeopathic Medicine and Surgery.
WILLIAM P. DICKINSON, D. D. S., Secretary of the College of Dentistry.
FREDERICK J. WULLING, Ph. G., Dean of the College of Pharmacy.
HENRY WEBB BREWSTER, Ph. D., Principal of the School of Agriculture.

THE UNIVERSITY OF MINNESOTA,
OFFICE OF THE BOARD OF REGENTS,
December 31, 1898. }

To His Excellency, David M. Clough, Governor of Minnesota,

Sir: In accordance with the requirements of law, I have the honor on behalf of the Board of Regents to herewith present the tenth biennial report of the Regents of the University of Minnesota.

I am, very respectfully, your obedient servant,

J. S. PILLSBURY,
President of Board of Regents.

TENTH BIENNIAL REPORT
OF THE
President of the Board of Regents
OF THE
UNIVERSITY OF MINNESOTA.

Perhaps there has been no time since the opening of the University in 1869 in which there has been more thorough and more faithful and successful work done than during the past two years. To the able and efficient administration of President Northrop, together with the earnest co-operation of all the teachers, instructors and professors desirous of contributing in every way possible toward the development and progress of the work under their charge, is largely due the success attained.

Harmony has prevailed throughout the institution in all departments. So great has been the advance made in the several departments that the University of Minnesota now fairly ranks second among the State Universities of our country.

The people of this commonwealth have great reason to be proud of the progress in education during the past twenty years or more. Our schools are among the best in the country.

There is no reason why the youth of this commonwealth from the lowest to the highest rank should not acquire a finished education. The state wisely and with liberality offers unexcelled facilities for education free to all. Our youth have but to seize the opportunity and make it their own.

The following is the attendance since 1883:—1883, 223; 1884, 288; 1885, 310; 1886, 406; 1887, 412; 1888, 491; 1889, 781; 1890, 1002; 1891, 1183; 1892, 1374; 1893, 1620; 1894, 1828; 1895, 2171; 1896, 2467; 1897, 2647; 1898, 2890.

The following is a statement of the receipts and disbursements for the years 1897 and 1898:

TENTH BIENNIAL REPORT

RECEIPTS.

The University revenues for current expenses for the fiscal year ending July 31, 1897, were derived from the following sources:

Balance on hand Aug. 1st, 1896.....	\$101,958.21
From U. S. government, Hatch bill appropriation.....	\$15,000.00
From U. S. government, Morrill bill appropriation....	23,000.00
From interest on University bonds and land contracts.	49,266.55
From sales of farm products and fees from school.....	4,825.23
From University fees.....	64,671.25
From 3-20 of one mil revenue tax.....	82,332.59
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	\$239,095.62
From sale of salt spring lands.....	5,000.00
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Total.....	\$346,053.83

DISBURSEMENTS.

The disbursements for current expense for the fiscal year ending July 31, 1897, were as follows:

For salaries of officers.....	\$182,151.62
For wages of employes.....	39,680.24
For fuel and lights.....	11,629.16
For freight and express.....	4,778.00
For postage.....	1,381.70
For library.....	4,021.02
For stationery and printing.....	5,289.63
For furniture and fixtures.....	1,600.82
For scientific apparatus and instruments.....	2,052.00
For building.....	131.80
For equipment of building.....	673.87
For live stock.....	1,557.72
For tools, implements and machinery.....	2,214.34
For feed.....	1,366.22
For seeds and plants.....	300.95
For supplies for instruction and illustration.....	14,712.00
For repairs.....	1,874.00
For traveling expenses.....	1,025.66
For petty supplies.....	4,152.91
For museum.....	50.01
For taxes, rents, ads.....	743.16
For publications.....	1,261.05
For contingent expenses.....	1,068.38
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Total.....	\$283,716.26

RECEIPTS.

Revenues for current expenses for the fiscal year ending July 31, 1898, were derived as follows:

Balance on hand Aug. 1st, 1897.....	\$ 61,962.39
From U. S. government, Hatch bill appropriation.....	\$ 15,000.00
From U. S. government, Morrill bill appropriation....	24,000.00
From interest on University bonds and land contracts.	56,277.68
From sales of farm products and fees from school.....	6,966.16
From University fees.....	68,657.00
From 23-100 of one mil revenue tax.....	88,904.78
Legislative appropriation for deficit 1897.....	10,000.00
	<hr/>
	\$269,805.62
From sales of salt spring lands.....	19,981.35
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Total.....	\$351,749.36

DISBURSEMENTS.

The disbursements for current expense for the fiscal year ending July 31, 1898, were as follows:

For salaries of officers.....	\$182,909.15
For wages of employes.....	39,065.10
For fuel and lights.....	13,486.99
For freight and express.....	2,040.86
For postage.....	1,849.04
For library.....	3,958.75
For stationery and printing.....	5,817.77
For furniture and fixtures.....	2,161.69
For scientific apparatus and instruments.....	4,394.15
For building.....	5,256.61
For equipment of building.....	3,517.88
For live stock.....	2,733.72
For tools, implements and machinery.....	1,695.31
For feed.....	1,953.46
For seeds and plants.....	318.28
For supplies for instruction and illustration.....	12,486.65
For repairs.....	4,539.83
For traveling expenses.....	1,045.17
For petty supplies.....	4,753.97
For museum.....	125.10
For taxes, rents, ads.....	1,380.98
For publications.....	325.25
For contingent expenses.....	667.90
Total.....	\$296,483.61

The following is the staff of professors of the several departments, also a statement of the expenses of each department:

GENERAL UNIVERSITY.

The disbursements of this department for the years....	1897	1898
	\$40,954.12	48,305.27

The College of Science, Literature and the Arts.

THE FACULTY.

CYRUS NORTHROP, LL. D., President.
 WILLIAM W. FOLWELL, LL. D., Professor of Political Science.
 JABEZ BROOKS, D. D., Senior Professor of Greek.
 CHARLES N. HEWITT, M. D., Professor of Sanitary Science.
 JOHN G. MOORE, B. A., Professor of German.
 CHRISTOPHER W. HALL, M. A., Professor of Geology and Mineralogy.
 JOHN C. HUTCHINSON, B. A., Professor of Greek.
 JOHN S. CLARK, B. A., Professor of Latin.
 JOHN F. DOWNEY, M. A., C. E., Professor of Mathematics.
 MARIA L. SANFORD, Professor of Rhetoric and Elocution.
 CHARLES W. BENTON, M. A., Litt. D., Professor of French.
 O. J. BREDÁ, Professor of Scandinavian.
 HENRY F. NACHTRIEB, Professor of Animal Biology.
 FREDERICK S. JONES, M. A., Professor of Physics.
 CONWAY MACMILLAN, M. A., Professor of Botany.
 FREDERICK J. E. WOODBRIDGE, B. A., Professor of Philosophy.

HARRY A. LEONHAEUSER, Lieut. U. S. A., Professor of Military Science and Tactics.
 WILLIS M. WEST, M. A., Professor of History.
 DAVID L. KIEHLE, LL. D., Professor of Pedagogy.
 GEORGE B. FRANKFORTER, M. A., Ph. D., Professor of Chemistry.
 JAMES RICHARD JEWETT, Ph. D., Weyerhaeuser Professor of Semetic Languages and History.
 FRANCIS P. LEAVENWORTH, M. A., Professor of Astronomy and Director of the Observatory.
 CHARLES L. WELLS, Ph. D., Professor of History.
 MATILDA J. WILKIN, M. L., Assistant Professor of German.
 CHARLES F. SIDENER, B. S., Assistant Professor of Chemistry.
 JOSEPH BROWN PIKE, M. A., Assistant Professor of Latin.
 E. EUGENE McDERMOTT, B. S., Assistant Professor of Rhetoric and Elocution.
 D. T. MACDOUGAL, Ph. D., Assistant Professor of Botany.
 WILLIAM H. KIRCHNER, B. S., Assistant Professor of Drawing.
 JOHN ZELENY, B. S., Assistant Professor of Physics.
 SAMUEL G. SMITH, D. D., Lecturer on Sociology.
 FREDERICK KLAEBER, Ph. D., Assistant Professor of English Philology.
 CHARLES F. McCLUMPHA, Ph. D., Assistant Professor of English Literature.
 CHARLES P. SIGERFOOS, Ph. D., Assistant Professor of Animal Biology.
 CHARLES H. HINTON, M. A., Assistant Professor of Mathematics.
 LOUIS J. COOK, M. D., Director of the Gymnasium.
 RICHARD BURTON, Ph. D., Lecturer on Development of English Novel.

INSTRUCTORS.

CHARLES M. ANDRIST, M. L., French and German.
 FRANK MALOY ANDERSON, M. A., History.
 LLOYD B. AUSTIN, B. A., Rhetoric.
 CHARLES P. BERKEY, Ph. D., Mineralogy.
 EMMA BERTIN, French.
 FLORA E. BREWER, B. L., Latin.
 AMELIA I. BURGESS, Drawing.
 ALBERT I. CALAIS, B. es L., French.
 HENRIETTA CLOPATH, Drawing.
 HENRY A. ERICKSON, B. E. E., Physics.
 OSCAR W. FIRKINS, B. A., Rhetoric.
 HARLOWE S. GALE, B. A., Psychology.
 ULYSSES S. GRANT, Ph. D., Geology.
 EVERHART P. HARDING, M. S., Chemistry.
 ARTHUR A. HELLER, B. S., Botany.
 LOUISE G. KILHLE, Physical Culture.
 WILLIAM F. KUNZE, B. S., Chemistry.
 JENNINGS C. LITZENBERG, B. S., Gymnastics.
 HOPE McDONALD, B. S., History.
 FRANK L. McVEY, Ph. D., Political Science.
 EDWARD E. NICHOLSON, B. S., Chemistry.
 OSCAR W. OESTLUND, M. A., Animal Biology.
 ALBERT PFAENDER, B. L., German.
 HENRY A. SANDERS, M. A., Latin.
 FREDERICK W. SARDESON, Ph. D., Paleontology.
 IDA SCHON, German.
 JOSEPHINE E. TILDEN, M. S., Cryptogamic Botany.
 HELEN A. WILDER, Rhetoric.
 ALICE YOUNG, B. L., English.
 ANTHONY ZELENY, M. S., Physics.

ASSISTANTS.

BURT L. NEWKIRK, B. A., Astronomy.
 HANNAH R. SEWELL, M. A., Political Science.

SCHOLARS.

LAURENCE E. GRIFFIN, Animal Biology.
 ERNEST C. PEITHMAN, Philosophy.

A statement showing receipts and disbursements of this department for the years 1897 and 1898:

1897—Disbursements.....	\$85,672.44
Receipts.....	10,713.60
Net cost.....	\$74,958.84
1898—Disbursements.....	\$85,418.24
Receipts.....	8,802.95
Net cost.....	\$76,615.29

The College of Engineering and the Mechanic Arts.

FACULTY.

CYRUS NORTHROP, LL. D., President.

OFFICERS OF THE DEPARTMENT OF CIVIL ENGINEERING.

WILLIAM R. HOAG, C. E., Professor of Civil Engineering, in Charge of Road and Sanitary Engineering.
FRANK H. CONSTANT, C. E. Professor of Structural Engineering.

OFFICERS OF THE DEPARTMENT OF MECHANICAL ENGINEERING.

HARRY E. SMITH, M. E., Assistant Professor of Mechanical Engineering in charge of Experimental Engineering and Shop Work.
H. WADE HIBBARD, A. B., M. E., Assistant Professor of Mechanical Engineering in charge of Machine Designs and Railway Mechanical Engineering. (Resigned).
JAMES H. GILL, M. E., Instructor in Iron Work.
JAMES M. TATE, Instructor in Carpentry, Pattern and Foundry Practice.

OFFICERS OF THE DEPARTMENT OF ELECTRICAL ENGINEERING.

GEORGE D. SHEPARDSON, A. M., M. E., Professor of Electrical Engineering.
FRANK W. SPRINGER, B. E. E., Instructor of Electrical Engineering.

OFFICERS OF THE DEPARTMENTS OF ENGINEERING AND MECHANICS, AND MATHEMATICS.

HENRY T. EDDY, C. E., Ph. D., LL. D., Professor of Engineering and Mechanics.
ARTHUR EDWIN HAYNES, M. S., M. Ph., D. Sc., Professor of Mathematics.

OFFICERS OF THE DEPARTMENT OF PHYSICS.

FREDERICK S. JONES, M. A., Professor of Physics.
ANTHONY ZELENY, M. S., Instructor in Physics.
HENRY A. ERICKSON, B. E. E., Instructor in Physics.

OFFICERS OF THE DEPARTMENT OF CHEMISTRY.

CHARLES F. SIDENER, B. S., Assistant Professor of Chemistry.
GEORGE B. FRANKFORTER, M. A., Ph. D., Professor of Chemistry.

OFFICERS OF THE DEPARTMENT OF DRAWING AND INDUSTRIAL ART.

WILLIAM H. KIRCHNER, B. S., Assistant Professor of Drawing.
AMELIA I. BURGESS, Instructor in Freehand Drawing.
NELLIE S. TRUFANT, Instructor in Freehand Drawing.
HENRIETTA CLOPATH, Instructor in Freehand Drawing.

TENTH BIENNIAL REPORT

OTHER DEPARTMENTS GIVING INSTRUCTION.

CHRISTOPHER W. HALL, M. A., Professor of Mineralogy.
 CHARLES P. BERKEY, Ph. D., Instructor in Mineralogy.
 JOHN G. MOORE, B. A., Professor of German.
 CHARLES D. BENTON, Litt. D., Professor of French.
 HARRY A. LEONHAEUSER, Lieut. U. S. A., Professor of Military Science.
 FRANCIS P. LEAVENWORTH, M. A., Professor of Astronomy.
 WILLIAM S. PATTEE, LL. D., Lecturer on Contracts and Torts.

HARRY W. DIXON, Engineer.
 JOHN F. CATES, Engineer.
 WILLARD W. DAKIN, Instrument Maker.

SPECIAL LECTURERS.

The following lecturers have contributed to this course during the past year:

Wm. I. GRAY, B. E. E., Electrical Engineer and Contractor. Minneapolis. 220 volt lighting plants.
 EDWIN REID, Superintendent National Conduit & Cable Company, New York. Underground wires and cables.
 O. B. PLAYTER, with Fairbanks, Morse & Co., St. Paul. Arrangement of electric plants.
 A. D. MEEDS, City Gas Inspector, Minneapolis. The manufacture and testing of illuminating gas.
 CAPTAIN FREDERICK V. ABBOTT, U. S. A., St. Paul. Coast defenses.
 A. B. CHOATE, Minneapolis. The state aid law.
 A. C. BEYER, Minneapolis. Pen pictures of New York.
 E. E. WOODMAN, St. Paul. Economics of railway transportation.

A statement showing receipts and disbursements of this college for the years 1897 and 1898:

1897—Disbursements.....	\$22,463.21
Receipts.....	1,224.36
Net cost.....	\$21,238.85
1898—Disbursements.....	\$18,609.16
Receipts.....	2,644.70
Net cost.....	\$15,964.46

The School of Mines.

OFFICERS.

CYRUS NORTROP, LL. D., President.

OFFICERS OF THE DEPARTMENT OF MINING AND METALLURGY.

WILLIAM R. APPLEBY, M. A., Professor of Metallurgy.
 FREDERICK W. DENTON, C. E., Professor of Mining.
 PETER CHRISTIANSON, B. S., B. E. M., Instructor in Metallurgy.
 EUGENE C. MILLS, E. M., Instructor in Mining.

OFFICERS OF THE DEPARTMENT OF GEOLOGY AND MINERALOGY.

CHRISTOPHER W. HALL, M. A., Professor of Mineralogy and Geology.
 CHARLES P. BERKEY, M. S., Instructor in Mineralogy.

OFFICERS OF THE DEPARTMENT OF CHEMISTRY.

GEORGE B. FRANKFORTER, Ph. D., Professor of Chemistry.
 CHARLES F. SIDENER, B. S., Assistant Professor of Chemistry.
 EDWARD E. NICHOLSON, M. A., Assistant Professor of Chemistry.
 EVERHARD P. HARDING, M. S., Instructor in Chemistry.

OFFICERS OF THE DEPARTMENT OF ENGINEERING AND MECHANICS, AND MATHEMATICS.

HENRY T. EDDY, Ph. D., Professor of Engineering and Mechanics.
 ARTHUR E. HAYNES, M. S., M. Ph., D. Sc. Professor of Mathematics.

OFFICERS OF THE DEPARTMENT OF ELECTRICAL ENGINEERING.

GEORGE D. SHEPARDSON, M. A., M. E., Professor of Electrical Engineering.
 FRANK W. SPRINGER, B. E. E., Instructor in Electrical Engineering.

OFFICERS OF THE DEPARTMENT OF MECHANICAL ENGINEERING.

HARRY E SMITH, M. E., Assistant Professor of Mechanical Engineering.

OFFICERS OF OTHER DEPARTMENTS GIVING INSTRUCTION.

FREDERICK S. JONES, B. A., Professor of Physics.
 WILLIAM H. KIRCHNER, B. S., Assistant Professor of Drawing.
 HARRY A. LEONHAEUSER, Lieut. U. S. A., Professor of Military Science and
 Tactics.
 JOHN ZELENY, B. S., Assistant Professor of Physics.

A statement showing receipts and disbursements of this department for the years 1897 and 1898:

1897—Disbursements	\$9,762.38
Receipts	816.24
Net cost.....	<u>\$8,946.14</u>
1898—Disbursements.....	\$9,834.96
Receipts.....	1,763.14
Net cost.....	<u>\$8,071.82</u>

The College of Agriculture.

THE FACULTY.

CYRUS NORTHPROP, LL. D., President.
 WILLIAM M. LIGGLTT, Dean.
 SAMUEL B. GREEN, B. S., Professor of Horticulture.
 OTTO LUGGER, Ph. D., Professor of Entomology.
 HENRY W. BREWSTER, Ph. D., Professor of Mathematics.
 HARRY SNYDER, B. S., Professor of Agricultural Chemistry.
 T. L. HAECKER, Professor of Dairy Husbandry.
 M. H. REYNOLDS, M. D., V. M., Professor of Veterinary Medicine and Surgery.
 WILLET M. HAYS, M. S. Professor of Agriculture.
 THOMAS SHAW, Professor of Animal Husbandry.

NOTE.—The instruction not given by the faculty of the college of agriculture is given by the faculty of the college of science, literature and the arts.

Statement showing receipts and disbursements of this college for the years 1897 and 1898:

1897—Disbursements.....	\$32,426.83
Receipts.....	3,205.45
Net cost.....	<u>\$29,221.38</u>
1898—Disbursements.....	\$34,576.27
Receipts.....	5,462.38
Net cost.....	<u>\$29,113.89</u>

The College of Law.

FACULTY.

CYRUS NORTHROP, LL. D., President.
 WILLIAM S. PATTEE, LL. D., Dean, Department of Contracts and Equity Jurisprudence.
 A. C. HICKMAN, A. M., LL. B., Department of Pleading and Practice.
 JAMES PAIGE, A. M., LL. M., Department of Domestic Relations, Partnership and Agency.
 EDWIN A. JAGGARD, A. M., LL. B., Department of Torts and Criminal Law.
 HENRY J. FLETCHER, ESQ., Department of Property.
 HOWARD S. ABBOTT, B. L., Department of Corporation Law.
 RANSOM J. POWELL, LL. B., Librarian.

LECTURERS.

HON. CUSHMAN K. DAVIS, M. A., St. Paul, Minn. (U. S. Senator.) Special Lecturer on International Law.
 GEORGE B. YOUNG, LL. B., St. Paul, Minn., (Ex-Associate Justice of the State of Minnesota. Conflict of Laws.
 CHARLES A. WILLARD, LL. B., Minneapolis, Minn. Bailments.
 HON. JAMES O. PIERCE, Minneapolis, Minn., (Ex-Judge of the Circuit Court of Memphis, Tenn.) Constitutional Jurisprudence and History.
 HON. C. D. O'BRIEN, St. Paul, Minn. Criminal Procedure.
 CHARLES D. ELLIOTT, Ph. D., LL. D., Minneapolis, Minn., (Judge of District Court of Hennepin County.) International Law.
 HON. JOHN DAY SMITH, LL. M., Minneapolis, Minn. American Constitutional Law.
 HON. HIRAM F. STEVENS, St. Paul, Minn. Trusts.
 T. DWIGHT MERWIN, A. B., St. Paul, Minn. Law of Patents.
 FRANCIS B. TIFFANY, LL. B., St. Paul, Minn. Criminal Law.
 HERBERT R. SPENCER, Duluth, Minn. Admiralty Law.
 A. D. KEYES, Faribault, Minn. Insolvency.
 JOHN COCHRANE SWEET, LL. M., Minneapolis, Minn. Mortgage Foreclosure
 CHARLES E. BOND, LL. M., Minneapolis, Minn. Instructor in Justice Court Practice.
 FREDERICK V BROWN, Minneapolis, Minn. Chattel Mortgages.
 ROBERT S. KOLLINER, LL. B., Minneapolis, Minn. Sales.

Statement showing receipts and disbursements of this college for the years 1897 and 1898:

1897—Receipts.....	\$12,754.20
Disbursements.....	12,468.35
Net gain.....	\$ 285.85
1898—Receipts.....	\$16,336.82
Disbursements.....	14,887.55
Net gain.....	\$ 1,449.27

The College of Medicine and Surgery.

THE FACULTY.

- CYRUS NORTROP, LL. D., President.
 PARKS RITCHIE, M. D., Dean and Professor of Obstetrics.
 THOMAS G. LEE, B. S., M. D., Professor of Histology and Embryology.
 GEORGE A. HENDRICKS, M. S., M. D., Professor of Anatomy.
 RICHARD OLDING BEARD, M. D., Professor of Physiology.
 CHARLES JOHN BELL, B. A., Professor of Chemistry.
 HENRY MARTYN BRACKEN, M. D., L. R. C. S., Edin., Professor of Materia Medica, Therapeutics and Clinical Medicine.
 CHARLES H. HUNTER, A. M., M. D., Professor of the Theory and Practice of Medicine.
 EVERTON J. ABBOTT, A. B., M. D., Associate Professor of Practice and Professor of Clinical Medicine.
 J. W. BELL, M. D., Professor of Physical Diagnosis and Clinical Medicine.
 ALBERT E. SENKLER, M. D., Professor of Clinical Medicine.
 CHARLES A. WHEATON, M. D., Professor of Practice of Surgery.
 FREDERICK A. DUNSMOOR, M. D., Professor of Operative and Clinical Surgery.
 JAMES H. DUNN, M. D., Professor of Genito-Urinary Diseases and of Clinical Surgery.
 JAMES E. MOORE, M. D., Professor of Clinical Surgery.
 JUSTUS OHAGE, M. D., Professor of Clinical Surgery.
 ARTHUR J. GILLETTE, M. D., Professor of Orthopedia.
 A. B. CATES, A. M., M. D., Clinical Professor of Obstetrics.
 FRANK FAIRCHILD WESBROOK, M. A., M. D., C. M., Professor of Pathology and Bacteriology.
 J. CLARK STEWART, B. S., M. D., Professor of Surgical and Clinical Pathology.
 ALEX J. STONE, M. D., LL. D., Professor of Diseases of Women.
 AMOS W. ABBOTT, M. D., Clinical Professor of Diseases of Women.
 A. McLAREN, A. B., M. D., Clinical Professor of Diseases of Women.
 JOHN F. FULTON, Ph. D., M. D., Professor of Ophthalmology and Otology and Hygiene.
 FRANK C. TODD, M. D., Clinical Professor of Ophthalmology and Otology.
 C. EUGENE RIGGS, A. M., M. D., Professor of Nervous and Mental Diseases.
 W. A. JONES, M. D., Clinical Professor of Nervous and Mental Diseases.
 _____, Professor of Diseases of Children.
 MAX P. VANDERHORCK, M. D., Professor of Diseases of the Skin.
 W. S. LATON, M. D., Professor of Diseases of the Nose and Throat.
 CHARLES LYMAN GREENE, M. D., Professor of Clinical Medicine and Clinical Professor of Physical Diagnosis.
 HENRY L. STAPLES, A. M., M. D., Professor of Clinical Medicine and Instructor in Medical and Pharmaceutical Latin.
 ARTHUR SWEENEY, M. D., Professor of Medical Jurisprudence.
 CHARLES ERDMANN, M. D., Demonstrator of Anatomy.

CORPS OF CLINICAL PROFESSORS AND INSTRUCTORS.

- J. E. SCHADLE, M. D., Clinical Professor of Diseases of the Nose and Throat.
 BURNSIDE FOSTER, M. A., M. D., Clinical Professor of Diseases of the Skin.
 JOHN T. ROGERS, M. D., Clinical Instructor in Surgery.
 HERBERT W. DAVIS, M. D., Clinical Instructor in Obstetrics.
 GEORGE L. COON, M. D., Clinical Instructor in Genito-Urinary Disease.
 JAMES T. CHRISTISON, M. D., Clinical Instructor in Diseases of Children.
 GEORGE D. HEAD, B. S., M. D., Instructor in Pathology.
 H. C. CAREL, B. S., Demonstrator of Chemistry.
 C. NOTHNAGLE, M. D., Instructor in Clinical Medicine.
 WINFIELD S. NICKERSON, Sc. D., Instructor in Histology.
 M. RUSSEL WILCOX, M. D., Demonstrator of Physiology.
 E. BATES BLOCK, M. D., Demonstrator of Pathology and Bacteriology.
 J. WARREN LITTLE, M. D., Demonstrator of Operative Surgery.
 GEORGE SENKLER, M. D., Clinical Instructor in Physical Diagnosis.
 A. W. DUNNING, M. D., Clinical Instructor in Nervous and Mental Diseases.

CLINICAL AND LABORATORY ASSISTANTS.

- M. W. GLENN, M. D., Assistant in Clinical Medicine.
 A. E. BENJAMIN, M. D., Assistant in Gynecology.
 R. E. CUTTS, B. S., M. D., Assistant in Clinical Medicine.

E. P. WRIGHT, M. D., Assistant in Surgery and Dermatology.
 G. EDMUND SMITH, M. D., Assistant in Surgery.
 S. E. HOWARD, M. D., Assistant in Clinical Medicine.
 R. A. CAMPBELL, M. D., Assistant in Diseases of the Nose and Throat.
 MARGARET L. NICKERSON, M. A., Assistant in Histology.
 HELEN B. NUZUM, M. D., Assistant in Clinical Obstetrics.
 CHARLES W. HACK, M. D., Assistant in Practical Anatomy.
 CHARLES R. BALL, M. D., Assistant in Nervous and Mental Diseases.
 HARRY P. RITCHIE, Ph. D., M. D., Assistant in Gynecology.

UNIVERSITY SCHOLARS GIVING INSTRUCTION AND ASSISTING IN LABORATORIES.

A. W. SHAW, W. E. HARTSHORNE, Ph. B., Anatomy.
 W. H. CONDIT, B. S., A. E. WILLIAMS, A. B., FRED HUXLEY, Bacteriology
 and Pathology.
 J. H. BURGAN, Dispensary.
 H. H. HAZLETINE, Materia Medica.
 LAURA A. LINTON, B. S. Physiology.
 *CARL HUHNS, B. A., A. W. SHAW, Surgical Pathology.

Statement showing receipts and disbursements of this department for the
 years 1897 and 1898:

1897—Disbursements.....	\$27,735.49
Receipts.....	22,192.40
Net cost.....	\$ 5,543.09
1898—Disbursements.....	\$31,403.46
Receipts.....	21,898.32
Net cost.....	\$ 9,505.14

College of Homeopathic Medicine and Surgery.

THE FACULTY.

CYRUS NORTHROP, LL. D., President.
 ALONZO P. WILLIAMSON, LL. B., M. D., Dean, and Professor of Mental and
 Nervous Diseases and Medical Jurisprudence.
 WILLIAM E. LEONARD, A. B., M. D., Professor of Materia Medica and Thera-
 peutics
 GEORGE E. RICKER, A. B., M. D., Professor of Clinical Medicine and Physical
 Diagnosis.
 ROBERT D. MATCHAN, M. D., } Professors of Principles and Practice of
 THOMAS J. GRAY, M. D., } Surgery.
 WARREN S. BRIGGS, B. S., M. D., } Professors of Clinical and Orthopædic
 MARSHALL P. AUSTIN, M. D., } Surgery.
 B. HARVEY OGDEN, A. M., M. D., Professor of Obstetrics
 EUGENE L. MANN, A. B., M. D., Professor of Diseases of Nose, Throat and Ear.
 FREDERIC M. GIBSON, M. D., O. et. A. Chir., Professor of Ophthalmology.
 GEORGE E. CLARK, Ph., B., M. D., Professor of Theory and Practice of Medicine.
 GEORGE F. ROBERTS, M. D., } Professors of Diseases of Women.
 EDWARD E. AUSTIN, M. D., }
 HARRY M. LUFKIN, M. D., Professor of Diseases of Children.
 THOMAS J. GRAY, M. D., Professor of History and Methodology of Medicine.
 ROBERT R. ROME, M. D., Professor of Clinical Obstetrics.
 ASA F. GOODRICH, M. D., Professor of Skin and Genito-Urinary Diseases.

*Deceased.

Instruction in the following branches is received in common with the students of the other colleges in the department of medicine.

GEORGE A. HENDRICKS, M. S., M. D., Professor of Anatomy.
 RICHARD O. BEARD, M. D., Professor of Physiology.
 CHARLES J. BELL, A. B., Professor of Chemistry.
 JOHN F. FULTON, Ph. D., M. D., Professor of Hygiene.
 THOMAS G. LEE, B. S., M. D., Professor of Histology and Embryology.
 F. F. WESBROOK, M. A., M. D., C. M., Professor of Bacteriology and Pathology.
 J. CLARK STEWART, B. S., M. D., Professor of Surgical Pathology.
 H. L. STAPLES, M. A., M. D., Instructor in Latin.
 EDWARD M. FREEMAN, B. S., Instructor in Botany.
 JAMES F. BECK, M. D., Instructor in Minor Surgery.
 ALBERT E. BOOTH, Dispensary Assistant.

Statement showing receipts and disbursements of this department for the years 1897 and 1898:

1897—Receipts.....	\$3 315.65
Disbursements.....	2,103.03
Net gain.....	\$1,212.62
1898—Receipts.....	\$3,267.09
Disbursements.....	1,844.35
Net gain.....	\$1,422.74

The College of Dentistry.

FACULTY.

CYRUS NORTROP, LL D., President.
 THOMAS E. WEEKS, D. D. S., Professor of Operative Dentistry and Crown and Bridge Work.
 WILLIAM P. DICKINSON, D. D. S., Professor of Therapeutics and Clinical Professor of Operative Dentistry.
 THOMAS B. HARTZELL, D. M. D., M. D., Professor of Pathology and Oral Surgery.
 OSCAR A. WEISS, D. M. D., Professor of Prosthetic Dentistry and Orthodontia.

OTHER INSTRUCTORS.

GEORGE A. HENDRICKS, M. S., M. D., Professor of Anatomy.
 RICHARD O. BEARD, M. D., Professor of Physiology.
 CHARLES J. BELL, A. B., Professor of Chemistry.
 THOMAS G. LEE, A. M., M. D., Professor of Histology and Embryology.
 HENRY M. BRACKEN, M. D., Professor of Materia Medica.
 FRANK F. WESBROOK, M. A., M. D., C. M., Professor of Bacteriology and Pathology.
 HENRY L. STAPLES, A. M., M. D., Instructor in Medical and Pharmaceutical Latin.
 FRANK R. WRIGHT, D. D. S., M. D., Lecturer on Anesthesia and Chief of Anesthetic Clinic.
 ALFRED OWRE, D. M. D., M. D., C. M., Instructor in Metallurgy and Operative Dentistry.
 MARY V. HARTZELL, D. M. D., Instructor in Dental Anatomy.
 H. M. REID, D. D. S., Instructor in Prosthetic Dentistry.

Statement showing receipts and disbursements of this department for the years 1897 and 1898:

1897—Disbursements.....	\$10,108.87
Receipts.....	10,076.00
Net cost.....	\$ 32.87
1898—Receipts.....	\$ 9,860.06
Disbursements.....	8,836.21
Net gain.....	\$ 1,023.85

The College of Pharmacy.

THE FACULTY.

- CYRUS NORTHROP, LL. D., President.
 FREDERICK J. WULLING, Ph. G., B. S., LL. B., Dean, Professor of Pharmacology, Pharmaceutical Chemistry, Pharmacal Jurisprudence and Sanitary Science.
 HENRY M. BRACKEN, M. D., Professor of Materia Medica.
 CHARLES J. BELL, A. B., Professor of Chemistry (General, Medical and Analytical).
 GEORGE B. FRANKFORTER, Ph. D. Professor of Chemistry.
 CHARLES F. SIDENER, B. S., Assistant Professor of Chemistry.
 CONWAY MACMILLAN, M. A., Professor of Botany.
 EDWARD M. FREEMAN, B. S., Instructor in Botany and Practical Pharmacognosy.
 FRANK F. WESBROOK, M. A., M. D., C. M., Professor of Bacteriology.
 GEORGE D. HEAD, B. S., M. D., Instructor in Clinical Microscopy.
 RICHARD O. BEARD, M. D. Professor of Physiology.
 JOHN F. FULTON, Ph. D., M. D., Professor of Hygiene.
 H. L. STAPLES, A. M., M. D., Instructor in Medical and Pharmaceutical Latin.
 B. O. LEUBNER, Ph. M. D., Assistant in Pharmacy.
 H. C. CAREL, B. S., Instructor in Chemistry.

Statement showing receipts and disbursements of this department for the years 1897 and 1898:

1897—Disbursements.....	\$3,789.09
Receipts.....	2,678.70
Net cost.....	\$1,110.39
1898—Disbursements.....	\$3,735.56
Receipts.....	3,683.92
Net cost.....	\$ 51.64

Geological and Natural History Survey.

NEWTON H. WINCHELL, M. A., Geologist of the Geological and Natural History Survey.
 HENRY F. NACHTRIEB, B. S., Zoologist of the Geological and Natural History Survey.
 CONWAY McMILLAN, M. A., Botanist of the Geological and Natural History Survey.
 WILLIAM R. HOAG, C. E., State Topographer.

ASSISTANTS.

ULYSSES S. GRANT, Ph. D., Geological Survey.
 A. A. HELLER, B. S., Botanical Survey.

The disbursements of this department for the years.....	1897.	1898.
	\$9,268.25	\$9,297.87

Experiment Station.

OFFICERS OF THE STATION.

WM. M. LIGGETT, Director.
 WILLET M. HAYS, M. Agr., Agriculturist.
 SAMUEL B. GREEN, B. S., Horticulturist.
 OTTO LUGGER, Ph. D., Entomologist and Botanist.
 HARRY SNYDER, B. S., Chemist.
 T. L. HAECKER, Dairy Husbandry.
 M. H. REYNOLDS, M. D., V. M., Veterinarian.
 THOMAS SHAW, Animal Husbandry.
 ANDREW BOSS, Asst. in Agr., University Farm.
 R. S. MACKINTOSH, Asst. in Hort., University Farm.
 J. A. VYE, Secretary.

SUB EXPERIMENT FARMS. —OFFICERS.

WM. M. LIGGETT, Director.
 T. A. HOVERSTAD, Superintendent at Crookston.
 H. H. CHAPMAN, Superintendent at Grand Rapids.
 WM. G. SMITH, Superintendent at Lynd.

Statement showing receipts and disbursements of this department for the years 1897 and 1898:

1897—Disbursements.....	\$32,140.28
Receipts.....	1,619.78
Net cost.....	<u>\$30,520.50</u>
1898—Disbursements.....	\$32,606.27
Receipts.....	4,933.33
Net cost.....	<u>\$27,672.94</u>

Military Science and Physical Culture.

The disbursements of these departments for the years 1897, \$2,162.13; 1898, \$4,510.13.

The School of Agriculture.

THE FACULTY.

CYRUS NORTHROP, LL. D., President.
 WILLIAM M. LIGGETT, Dean.
 HENRY WEBB BREWSTER, Ph. D., Principal, Mathematics.
 SAMUEL B. GREEN, B. S., Horticulture. Forestry.
 OTTO LUGGER, Ph. D., Zoology, Entomology.
 CHARLES R. ALDRICH, Carpentry, Drawing, Farm Buildings.
 FLORENCE A. BREWSTER, Librarian.
 WILLIAM ROBERTSON, B. S., Physics, Botany.
 J. A. VYE, Penmanship, Accounts.
 HARRY SNYDER, B. S., Chemistry.
 T. L. HAECKER, Dairy Husbandry.
 M. H. REYNOLDS, M. D., V. M., Physiology, Veterinary Science.
 WILLET M. HAYS, M. S., Agriculture.
 THOMAS SHAW, Animal Husbandry.
 J. M. DREW, Blacksmithing, Poultry.
 ANDREW BOSS, Dressing and Curing Meats, Farm Machinery.
 WILLIAM BOSS, Carpentry, Power Machinery.
 ALVIN D. GAINES, A. M., Language, Civics, Music.
 HARRY A. LEONHAEUSER, Lieutenant U. S. A., Military Drill.
 E. W. MAHOOD, M. A., Arithmetic and Athletics.
 JUNIATA L. SHEPPARD, M. A., Cooking, Laundering.
 MARGARET BLAIR, Sewing.
 VIRGINIA C. MEREDITH, Preceptress.

When applying for admission or information, address Dr. Henry W. Brewster, Principal, St. Anthony Park, Minn.

Dairy School.

THE FACULTY.

CYRUS NORTHROP, LL. D., President.
 WILLIAM M. LIGGETT, Dean.
 T. L. HAECKER, Professor of Dairy Husbandry, in charge of School.
 HARRY SNYDER, B. S., Dairy Chemistry.
 OTTO LUGGER, Ph. D., Bacteria in Dairy Products.
 W. M. HAYS, M. S., Forage and Pastures.
 M. H. REYNOLDS, M. D., V. M., Diseases of the Dairy Cow.
 J. A. VYE, Creamery Records and Accounts.
 WM. ROBERTSON, B. S., Care of Boiler and Engine.
 C. R. ALDRICH, Dairy Buildings.
 J. M. DREW, Silo and Stable Conveniences.
 B. D. WHITE, Instructor in Butter Making.
 A. J. GLOVER, Instructor in Cheese Making.
 WM. BOSS, Instructor in Practical Engineering.
 E. W. MAJOR, Instructor in Sweet Curd Cheese Work.
 N. H. FULTON, Assistant in Creamery.
 L. R. HOBART, Assistant in Creamery.
 H. C. HAECKER, Instructor in Dairy Laboratory.

DEPARTMENT OF AGRICULTURE.

This department of the University continues in favor with the agriculturists in all portions of our state. A growing interest is generally noticeable among all classes of our citizens.

The scope of the work of the station and school is being so much enlarged that new buildings, apparatus and equipments are demanded to keep pace with the progress and development which has been marked and continuous since our last report.

More than 10,000 persons have visited the station and school to see what is being done, and to obtain information.

A common feeling pervades the community that generous returns are already being made for money expended for the support of this most prosperous department.

The legislature at its last session made an appropriation of \$25,000 to erect and equip a building for a dormitory for girls. Mr. C. R. Aldrich prepared plans for this building and proposals were invited for its construction.

The following bids were received for the erection of the girls' dormitory:

A. J. Sampson.....	\$24,425
Lovene & Anderson.....	24,812
Charles Skooglun.....	22,886
P. H. Donovan & Son.....	23,265
Angus McLeod Company.....	22,437
George S. Deeks & Co.....	23,640
G. W. Brown.....	22,778
Erick Lund & Son.....	23,831
James Leck.....	21,243
R. McWhelan & Co.....	20,148
H. Dacons & Son.....	20,500
Husby & Whitney.....	23,400
Pike & Cook.....	20,400
B. Cooper.....	23,857
A. F. Wasielewski.....	21,997
*P. W. DeLancy.....	18,950

*The bid of DeLancy included the steam heating.

The following bids were received for steam heating and ventilating the girls' dormitory:

Allan Black.....	\$2,465
Saxton, Phillips & Co.....	2,245
C. E. Hasey.....	2,750
W. F. Porter & Co.....	2,681

P. W. DeLancy's bid, including the steam heating apparatus, and being the lowest contract for the erection of the building, was awarded to him at the price of \$18,950. He performed his contract to the entire satisfaction of the building committee.

The building is 114x55 feet in size and three stories high. It

is constructed of Princeton buff brick with Kasota stone trimmings and slate roof. It contains dormitory and study rooms to accommodate sixty girls, is finished with all the modern improvements and is a most substantial and imposing structure.

HEATING AND LIGHTING PLANT.

At the last session of the legislature an appropriation of \$22,000 was asked for the erection and equipment of a central lighting and heating plant. This sum was found to be the lowest amount for which this plant could be finished, and was the estimate of the architect.

The legislature, however, appropriated \$18,000, obliging us to leave out necessary portions of the plant. The building is 69x96 feet, one story high with basement. It is built of red mold brick and stone trimmings with iron and wood roof. It contains a boiler room 65x32 feet, engine room 30x25 feet, mechanical lecture room 25x30 feet, a small work shop for repairs and an office for the engineer. Two 100 horse-power return boilers are set in place with a 200 horse-power iron smoke stack. There is also a large amount of steam piping. An 80 horse-power engine is provided for electric light power. In order to erect this plant with all its equipment, the most rigid economy was necessary. More than 100 bids were received for furnishing the different parts of the work. The cheapest material had to be used in order to keep within the appropriation.

It is to be regretted that the \$22,000 asked for was not allowed for this building. To come within the appropriation granted, it was necessary to leave all the tunnels to the buildings northeast of the power house uncompleted, to reduce the boiler capacity to a point where satisfactory results can not be obtained in very cold weather, and to substitute an iron for a brick smoke stack.

An appropriation of \$10,000 should be made to complete the tunnels in which the steam pipes are laid, to furnish more boiler capacity, and for the erection of a brick chimney.

The school of agriculture has made rapid and satisfactory progress since our last report. The attendance has steadily increased. The summer school for girls has been merged into a system of co-education made possible by the appropriation for the girls' dormitory. Thus far co-education at the agricultural school has been a pronounced success. The number of girls enrolled the first year was 32. The number of girls enrolled the second year was 53.

Mrs. Virginia C. Meredith, of Cambridge City, Ind., was engaged as preceptress; Miss Juniata L. Sheppard as instructor in cooking and laundering; Mrs. Margaret Blair as instructor in sewing; Miss Mary L. Bull, of Edina Mills, as assistant to Miss Sheppard; and Miss Elizabeth Biery as assistant to Mrs. Blair.

The legislature at its last session appropriated \$7,000 for the establishing of co-education at the school of agriculture. In order to continue the system of co-education, which is giving very general satisfaction throughout our state, we would most respectfully ask that a standing appropriation of \$5,000 be made for its support.

The attendance in the entire department of agriculture for the last two years has been as follows:

	1896-7	1897-8
College of Agriculture.....	14	23
School of Agriculture, Summer term.....	70	65
School of Agriculture, Winter term.....	265	312
Dairy school.....	91-440	84-493
	<hr/>	<hr/>
Less duplicates.....	6-434	13-470

At the experiment stations, experiments are carried on in chemistry, human foods, food experiments, horticulture, forestry, plant disease, plant, and animal breeding, feeding, diseases of animals, veterinary, entomology and dairying. Over 250,000 copies of regular and press bulletins have been issued and distributed free since the last biennial report.

On July 28, 1897, the barn at the Crookston station was struck by lightning and totally destroyed by fire. The loss was \$5,508.50. The barn cost \$3,775. The contents were valued at \$1,733.50. Insurance to the amount of \$3,000 was carried on the barn; the contents were not insured.

Charles R. Aldrich, architect, was instructed to draw plans for a new barn, and bids were invited for its construction.

The following bids were received:

P. W. DeLancy, Minneapolis.....	\$3,250
Mr. Syoerson, Crookston.....	3,678
Marian & Nolan, Crookston.....	3,710
Thomas Husby, St. Anthony Park, 30 feet wide.....	2,890
“ “ “ “ “ 32 feet wide.....	2,990

Mr. Husby as the lowest bidder was awarded the contract at \$2,990, and he completed the barn to the satisfaction of the building committee on November 1st, 1897.

The equipments for this barn, amounting to \$1,645.85, were purchased and paid for out of the appropriation made by the leg-

islature of 1897 for the support of the station for the years 1897-1898.

The experiment work being done at these stations is developing a great interest among the people of the section of the state where they are situated.

THE DAIRY SCHOOL.

Minnesota is now recognized as one of the leading dairy states of the Union. More than 200 new creameries have been built since our last report, and are now in successful operation. The total number of creameries in the state exceeds 600. The influence of this school upon the dairy industry cannot be overestimated. Young men and women are given a course of practical instruction which, upon completion, enables them to successfully operate either a cheese factory or a creamery. This school has enrolled 522 students since its beginning.

DEPARTMENT OF GEOLOGICAL AND NATURAL HISTORY.

Professor N. H. Winchell, who has had charge of the geological survey for the past 26 years, presents his final report in manuscript.

With the publication of this report the geological part of the survey will be closed. This report embraces thirty-three geological maps or plats representing the counties and several specially important areas in the north one-third of the state. The entire Mesaba Range is mapped in detail in sections, and its entire extent is also shown in one general map. The Vermillion Lake area occupies a special plat, as does also the vicinity of Duluth and the vicinity of Carleton. The entire Lake Superior shore line is also mapped in detail on two plats from Duluth to Pigeon Point. A chapter is devoted to commercial and other industrial features of the iron ore of the state. There is also a mass of detailed descriptive matter dealing with rocks and minerals. About 2,000 rocks from this section have been examined with the microscope.

The report embraces a discussion of the general structural geology, and of the relations which the rocks and formations bear to each other both genetically and chronologically.

This final report contains an index to all earlier annual reports by which it is possible to consult any of the reports on specified subjects without loss of time.

Professor Winchell has prosecuted this great work for twenty-six years. He commenced in the southeast county of the state in

1872 and has diligently and faithfully made a thorough examination of every county in the state. We have heard at times some criticism about the length of time taken in completing this survey and of the expense made in its prosecution by Mr. Winchell. In justice to him we find upon investigation that he has done the work economically, and upon comparing the work done by him in this state with similar work done in Wisconsin, Illinois, Ohio and New York we find that the work done in this state has taken much less time, and has been done at about one-half the cost.

The character of the work done in Minnesota has also been equal to that done in other states. The funds from which this department has been conducted are derived from the sale of the Salt Spring lands. As the sale of these lands has been slow, the available funds on hand at times have been such that both the time and expense in doing the work have been thereby increased.

Professor Winchell has issued four reports covering two-thirds of the state. This last manuscript covering the balance of the state will be published in two volumes. These volumes will be of great interest to the people, not only of this state, but of other states, as they contain much information not only of educational value but also of commercial and industrial value.

This will close the geological part of the survey, but the natural history department of the survey will be continued and reports made from time to time.

THE BOTANICAL DIVISION OF THE SURVEY.

Since the last report of the regents more than 25,000 specimens of plants have been added to the herbarium. It has been impossible to secure, with the present force of assistants, the proper mounting of these, although the work has been and now is being prosecuted with diligence. Twenty-three specimens not previously known to grow within the boundaries of Minnesota, and eight species new to science, have been secured. General field work has been suspended. The energies of the botanist have been devoted to the work of displaying the collections of the enormous accumulations of the past ten years. This work is not finished, but is progressing rapidly.

ZOOLOGICAL DIVISION OF GEOLOGICAL SURVEY.

The work of this division of the survey has been largely suspended during the two years past for want of funds with which to prosecute it. A number of valuable donations, however, have increased the museum collections. Mr. G. A. Clark, of California,

a University Alumnus, presented a family of the Alaska fur seal; these have been mounted and placed in the museum. The moose presented by R. G. Brooks has been mounted and placed in the museum and a fine mounted beaver has been presented by Hon. Alphonso Barto. A valuable donation of birds has also been received.

The game law as at present enacted has been quite an obstruction to obtaining zoological specimens. It is hoped the present legislature will modify this law so as not to hinder the prosecution of the zoological work.

The work upon fishes has been continued. The preliminary work on fishes compiled by Mr. Cox and published in March, 1897, has been heartily received in all parts of the state and many persons desire to obtain the final report when issued.

The work on reptiles has been begun by Charles Zeleny.

The final report on birds of Minnesota will be ready this winter for publication. This is a most interesting report. Much inquiry is being made relative to it from all parts of the state. It is hoped to publish an edition of 3,000 copies during the winter.

CRIPPLED AND DEFORMED CHILDREN.

Pursuant to the provisions of Chapter 289, Laws of 1897, the Board of Regents has undertaken the labor of caring for crippled and deformed children as provided therein. An earnest effort has been made to carry out the provisions of the law and to give to the children of poor people the benefit and advantage contemplated by it.

After a very careful examination of all the hospitals in St. Paul and Minneapolis by our committee, and after receiving bids from each of them, a contract was entered into with the Board of Control of the City and County Hospital of St. Paul by the terms of which the Board of Control agrees to set apart a ward in its hospital for the exclusive use of the children who may be received under the provisions of the law, and to provide and care for them as patients are ordinarily provided and cared for in first class hospitals, including nurses' attendance, food, washing, bandages and medicines, in fact everything that the children need except physicians' attendance and braces or mechanical appliances. The Board of Regents pays the Board of Control for the services above mentioned \$3.75 per week for all children between two and twelve years of age, and \$4.50 per week for children between twelve and sixteen years. These prices we consider very reasonable and we

have found our arrangement with the Board of Control very satisfactory. The children have been well cared for and the Board of Control has now fitted up a separate building on its hospital grounds for the exclusive use of the children under our charge, thus removing them from any contact with the hospital proper and the patients therein.

Rules and regulations for the purpose of determining what children are eligible for admission to the hospital under the provisions of the law, and to aid persons who desire to make application, and providing for the care and treatment of children while in the hospital and for their discharge when cured have been adopted by this Board. These rules have been printed and copies have been distributed among the physicians throughout the state and are sent to all persons making inquiry about the work or making application for admission of children.

The work was actually begun in the hospital and the first child received on October 16th, 1897. Since that date and up to December 1st, 1898, thirty-five applications for admission have been received, of which twenty-eight have been granted and seven rejected. Twenty-six children have been received and treated at the hospital. What has been done for these children will fully appear from the annual report of the surgeon in chief. It seems to us quite probable that as the hospital and its work become better known the number of patients will increase rapidly.

Under the law above mentioned \$5,000 a year for two years was appropriated for this work. Of this amount only the sum of \$2,147.82 has been expended up to December 1st, 1898. This amount is distributed as follows:

Board of control for hospital service.....	\$1,984.56
Artificial limbs, braces, etc.....	126.36
Printing, stationery and postage.....	36.90

This board has appointed Dr. Arthur J. Gillette, St. Paul, surgeon in chief of the hospital, and Dr. James E. Moore, of Minneapolis, consulting surgeon. Both of these gentlemen have given their time and services to the children under our charge cheerfully without any compensation. We feel it our duty to make special mention of Dr. Gillette's services. He has done the greater part of the work, as we think, with great skill and success. So enthusiastic and devoted has he been to these poor children who are temporarily wards of the state, that no private patients in any hospital have had better care and attention than

they. And all of this has been done, as we have said, without any pecuniary compensation whatever.

Inasmuch as many of the children will be detained in the hospital a considerable length of time, from six months to two years or even longer, it is desirable that they be provided with such instruction as may be suited to their physical and mental conditions. This feature of the work has not yet been fully developed. No teacher has been employed, but the board has availed itself of the services of Miss Antionette Choate of St. Paul, which have been rendered gratuitously. Nothing more than very simple instruction in Kindergarten work and singing has been attempted up to the date of this report.

As to the future of this work, we would say that in our judgment it ought to be continued by the state through some agency. There are, no doubt, many hundreds of children in Minnesota suffering from various deformities such as club feet, hip disease, spinal disease, and dislocation of joints, most of which can not only be remedied, but entirely cured under the care of a competent orthopedic surgeon having at his command suitable hospital facilities, braces, mechanical appliances, etc. Few people appreciate what modern science has been able to accomplish in this direction. And this can be done without any considerable pain or suffering to the child. On the contrary the child is in most instances relieved from pain as soon as the treatment commences. If these children are taken while young they may be saved from the terrible misfortune of going through life as cripples and hunchbacks; and instead of being helpless paupers and beggars they may become respectable self-supporting citizens. It is difficult to imagine a more humane or a more profitable work in which the state could engage or to which it could devote a small part of its revenue.

The work of carrying out the provisions of the law above mentioned is entirely foreign to the duties of the Board of Regents in the management of the University. The legislature saw fit to assign to the Board the duty of inaugurating and carrying on the work for two years. It was no doubt regarded as an experiment. We have made an earnest effort to give it a fair trial and to expend the money placed at our disposal economically, and solely for the purpose for which it was intended. We now present the results of our labors and if the legislature at its coming session shall be able to find some other agency through which the state can carry on this work we shall be much pleased.

The chairman of the Medical Department has devoted much time in perfecting arrangements for the care of these unfortunate children. He is entitled to the thanks of the Board and the gratitude of all those who are more closely interested in these children for the services which he has rendered.

WANTS.

The continual increase in the number of students for the past few years, and the consequent demand upon the Regents for new buildings, equipments, apparatus, etc. is the strongest evidence that the people of this state appreciate the necessity of a finished education for their children. They are earnestly awake to the importance of having them avail themselves of the great advantages which the University of Minnesota is furnishing in this respect.

The Regents have met the demands as far as possible with the funds placed at their disposal by the legislature, but the wonderful growth in all respects has been so rapid that with all the generosity of the legislature in making appropriations, we find the present facilities wholly inadequate to accommodate the present attendance, which has already reached in round numbers 2,900.

The Department of Physics and Chemistry.—Eight years ago when the present building occupied by the departments of chemistry and physics was erected, it was thought of sufficient size to accommodate the attendance for at least the next 20 years. The development, however, has been so great that we find the building insufficient in size to accommodate the two departments longer and in order to satisfy the pressing demand upon us, the entire building must be devoted to the development of chemistry as originally intended.

A new building should be provided at once for the Physical Department, one of the most important departments of the University and which has steadily grown in great favor throughout our state. The department is fully equipped with apparatus so that we only ask for an appropriation of \$25,000 with which to erect a building of sufficient size for its accommodation.

In separating these departments and erecting a new building for the Physical Science, it will become necessary to put the chemistry building in shape for the accommodation of that department. To do this will require the sum of \$20,000. An appropriation of \$20,000 for this purpose is asked.

Department of Botany.—The departments of botany, animal biology, geology and mineralogy, drawing, mining and metallurgy, and the geological and natural history survey and the museum are all conducted under one roof—Pillsbury Hall. The building is not large enough to accommodate all of these without crippling the efficiency of each.

The erection of a building to accommodate one of these departments would largely relieve the rest. To that end a building should be erected for the department of botany. As at present housed in Pillsbury Hall, the department of botany has laboratory space for but fifty students. Ten years ago, when plans were made in Pillsbury Hall for this department, there were but forty study students pursuing the study of botany. To-day there are 420. No department in the University has as small a percentage of floor space in proportion to number of students as this.

The herbarium connected with this department is exceeded in number of specimens and value by only four in America, and contains more than 200,000 specimens; a library of the value of \$15,000 has also been accumulated in this department by purchase and a system of exchanges. At present this valuable herbarium and library are exposed to loss by fire as Pillsbury Hall is not fire proof.

We recommend the erection and equipment of a fire proof building for the department of botany at an estimated cost of \$55,500.

Library.—Workmen cannot do good work without proper tools, and the library of an institution of learning is to its students what the tool chest is to the mechanic. The library of the University of Minnesota is one of the most important parts of the institution and is now protected in an appropriate fire proof building. To keep it in repair and up-to-date, and in touch with the progress in all branches of science, literature and the arts, a fund should always be at its command to rebind the old and to buy the new and expensive works which are constantly being published. We recommend that a standing appropriation of \$10,000 be made for the library.

Repairs.—It has been the custom in the past to pay all repairs on buildings out of the current expense fund. When one remembers that there are now some twenty-six buildings, mostly of large size, in which it is necessary to constantly repair the steam pipes, plumbing, re-kalsomine and paint, put in new floors, renew

the blackboards, set glass, buy new and repair the old furniture, replace the grate bars, rebind books, supply help for cleaning, and do a hundred other necessary things, it is not hard to understand why this custom should no longer be continued. A separate fund should be provided for this purpose. We ask an annual appropriation of \$10,000.

Heating Plant on the Campus.—The present heating plant is inadequate to supply heat for the large number of buildings now upon the campus. The construction of new buildings, especially the Armory and Pathological building, since this heating plant was erected makes it necessary to enlarge the present plant and to add several boilers in order that the buildings which are now on the campus and which will be from time to time erected, may be properly heated during all seasons of the year. For this purpose an appropriation of \$10,000 is asked.

Lighting Plant.—There are no facilities at the present time at the University to properly light the various buildings. It is possible by cutting off this and that building to furnish some particular building with abundance of light, but it is impossible to furnish light for all buildings at the same time. It is therefore necessary that \$10,000 should be appropriated for constructing an additional lighting plant.

Mechanics Art.—The department of Mechanical Art has outgrown its present quarters, but the present building can be enlarged by adding a wing. This will meet the requirements of the department for some time. This will cost \$20,000.

An appropriation is asked for this purpose.

Medical Department.—It is now seven years since the present building was erected for this department. The department of dentistry, of clinics, and the dispensary occupy portions of this building, and with other departments so over-crowd it that all work is done under unfavorable circumstances. It is well understood that no medical department is complete without clinical facilities. Great complaint has been made by the students over the unsatisfactory conditions under which clinics are conducted at our University. This department and the dispensary may be placed in one building, and for the purpose of relieving the over-crowded condition of the present medical building, we urge upon the legislature the construction of a new building for clinics and the dispensary.

The construction of such a building will allow ample room

for the department of dentistry in the quarters made vacant.

The importance of supplying the medical department with ample facilities for clinics and for the dispensary cannot be over-estimated. \$35,000 is therefore asked for a new building to be occupied by clinics and the dispensary.

The medical department is also in need of a house for the dead. The requirements of the department have entirely outgrown the present quarters. An appropriation of not less than \$10,000 is asked for the construction of an anatomical laboratory.

Horticultural and Physics Hall.—The buildings which have been occupied for years past by the horticultural department at the School of Agriculture are very inferior in their appointments, but the department has managed to get along up to this date. The increase in attendance, the development of the department and the greater interest now taken in horticulture throughout the state, requires that a new building should be constructed.

At a meeting of the State Horticultural Society held in Minneapolis in the month of December, 1898, a resolution was adopted recommending an appropriation by the legislature of \$35,000 for constructing and equipping a building for horticulture at the Agricultural School. We therefore ask for an appropriation of \$35,000 for this purpose.

Veterinary Department.—Very poor quarters have been furnished the department of veterinary science, and the buildings occupied at present are illy adapted to the purposes of the department and are entirely insufficient for its requirements. This will be clearly understood when it is known that the present building was formerly a barn. To make the department what it ought to be requires an appropriation of \$25,000, which we believe will be sufficient to construct and equip a suitable building.

The main building, portions of which were erected in 1857 and 1873, is now very much out of repair. New floors must be laid, re-plastering, papering and painting must be done; a new tin roof must be furnished, and many other necessary repairs made, the estimated cost of which is \$5,000. We would most respectfully ask that an appropriation for this amount be made that the building may be put in good condition.

SUMMARY.

A tabulated statement of the appropriations desired is as follows:

Physical laboratory.....	\$25,000
Chemistry.....	20,000
Library (annual).....	10,000
Repairs (annual).....	10,000
Enlargement heating plant.....	10,000
Lighting plant.....	10,000
Mechanics art.....	20,000
Botany.....	55,000
Anatomical building.....	10,000
Clinical building and dispensary.....	35,000
Horticultural hall and physical laboratory.....	35,000
Veterinary.....	25,000
Heating plant at school of agriculture.....	10,000
Repair of main building.....	5,000

CONCLUSION.

We cannot expect that the growth of the institution hereafter will be equal to its growth in the past, but it must be remembered that the population of our state is rapidly increasing and the people are better able to educate their children now than when the state was in its infancy and the people were poor. It would seem reasonable for us to expect an attendance of 3,500 students at the University within a reasonable time; this will probably be the maximum attendance. When we have made accommodations for that number our demands for buildings ought to cease and we will not be coming to the legislature for further appropriations for that purpose.

We have now placed before the legislature the needs of the University which are imperative. They are by no means all the improvements which should be made to fully accommodate the various departments of the institution. We do not present these requests as our choice but because we feel that it is our duty to do so in order that the people of the state may know the requirements of the institution, and the students be properly accommodated, and in order that none of our youth who desire an education may be turned away.

While we are not unmindful of the generosity of the legislature in the past and do not wish to clamour for appropriations, we feel that the appropriations which we now ask are not only absolutely necessary but are small compared to the real necessities of the University. The needs have been cut as far as possible. If the state had been more prosperous during the past few years we would feel like asking for more liberal appropriations.

We are prone to look upon Minnesota merely as one of the

states of the Union without considering the extent of her area, the fertility of soil, the inexhaustable mines, the varieties of building stone, the virgin forests, the heathful climate and topographical beauty. The 83,000 square miles of territory within her boundary, would, if it could be set down on the New England states, completely cover them and lap over one-half of New York. Of this vast territory, not more than one-seventh is now under cultivation. The balance with its rich soil, and primeval forests and fresh water lakes, awaits the coming of man. In 1850 the population of the state was only 6000. Two score and ten years have passed and 2,000,000 souls enjoy life within her limits. The assessed value of property has sprung from \$36,000,000 in 1860 to \$615,000,000 in 1898. In 1860 there was not a foot of railroad in the state. To-day railroads cross and re-cross from all sides carrying the product of her soil and the finished output of her manufacturing plants to every part of the nation. The mining and shipping of iron ore from the Vermillion and Mesaba ranges have built up a gigantic industry at the head of the Great Lakes. The amount of wheat raised, hay cut, crops harvested within her limits, and the quantity and quality of her butter and cheese product, when looked upon through the light of the past, seem more like fiction than truth.

The people who have made all this possible have come to us from every state and from nearly every country on the globe. They have assimilated our customs and ways of living and system of government. They have intermarried and from them is being formed a new race, the true American.

It is in this development of the commercial, educational and social parts of the state that the University of Minnesota seeks to take a stand on the most advanced ground. Already her influence has been most marked. Her students have gone forth into every walk of life, as lawyer, doctor, editor, minister, and to the farm, the mechanic's shop and the school house to mould and shape the destiny of our people. In the advancement and enlightenment of her people, the state has been paid a hundred fold for all the outlay of money. This is not the time to weary of the good work. The University of Minnesota to-day is in distress not because of misfortunes, but because of unexpected success. Her buildings are overcrowded, many of her corps of instructors are underpaid, and yet the clamor for admittance and for an education goes on.

A state is great because of the enlightenment of her people, not because of her affluence.

We earnestly ask the legislature to lend a willing ear to our appeal for all the appropriations we ask. For it is only by granting them that the institution can furnish the education to the youth of our state which they and the welfare of the commonwealth demand.

Respectfully submitted,

J. S. PILLSBURY,
President of the Board of Regents.

REPORT OF THE PRESIDENT
OF THE
UNIVERSITY OF MINNESOTA.

*To the Honorable John S. Pillsbury,
President of the Board of Regents.*

Dear Sir: I have the honor to submit my biennial report of the University of Minnesota for the two academic years ending July 31st, 1898.

During these years the University has been in a prosperous condition; all the colleges have made progress in the extent and methods of work, and nearly all have had more students than ever before. In a few of the departments, it has been difficult to meet the wants of students, on account of the overcrowding of laboratories, but the best has been done under the circumstances, and the readiness of professors and instructors to adapt themselves to the situation and to make any reasonable sacrifice of convenience in order to accommodate the students has been very helpful. As a result it is believed that the work of instruction has not suffered materially in any department, though in one, at least, it has been carried forward with undesirable difficulties.

The number of students enrolled in the year 1896-97 was 2,467; in 1897-98, 2,890. This is an increase in the two years of 423. The increase of the two preceding years was 639. The wise regulations governing the admission of "unclassed students" and demanding on their part as much preparation as is required of the regular students, and the reduction in the number of conditions allowed have tended to diminish the number of applicants as well as of admissions, and the result has been very wholesome. Very few students can now be found in the University who have not come here with serious purpose of study, and the standard of scholarship in the institution, both theoretical and natural, has in consequence been raised. In all departments at the present time the number of students who, by reason either of lack of abil-

ity or lack of industry, require the special discipline of the Faculty as an incitement to better work, is smaller than it has been before in recent years.

The faculty has been strengthened by a number of additions and I think it has not been weakened by any of the changes which have occurred. The courses of study have been increased and in most of the departments it is possible now for students to pursue a much wider range of investigation than ever before.

The faculty of the University at the close of the college year 1897-98 numbered 186, distributed as follows:

College of Science, Literature and Arts.....	66
College of Engineering and Mechanic Arts.....	25
School of Mines.....	6
College and School of Agriculture.....	20
College of Law.....	8
College of Medicine and Surgery.....	48
College of Homeopathic Medicine and Surgery.....	28
College of Dentistry.....	16
College of Pharmacy.....	16
	233
Duplicates.....	47
	186

The foregoing statement does not include 16 lecturers in the Law Department nor 12 clinical assistants in medicine.

Since my last report degrees have been conferred as follows:

FIRST DEGREES.

	1897.	1898.
Bachelor of Arts.....	26	18
Bachelor of Science.....	46	57
Bachelor of Literature.....	37	40
Civil Engineer.....	4	7
Mechanical Engineer.....	6	5
Electrical Engineer.....	8	8
Mining Engineer.....	3	6
Chemical Engineer.....	4	..
Bachelor of Agriculture.....	2	1
Bachelor of Laws.....	42	98
Doctor of Medicine.....	67	17
Doctor of Dental Medicine.....	28	14
Doctor of Pharmacy.....	8	12

SECOND DEGREES.

Doctor of Philosophy.....	3	1
Master of Arts.....	6	5
Master of Science.....	7	9
Master of Literature.....	4	4
Master of Laws.....	19	10
	Totals.....	312
	320	312

THE COLLEGE OF SCIENCE, LITERATURE AND ARTS.

The faculty of this college consists of twenty-three professors, thirteen assistant professors, and thirty lecturers and instructors. The subjects embraced in this curriculum are Greek, Latin, German, French, English, Hebrew, Arabic, Sanskrit, Scandinavian, and Romance Languages, Political Science, Sociology, Physics, Botany, Chemistry, Animal Biology, Psychology, Logic, History, Pedagogy, Mathematics, Astronomy, Geology, Mineralogy, Paleontology, Drawing, Literature, Rhetoric, Elocution, Military Science and Tactics and Physical Culture.

The number of students in this college in 1896-97 was nine hundred nine; in 1897-98 nine hundred thirty-four.

The department of Political Science has been in charge of Dr. William W. Folwell during the last fourteen years. Only during the last two years has he had any assistance in the work of instruction. At the beginning of the year 1896-97, Dr. Frank L. McVey was engaged as an instructor, and in 1898 he was promoted to the position of assistant professor. He has had charge of the instruction in the junior class, and of a portion of the work with graduates. Dr. McVey, to use the language of Dr. Folwell which I heartily indorse, "has proved himself a capable teacher, and sets the example of a judicious, conservative, earnest man." Dr. Folwell has continued to have charge of the seniors and of most of the graduate instruction. It is his opinion that the graduate work "will remain crippled and handicapped until large additions are made to its literature." This department is a very important one, on account of the practical character of the subjects taught and the very general interest of students in these subjects. Considering the number of students in our University and the wide range of subjects covered by the department, the teaching force is particularly small and it ought to be increased at the earliest practicable moment. Whenever a definite policy of expansion shall have been decided on by the department, I shall be happy to recommend an increase of the teaching force to meet the needs of the changed conditions.

The following table shows the undergraduate courses in this department as given term by term in the biennial period, the numbers of sections and numbers of students attending:

Year	Term	Class	NAME OF COURSE.	No. of Sections	No. of Students
1896-97	I	Sen.	Economic Schools and Movements...	1	58
		Jun.	Political Economy.....	3	100
	II	Sen.	International Law.....	1	57
		Jun.	Politics.....	3	87
	III	Sen.	American Public Economy.....	1	59
		Jun.	Industrial History.....	2	56
1897-98	I	Sen.	The Law and the Constitution.....	1	45
		Jun.	Political Economy.....	3	81
	II	Sen.	International Law, ½ term.....	1	50
			Money and Banks, ½ term.....	1	51
	III	Jun.	Politics.....	3	79
		Sen.	American Public Economy.....	1	36
		Jun.	Industrial History.....	2	37

The department of Geology and Mineralogy, in charge of Professor Christopher W. Hall, with Dr. Berkey and Dr. Sardeson as assistants, finds it necessary to ask for a special appropriation for equipment, in consequence of the development of new methods of research in recent years. This is further made necessary by the advanced courses offered to students desiring to specialize and by the demands made by the three professional courses in which Geology with Mineralogy is an important fundamental branch. Professor Hall was granted a leave of absence during the year 1897-98 and spent the year in Leipzig in Geological work. During his absence Dr. Berkey had charge of the department. Dr. Ulysses S. Grant, of the Geological Survey, assisted in the work of instruction.

The work in Mineralogy has been greatly developed through the efficient aid of Dr. Berkey. New courses have been added to the curriculum and the facilities of the department for high scientific work have been considerably increased.

In Paleontology a year's work has been opened by Dr. Sardeson which promises to be most helpful to those who aim to take advanced work in Geology, as well as to those students of biology who desire to investigate the historical phase of their science.

An important accession to the material equipment of the department is the acquisition of the Sardeson Collection of Paleozoic fossils. This collection, embracing a large amount of material collected by F. W. Sardeson in the states of Minnesota, Iowa, Illinois, Indiana, Ohio and Wisconsin during the past several years, contains more than three thousand entries in the Museum catalogue of the department and between thirty and forty

thousand good specimens. While it is in a sense local and representative of only a part of the Geological series, the collection is believed to be one of the best of its kind in the United States. Dr. Sardeson is constantly at work upon it, adding new material and making more accurate the identification of Genera and species.

The department of Botany under the care of Professor Conway McMillan, reports 362 students engaged in Botanical study the past year.

The department staff consists of one professor, one assistant professor, one instructor, two scholars and one paid assistant.

The library of the department includes 2,379 bound volumes and 7,770 pamphlets. During the biennium there have been added 692 bound volumes and 4,020 pamphlets.

During 1897-98 the additions to the herbarium were 14,970 specimens, during 1898-99, 10,590, making a total of 25,560, representing a value of \$2,556.00. The whole herbarium includes upward of 200,000 specimens.

Large additions of alcoholic collections have been made during the biennium and over 400 jars have been filled with material for laboratory and museum purposes.

Four hundred forty-four pages of *Minnesota Botanical Studies* have been issued, the first volume has been completed and fully indexed and the second volume begun. About 40 papers and books have been issued during the biennium by members of the staff including Professor MacMillan's ecological volume on *Distribution of Plants along shore*, Assistant Professor MacDougal's "*Living Plants and their Properties*" in collaboration with Professor Arthur of Purdue University, Instructor Heller's "*Checklist of North American Plants*" and Miss Tilden's Vol. III of "*American Algae*."

Vacation Work.—During the biennium all members of the staff have spent their vacations in University work. Professor MacMillan devoted one summer to the collection of government books in England for the University library and another to botanical research in the British museum. Assistant Professor MacDougal devoted the summer of 1897 to researches in Jamaica pursuant to the establishment of a Tropical Botanical Station, and the summer of 1898 to the study of plant life in the desert-region of Arizona where he made collections for the University. Instructor Heller devoted the summer of 1897 to collection of plants in New Mexico, Miss Tilden spent both summers in the Puget Sound

country and shipped large collections for the museum and the herbarium. The summer school was conducted by Instructor Ramaley during 1897 and by Professor MacMillan during 1898, who returned from abroad for that purpose earlier than he would otherwise have done.

General Retrospect.—The biennium just past has been the most successful one in the history of the department. Classes have been large and enthusiastic. Work has been thoroughly systematized and has been carried forward in all directions with true University spirit. The researches emanating from the department have received high commendation from the scientific centres both at home and abroad and the students generally have expressed themselves uniformly as thoroughly gratified with the instruction given them, the advantages offered them and the atmosphere around them. If the Botanic Institute building so urgently required be erected it will be possible to hold all of the advantages that have been gained and to continue the solid development that has been begun.

The Department of Philosophy has been strengthened the present year by the appointment of Norman Wilde, Ph. D., of Columbia University, as Instructor in Philosophy. The Department now consists of the professor in charge, two instructors, and two graduate scholars assisting, one in the Psychological Laboratory and the other in the other branches of the department. The number of undergraduate students has increased 50 per cent. during the past two years, and the number of graduate students in residence has more than doubled. During the same period one student has received the Doctor's degree and three have received the Master's degree with their major work in the Department; one has received the Doctor's degree and eight the Master's degree with minor work in the Department.

In the Department of Physics during the last two years, the laboratory equipment has been increased so that all students are now required to take laboratory practice in connection with class-room work and lectures. Six instruments of each kind have been procured, making it possible to work twelve students in a division. This necessitates many divisions, and provision should be made for ten instruments, or twenty men in a division.

A number of additions to the stock of apparatus should be noted. Especially an X Ray outfit; also valuable additions to the departmental library.

The underground cables running from the new power house

to St. Paul prove a source of disturbance and all electrical and magnetic instruments in the laboratory will require to be shielded from these external influences. At present satisfactory work cannot be done.

The physical lecture room has been provided with a set of shutters worked by an hydraulic press and is now the best appointed lecture room on the campus.

Professor Zeleny, who has been studying in Europe, will return next fall and will relieve the pressure of class and lecture work which has embarrassed the department. His success in Cambridge justifies the expectation that he will render the department much more effective even than it is at present.

The Department of French, at the head of which is Professor Charles W. Benton, had 357 students in its classes the first term of last year; 328 the second term, and 273 the third term. In addition to classes in French, Professor Benton had Seminars in Old French, in Dante and in Spanish. Mr. Calais, who was an instructor in French the last two years, tendered his resignation at the close of the last College year to engage in work in New York. His resignation was accepted and Dr. Albert Schinz was subsequently elected in his place.

The very important Chair of English Language and Literature, formerly held by Dr. George E. McLean, at present Chancellor of the University of Nebraska, was most happily filled in the year 1898 by the election of Dr. Richard Burton, a gentleman well known as a writer of both prose and poetry. Dr. Burton, before his appointment to the Chair of English, gave a course of twenty lectures at the University. The popularity of these lectures was shown by audiences that crowded the Chapel, and at the conclusion of the course there was no doubt in the minds of the faculty as to his fitness for the Chair of English. His acceptance is an occasion for congratulation to all friends of the University.

The department of German has lost the services of Fraulein Marie Schon, and of her sister who succeeded her, both of them having returned to Germany. The place has been filled by the appointment of Carl Schlenker, an instructor in the University of Iowa.

The department of Rhetoric, by reason of the unlimited work which may be done in it and the wide diversity of attainments in scholars as preparation for its work, is always and everywhere a difficult one to manage. If efforts are concentrated on the

special culture of a few students and those the best, a good showing may be made on special occasions but the mass of students will be neglected. If the efforts are spread equally over the whole number of students, the impression made and the culture given can not but be inadequate. Professor Sanford has been indefatigable in her work, and there has been improvement in the general character and efficiency of the work. There is a marked increase of interest among the students in debating and oratory, and I hope that something like the interest which was felt in these subjects many years ago, but which for the last quarter of a century at least has existed to a much less degree in nearly all colleges, may again be excited. I am sure that the department of Rhetoric will do all it possibly can to bring this about, and I hope that all the other departments of the University may assist by stimulating thought and by emphasizing the value of the power to express one's thoughts effectively. No work in the University requires the hearty sympathy and encouragement of the entire faculty more imperatively than the rhetorical work.

In the department of Latin some changes of interest have occurred in the past two years. The course in the required work has been made more complete by an additional term of required Latin. In junior and senior years several courses have been added, some of them general and others intended to prepare students for special lines of work. The work of the Seminar has become more efficient, the result largely of a "Seminar room" and library.

The most important change is the fuller development of the graduate courses and work.

Instead of offering several independent and individual courses, each year's work comprises what may be termed a field of study and in this field several interdependent courses are offered.

This year the subject is Roman History. In this field one instructor gives a course based upon Livy; another, a course based on Tacitus, while a third instructor gives a course based on Suetonius. The advantages of this change in the graduate work are already apparent.

In the Department of Animal Biology, under the care of Prof. H. F. Nachtrieb, Charles P. Sigerfoos accepted the call to an assistant professorship in 1897. His coming has materially strengthened the Department and has made possible the extension of the two terms course in physiology to a three terms course. With the present facilities it is, however, still impossible

to do justice to this subject or even meet the demands actually made for work in this line.

The collection of bird skins, eggs and nests have been arranged and catalogued under the supervision and through the generosity of Dr. Thomas S. Roberts, one of our former students and an authority on the ornithology of the Northwest.

Mr. G. A. Clark, of the class of '91, presented a fine family of the Alaskan Fur Seal to the University. The valuable group was mounted by Ward, of Rochester, N. Y., and is now on exhibition in the museum.

The Orinoco Company Limited, through the kindness of Dr. C. E. Rogers and several of our former students, presented a collection of South American snakes and lizards to the University. This collection was received but a few weeks ago, and has not yet been arranged for exhibition.

The Department of Chemistry has been ably conducted by Professor Frankforter and his assistants. The laboratories are overcrowded and the lecture room is too small for the comfort or health of the students. Two years ago I called special attention to the need of larger quarters for the department, and I hope that suitable quarters may be provided the coming year. No other requirement seems to be more pressing than this.

The department of Physical culture under Miss Louise Kiehle is intended for ladies only. In the fall of 1896 there were 183 students enrolled, and the present year the enrollment is 235. A year of physical culture is required of freshmen, and a credit is allowed for a second year's work. In 1896 there were 19 students taking a second year's work, in 1897 there were 39, and the present year there are 78.

The department was moved in the fall of 1897 into new apartments in the Armory, where it enjoys a commodious class-room, a pleasant parlor and office and convenient baths and dressing rooms.

The plan of work among the young ladies differs somewhat from that pursued in many Universities. I quote from Miss Kiehle's report :

"First. We require no change in dress, believing that clothing ought to be made to fit the wearer's needs and should not hamper or restrict bodily freedom. To this end the young women are quietly urged to make such changes in their clothing as they must see are needed. We find a gradual improvement along this line which is very encouraging. Another reason for not changing the

ordinary dress is the loss of valuable time, and still another is the influence the inartistic regulation gymnasium costume must have upon the wearers, many of whom can ill afford to sacrifice the aesthetic even for an hour a day.

"Second. Our work is done without apparatus of any sort. The plan is to develop the body along natural lines without forcing the development of any one part. The vital centre of the body is the part that must contain the greatest strength and power, and other parts must be trained only in relation to that fundamental centre. The development of the chest for strength and flexibility is of foremost importance.

"Tests of skill and strength play no part in the work, the aim of the training being to develop the body in a normal way, so that it may rightly perform the duties it has to perform through life. Foremost among these are standing and sitting, the carriage of the body in walking and in going up and down stairs.

"It has been our aim to interest the young women in various subjects connected with their physical culture work. To this end they receive from day to day short talks upon such subjects as *walking, breathing, ease, strength, beauty, dress, food, care of the body, pleasure*, etc. A number of books placed upon the reserve shelves and drawn from frequently by the students also add much to the general interest.

"We plan to so interest the young women in their work that they may form the habit of taking ten or fifteen minutes of exercise at home each day in addition to their class room work. During the present year fully three-fourths of the students in the physical culture classes are working at home also. The success of this plan is shown when we meet students who have been out of the University for some time who say that the habit of exercise is so well established that they expect to take their systematic exercise each day, just as they expect to take their bath.

"Twice each year, in the fall and again in the spring, physical examinations are made and a few important physical measurements taken of each student. We do not go into this matter of physical examinations as extensively as many do, but plan to spend a short time with each student, the greatest importance of it all lying in the fact that the student's attention is brought strongly to bear upon her own body. This often stimulates an interest which was before wanting. Two of the most important measurements taken are those of *height* and *chest expansion*. Some of the most desirable improvements can not be measured

by any instrument, namely those of ease, freedom of self consciousness, a harmony in the movement of the various parts of the body, a lessening of the nervous tension, etc.

"We endeavor not to call attention to various physical defects and deficiencies unless positively necessary, believing that the individual who overcomes a weakness by general training is stronger afterwards than he who is habitually conscious of his condition.

"An important extension of the work was begun last year in the introduction of sports and pastimes. These include such games as basket ball, Newcomb battle ball and other ball games, also running games of various kinds, many of which are taken from the German. The young women are allowed to form themselves into teams and classes at any hours when the room is not in use for the enjoyment of these recreative sports. An instructor meets with them to direct and encourage them. The games offer an opportunity for free and exhilarating play and afford a nerve stimulus not obtained in regular systematic exercise. The complete abandon and the opportunity offered also for free and decisive action is a matter of great importance.

"It remains to improve the work of the department still further in the future as some facilities now wanting shall be supplied."

THE DEPARTMENT OF PHYSICAL CULTURE FOR MEN.

The need of systematic exercise and physical training for the students became so apparent in the winter of 1897, that a temporary equipment of apparatus was provided and a gymnasium was opened in the Armory, February 1st, 1897. Dr. L. J. Cooke was engaged to give a part of his time to the supervision of the work till the close of the year. The experiment proved successful, and many students availed themselves of the privileges and instruction of the gymnasium, although the work the first year was optional. At the beginning of the next year, Dr. Cooke was engaged to take permanent charge as director. All young men of the freshman class were required to exercise in the gymnasium two hours a week from Dec. 1st, to April 1st, and students of the Sophomore class had the choice in the second term of gymnasium work in place of military drill. The attendance the second year was double that of the first year. The number exercising in class or taking special work was about 300. The total number using the gymnasium was about 600.

The character of the work given in the gymnasium has been primarily for promotion of health and the development of the body. The hour of required work has been divided into two periods—thirty minutes for body-building work, and thirty minutes of educative work. The educative exercises have been graded according to the needs of the individual. A fair standard of judging the real value of this work, from the testimony of the students themselves, has been obtained from a series of questions sent to those taking the required work. Of the replies received, the following are the results: To the question, "Has your general health improved, remained about the same or been impaired?" seventy-two per cent replied "improved," twenty-eight per cent "about the same," and none replied "impaired."

To the question, "What effect have you noticed upon your application to studies?" seventy-nine per cent replied "improved," twenty-one per cent "about the same," and none replied "impaired."

To the question, "What effect upon digestion?" sixty per cent replied "improved," forty per cent "about the same," and none replied "impaired."

To the question, "What effect upon respiration?" seventy-seven per cent replied "improved," twenty-three per cent "about the same," and none replied "impaired."

These replies came from students of whom one-third came to the University from the farm, many others spent the summer out of doors, and all were in good health when the fall studies commenced. It will be noticed that the good health of all has been maintained, and 72 per cent testify to a greater excellence of health.

By action of the faculty, all young men are required to take a physical examination at the beginning and at the close of the course of gymnasium work. The object of this examination is to determine the condition of vital organs and the student's fitness for the regular course of exercise; also to determine the deviation from the normal physical proportions as dependent upon a basis of height, and the change in the physique of the student from year to year, and, finally, to diagnose, and prescribe for, any physical defect or ailment that may be benefitted by exercise.

The report of Dr. Cooke giving measurements of class, and showing the improvement after months of exercise, is exceedingly interesting, and demonstrates beyond question the great value of the work.

PUBLICATION OF RESULTS OF RESEARCH.

A university ought to be a place for original research. If the investigations of the members of the various faculties are of any value, there ought to be some convenient way of bringing the results of their labors in a permanent form to the attention of scientists and of the people. The State Universities of Wisconsin, Iowa, Nebraska and Kansas issue bulletins of the character indicated. Our Experiment Station issues bulletins of great value with considerable frequency. There is, however, no provision for the publication of any results of original investigation except in the Experiment Station and the Geological and Natural History Survey. Some provision for the issuing of a regular publication by the University to contain the record of investigations in literature and arts, as well as in science, seems to be very desirable and likely to prove of great value to the state. An annual appropriation of a few thousand dollars for this purpose would be extremely helpful and would enable the University to benefit the state by services whose value would be second only to those rendered in the class rooms.

THE LIBRARY.

The appropriation of six thousand dollars a year for the Library the last few years has been most beneficial. While it has not enabled us to enrich the Library in any one department as much as the highest interests of the department required, it has been a great relief to the current expense fund, has enabled us to keep up to date with the binding of periodicals and the necessary repairs of books, and has made it possible to purchase all the books that seemed to be imperatively demanded for immediate use. I hope that an annual appropriation of \$10,000 may be made for this purpose.

We are still using the provisional card catalogue of authors. Although it has served the main purpose of enabling readers to ascertain what authors and what books are in the Library, this catalogue ought soon to be replaced by a full and complete one. Such a catalogue would render all the resources of the Library immediately available.

The collection of United States documents has been enriched in the last two years by receipts from the Superintendent of Documents, under the "clearing" system in operation in late years. About one thousand volumes have lately been received. In return we have shipped nearly the same number of duplicates here-

tofore encumbering our shelves. In July last 589 volumes of government publications and 208 pamphlets, most of the former in fine leather bindings, were received from Hon. Loren Fletcher—a very welcome gift. The number of volumes presented by the British government, at the instance of Professor McMillan, is 279; of pamphlets, 82. The number of volumes presented by the British museum, also at the instance of Professor McMillan, is 71; of pamphlets, 46. The whole number of bound volumes in all the libraries of the University, general and departmental, is about 60,000. The whole number of volumes donated to the Library in the biennial period is 2051. Progress has been made in the assortment of pamphlets of which large numbers still await cataloguing, classification and arrangement. With the increase of readers and the absence of catalogues, the time of the assistants is now largely occupied in directing students to the material required for their investigation. The patience and intelligence with which this work is done are worthy of commendation. Considering the qualifications required of assistants in the Library and the services rendered, I do not think that the assistants are adequately paid, and I hope the board will, at its earliest convenience, establish a more liberal scale of salaries in the Library.

THE COLLEGE OF ENGINEERING AND MECHANICAL ARTS.

In the spring of 1897 Dean C. W. Hall resigned his office and by vote of the Board of Regents the duties of dean were assumed by the President of the University. Since that time the college has been much more independent, its faculty no longer meeting with the faculty of the college of Science, Literature and Arts, as had been customary before, but having entire jurisdiction over the affairs of the college. The appropriation by the last legislature of twelve thousand dollars for equipment has proved most helpful. Many articles for the want of which the college had suffered have been procured and the work in consequence has been much more satisfactory. Assistant Professor H. Wade Hibbard resigned his office in 1898 to accept a position at Cornell University, and Professor John J. Flather, of Purdue University, was elected professor of Mechanical Engineering. Professor Flather was a graduate of the Sheffield Scientific School of Yale University, and his appointment has proved to be a very fortunate one. The faculty is entirely harmonious, the entering classes are larger than hitherto and the prospect for the future is brighter than ever before. The students in this college now receive at graduation

the full professional degree of Engineer instead Bachelor of Engineering. Under proper regulations, provision has been made for conferring the same degree upon former graduates of the college. Some changes in the curriculum have been made which strengthen the course, especially in Physics and Mathematics.

The professor of Civil Engineering is of the opinion that a two or three term course in Sanitary Engineering should be added soon to the elective courses. It is his intention to devote, in the near future, a year of study to professional preparation for this special work.

A one-term course in highway Engineering has been conducted by the department in response to an emphatic demand in the state for such instruction.

The present interest in good roads in the state seems to justify a liberal extension of this work. A small beginning has been made in the matter of collecting photographs and lantern slides illustrating road machinery, road material, good and bad roads, etc.

The equipment of a laboratory for testing and studying the relative soils and stones of the state for use as road material is necessary for this work.

Two years ago the Department of Structural Engineering asked for \$5,000 with which to equip a structural laboratory. The growing needs of this work, as well as the fact that other technical institutions of equal rank with our own are beginning to recognize the necessity of developing the experimental along with the theoretical side of engineering instruction, seem to justify this request. Thirty-seven hundred and fifty dollars were granted to the Civil Engineering department for the purchase of necessary apparatus and the establishment of a Structural Laboratory.

By mutual agreement between the instructors in this department \$3,000 were allotted to this latter purpose. Of this, \$2,600 has been expended for a 200,000 pound Olson Testing Machine. It was not without much thought that the bulk of this appropriation was expended for a single machine of large capacity. The mechanical testing laboratory contains two excellent small machines of 50,000 pounds and 100,000 pounds capacity respectively. A structural laboratory should be equipped to test the properties of the large pieces actually met with in construction as well as the properties of the material entering into these pieces. There are very few technical colleges which do not possess a machine of at least 200,000 pound capacity, though in but two or three cases is the machine quite so complete and modern as ours.

Moreover, since ours is the only large testing machine in the northwest it is hoped that it may assist in drawing the interest of the engineering public to our college.

The cement laboratory has likewise been practically created anew and is now in excellent condition. The expansion of this work is likewise in accord with the needs of modern structural engineering. Private and public engineering offices are being equipped for this work and nearly every engineering college includes it in its curriculum.

Part of the remainder of the Civil Engineering fund has been expended for field instruments for surveying and railroad work.

The next important step contemplated by this department is the establishment of a hydraulic laboratory and the development of the instruction in hydraulic and sanitary engineering. This also is in accord with the growing needs which civil engineers must meet, especially in the northwest, when new towns and cities are to be supplied with pure water, hydraulic power, and good sanitation.

Our country undoubtedly needs a larger industrial education (of which engineering education is the highest type) which will reduce the ranks of the unskilled and the unproductive, and the discontented, and convert these into useful, sturdy, high minded men, capable of directing the forces of men and nature for the highest material good of the people and country.

The equipment of the department of Mechanical Engineering has been enlarged by the purchase of two hot air pumping engines, a 100,000 testing machine, a 25-horse power transmission dynamometer, a 10-horse power high pressure steam boiler, capable of carrying a steam pressure of 300 lbs. per square inch, a pulsometer pump, several injectors of different makes, a water ram and Pelton water motor, two calorimeters of latest design, three indicators and an apparatus for testing indicator springs and steam gauges by direct steam pressure, a 16 inch screw cutting lathe, and various smaller articles required in the shops. A number of machines have been constructed in the shops which have been of considerable value as illustrating actual machine construction as well as of real use in the subsequent work of instruction. The following may be mentioned as examples:

	Value.
One power hack-saw.....	\$ 25.00
One sensitive drill press.....	35.00
One 100-lb. drop hammer.....	200.00
Part of a pattern maker's lathe.....	50.00
Total.....	\$310.00

The number of students entering the Mechanical Department for instruction has steadily increased, the present Freshman Class being the largest ever entering the department.

The part of the recent legislative appropriation which has been expended so far by the Department of Electrical Engineering has benefited the work in four principal lines. A motor of sufficient power to handle the work of the laboratory satisfactorily has been erected in the laboratory and connected with the power circuit of the Minneapolis General Electric Company, thus obviating much of the difficulty formerly encountered in the operation of a small steam engine of inadequate power. This motor now furnishes power for lighting the armory.

A few laboratory standards have been purchased and set up for use in checking and correcting the various instruments used in the laboratory, thus making it possible to keep the instruments reliable and affording the students the possibility of doing accurate work. As a result, there has been a marked improvement in the work of the students. It is hoped to develop the standardizing laboratory further.

An accurate photometer with necessary accessories has been set up in a well arranged dark room set off from one of the laboratories, enabling students to do more and better work in the measurement of light and in investigations of lighting apparatus. A portable photometer is also available for studying the results actually obtained in the lighting of streets or enclosed areas.

An excellent beginning has been made in securing machinery and apparatus for the experimental study of alternating currents, which are coming into so extensive use for lighting and for transmission of power. Some investigations have already been made which have been of use to the scientific and commercial world, notably in the nature and causes of the disturbances in telephones from lighting and power circuits, and the remedies therefor, and in the design of rotary transformers.

There are a number of lines of electrical engineering which it has not been possible to treat with justice, because of the combined lack of instructors, space and apparatus. More attention should be given to telephony, telegraphy, electro-chemical and electro-metallurgical processes and to the financial and legal aspects of electrical industries. I trust that additional instructing force may be allowed as soon as possible.

At present and for several years past, our laboratory work is greatly interfered with by the fact that we have been compelled

to use our laboratory machinery for lighting various buildings of the University. Especially is this true during the winter term, when the lights are required early in the afternoon, thus practically taking out the best of the afternoon from laboratory purposes. This department is believed to be the only one in the whole University which is required to displace its regular work for the purpose of supplying other departments. Even did this necessity not interfere regularly with the purposes for which the equipment was purchased, the loads thrown upon the machines daily in lighting the armory and, as will soon be required, in helping light the library, overtax the machines so that we daily run the risk of injuring the machines. An appropriation of \$10,000 will be sufficient to put in an outfit large enough to carry the present load with safety and with economy.

SCHOOL OF MINES.

Under the very efficient direction of Professors Appleby and Denton the school of Mines has increased in numbers and in completeness of work. Professor Denton, I very much regret to say, has tendered his resignation, not from any dissatisfaction with his position and work in the University, but because he has received a very attractive offer of the superintendency of a Mine at a much larger salary. He has been an excellent instructor and it will be hard to fill his place. The school has labored under embarrassment on account of limited room, and the faculty have appealed to the Board of Regents most earnestly for relief. I know the reasonableness of their wishes and I hope that, either directly by an appropriation for a building or indirectly by assigning to the school the quarters at present occupied by some other department for which other provision shall be made, the needs of the school of Mines may be met. The large interest of the state in mines and the growing interest likely to be developed in the state and in the country west of Minnesota, make this school an important educational institution and its welfare should be carefully provided for by the board and by the legislature.

THE DEPARTMENT OF AGRICULTURE.

In the spring of 1897, Hon. Wm. M. Liggett was appointed Dean of the department and Director of the Experiment Station. Under his wise and efficient administration the work of all portions of the department, including the College of Agriculture, the School of Agriculture, the Dairy School, the Experiment Stations,

has been carried forward with enthusiasm and success. There has been perfect harmony among the faculty, and the whole force has shown great willingness to co-operate with the Dean in carrying forward the work of instruction and of investigation.

The College of Agriculture has grown in the number of its students beyond expectation. Thirty courses of study are now offered by the Faculty at the Farm, of which twelve must be selected by the students. A demand is arising for graduate work in special subjects, and the professors are ready to meet this demand. Some of the graduates are filling responsible positions in the University and in other states. It is now generally recognized that the course in agriculture is as scientific and as valuable as are the courses offered without special relation to agriculture.

The School of Agriculture has continued its usual rapid growth, has developed new lines of work and has assumed the co-educational form.

The Summer School for Women, successfully maintained for several years, has been discontinued, but instead young women were, October 2nd, 1897, admitted to the regular course of study in the School of Agriculture. During October, 1897, twenty-eight young women were enrolled; during October, 1898, fifty-two. The course of study previously pursued in the school has been enlarged to meet the special need of the new element. In the sciences, young men and women share class work together, while the latter in sewing, cooking, laundering, physical culture, home economy and household art are taught separately in an orderly and scientific manner. An attractive building has been erected for the use of the young women, their social life is guarded and guided along lines which secure refinement of mind and manner, instill a taste for good reading, exalt home ties and strengthen character. This increased scope of plan and work has necessitated the addition of new instructors to the faculty.

Mrs. Virginia C. Meredith, of Cambridge City, Ind., was engaged as preceptress; Miss Juanita L. Sheppard, of Pratt Institute, Brooklyn, as matron and instructor in cooking and laundering, and Miss Mary L. Bull, of Edina Mills, as her assistant; Mrs. Margaret Blair, of St. Anthony Park, as instructor in sewing. In the fall of 1896, Mr. E. W. Mahood, of the Chicago University, was engaged to take charge of the instruction in arithmetic and athletics. At the beginning of the present year, Mr. C. F. Keyes, of Minneapolis, succeeded Prof. A. D. Gaines, who was granted leave of absence, as instructor in language and

singing; Miss Louise G. Kiehle of the University, took charge of the work in physical culture. The attendance for the entire department of agriculture for the last two years has been as follows:

	1896-7
College of Agriculture.....	14
School of Agriculture, summer term.....	70
School of Agriculture, winter term.....	265
Dairy School.....	91—440
	<hr/>
Less Duplicates.....	6—434
	1897-8
College of Agriculture.....	23
School of Agriculture, summer term.....	65
School of Agriculture, winter term.....	312
Dairy School.....	83—483
	<hr/>
Less Duplicates.....	13—470

In reference to the Dairy School, Dean Liggett reports as follows: "Since the establishment of this school dairy industry has made such remarkable growth that Minnesota is now recognized as one of the leading dairy states of the Union, so far as quantity of product is concerned; and, in regard to the quality of our butter, it is unquestionably leading all other states as evidenced by the scores it has won during the past two years in both state and national contests.

"During the past two years some two hundred new creameries have been built, equipped, and are being successfully operated, bringing the number of creameries in the state up to six hundred and fifty. When the last biennial report was made it was estimated that half of the dairy products in the state was manufactured in creameries. Now the product of the creameries is about fifty per cent greater than that of the home dairy. A careful estimate of the annual amount received by patrons of the creameries in this state is \$10,000,000, and the receipts from the home dairy \$6,500,000. During the seven years that the school has been established, 484 students have been in attendance. Of these 180 have been in attendance since the last report. The pure and wholesome milk supply for our cities has become a matter of vital importance, and there is great need for improved methods of handling milk intended for this purpose. To meet this, a milk and cream pasteurizing apparatus has been manufactured especially for our Dairy School and a few advanced students will be given instruction in the process. There is a constant call for information, both from the milk producers and those engaged in manufacture, for information which can be better given by visiting the

creameries and factories and giving instruction to farmers in school houses and town halls. We have met this demand as far as possible. As the time of our Professor of Dairy Husbandry and his helpers is required to give instruction in the school, and in carrying on experimental work, it is not possible to meet all the demands made upon us. To bring the school to its greatest usefulness some provision should be made for a field instructor."

The University has suffered a very great loss in the death of Warren W. Pendergast, which occurred Aug. 26th, 1897. Mr. Pendergast was one of the brightest and most promising graduates of the School and College of Agriculture. He was at the time of his death Superintendent of the Grand Rapids Sub-station. Although only twenty-two years of age, he had shown both in his college work and in his administration of the experiment sub-station, a maturity of judgment, an ability for research, and an originality in planning investigation which gave the fullest assurance not only of unusual usefulness in the development of agriculture, but of most honorable reputation and fame. The entire University most deeply lamented his death and sympathized in the sorrow of his honored father and family.

Mr. Herman H. Chapman, a graduate of the School of Agriculture and of the College of Agriculture, was appointed in 1897 to succeed Mr. Pendergast as superintendent of the Experiment Sub-station at Grand Rapids.

COLLEGE OF LAW.

During the last two years, the College of Law has had a steady and substantial growth in the number of its students, in the number and efficiency of its teaching force, in the enlargement of its library both by way of purchase and donation, and also in its enriched and added courses of study, securing a broader and profounder scholarship in the science of jurisprudence.

During the year ending June, 1896, there were enrolled 371 students in this department of the University, and in the year ending June, 1898, there were enrolled 437. The class graduating in June last was the first to complete the course of three years which is now prescribed for all under-graduates. The lengthening of the course from two to three years has proved in every way beneficial to the students, and helpful to the department by placing it on an equality with the very first law schools in the land, so far as regards the course of study offered its students.

The faculty has also been strengthened by adding to it, during the last two years, several able lawyers who have proved themselves efficient teachers.

During the same period the library has been very materially increased and enriched. One year ago last June, Hon. R. R. Nelson of St. Paul, upon retiring from the federal Bench, donated his valuable library of about fifteen hundred volumes of books and pamphlets to the University for the benefit of the law school. Many of these earlier volumes were used by his father, Samuel Nelson, of the supreme court of the United States. It is a valuable and useful addition to the library, which has now been enlarged to about six thousand five hundred volumes of text-books, reports, and general legal literature.

An additional course of graduate work has been provided by the Regents, leading to the degree of doctor of the civil law. Before the degree can be applied for by any student, he must have received his Bachelor's and Master's degrees, now requiring, at least, a period of four years of study. The object of this additional course is to inspire a broader and deeper scholarship in the ranks of the legal profession, and to induce young men to extend their legal inquiry into the helpful regions of the civil law, and to enrich their legal learning by an extended acquaintance with the constitutional provisions of the leading nations of the earth. The object of this course is not to better prepare men for professional life, in the details of common law and statutory provisions, but to induce those who have the time and the taste for research to enter upon an extended course in the civil law, in political science, comparative jurisprudence, and the philosophy of law in general. Scholarship in these directions is the object of this course, and, by its addition to the courses already provided, ample opportunity is now afforded students to continue their studies, to gratify and refine their tastes, and to attain by years of labor the broadest legal scholarship. Work for about two years of instruction is provided in the subjects named, under the guidance of the faculty, after which the student enters upon the work of preparing a thesis upon which chiefly his degree is to be based, which thesis, in order to be acceptable to the faculty, must be an original contribution to the sum of human knowledge.

THE COLLEGE OF MEDICINE AND SURGERY.

While the history of the Department of Medicine, during the past two years, has been one of satisfactory progress, it records

the loss of more than one man who had well and faithfully served the University.

At the opening of the session of 1896-7, it was apparent that Dr. Perry H. Millard, Dean of the College of Medicine and Surgery, to whose earnest efforts the organization of the department had been largely due, and whose untiring labors had been devoted to its development, was in rapidly failing health. He was granted a prolonged leave of absence, but the relief had been sought too late, and in February, 1897, the Regents and the faculty received the tidings of his death.

Both of these bodies took action at that time which was fitly commemorative of Dean Millard's personal and professional qualities and of his long devotion to the interests of medical education. Upon the foundation which he laid, a school of medicine is being built which is the best record of his worth and work.

During his illness and for some months following his death, the difficult position of acting dean was filled acceptably by Dr. H. M. Bracken. In May, 1897, Dr. Parks Ritchie was chosen by the Board of Regents as Dr. Millard's successor. Dean Ritchie has discharged the duties of this responsible place with entire satisfaction to his colleagues and to the executive of the University. By his energetic and conservative leadership, he has won the respect of his students and the harmonious service and loyal support of his faculty. The late Dr. Millard's place as Professor of Surgery has been filled by the appointment of Dr. Charles A. Wheaton and his professorship of Medical Jurisprudence by Dr. Arthur Sweeney. Dr. Wheaton's previous place in clinical surgery has been taken by Dr. Justus Ohage.

The University has sustained the loss of one of its most scholarly teachers of medicine in the death of Dr. Charles L. Wells, who occupied the chair of Diseases of Children. His vacant post has been filled by the choice of Dr. H. B. Sweetser for the clinical teaching of this branch.

The corps of clinical instructors has suffered in the death of Dr. Robert A. Wheaton, one of the most promising of the younger men of the state.

By his recent removal from the state, the University has lost the valuable services of Dr. Frank Allport as clinical professor of ophthalmology and otology. He has been succeeded by Dr. Frank C. Todd.

Dr. James E. Moore has resigned the chair of orthopedia,

which has been assigned to Dr. Arthur J. Gillette, while Dr. Moore continues his teaching in clinical surgery.

The faculty of the College, while finding itself sufficiently large for executive purposes, has commended to the Board of Regents the policy of maintaining a large corps of clinical instructors. The members of this corps, including some of the younger and most progressive men in the profession, are proving themselves valuable aids to the faculty.

With the increase of the number of medical students, it has been equally necessary to enlarge the staff of laboratory teachers and assistants. The teaching of modern medicine is evolving rapidly in the direction of laboratory and clinical methods; it is becoming essentially practical, even where it remains most didactic. This advance along both these lines means more direct and individual instruction than in the past and necessitates better equipment and a larger number of instructors.

The increasing executive work of the College has made it necessary to second the Dean's services by the appointment of a secretary.

Within the period covered by this report the medical colleges of this department have been in transition from the three years' to a four years' course of study. In effecting this change, they have kept in line with the higher medical institutions of the country. In 1897, the last regular class of the three years' course received the medical degree. In 1898 the transition involved the absence of a regular graduating class, and only a small number of advanced and special students (15) took their diplomas.

The University has entered into a joint agreement with Hamline University by which the entrance requirements of the medical departments of both institutions are enlarged yearly until they culminate in an equivalent to the entrance examinations of other departments of the Universities. While the greater number of the students enter with diploma qualifications, this growing standard of excellence is gradually determining a higher quality in the applicants for admission and is stimulating prospective candidates to secure a better preliminary education.

Numbers are not the safest index to growth; yet it is well to note that these progressive steps have not prejudiced the attendance in the College of Medicine and Surgery. In 1896-7, 222 students were enrolled; in 1897-8, 226; while in the present season 272 have been entered. An increase of twenty per cent. in the income of the College is represented by this added attendance

which means that while the department of medicine, as a whole, has always presented a deficit, the College of Medicine and Surgery is now more than self-supporting.

The executors of Dean Millard's estate, obedient to his expressed wish, presented to the University soon after his death, his large and valuable library of medical works. In view of the minority of one of the heirs, this gift rests in trust with the Board of Regents until such time as it can legally become the property of the State. It has been housed appropriately in the library of the medical department, where students can profit by its use.

COLLEGE OF HOMEOPATHIC MEDICINE AND SURGERY.

The number of students in this college has been smaller the last two years than it was in the two preceding years. It has, however, been slightly larger than the average since the institution opened. Beginning with the year 1888-9, the number of students in the succeeding years in order has been as follows: 13, 8, 15, 21, 23, 17, 33, 31, 32, 27.

The faculty of the college has been very faithful in its work and very harmonious. Dean Williamson has done all that could be done to bring the institution to the notice of the medical profession and of prospective students. The faculty has maintained, at its own expense, a dispensary for the purpose of enlarging the facilities for clinical teaching. It has also paid all the expense of the hospital board and care of the cases used in teaching the students. The amount thus expended by the faculty has varied from \$500 to \$700 a year. This fact is most creditable to the faculty and is proof of their interest in and devotion to the work of the college. It may be fairly asked whether the faculty ought to be expected to meet this particular expense for clinical material.

I do not think it necessary at this time to go into an examination of the causes for the comparatively small attendance of students at this college. Some of the causes are patent. None of them are in any degree discreditable to the faculty or to the college. Dean Williamson has presented to me in an able report his views upon the subject and at some time in the near future I shall ask that the subject receive the special attention of the Board of Regents. But even as matters now are, it is pleasant to know that the clinical material furnished to the students in this college is so abundant and the opportunity to get near the patients is so good, in consequence of the smallness of the number of students,

that a great good comes to the individual student out of what appears to be an evil for the college.

Two changes in the Faculty have been made in the last two years. Dr. Asa F. Goodrich was appointed professor of skin and genito-urinary diseases, and Dr. H. M. Lufkin was appointed professor of diseases of children to fill a vacancy occasioned by the resignation of Dr. Henry H. Leavitt.

THE COLLEGE OF DENTISTRY.

In the summer of 1886, Dean Thomas E. Weeks resigned his position and the duties of dean of the college of Dentistry were assigned by the Regents to the president of the University. Dr. William P. Dickinson, secretary of the faculty, has to a very large extent relieved the president of this added burden by his very faithful and efficient discharge of his duties as secretary and by a general oversight of the college. Dr. Dickinson has been exceedingly careful of the interests of the University in his plans and expenditures. He has been supported in his efforts by his colleagues, who in their several places have done all that could be asked of them in maintaining and advancing the standard of work in the college.

The great need of the college at the present time is more room. The attendance is large. In the nature of the work, there is an impossibility of accommodating a large number of students in a small room, as is sometimes done in didactic work. The attendance would be considerably larger if there were accommodations for all who desire to come. The relief which the college needs may possibly be brought about by giving the college of Medicine and Surgery another building for part of the work and thus enabling the college of Medicine to relinquish a larger part of the present building to the college of Dentistry. If the relief is not brought about in this way, direct relief should be given by erecting a building for a part or the whole of the dental work. In the latter case, the part of the Medical College now used for dental instruction would become serviceable to both of the Medical colleges. I am not in the least strenuous as to which of these colleges is relieved directly and which indirectly; but I can not urge too strongly upon the attention of the Regents the necessity for relief from the present congested condition in the Medical college building.

THE COLLEGE OF PHARMACY.

The prosperity of this college has been marked. The number of students the first year was 35; the number the second year was

50. The following facts are derived from the report of Dean Wulling:

"In 1896-7. First—A brief course in microscopical urinalysis added, under direction of Dr. George D. Head for seniors, has proved popular and useful.

"Second—A course in inorganic pharmaceutical chemistry was extended.

"1897-8. First—Separate courses in *organic pharmaceutical chemistry* and in *quantitative analysis* were instituted under the direction of Prof. Charles J. Bell. These courses were formerly given in the College of Literature, Science and Arts; but were not adapted to students in pharmacy. The present courses are carried on with the needs of pharmacists in view. The change has increased largely the value of the entire course in the College of Pharmacy.

"Second—In *Materia Medica* Dr. Bracken has found it possible to section his classes in such a way that one entire section is made up of pharmacy students. This makes it possible to give the instruction in *Materia Medica* most valuable to pharmacists.

"Third—*Pharmacognosy and Botany*. The resignation of Mr. Ramaley in January, 1898, made it necessary to make slight changes in the courses, but the students did the usual amount of work.

"Fourth—*Homeopathic Pharmacy*. A short course was added to the curriculum under Dean Wulling.

"Fifth—The course in *Dispensary* was lengthened by two weeks.

"Sixth—The work in the Senior Laboratory was extended somewhat to include more pharmacopoeial testing.

"Seventh—Several prominent pharmacists addressed the classes during the year. A course on practical subjects by practical pharmacists is in preparation for the present year.

"*Changes in Faculty*—First—1897-8. The work in organic chemistry and quantitative analysis has been transferred from Prof. Frankforter to Prof. Bell.

"*Second*—Mr. Francis Ramaley, Instructor in Pharmaceutical Botany and Pharmacognosy, resigned in January, 1898, to accept a call to the University of Colorado. Mr. Edward Monroe Freeman was appointed to complete the work in botany. Dean Wulling carried the course in pharmacognosy to its conclusion. In the spring of 1898, Mr. Freeman was appointed to succeed Mr. Ramaley in the work in botany and pharmacognosy.

"*Third*—1896-7 Dr. Geo. D. Head was appointed as Instructor in Clinical Microscopy. (This is an addition to the Faculty.)

"*Equipment*—No equipment to speak of has been added during the past two years excepting for the initial work in organic chemistry and quantitative analysis. Fifty lockers and shelving have been added.

"*Needs*—Of those there are many. Prominent are more room and equipment. The college has thirty-six working tables in the laboratory, when it should have as many as it has students (indications point to an enrollment of sixty this year). There are dispensing tables for four when there should be for at least half as many as there are students."

The University has received a gift of two hundred and fifty dollars from Hon. William J. Bryan, the income of which is to be devoted to an annual prize for the best essay on government.

On the breaking out of war with Spain, a strong disposition was manifested by many students to enter the army. Nearly one hundred did enter the army, and but for the advice not to do so, given by friends who did not see the necessity for large numbers of students to give up their studies when more than enough volunteers could easily be obtained, a much larger number would undoubtedly have enlisted. Of those who entered the service, I regret to say that five have died: Harry L. Currier, a junior in the school of Mines; C. E. Payson Colwell, a junior in the college of Science, Literature and Arts; August Foss, a graduate of the class of 1897; Sidney Pratt, for two years a student in the University, and Fred C. O. Smith, a member of the Sophomore class. *Dulce et decorum est pro patria mori.*

There are many particulars in which the University might be improved if the necessary funds could be provided. It is not my custom to catalogue all the things which are desirable and lay them before the Board of Regents. Recognizing the fact that the board is doing all that it can to promote the best interests of the University, I bring to the notice of the board only those needs which seem to be imperative and which there is some reason to suppose can be met. When the resources at the command of the board shall become large enough to provide for such expansion of work as would be proper for an ideal University, I shall be very glad to specify and recommend many things which would be helpful; but adequate provision has not yet been made for the work as now planned; the Regents have carefully considered the pres-

sing wants which are too numerous to be all supplied at once and in due time the conclusions of the board as to what is most necessary will be presented to the legislature. In the mean time, I shall content myself with administering as faithfully as possible the means which are placed at the disposal of the University.

Very respectfully yours,

CYRUS NORTHROP,

President of the University of Minnesota.

REPORT OF EXPERIMENT STATION.

ST. ANTHONY PARK, MINN.

ST. ANTHONY PARK, Dec. 1st, 1898.

*Hon. John S. Pillsbury, President Board of Regents, Minneapolis,
Minn.;*

My Dear Sir:—I have the honor to present herewith the biennial report of the Experiment Station for the period beginning Aug. 1st, 1896, and ending July 31st, 1898. Reports of the members of the Experiment Station staff are appended giving results of investigations of the Experiment Station during the biennial years.

WM. M. LIGGETT,

Director.

REPORT OF DIRECTOR OF EXPERIMENT STATION.

Our Experiment Station has made great progress since the last biennial report and is recognized as a most useful institution. Our farmers have learned to look to it for advice on many subjects of vital interest.

The station makes new varieties of wheat, corn and of other crops which yield better than those heretofore used. The increased yield per acre of wheat, as our experiments are showing, means more to our farmers than I would care to state at this time. Our agricultural department teaches how to increase the profits of the farm by a proper rotation of crops. It has done much valuable work in the growing of sugar beets, how to plant, cultivate and cost of cultivation. In this connection, I call attention to pages 403 and 411 of bulletin 56.

The entomologist is engaged in different lines of work. Like all members of the station staff he instructs during the winter classes in the college and school of agriculture. He also aids in the control of plant diseases and insect pests. In 1898 his special attention was given to the study of butterflies and moths which in the caterpillar state are destructive to our orchards and to small fruits. The results of this labor will be published in the form of a well illustrated bulletin of at least 250 pages. In zoology, the entomologist continued his investigations in the food habits of the native animals of the state and their relation to agriculture, horticulture and forestry. In botany, a large number of plants were received for identification, and the diseases of cultivated plants were studied and means tried to counteract them.

The lines of work which seem to have been most productive of good results in the division of horticulture and forestry have been in connection with the experiments and studies made in the growing of apples in Minnesota, and in the introduction of hardy timber and ornamental trees and shrubs. Several foreign varieties of apples which have fruited at this station give promise of being of special value to this section. The seedling orchard of three hundred trees is in excellent condition and contains many trees whose fruiting will be watched with interest. The orchards of named sorts have begun to bear considerably and seem to show the value of clear cultivation and a dust blanket in orcharding in this section. About eighty varieties of apples fruited at the station the past year.

In the division of agricultural chemistry, the main features of the work have been soil, and human food investigations. Particular attention is being paid to the question of soil fertility and to the various natural ways by which fertility may be maintained. In the human food work, the actual values of our common food products were considered, and numerous digestion experiments made to determine the amount of work capable of being performed by different foods. Very creditable bulletins have been published upon both of these subjects.

In the division of dairy husbandry, the first series of the work on the cost of production has been completed so far as it has reference to the commercial aspect, but further investigation is needed for a better understanding of animal nutrition. To this end experiments are being continued in the line of food maintenance for the dairy cow, and the nutrients available in the different kinds of grains and forage at different stages of growth. A series of experiments in breeding dairy stock, with a view of establishing a uniformity of type and adaptability for economical dairy work, has been in progress and promises most gratifying results. Experiments in rearing dairy calves have been carried on for a series of years, which show that when separator skim-milk is fed in connection with flaxmeal and roughage the finest specimens of calves can be reared for about half the cost of those reared on whole milk.

A new herd of dairy cows has been secured and experiments in dairy lines in the future will be confined more to scientific investigation.

Since the previous report, experiments have been conducted in growing and fattening cattle, sheep and swine and in growing pastures other than grass for sheep in summer, and fodders other than grass to provide food for winter. Four bulletins have been issued giving the results of fourteen separate experiments and others are in course of preparation. Other important experiments have been instituted, notably an extensive one relating to the growing of bacon from various breeds and grades of swine.

The veterinarian has paid especial attention to hog cholera, which has been the most serious disease among the farm stock. Dr. Reynolds has done a great deal of useful work along this line upon the institute platform, and by distributing information freely concerning the nature of the disease and the best methods of dealing with it. The presence of this disease has been continually diminishing the past two years and it is believed that

much good has been accomplished. The work with bovine tuberculosis has been continued and a bulletin of seventy-four pages, ("Bovine Tuberculosis" bulletin 51) and a supplement of sixteen pages have been issued. I am pleased to report that this bulletin was given a flattering reception by the veterinary profession and medical journals of America. Many outbreaks of diseases among domestic animals have been investigated, and needed help given to owners and neighbors. The work in this division has been seriously crippled and hindered by lack of a building and equipment for class, experimental and hospital purposes.

The sub-stations established by an act of the legislature in 1895, of which a full account is given in the biennial report of '96, are beginning to be useful, and the farmers in the respective portions of the state are taking a great interest in the experiments and work done. In the appended reports from the superintendents of these stations, T. A. Hoverstad of the Northwest Experiment Farm, and Herman H. Chapman of the Northeast Experiment Farm, the work is pretty fully outlined; also a report of Wm. G. Smith, superintendent of the work carried on in Lyon county on the farm of O. C. Gregg. The objects and methods are given in full. This work is attracting considerable attention.

The following railway companies have aided us very materially in furnishing transportation in the transaction of the work at the different stations in the state and enabling the station staff to visit various places in the state to meet the demands made upon it in helping all lines pertaining to better agriculture: St. Paul & Duluth; Northern Pacific; Minneapolis, St. Paul & Sault Ste. Marie; Great Northern; Chicago Great Western; Chicago, St. Paul, Minneapolis & Omaha; Minneapolis & St. Louis; Eastern Railway of Minnesota; Brainerd & Northern; and Duluth & Iron Range.

Thirteen bulletins have been published during the last two years. Twenty thousand copies of each issue, excepting 53 and 55 (the former seventeen thousand, the latter fourteen thousand) making over nineteen million two hundred thousand pages, giving the results of investigation and observation made by the station staff have been issued.

The following regular and press bulletins and annual reports of the experiment station for 1896 and 1897 have been issued since the last biennial report was made:

Press Bulletin No. 6, Feb. 10th, 1896—Smut in Wheat.

Press Bulletin No. 7, April 22nd, 1896—Azoturia.

Press Bulletin No. 8, April 13th, 1897—Sugar Beets.

Press Bulletin No. 9, January 2d, 1898—Publications.

Bulletin No. 47, July, 1896—Flax.—The Draft of Flax on the Soil, and the Composition of Flax Soils. The Feeding Value of Flax Products.

Bulletin No. 48, December, 1896—Insects Injurious in 1896.

Bulletin No. 49, December, 1896—Rate of Increase on the Cut-Over Timber Lands of Minnesota.

Bulletin No. 50, December, 1896—Progress at the Several Experiment Farms in 1896. Beans—Variety Tests. Barley—Variety Tests. Corn—Variety Tests. Oats—Variety Tests. Wheat—Variety Tests. Wheat—Smallest vs. Largest vs. Hardest Kernels for Seed. Rotation of Crops; Cross Rotation Experiments. Sugar Beets, Cost per Acre and per Ton. Root Crops—Variety Tests,

Bulletin No. 51, December, 1896—Bovine Tuberculosis.

Bulletin No. 52, December, 1896—Potatoes—Variety Tests in 1896. Potato Implements.

Bulletin No. 53, June, 1897—Effects of the Rotation of Crops Upon the Humus Content and the Fertility of Soils. Production of Humus from Manures.

Bulletin No. 54, September, 1897—Human Food Investigations The Gluten of Wheat. The Digestibility and Composition of Bread. The Loss of Food Value by Prolonged Fermentation in Bread Making. The Digestibility of Potatoes, and the Loss of Food Value when Potatoes, Carrots and Cabbages are Boiled in Different Ways. The Rational Feeding of Men.

Bulletin No. 55, December, 1897—Grasshoppers, Locusts, Crickets, Cockroaches, Etc., of Minnesota.

Bulletin No. 56, April, 1898—Sugar Beets. Summary of Investigation from 1888 to 1898. Report for 1897. Proposed Experiments for 1898.

Bulletin No. 57, June, 1898—Fattening Lambs in Winter. 1. Fattening Minnesota Lambs. 2. Fattening Range Lambs. 3. Fattening Range Lambs.

Bulletin No. 58, June, 1898—Fattening Steers in Winter. 1. Fattening Minnesota Steers. 2. Fattening Range Steers.

Bulletin No. 59, June, 1898—Fattening Lambs and Wethers in Winter. 1. Fattening Home-Grown Lambs. 2. Fattening Home-Grown Lambs. 3. Potatoes and Field Roots for Fattening Lambs. 4. Fattening Range Wethers. 5. Fattening Range Wethers.

Annual Report for 1896—Containing Bulletins 47 to 52 inclusive and a meteorological record at various points in the state for 1896 and averages for a series of years.

Annual report for 1897 for the fiscal year beginning July 1st, 1897, and ending June 30th, 1898, containing Bulletins 53 to 59 inclusive, and a meteorological record at various points in the state for 1897 and averages for a series of years.

Especial attention is called to the appended reports of the several divisions relative to the work since the last report, including that under way and suggestions as to the future.

WM. M. LIGGETT,

Director.

DIVISION OF AGRICULTURE.

Steadily pursuing lines of experimentation through long series of years is not tedious after results begin to be reaped. The fields, roads, buildings and even the fences are giving expression to many useful facts. The work with fields, crops, etc. at University Farm supplemented by that of the several sub-stations is beginning to bear its fruits. Five years' results from the system of rotation plots are in hand. These data have not been worked up as yet, but will yield many useful facts. Other rotation experiments have been started and rotations at the sub-stations have been planned. The experiments in pasturing cattle on numerous classes of pasturage have yielded further facts. The planting and cultivating of crops have been given much attention. At University Farm, the roots of crops have been the subject of special investigations, and at Coteau Farm, extensive studies have been made of all soil moisture, and the best ways of conserving it for increased crops.

The introduction of new seeds, the testing of varieties and the improvement of our best kinds of staple crops have progressed during the past biennial period. The most noteworthy acquisition from abroad in recent years is Brome grass (*Bromus inermis*), a grass native to Russia. In part upon the request of this station, the Secretary of Agriculture purchased twelve tons of the seeds of this grass in Russia last season through their agent, Prof. N. E. Hansen, of the South Dakota Agricultural College. Thirty-seven hundred and fifty pounds of this seed were sent out by Secretary Wilson to Minnesota farmers through this station. Numerous favorable reports have been received regarding this grass. We have had it under experiment for several years, and believe it a very important acquisition to our list of forage plants and especially suited to drouthy conditions. In 1894 we started the breeding of this grass and several promising new varieties have already been originated. Timothy has been the subject of extended experimentation and varieties have been originated which promise larger yields than the common stock of this grass.

The leading cereal crops under trial are bringing numerous lessons. So far the best varieties found were, as a rule, those already in the state ten years ago. One of the best varieties of corn, University No. 13, secured in 1893 from DeCou & Co., of St. Paul, has been carefully bred for a series of years. This improved seed has been sold annually at one dollar per bushel with no charge for package. It has been distributed widely throughout the southern half of the state and has had nearly universal commendation. It has proved valuable for a fodder variety in the northern portion of the state, also. Other varieties suited to the southern third, the central third and the northern third of the state are being developed for their respective climatic conditions. It has been found that corn must be bred to suit each general locality, and a plan has been devised under which farmers who care to make a specialty of seed growing can breed varieties and sell them at a profit, as breeders of live stock raise breeding animals for sale.

Blue Stem and Red Fife wheat have proven superior to nearly or quite all newly acquired wheats for most sections of this state. The best stocks procurable of these and of a few other good varieties have been obtained and extensively used as foundation stocks for new varieties. Some of these new varieties have now been sufficiently tested at University Farm and at the sub-stations that their superiority in yield seems to have passed beyond question. An increase of one, two or even more bushels per acre seems to have been obtained by rigid, scientific selection alone. Other new varieties, part of which are the results of cross breeding, give results of a still greater increase in yield over the standard fife and blue stem wheats now grown by our farmers. A method of breeding wheat has been devised and numerous new varieties have already been originated. A few of these are being produced in quantity. These will be sold in bushel or bag lots to several farmers in each county who care to embark in the business of seed growing in a very careful manner. These seed growers will be expected to sell their crops at reasonable seed prices to their neighbors and thus co-operate with the station in multiplying new varieties so that a large number of farmers can get the seed pure, true to name, and direct. This plan of seed distribution has succeeded better than a system of free distribution. Experiments are in progress in raising winter wheat, and an effort is being made to breed some of the hardiest varieties so that the winter wheat belt may be extended north farther than at present. Oats, barley, and winter rye are in like manner under

experimentation, but the newly originated varieties have not as yet been fully developed. New varieties of flax for seed and other varieties for fiber have been originated and are being developed.

Field peas and beans and the clovers are being tested and bred and the methods of their culture extensively studied. Methods of breeding these plants, which are cross-fertilized by insects, are being perfected and practical results in the form of new varieties are already promised.

In connection with the breeding of crops and the study of cultivation, numerous charts are being prepared for publication of the roots, of the stems, and of the floral organs of all the leading field crops. While seeking to develop new varieties of field crops, the science of breeding is being extensively studied with great interest and with promise of usefulness.

Road making is the subject of careful experimentation and the roads of the several farms are being developed, the various conditions there found giving opportunity for the construction of numerous kinds of roads and culverts. Likewise, the subject of drainage has received much attention. The lands of the experiment farm has given opportunity to study open drainage in the broad flat areas of the Red River Valley, the swamp lands of the prairie portions of the state, the swamp lands of the timbered area, and over a mile of tile drains has been laid on University Farm. Numerous kinds of fences and gates are under trial and the subjects of selecting, and planning farms have received attention.

W. M. HAYS.

Agriculturist.

DIVISION OF HORTICULTURE.

During the biennial period just ended the progress in the division of horticulture has been quite marked. The orchard and small fruit plantations have increased in size and productiveness and are in very satisfactory condition. In the apple orchards about eighty varieties of apples fruited and they have become of much assistance in the study of the possibilities of apple growing in this section, and also as aids in the instruction in the School of Agriculture. The small fruit plantations are in good condition and well represent this important and growing industry.

Trials have been made of the newer varieties of vegetables

which have been put upon the market so that we might keep our notes of them up to date. Especial attention has been paid to the trial of varieties of potatoes, since this subject seems to demand special attention. We have grown during each of the past two years between fifty and sixty varieties of potatoes of the more important or newer kinds, and have followed the practice of discarding each year varieties that have proven themselves of little value.

An important line of the experiment work, and one that seems to interest a large portion of our citizens, is that relating to the growth of trees and shrubbery. The plantings which have been made upon our grounds from time to time during the past twelve years have now become of size and age so that they can be reported on at considerable length and furnish data of value. Many visitors come to the grounds each season who are especially interested in these matters and find in these plantings very many interesting object lessons. Our collections are without doubt the best in the northwestern states and are exciting increased interest from year to year.

During the past year I have prepared a book entitled "Forestry in Minnesota," which has been published by the Minnesota Forestry Association and ten thousand copies printed for free distribution in this state. This is really a bulletin of 312 pages embracing the results of our experiments and studies with tree growth in this section. It is arranged in text book form so as to be adapted for classes in the School of Agriculture. It contains sixty nearly full page illustrations of the different species of trees, besides about forty smaller figures.

The notes of the office have been changed from the old record book style and are now arranged in card index form. We find this system the more convenient.

The collection of photographs illustrating horticultural work has been increased until we have now something over eight hundred on record in the office. A fine set of photographs has also been made of our apples, and it is my wish to publish it shortly as half-tone illustrations in a bulletin.

SAMUEL B. GREEN.

Professor of Horticulture and Forestry.

DIVISION OF ENTOMOLOGY.

In the division of entomology bulletin No. 55 was published. It is a text-book of nearly 300 pages in which all the grasshoppers, locusts, crickets, cockroaches and allied insects found in Minnesota are fully described and illustrated. Both their external and internal anatomy are given. The methods used to combat these destructive insects successfully are discussed in detail and a glossary of the terms used assists the reader to understand the descriptions, which are necessarily somewhat technical. Over 6,000 tin boxes filled with spores to combat the chinch-bugs were mailed to those desiring to use them, but especially to millers who distributed this material among their farmer customers. The results have been very gratifying in numerous instances, as indicated by many letters. Diseases killing the tent-caterpillars and cabbage worms were also distributed with amazing results. Generally speaking the past season has been a remarkable one as far as insects were concerned, and the damage caused by these pests has been exceptionally slight, excepting in some individual cases. Reports of injuries to our grains caused by the frit-fly, the wheat-stem-maggot, and the Hessian fly, were less numerous than in the previous year, while the number of letters in regard to the wire-worms, several kinds of cut-worms, and a boring cut-worm became very numerous for a time, showing that these insects are increasing in numbers and destructiveness. Grave fears were entertained for a time that the genuine Rocky Mountain locust had reached or would reach our state. Happily these fears were unfounded, as the nearest region in which this insect occurred in destructive numbers was some 1,000 miles west of our boundary line in North Dakota. At the invitation of the Northern Pacific Railway Company, and later of that of the Soo Line, I visited the infested region and showed the farmers how to go to work to prevent further injuries. Later, the proper authorities in North Dakota took the matter in hand, and with very marked results. In some of our older cities, the shade trees are badly infested with the cottony scale, and there is great danger that many kinds of trees will be killed if no proper steps are taken to destroy this pest, which is rapidly spreading to many other cities, and even to wind-breaks and timber claims. I made a number of trips to arouse the people in the infested cities to united action to save their trees. A number of nurseries were also visited to inspect the stock, so that it could be sold to other

states and Canada. In the entomological division the correspondence has grown to such an extent that very much time is required to answer letters. During the busy season it is not unusual to receive fifty or more letters per day, hence correspondents cannot always expect to receive lengthy answers. The museum, which contains not alone entomological specimens, but also mounted specimens of mammals and birds, has grown very rapidly in size and in importance, and is not alone visited by the students but by many visitors and quite frequently by classes from the public school of the twin cities.

OTTO LUGGER,
Entomologist and Botanist.

DIVISION OF AGRICULTURAL CHEMISTRY.

Publications.—During the biennial period—1897-1898—five bulletins have been published from this division relating to soils, human foods, flax, sugar beets and the rotation of crops. A text book for use in the School of Agriculture, entitled "The Chemistry of Soils and Fertilizers," has also been prepared. In co-operation with the U. S. Department of Agriculture, a bulletin has been published relating to the "Losses in Boiling Vegetables and the Composition and Digestibility of Potatoes and Eggs."

Soil Investigations.—Soil investigations form one of the main features of the work in the division of agricultural chemistry. Complete chemical analyses have been made of over three hundred samples of soil from various parts of the state. The influence which different methods of farming have upon the reserve fertility of the soil has been found to be very marked. While the prairie soils are naturally rich in fertility, they nevertheless require careful attention in order to prevent the fertility from becoming unavailable. The excessive loss of vegetable matter from the soil has been one of the main reasons why a decline of fertility has been so noticeable in some soils. The continual cultivation of grain crops, which opens up the soil so that the vegetable matter rots, the "burning over" of the grain stubble, and summer fallowing, have been the means of the loss of a large amount of gross fertility from the state. This wholesale destruction of fertility should be superseded by improved methods of rotation of crops, the culture of clover, and the production and use of farm

manures. At the experiment station wheat grown on soils where the fertility is kept up by simple natural methods has shown an increase in yield of five bushels per acre over that from soils where wheat is grown continually. In the soil work samples are taken from farms where the soil is kept in good condition and from adjoining farms where the soil has been neglected. Briefly stated the results have been:

	Farms well cultivated and fertility kept up.	Farms which have produced only grain.
Power of storing up water.....	High.	Low.
Nitrogen (the chief element found in wheat gluten).....	High.	Low.
Available phosphates and other forms of plant food.....	High.	Low.
Crop producing food.....	Good.	Poor.

Study of Crops.—A special study has been made of sugar beets, flax and wheat. A summary of the investigations on sugar beets for the past ten years is given in bulletin No. 56. 1351 samples of sugar beets grown in all parts of the state during the past ten years have shown a sugar content of 14.22 per cent. with a purity coefficient of 81.2. The beets raised at the experiment station under the best conditions have shown an average of 15.5 per cent. sugar with a purity of 85.9. Numerous analyses have also been made of limestones from various parts of the state with the view of ascertaining the value of our lime for the refining of beet sugar. Nearly all common limestone contains so much magnesia that it cannot be used. We have, however, deposits of lime in the state which show a purity of 95 per cent. and are all that could be desired for beet sugar purposes. The sugar beet experiments are being continued in co-operation with the U. S. Department of Agriculture.

The flax crop has also been made a subject of special study, and the results are recorded in bulletin No. 47. Both flax and wheat require the best methods of farming in order to obtain good yields and to leave the soil in good condition. Both crops should be grown, but their culture should be on a more scientific basis than is too frequently the case. Analyses have also been made of Minnesota and foreign flax seeds for the state grain and warehouse commission. This was done because some discrimination was made against our flax on the ground that it contained less oil than the Russian or Indian flax. The results showed that the Minnesota flax contained as much oil as any found in foreign markets.

The corn crop has also been studied, but it is desired to obtain results from another season's crop before publication.

Human Food Investigations.—In co-operation with the U. S. Department of Agriculture, investigations have been carried on relating to the food of man. In this work particular attention is given to the study of the comparative value of foods. It is the object to furnish such information as will enable both farmers and laboring people to select foods on the basis of their actual values. For example, when beef is 14c per pound, milk 4c a quart, beans 5c per pound, and cheese 15c per pound, which are the cheapest and best foods, or how can a dollar be expended so as to secure the largest amount of tissue repairing and heat producing nutrients? These and similar topics are discussed in bulletin No. 54. The feeding of balanced rations to men has also been studied, and a number of human digestion experiments have been made to determine the comparative value of foods. Attention has also been given to the losses which occur in the preparation of foods. For example, in the boiling of potatoes, it frequently happens that 80 per cent. of the vegetable albumin is extracted and thrown away in the water used for cooking. When the clean, unpeeled potatoes are placed directly into hot water there is less than one per cent. loss of albumin. When sliced, soaked for a few hours in cold water, and finally placed in a kettle of cold water the loss of albumin amounts to 80 per cent. The losses which occur in bread-making, and the chemical changes which take place during its baking have also been studied. There is no subject about which so little is actually known as the subject of human foods, and there is great need of continuing the experiments along this line.

Miscellaneous Work.—In addition to the main lines of work—soils, human foods and crops—other investigations are also made. During the past year a study was made of the various factors as nature of seed, cultivation, care of crops, etc., which influence the composition and feeding value of our fodders. Many of these factors are in a great measure controllable making it possible to produce within certain limits crops of greater feeding value. Losses in the handling of manure have also been considered. The influence of the water of the soil has been investigated. Numerous free analyses have also been made for the farmers of the state of oil meal, bran, shorts, etc., supposed to be adulterated. During the time the pure flour bill was before congress analyses of adulterated flour offered for sale in the large trade centres as Chicago, Cincinnati and Richmond, were made because of the

threatened danger to the wheat and milling industries of our state.

Very respectfully submitted,

HARRY SNYDER,
Chemist.

DIVISION OF VETERINARY MEDICINE.

During the past two years the work in this division has been largely with infectious diseases of the various domestic animals.

Hog cholera and swine plague have spread, practically as one disease over nearly the southern half of the state and have caused annual losses running into the millions. It has been the plan and work of this division to scatter popular information among farmers and stockmen concerning the disease, and to arouse local health officers to the possibilities in the way of quarantine and intelligent prevention. Two editions of the bulletin on hog cholera and swine plague have been exhausted. I have spent considerable time in the field with the State Farmers' Institutes presenting various phases of the hog cholera problem.

Conditions of food and care are being studied with reference to their relation to these diseases. It is hoped that this work may develop some valuable data. This division has also been doing experimental work with a hog cholera serum, the work being done in connection with the veterinary division of the Nebraska station.

Tuberculosis has probably been as prevalent among well bred stock and dairy cattle as during the previous biennial period and it has been the constant work of this department to interest breeders in the work. A few breeders are already selling tested stock, and it is not unusual for intending purchasers of young stock to ask for certificate of test or to purchase subject to the test.

Tuberculin together with necessary blanks for recording results of test is being distributed free of expense through local health officers. It is now an easy matter for any breeder to have his herd tested and to know positively whether it is free from the disease or not.

Some experimental work with reference to the use of tuberculous cows for breeding purposes seems to indicate that such cows may, under certain circumstances, be profitably used for breeding purposes. A large percentage of calves from tuberculous

dams have remained healthy at three years of age. In this work the calves were removed from the mother at birth and reared on the milk of healthy cows or on sterilized milk.

The experimental work with bovine tuberculosis, referred to in the two previous biennial reports, has been completed and results published in bulletin No. 51, which has been very kindly received by the veterinary journals and veterinary profession of America.

Cornstalk disease has been seriously prevalent during the past two years, and especially during the fall and winter of 1897-98. A circular letter concerning this peculiar disease, has been freely distributed and it is believed that quite an important saving for the cattle interests has been effected in this way, as this disease is very fatal. The history of the disease and the conditions under which it appears are quite well understood, and so the checking of this disease, and in fact original prevention, are simple and quite easily managed.

Several apparently new diseases have been investigated in connection with the state board of health, and while we have no positive information ready for publication, it is evident that there are great opportunities in Minnesota for field study along these lines.

Several outbreaks of epizootic cerebro-spinal meningitis have been investigated. Owners have been given information concerning the disease and neighborhood fears allayed.

Black leg among young cattle has been quite prevalent and there has been an active demand for the black leg vaccine, which vaccine is proving very satisfactory as a preventative.

Anthrax has not been common and there has been but little call for the anthrax vaccine.

Glanders among horses has prevailed in thirty-six counties during the past two years. Our western counties seem to be especially infested with cases of this kind. It is not probable that the disease has been more prevalent, but it has seemed to be so because cases have been reported more promptly than formerly. It will be very difficult to deal with glanders in these western counties in a satisfactory way until some means can be devised to protect them against herds of range horses which are driven through these counties and distributed in them every year.

Need of Facilities.—The work in this division has been hindered and crippled by lack of building and facilities for experimental work. A different operating room, a post-mortem room,

stalls and stables for experimental work are urgently needed, as well as class room, laboratory and hospital facilities.

M. H. REYNOLDS,
Veterinarian.

DIVISION OF DAIRYING.

The work in this division during the past six years has been chiefly towards the solving of the problem of the cost of milk production. The primary object was to ascertain, in a general way, what might be considered a fair yield of milk and butter fat from the different breeds of cows, and the cost of feed under conditions obtaining generally in Minnesota and the Northwest. The results that might have been obtained during the first year's work were in a measure lost for want of a proper record of the feeding operations carried on in the barn. From the beginning of the year 1893 a complete record has been kept of the amount and kind of feed given to each animal in the division each day, with a complete chemical analysis of the different feed stuffs used and the average market price for which they were selling in different portions of the state. Since the establishment of the dairy division in October, 1891, every milking of each cow has been weighed and tested for per cent of butter fat and the cost of producing milk and butter fat has been calculated as rapidly as circumstances would permit. The records for the year 1893 and for the winter of 1893-4 were published in bulletin No. 35 and gave such remarkable results that it was deemed advisable to continue along the same line with a view of ascertaining for a certainty that the findings were correct.

The records for the years 1894, 1895 and 1896 have been compiled and in all material points confirm the conclusions found and published in bulletin No. 35, which were that the productive capacity of a cow depended more upon the type and conformation than upon size and breed; that cows of the beef type, at prices then ruling for feed stuffs, produced butter fat at a cost of 17.5c, while spare cows having deep bodies produced the same at a cost of 12.1c per pound. While the cost of producing dairy products during the years 1894, 1895 and 1896 decreased in proportion to the decrease in price of feed stuffs used, the relative cost of producing butter fat from the two types of cows mentioned has been practically the same each year, and the findings

first published in bulletin No. 35 have been fully confirmed and are now accepted as settled facts.

During the winters of 1895-6 and 1896-7, an experiment was carried on to ascertain why some of the cows in the herd have been able to make such large return in dairy products, while others under similar care and conditions make a much smaller return. This has been found to be a very complicated and difficult problem to demonstrate, as it involved several distinct questions. First, the amount of food nutrients needed for bodily maintenance; second, the amount of nutritive substances required for a pound of gain; and third, the amount of food nutrients represented per pound loss of bodily weight.

The food nutrients needed for bodily maintenance are not fully understood, and since some cows gain during their period of lactation while others lose, and some produce more solids, not fat, in their milk than others, it has been exceedingly difficult to trace the disposition made of the nutritive substances in the food taken.

First, in order to ascertain the amount of food that was required to maintain the body, several cows that had passed the period of usefulness in the dairy and had gone permanently dry, were employed in this part of the work with highly satisfactory, though new, results.

Second, to ascertain the amount of food required for a pound of gain in weight and for a pound of butter, four cows and four steers were used and the selection of the animals for this work was so fortunate and the results obtained were so clearly demonstrated that there seems to be no doubt as to their accuracy.

This experiment also incidentally shows the kind of steer that makes the largest gain for food consumed, and why; the effect that both external and internal disturbances have on a steer that is being fed for gain and the difference in the amount of food required as food of maintenance by different animals.

The amount of food nutrients represented per pound loss in weight of body has not been ascertained and will be the subject of further investigation.

The experiment on cost of production was originally laid out along popular lines to give dairymen of Minnesota information on subjects which would be of the greatest immediate value, but as the work progressed it has been gradually more and more narrowed down to the solution of scientific problems which are really of more value as time passes.

Since accurate records are being kept of the kind and amount of food consumed by each animal in the dairy division, the weight of each ascertained every Monday morning and recorded, and the daily yield of milk and butter fat obtained and credited to each, it is possible to note the influence of different kinds of feed on the yield and quality of milk, the changes that take place in the composition of milk during the period of lactation, or from year to year.

In order to make a more careful study of the cow covering the period of fecundity twenty dairy bred heifers have been purchased. Eighteen of these are now in milk. In order to make the study broad and comprehensive it is hoped that in addition to the several dairy breeds that are now represented in the herd, provision will be made for obtaining about ten more heifers representing the average cows found on the farms of Minnesota.

The general health of the cows in the dairy herd are excellent. No new cases of tuberculosis have been developed during the past two years, and the indications are that the disease has been destroyed.

The experiment in rearing dairy calves is still in progress with most satisfactory results, and will be the subject of a bulletin to be prepared for publication early next season.

The experiments in progress are:

- 1st—Breeding dairy stock to type within the breeds and irrespective of breeds.
- 2nd—Rearing dairy calves on skimmed milk, flax meal and roughage.
- 3rd—Ascertaining the digestibility of the various feed stuffs at different stages of growth and as cured fodder, used in feeding dairy cows.
- 4th—Ascertaining the digesting coefficients for each cow in the herd to the end that each will be a proper animal with which to carry on scientific feeding experiments.
- 5th—Comparing the feeding value of different feed stuffs for milk production.
- 6th—A study of the disposition of food nutriment in milk production with a view of finding the nutrient equivalent of a pound of milk solids, a pound of gain and a pound of loss in bodily weight. Experiments 3rd and 4th are preliminary to this study.
- 7th—In dairy hall, a study of the creaming qualities of the milk by the gravity process from each cow in the new herd.
- 8th—A microscopic examination of the character of the fat globules in the milk of each cow in different stages of the period of lactation, and a study of the influence of the size of the globules on the creaming qualities of the milk.

All this proposed work is arranged with a view of getting all the data necessary to give a full and complete analysis of the cow that is best adapted for the dairy, believing that by confining our

work to one line, that of economical milk production, more permanent good will be accomplished than would accrue were we to branch off into work not bearing directly upon this special line.

Respectfully submitted,

T. L. HAECKER,
Prof. of Dairy Husbandry.

DIVISION OF ANIMAL HUSBANDRY.

In this division there has been considerable expansion since the last report. A stable has been fitted up in the south wing of the barn for the accommodation of animals of the beef breeds, and representatives of the Aberdeen Angus Polls have been added to the Shorthorns and Herefords now kept for class room purposes. If representatives of some of the other beef and dual purpose breeds were also purchased, it would add much to the value and effectiveness of the class room work.

The land placed at the disposal of this division to experiment in growing forage and fodder plants has also been so increased that it now embraces about twenty acres. This increase will add greatly to the value of the experimental work done in the division.

Experiments in the Beef Division.—In the beef division experiments have been conducted, (1) in fattening steers grown on the range; (2) in fattening steers of different types; and (3) in growing cattle from birth on cheap home grown products until ready for the block. The range steers were fed to demonstrate the practicability of this line of work on the average Minnesota farm. While being fattened the steers were fed varying quantities of meal to ascertain the relative outcome from light and heavy feeding respectively. The steers of different types were fed to ascertain their relative suitability for such work. And while being thus fed they were used with much effectiveness in the class room to show the contrasts in type and the relation of type to probable production. And the cattle grown and finished were thus produced to demonstrate the profitable nature of the work.

Experiments in the Sheep Division.—Experiments in this division may be divided into three classes. The first related to the growing of foods for sheep for summer grazing and winter feeding; the second related to the fattening of sheep, and the third

to changing the breeding habit of the same. The summer pastures were chiefly sown the same season that they were grazed, and the objects sought in growing them were, to ascertain, (1) the most suitable crops for the purpose; (2) the most suitable method of growing them and pasturing them off; and (3) the influence of such a system on weed eradication and on fertility. In 1897, 93 sheep and lambs, of which about two-thirds were sheep, were pastured on ten acres of light, rolling, sandy land, and from the same were cut that season more than ten tons each of cured fodder and of green food. The growing of winter foods began in 1898, and the experiments relate to the growing of many varieties to ascertain, (1) the most suitable of these for Minnesota conditions; (2) the least expensive and most satisfactory methods of growing them; and (3) the methods of producing them in that form which will possess highest palatability and nutrition, and that will involve the least outlay in handling and feeding.

The winter feeding included the fattening of range and home grown sheep—lambs and wethers—and on various kinds of food. The objects sought included the following:—(1) the practicability of fattening range sheep profitably under average Minnesota conditions; (2) the relative profit from feeding range lambs and range wethers, and from feeding home grown lambs and range lambs; (3) the relative suitability of various foods for the work, such as our state produces in best form.

The experiment in changing the breeding habit of sheep seeks to ascertain, (1) the practicability of breeding sheep from common stocks that will regularly drop lambs in the fall rather than in the spring; and (2) the length of time that will be required to insure such change. In this experiment the males used are pure bred, Dorsets. Years must elapse before the experiment is completed, but thus far the results have been most encouraging.

Experiments in the Swine Division.—In this department, but little progress can be reported. Early in the winter of 1897, an outbreak of hog cholera occurred at the station and in a few days swept away the results of some years of experimentation in growing cross breeds of various types. The contagion is supposed to have inadvertently been brought to the station by some visitor from a section where hog cholera prevailed. However, something has since been done in growing cross breeds and now an extensive and far reaching experiment has been begun which will probably cover several years. It contemplates the production of bacon

hogs through cross breeding, using the common short-bodied types in the country as the foundation dams, and the growing of these as pitted against the types that now prevail.

Bulletins Issued.—Since the last report four bulletins have been issued from this department which give the results of thirteen carefully conducted experiments, and a fifth will be ready by the end of 1898 that will give the results of three years' work in growing summer pastures for sheep.

Disposal of the Live Stock.—Much of the live stock grown and fattened in this department has been sold to the School of Agriculture and used on the tables in the dining room. A considerable number of breeding animals have been sold at moderate prices to farmers in various parts of the state. The live stock put upon the public market in the finished form has always brought prices the best that were being paid.

Respectfully submitted,

THOMAS SHAW,
Professor of Animal Husbandry.

POULTRY DIVISION.

Work in the poultry division has included experiments in breeding and feeding for egg and meat production; crossing of different breeds for the two purposes; duck raising; caponizing; the management of incubators and brooders. Nearly all of the work has been done with special reference to its application to the needs of the general farmer rather than the poultry specialist or fancier. Artificial and natural methods of incubation and brooding have been compared, and comparisons have been made between the different classes (hot air and hot water) of incubators. These comparisons included tests of the cost of running, ease of management, variations in temperature and general results. Experiments have been conducted comparing results in egg production and fertility of eggs from fowls confined in houses, in large yards, and with unlimited range. During the past season a flock of Pekin ducks has been added to the equipment with a view to showing what may be done toward developing the rearing of ducks for market. It is believed that a large section of the state with its many lakes is peculiarly adapted to this industry. Dur-

ing the year there have been a good many inquiries from farmers in regard to poultry matters, particularly the building and arrangement of poultry houses. Last summer an experiment in caponizing was made, and a dozen capons are at present being fed with a view to determine whether the practice of caponizing can be made profitable in this state. Feeding experiments are also being conducted to show the comparative cost of egg production in warmed and unwarmed poultry houses.

JAS. M. DREW.

COTEAU FARM, LYND.

The experiment work started here in 1894 under Prof. W. M. Hays has resolved itself into a study of soil moisture, soil fertility, buildings suited to this section, and forestry protection. This location is representative of a large area of glacial drift soil peculiar to the southwestern part of the state, as well as a still larger area of similar land in adjoining states.

The soil moisture studies are facilitated very much by the use of an electrical device perfected by Dr. Milton Whitney, chief of the division of soils, Washington, D. C. The principle on which the method rests is that the electrical conductivity of soils varies regularly, according to fixed laws, with the amount of water in the soil. By this method the moisture conditions of the soil are noted daily instead of in periods of from ten to fifteen days as by the old method. The temperature of the soil is taken by the same device. Some two dozen temperature and moisture observations can be made with this device while one moisture determination is being made by the old method.

Mulching, surface cultivation, spring and fall plowing, sub-surface packing and sub-soiling are tested for their moisture and temperature conditions with and without crops, the object being to find the treatment that not only conserves moisture but which will also give rise to that moisture and temperature condition by which the decomposition of organic matter is quickly brought about and the best crops produced.

A complete set of meteorological instruments furnished by the weather bureau enables us to secure a complete record to use in connection with the soil moisture and temperature work.

This section of the state lies in the driest portion of Minne-

sota and the method of soil culture that will best conserve the soil water for the use of crops here should succeed elsewhere. During the past two years data have been gathered along this line that are being prepared for publication in a much more comprehensive form than anything of the kind presented before. When it is remembered that from three to five hundred tons of water are necessary in growing one ton of field crops, the importance of this work is more evident.

The soil fertility studies are shaped by the suggestion that the products of organic decay, uniting as they do with the inert minerals of the soil, give rise to important plant foods. The practical methods of thus building up the soil are being carefully studied. The significance of using a leguminous crop every fourth or fifth year to supply this food which the non-leguminous plants consume, is also receiving systematic attention. Adding organic matter to the soil by pasturing animals on summer crops and grass lands is also under way. This year three crops were grown upon the same piece of land and each crop was pastured off as soon as ready. In this manner much organic matter is added to the soil.

The size of fields and the cost of fencing comes up for solution in connection with this system of field management, while at the same time better crops may be grown. The relative value of this method of soil culture is to be compared with continuous wheat growing. Methods of grass and clover culture is a necessary study in connection with the soil fertility work. Much success attends the grass and clover experiments.

The forest started in 1894 under the direction of Prof. S. B. Green is doing well. It is much appreciated by those who have been unsuccessful in tree growing. This work is shaped by the theory of planting quick-growing trees, such as the willow and caragana for protection to the slower growing evergreens and deciduous trees. In this work we are aided very much by the active interest of Supt. O. C. Gregg on whose farm the work is carried on. He is having marked success in growing small fruits and orchard fruits aided by this system of forestry protection. In the field work he is giving substantial aid by shaping his farm into demonstration fields along the lines suggested by the experiment work.

Respectfully submitted,

W. G. SMITH,
Superintendent.

NORTHEAST EXPERIMENT FARM, GRAND RAPIDS.

It has been the effort to direct the energies of the station towards the solution of those problems which are of especial interest to the settlers in the cut-over pine regions which embrace so large an area in the state. The foremost of these is clearing land. Much valuable information as to methods and cost of clearing has been acquired. The farm now has one hundred acres from which the stumps have been completely removed, and the land practically freed from roots and stones. In three years' time large fields have been transformed from a heavily wooded condition to one of perfect tilth, premitting the use of all modern farm machinery. Stump pullers and dynamite have been tested in this work. The swamp land or muskeg of which there is such a great area, offers a large field for experiment, and the work of subduing it is progressing very satisfactorily. There are two muskegs upon the farm favorably situated for operations. The first problem, that of drainage, has been solved by means of a large open ditch, which has lowered the water level enough to permit the use of a team. Various methods of getting rid of the moss are being tried, as stripping and burning, and the underlying peat or muck is being broken for crops, which will be tried as soon as it is sufficiently weathered and softened. Its treatment for grass production will be especially emphasized. The management of the fields is receiving the attention which its importance demands with especial reference to maintaining the fertility of the soil, some of which is light and sandy. For this purpose manuring with farm yard manure, and the use of green manure, and especially clover and other nitrogen-collecting crops are the chief means employed. The station is planning a careful system of crop rotations to study the effect of different rotations on fertility and profits. The tests conducted for the last three years to determine as far as possible the varieties of the different crops best adapted to the soil and climate, have placed a large store of information at the disposal of settlers in this region. Many varieties of wheat, oats, barley, roots and potatoes have been raised, showing great differences under the same conditions in points of yield, earliness and hardiness. The testing of varieties of corn is of especial importance in view of the difficulty of ripening it so far north. A large quantity of forage is annually grown of both annual and perennial plants. The use of corn-fodder, rape,

sorghum, millet and oats and peas for summer pastures, and winter forage for dairy and other stock is being demonstrated. Tests of the different grasses for meadow and pasture are being made to show their hardiness and suitability to different soil conditions. A large vegetable garden has shown the possibility of raising nearly all kinds of vegetables of a quality which is excelled nowhere in the state. Supplementary to this, the station possesses a small greenhouse heated by fermenting manure in which early plants are started. Plantations of hardy ornamental shrubs were made in '96, and have proved of value in showing which varieties can stand the winters and as an object lesson for the settlers. The orchard is now in its third year, and a few varieties of apples and crabapples give promise of being able to withstand the climate. Small fruits, as strawberries and raspberries, have been very successful. A part of the farm is devoted to experiments in tree culture in connection with the U. S. Department of Forestry. Seedlings and transplants of the White, Norway, Jack, Scotch and Austrian Pines from one to three years old show splendid growth. The co-operative experiment in the effect of locality upon the vitality of seed has given instructive results. The farm buildings are being remodeled and improved to serve as models for incoming settlers. The root house is very important in this region. During the summer a new root cellar was built with stone walls, roofed with white cedar, with four hundred square feet floor space and a capacity of twelve hundred bushels. The pig-pen has been made over and greatly improved. In the fall, a well house was erected using for the walls the stone taken from the fields. A water tank was incorporated in the roof of this structure as a tower, and connections made with the barn and house. It is intended to erect a dairy barn in the near future.

Very respectfully yours,

HERMAN H. CHAPMAN,
Superintendent.

NORTHWEST EXPERIMENT FARM, CROOKSTON.

It is with pleasure I report to you the progress of the work executed under your direction at the Northwest Experiment Station during the years 1897-8. The outline in the report of 1896 has been followed as closely as seemed wise. The work of preparing the land so it would be suitable for experimental work has been continued. The system of drainage has been improved, part of the farm not suited to the growing of small grain has been seeded to grass, while other portions have been broken and backset. Some of the land found to have been infested with foul weeds has been cleaned by summer fallow or manuring made fertile.

The most prominent permanent improvement made is the building of the new horse barn. This was made necessary owing to the total destruction of the old one by lightning July 28, 1897. While the barn was built wholly from the insurance money, part of the equipment fund had to be used in replacing horses, harnesses and machinery that were destroyed in the same fire. This made impossible many improvements that were planned to be carried out during this period.

Drainage.—Among other drawbacks during the past two years may be mentioned the unusually heavy rains during July, 1897, which amounted to eight inches during three days. This partially destroyed the most promising crop of that season. Every year since the station was organized, the crop has either been wholly or partially destroyed by rain. The plan of drainage has been so far completed and tested to know that if wholly completed it will remedy this evil. Not only would this be of value to the farm, but it would serve as an object lesson for the thousands of farms similarly situated in the Red River Valley. Few things could be undertaken that would give better financial returns.

Trees, Shrubs and Flowers.—The trees planted in '96 have made good growth and are now making a creditable showing.

The same plan was followed in the plantings of '97. About ten acres are now planted to forest trees. In addition to this the National Department of Agriculture has planted five acres to evergreens. Thirty varieties of deciduous trees and about twelve varieties of evergreens have so far been tried.

All the leading varieties of ornamental shrubs have been placed in our trial grounds, and some of the native varieties have

also been given a test. The lawn around the house begins to present a velvety appearance. About one-half acre of flowers was grown the past year very successfully. From what has been learned there is reason to believe that there is material already acclimated to furnish the Red River Valley farmer both shelter and ornament about his home.

Vegetables.—Besides shelter and ornament, the farmer needs a vegetable garden near the house to make his home life more comfortable. Fifty-one varieties of vegetables were tried in '97 and eighty-one in '98. Most of these gave good yield and proved to be of very high quality.

Field Work.—In field work, great progress has been made. In '97, thirty-one varieties of wheat were tried and thirty-eight in '98. In a similar way, but on a smaller scale, oats, barley and flax were tried. Some of these varieties proved better than others, and have been raised in larger quantities and sold to farmers for seed. From reports so far received the results have been most satisfactory and in many cases flattering.

Grasses.—Special attention needs to be called to the grass experiments. Forty plots, including all the clovers, were sown June 20, '96. These gave a very good yield in '97. Many of these were wholly or partially destroyed during the winter of '97-8. One variety, the Austrian brome grass, proved very hardy and stood the severe winter without injury. Clover, that was thought would not grow so far Northwest, made good growth and there is reason to hope that clover will soon be used in the rotations to be followed in the Northwest. The growth of the clovers called forth the admiration of the delegates of the National Association of Agricultural Colleges and Experiment Stations visiting the farm in July, '97, and gave great encouragement to what seemed very hopeful before.

Sixty-six plots of grasses were sown in fifty-two acres in '98, and they have all "gone into winter quarters" in most excellent condition. The less promising grasses will be discontinued in the future.

Forage Crops.—Each year annual forage crops, including corn, have been raised. These have given returns that warrant further experimentation. Corn, rape, and sorghum have given the best returns.

Live Stock.—A number of head of all classes of live stock have been added to the equipment. Some good animals have been sold for breeding purposes.

Poultry was added to the list last year and as many fowls raised as the winter quarters would accommodate.

Feeding experiments have been confined to horses. The object has been to determine: First, the quantity of food to feed the horse; second, the relative proportion of roughage to feed with the concentrated food; third, the relative value of the different kinds of roughage for horse feed.

Feeding experiments with other stock have been carried on only in a preliminary way and nothing definite has been learned.

The station has so far been new, and one of the objects has been to learn the real needs of the farmer. Accordingly, numerous visits have been made into the country districts and farmers' meetings have been frequently attended. It is believed that such knowledge is acquired to a certain extent, and future experiments will be influenced in accordance with the impressions so formed. The field of work is large and promising, and it is hoped that the station will in the future be able to fulfill the mission for which it was organized. I am,

Yours respectfully,

T. A. HOVERSTAD,
Superintendent.