FORTY-FIFTH ANNUAL REPORT

OF THE

SECRETARY

OF THE

STATE BOARD OF AGRICULTURE

OF THE

STATE OF MICHIGAN

AND

NINETEENTH ANNUAL REPORT

OF THE

EXPERIMENT STATION

FROM

JULY 1, 1905, TO JUNE 30, 1906.

BY AUTHORITY

LANSING, MICHIGAN
WYNKOOP HALLENBECK CRAWFORD COMPANY, STATE PRINTERS
1906

REPORT OF THE SECRETARY

OF THE

STATE BOARD OF AGRICULTURE

AGRICULTURAL COLLEGE, *July 1, 1906.*

To HON. FRED M. WARNER,

Governor of the State of Michigan:

SIR—I have the honor to submit to you herewith, as required by law, the accompanying report for the fiscal year ending June 30, 1906, with supplementary papers.

Very respectfully,

ADDISON M. BROWN,

Secretary of the State Board of Agriculture.

STATE BOARD OF AGRICULTURE

	Term Expires
CHARLES J. MONROE, South Haven, President of the Board.	1907
HENRY F. BUSKIRK, Wayland,	1907
WILLIAM H. WALLACE, Bayport,	1909
AARON P. BLISS, Saginaw,	1909
ROBERT D. GRAHAM, Grand Rapids,	1911
THOMAS F. MARSTON, Bay City,	1911
WILLIAM J. OBERDORFFER, Stephenson,	1911
FRED M. WARNER, Governor of the State,	*Ex-Officio.*
JONATHAN L. SNYDER, President of the College,	*Ex-Officio.*

A. M. BROWN, Agricultural College, Secretary.
B. F. DAVIS, Lansing, Treasurer.

STANDING COMMITTEES.

The President of the Board is *ex-officio* a member of each of the Standing Committees.

Botany and Horticulture,	R. D. Graham, H. F. Buskirk.
Buildings and College Property,	A. P. Bliss, W. H. Wallace.
Chemical, Physical, Bacteriological and other Departments not otherwise provided for,	A. P. Bliss, T. F. Marston.
Employees,	R. D. Graham, H. F. Buskirk, J. L. Snyder.
English and Mathematics,	W. H. Wallace, T. F. Marston.
Experiment Station,	H. F. Buskirk, A. P. Bliss.
Farm Management,	T. F. Marston, R. D. Graham.
Finance,	R. D. Graham, A. P. Bliss.
Forestry,	A. P. Bliss, H. F. Buskirk.
Farmers' Institutes,	T. F. Marston, R. D. Graham.
Land Grant,	H. F. Buskirk, W. H. Wallace.
Library,	W. H. Wallace, A. P. Bliss.
Mechanical Department,	W. H. Wallace, R. D. Graham.
Military and Athletic,	T. F. Marston, W. H. Wallace.
Women's Department,	H. F. Buskirk, T. F. Marston.

STATE AGRICULTURAL COLLEGE

(Under control of the State Board of Agriculture.)

FACULTY AND OTHER OFFICERS.

Jonathan L. Snyder, A. M., Ph. D., President; [a b c] Feb. 25, '96.
Wm. J. Beal, Ph. D., D. Sc., Professor of Botany; [a b] July, 9, '70; [c] Sept. 1, '02.
Frank S. Kedzie, M. S., Professor of Chemistry; [a] Sept. 15, '80; [b c] Sept. 1, '02.
William S. Holdsworth, M. S., Professor of Drawing; [a] Feb. 22, '81; [b] Aug. 22, '87; [c] Sept. 1, '03.
Levi R. Taft, M. S., Superintendent of Farmers' Institutes and State Inspector of Orchards and Nurseries; [a] Aug. 1, '88; [b c] July 1, '02.
Howard Edwards, A. M., LL. D., Professor of English Literature and Modern Languages; [a b c] Aug. 25, '90.
Herman K. Vedder, C. E., Professor of Mathematics and Civil Engineering; [a b c] Sept. 15, '91.
Clinton D. Smith, M. S., Dean of Short Courses, College Extension Lecturer; [a b] Sept. 1, '93; [c] July 1, '02.
Charles L. Weil, B. S., Professor of Mechanical Engineering and Director of the Mechanical Department; [a b c] Sept. 1, '93.
Walter B. Barrows, B. S., Professor of Zoology and Physiology and Curator of the General Museum; [a b c] Feb. 15, '94.
George A. Waterman, B. S., M. D. C., Professor of Veterinary Science; [a b c] Sept. 1, '98.
Charles E. Marshall, Ph. D., Professor of Bacteriology and Hygiene; [a] Sept. 1, '98; [b c] Sept. 1, '02.
Joseph A. Jeffery, B. S. A., Professor of Agronomy and Soil Physics; [a] Sept. 1, '99; [b c] Nov. 11, '02.
Maud Gilchrist, B. S., Dean of the Women's Department; [a b c] Sept. 1, '01.
Addison M. Brown, A. B., Secretary; [a b c] June 1, '02.
Robert S. Shaw, B. S. A., Professor of Agriculture and Superintendent of Farm; [a b c] Sept. 1, '02.
Ernest E. Bogue, M. S., A. M., Professor of Forestry; [a b c] Sept. 1, '02.
Arthur R. Sawyer, E. E., Professor of Physics and Electrical Engineering; [a b c] April 11, '04.
S. W. Fletcher, M. S., Ph. D., Professor of Horticulture and Landscape Gardening; [a b c] Sept. 1, '05.
Capt. F. W. Fuger, U. S. A., Professor of Military Science and Tactics; [a b c] Sept. 1, '05.

WILBUR O. HEDRICK, M. S., Assistant Professor of History and Political Economy; [a b] Aug. 24, '91; [c] Sept. 1, '93.
WARREN BABCOCK, B. S., Associate Professor of Mathematics; [a b] June 30, '91; [c] Sept. 1, '05.
E. SYLVESTER KING, Assistant Professor of English; [a] Jan. 1, '00; [b c] Sept. 1, '02.
JAMES B. DANDENO, Ph. D., Assistant Professor of Botany; [a b c] Sept. 1, '02.

The names of instructors whose resignations took effect between June 30 and Sept. 1, '05, do not appear below.

THOMAS GUNSON, Instructor in Horticulture and Superintendent of Grounds; [a b] April 1, '91; [c] Sept. 1, '05.
MRS. LINDA E. LANDON, Librarian; [a b c] Aug. 24, '91.
W. S. LEONARD, Instructor in Mechanical Engineering; [a b c] Sept. 1, '96.
RUFUS H. PETTIT, B. S. A., Instructor in Zoology; [a b c] Jan. 1, '97.
MRS. JENNIE L. K. HANER, Instructor in Domestic Art; [a b c] Sept. 1, '97.
CHACE NEWMAN, Instructor in Mechanical Drawing; [a b] Sept. 1, '97; [c] July 23, '01.
E. C. BAKER, Foreman of Foundry; [a b c] Nov. 1, '97.
CAROLINE L. HOLT, Instructor in Drawing; [a b c] Sept. 1, '98.
BERTHA M. WELLMAN, B. S., B. Pd., Instructor in English; [a b c] Sept. 1, '00.
SARAH B. S. AVERY, Instructor in Physical Culture; [a b c] Sept. 1, '00.
JESSE J. MYERS, B. S., Instructor in Zoology; [a b c] Sept. 1, '01.
LOUISE FREYHOFER, B. S., Instructor in Music; [a b c] Sept. 1, '02.
HARRY S. REED, Instructor in Chemistry; [a b c] Sept. 1, '02.
ANDREW KRENTEL, Foreman Wood Shop; [a b c] Sept. 1, '02.
H. W. NORTON, JR., B. S., Instructor in Animal Husbandry; [a b c] Sept. 1, '03.
HARVEY L. CURTIS, A. M., Instructor in Physics; [a b c] Sept. 1, '03.
CHESTER L. BREWER, B. S., Director of Physical Culture; [a b c] Sept. 1, '03.
ALBERT E. JONES, A. B., Instructor in Mathematics; [a b c] Sept. 15, '03.
C. A. MCCUE, B. S., Instructor in Horticulture; [a b c] Oct. 1, '03.
LESLIE B. MCWETHY, B. S., Instructor in Agriculture; [a b c] June 1, '04.
*ALBERT G. CRAIG, B. S., Instructor in Horticulture; [a b c] Sept. 1, '04.
CARL GUNDERSEN, A. M., Ph. D., Instructor in Mathematics; [a b c] Sept. 1, '04.
WALTER G. SACKETT, B. S., Instructor in Bacteriology and Hygiene; [a b c] Sept. 1, '04.
W. W. WELLS, B. S., Instructor in Mechanical Engineering; [a b c] Sept. 1, '04.
EDWARD BOYER, Instructor in Chemistry; [a b c] Sept. 1, '04.
ELLEN B. BACH, A. M., Instructor in Botany; [a b c] Sept. 1, '04.
*[a]CHARLES H. SWANGER, B. S., Instructor in Chemistry; [a b c] Sept. 1, '04.
OTIS N. BLAIR, B. S., Instructor in Mechanical Engineering; [a b c] Sept. 1, '04.
FLOYD O. FOSTER, B. S., Instructor in Dairying; [a b c] Sept. 1, '04.
MARY WETMORE, M. D., Instructor in Bacteriology; [a b c] Sept. 1, '04.
ARCHIE R. ALGER, B. S., Instructor in Mathematics; [a b c] Nov. 15, '04.

E. H. Ryder, A. M., Instructor in History and Economics; [a b c] Sept. 1, '05.
Rachel H. Colwell, A. M., Instructor in Domestic Science; [a b c] Sept. 1, '05.
Bessie Bemis, B. S., Instructor in Cookery; [a b c] Sept. 1, '05.
Annie L. Robinson, Instructor in Sewing; [a b c] Sept. 1, '05.
Norma L. Gilchrist, A. B., Instructor in English; Sept. 1, '05.
Glenn James, A. B., Instructor in Mathematics; Sept. 1, '05.
L. D. Bushnell, B. S., Assistant in Bacteriology; [a b c] Sept. 1, '05.
*[b]H. F. Tuttle, B. S., Assistant in Bacteriology; [a b c] Sept. 1, '05.
Oliver Burk, B. S., Instructor in Physics; [a b c] Sept. 1, '05.
S. C. Hadden, B. S., Instructor in Mathematics and Civil Engineering; [a b c] Sept. 1, '05.
*[c]E. L. Larison, E. M., Instructor in Chemistry; [a b c] Sept. 1, '05.
F. I. Rittenour, B. S., Instructor in Chemistry; [a b c] Sept. 1, '05.
G. L. Stevens, A. B., Lit. B., Instructor in English; [a b c] Sept. 1, '05.
Rudolph Rosenstengel, B. S., Instructor in Mechanical Engineering; [a b c] Sept. 1, '05.
Sherwood Hinds, B. S., Instructor in Mathematics and Civil Engineering; [a b c] Sept. 1, '05.
*[d]H. S. Hunt, B. S., Instructor in Drawing; [a b c] Sept. 1, '05.
Harry G. Walker, B. S., Instructor in Drawing; [a b c] Oct. 1, '05.
Fred C. Kenney, Cashier; [a b] Sept. 18, '95; [c] Oct. 1, '97.
S. Alice Earl, Clerk to Secretary; [a b c] Oct. 1, '02.
Cowan H. McGugan, Bookkeeper; [a b c] June 1, '05.
Elida Yakeley, Secretary to President; [a] July 15, '03; [b c] Feb. 1, '06.
B. A. Faunce, Clerk to President and Editor M. A. C. Record; [a b c] Sept. 1, '04.
L. F. Newell, Engineer; [a b c] Jan. 1, '98.
E. A. Bowd, Architect; [a b c] Jan. 1, '02.
Rowena Kecthum, in charge of College Hospital; [a b c] Sept. 1, '00.
Cora L. Feldkamp, B. S., Assistant Librarian; [a b c] Sept. 1, '05.

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a First appointment.
b Present appointment
c Present title.
* Resigned February 15, 1906.
*a Resigned April 1, 1906
*b Resigned February, 1906.
*c Resigned April 1, 1906.
*d Resigned October 1, 1906

AGRICULTURAL EXPERIMENT STATION

OF THE

MICHIGAN AGRICULTURAL COLLEGE

(Under the control of the State Board of Agriculture.)

STATION COUNCIL.

J. L. Snyder, M. A., Ph. D., Pres., *Ex-officio* Member.
Clinton D. Smith, M. S., Director.
L. R. Taft, M. S., - Horticulturist.
R. H. Pettit, B. S. A., Entomologist.
A. J. Patten, B. S., - Chemist
Chas. E. Marshall, Ph. D., Bacteriologist and Hygienist.
R. S. Shaw, B. S. A., Experimenter with Live Stock.
A. M. Brown, A. B., - Sec. and Treas.

ADVISORY AND ASSISTANT STAFF.

S. W. Fletcher, M. S., Ph. D., Associate Horticulturist.
Geo. A. Waterman, V. S., M. D. C., Consulting Veterinarian.
Mrs. L. E. Landon, - Librarian.
W. G. Sackett, B. S., Asst. in Bacteriology and Hygiene.
W. R. Wright, B. S., Asst. in Bacteriology and Hygiene.
*T. A. Farrand, - In Charge of South Haven Sub-Station.
Leo M. Geismar, Chatham, In Charge of Upper Peninsula Exp'm't Station.
F. A. Wilken, In Charge of South Haven Sub-Station.

SUB-STATIONS.

Grayling, Crawford County, 80 acres deeded.
South Haven, Van Buren County, 10 acres rented; 5 acres deeded. Local agent, F. A. Wilken.
Chatham, Alger County, 160 acres deeded. Local agent, Leo M. Geismar.

STANDING COMMITTEE IN CHARGE.

Hon. H. F. Buskirk, - - - - - - - - - Wayland.
Hon. A. P. Bliss, - - - - - - - - Saginaw.

STATE WEATHER SERVICE

(Under the control of the State Board of Agriculture.)

C. F. Schneider, Director U. S. Weather Bureau, - - Grand Rapids.

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* Resigned Jan. 1, 1906.

ACCOUNTS OF THE STATE AGRICULTURAL COLLEGE

FOR THE YEAR ENDING JUNE 30, 1906.

SECRETARY'S FINANCIAL REPORT.

			Dr.	Cr.
July 1, 1905.	To cash on deposit, college treasurer		$20,517 18	
July 1, 1905.	To cash on hand		1,994 65	
June 30, 1906.	To special appropriation receipts		115,332 17	
	From State Treasurer	$94,500 00		
	From United States Treasurer	15,000 00		
	From institution and other sources	5,832 17		
June 30, 1906.	By special appropriation disbursements			$106,744 19
June 30, 1906.	To current account receipts		$195,768 96	
	From State Treasurer, land grant interest	$70,286 56		
	From State Treasurer, one tenth mill tax	47,000 00		
	From U. S. Treasurer, Morrill fund	25,000 00		
	From Institutions and other sources	52,545 81		
	From South Haven Experiment Station	473 66		
	From Upper Peninsula Experiment Station	462 93		
	By general account disbursements			202,495 04
	From current account	$184,959 52		
	From supplementary accounts	17,535 52		
June 30, 1906.	By cash on hand			1,840 23
June 30, 1906.	By cash on deposit, college treasurer			22,533 50
			$333,612 96	$333,612 96

Table No. 1.—*Tabular exhibit of secretary's report.*

	Balance sheet, July 1, 1905.		Transactions, July 1, 1905, to June 30, 1906.		Balance sheet, June 30, 1906.	
	Dr.	Cr.	Dr.	Cr.	Dr.	Cr.
Cash	$1,994 65		$154 42		$1,840 23	
College treasurer*	20,517 18			$2,116 32	22,533 50	
Special appropriations		$9,803 45	115,332 17	106,744 19		$5,982 30
Current accounts		12,708 38	194,832 37	184,959 52		18,391 43
Supplementary accounts			936 59	17,535 52		
Totals	$22,511 83	$22,511 83	$311,255 55	$311,255 55	$24,373 73	$24,373 73

*Treasurer's statement is greater July 1, 1905, by $9,357.57 and June 30, 1906, by $9,861.06; warrants outstanding.

TREASURER'S ACCOUNT.

	Dr.	Cr.
Balance on hand July 1, 1905	$29,874 75	
Receipts from State Treasurer and Secretary	310,481 14	
Interest on deposits, 12 months at 2½ per cent	798 66	
Warrants paid July 1, 1905, to June 30, 1906		$308,759 99
Balance on hand June 30, 1906		32,394 56
Total	$341,154 55	$341,154 55

TABLE No. 2.—*Statement of special appropriation account for fiscal year, July 1, 1904, to June 30, 1905.*

Name of appropriation.	Balance of accounts, July 1, 1904.		Receipts during fiscal year.		Total available.	Total expended.	Balance of account June 30, 1905.	
	Dr.	Cr.	From State treasury.	From institution and other sources.			Dr.	Cr.
Experiment Station		$920 95	†$15,000 00	$4,486 16	$20,407 11	$19,203 04		$1,204 07
Nursery License and Inspection		5 00		1,078 67	1,083 67	1,083 67		
Sundry Improvements		495 06	5,000 00	48 39	6,171 58	6,026 46		1,303 21
Power Plant		*628 13						
Power House		4,917 55			4,917 55	4,917 55		
Extension Tunnels		3,470 77		100 00	3,570 77	‡2,412 68		
Coal Shed	$661 45		6,500 00		5,838 55	5,838 55		
Barns			5,000 00		5,000 00	5,512 35	$512 35	
Wells Hall			45,000 00		45,000 00	37,186 87		7,813 13
Electric Light and Power Plant			10,000 00	71 60	10,071 60	5,863 85		4,207 75
U. P. Exp. Station, Special			5,000 00		5,000 00	2,470 01		2,529 96
Live Stock, Special			5,000 00	47 35	5,047 35	5,019 14		28 21
Live Stock, Special Poultry			1,000 00		1,000 00	723 41		276 59
Live Stock, Special Poultry House			1,000 00		1,000 00	908 82		91 18
Engineering Building			10,000 00		10,000 00	8,566 31		1,433 66
Weather Bureau		27 44	1,000 00		1,027 44	1,011 42		16 02
Balance	9,803 45						18,391 43	
Total	$10,464 90	$10,464 90	$109,500 00	$5,832 17	$125,135 62	$106,744 19	$18,903 78	$18,903 78

*This balance transferred to Sundry Improvements.
†U. S. Treasurer.
‡The balance from this account, $1,158.69, transferred to Sundry Improvements.

TABLE No. 3.—*Current account July 1, 1905, to June 30, 1906.*

On account of—	Dr. To disbursements.	Cr. By receipts.
U. S. Treasurer, 17th annual payment under act of congress of August 30, 1890	....	$25,000 00
State Treasurer, one-tenth mill tax	....	47,000 00
State treasurer, interest on proceeds of sales of U. S. land grant	....	70,286 56
Salaries	$79,229 20	907 40
Farm department	10,718 33	7,539 56
Horticultural department	6,489 30	2,681 18
Mechanical department	7,129 35	1,961 53
Heating department	17,516 02	521 67
Cleaning department	2,070 31	277 29
Electric lighting department	5,748 58	2,279 39
Office	1,961 18	97 39
Advertising	2,241 14	34 13
M. A. C. Record	1,278 89	463 50
Special courses	4,455 33	1,579 51
Academic departments	17,374 12	5,121 14
Contingent building	23,407 39	23,266 94
Miscellaneous	2,742 61	4,347 06
Women's	2,320 47	1,127 50
Ice	246 25	249 62
Totals	$184,959 52	$194,832 37
Supplementary amounts:		
Bulletins	4,826 88	....
Farmers' institutes	7,903 56	
South Haven experiment station	2,159 95	473 66
Upper Peninsula experiment station	2,645 13	462 93
Balance at beginning of period, July 1, 1905	....	12,708 38
Balance at close of period, June 30, 1906	5,982 30	....
Total	$208,477 34	$208,477 34

TABLE No. 4.—*Experiment station account, July 1, 1905 to June 30, 1906.*

On account of—	Dr. To disbursements.	Cr. By receipts.
Balance from fiscal year, July 1, 1905	....	$920 95
U. S. Treasurer for fiscal year	....	15,000 00
Fertilizer license fees	....	2,860 00
Salaries	$8,567 85	....
Farm department	3,656 06	1,357 03
Horticultural department	430 63	....
Chemical department	1,732 14	14 54
Botanical department	43 95	11 40
Entomological department	776 58	1 60
Library	340 96	....
Secretary's office	643 27	241 05
Veterinary	76 33	
Sundry	60 45	54
Live stock	989 11	
Bacteriological department	1,320 91	
Director's office	564 80	
Balance on hand June 30, 1906, close of fiscal year	1,204 07	
Total	$20,407 11	$20,407 11

TABLE No. 5.—*Regular employes and salaries.*

Grade.	Rate per year.	Classification. Current.	Classification. Experim't station.	Other sources.	
President's Office.					
President	$5,000 00	$5,000 00			House.
Clerk	1,000 00	1,000 00			
Clerk	600 00	600 00			
Agricultural Department.					
Professor	2,400 00	2,000 00	$400 00		
Professor of Agronomy	2,000 00	2,000 00			
Instructor Animal Husbandry	480 00	480 00			
Ass't Instructor Animal Husbandry	1,140 00	1,140 00			
Instructor Dairying	1,000 00	1,000 00			
Instructor Agriculture	700 00	700 00			
Foreman of College Farm	540 00	540 00			
Clerk. Farm department	540 00				
Bacteriological Dept.					
Professor	2,000 00	1,000 00	1,000 00		
Instructor	1,100 00	950 00	150 00		
Instructor	360 00	360 00			
Instructor	360 00		360 00		
Botanical Dept.					
Professor	1,800 00	1,800 00			House.
Assistant Professor	1,150 00	1,150 00			
Instructor	700 00	700 00			
Chemical Dept.					
Professor	2,000 00	2,000 00			
Instructor	900 00	900 00			
Instructor	800 00	800 00			
Instructor	640 00	640 00			
Chemist Exp. Station	1,500 00		1,500 00		
Drawing Dept.					
Professor	2,000 00	2,000 00			
Instructor Mechanical Drawing	900 00	900 00			
Instructor Drawing	700 00	700 00			
Instructor Mechanical Drawing	600 00	600 00			
English Dept.					
Professor	1,800 00	1,800 00			House.
Assistant Professor	1,000 00	1,000 00			Rooms.
Instructor	700 00	700 00			
Instructor	650 00	650 00			
Instructor	650 00	650 00			
Forestry Dept.					
Professor	1,500 00	1,500 00			
Horticultural Dept.					
Professor	2,000 00	2,000 00			
Instructor	900 00	500 00	400 00		
Instructor	600 00	600 00			
Instructor	1,000 00	1,000 00			House.
Foreman of Grounds	500 00	500 00			House.
History and Pol. Economy Dept.					
Assistant Professor	1,500 00	1,500 00			Rooms.
Assistant Instructor	900 00	900 00			
Institutes and Nursery Inspector.					
Superintendent	1,800 00	500 00	600 00	$700 00	House.
Library Dept.					
Librarian	1,000 00	880 00	120 00		Rooms.
Assistant Librarian	400 00	400 00			
Mathematical Dept.					
Professor	1,800 00	1,800 00			House.
Assistant Professor	1,650 00	1,650 00			Rooms.
Instructor Civil Engineering	750 00	750 00			
Instructor Civil Engineering	600 00	600 00			

TABLE No. 5.—*Concluded.*

Grade.	Rate per year.	Classification. Current.	Classification. Experim't station.	Other sources.	
Mathematical Dept.—*Con.*					
Instructor Mathematics	$700 00	$700 00			
Instructor Mathematics	600 00	600 00			
Instructor Mathematics	600 00	600 00			
Instructor Mathematics	550 00	550 00			
Mechanical Dept.					
Professor	1,800 00	1,800 00			House.
Instructor	1,100 00	1,100 00			
Instructor	900 00	900 00			
Instructor	720 00	720 00			
Foreman Machine Shop	1,200 00	1,200 00			
Foreman Wood Shop	750 00	750 00			
Foreman Foundry	750 00	750 00			
Clerk	480 00	480 00			
Miscellaneous.					
Dean Short Courses	2,000 00	400 00	$1,600 00		House.
Architect	1,500 00	1,500 00			
Engineer	1,150 00	1,150 00			
Plumber	900 00	900 00			
Night Watchman	480 00	480 00			
Nurse	450 00	450 00			
Dept. of Physics.					
Professor	2,000 00	2,000 00			
Instructor	900 00	900 00			
Instructor	600 00	600 00			
Dept. of Physical Culture.					
Director	1,400 00	1,400 00			
Secretary's Office.					
Secretary	1,800 00	300 00	500 00	$1,000 00	House.
Cashier	1,300 00	1,100 00	200 00		
Bookkeeper	800 00	700 00	100 00		
Clerk	600 00	475 00	125 00		
Clerk	420 00		420 00		
Veterinary Dept.					
Professor	1,500 00	1,200 00	300 00		
Women's Dept.					
Dean	1,400 00	1,400 00			Rooms.
Instructor Sewing	800 00	800 00			Room.
Instructor Domestic Science	800 00	800 00			Room.
Instructor Physical Culture	650 00	650 00			Room.
Instructor Music	900 00	900 00			
Instructor Cookery	500 00	500 00			Room.
Instructor Sewing	500 00	500 00			
Zoological Dept.					
Professor	1,800 00	1,800 00			House.
Instructor	1,300 00	600 00	700 00		House.
Instructor	900 00	900 00			
Total pay roll	$92,110 00	$81,935 00	$8,475 00	$1,700 00	

TABLE NO. 6.—*Income of the State Agricultural College from all outside sources from the date of its foundation to the present time.*

Year.	From State Legislature.			From U. S. Congress.			Total.
	For current expenses.	For special purposes.	Land sales, salt spring and swamp land grants.	Morrill act of 1862, interest from land grant and trespass.	Hatch act of 1887 experiment station.	Morrill act of 1890, supplementary endowment.	
1855...			$56,320 00				$56,320 00
1856...							
1857...	$40,000 00						40,000 00
1858...							
1859...	37,500 00						37,500 00
1860...							
1861...	6,500 00		152 25				6,652 25
1862...	10,000 00		218 97				10,218 97
1863...	9,000 00		407 80				9,407 80
1864 ..	9,000 00		726 09				9,726 09
1865...	15,000 00		1,156 61				16,156 61
1866...	15,000 00		1,094 27				16,094 27
1867...	20,000 00		7,608 38				27,608 38
1868...	20,000 00		592 49				20,592 49
1869...	20,000 00	$30,000 00	17,559 00	$58 96			67,617 96
1870...	20,000 00		1,320 02	2,720 93			24,040 95
1871...	18,250 00	10,500 00	4,135 72	3,785 54			36,671 26
1872...	18,250 00	3,000 00	217 05	7,175 65			28,642 70
1873...	21,796 00	15,602 00	10 13	11,059 06			48,467 19
1874...	13,000 00	15,602 00	150 13	14,061 98			42,814 11
1875...	7,638 00	7,755 50	144 53	14,446 14			29,984 17
1876...	7.638 00	6,755 50	1,773 09	16,830 17			32,996 76
1877...	6,150 00	30,686 80	979 06	15,172 86			52,988 72
1878...	6,150 00	5,686 80	826 60	15,807 09			28,470 49
1879...	4,971 80	16,068 32	712 22	16,978 22			38,730 56
1880...	4,971 80	7,068 32	797 55	17,837 24			30,674 91
1881...	7,249 00	43,720 50	461 95	20,935 25			72,366 70
1882...	7,249 00	8,945 50	358 46	22,507 45			39,060 41
1883...	8,385 00	23,793 00	391 95	30,749 60			63,319 55
1884...	8,385 00	10,526 00	1,259 90	27,909 72			48,080 62
1885...		35,163 00	187 50	29,770 40			65,060 90
1886...		22,617 00		30,461 04			53,078 04
1887...		*44,040 00	198 20	†24,611 37			68,849 57
1888...		30,752 50	144 20	32,406 60	$15,000 00		78,303 30
1889...		*20,973 00	10 50	31,322 69	15,000 00		67,306 19
1890...		*27,172 00	238 50	32,360 64	15,000 00	$15,000 00	89,771 14
1891...		22,947 50	37 38	34,750 54	15,000 00	16,000 00	88,735 42
1892...		22,947 50	137 38	34,948 12	15,000 00	17,000 00	90,033 00
1893...		18,862 50	10 50	37,927 04	15,000 00	18,000 00	89,800 04
1894...		18,862 50	433 59	44,527 26	15,000 00	19,000 00	97,823 35
1895...		‡19,000 00	10 50	45,301 85	15,000 00	20,000 00	99,312 35
1896...		‡16,000 00		45,886 40	15,000 00	21,000 00	95,886 40
1897...		§17,700 00		43,779 54	15,000 00	22,000 00	98,479 54
1898...		‖17,500 00		47,508 28	15,000 00	23,000 00	103,608 28
1899...		¶8,759 00	705 00	52,526 11	15,000 00	21,000 00	100,981 11
1900...		¶72,500 00	175 00	72,298 38	15,000 00	25,000 00	184,973 38
1901‡‡.		¶72,500 00		63,976 79	15,000 00	25,000 00	176,476 79
1902 ..	100,000 00	**1,000 00		64,081 81	15,000 00	25,000 00	205,081 81
1903...	100,000 00	**1,000 00		65,573 90	15,000 00	25,000 00	206,573 90
1904...	100,000 00	**1,000 00	61 19	67,312 37	15,000 00	25,000 00	208,373 56
1905...	100,000 00	**1,000 00		72,035 32	15,000 00	25,000 00	213,035 32
1906...	157,810 00	**1,000 00		70,286 56	15,000 00	25,000 00	269,096 56
Totals..	$919,893 60	$728,937 74	$101,723 66	$1,279,688 87	$285,000 00	$370,000 00	$3,685,243 87

*Including appropriation for weather service.
†October 1, 1886, to June 30, 1887, nine months.
‡Including $5,000 for institutes and $1,000 for weather service.
¶Including $5,500 for institutes and $1,000 for weather service
‖Including $5,500 for institutes and $1,000 for weather service.
§Including $2,750 for institutes and $500 for weather service.
††To June 30. **Weather service.

SUMMARY OF INVENTORY, JUNE 30, 1906.

College farm and park, 671 acres @ $70		$46,970 00
Athletic field and drive, 13 acres @ $87.50		1,137 50
Buildings—		
Library and museum, built 1881	$22,000 00	
College hall, built 1856	17,000 00	
Wells hall, rebuilt 1905-06	55,000 00	
Williams hall, built 1869	30,000 00	
Abbot hall, built 1888, add. in 1896	15,000 00	
Chemical laboratory, built in 1871, south end add. 1881	18,000 00	
Machine shops and foundry, 1885, south end add. 1887	15,000 00	
Veterinary laboratory, built 1885	5,000 00	
Horticultural laboratory, built 1888	7,000 00	
Agricultural laboratory, built 1889, imp. 1897	7,500 00	
Botanical laboratory, built 1892	10,000 00	
Armory, built 1885	6,000 00	
Greenhouses and stable, built 1873, 1879; rebuilt 1892 and 1902	6,000 00	
Boiler house and chimney, built 1893-4	3,000 00	
President's and two frame dwellings, built 1874	12,000 00	
Six brick dwellings, built 1857, 1879 and 1884	18,000 00	
One frame dwelling, built 1885	3,500 00	
Howard terrace dwelling, built 1888	13,000 00	
Farm house dwelling, built 1869	2,000 00	
Herdsman's dwelling, built 1867	400 00	
Seven barns at professors' houses	1,050 00	
Horticultural barn and shed, built 1868, '75, '87	1,200 00	
Cattle barn and shed, built 1862	1,500 00	
Sheep barn, built 1865	1,000 00	
Horse barn, built 1871	1,000 00	
Piggery, built 1871	1,000 00	
Corn barn, built 1878	400 00	
Grade herd barn, built 1905	4,000 00	
Horse sheds, built 1894	200 00	
Tool barn, built 1881	1,000 00	
Brickwork shop, built 1857	500 00	
Observatory, built 1880	100 00	
Bath house and fittings, built 1902-3	17,000 00	
Paint shop, built 1879	150 00	
Hospital, built 1894	3,000 00	
Bull barn, built 1905	1,500 00	
Waiting room street car terminus, built 1902	1,700 00	
Street car track and fixtures, 600 ft., built 1897	360 00	
Lumber shed, mechanical department	250 00	
Silo	210 00	
Coal shed, built 1899	700 00	
Women's building, built 1900	91,000 00	
Dairy barn, built 1900	4,000 00	
Dairy building, built in 1900	15,000 00	
Bacteriological laboratory, built 1902	27,000 00	
Power house, built 1904	25,000 00	
Coal shed, built 1905	6,500 00	
Tunnel system	45,000 00	
Cold storage, rebuilt 1905	2,000 00	
		518,720 00
Amount carried forward		$566,827 50

Amount brought forward		$566,827 50
Iron bridge over Cedar river, built 1888		1,500 00
Dynamo at Agricultural laboratory		280 00
Bridge to athletic field		516 50
Heat, light and water department—		
Stock	$68 55	
Brass goods	45 00	
Coal	2,500 00	
Water works plant	12,874 00	
Electric light plant	6,880 00	
Steam heating plant	30,192 00	
Bath house plant	698 00	
Tools and fixtures	1,262 90	
Electric light stock	207 60	
		54,728 05
Bacteriological Department—		
Apparatus	$4,634 99	
Chemicals	210 63	
Office fixtures	1,210 45	
Books and pamphlets	48 30	
		6,104 37
Botanical Department—		
Herbarium	$11,075 80	
Museum	767 95	
Books	372 41	
Maps and charts	396 00	
Negatives	239 58	
Photographs and engravings	943 05	
Lantern slides	263 25	
Microscopes and accessories	1,801 14	
Glassware	430 08	
Chemicals, stains, etc.	50 49	
Office and class-room equipment	733 07	
Garden tools	44 36	
General equipment	173 15	
		17,290 33
Chemical Department—		
Cases and fixtures	$3,192 95	
Specimens	393 00	
Balances	1,700 50	
Weights	674 20	
Mercury	64 00	
Glassware ungraduated	3,365 05	
Glassware graduated	1,015 65	
Porcelain ware	557 55	
Wooden apparatus	160 78	
Rubber material	80 00	
Platinum ware	1,678 43	
Electrical apparatus	1,208 75	
Metals	71 37	
Special apparatus	1,878 65	
Miscellaneous	186 78	
Assay room supplies	100 82	
Chemicals, inorganic	538 97	
Acids	65 14	
Chemicals, organic	299 12	
Miscellaneous samples	17 35	
Tools	64 55	
Hardware	822 67	
		18,136 28
Amount carried forward		$665,383 03

Amount brought forward		$665,383 03
Farm Department—		
Live stock, cattle	$7,850 00	
Live stock, swine	1,196 50	
Live stock, sheep	1,560 00	
Live stock, horses	1,150 00	
Agronomy division	1,781 54	
Agronomy office	70 34	
Lower class room	42 70	
Upper class room	160 00	
Tool barn	700 20	
Grade barn	107 60	
Horse barn	21 05	
Dairy barn	$450 30	
Feed	654 00	
Field crops	996 00	
Miscellaneous	38 35	
Meat house	120 85	
Farm house equipment	32 70	
Office	705 92	
Office books and library	1,347 03	
Dairy	991 75	
Poultry department	1,070 17	
		21,047 00
Horticultural Department—		
Tools	$141 55	
Heavy tools	540 50	
Teams, harness, etc	323 60	
Grafting and pruning tools, etc	61 75	
Tools in laboratory	22 45	
Animals in Zoo	128 00	
Spraying outfit	300 05	
Class room	491 54	
Laboratory equipment	279 15	
Office fixtures	2,473 12	
Greenhouse tools	282 95	
Greenhouse plants	1,642 90	
Miscellaneous	429 87	
		7,117 43
Department of Mathematics and Civil Engineering—		
Surveying instruments	$4,840 20	
Photographic material	58 25	
Tools and apparatus	1,246 94	
Class rooms	235 50	
Office furniture	440 95	
Engineering class room	157 55	
Astronomical laboratory	838 50	
Books and pamphlets	91 07	
		7,908 96
Mechanical Department—		
Office and class room fixtures	$2,867 79	
Experimental laboratory instruments	2,187 74	
Experimental laboratory apparatus	3,145 45	
Drawing and mathematical instruments	177 47	
Iron-working machinery	5,228 70	
Small iron-working tools	1,769 15	
Wood-working machinery	1,296 70	
Small wood-working tools	806 02	
Forge shop	747 13	
Foundry	612 18	
Belting, pulleys, shafting, etc	362 48	
Amount carried forward		$701,456 42

Amount brought forward		$701,456 42
Mechanical Department—Continued:		
Office supplies and stock	$408 35	
Sundry supplies	200 04	
Machine shop, stock	1,064 04	
Foundry, stock	393 50	
Wood shop, stock	338 90	
Forge shop, stock	59 05	
		21,704 69
Department of Physics—		
Office and shop	$982 49	
Mechanics	814 10	
Heat	381 85	
Sound	195 00	
Light	1,159 25	
Dynamic electricity	4,260 49	
Static electricity	1,012 50	
		8,805 68
Women's Department—		
Furniture, musical instruments, etc.	$5,364 60	
Cooking school	646 76	
Wood-working room	405 76	
Domestic art	488 21	
Library	89 60	
Offices	130 15	
Miscellaneous	109 63	
Gymnasium	710 26	
		7,944 97
Department of Zoology and Geology—		
General museum	$18,091 75	
Furniture and general apparatus	1,297 80	
Tools	24 25	
Dissecting instruments	81 31	
Drawing instruments	12 75	
Microscopes	1,240 87	
Miscellaneous	705 41	
		21,454 14
Carpenter shop		887 76
Drawing Department—Furniture and equipment		2,385 89
English Department—Furniture and equipment		319 00
Forestry Department—Furniture, tools, etc.		1,122 73
Department of History and Economics		215 00
Library		48,921 83
Military Department		777 60
Physical Culture and Athletics		661 45
President's Office		648 25
Secretary's Office		1,973 44
Veterinary Department—Apparatus and equipment		1,659 95
Hospital		269 96
Farmers' Institutes		579 75
Board Rooms		270 55
Postoffice		281 65
Weather Bureau		1,774 87
Miscellaneous		597 72
Cleaning supplies		270 90
Furniture in Chapel		342 30
Paint shop		482 44
Special courses		2,080 87
Office State Inspector of Nurseries		109 55
Total		$827,999 36

SUMMARY OF EXPERIMENT STATION INVENTORY.

Lands donated to the Station—		
80 acres at Grayling, fenced and improved at cost.	$1,000 00	
5 acres at South Haven, fenced and improved.....	1,000 00	
160 acres at Chatham, including buildings........	4,000 00	
		$6,000 00
Buildings—		
Bacteriological stable	$3,700 00	
Experiment station feed barn.....................	800 00	
Veterinary laboratory, experimental rooms......	250 00	
House	1,000 00	
Station Terrace building	3,000 00	
Seed room	500 00	
Slaughter house	625 00	
Storage barn	600 00	
		10,475 00
Bacteriological Department—		
Apparatus	$2,057 71	
Chemicals	683 82	
Office	36 00	
Library	870 00	
		3,647 53
Botanical Department—		
Office	$322 21	
Books	35 10	
Apparatus	390 86	
Glassware	24 51	
Sundry	16 13	
		788 81
Chemical Department—		
Platinum ware	$357 26	
Porcelain ware	59 72	
Chemicals	227 48	
Apparatus	1,297 40	
Glassware	447 99	
		2,389 85
Entomological Department—		
Office equipment	$884 67	
Apparatus	587 19	
Supplies	41 44	
Chemicals	49 32	
Glassware	103 74	
Books	236 86	
Spraying equipment	84 57	
Miscellaneous	78 60	
		2,066 39
Farm Department—		
Tools and equipment	$993 85	
Office	327 90	
		1,321 75
Horticultural Department		529 70
Secretary's Office		169 13
Library		3,810 50
South Haven Station, equipment................................		307 64
Upper Peninsula Station, equipment............................		1,285 44
Total..		$32,791 74

DEPARTMENT REPORTS.

REPORT OF THE PRESIDENT.

To the Honorable State Board of Agriculture:

I herewith submit my report as president for the year ending June 30, 1906.

The constitution of the State of Michigan, as revised in the year 1850, made provision for the establishing of a State Agricultural College. This provision in the state constitution was carried into effect by the state legislature in 1855. The sum of $56,320 resulting from the sales of salt-spring and swamp land grants was set apart by the legislature to be used in the purchase of a farm and the erection of buildings. A tract of 676 acres of uncleared land, located three miles east of the state capital, was purchased, four brick residences, a barn, a dormitory and a recitation building were erected, and the college was opened for students with appropriate exercises on May 13, 1857.

By the act of 1855 the college was placed in control of the State Board of Education. The State Board of Agriculture was created and placed in charge of the college by the legislature in 1861. This board consisted of six members appointed by the governor and confirmed by the senate. The appointments were so arranged that two members retire each two years. The legislature of 1905 added one member to the board. This member is appointed in the same manner and for the same length of term as the other members, but must be a resident of the "northern peninsula" of the state. The governor of the state and the president of the college are *ex officio* members of the board.

In 1862 congress appropriated land for the maintenance by the several states of "Colleges of Agriculture and the Mechanic Arts." The state of Michigan by accepting this act came into the possession of 240,000 acres of land. Happily, the provision of the congressional act, commonly termed the "Morrill Act," as to the type of education to be fostered and maintained, coincided almost identically, with the exception of mechanic arts, with the course of instruction as already given in the Michigan Agricultural College. The character of the institution has become more firmly fixed by the provisions of the various acts of congress. The Morrill act states that:

"The leading objects shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the states may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life."

The act of 1887, called the Hatch act, appropriates $15,000 annually for each experiment station, and states that it is—

"In order to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science * * *."

The act of 1890, usually called the second Merrill act, and granting to the college $25,000 annually, stipulates that it shall—

"Be applied only to instruction in agriculture, the mechanic arts, the English language, and the various branches of mathematical, physical, natural, and economic science, with special application to the industries of life, and to the facilities for such instruction."

The act of 1906, which we trust may always be known as the Adams act, grants additional aid to the experiment stations—$5,000 the first year, with an increase of $2,000 each succeeding year until the total amounts to $30,000 per annum. The provisions of this act lay emphasis upon research work.

This college, in conformity to these acts as well as by direction of the various state acts of Michigan, offers instruction along the following lines: Agriculture—including horticulture and forestry, engineering, and home economics. This work is preceded and supplemented by such other studies in science, art, history, and literature, as will tend to develop men and women of strong character, cultured minds, and refined manners.

The college also offers during the winter months practical short courses in the various phases of agriculture for young farmers who are not able to enter upon one of the long courses.

The college has graduated with the degree of Bachelor of Science 1,218 persons, and more than six thousand have here received instruction for a longer or shorter period of time. During its history the institution has conferred advanced degrees as follows:

Master of Science, 106.
Master of Agriculture, 12.
Master of Horticulture, 2.
Doctor of Science, 4.
Doctor of Laws, 3.

The following table shows the attendance at the college during the last ten years:

Year.	Entering class.	Short courses.	Total attendance.
1896	108	....	393
1897	135	65	467
1898	214	71	528
1899	293	71	627
1900	250	91	652
1901	271	94	689
1902	349	148	854
1903	377	137	917
1904	351	162	1,009
1905	290	184	950

Summary of enrollment during the past year.

	Engineering.	Cheese.	General Agricultur'l.	Creamery.	Fruit.	Agriculture.	Mechanical.	Women's.	Forestry.	Totals.
Post graduates						3	......	......	......	3
Class of '06						15	44	17	1	77
Class of '07						41	59	23	5	128
Class of '08						36	71	25	3	135
Class of '09						58	117	27	7	209
Sub-freshmen						31	73	24	6	134
Special students						18	22	45	......	85
Special course students	7	13	94	57	13	177	7	......	......	184
Totals						379	393	161	22	955
Deduct names repeated						......	......	......	......	5
Final total						......	......	......	......	950

The faculty of instruction at the present time numbers 73 persons, and the number of other regular employes of the college, not counting day laborers, is 14. This corpse of workers is organized as follows:

FACULTY DEPARTMENTS.

President's Office:

J. L. Snyder, A. M., Ph. D., President.
B. A. Faunce, Clerk.
Elida Yakeley, Secretary.

Secretary's Office:

A. M. Brown, A. B., Secretary of the State Board of Agriculture.
Fred C. Kenney, Cashier.
Cowan H. McGugan, Bookkeeper.
S. Alice Earl, Clerk.

Agricultural Department:

R. S. Shaw, B. S. A., Professor.
Jos. A. Jeffery, B. S. A., Professor of Agronomy.
A. C. Anderson, B. S., Instructor in Animal Husbandry.
H. W. Norton, B. S., Instructor in Animal Husbandry.
F. O. Foster, B. S., Instructor in Dairying.
L. B. McWethy, B. S., Instructor in Agriculture.
C. D. Fick, Foreman of the College Farm.
Bertha Marshall, Clerk of the Farm Department.

Bacteriological Department:
Chas. E. Marshall, Ph. D., Professor.
Walter G. Sackett, B. S., Instructor.
Mary Wetmore, M. D., Instructor.
L. D. Bushnell, B. S., Assistant.
H. Foley Tuttle, B. S., Assistant.

Botanical Department:
Wm. J. Beal, Ph. D., D. Sc., Professor.
J. B. Dandeno, Ph. D., Assistant Professor.
Ellen B. Bach, A. M., Instructor.

Chemical Department:
Frank S. Kedzie, M. S., Professor.
Harry S. Reed, Instructor.
F. I. Rittenour, B. S., Instructor.
C. H. Swanger, B. S., Instructor.
E. A. Boyer, Instructor.
E. L. Larison, M. E., Instructor.

Drawing Department:
W. S. Holdsworth, M. S., Professor.
Caroline L. Holt, Instructor.
Chace Newman, Instructor in Mechanical Drawing.
H. G. Walker, B. S., Instructor in Mechanical Drawing.

Department of Physics and Electrical Engineering:
A. R. Sawyer, B. S., E. E., Professor of Physics and Electrical Engineering.
H. L. Curtis, A. M., Instructor.
O. W. Burk, B. S., Instructor.

Department of Physical Culture:
C. L. Brewer, Director.

English Department:
Howard Edwards, A. M., LL. D., Professor.
E. S. King, Assistant Professor.
G. L. Stevens, A. B., Lit. B., Instructor.
Bertha M. Wellman, B. S., B. Pd., Instructor.
Norma Lucile Gilchrist, A. B., Instructor.
Bessie K. Paddock, B. S., Instructor.

Forestry Department:
E. E. Bogue, M. S., A. M., Professor.

Horticultural Department:
S. W. Fletcher, M. S., Ph. D., Professor.
Thomas Gunson, Instructor and Superintendent of the Grounds.
C. A. McCue, B. S., Instructor.
A. R. Kohler, B. S., Instructor.
Chas. Davis, Foreman of the Grounds.

History and Political Economy Department:
W. O. Hedrick, M. S., Professor.
E. H. Ryder, A. M., Instructor.

Institutes and Nursery Inspection:
L. R. Taft, M. S., Superintendent.

Library Department:
Linda E. Landon, Librarian.
Cora Feldcamp, B. S., Assistant Librarian.

Mathematical Department:
H. K. Vedder, C. E., Professor of Mathematics and Civil Engineering.
Warren Babcock, B. S., Associate Professor of Mathematics and Secretary of the Faculty.
Samuel C. Hadden, B. S., Instructor in Civil Engineering.
Sherwood Hinds, B. S., Instructor in Mathematics and Civil Engineering.
Carl Gunderson, A. M., Ph. D., Instructor in Mathematics.
A. E. Jones, A. B., Instructor in Mathematics.
A. R. Alger, B. S., Instructor in Mathematics.
Glenn James, A. B., Instructor in Mathematics.

Mechanical Engineering Department:
Chas. L. Weil, B. S., Director and Professor of Mechanical Engineering.
W. W. Wells, B. S., Instructor.
R. Rosenstengel, B. S., Instructor.
O. N. Blair, B. S., Instructor.
W. S. Leonard, Instructor in Machine Design.
A. T. Krentel, Foreman of the Wood Shop.
E. C. Baker, Foreman of the Foundry.
Clara B. Purcell, Clerk.

Military Department:
Capt. F. W. Füger, B. S., U. S. A., Commandant.

Veterinary Department:
Geo. A. Waterman, B. S., Professor.

Women's Department:
Maude Gilchrist, B. S., Dean.
Jennie L. K. Haner, Instructor in Domestic Art.
Rachel H. Colwell, A. M., Instructor in Domestic Science.
Sarah B. S. Avery, Instructor in Physical Culture.
Louise Freyhofer, B. S., Instructor in Music.
Bessie Bemis, B. S., Instructor in Domestic Science.
Annie L. Robinson, Instructor in Domestic Art.

Zoological Department:
Walter B. Barrows, B. S., Professor of Zoology and Physiology, and Curator of the General Museum.
R. H. Pettit, B. S. A., Instructor in Zoology and Entomologist of the Experiment Station.
J. J. Myers, B. S., Instructor in Zoology.

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Miscellaneous:

C. D. Smith, M. S., Director of the Experiment Station, Dean of the Short Courses, and College Extension Lecturer.

E. A. Bowd, College Architect.

L. T. Newell, Engineer.

Edward Gibbons, Plumber.

Rowena Ketchum, Nurse in charge of the College Hospital.

Instructors in Short Courses:

Walter E. Spreiter, Carpenter shop.

L. J. Smith, Blacksmith shop.

James Fisk, Blacksmith shop.

Franc Bennett, Accounts.

Roy E. Potts, Babcock testing and Lactometer.

A. J. Patten, Agricultural chemistry.

E. A. Edgerton, Creamery mechanics.

Jay Pullen, Buttermaking from whole milk.

Helmer Rabild, Buttermaking from gathered cream.

The work of the past year has been satisfactory in all respects. The number in attendance, while a little less than that of last year, mainly on account of lack of accommodations incident to the burning of Wells hall, have been of higher scolastic standing than those of any previous year. Of those entering the regular courses last year 57 per cent were of college grade. It will be the policy in the future, as it has been in the past year, to advise very earnestly those of doubtful preparation to spend more time in the high school before attempting college work. The number of students enrolled this year as sub-freshmen and specials was 62 less than last year. This shows, as previously indicated, that the falling off in attendance was in those classes of persons least prepared to enter upon college work. No doubt many of those thus prevented from entering will find their way into this college either next year or later, and will then have such preparation as will enable them to do college work successfully. Largely due to the greater care exercised in the admission of students at the beginning of this year, a very small number were compelled to drop out during the year from inability to do the work required. The complete statistics of the entering class are shown in the following tables:

Students entering during the year, not including those in special short courses.

Items	Men.	Women.	Totals.
Number entering	219	71	290
Average age	19.6	19.4	19.5
Schools previously attended:			
High school	167	58	225
District school	21	5	26
College	11	2	13
State normal	2	1	3
Private school	18	5	23
Entered college on:			
High school diploma	88	32	120
Eighth-grade diploma	20	5	25
Teacher's certificate	3	3	6
Tenth-grade standings	47	19	66
College standings	10	2	12
State normal standings	1	1	2
Private school standings	11	4	15
Examination	24	2	26
Age	15	3	18
Support while here:			
Father	120	41	161
Self	61	17	78
Parents and self	24	7	31
Mother	4	....	4
Guardian	9	3	12
Other sources	1	3	4
Occupation of father:			
Banker	....	3	3
Carpenter	3	2	5
Clergyman	3	1	4
Contractor	3	1	4
Deceased	11	4	15
Druggist	2	3	5
Editor	2	....	2
Engineer (mechanical)	5	1	6
Engineer (civil)	4	....	4
Farmer	90	24	114
Lawyer	5	....	5
Lumberer	3	1	4
Manufacturer	4	2	6
Mechanic	5	3	8
Merchant	24	3	27
Miller	3	....	3
Mining	5	....	5
Miscellaneous	21	4	25
Not given	14	10	24
Physician	3	1	4
Railroad employee	6	1	7
Real estate	2	3	5
Teacher	3	4	7
Proposed occupation after leaving college:			
Engineer (agricultural)	1	....	1
Engineer (civil)	11	....	11
Engineer (electrical)	17	....	17
Engineer (mechanical)	35	....	35
Engineer (mining)	2	....	2
Farmer	26	....	26
Forester	6	....	6
Horticulturist	2	....	2
Mechanic	3	....	3
Miscellaneous	3	7	10
Teacher	7	20	27
Uncertain	106	44	150

Church membership.

Denominations.	Members.	Preference.	Total.
Baptist	9	14	23
Courch of Christ	2	3	5
Church of Christ, Scientist	2	2	4
Congregational	18	23	41
Dutch Reformed	2	....	2
Episcopal	19	4	23
Evangelical	2	1	3
Friends	1	1	2
Jewish	2	1	3
Lutheran	3	1	4
Methodist Episcopal	31	40	71
Methodist Protestant	1	....	1
Moravian	1	....	1
No preference	....	....	45
Presbyterian	17	21	38
Presbyterian (United)	2	....	2
Roman Catholic	15	1	16
United Bretheren	1	1	2
Unitarian	1	....	1
Universalist	1	2	3

Counties represented in the entering class.

Alger	1	Kalkaska	3
Allegan	6	Kalamazoo	5
Antrim	1	Kent	12
Arenac	2	Lapeer	1
Barry	4	Lenawee	12
Bay	4	Livingston	4
Benzie	2	Macomb	2
Berrien	6	Marquette	1
Branch	6	Midland	1
Calhoun	8	Missaukee	1
Cass	1	Montcalm	4
Charlevoix	1	Newaygo	3
Chippewa	4	Oakland	1
Clinton	8	Oceana	2
Dickinson	1	Ontonagon	1
Eaton	13	Osceola	2
Emmet	2	Ottawa	2
Genesee	8	Saginaw	6
Grand Traverse	2	Schoolcraft	1
Hillsdale	4	Shiawassee	4
Houghton	4	St. Clair	5
Huron	3	St. Joseph	5
Ingham	45	Tuscola	3
Ionia	7	Van Buren	10
Iosco	1	Wayne	19
Isabella	2	Washtenaw	3
Jackson	6		

Other states represented.

Germany	1	New York	3
Illinois	4	Ohio	4
Indiana	2	Pennsylvania	4
Massachusetts	1	Russia	1
Minnesota	1	Wisconsin	1
Total			22

The baccalaureate sermon was delivered this year by the Rev. Robert W. McLaughlin, D. D., pastor of the Park Congregational Church, Grand Rapids. The commencement address was given by the Hon. Geo. H. Maxwell, editor of "Maxwell's Talisman" and chairman of the executive committee of the National Irrigation Association. In addition to the commencement oration, the class, as has been the custom for years, was represented by three speakers, one for each department. Mr. C. A. Wilson spoke on "The Farmer in Politics." Mr. J. R. Lambert took as his subject "Hydraulic Power Development," and Miss Alida Alexander read a paper on "Women's Influence in Public Affairs." The graduating class this year numbered seventy-four. The number graduated from the agricultural course was small on account of the change in entrance requirements when this class entered the college. The names and addresses of the class are shown in the following table:

Name.	Postoffice.	County.
Adams, Edwin H., *e*	Chesaning	Saginaw.
Alexander, Alida, *w*	Geneva	Lenawee.
Anderson, A. Crosby, *a*	Forestville	NEW YORK.
Angell, Anna M., *w*	Agricultural College	Ingham.
Armstrong, Scott, *e*	Hanover	Jackson.
Barnett, Howard H., *e*	Pontiac	Oakland.
Bates, Erastus N., *e*	Moline	Allegan.
Bird, Ralph C., *e*	Milford	Oakland.
Boomsliter, George P., *e*	Grand Haven	Ottawa.
Boughton, Carl H., *e*	Traverse City	Grand Traverse.
Bucknell, Howard C., *a*	Centerville	St. Joseph.
Cameron, Arba H., *e*	Charlevoix	Charlevoix.
Campbell, Flora L., *w*	Okemos	Ingham.
Case Florence, *w*	Berlin	WISCONSIN.
Cavanagh, John G., *e*	Galt	Missaukee.
Champe, Silas, *a*	Agricultural College	Ingham.
Crosby, Henry H., *a*	Three Oaks	Berrien.
Dorsey, Maxwell J., *a*	Dresden	OHIO.
Flaconer, Archer E., *e*	Agricultural College	Ingham.
Farley, Fred A., *a*	Almont	Lapeer.
Farrand, Bell, *w*	Jackson	Jackson.
Fisk, James E., *e*	Colling	Tuscola.
Francis, Howard L., *e*	Charlevoix	Charlevoix.
Freedman, Blanche, *w*	Lansing	Ingham.
Gordon, Lawrence O. *e*	Muskegon	Muskegon.
Graham, Ralph, *e*	Owosso	Shiawassee.
Grover, Frank N., *e*	Alma	Gratiot.
Hagadorn, Earl, *a*	Okemos	Ingham.
Hebblewhite, Gilbert W., *e*	Armada	Macomb.
Hebblewhite, Grace, *w*	Armada	Macomb.
Hough, Walter K., *a*	Almont	Lapeer.
Kedzie, Rosmond, *w*	Lansing	Ingham.
Keech, Rollo E., *e*	Rockfort	Kent.
Kendrick, Earl W., *e*	Reading	Hillsdale.
Kingscott, Walter J., *m*	Manistee	Manistee.
Lamb, Cass A., *e*	Washington	Macomb.
Lambert, John R., *e*	Niles	Berrien.
Langeler, Marinus B., *e*	Grand Rapids	Kent.
Lawrence, Carrie, *w*	Hudson	Lenawee.
Linkletter, Frank D., *a*	Benzonia	Benzie.
Liverance, Frank, *e*	Lansing	Ingham.
Locke, Franklin, *e*	Caro	Tuscola.
Markham, Allan, *e*	Owosso	Shiawassee.
Mastenbrook, Henry, J. *e*	Grandville	Kent.
Matthews, Mildred M., *w*	Lansing	Ingham.
Morgan, William E., *e*	Detroit	Wayne.
Neilson, Wilhelm, *e*	Howell	Livingston.
Northrop, Zae, *w*	Thompsonville	Benzie.
Peters, Gertrude *w*	Springport	Jackson.
Phippeny, Max, *m*	Manistique	Schoolcraft.
Poole, John E., *e*	Mackinac Island	Mackinac.
Potts, Ray G., *a*	Washington	Macomb.
Potts, Roy C., *a*	Washington	Macomb.
Ranger, Karl F., *e*	Battle Creek	Calhoun.
Rasmussen, Rasmus, *e*	Ludington	Mason.
Robinson, Lulu B. *w*	Lansing	Ingham.
Robson, Albert *f*	Ilion	NEW YORK.
Salisbury, Hugh C., *e*	Hart	Oceana.
Sanborn, Leslie M., *e*	Flushing	Genesee.
Skeels, Dora, *w*	Harriette	Wexford.
Smith, Leslie J., *e*	Petoskey	Emmet.
Smith, Ernest, F., *e*	Marshall	Calhoun.
Spencer, Louis M., *e*	Nunica	Ottawa.
Stanton, Walter E., *a*	Lacey	Barry.
Stevens, Kinton B., *e*	Santa Barbara	CALIFORNIA.
Strand, W. C., *e*	Otsego	Allegan.
Taylor, Jenne, *w*	Eaton Rapids	Eaton.
Taylor, Joseph H. *e*	Almont	Lapeer
Willson, C. A., *a*	Clifford	Lapeer.
Wilson, William E., *e*	Bay City,	Bay.
Wilson, William P., *e*	Detroit	Wayne.

Master of science.

Name.	Postoffice.	County.
Spragg, Frank A., B. S.	Denton	MONTANA.
Woodbury Charles G., B. S.	Lansing	Ingham.

CHANGES IN THE FACULTY.

There are always a number of changes at the end of each year among the college instructors. This is due largely to the fact that the college cannot advance salaries for subordinate positions rapidly enough to meet the growth in experience and attainments of the young men and young women holding instructorships. In other words, they rapidly outgrow these positions. So many changes are to be deplored; but it is solely a business proposition. By a greater outlay for salaries a large percentage of these changes would be avoided. Such a policy, however, would soon reach a limit. A good six-hundred-dollar instructor will in five years, and often before that time, demand twelve hundred; and in another five years will be ready for the maximum salary. If the salary were advanced to the maximum it would not make it possible to create a position of first-grade for such a man, and it would be unfair to full professors at the heads of departments to pay the maximum salary to subordinates who carry very little responsibility outside of their teaching.

The college has been fortunate in recent years in retaining the services of its full professors. Notwithstanding the addition of new departments in recent years, the average length of service in this college of those now holding full professorships is more than eleven years. It seems to me a remarkable fact that pallid death has rapped so few times at the doors of the faculty. So far as I have been able to learn, there has not been a death among the active teaching force during the forty-nine years of its existence.

It is with regret that I have to report the resignation at the close of this year of Dr. Howard Edwards, professor of English literature and modern languages. Dr. Edwards has given to this college sixteen years of most faithful and efficient service. He has been an exceptionally popular and successful teacher. His breadth of scholarship and sterling qualities of character made his service to the college of a very high order. He leaves this institution to accept the presidency of the Rhode Island College of Agriculture and Mechanic Arts.

COURSES OF STUDY.

The only change of importance made in the course of study during the year was the addition of elective work in electrical engineering in the junior and senior years of the engineering course. The college now offers an engineering course which is the same for all students during the freshman and sophomore years. It endeavors during these years to give thorough training in the basic subjects, accompanied with daily practical work in the shop and drafting room. At the beginning of the junior year students are given the opportunity to elect their work either in mechanical, civil or electrical engineering, or under certain limitations they may elect subjects in any of these courses.

The faculty has discussed very thoroughly during the year our courses for agricultural and women students. The opinion of the faculty is practically unanimous that this college should retain in its courses certain general culture studies, such as English, history, political economy, etc. It does not look with favor upon the free elective system adopted by some distinguished agricultural schools, which makes it possible for a student to gain the bachelor's degree without mathematics beyond the rudiments of arithmetic, or without pursuing even to a limited extent those culture studies which give to the student a degree of ease in expressing his own thoughts, and a fair appreciation of the great fields of knowledge that lie outside his own narrow profession.

This does not mean that our courses will not be changed. They have undergone many changes in the past few years, and will be changed to an even greater extent in the near future. As the field of knowledge in agriculture and home economics broadens our courses must keep pace with the trend of development in these lines. Much that was considered essential a few years ago has already, or will soon, give way to something better; but the preparation of young men and women for their places as members of society, as responsible citizens, as future leaders in their own communities, will not be lost sight of in the effort to make them exceptionally capable in their chosen lines of work.

IMPROVEMENTS.

The physical equipment of the college during the past decade has been very much enlarged and improved. The following may be noted:

The Women's Building, 1899-1900, costing..........	$95,000
Dairy building, 1900	15,000
Barn, 1900	4,000
Bacteriological laboratory, 1902	27,000
Waiting room and postoffice, 1902................	1,700
Bath house, 1903	17,000
Athletic field and improvements..................	2,500
Right of way for railroad........................	1,000
Street car track on campus......................	360
Three new wells	1,800
Central heating and lighting plant................	140,000
Wells hall	55,000
Barns	11,000
Poultry plant	2,000
Engineering building	100,000
Total	$473,360

CENTRAL HEATING AND LIGHTING PLANT.

We have just completed the central heating and lighting system. The cost has been about $140,000. The building which houses the equipment is located about one hundred feet south of the veterinary laboratory. From this building tunnels radiate to all the large buildings on the grounds. These tunnels are constructed of concrete, and are six feet wide and six and one-half feet high. Their entire length is nearly three-quarters of a mile. In them are placed the steam pipes for heating purposes and the electric lighting wires; and they will also soon contain the telephone wires. The building proper is 100 by 70 feet. The smokestack is 125 feet high, 6 feet in diameter inside, and 10 feet in external diameter at the base. It is built of vitrified hollow blocks. There are four 150-H. P. Scotch marine boilers equipped with the Jones underfeed stokers. There are two 125-kilowatt dynamos. These are duplicates, either one of which is ample to carry the entire load. A smaller 45-kilowatt dynamo carries the day load. The entire plant represents engineering skill of a high grade and will be of great educational value to all our engineering students. A coal shed of 1,800 tons capacity is located back of the boiler house. The coal is transferred to hoppers automatically. The ashes drop to a car placed in a tunnel in front of the boilers and are likewise handled automatically, or without the use of the shovel. The entire plant is very satisfactory. The absence of smoke from it is very much appreciated by the dwellers on the campus.

WELLS HALL.

The new Wells Hall which will take the place of the one destroyed by fire on February 11, 1905, will be ready for occupancy at the opening of the next school year. This building is erected in six compartments or wards, with fire-proof walls between, and with an outside entrance for each. Every floor in each ward contains five rooms and a toilet room, making accommodations in the entire building for 156 students. Of the rooms, sixty-six are double rooms, 15 by 15 feet, with a large cloak room, and twenty-four are single rooms. All are well lighted and each is ventilated with a separate flue. The finishings are Georgia pine and the floors are of maple. The attic of each ward is finished in the same manner and will furnish very pleasant quarters for six literary societies. The basement is high and well lighted. It contains a large kitchen with serving rooms, pantries, storage rooms. dining rooms with a seating capacity for three hundred, besides toilet rooms and six fine living rooms for the help.

BARNS.

The last legislature appropriated $10,000 for the erection of a new barn and for the moving and repairing of the old ones. This work will be completed during the coming summer and will not only add greatly to the appearance of the buildings and yards but will also afford commodious quarters for the housing of stock and farm machinery.

POULTRY PLANT.

In the bill passed by the last legislature appropriating $20,000 for experimental work in live stock it was provided that $2,000 of this sum should be expended in erecting and equipping a poultry plant. In carrying out this project a site was selected on the high ground about twenty-five rods east of the farm house, and the following buildings were erected: A winter laying house 15 by 84 feet, a combined incubator cellar and laboratory, and three portable gasoline colony brooders. A fattening shed and several small model poultry houses are yet to be erected.

ENGINEERING BUILDING.

The new building which is now under construction but which will not be completed before next June will be the finest building on the grounds. The material used is stone for the basement story and paving brick above. The interior is mill proof construction with maple floors and oak finishings. It is 182 by 84 feet in size with an extension on the rear of 47 by 37 feet. The basement is nearly all above ground and will answer splendidly for laboratory purposes. The fifth story, counting the basement as the first, will be used mainly for drawing rooms, on account of the excellent lighting made possible by the skylights in the roof. The building will contain more than forty laboratories and recitation rooms, besides offices, storage, toilet, and other small rooms. It will be occupied by the engineering—mechanical, civil and electrical,—the drawing and the physics departments, and will be fully occupied from the start. This building is located between Wells hall and the present mechanical building, and will cost about $100,000.

THE CAMPUS.

The campus is undergoing some slight changes from time to time. The board employed the noted landscape architect, Mr. Simons, of Chicago, to visit the college last spring and spend two or three days in looking over the campus and in consultation with the men now in charge. This was done not with a view to any radical changes but rather, if possible, to settle upon some plan with reference to the location of buildings in the future. He approved slight changes in a few of the old roads and the removal of some unimportant trees. His suggestion that no new buildings be placed on the inner campus has been approved by the board and will, no doubt, be adhered to in the future. If this policy is followed, the M. A. C. campus will go down to future generations as "a thing of beauty and a joy forever." His other important recommendation was that the new auditorium and administration building which we hope to erect in the near future be located near the public highway northeast of the horticultural building. This building will very naturally be the center of campus life, and the wisdom of placing it on the edge of the campus is doubted by some. As College hall has become antiquated and the outer walls are badly cracked and growing worse, it has been suggested that it should be removed and the new building placed on this site. These and similar matters are receiving careful consideration, with the hope that serious mistakes may be avoided. On such questions every one has an opinion, but the final decision should be left to the expert. Here, if anywhere, special training and experience counts, and should not be set aside for preferences that may be largely matters of sentiment.

THE EXPERIMENT STATION.

The act approved February 12, 1855, establishing the Michigan Agricultural College provided among other things that the secretary of the college—

"Shall keep a careful account with each field, in connection with a plan of the farming lands or farm, exhibiting the position of each, in which shall be shown the manner and cost of preparing the ground, the kind of crop, time of planting or sowing, the after condition, the time and manner of harvesting, the labor devoted to each process, and its cost price, with the cost of preparing the matured crop for market, and the price for which it was sold * * * and the said record shall, at all reasonable hours, be open to the inspection of any citizen of this state."

Experimental work in agriculture, under the operation of this act, began with the opening of the college and has continued without a break to the present time. When the college was reorganized in 1861 the work of experimentation was made even stronger. The secretary of the board of agriculture was instructed to gather information from all sources and disseminate it among the farmers of the state. Section 9 of this act authorizes him to distribute seeds, plaats, trees and shrubs to those farmers who would agree to cultivate them properly and return to the secretary a portion of the products thereof, with a full statement of the mode of cultivation, and such other information as might be necessary to ascertain their value for general cultivation in the state. This information was to be given to the newspapers of the state.

It does not seem from the reports that there were many results at that time from the co-operative work with farmers; but there was much valuable research work done by the various professors in the early years of the college. Manly Miles was connected with the institution as a professor from 1861 to 1875. Much of his work was at least a quarter of a century ahead of his time. His experiments in lamb feeding in 1866 would be a credit to any experiment station at the present day. Who was Doctor Miles?—Dr. Burrell, vice president of the university of Illinois, in speaking of the call extended by that institution to Dr. Miles in 1870 says, "No one else in America at this time enjoyed anything comparable with Dr. Miles in the public estimation of competency to give instruction in scientific agriculture. It was he who had been called the only professor of the subject in the country."

In 1885 the legislature of Michigan passed an act providing for the dissemination of the results of experiments made at the college among the people of the state, in bulletin form. The professors of chemistry, botany, zoology, agriculture, horticulture and veterinary science, were required to prepare at least two articles each year which were to be sent to the press of the state. The expense for printing these bulletins, postage, etc., was to be paid out of the general funds of the state.

This is a very brief and meager history of the legal status of the work in experimentation carried on at the college before the passage of the United States act of 1887. This act, usually spoken of as the Hatch act, grants annually $15,000 from government funds to the experiment station in each state. In Michigan, by legislative enactment, the state experiment station is a department of the State Agricultural College.

The national congress at its last session granted additional aid to the state experiment stations. The Adams act gives each station $5,000 for the year 1906, with an increase of $2,000 each year for five years. At the end of that time, and thereafter, the appropriation by the general government for each experiment station will be $30,000 per annum.

The one who deserves special credit for the latter act was the late Hon. H. C. Adams, a member of congress from Wisconsin. To him more than to any other man, even more than all other men not officially concerned in its passage, is due the credit. As a member of the executive committee of the National Association of Agricultural Colleges and Experiment Stations, I have visited Washington many times, with other members of the committee during the past three years in behalf of this legislation. We always found Mr. Adams at the helm, ready to confer and advise. He was a man of most remarkable energy, sane and sensible at all times. He threw all his energy and even his very life into the passage of this act. His untimely death at the Auditorium Hotel, Chicago, on July 9th, has brought universal sorrow to all friends of scientific and practical agriculture.

The state of Michigan has in recent years supplemented the funds received from the general government to the extent of about $9,000 annually. The northern peninsula and South Haven sub-stations are supported entirely by the college. The expense of publishing the station bulletins is annually about $4,000 and is borne by the college. During the past year the following bulletins were issued and mailed to our regular bulletin list, which now numbers nearly 40,000 farmers of Michigan:

No. 232, Fertilizer Analysis, Station Chemist A. J. Patten.

No. 233, Insects of the Garden, Entomologist R. H. Pettit.

No. 234, Feeding Dairy Cows, Director C. D. Smith.

No. 235, Succotash as a Soiling Crop, Professor R. S. Shaw.

No. 236, Spraying for Potato Blight, Assistant C. A. McCue.

No. 237, Digester Tankage for Swine, Professor R. S. Shaw.

No. 238, First Annual Report of the Grade Dairy Herd, Professor R. S. Shaw and A. C. Anderson.

Special 34, Corn Improvement, Professor J. A. Jeffery.

Special 35, Report of the South Haven Sub-station, Professor L. R. Taft and T. A. Farrand.

These bulletins are, of course, not all read by all farmers who receive them. A farmer engaged entirely in fruit culture is not likely to take much interest in a dairy bulletin, but that a great many of these bulletins are read intelligently and the advice therein given followed, is evident to anyone who attends farmers' institutes or mingles in any way with the farmers of the state. With experiment station bulletins to be had for the asking, with farmers' institutes brought to his very door, and with an intelligent agricultural press available at a trifling expense, there seems to be no necessity for any farmer to remain ignorant of the most advanced methods of agriculture.

FARMERS' INSTITUTES.

On May 7, 1875, Dr. Kedzie offered the following resolutions in a meeting of the college faculty, and they were unanimously adopted:

"Resolved, That a committee of three be appointed by the president to draw up a scheme for a series of farmers' institutes to be held in different parts of the state during the next winter, including in the exercises of such institutes lectures and essays by members of the faculty; that the several members of the State Board of Agriculture and leading farmers residing in the vicinity of the place of holding such institutes, be respectfully and earnestly requested to participate in the exercises by lectures, essays, and discussions."

"Resolved, That said committee be instructed to confer with the State Board of Agriculture, at its next meeting, to make all necessary arrangements for inaugurating and carrying out such series of farmers' institutes."

Dr. Kedzie, Dr. Beal and Prof. R. C. Carpenter, representing the faculty, presented to the board on June 1st a memorial requesting the board to adopt a regular system for the holding of six farmers' institutes each winter in the older settled portions of the state. This plan was adopted by the board, and during the month of January, 1876, institutes were held in Allegan, Armada, Decatur, Rochester, Adrian and Coldwater. These institutes were the first held in this state, and as far as we know, the first held in this country under the authority of a state board or college faculty. The reports show that the college received aid from the legislature from time to time for the purpose of carrying on these institutes. The demand from the different sections of the state for institutes finally became so urgent that in 1897 the legislature passed an act authorizing our present institute system and made an annual appropriation of $5,000 for carrying it forward. When the legislature, in 1901, granted to the college a mill-tax, it was stipulated that the college should carry on the farmers' institutes, expending for this purpose not less than $7,500 annually. This sum now seems inadequate, and provision has been made to add at least $1,000 to this amount for next year.

Under the present law institute societies are formed in each county and upon their initiative one two-day institute, and where convenient a few one-day meetings, are held in each county. Speakers are provided by the state, under direction of the college, for each of these meetings. Last year there were held 74 two-day institutes, with a total attendance of 65,285; 257 one-day meetings, with a total attendance of 57,148; making a total attendance for the series of 122,433.

In addition to these meetings a series of "railroad institutes" was held during the month of April in co-operation with the Lake Shore & Michigan Southern and the Michigan Central railroads, thirty being held upon the former line and seventeen upon the latter. Each road furnished a special train consisting of two passenger coaches and one baggage car, and stops of from one hour to an hour and a quarter were made at each meeting. These had been well advertised beforehand, and the two passenger coaches were usually filled with an audience assembled to hear a lecture or two by members of the college faculty and occasional addresses by others who accompanied the trains for a part of the series. The subject generally presented was that of corn selection and culture, and after the addresses the audience adjourned to the baggage car to inspect the sample ears of various varieties exhibited in illustration of the lectures. These traveling institutes were accompanied by several newspaper reporters, railway officials, and representatives of leading farm journals. Governor Warner was with the "corn train" one day and made several addresses. The total number of these meetings was forty-nine, and the aggregate attendance was 3,962. The success and interest of this series suggests the question—may it not be that the further development of institute work should lie along this line? Would it be possible to hold institutes during the fall and take from county to county several car loads of live stock, fruits, etc., for demonstration purposes?

The greatest problem at present in institute work is to find competent speakers. These institutes are held during the winter at the same time that the short courses are in progress at the college. This makes it practically impossible for the college professors to render much assistance to the institute work. The superintendent of institutes is compelled to select his speakers largely from the practical farmers of the state. Such men are not always to be had. Many of them cannot leave their business and others do not regard the remuneration sufficient to warrant them in turning over their own affairs to hired men. Traveling from place to place in disagreeable weather and often with very poor hotel accommodations makes the task very onerous to some. A few loyal and able workers have remained in the ranks year after year, but as they drop out it seems more difficult each year to fill their places. The public is becoming better educated in agricultural matters every year and demands a higher grade of ability in institute workers. To meet this demand for a higher quality of instruction, is the problem. May it not be necessary in the near future to educate men specially for this work and arrange the institutes throughout the state in such a way as to afford these workers almost continuous employment? The summer months could be spent in visiting and rendering assistance to the cheese factories and dairies of the state, and also to the individual farmers engaged in dairying. In the early fall attention could be given to the fruit interests, and the later fall to institute work in the upper peninsula. The winter to institute work in the state proper and the spring to corn trains and such other work as would from time to time develop. Men in such work could no doubt publish from time to time descriptions of model dairies, dairy barns, fruit farms and advanced methods in various lines of farming, such as seen in the different parts of the state. Could not a few well trained men render the farming interest of the state a great service by some such method?

NEEDS OF THE COLLEGE.

The growth in attendance during the past few years has very much overcrowded our class rooms and laboratories. The engineering building, which is now under construction, will give some relief, but the need of a similar building for the agricultural department is very pressing. An old barn has been converted into class rooms, so great is the demand for room. We have for years suffered for lack of an auditorium. Our present chapel room has seating capacity for about one-fourth of our students. When a large meeting is to be held chairs must be placed in the armory. This is a great inconvenience and interferes very much with the work of the military department. It is almost impossible to call the student body together for counsel or religious exercises.

Our library is not fire-proof and is very much overcrowded. Book shelves have been placed in many of the alcoves and the available room for students is not only very limited but is growing smaller each year.

The college has no gymnasium for young men. Formerly the armory was used for this purpose, but with the large number at present in military drill, there is practically neither time nor space for gymnastic work.

The additional wing should be added to our women's building, and more space should be provided for the department of botany. These are a few of the more pressing needs.

The agricultural building, the auditorium and the library should cost not less than one hundred thousand each. Another hundred thousand could be used without extravagance in providing the other buildings which are needed.

SEMI-CENTENNIAL.

The college will celebrate its fiftieth anniversary during the last week of next May. The exact date is the 13th, but as this seems a little too early for comfort it has been decided to hold the exercises during the week stated above. Measures have already been taken which will provide for the celebration of this event in a most fitting and dignified manner. It is greatly desired that all former students and alumni be present on this occasion.

Respectfully submitted,

J. L. SNYDER.

REPORT OF THE DEPARTMENT OF BOTANY.

President J. L. Snyder:

Please accept my report for the year ending June 30, 1906. As my last report gave many details, I make this one brief.

A summary of the classes and number of students receiving instruction is as follows:

Class.	Subject.	Term.	Hours per week.	Students enrolled.
Seniors and Juniors, Agricut'l.	Plant physiology	Spring	5	12
Seniors, women	Plant physiology	Fall	5	10
Seniors, women	Histology	Spring	8	2
Juniors, agricultural	Plant pathology	Fall	9	45
Juniors, agricultural	Grasses and other forage plants	Winter	2–3	31
Juniors, agricultural	Weeds	Winter	2–3	29
Juniors, agricultural	Trees and shrubs	Spring	2	38
Juniors, forestry	Wood technology	Winter	8	5
Sophomores agricultural	Plant histology	Winter	8	38
Sophomores, agricultural	Ecology	Spring	3	43
Sophomores, agricultural	Taxonomy	Spring	3	19
Sophomores, women	Trees and shrubs	Spring	2–3	34
Sophomores, women	Plant histology	Spring	8	7
Sophomores, women	Taxonomy	Spring	3	15
Freshmen, agricultural	Taxonomy	Spring	3	32
Freshmen, agricultural	Fruits and seeds	Fall	4½	63
Freshmen, women	Taxonomy	Spring	3	32
Freshmen, women	Fruits and seeds	Fall	4½	30
Subfreshmen, agricultural	Beginning	Fall	2	9
Subfreshmen, agricultural	Beginning	Spring	2	29
Subfreshmen, women	Beginning	Spring	2	18
Short course—for 8 weeks	Beginning	Winter	4	10
Total				551

BOTANIC GARDEN.

The southeast portion of the garden, which contains the compositæ by tribes, and the area covered by the Poppy family, have been raised to high water mark. We have begun to raise certain other portions which have suffered most from high water during the growing season. This will include large areas occupied by the legumes, the mints, the mallows, the parsnip family, and a number of small families.

The artesian well has never failed us, and is a perpetual satisfaction to all concerned.

As I write this report, I have to record another June freshet, which killed a small number of species and injured many more. It is plain that the frequent occurrence of high water makes it imperative to raise more of the garden to high water mark or still higher.

In behalf of the garden, the State Board of Agriculture permitted me this month to visit four of the leading botanic gardens in this country, viz., the one at Cambridge, the Arnold Arboretum at Jamaica Plains, and one at Smith college, Northampton—all of Massachusetts—and another at Bronx park, New York City. By seeing the plants growing at this time of year, and by consulting the directors, I was enabled to take the names of about 450 kinds of shrubs and herbaceous plants that are most desirable for a botanic garden like our own. A great majority of these are not in the market, a considerable number of them were grown from seeds and cuttings selected in China and Japan by Dr. C. S. Sargent. The directors of each garden will give us gladly anything they have in stock. Three of them will be glad to receive from our garden a small number of plants.

Besides securing just such plants as we shall need, it is unnecessary to tell you that many other valuable hints were obtained as to cultivation, labels, etc.

THE HERBARIUM.

Two new cases have been added during the year, each capable of holding about 4,000 plants.

The additions that have been mounted and installed during the year past are here summarized:

SEED PLANTS, FERNS AND THEIR ALLIES.

A. A. Heller, Desiderata from California	283
E. H. Evans, Connecticut	540
J. M. Macoun, Canadian Geological Survey	655
S. H. Pepoon, Cass County, Michigan	630
U. S. Dept. Agriculture, Grasses of C. V. Piper	450
U. S. Dept. Agriculture, Fiber Plants of L. H. Dewey	12
Roland N. Harper, New York, Desiderata	167
C. G. Pringle, Mexican plants	300
E. S. Steele, Washington, D. C., and vicinity	1,225
E. E. Steele, Virginia and West Virginia	273
J. F. Collins and M. L. Fernald, rare plants from Eastern Quebec	148
L. M. Umbach, plants from Montana	703
C. F. Baker, Desiderata, Pacific coast plants	299
C. A. Davis, plants collected in Michigan and elsewhere	6,705
Home collections, mostly desiderata	160
	12,525

MOSSES.

L. M. Umbach, Montana	36

FUNGI.

E. Bartholomew, Fungi Columbiana Century XXII	100
Home collection	10
	110

ALGAE.

F. S. Collins, Fascicle XXVI	50
Total additions for the year	12,721

GENERAL SUMMARY OF PLANTS IN THE HERBARIUM.

Seed plants, ferns and their allies	79,641
Mosses and Liverworts	2,010
Lichens	1,186
Fungi	16,953
Algae	2,120
Grand total in herbarium	101,910

The collection of 6,705 specimens purchased of Charles A. Davis of Ann Arbor was especially full in Michigan plants and mainly for this reason I was much gratified when the state board made a special appropriation for adding this collection to our herbarium. Besides his own collections in this state and elsewhere, I enumerate the leading persons who had furnished plants to the herbarium purchased of Mr. Davis:

Geo. B. Aiton, Minnesota.
A. P. Anderson, Minnesota.
S. M. Bain, Tennessee.
O. F. Baker, Colorado.
C. A. Ballard, Minnesota.
H. C. Beardslee & C. A. Kofoid, Biltmore Collectors, North Carolina.
H. C. Blodgett, Michigan.
F. P. Briggs, Maine.
B. C. Buffum, Wyoming.
F. Burglehaus, Minnesota.
S. H. Burnham, New York.
S. H. & R. D. Camp, Jackson, Michigan.
H. P. Chandler, Norway, Europe.
A. H. Curtis, Florida.
W. E. Damon, New Mexico.
J. R. Davy, California.
C. K. Dodge, Michigan.
E. H. Eames, Connecticut.
H. Eggert, Missouri.
W. W. Eggleston, Vermont.
M. L. Fernold, Maine.
Asa Fitch, New York.
A. Gottinger, Tennessee.
V. M. Glatfetter, Missouri.
Dr. E. Hasse, Arkansas.
A. A. Heller, California.
G. H. Hicks, District of Columbia.
C. H. Hitchcock, New Hampshire.
O. Hofman, Switzerland.
J. H. Holzinger, Minnesota.
E. W. D. Holway, Iowa.
W. L. Jepson, California.
C. A. Kofoid, Ohio.
J. B. Lieberg, Washington.
L. H. Lighthipe, New Jersey.

F. C. McDonald, Illinois.
Messrs. Michens & Bioletti, California.
W. S. Moffatt, Illinois.
J. H. Morton, Ontario.
L. R. Moyer, Minnesota.
G. V. Nash, New Jersey.
C. R. Orcutt.
S. B. Parish, California.
C. V. Piper, Washington.
C. L. Pollard, Maryland.
W. M. Pollock, West Virginia.
E. A. Ross, Iowa.
H. H. Rusby, New York.
A. Ruth, New York.
J. A. Sandberg, Washington.
C. S. Sheldon, Ohio.
Emma A. Shumway, Oregon.
B. C. Taylor, Minnesota.
R. A. Taylor, South Carolina.
L. M. Umbach, Illinois.
W. C. Werner, Ohio.

THE HERBARIUM HAS PASSED THE 100,000 MARK.

In 1889, there were mounted and installed in cases less than 10,000 specimens of seed plants, with about 700 species of ferns, fungi, etc. Students were few in number, the college was poor, and one man had to give instruction in a variety of topics. A professor did not fill a "chair," but had a whole "settee" to himself, as Oliver Wendell Holmes once expressed it. No time could be given to making an herbarium.

In 1890, C. F. Wheeler became instructor in botany, and of all things he liked best to collect specimens and work in an herbarium. I encouraged him in this direction as far as possible. By collecting and exchanging and purchase, we began to add each year 2,500—10,000 specimens. During the year now closing, 12,721 specimens have been added, surpassing the best previous year by about 2,700.

The collections are in first-class condition. To find any traces of insects' work is a rare thing. Specimens are by no means limited to grasses, clovers, weeds and ornamental plants, but include large numbers of other things in variety, as will be seen by this summary:

Seed plants, ferns and their allies	79,641
Mosses and liverworts	2,010
Lichens	1,186
Fungi	16,953
Algae	2,120
Total	101,910

The collection is especially rich in Michigan plants, much the best of any in existence. Seven thousand at one time were purchased of C. F. Wheeler; 4,000 or more were purchased of the heir of Dr. Cooley of Macomb county; 5,000 were purchased of the son of Dr. D. Clark of

Flint, Mich.; 2,886 were purchased of the widow of G. H. Hicks; 6,705 were purchased of Prof. Chas. A. Davis while teaching in the University of Michigan. All of the above collections are distinguished especially for the Michigan plants therein contained. Add to these the work of a host of other collectors in various parts of Michigan. I enumerate some of them:

L. H. Bailey, Bronson Barlow, E. J. Cole, A. A. Crozier, L. H. Dewey, C. K. Dodge, O. A. Farwell, U. P. Hedrick, B. O. Longyear, C. D. McLouth, A. A. Petton, A. J. Pieters, H. C. Skeels.

Especial pains have been taken to make the collection complete in grasses, sedges, clovers, weeds and economic plants in general. For example, A. Phelps Wyman in two seasons collected over 1,700 numbered and authentic herbarium specimens of trees and shrubs in the Arnold Arboretum, Massachusetts. Hundreds of my own collections—more than 4,000 specimens—are included in this herbarium.

The chief value of a good herbarium to this college is to aid in identifying plants received in the botanic garden, planted on the campus, or plats of the experiment station. You would be surprised to learn of the large number of cultivated plants, weeds and plants from forests and swamps which are sent the department of botany to learn name, use, whether poisonous, whether a weed, and if noxious, easiest way to combat. Samples of grass seeds and clover seeds are sent asking names of weed seeds therein contained. In like manner specimens of plants attacked by fungi are often sent in for name and remedy. Nor are all the inquiries from Michigan people. They come from any state in the union, not excepting Canada. One letter brought three kinds of dodder—a parasitic vine—collected in Nevada. To help in experiments and in the preparation of a bulletin it was important that each be correctly identified. The herbarium was a great help in enabling us to send him a full and correct reply to all questions.

The department owns a recent list of seed plants of North America prepared by A. A. Heller of California. Blank leaves intervene on which may be written names of new plants or those introduced from any sources. For more than three years past I have examined every new specimen, comparing it with the name in the catalog, checking everything that is new to the herbarium. Again, specific directions are given an unskilled person, telling how to poison, mount and put in place every acquisition. When mounted, I inspect every specimen to know that the work has been well done.

By this report you get a little insight into the labor required to make a large herbarium and keep it in repair. The work is out of sight of members of the state board, of the faculty, of visitors, and might be slighted or discontinued at any time and no one would be likely to know it. My love for work and of work well done is an ever-present stimulus to keep doing.

The present room will not contain cases for the installation of more than an addition of eight or ten thousand specimens. Shall we then stop, or make more room?

THE ARBORETUM.

This continues to grow and renders considerable assistance by way of illustration for classes in botany and in forestry. It cannot be very nicely kept, owing to a wide winding footpath running diagonally through it. Old papers, bottles, cans and other rubbish find a lodging there. Young trees are broken down, carved with knives, the bark peeled off. This must continue to grow worse as long as the arboretum is open to everybody, at least until the college can support one or more policemen always on duty.

DONATIONS TO THE BOTANICAL DEPARTMENT.

From Wm. C. Smith, Washington, Mich., Coltsfoot.

From U. S. Dept. of Agriculture, L. H. Dewey, Dept. Fibers; Abaca (Manila Hemp), Musa textilis Nee; Jute, Corchorus capsularis L.; China Jute, Abutilon abutilon (L.) Rusby; Flax, Linum usitatissumum L.; Hemp, Cannabis sativa L.; Mauritius Fiber, Furcraea faetida (L.) Han.; Jamnare Istle, Agave laphantha (Scheide); Sisal, Agave ridida elongata (Jacobi) Baker; New England Fiber, Phormium tenax Forst; Cotton, Gassypium hirsutum L.

From Wm. Trelease, Botanic Garden, St. Louis, Mo., Plant of Triosteum angustifolium.

GIFTS TO OTHERS.

To U. S. Dept. of Agriculture, Seed Division, Seeds of Solanum rostratum, Linaria linaria	2
To H. C. Skeels, Joliet, Ill., for his herbarium	106
To J. M. Macoun, for Canadian Geological Survey	730
Total	838

Thirty-four bundles of grasses were shown at the county fair at Adrian, Mich.

Respectfully submitted,

W. J. BEAL,

Professor of Botany.

Agricultural College, Mich., June 30, 1906.

REPORT OF THE DEPARTMENT OF HORTICULTURE.

To the President:

I submit the report of the Department of Horticulture and Landscape Gardening for the year 1906:

THE COURSES OFFERED AND STUDENTS ENROLLED.

Fall Term.

1. Fruit-growing; lectures 5 hours per week; Prof. Fletcher; laboratory 10 hours per week; Mr. McCue; 48 students.
2. Harvesting, marketing and plant breeding; lectures and laboratory 10 hours per week; Prof. Fletcher; 2 students.
3. Forest tree propagation; laboratory 6 hours per week; Mr. Gunson; 7 students.

Winter Term.

4. Floriculture and vegetable forcing; lectures 5 hours per week; Mr. Gunson; laboratory in above 10 hours per week; Mr. Gunson; 12 students.
5. Evolution of cultivated plants; 10 hours per week; Prof. Fletcher; 2 students.
6. Fruit-growing and vegetable gardening (short course in horticulture); lectures 5 hours per week for 6 weeks; Prof. Fletcher, Mr. McCue and Mr. Craig; laboratory 10 hours per week; Mr. Gunson, Mr. McCue and Mr. Craig; 13 students.
7. Horticultural seminar, with reports and discussions; 4 hours per week; Prof. Fletcher; 12 students.
8. Greenhouse gardening for women; lectures 5 hours per week; Mr. Gunson; laboratory in above 10 hours per week; Mr. Gunson; 15 students.

Spring Term.

9. Experimental horticulture; 10 hours per week; Prof. Fletcher; 1 student.
10. Horticultural seminar; 4 hours per week; Prof. Fletcher; 12 students.
11. Landscape gardening; lectures 5 hours per week for 6 weeks; Mr. Gunson; 56 students.
12. Floriculture for women; lectures and laboratory 5 hours per week for 6 weeks; Mr. Gunson; 15 students.
13. Spraying of plants; lectures 2 hours per week; laboratory 6 hours per week; Mr. McCue; 13 students.
14. Plant propagation and vegetable gardening; lectures 3 hours per week; Mr. McCue; laboratory 6 hours per week; Mr. McCue and Mr. Kohler; 12 students.

15. Plant propagation and vegetable gardening for women; lectures 1 hour and laboratory 2 hours per week; Mr. Kohler; 22 students.
16. Graduate work; hours by appointment throughout the year; Prof. Fletcher; 1 student.
17. Special work has been given in landscape gardening and floriculture to 5 students.

The total number of hours of lectures given by this department to undergraduate students during the year is 630; of laboratory work 888. We hope that the proportion of practice work to lectures will never be lower than this. The total number of students enrolled in all courses, considering lectures and the accompanying laboratory hours as one course is 277.

CHANGES IN METHODS OF INSTRUCTION.

Gardening.—The men students in plant propagation and vegetable gardening have been divided into two sections, each of which has planned, planted and tended a typical home garden in addition to laboratory work indoors. This change has worked out quite satisfactorily, but next year we propose that each student shall have a garden at least 15x30. The change is made in order to place a larger measure of personal responsibility upon each student for practical work done.

Hitherto sophomore women students have taken the 3 hours lectures on plant propagation and vegetable gardening with the men, but have not done the practical work that is required of the men. This year we have given a separate and shorter course of lectures to the women, and required them to make a garden and do other practical work. This change has worked so well that it seems to us best to make it permanent.

Fruit-growing.—The course in fruit-growing offered to juniors in the fall term has hitherto been a thoroughly professional course, especially the laboratory work, which has been largely devoted to systematic pomology or a critical study of species and varieties of fruits, more especially of the description of varieties. The larger proportion of the class do not expect to specialize in horticulture and this work is too technical for them. The plan now is to make the lectures deal more largely with amateur than with professional fruit-growing, and to make the laboratory work deal chiefly with planting, spraying, pruning and other operations that are of interest to the home fruit-grower, with the study of varieties as an incidental feature. The detailed and critical study of varieties, which has hitherto been given in this course and required of all agricultural students, will now be given in the fall term of the senior year, and only to those who have elected to specialize in horticulture.

Landscape Gardening.—The college cannot afford to ignore the demands upon it for young men trained to superintend large estates, to carry out the planting designs of eminent landscape gardeners, and to take other responsible positions in this profession. During the past year we have had eight calls for men to work in this field; the demand is increasing every year. There is need that the department should develop its work in landscape gardening. Up to two years ago the only course offered aside from the general training in horticulture that every landscape gardener should have, was that given in the spring term of the junior year to agricultural and women students, and lasting but half the term. It has been necessary to make this course elementary and largely non-professional, since it is given for so short a time and to a large class, most of whom are interested in it only from the point of view of the home-maker, not of the professional landscape gardener. For this reason we purpose, in 1907, to make this a course in the planting of home grounds, and to introduce more field work in connection with the lectures, taking up practical problems in design and planting as presented by typical home grounds in Lansing and near the college. Two years ago Professor Hedrick strengthened the professional landscape gardening work in our curriculum by introducing special reading courses for seniors who elected the work, and by providing for a thorough course in landscape design drafting, given in the spring term of the senior year by the department of drawing and design. We propose, if the plan meets the approval of the board and of the faculty, to give three hours a week throughout the senior year to professional landscape gardening, this time to be a part of the ten hours a week already assigned to the department.

Horticultural Seminars.—The work done in the seminars, which were begun the past year, is designed specifically to develop initiative and original research in horticulture. Reports are made on assigned topics and on current events in horticulture, followed by discussions. These seminars continue through the winter and spring terms of the junior year, and throughout the senior year.

Spraying of Plants.—This course, hitherto consisting of five hours a week of lectures, and ten hours a week of laboratory, has had the laboratory hours reduced to six and the number of lectures to two, which more adequately expresses the relative importance of this subject to other horticultural work. The four laboratory hours have been used for the seminar, and the three lecture hours are transferred to the department of entomology for use in the parallel course in "injurious insects of the orchard and garden," which is shaped specifically for horticultural students.

The Literature of Horticulture.—It has seemed best to combine the two closely related subjects, plant breeding and plant evolution, into one term. This leaves one-half of the fall term, senior year, free for a new course in the literature of horticulture, "a critical examination of the books, bulletins and magazines of interest to the horticulturist, with practice in library research."

"Experimental Horticulture," hitherto confined to the spring term of the senior year, we now give, when necessary, at any time in the course when it seems best that the student should begin his experiment, credit for the work being given, however, only in the spring term of the senior year. We expect every horticultural student to make an experiment that will yield results worth publishing; this often means that it is necessary to start it in the junior year, so that it may be duplicated or extended in the senior year.

The course in forest tree propagation, offered to forestry students, is not a horticultural subject, and is given by this department only until the department of forestry has the facilities to teach it.

Orchards and Gardens.—During the year all of the old college orchard has been removed except two blocks of fifty Northern Spy trees. The trees removed had passed their usefulness, being about forty-five years old, and very badly split and rotted. The sit on which they were planted is very poorly drained and not at all adapted for fruit trees. The fifty trees that remain are in fair condition, and will be left for a number of years. The cleared area will be used for vegetables.

Further details on orchards and gardens will be found in the report of the associate horticulturist of the experiment station.

The Grounds.—An important step was taken this past year to preserve and to enhance the beauty of our campus. The board authorized the department to secure the services of Mr. O. C. Simonds, an eminent landscape gardener of Chicago, to make suggestions for the improvement of the grounds. Previous to his visit, a map of the campus was made, showing the location of all walks, drives, plants and other features. The report of Mr. Simonds has been made and that part of it referring to walks, drives, drains and planting has already been accepted by the board. No radical changes are proposed; the report calls only for the elimination of minor objectionable features, and for considerable new planting, especially of shrubbery. These improvements the department will now proceed to execute as rapidly as possible.

A cement culvert has been constructed across the brook running through the botanic garden at the point where the river road crosses it. Permanent improvements are necessary to keep the river in its course at this point, and to protect the approach to the athletic field bridge.

Mr. Thomas Gunson, who has served the horticultural department for fourteen years, was made superintendent of grounds by the board in October. The efficiency of Mr. Gunson in this capacity is known to all who know the college. He has immediate supervision and responsibility for all work on the grounds, which are under the general supervision of the professor of horticulture and landscape gardening.

Ice Service.—The ice service has been for many years a hindrance to the efficiency of the department. On April 1st the department transferred to the engineer a horse and wagon, together with the ice gathering appliances. Besides using this team for delivering ice, the engineer will use it for the many odd jobs of hauling connected with his work. This arrangement is a relief to the horticultural department and to the engineer as well.

I very much wish that the board would adopt the recommendation in a paragraph of Professor Hedrick's last annual report. He said:

"I must call your attention also to the fact that the instruction of the students in the greenhouses is most seriously interfered with, and the finances of the department greatly depleted, by the custom of furnishing the legislature, state and college officials with flowers and plants. In my opinion, this custom should be almost wholly stopped; or failing in this, it should be regulated by the State Board of Agriculture. In the latter case my recommendation is that the college be asked to pay the department for all such donations, and that no presents whatever be made of flowers or plants to state or college officials except upon the written order of the president of the college."

Every word of this I repeat and re-emphasize, and I urge that the board take action upon it.

NEEDS OF THE DEPARTMENT.

The department has three needs for which I hope the board may make provision during the coming year. We need very much a greenhouse specifically adapted for student work. At one time last winter there were thirty-four students working in the greenhouses, where we had room to do justice to not more than half that many. We need an even span house 75x20, fitted with benches so divided that each student can have a section by himself. Such a house can be built, with the materials already on hand, for $300.

That part of the report of Mr. Simonds already accepted by the board calls for a considerable expenditure for planting, grading, etc. Much of this work can be done with regular help and funds; some of it, especially the grading and the purchase of plants, must be done under special appropriation. We would like to get much of this work done this fall, before the great gathering on the campus next spring. Estimates of the cost of these improvements will be submitted to the board.

The department desires to establish and maintain a fruit garden. This will contain several plants each of all the different species of fruits, large and small, that have cultivated varieties. We have some of these plants now, but they are too widely scattered for the most helpful comparative study. The garden will be to the department of horticulture what the botanic garden is to the department of botany; it is indispensable to the practical teaching of our course in systematic pomology. Our plan calls for about two hundred species and types of fruits hardy in this climate. Plants for this garden will cost $100.

THE PERSONNEL OF THE DEPARTMENT.

Professor U. P. Hedrick resigned July 1, 1905, to become horticulturist of the New York State Agricultural Experiment Station. His successor has had many opportunities to note the growth of the department during the three years in which he served it, especially in the strengthening and systematizing of the class room work. Mr. A. G. Craig, who has been our efficient instructor since September, 1904, and was especially valuable in the gardens, resigned on April 1st to accept a more lucrative and more responsible position at the Washington State College. Mr. A. R. Kohler, a graduate of the Iowa Agricultural College, was appointed assistant in horticulture on April 1st, and is proving to be the man we need. I am under personal obligation to Instructors Gunson and McCue, not merely for the work they have done, but more especially for the courtesy they have shown in helping me to an understanding of the problems of the department.

Very respectfully submitted,

S. W. FLETCHER,

Professor of Horticulture and Landscape Gardening.

Agricultural College, June 30, 1906.

REPORT OF THE DEPARTMENT OF MATHEMATICS AND CIVIL ENGINEERING.

President J. L. Snyder:

Dear Sir—There are a large number of considerations which combine to form a basis of recommendations concerning the needs and conduct of this department. That all of these shall have their proper measure in determining future policy, it is desirable to make note of them when circumstances upon which they depend are in active operation. Accordingly, I have addressed several communications to you during the year which have dealt with existing situations and I need scarcely mention the subject matter of those earlier reports. The fact that most suggestions made with a view to future welfare take the form of complaints is not to be wondered at. There is not time to commend all things which work satisfactorily in our general plan. Progress is built on discontent and the discovery of improper conditions.

If there is any element of satisfaction in the year's work just passed, it arises from the reflection that we have been able to do so much notwithstanding hindrances. We regret that there are any unsatisfactory results, and I have no doubt that you share our regret. The unpleasant augury for the future consists in the regularly increasing increment of futility or of capable effort that is barren of results.

In many respects, the conditions for work have been chaotic. Combined to produce such a situation were lack of class rooms, laboratories and drafting rooms, poor arrangement and equipment of the rooms provided, lack of facilities for storing and protecting our instruments, inadequate provision for issuing and checking the return of equipment and imperfect condition of the instruments, caused not by their manner of use, but by accumulations of dirt in a repository unfitted for the purpose. These matters, as well as our need of a mechanicians' laboratory, more suitable office accommodations, and better janitor service, have been discussed with you during the year. Fortunately for the successful prosecution of department work, a new engineering building seems to promise some relief, and the solution of a number of difficult problems connected with the situation. It is to be regretted that another year must pass before the promised relief can be realized; also that more generous provision of class room and laboratory space has not been made in the design of that building. A very small increase in the demands upon us for technical instruction in civil engineering will result in over-taxing the quarters provided by the time they are available.

Throughout the college year, the staff of the department included the following: Associate Professor W. Babcock and Instructors A. E. Jones, C. Gundersen, A. R. Alger, S. C. Hadden, G. James and S. Hinds. These gentlemen have satisfied all demands made upon them, and have all contributed to the year's successful results. Mr. Hinds has resigned and will probably take up practical engineering. The others have signified their intention of remaining for another year.

Following our usual custom, a table is presented below in which is shown the class work of the department, the assignments of instructors and other information which might be called in question:

Class work of the department of mathematics and civil engineering for the college year 1905-6.

Class.	Subject.	Number of course.	Teacher.	Class-room.	Hour of meeting.	Hours per week.	No. students in class.
Fall term.							
Sub-freshmen....	M. algebra............	Math. 1c......	Dr. Gundersen.....	6, College Hall.....	2–3	5	16
Sub-freshmen....	M. algebra............	Math. 1c......	Mr. Alger..........	12, College Hall....	8–9	5	20
Sub-freshmen....	M. algebra............	Math. 1c......	Mr. Alger..........	8, College Hall.....	9–10	5	33
Sub-freshmen....	Ag. & W. algebra......	Math. 1.......	Mr. Hadden........	8, College Hall.....	10–11	5	15
Sub-freshmen....	Ag. & W. algebra......	Math. 1.......	Mr. James.........	Abbot Hall........	8–9	5	15
Sub-freshmen....	Ag. & W. algebra......	Math. 1.......	Mr. James.........	Abbot Hall........	9–10	5	22
Freshmen.......	M. algebra............	Math. 1e......	Prof. Babcock.....	6, College Hall.....	1–2	5	25
Freshmen.......	M. algebra............	Math. 1e......	Mr. Jones..........	Dairy............	9–10	5	13
Freshmen.......	M. algebra............	Math. 1e......	Mr. Jones..........	Dairy............	10–11	5	12
Freshmen.......	M. algebra............	Math. 1e......	Mr. Jones..........	8, College Hall.....	2–3	5	38
Freshmen.......	M. algebra............	Math. 1e......	Mr. James.........	Abbot Hall........	10–11	5	36
Freshmen.......	Ag. & W. algebra......	Math. 1b......	Prof. Babcock.....	6, College Hall.....	3–4	5	20
Freshmen.......	Ag. & W. algebra......	Math. 1b......	Dr. Gunderson.....	12, College Hall....	1–2	5	26
Freshmen.......	Ag. & W. algebra......	Math. 1b......	Mr. Jones..........	8, College Hall.....	3–4	5	27
Freshmen.......	Ag. & W. algebra......	Math. 1b......	Mr. Hinds.........	12, College Hall....	10–11	5	26
Freshmen.......	M. geom..............	Math. 2d......	Dr. Gunderson.....	Dairy............	11–12	5	16
Freshmen.......	M. geom..............	Math. 2d......	Mr. Jones..........	8, College Hall.....	1–2	5	16
Freshmen.......	M. geom..............	Math. 2d......	Mr. Alger..........	12, College Hall....	11–12	5	19
Freshmen.......	M. geom..............	Math. 2d......	Mr. Hinds.........	8, College Hall.....	8–9	5	13
Freshmen.......	M. geom..............	Math. 2d......	Mr. James.........	Abbot Hall........	11–12	5	19
Freshmen.......	M. geom..............	Math. 2d......	Mr. James.........	Abbot Hall........	1–2	5	22
Sophomores.....	Anal. geom............	Math. 5.......	Prof. Babcock.....	6, College Hall.....	8–9	5	24
Sophomores.....	Anal. geom............	Math. 5.......	Prof. Babcock.....	6, College Hall.....	9–10	5	16
Sophomores.....	Anal. geom............	Math. 5.......	Dr. Gundersen.....	Dairy............	8–9	5	21
Sophomores.....	Anal. geom............	Math. 5.......	Dr. Gundersen.....	Dairy............	9–10	5	18
Juniors.........	Mech. of eng..........	Math 7a......	Prof. Babcock.....	6, College Hall.....	11–12	5	17
Juniors.........	Mech. of eng..........	Math. 7a......	Mr. Hinds.........	2, College Hall.....	11–12	5	19
Juniors.........	Mech. of eng..........	Math. 7a......	Mr. Hadden........	8, College Hall.....	11–12	5	17
Juniors.........	Surveying (class)......	Civ. eng. 1b...	Prof. Vedder......	2, College Hall.....	10–11	2	37
Juniors.........	Surveying (class)......	Civ. eng. 1b...	Mr. Alger..........	2, College Hall.....	10–11	2	27
Juniors.........	Surveying (field).......	Civ. eng. 1b...	Mr. Alger, Mr. Hadden and Mr. Hinds	....	1–3	2	20
Juniors.........	Surveying (field).......	Civ. eng. 1b...	Mr. Alger, Mr. Hadden and Mr. Hinds	....	1–3	2	20
Juniors.........	Surveying (field).......	Civ. eng. 1b...	Mr. Alger, Mr. Hadden and Mr. Hinds.	....	1–3	2	24
Seniors.........	Ag. civ. eng (class).....	Civ. eng. 2....	Prof. Vedder......	2, College Hall.....	9–10	5	8
Seniors.........	Ag. civ. eng. (field).....	Civ. eng. 2....	Prof. Vedder......	2, College Hall.....	1–3	2	8
Seniors.........	Graphics..............	Civ. eng. 4....	Mr. Hadden........	2, College Hall.....	8–9	3	24
Seniors.........	Graphics..............	Civ. eng. 4....	Mr. Hadden........	12, College Hall....	9–10	3	19
Seniors.........	R. R. surveying.......	Civ. eng. 7....	Mr. Hadden and Mr. Hinds.	2, College Hall.....	1–4	6	25
Seniors.........	Bridge stresses.........	Civ. eng. 8a...	Prof. Vedder......	6, College Hall.....	10–11	3	24
Totals......	39 sections..........	....	....	....	....	172	807

Class work of the department of mathematics.—Continued.

Class.	Subject.	Number of course.	Teacher.	Class-rooms.	Hour of meeting.	Hours per week.	No. of students in class.
Winter:							
Sub-freshmen....	Ag. & W. algebra......	Math. 1a......	Mr. Alger.........	Dairy............	9–10	5	17
Sub-freshmen....	Ag. & W. algebra......	Math. 1a......	Mr. James........	Abbot Hall........	10–11	5	14
Sub-freshmen....	Ag. & W. algebra......	Math. 1a......	Mr. Hadden.......	Dairy............	10–11	5	19
Sub-freshmen....	M. algebra............	Math. 1d......	Mr. Jones.........	Dairy............	10–11	5	17
Sub-freshmen....	M. algebra............	Math. 1d......	Mr. Hinds.........	12, College Hall....	10–11	5	13
Sub-freshmen....	M. algebra............	Math. 1d......	Mr. James........	12, College Hall....	2–3	5	20
Sub-freshmen....	M. algebra............	Math. 1d......	Mr. Alger.........	Abbot Hall........	2–3	5	21
Freshmen.......	Ag. geom.............	Math. 2b......	Prof. Babcock.....	6, College Hall.....	9–10	5	16
Freshmen.......	Ag. geom.............	Math. 2b......	Mr. Hinds.........	8, College Hall.....	8–9	5	10
Freshmen.......	Ag. geom.............	Math. 2b......	Mr. James........	Abbot Hall........	9–10	5	14
Freshmen.......	Ag. geom.............	Math. 2b......	Mr. Jones.........	Dairy............	9–10	5	14
Freshmen.......	W. geom..............	Math. 2b......	Mr. Jones.........	8, College Hall.....	2–3	5	21
Freshmen.......	W. geom..............	Math. 2b......	Mr. James........	8, College Hall.....	1–2	5	15
Freshmen.......	M. algebra............	Math. 1f......	Dr. Gundersen.....	8, College Hall.....	11–12	5	23
Freshmen.......	M. algebra............	Math. 1f......	Dr. Gundersen.....	Dairy............	1–2	5	18
Freshmen.......	M. algebra............	Math. 1f......	Mr. Jones.........	Dairy............	11–12	5	27
Freshmen.......	M. algebra............	Math. 1f......	Mr. Alger.........	Abbot Hall........	1–2	5	23
Freshmen.......	M. algebra............	Math. 1f......	Mr. James........	Abbot Hall........	11–12	5	22
Sophomores.....	M. & W. Dif. Cal......	Math. 6a......	Prof. Babcock.....	6, College Hall.....	10–11	5	17
Sophomores.....	M. Dif. Cal...........	Math. 6a......	Prof. Babcock.....	6, College Hall.....	2–3	5	18
Sophomores.....	M. Dif. Cal...........	Math. 6a......	Dr. Gundersen.....	8, College Hall.....	10–11	5	15
Sophomores.....	M. Dif. Cal...........	Math. 6a......	Dr. Gundersen.....	Dairy............	2–3	5	19
Juniors.........	Mechanics............	Math. 7b......	Prof. Babcock.....	6, College Hall.....	1–2	5	22
Juniors.........	Mechanics............	Math. 7b......	Mr. Hinds.........	8, College Hall.....	9–10	5	28
Juniors.........	M. drawing...........	Dr. & Des. 7..	Mr. Alger.........	Drawing rm, dairy	10–12	8	32
Seniors.........	Ag. Eng'g............	Civ. eng. 3....	Prof. Vedder......	2, College Hall.....	10–11	5	4
Seniors.........	Bridge design..........	Civ. eng. 8b...	Prof. Vedder......	2, College Hall.....	8–10	8	25
Seniors.........	Hydraulics (class)......	Civ. eng. 5....	Mr. Hadden.......	2, College Hall.....	11–12	5	27
Seniors.........	Hydraulics (laboratory)	Civ. eng. 5....	Mr. Hadden.......	2, College Hall.....	1–3	4	27
Seniors.........	Exp. lab..............	Civ. eng. 12...	Mr. Hadden and Mr. Hinds.	2, 12, College Hall.	1–5	8	23
Totals	30 sections...........	....	....	....	.. ..	153	581

Class work of the department of mathematics.—Concluded.

Class.	Subject.	Number of course.	Teacher.	Class room.	Hour of meeting.	No. hours per week.	No. students in class.
Spring term:							
Sub-freshmen.	Ag. & W. geom.	Math. 2a.	Dr. Gandersen	12, College Hall.	9–10	5	17
Sub-freshmen...	Ag. & W. geom	Math. 2a...	Mr. Alger.	8, College Hall...	8–9	5	22
Sub-freshmen.	Ag. & W. geom.	Math. 2a.	Mr. Alger.	8, College Hall.	9–10	5	14
Sub-freshmen.	M. geom.	Math. 2c...	Dr. Gandersen	6, College Hall...	2–3	5	33
Sub-freshmen.	M. geom	Math. 2c	Mr. Hinds.	Dairy	11–12	5	15
Sub-freshmen..	M. geom.	Math. 2c	Mr. James	Dairy	11–12	5	15
Sub-freshmen..	Mensuration...	Math. 3	Mr. Hinds.	Dairy	10–11	5	14
Sub-freshmen.	Mensuration..	Math. 3....	Mr. James	Dairy	10–11	5	14
Sub-freshmen..	Mensuration..	Math. 3....	Mr. James	8, College Hall...	1–2	5	33
Freshmen....	Ag. & W. Trig.	Math. 4a...	Mr. Alger.	8, College Hall...	10–11	3	25
Freshmen.......	Ag. & W. Trig	Math. 4a	Mr. Hinds	2, College Hall	8–9	3	33
Freshmen..	M. Trig	Math. 4b.	Prof. Babcock	6, College Hall...	11–12	5	15
Freshmen..	M. Trig.	Math. 4b...	Mr. Jones.	Abbot Hall....	8–9	5	33
Freshmen...	M. Trig.	Math. 4b..	Mr. Jones...	Abbot Hall....	11–12	5	16
Freshmen..	M. Trig.	Math. 4b....	Mr. Jones	6, College Hall....	1–2	5	15
Freshmen..	M. Trig	Math. 4b.	Mr. James	8, College Hall	2–3	5	13
Freshmen...	Ag. Surv'g (class).	Civ. eng. 1a...	Mr. Alger	Abbot Hall ...	10–11	2	23
Freshmen..	Ag. Surv'g (class).	Civ. eng. 1a...	Mr. Hinds...	2, College Hall....	8–9	2	29
Freshmen...	Ag. Surv'g (field)§.	Civ. eng. 1a...	Mr. Alger and Mr. Hinds.	2, College Hall...	1–3	2	27
Freshmen..	Ag. Surv'g (field).	Civ. eng. 1a...	Mr. Alger and Mr. Hinds.	2, College Hall...	1–3	2	25
Sophomores..	Integ. Calculus.	Math. 6b....	Prof. Babcock.	6, College Hall....	8–9	5	17
Sophomores	Integ. Calculus	Math. 6b..	Prof. Babcock	6, College Hall	9–10	5	20
Sophomores	Integ. Calculus.	Math. 6b....	Dr. Gandersen.	12, College Hall...	11–12	5	16
Sophomores..	Integ. Calculus.	Math. 6b....	Mr. Jones..	Abbot Hall....	10–11	5	7
Juniors	Dif. Equations.	Math. 8.	Prof. Babcock	6, College Hall.	10–11	2	23
Juniors	Dif. Equations.	Math. 8....	Dr. Gandersen	12, College Hall	10–11	2	23
Juniors	Higher surv'g (class).	Civ. eng. 6g	Prof. Vedder.	2, College Hall....	9–10	3	35
Juniors.	Higher surv'g (field).	Civ. eng. 6	Prof. Vedder, Mr. Hadden and Mr. Hinds.		1–4	6	35
Seniors.	Higher surv'g (class).	Civ. eng. 6g	Prof. Vedder	2, College Hall.	9–10	3	20
Seniors.	Higher surv'g (field).	Civ. eng. 6	Prof. Vedder, Mr. Hadden and Mr. Hinds.		1–4	6	20
Seniors..	Masonry and arches..	Civ. eng. 9	Mr. Hadden.	2, College Hall..	10–12	2	28
Seniors	Pavements	Civ. eng. 10	Prof. Vedder	2, College Hall..	9–10	2	13
Seniors	Contr. and specif	Civ. eng. 13	Prof. Vedder	2, College Hall	10–11	2	23
Seniors	Thesis	Civ. eng. 11	Prof. Vedder & Mr. Hadden.	2, College Hall.	1–5	12	23
Totals	34 sections..					144	734

§ Messrs. Hadden and Hinds assisted at quizzes.

The following text books have been used in our classes during the year: Beman & Smith's Higher Arithmetic for classes in mensuration; Beman & Smith's Academic Algebra for all beginning classes formed by women and agricultural students; Van Velzer & Slichter's University Algebra for all engineering students; Wentworth's Geometry; Ashton & Marsh's Trignometry; Tanner & Allen's Analytic Geometry; Murray's Calculus; Hodgman's Surveying; Johnson's Surveying for all classes in Higher Surveying; Church's Mechanics and Hydraulics; Merriman & Jacoby's Graphic Statics, Bridge Stresses, Bridge Design; Allen's Railroad Curves and Earthwork; Baker's Masonry Construction, Roads and Pavements.

The department inventory for 1906 presents an aggregate of $7,906.21, as against $5,610.95 for 1904. The total expenditure by the department during the year ending June 30, 1906, for all purposes has been $928.67, of which $62 was turned in by the department in fees for special examinations.

Respectfully submitted,

H. K. VEDDER,

Professor of Mathematics and Civil Engineering.

Agricultural College, June 30, 1906.

REPORT OF THE DEPARTMENT OF BACTERIOLOGY AND HYGIENE.

President J. L. Snyder, College:

Dear Sir—There is little to be added to the report of last year. The grand total of students passing through the department during the current year just closing has been about the same as in the previous year. We owe much to Mr. Sackett and Dr. Wetmore in carrying on the class work of the department. Mr. Bushnell assisted us during the winter term in giving laboratory instruction to the short course students.

It is unnecessary for me to call specific attention to the hospital for the past year, inasmuch as it has been doing practically the same work as in previous years. Each year, however, I am more and more impressed with the importance of caring for the sick of the institution and especially of being ready to cope with any contagious disease which may exist in the community. The difficulties in the way of managing contagious diseases multiply each year, as the surrounding territory becomes settled. We trust, however, that in the near future the dangers from this source will be lessened by incorporating the district into a village or city. I can foresee, in connection with contagious diseases, that the time will come in the not very distant future, when it will be necessary to provide some facilities for taking care of patients during epidemics, since the present hospital is not large enough to meet such an emergency. We hope that this will be borne in mind, and that when it becomes feasible some means will be provided.

Very respectfully submitted,

CHARLES E. MARSHALL,

Professor Bacteriology and Hygiene.

Agricultural College, June 30, 1906.

REPORT OF THE DEPARTMENT OF FORESTRY.

To the President:

Sir—The forestry department has made marked progress during the year. The instruction was reinforced by the aid of Mr. C. A. McCue of the horticultural department who took charge of the class in the principles of forestry during the winter term and by Mr. Thomas Gunson also of the same department, under whose guidance the work in forest tree propagation was done. This arrangement for instruction is possible only through the courtesy of the horticultural department and the kindness of the persons doing the work. We are in need of the full time of an instructor in this department to meet the rapidly growing schedule of work in this department. Some provision must be made at the beginning of the fall term, for we have not been able to make arrangements whereby classes in the different years of the course can come at different hours. Of class work there are twenty-seven hours per week in the fall term beside the ever increasing correspondence and attention that must be given to outside work connected with the department. In the winter term there are twenty-three hours per week beside the regular work of the office, extra lectures to short course students and lectures before farmer's institutes. In the spring term there are thirty hours per week of class room and field work. This is the most busy season of the year because we are then seeding and planting extensively. I have not been able to give any of the work the personal attention it should have because there has been so much to do and several things need attention at the same time. It has been left too much to the judgment and discretion of untrained and unskilled workmen who do the work to the best of their ability, but the results are too frequently unsatisfactory. There must be regular help in this department if the work is to be carried on successfully and in a satisfactory manner.

The class rolls show the number of students taking courses in this department the past year was as follows:

Forestry economics	1
Forest mensuration	1
Forest protection and regulation	1
Diseases of forest trees	1
Investigation	1
Forest botany (three terms)	23
Laboratory work in forest botany	23
Principles of forestry (two terms)	11
Silviculture	7
Laboratory and field work in silviculture	7
Forest tree propagation	8
Elements of forestry	60
Field and laboratory work in elements of forestry	60
Short course students taking forestry	21
Total	225
Number of different students	91

The nursery work and restocking and improving the wood lots and wood lands of the college has been carried forward as planned over three years ago. The nursery was invoiced in February and showed a total of 82,381 seedling and transplanted trees, which at retail rates would be worth $1,371.53 or at wholesale $822.92. About 21,000 trees from our own nurseries were set out this past spring. About 9,000 surplus trees were disposed of to outside parties. A trial was made at importing stock from Europe through a New York house but the results show little promise of gain from the practice. A permanent forestry exhibit of growing trees representing this department of the college has been made on the state fair grounds at Detroit.

This department is sadly in need of class rooms and a museum. The large class in elementary forestry must always be met in some building other than that in which the office of the department is located and where the most useful illustrative specimens are stored. There is no place whatever to exhibit the large collection of interesting and valuable specimens of forest products we now have. The specimens are now stored in five different buildings, too much subject to danger from fire and of very little service for purposes of illustration.

Respectfully submitted,

E. E. BOGUE,
Professor of Forestry.

Agricultural College, June 30, 1906.

REPORT OF THE CHEMICAL DEPARTMENT.

President J. L. Snyder:

I submit herewith two schedules showing the amount of class and laboratory work done in this department for the two years 1904-5 and 1905-6:

Fall term, 1904–5.	Number of students.	Instruction, hours per week per student.
General Chemistry:		
Agricultural and mechanical	186	7
Women	69	7
Organic Chemistry:		
Agricultural	59	7
Women	25	7
Winter term, 1904-5		
Mineralogy, mechanical	96	5
Qual. Anal., women	50	10
Qual. Anal., men	71	10
Agricultural chemistry, men	54	10
Domestic science chemistry	32	10
Spring term, 1904-5.		
Quaint. analysis	16	10
Mechanical, third term	87	6
Animal nutrition	10	10

Fall term, 1905–6.	Number of students.	Instruction hours per week per student.
General Chemistry:		
Agricultural and mechanical	204	7
Women	51	7
Organic Chemistry:		
Agricultural	40	7
Women	36	7
Winter term, 1905-6.		
Mineralogy, mechanical	120	5
Qual Anal., women	40	10
Qual. Anal., men	62	10
Agricultural chemistry, men	40	10
Domestic science chemistry, women	15	10
Spring term, 1905-6.		
Quaint. Analysis	2	10
Mechanical, third term	97	6
Agricultural Chem. Anal	2	10
Sugar beet chemistry	3	6

In the spring term of the year 1905 a new study, "animal nutrition," was introduced and as it was elected by both the junior and senior agricultural students and given to the two classes together it was omitted during the spring term of 1906. Instruction in the chemistry of sugar beet manufacture was given by special request to three students in the regular college course who desired the experience of a sugar campaign. These three men later have entered the service as sugar factory chemists in Michigan and New York.

The work of the college in this department has been carried on during the past year with a fair degree of success, but with a considerable amount of unnecessary labor on account of the limited space afforded by the laboratory building.

As you well know this department has never had for its object the training of chemists, nevertheless during the years since the founding of the college many of our students have found that chemistry was a science for which they had special liking and adaptibility and have entered the profession and done themselves and the college honor in this line of work. Since the opening of the college regular graduates have held the professorship of agricultural chemistry and chemistry in the state institutions of the following: Arkansas, Arizona, Connecticut, Colorado, Iowa, Kansas, Michigan, Mississippi, Oklahoma and Wisconsin. Aside from these there are and have been chemists and assistant chemists in experiment station work in the following states: Michigan, Minnesota, New York, Rhode Island, Philippine Islands and the bureau of chemistry, Department of Agriculture at Washington.

In addition to these a number of graduates have engaged in technical chemistry and industrial chemical work and also the work of food inspection both in state and United States laboratories.

Many students who did not complete the entire course have also engaged in chemical work.

The special course offered in beet sugar manufacture fitted a good many young men for this line of work which they have since pursued.

Of these men whom we have specially trained there are perhaps over twenty-five now distributed through the various beet sugar producing states and even down in the cane sugar belt and in Porto Rico. I make detailed statements of this in order that it may go on record at this time.

Early in April, after some correspondence with Hon. Milton Whitney, Chief of the Bureau of Soils, we were favored with the assistance of Mr. F. R. Reid, who is an expert demonstrator of the wire pot culture method for the experimental determination of the manurial requirements of soils. Mr. Reid spent the months of May and June in this laboratory teaching us the details of the work and tested some soils from our state by this method. A full report of Mr. Reid's work will probably be printed in Director Smith's report in this volume.

During the year the investigation of the chemical composition of some of the various condimental stock foods has engaged my attention. I was called as an expert witness before the United States district court at Detroit and also in the Eaton county circuit to testify regarding the general character and composition of these materials.

On invitation from Dr. F. W. Shumway, Secretary of the State Department of Health, I appeared before the annual conference of the health officers of Michigan, held at Grand Rapids, May 31st, and presented the topic of "Disinfectants from a Chemist's Stand Point."

The work of preparing a complete and accurate card index containing the names and addresses of all former students and graduates of the college has been entered upon and has been carried forward by this department.

During the year just passed I have had the following persons on my staff of instruction: Messrs: H. S. Reed, C. H. Swanger, F. I. Rittenour, E. L. Larison and E. A. Boyer.

All of these gentlemen have rendered most efficient service and have in every way helped to build up the work of the department.

I wish to thank you personally for your kind assistance and to acknowledge the hearty co-operation of all the other members of the faculty in making the year 1905-6 a successful year of college work.

Very respectfully,

FRANK S. KEDZIE,

Professor of Chemistry.

Agricultural College, June 30, 1906.

REPORT OF THE LIBRARIAN.

To the President:

Sir—I have the honor to present the following report on the library for the year ending June 30, 1906:

During the year 737 bound volumes have been added to the library, of which 340 were by purchase, 197 by binding, and 200 by gift. The additions of pamphlets and unbound volumes number 382, of which 36 were purchases. Gifts were in all possible cases acknowledged when received, and individual mention is therefore omitted.

To the following we are indebted for bound volumes:

American Short Horn Association, 3.
Bedford, Duke of, Canada, 1.
Burrows, Hon. J. C., 13.
Canada, 5.
Chase, Chas. H., 5.
Connecticut, 2.
Holstein-Friesian Association, 1.
Leonard, W. S., 1.
Mass. Board of Health, 12.
Minnesota, State Dairymen's Ass'n, 2.
Missouri Board of Agriculture, 1.
Michigan Academy of Science, 1.

Michigan reports—

House Journal, 2.
Labor Bureau, 7.
Local Acts for 1905.
Manual, 1905.
Public Acts, 1905.
State Board of Agriculture, 1.
State Board of Health, 1.
Senate Journal, 2.
Supt. Public Instruction, 1.
Supreme Court Reports, 6.
National Conference of Charities and Corrections, 1.
N. Y. Dept. of Agriculture, 2.
N. Y. State University, 10.
Oregon State Board of Horticulture, 1.
Smith, H. B., 1.
Smithsonian Institution, 23.
Texas, Commissioner of Agriculture, 1.
University of Michigan, Librarian, 6.
Welles, C. S., 1.
Wells, W. W., 1.

United States reports—

Agricultural Department, 9.
Bureau of Education, 1.
Bureau of Statistics, 3.
Congressional Library, 1.
Civil Service Commission, 2.
Geological Survey, 1.
Interstate Commerce Commission, 4.
Interior Department, 1.
Labor Bureau, 8.
State Department, 1.
Treasury Department, 3.
War Department, 9.

One hundred nineteen American periodicals, and fifty-four foreign periodicals are purchased by the college for the use of faculty and students. In addition to these are the following publications received either by exchange, or through the courtesy of the publishers.

Adrian Times.
Agricultural Advertising.
Agricultural Gazette, New South Wales.
Allegan Gazette.
American Blacksmith.
American Botanist.
American Dairymen.
American Grange Bulletin.
American Missionary.
American Society of Civil Engineers, Proceedings.
American Swineherd.
American Thresherman.
Arboriculture.
American Sugar Industry.
American Phil. Society, Phila., Proceedings.
Armada Graphic.

Battle Creek Journal.
Belding Banner.
Big Rapids Herald.
Boys and Girls.
Bear Lake Eagle.
Capitol City Dem.
Christian Herald.
Christian Science Journal.
Cornell Countryman.
Christian Science Sentinel.
Church Helper.
Congressional Record.
Chicago Daily Drovers' Journal.
Chicago Packer.
Civic News.
Detroit Farm and Live Stock Journal.
Deutsch American Farmer.
Farm and Fireside.
Farm and Home.
Farm, Field and Fireside.
Farm Home.
Farmers' Advocate.
Farmers' Guide.
Farmers' Tribune.
Farmers' Voice.
Farming World.
Farm News.
Florist's Exchange.
Fruit Growers' Journal.
Fruit Grower.
Farm and Floral World.
Gas Engine.
Gleanings in Bee Culture.
Good Health.
Grand Ledge Independent.
Gleaner.
Hillsdale Leader.
Hillsdale Standard.
Hoard's Dairyman.
Holstein Friesian World.
Home and Farm.
Homestead.
Horse Shoer's Journal.
Horse World.
Horticultural Visitor.
Improvement Era.
Indiana Farmer.
Indians' Friend.
Ionia Sentinel.
Johns Hopkins University Circulars.
Journal of Agriculture, Australia.
Journal of Agriculture, Victoria.
Kalamazoo Telegraph.
Kansas Farmer.
Lansing Journal (daily).
Lewiston Journal.
Lawton Leader.
Livestock Journal.
Michigan Mirror.
Michigan Presbyterian.
Midland Republic.
Moderator-Topics.
Mystic Worker.
Mark Lane Express.
Michigan University News Letter.
Mining Magazine.
National Farmer and Stock Grower.
New Voice.
New York Meteorology.
New York Produce Review.
New York Weekly Witness.
Official Gazette, U. S. Patent Office.
Oregon Agriculturist.
Petoskey Independent, Democrat.
Pinckney Dispatch.
Practical Farmer.
Philippine Teacher.
Publicity Magazine.
Republic.
Rural Advocate.
Saginaw Evening News.
State Republican (daily).
Stockbridge Brief.
Successful Farming.
Traverse Bay Eagle.
Wallace Farmer.
Western Swine Breeder.
Western Society of Engineers, Journal.
Williamston Enterprise.
Woman's Home Companion.
Writer.
Ypsilantian.

The M. A. C. Record exchanges are placed in the reading room, and in exchange for our catalogue, the library receives the year books, catalogues or registers from all the leading institutions of the country. We also receive the bulletins of the various state experiment stations, and of the U. S. Department of Agriculture.

The library hours have remained unchanged during the year. Fines to the amount of $12.80 have been collected.

To the library of the experiment station seventy-four volumes have been added—fifteen by purchase, fifty-four by binding, and five by gift. Total number of volumes in this library 2,266. The college library now numbers 24,367 volues. Total number in both libraries, 26,633 volumes.

We take pleasure in commending the work of our assistant, Miss Cora Feldcamp, appointed to succeed Miss Balbach, whose resignation took effect September 1, 1905. Miss Feldcamp has been earnest and interested in her efforts, and we are sure that all connected with the college will be pleased to know that she has been retained for another year.

Respectfully submitted,

LINDA E. LANDON,

Librarian.

Agricultural College, June 30, 1906.

REPORT OF THE VETERINARY DEPARTMENT.

To the President:

Dear Sir—The work for the veterinary department during the past year has been very similar to that of previous years. The seniors electing the work received one lecture a day throughout the entire year. During the last three weeks of the fall term they also spent two hours a day in the dissecting room. The fall term is devoted almost entirely to the study of anatomy, the winter and spring terms are given up to the study of medicines, their actions, uses and doses, and to the study of the diseases which affect the domestic animals.

During the first half of the winter term the sophomores received thirty lectures covering some of the more common diseases; also some suggestions along the line of care in the prevention of disease.

The first year short course students received forty lectures upon the subject. The course for the short course students is now given in from seventy-five to eighty lectures, one-half of which are given the first year, the remainder the second year. An endeavor is made to make the course as practical as possible. While a little time is devoted to anatomy and medicines, the most of it is given to the prevention and treatment of diseases.

The second year short course men received thirty-five lectures covering the last half of the course.

At the request of Prof. Shaw, I also gave a course of lectures to the students in stock judging on the breeds of horses, and horse judging, including the practical work in the judging room.

Respectfully submitted,

GEO. A. WATERMAN,

Prof. of Veterinary Science.

Agricultural College, June 30, 1906.

REPORT OF THE DEAN OF SPECIAL COURSES.

President Snyder:

It gives me pleasure to report the work for the department of special courses for the winter 1905-6. The number in attendance upon the special courses were as follows:

Horticulture	13
General Agriculture, first year	72
General Agriculture, second year	22
Creamery	56
Cheese	15

The principal change in the instruction given in these courses has been the addition of carpenter and blacksmith shops. Twenty-five forges and a like number of anvils were installed in a room properly prepared, lighted and heated, and instruction given in the elements of the work of a blacksmith. Young men were taught the use of the tools, how to set up a forge and properly cement it, what tools are necessary in a work room on a farm, how to heat the iron, what coal to use, how to hold the hammer and handle the iron operated upon to work it into any desired form. Some work was done also with steel. The instruction was given on alternate days throughout the course from three to five in the afternoon.

In the carpenter shop the sole furniture at the beginning consisted of twenty-five kits of carpenter tools, saws, a hammer, planes, a guage, a bevel, a square and other tools absolutely necessary. From the lumber, planed where necessary, the students built their own work benches and fitted them with vises and drawers for their tools. Thereafter they had simple exercises in woodwork and were taught to lay out rafters, build wagon boxes and do many of the other kinds of work which a farmer would be likely to be called upon to do. This work came on alternate days from three to five in the afternoon and was given to the students of the first year in the special course in agriculture.

The shops were in charge of Mr. W. E. Spreiter of West Concord, Minnesota, who had been trained in the school of agriculture of the university of that state. The popularity of the work among the students combined with the rapid progress made is a sufficient certificate of the efficiency of Mr. Spreiter. James Fisk and L. J. Smith of the class of 1906, mechanical course of this college, gave the instruction in blacksmithing. The subject is not an easy one to teach when the class is large as it was last winter. These young men succeeded in interesting the students in the work and causing them to make a steady and satisfactory progress.

Other than the introduction of this shop work few changes were made in the curriculum of the first year in general agriculture. The work in stock judging was given from eight to ten, veterinary followed at ten and stock feeding at eleven. After dinner Professor Jeffery gave his lecture on soils and crops from one to two. Because the class was larger than the shops could accommodate the work in soils was repeated allowing the class to be divided into two sections for the afternoon work, one coming to the shops from one to three and the other from three to five.

At the close of the session for 1905, so many of the class petitioned for a second year that it was decided to give a course of advanced work to these men during the winter of 1906. Twenty-two young men returned for this second winter. They were allowed a wide latitude of election, some taking horticulture, others getting work in butter making, as a specialty. They were given in addition advanced work in stock judging, in veterinary anatomy and medicine, and in rural engineering. The physical department kindly gave them instruction in the principles of physics as applied to agriculture. They also had training in agricultural chemistry and the theory and principles of nutrition. So satisfactory was this work of the second year that it will be continued next season with every prospect of a much larger attendance.

The creamery course had its usual full attendance, more students than the accommodations could properly care for. No change in method or matter was introduced except that gathered cream was purchased and made into butter. The proposition that clean, wholesome and properly flavored butter cannot be made from rancid or unwholesome cream needs no demonstration. No butter maker can be expected either to make something out of nothing nor to make pure butter from rotten cream. While the system of making butter in gathered cream plants is rational and economical, the quality of the product is dependent upon the care which the farmer gives the milk and cream and the frequency of the delivery of cream to the factory. Until the butter makers can receive sweet and good flavored cream the gathered cream factory cannot make first class butter. It is well to teach the young men taking the creamery course the proper uses of pasteurizers and starters. The attempt will not again be made to teach them the impossible, the manufacture of pure butter from bad cream. Mr. F. O. Foster, the instructor in dairy husbandry of the college was assisted in the butter room by Mr. Helmer Rabild, a former instructor, now an inspector for the Dairy and Food Commission of the state, and by Mr. Jay Pullen, butter maker at the Parma creamery. Mr. E. A. Edgerton, of Lansing, gave the instruction in creamery mechanics.

The short course in horticulture offered many new features this year, especially emphasizing the large number of electives. The attendance was small, but the enthusiasm was most excellent.

The course in cheese making, following the close of the other special courses, had also a small attendance. Inspector R. J. Willis of the State Dairy and Food Department, presided at the vat while the lectures and laboratory work were given by Instructor F. O. Foster and Dr. C. E. Marshall.

Respectfully submitted,

C. D. SMITH,

Dean.

Agricultural College, June 30, 1906.

REPORT OF THE DEPARTMENT OF ENGLISH AND MODERN LANGUAGES.

To the President:

The report submitted by me June 30, 1905, might well serve as the report for the present year, and I respectfully refer you to said report for further consideration of the recommendations therein contained. They still hold and the need for them has been emphasized by the events of the year now closing.

On May 17 I sent to the Board of Agriculture the following paper which explains itself:

Agricultural College, Mich., May 17, 1906.

To the Board of Agriculture, Michigan Agricultural College:

Gentlemen—I hereby tender to you my resignation as Professor of English and Modern Languages at this institution, to take effect at the end of the school year September 1, 1906.

In laying down the work, which for sixteen years has absorbed my every energy, I desire to express my deep regret at breaking ties that bind me to this place more strongly than to any other on earth. It is here that my children have grown up and one, alas, has passed away. It is here that day after day the best of my life has flowed into the young spirits that were taking form and coherency around me, and I have found my one inspiration in the thought that they not only would not but could not forget the lessons learned from me. For sixteen years no one has passed out from any of the courses of this institution without having come under my direct personal influence and in them at any rate I "have become a part of all that I have met," in them, I humbly hope for good and not for evil, I shall live on and on, perhaps unconsciously to them but none the less really.

You will not therefore wonder that, although I and my work may be unknown to you, I have been unable, in formally relinquishing my position, to confine myself to the bare and cold announcement of the fact, or to refrain from adding an expression of my deep and abiding interest in the future of the institution and a fervent wish for its prosperity in all good work.

Very respectfully,
HOWARD EDWARDS.

In taking final leave of the work, I desire to express to the members of the department my high sense of the loyalty they have shown me in aiding and supporting to the full measure of their strength all my plans and efforts for the efficiency of the departmental work. In the counsel and sympathy of the departmental meetings, I have found much of wisdom and help.

To students and faculty and board of the college, my best and warmest thanks go out for the kindness expressed in word and deed through the series of years long, as the brief mind of man runs.

Respectfully submitted,

HOWARD EDWARDS,

Professor of English and Modern Languages.

Agricultural College, June 30, 1906.

REPORT OF THE WOMEN'S DEPARTMENT.

To the President, Michigan Agricultural College:

Dear Sir—I beg leave to submit the report of the Women's Department for the year 1905-6.

A class of sixteen members was graduated in June, being the first class to graduate under the new course.

Some changes in the teaching force for the coming year are made necessary by the adjustment of work to the changes in the course. One assistant in home economics will be sufficient for the present. Miss Robinson leaves the work in domestic art to take a similar position in the manual training high school of Saginaw.

Miss Calwell, senior instructor in domestic science, sent in her resignation early in the winter. Miss Waugh, a successful teacher and a graduate of Teacher's College, Columbia University, has been secured as her successor.

Miss Avery, for the past six years the successful and popular teacher in charge of the gymnasium, resigned in May. She had established herself during her stay in the esteem of the entire college community and her going was a matter of general and genuine regret. She was followed by a host of loving good wishes for her future happiness. The department regrets to have these ladies leave as they have all shown themselves to be most worthy and efficient in their work.

The demand for special work in home economics and for teachers in this line in the various public schools of the state, shows the desirability of a two year's course for this class of students. We suggest this step as the next one for the department to take.

The right to state certificates has been granted by the State Board of Education to graduates of the women's course who meet certain definite requirements. We believe that our graduates are well fitted for the work of the teacher and invite the attention of school boards to our course.

Respectfully submitted,

MAUDE GILCHRIST,

Dean of Women's Department.

Agricultural College, June 30, 1906.

REPORT OF THE DEPARTMENT OF PHYSICAL CULTURE.

To the President:

Sir—I have the honor to present the following report of the department of physical culture for the year just closed, 1905-6.

The work has been carried on along the two lines, athletics and general gymnasium work.

In athletics, the usual teams, baseball, football, basket-ball, track, relay, tennis, wrestling and tumbling, were developed for intercollegiate competition. All of these teams had successful seasons; those in track, football, basket-ball, relay and indoor winning their respective championships while the baseball and tumbling teams won second and the tennis team third in the yearly competition with the other state colleges. In order to reach a larger number of men in this branch of the work, class teams in nearly all of these sports were also organized and a regular schedule of interclass games played in each.

The general gymnasium work of the winter months consisted of regular class work in the armory with the Indian clubs, dumb-bells, barbells, free arm exercises as well as the indoor sports of basket-ball, hand-ball, indoor baseball, indoor track athletics, wrestling, tumbling and apparatus work. A class, meeting three times a week, for short course students only, was also offered and about seventy-five of those students took advantage of the opportunity.

The department promoted and held, on May 19th, on the athletic field an inter-high school field and track meet. Invitations were sent to all the schools of central Michigan, a large number of which accepted and some 500 high school students were in attendance the day of the meet. It is planned to make this meet an annual affair at the college.

The annual Michigan inter-collegiate field day also was again held on our field. All of the state colleges, which are members of the association, entered into the competition and a large crowd of visitors was in attendance during the two days of the meet.

An effort has been made during the year to reach as large a number of the students as possible. The work offered has been open to all and varied, as far as possible, so that all classes of students might take advantage of some of it. The total enrollment for the year has exceeded 700 which, allowing for duplications, gives 300 individuals, a good proportion when it is taken into consideration that the work is entirely optional on the part of the students.

It is unfortunate, as I mentioned in a previous report, that a large number, in fact a large majority of the physically weak students who need the work most, have not elected to take any of it. The remedy is to require physical examinations and gymnasium work or its equivalent of all students for a certain length of time. This change will be very difficult; however, until the department is equipped with a gymnasium as the armory, which is used in that capacity now, is used by the military department so large a portion of the available time.

Respectfully submitted,

C. L. BREWER,

Director of Physical Culture.

Agricultural College, June 30, 1906.

REPORT OF DEPARTMENT OF HISTORY AND ECONOMICS.

To the President:

I have the honor to submit the following report concerning the department of History and Economics for the year 1905-6.

The total number of enrollments in this department during the year was 480, distributed as follows:

By terms—autumn, 159; winter, 119; spring, 202.

By classes—freshmen, 28; sophomores, 148; juniors, 165; seniors, 61; sub-freshmen, 78.

By subject—history, 230; political science, 143; political economy, 107.

The total number of hours taught was 1,040, divided among the three terms as follows: Autumn, 312; winter, 320; spring, 408.

The circumstance of presenting history and political science in a school whose curriculum is so largely given over to laboratory sciences and to many technical subjects, renders the problem of presentation one of constant study and adaptation, so that in no two years are the subjects taught quite in the same way. I wish in this report to enlarge upon the exhibition usually given in the college catalogue of the courses in this department, and to describe their present status somewhat fully.

History may be pursued either as a required, an optional, or an elective study in some of its divisions by the students in each of the college departments; and is customarily taken by the agriculturals during three terms, by the mechanicals during two terms, and by the women during four terms.

Perhaps the thought of John Morley as nearly furnishes an intimation of the aim and spirit of historical work at this place as can be given in small compass. "It is the present," he says, "which interests us; it is the present we seek to explain and understand. I do not in the least care to know what happened in the past except as it enables me to see my way more clearly through what is happening today. I want to know what men thought and did in the thirteenth century, not out of any *dilletante* or idle antiquarian interest, but because the thirteenth century is at the root of what men think and do in the nineteenth."

The antipathy between our course of study and *dilletante* or mere antiquarian research purposes is emphasized by our arrangement of the divisions of the subject. It is assumed that modern history is of more importance to the student than ancient history; hence English history is given first, nineteenth century history in the freshman year, European history in the sophomore, early European in the junior, while an elective in United States history is offered in the senior year.

Practical usefulness and pedagogical worth unite in selecting the history of our own people as the crowning portion of a course in history. Its superior utility to the would-be citizen is obvious, while to our own students it is the only history in which the benefits from handling the original sources of history are possible. Two general methods of work compete with each other in all the fields of this study, one known as the English, the other as the German method. "The English method," says Professor Hart of Harvard, "aims to ground students in well-chosen secondary books, which they are to read, assimilate, and compare, and the divergences between which they must note, though they have not the means to reconcile them."

"The opposing method," he says, "expects some knowledge of the original material. The student's work is based upon some rather brief text-book, or combination of books, but from all students collateral use of sources is required. The English method may be compared to an orderly ship canal going straight to the end, with an ascertained depth of water, but always shallow and confined; the other method to a natural river, abounding in deep pools, with many branches and unfordable places, but winding among human habitations and giving glimpses of human life."

The utility of this latter method in studying advanced United States history is readily seen. To begin with, the student has already the common places of our history in his mind when he takes up the study. The records of congress and reports of state papers, records of the constitutional and state conventions, presidental messages, contemporary newspapers, and private correspondence—all this, well arranged for studying purposes, is easily found at the student's disposal in our library. I sometimes imagine that a dexterity in doing this sort of work is possessed by our students through the practice of handling materials at first-hand in their scientific studies. Certain it is, at any rate, that freshness and interest is given to historical study by this method of work.

At the risk, perhaps, of being thought insistent on trifles, I wish to say a few words concerning the conduct of the work between teacher and student. English history is taught here for a well-defined purpose —briefly to trace the growth among the English-speaking peoples of our characteristic institutions and forces. Free religion, free speech, free press, parliamentary government, and world expansion are the things emphasized. Elaborate note book work and map making are the auxilaries to the text in this study. In European history the text is aided mainly by extended reference reading.

Every fashion of assigning references has, I think, been indulged in by the history teachers at this college, to the final exclusion of all save the one now in use. The generality with which reference work as a class device is employed excuses, perhaps, some examination of the practice. It was first thought sufficient in our employment of references that the teacher should suggest the page or chapters in reference books where interesting information on the lesson in hand might be found. Pointed allusion to the desirability of having this reading done would also be made, with the result usually that while some of the students did the reading most of them did not.

The second method prevailed for a few years, in which abstracts of what was read were made by the students; these to be handed in, contents noted, and corrections made by the teacher. Measurement of a student's reference work can be made by this method, provided his notes are personally collected; but the conclusion ultimately comes that note-taking is the end of the student's efforts. He simply gleans through the reference for the purpose of making notes. The method now employed is to duplicate the reference books to the extent of the demand by the class, and to require recitations upon references the same as upon text-books. It is believed that every desirable end from reference reading can be attained in this way.

The subject of political science is required during two terms from women and agricultural students, and is optional during one term to mechanical students. This subject attends the study of history like language to literature or literature to language. "History is past politics, politics is present history." I adopt without alteration the following statement from Professor Hinsdale as to why civics should be taught: "The aim," he says, "is to teach certain facts and principles relating to governments in general and our own in particular in such a manner as to enlarge the intelligence of the student and inspire him with a spirit of civic duty and patriotism."

Some evolution of pedagogic method in teaching this subject has taken place during a period of ten years. It has been proven it seems to me, that the dictum of proceeding from the part to the whole, from the particular to the general, has no place in teaching civics. This transference of a principle which seems to work well in some of the physical sciences proves a failure, I believe, when carried into the abstract studies, like political geography, civics, political economy, and history; and text-books in civics are no longer written which begin with the township, county, and city governments before studying state and national ones. The insufficiency of working from the known to the unknown, from the particular to the general, as applied to the study of civics, arises from the equipment of the student's mind when he undertakes this subject. Mentally, he has a set of governmental symbols derived from reading or hearsay which stand for institutions and activities of a higher type than those found in township and county and state governments. It is the doings of congress and the president that he has heard of continually. They are the parts of government he knows something about, has idealized, and is interested in, and with which he feels at home in beginning his study. It is, then, not with the highest forms of government—like international relations, for instance —nor with the lowest type, like the school district, that the teaching of this subject should begin. Something intermediate is preferable.

Political economy is taught through two terms, and is a senior elective for women and agriculturals and an optional during two terms to juniors and mechanicals. Within the ten years that this subject has had its present teaching at this college two great economic movements have powerfully affected its pedagogical presentation. The two referred to are the money question and that of trusts and monopolies. The custom followed for years by President Hadley in teaching economics at Yale was to take the uppermost economic questions of the day as the means of entrance into the subject. This was easily realized by co-ordinating and grouping economic phenomena around this initial question. This method has many merits, and any method of study adopted for a living subject like our ever-changeable industrial and commercial life must assimilate itself to that life.

Nothing lends itself more properly, it seems to me, to the lecture system of instruction than a subject like this whose materials are changing from year to year. In spite of the vogue text-books have acquired among us, I incline to the view that no method of teaching will be ultimately satisfactory which is not some form of the lecture system—either the giving of notes, or oral discussions. It is best for the teacher because it enables him to keep in the front with his subject; it is best for the student because he is enabled to get the best from the teacher.

The bond of harmony in all the subjects of this department is the development in the student of "social consciousness." "The complete man," says Taine, "is the man in society and one who develops himself therein; the superior race is that which is disposed to social intercourse and to progress." "Man isolated from society," says Cooley, "is unthinkable." Surely no one may doubt that the inter-dependence of man upon man increases day by day.

The ties that bind society together are, perhaps, more concretely exhibited in civics than in either history or economics, though here again "history is past politics." A boy's earliest conception of society is that a mass of individuals—a human forest. The other conception —and this is the one that law-makers and statesmen act upon—defines society as something like an organism, within which man or woman has some function. Beyond dispute, this second view-point must be acquired by the good citizen. No true explanation of suffrage, of taxation, of legal penalties, of military service, or of compulsory education, is possible without the organic conception of society. The sense of relationship among those who form this organism is "social consciousness."

No other subject than political economy furnishes more material of a usable sort to bring out these relationships. The inter-dependency of man upon man for sustenance, under the regime of competition now prevailing, is put forth here. An inter-dependency whose absence would be suffering or death, comes out. For example, the numbers whose efforts contribute to the feeding and clothing of any one of us for one day is not inconsiderable. So, too, the wide-reaching consequences of such an event as the coal strike or the failure of a large bank are illustrative of the materials with which economics abounds for teaching the lessons of our dependence one upon another.

A further study, suggested by the series of disciplines described as naturally sequential both from the subjects and aims of this department and from the utilitarian character of this college, is the study of certain wide-spread institutions and activities of society not found properly within the limits of any of the courses thus far described. I refer to such activities as the care of the poor, the criminal, and the defective classes; religious and educational movements; organized efforts for improving the conditions of living, as undertaken by the grange, farmers' clubs, and civic improvement societies,—in a word, the subject-matter found in the study of sociology, I sincerely hope space may soon be found in our curriculum for presenting a course in sociology to the students in all the departments, or at least to some of them.

It is becoming more insistent each year that a prime need of this department is a regular class room for its work. The scattering of maps and other illustrative material through four or five borrowed class rooms, as is now our necessity, is obviously neither economical for the college nor convenient for the department. The necessity of going from department to department at the beginning of each term, borrowing these class rooms, is likewise full of inconveniences.

It gives me great pleasure to commend the services of Mr. Ryder as assistant in this department during the past year. The work in political science and much of the history was under Mr. Ryder's care, and there seems to be no merit of worth that he did not supply in teaching these subjects.

Very respectfully,
WILBUR O. HEDRICK,
Professor of History and Economics.

Agricultural College, June 30, 1906.

REPORT OF THE DEPARTMENT OF PHYSICS AND ELECTRICAL ENGINEERING.

To President J. L. Snyder:

The work of this department has been carried along during the past year very well. Messrs. Curtis, Burk and Morgan have all done very efficient work. We have had to have some student assistants also in order to carry the work. The different arrangement of the laboratory as mentioned in my last report was completed and we have not been crowded during the year for laboratory space, although we have had less students this year than the year previous. We are hoping to give more efficient instruction and have our laboratories properly equipped on entering the new building,—until that time we shall be more or less inconvenienced for lack of recitation rooms.

Yours very truly,
A. R. SAWYER,
Professor of Physics and Electrical Engineering.

Agricultural College, June 30, 1906.

REPORT OF THE DEPARTMENT OF PRACTICAL AGRICULTURE.

To President J. L. Snyder:

The following is the report of the department of Practical Agriculture for the year ending June 30, 1906:

DIVISION OF ANIMAL HUSBANDRY.

During the year the head of the department was assisted by Mr. H. W. Norton, both in the instruction work and in the execution of live stock experiments and compilation of results therefrom. The keeping of experimental herd records, registration of live stock and the preparation of data for publication formed no small part of Mr. Norton's work. Mr. A. C. Anderson also assisted with the instruction work and took charge of the dairy herd and swine. The following instruction work was given in this division, viz.: For sub-freshmen and freshmen, study of breeds, 81 students, 10 hours per week for 12 weeks. For seniors and specials, advanced stock judging, fall term, 16 students, 10 hours per week for 10 weeks. For sophomores, animal breeding, winter term, 50 students, 5 hours per week, 6 weeks. For juniors, stock feeding, spring term, 30 students, 5 hours per week, 12 weeks. For juniors, live stock experimentation, spring term, 18 students, 10 hours per week for 12 weeks. In the special short courses 73 first year students were instructed in stock judging, 10 hours per week for 8 weeks, and 23 second year students in advanced stock judging, 10 hours per week, 8 weeks.

During the year a large amount of new work has been undertaken along the line of moving and remodeling the farm buildings, and improving the live stock equipment. This work was made possible by the passage of an act by the last legislature appropriating $10,000 for the moving and refitting of the farm buildings, and $20,000 for use in the live stock division to be used in upbuilding the college flocks and herds, in conducting live stock experiments, making exhibits, or in other ways tending to stimulate and develop the live stock interests of the state. The special live stock appropriation was secured largely through the efforts of the Michigan Association of Improved Live Stock Breeders, the committee consisting of Messrs. A. H. Zenner, Robert Gibbons and Jas. Slocum. The work first undertaken was that of moving and rebuilding the barns, a portion of the work only was completed this year, owing to the fact that only one-half of the money was available. It was felt that it would not be wise to make purchases of expensive live stock until the building equipment was in shape to handle them, hence the delay. What was known as the grain barn, across the road from the farm house, was moved south and west, opposite the dairy barn, and joined to the grade herd barn, which was moved back the previous year; these two buildings were converted into a structure 45x150 feet and is used entirely by the grade beef and dairy herds, accommodating in all about one hundred head. The annex to the old beef barn, a structure 25x94 feet, standing close to the agricultural laboratory, was moved due south and placed at right angles to the grade herd barn. This building has been refitted and now houses the nine bulls owned by the college, which were formerly scattered around in the numerous buildings. The sheep barn, 34x90 feet, was also moved due south and placed west of the grade herd barn, 150 feet from it. To this is to be added 60 feet more, which will form the western boundary of a court bounded on the south by the bull barn, on the east by the grade herd barn and on the north by the proposed new horse barn, the northeast corner of which will only be a few feet from the piggery as now located. What was known as the experiment station cattle barn has been removed to a point opposite the railroad track from the old engine house, and is to be converted into a hospital for the control of diseases as they may break out in the herds and flocks, and also for the handling of diseased animals which may be shipped in for investigation purposes. A detailed account of the moving, building and remodeling will likely be given in a special report, hence we shall refrain from going into further detail here.

The $2,000, a part of the special live stock appropriation which the legislative act specified was to be used in the interests of the poultry business has been practically expended. Two buildings have been erected. One is an incubator house 18x36 feet; this building has been designed with a half basement for carrying on the incubation work and one story above to provide a class room and work room for students. The poultry house is 15x84 feet with a capacity for handling 175 mature fowls with twenty-five in each breeding pen. Three large brooders with capacity for handling 200 chicks each were also built after a pattern now in use by Cornell university. The grounds now occupied by the poultry division have been enclosed by a 72-inch heavy poultry fence. This division is equipped to meet the present need, with incubators, brooders, etc., of different makes and styles. At the present time there are about 400 chicks which were all incubated at the college last spring from eggs secured from some of Michigan's best breeders. The breeds represented are Brahma, Barred Plymouth Rock, White Wyandotte, and White and Brown Leghorns. The work of this division is in charge of Mr. James G. Halpin, a graduate of Cornell university, who comes to us after having spent a year in charge of the college poultry plant at Kingston, Rhode Island.

A division of farm mechanics has also been added to the farm department, with Mr. L. J. Smith, a graduate of the engineering department of 1906, in charge. This division will furnish instruction work to regular agricultural and short course men in blacksmithing, carpentry, engines and power machines, and farm machinery in general. The demand for special training in these lines of work has been such as to justify the establishment and equipment of a division to fill the need.

There has been little change in the general method of handling the college farm, except for some alterations in the system of crop rotation in order to exterminate some quack grass which has had a strong hold in fields numbers 5, 7, 12, 13 and 14 for some years past. It is now practically eradicated. A large amount of new fence has been constructed during the year, but our needs in this line are still considerable. The general supervision of the farm work has been conducted by Mr. Christopher Fick, farm foreman, in a very creditable manner.

DIVISION OF AGRONOMY.

Prof. Jeffery reports the following relative to his division:

During the year just closed instruction has been given as follows:

During the fall term to 91 regular students; during the winter term to 180 regular and to 90 special students, and during the spring term to 83 regular students. These students were handled in 14 classes.

During the year Mr. McWethy has had complete charge of the work in farm crops, and has helped as before with the other work.

The head of the division has attended 19 institutes and farmers' meetings, at nine of which corn judging was done in corn contests, and from one to four talks given. Eight days were spent with the train known as the "Corn Special," with which forty-six stops were made and more than that number of talks were given.

Temporary quarters in the old tool barn are being equipped for the work in farm crops. In these our students will be better able to study methods of saving, caring for and preparation of seed, as well as to better study the characteristics of breeds of grains, seeds and corn.

The field work with corn and grains as outlined a year ago is being continued and enlarged.

DAIRY DIVISION.

Mr. F. O. Foster reports the following relative to his division:

During the leave of absence in the summer of 1905, one month was devoted to the study of the manufacture of ice cream, to the operations of city milk plants in the cities of Baltimore, Buffalo and Detroit. This work, together with the previous experience of the instructor, formed the basis of a series of lectures that have been included in the advanced dairy work in the senior year. The remainder of the time was spent mainly in the cheese factories and creameries of Michigan, special attention being given to the manufacture of Michigan cheese. During the three months thirteen cheese factories, nine creameries and seven city milk plants were visited.

In the fall term instruction was given to a class of four senior women in household dairying, and to a class of seven senior men in advanced dairying. During the winter term the instructor was occupied in short course work. Two seniors, six juniors, thirty-five sophomores, and thirty-three freshmen took the dairy work offered their respective classes during the spring term. The large class in elementary dairying made it necessary to secure some assistance in teaching, and in this capacity Instructors Norton and Anderson did very efficient service.

The free testing of milk and cream samples was continued throughout the year, and the number of such samples is increasing.

In order to give dairy students as much practical experience as possible before taking advanced work, an attempt was made to secure positions for them in the summer vacation, which resulted in the placing of six men in milk plants, creameries and on dairy farms for the summer of 1906.

Yours respectfully,
ROBERT S. SHAW,
Professor of Agriculture.

Agricultural College, June 30, 1906.

REPORT OF THE MILITARY DEPARTMENT.

President J. L. Snyder:

Sir—I have the honor to submit my report of the military department for the year ending June 30, 1906.

I reported for duty at the college September 15, 1905. At the beginning of the fall term, September 19, 1905, I found the battalion very much disorganized and the drill at best very indifferent. The first condition was due to the seniors dropping out of drill. Last school year they were obliged to drill, this year it was made optional, as a result all dropped out but seven. The indifference in drill, I believe, was due to a condition of affairs in this department which has gradually developed until this inefficiency and lack of interest became most glaring, as shown by the report of inspection of last year.

During the fall and winter terms I have divided my time among the various organizations, striving to acquaint myself with the men and to observe the effort made by them individually. The last half of the fall term and first half of the winter term the new men only drill, the drill being held in the armory. In order to get in the prescribed time, three companies drilled each day instead of one as had been done in previous years. Drill was held five times a week during this period. As there are five companies, each company drilled three times a week. The last half of the winter term all cadets are due for drill and on account of the increased strength of the companies only two companies drilled each day in the armory, the third hour being devoted to theoretical work. During the fall and winter terms the band practiced five hours a week, thus putting in a good deal more time than actually scheduled, but which resulted in developing a most creditable band.

I feel quite encouraged as to the result of my work. I believe the increased interest and consequent improvement to be quite marked. The work of the corps is far from that degree of efficiency which I desire, but which I believe is being gradually attained.

Major J. S. Mallory, General Staff, U. S. Army, inspected the corps May 16th last, a month previous to the close of the college year. The military exercises ordered by the inspector were as follows: Review, battalion inspection, dress parade, battalion drill in close order, company drills in close and extended order, signal drill, and litter drill. The inspector stated that the ceremonies in general were well executed, also the infantry drills with a few exceptions in details, and that the signal and hospital drills were quite good.

As an indication of the increased interest taken by cadets there were only five absent at the inspection on April 16th out of a total of 362, and these five were reported sick. All in ranks were completely uniformed. The band, composed entirely of students and numbering twenty-three, made a most creditable showing.

I believe the military instruction as now prescribed, if properly carried out, to be of such extent and thoroughness as to qualify the average graduate for a commission as a lieutenant of volunteers.

The hour for drill comes in the afternoon from 5 to 6. Quite a few of the men tell me that this is not a good time. In the spring term this hour has its advantages, but I believe a better time would be from 1 to 2 p. m.

Very respectfully,
F. W. FUGER,
Capt. 13th Inf., Commandant.

Agricultural College, June 30, 1906.

REPORT OF THE DEPARTMENT OF DRAWING.

President J. L. Snyder:

The report of the department of drawing for the college year ending June 30, 1906, is herewith respectfully submitted.

The resignation of Arthur E. Palmer, instructor, to accept a position at the university, rendered it necessary to secure a new man. Mr. H. S. Hunt, graduate of the engineering course in 1905, accepted the offer of the position, but at the opening of the fall term asked to be released. After a good deal of trouble Mr. H. G. Walker, graduate of 1904, was secured, and filled the position acceptably until the close of the year, when he resigned. The difficulty of securing suitable men as instructors in this work and the seeming impossibility of retaining them for a longer period than one year, would suggest that possibly the salary offered is too small.

Through the action of the State Board of Agriculture it was my privilege at the close of the fall term to enter upon a leave of absence lasting until the middle of the spring term. The department work was very efficiently taken care of during my absence by the regular members of the department force, assisted by A. R. Alger of the mathematical department and Miss Franc Bennett, a recent graduate. It was very gratifying upon my return to find how well everything had been done, and I wish to express thanks to my assistants for the care with which they managed the affairs of the department.

Thanking you for the interest shown by you in the work of the department.

W. S. HOLDSWORTH,
Professor of Drawing.

Agricultural College, June 30, 1906.

REPORT OF STATE INSPECTOR OF ORCHARDS AND NURSERIES.

Hon C. J. Monroe, President State Board of Agriculture:

Sir—As in previous years, the work of this department has consisted of inspecting all of the nurseries in Michigan during the months of August and September and investigating outbreaks of San Jose scale as they are reported from time to time. There has been a slight increase in the number of nurseries, as well as in that of nurseries in other states who have agents in Michigan, and of residents of the state who sell nursery stock on their own account but purchase their supply from other parties. All of these parties are required to pay the license fee and file a bond before receiving a license entitling them to sell nursery stock within the state.

There was little change in the condition of nursery stock as compared with previous years. The San Jose scale was found in small numbers in all of the nurseries that were infested in 1904-5, but in most of them the extent of the infestation was reduced and there is every reason to expect that, with proper care, it can be eradicated within a year or two except where the nursery blocks are in close proximity to infested orchards. In such cases in order to keep down the scale it may be necessary to make use of summer as well as winter applications upon the infested orchards.

With one exception, the nurseries found to be infested were located in infested regions and, in this case, about a dozen trees were found in a nursery that was closing out its business. The trees in the infested blocks were four years old but careful examination failed to reveal the presence of the scale in the orchard trees in the vicinity and the San Jose scale is not known to be found within a dozen miles.

The infested nurseries were inspected a second time just before the trees were dug and all upon which the scale could be found were taken out and destroyed. As is required by the state law, the proprietors of infested nurseries and also those having nursery stock within a half mile of where the scale was known to exist were required to fumigate it with hydrocyanic acid gas before selling the trees. Several nurseries that do not come under the requirement of the law have also erected and made use of fumigating houses in order to give their customers as much protection as possible.

Some nurserymen and fruit growers have expressed themselves as opposed to the fumigating of nursery stock, believing that it injures the trees. That this is not the case when the work is properly done has been conclusively shown by experiments that have been conducted in a number of states. These have demonstrated that no injury is done to nursery stock by fumigation unless at least twice the amount of chemicals usually recommended are used and the gas is confined for a long period. While it is barely possible that the injury attributed to the fumigation was actually caused by using the gas in an improper manner, it seems more probable, in the light of the experiments that have been tried, that this is merely an excuse to account for injuries due to careless handling of the trees.

That fumigating is effectual against the San Jose scale has been demonstrated by the fact that the writer has never found living San Jose scale on trees that have been fumigated, where there was reason to think that it had been brought from a nursery. Although comparatively few Michigan nurseries are infested, the number in the eastern states from which many thousand trees are brought each year is quite large, but our state law, which requires the fumigation of all stock that is subject to the attack of San Jose before it is brought into Michigan, seems to have been very effectual in preventing the bringing in of scale upon nursery stock.

The Michigan nurseries in which the scale has been found have gladly co-operated in all the efforts that have been made to rid their stock of its presence, and with the work that is being done in other states there seems to be little reason to fear the introduction of the scale upon nursery stock. While careful inspection of nursery stock before it is dug will show the presence of scale if it has become in any way abundant, the minuteness of the insect and the fact that at the time when the inspection is made the young are appearing, make it impossible for anyone, even with the most careful examination, to say that the trees are actually free from the presence of the scale. Although the law does not require the fumigation of stock, except when it is known to have been grown near where the scale has been found, from the very nature of the case it would be far better if the fumigation of all stock could be required.

What was said regarding the development of the scale in nurseries applies to this year's experience with it in orchards. Although a large number of orchards have been found to be infested during the year, in no case has the scale been found except in sections known to be infested at least one year ago. As might be expected from the minuteness of the insect, new infested areas are constantly being found but, without exception, they have been within short distances of orchards that have been infested for some years. The scale spreads most rapidly and does most harm in the larger villages and cities. The trees themselves were obtained from a large number of nurseries, which alone increases the chance of obtaining infested trees. Then, too, the small lots bring the trees close together and it is not strange for the scale to spread the length of a street before its presence is known.

The same steps as in former years for the eradication of the scale in orchards have been taken. When the trees are very badly infested and especially if they are of poor varieties or for any other reason are of little value, their destruction is advised. This is also the best course to pursue when the insect is confined to a few trees, but as a rule, one cannot be sure of this and especially after the scale has been on a tree for two or three years it is more than probable that it has spread to some of the others in the vicinity, even though its presence cannot be detected. Whenever the condition or kind of the trees makes it advisable to attempt to save them, the work should not be delayed and it should be prosecuted with the utmost thoroughness. In order to increase the efficiency and at the same time effect a saving in the amount of labor and material required, it is advisable to prune the trees thoroughly. All surplus branches should be removed and the ends of the others headed back. Experience has shown that it is a difficult task to spray the trees to the tips of the branches, especially if they are irregular and straggling.

No discoveries have been made regarding remedies, and dependence should still be placed upon the sulphur and lime mixture. The same formula, fifteen pounds of sulphur and twenty-five pounds of lime, is used as in previous years. The addition of eight pounds of salt seems to be beneficial in places where heavy rains occur soon after application. While the lime is slaking the sulphur should be added and the two thoroughly mixed so that they can form a chemical combination. To bring this about it is advisable to add a gallon of water for each pound of sulphur and to boil the mixture for at least forty-five minutes. It should then be diluted to fifty gallons. Although it is not necessary that the mixture be hot when applied there will be less trouble in applying it if it is at least as warm as 120 degrees. When but a small quantity is required it can be prepared in an iron kettle, but for spraying large orchards a steam boiler will be desirable. Fairly good results can be secured in the preparation of a small quantity where a large kettle is not available, if the sulphur and lime are placed in a barrel and the lime is slaked by the application of boiling water. The two should be thoroughly mixed and as soon as the lime is slaked the barrel should be covered for an hour or two to hold in the heat.

The use of the above mixture is recommended not only on account of its efficacy in destroying the scale but because it has excellent fungicidal qualities. As a preventive of leaf-curl and for the control of apple scab and similar diseases it has no equal. When fruit trees are sprayed with sulphur and lime mixture there is no occasion for Bordeaux mixture or copper sulphate solution previous to the blossoming period. During the year the testing of various patent scale exterminators has been continued but none of them have been found equal to the sulphur and lime for this purpose and besides this they lack its fungicidal qualities. Most of these remedies contain a soluble oil and on this account possess a slight advantage over the sulphur and lime mixture when it is not thoroughly used, owing to its tendency to spread along the branches and thus correct at least in part any imperfect work.

Where sulphur and lime has been used on infested trees and the applications have been thoroughly made, excellent results have been secured. It can be safely said, however, that not one person in ten sprays sufficiently thorough to secure the best results. In many cases the trees would not be considered more than half sprayed. The folly of this imperfect work can be seen from the fact that where a single female scale remains alive upon the trees, the reproduction is so rapid that at the end of one season the number of progeny may have reached three-quarters of a million, provided all of them lived and reproduced. While thoroughness is essential in spraying for other insects and the fungous diseases, it is especially so against the San Jose scale.

The best results can be secured if the trees are sprayed while they are dormant. This is particularly the case because at that time it is possible to use very strong mixtures but the fact that there are no leaves on the trees enables one to do more thorough work than after the growth has started. An excellent time for spraying is as soon as the leaves have dropped in the fall, but fully as good results can be secured just before the buds start in the spring. Although the spraying can be done during warm days in the winter, it will be even better to wait until the first half of April. It sometimes happens that the presence of the scale is not detected until after the growth has started. Especially if upon young trees they might become so numerous during the summer as to seriously injure and perhaps kill the trees. For this reason, something in the way of a summer application is desirable. Although it will be likely to burn the leaves slightly, in cases where the scale are very numerous upon a tree it will often be well to apply sulphur and lime at about two-thirds the usual strength. If care is taken to cover the trunk and larger branches without getting more than is necessary upon the leaves, the benefits will greatly exceed the injury that will be done to the foliage. However, there will be a large number of scale near the ends of the branches that will not be destroyed. When the broods appear, which will be at about the middle of the months of June, August and October, the young scales and the sets that they form can be killed by applications of kerosene emulsion or similar remedies without injuring the trees. For use upon apple trees this can be made as strong as ten per cent, using one gallon of kerosene, one pound of soap and nine gallons of water, but for other fruit trees the amount of water should be increased to eleven or twelve gallons. If care is taken to make the application when large numbers of the minute, yellow lice are crawling upon the branches, excellent results will be secured. This treatment, however, will not be sufficient to kill the old scales although an emulsion containing twenty-five per cent of kerosene, which can be used with safety during the winter, could be used with good results.

During the past year numerous complaints have been investigated where the injury was caused by scurfy scale, oyster shell scale and the European fruit scale, but in only a few cases was serious harm being done. The same treatment was recommended as for the San Jose scale but if only a few insects were upon the trees an application of kerosene emulsion when the young appear in June will be found effectual.

Owing largely to the vigilance of the township inspectors in the counties where the disease has been most troublesome comparatively few cases of peach yellows were reported in 1905, although the number in 1904 was unusually large. For the most part the only places where the disease was very troublesome last year was in orchards that had been neglected or practically abandoned and in sections of the state where the peach growing industry is of little importance and where there are no township inspectors. Under these conditions it often happens that the owners of infected orchards not being familiar with the characteristic appearance of the disease as it manifests itself in the fruit, branches and foliage, entire orchards are sometimes destroyed before the cause of the trouble is known, being attributed to the winter or other natural causes.

Not only should every peach grower endeavor to familiarize himself but they should understand that unless prompt attention is paid to the removal of infected trees all of the others in the orchard as well as in the surrounding country will be doomed. On the other hand, they should know that if trees in which yellows appears are removed as soon as the characteristic symptoms are shown in the fruit, the disease will be checked. It is not uncommon to find the loss reduced to considerably less than one per cent annually when infected trees are given attention immediately, while it is seldom more than three or four years before it amounts to a hundred per cent if this is neglected.

Comparatively few reports of "little peach" have been received during the year. In some sections where rigid steps have been taken to destroy infected trees, the number of cases has undoubtedly been reduced, but from the insidious nature of the disease and the fact that even those who are most familiar with it sometimes have difficulty in detecting it in its early stages, it is probable that it is in orchards where its presence is not suspected.

The changes made in the nursery and orchard inspection law by the legislature of 1905 have been very helpful, as it is now possible to secure the appointment of inspectors in cities as well as in the townships. This is especially desirable as the San Jose scale seems to be doing more harm in some of the cities and larger villages than in the country, except perhaps in the fruit belt itself where the orchards are situated so close together that if the scale appears in one it will very certainly spread to a number of others in the vicinity.

Aside from preventing the dissemination of the San Jose scale and other injurious insects and diseases upon nursery stock the law has been very helpful in sections where they have appeared in the orchards, as we have in numerous cases found the San Jose scale in large, commercial orchards where its presence was not suspected by the owner and have thus enabled him to take the proper steps to control it before any harm had been done. The law also makes it possible to compel all persons to see that their trees have proper attention so that the efforts of the fruit grower who takes pride in and looks after his trees will not be set at naught by his shiftless neighbor who cares nothing for his trees and would take no steps to save them no matter what danger threatened them.

The principal need, so far as this department is concerned, is more knowledge on the part of the public regarding the nature of and danger from these pests when allowed to go without attention, and a public spirit that will insist upon the appointment of local inspectors where these dangerous insects and diseases have made their appearance.

The work of inspecting orchards and nurseries has been done for the most part by the same deputies as last year. It has been thought best to delay the inspection of the nurseries until as late a date as possible and this has necessitated using a somewhat larger force. The writer has attended to nearly all of the reports of infested orchards, and has inspected the nurseries in the central, northern and eastern portions of the state; Mr. T. A. Farrand and Mr. F. A. Wilken did most of the work in Van Buren, Berrien and Kalamazoo counties;

Mr. E. W. Allis visited those in the southern part of the state; Mr. R. J. Stahelin attended to the inspection of the small fruit plantations and orchards in the vicinity of Bridgman; Mr. H. G. Welch in addition to inspecting the nurseries in Allegan, Muskegon, Oceana and Newaygo counties, looked after the inspection of peach orchards in the vicinity of Douglas, where the co-operative work in connection with the U. S. Department of Agriculture has been continued; L. M. Geismar inspected the nurseries in the upper peninsula.

The following is a list of the nurseries that received licenses to sell nursery stock in Michigan:

LICENSES GRANTED FOR THE YEAR ENDING JULY 31, 1906.

Michigan Nurserymen.

Allen, R. E., Paw Paw.
American Nursery Co., Kalamazoo.
Bladwin, O. A. E., Bridgman.
Battle Creek Nursery Co., Battle Creek.
Biehler, E. J., Stevensville.
Bigelow, J. N., Bangor.
Bragg, L. G. & Co., Kalamazoo.
Briscoe, J. A., Highland Park.
Brooke, F. W., Ithaca.
Central Michigan Nursery Co., Kalamazoo.
Clark, D. H., Holland.
Collins, W. E., Fennville.
Coryell, R. J., Birmingham.
Cross, J. A., Nunica, R. D.
Culver, O. B., Colon.
Curtis, L. T. & Son, Flint, R. D.
Cutler & Downing, Benton Harbor.
Dean, George N., Shelbyville.
Dow, H. C., Kibbie, R. D.
Dressel, G. L., Frankfort.
Dunham, E. W., Stevensville.
Essig, W. W. & Co., Detroit.
Ferrand, E. & Son, Detroit.
Flansburgh & Potter Co., Leslie.
Grand Rapids Nursery Co., Grand Rapids.
Greening Nursery Co., Monroe.
Gustin, C. F., Adrian.
Haines, J. W., Eaton Rapids.
Hamilton, A. & Son, Bangor.
Hamilton, John, Benton Harbor.
Haughey, J. H., Berrien Springs.
Havekost, G. H., Monroe.
Hawley, George A., Hart.

Hodges, Ezra & Son, Mayville.
Husted, N. P., Lowell.
Ilgenfritz, I. E. Sons' Co., Monroe.
Jaquay, Irving, Co., Buchanan.
Jeffrey, James, Jr., Bronson.
Jeffrey, James, Sr., Kalamazoo.
Kaiser, John A., Eau Claire.
Kalamazoo Nurseries, Kalamazoo.
Keirnan, T. W., Fennville.
Kellogg, R. M. & Co., Three Rivers.
Knight, David & Son, Sawyer.
Lake Shore Nursery Co., St. Joseph.
Lamson & Rood, Covert.
Lewis, A. E. & Sons, Lowell.
Maudlin, The E., Nursery, Bridgman.
McKee, H. R., Coloma.
Michigan Nursery Co., Monroe.
Michigan Nursery & Orchard Co., Kalamazoo.
Moore, Bert R,. Eau Claire.
Morley & Dyer, Benton Harbor.
Muchmore, Wm. O., Augusta.
Munson, W. K. & Son, Grand Rapids.
Muskegon Fruit Growing Co., Muskegon.
Nash, Lewis, Bridgman.
Negaunee Nurseries & Greenhouse, Negaunee.
Nelson, J. A. & Son, Paw Paw.
Newaygo County Nursery Co., Fremont.
Northwestern Nursery Co., Muskegon.
Paul, J. M., Eau Claire.
Paw Paw Valley Nursery Co., Coloma.
Peninsula Nursery Co., Benton Harbor.
Prater, Germain E., Jr., Paw Paw.
Sheldon, W. E., Litchfield.
Singer, W. H., Lapeer.
Smith, E. J., Cheboygan.
Speyers, Chas. M., Willis.
Spielman Brothers, Adrian.
Stone, John & Son, Hillsdale.
Taplin, Stephen, Detroit.
Utter, Jay J., Bravo.
Watterson, W. J. & Son, Ada, R. D.
Webb, D. S. & Co., St. Joseph.
West Michigan Nurseries, Benton Harbor.
Weston, A .R. & Co., Bridgman.
Whitten, C. E., Bridgman.
Wilber Nursery, The, Mecosta.
Willis, Orville, Bangor.
Wise, Ralph, Plainwell, R. D.
Wooll & Tillotson, Elsie.

Michigan Dealers.

Alferink. Alfred, Holland, R. D.
Augustine, L. D., St. Joseph.
Bagley, W. D., Old Mission.
Beattie, Thomas, Detroit.
Bond, I. J., Athens.
Booske, Adolph, Marine City.
Callahan, S. L., Okemos.
Davison Nursery Co., Davison.
Dodge, Thomas T., Lawton.
Dumphry, W. C., Sr., Battle Creek.
Healy, Wm., Bloomingdale.
Houghton, M. H., Wayne.
Hudson, J. L. Co., Detroit.
James, Arthur M., Midland.
Kimball, D. S., Detroit.
Knapp, W. F., Monroe.
Merrill, W. F., South Haven.
Mosier, C. H., Paw Paw.
Oregon Nursery Co., Detroit.
Sanders & Vanderhoof, Eau Claire.
Shepard, Andrew G., Paw Paw.
Souther, George H., Holland.
Steele, George & Co., Sodus.
Strittmatter, Adolph, Detroit.
Sweet, L. H., Carsonville.
Thrasher, C. D., Hamburg.
Washington Nursery Co., Detroit.
Westgate Nursery Co., The H. L., Monroe.
Wolverine Nursery Co., Williamston.

Foreign Nurseries.

Albaugh Nursery Co., Phoneton, Ohio.
Albertson & Hobbs, Bridgeport, Ind.
Allen Nursery Co., Rochester, N. Y.
Bogue, Nelson, Batavia, N. Y.
Brown Brothers Co., Rochester, N. Y.
Bowman, Thomas W. & Son, Rochester, N. Y.
Bryant Bros., Dansville, N. Y.
Bryant, Arthur & Son, Princeton, Ill.
Charlton Nursery Co., Rochester, N. Y.
Chase Brothers Co., Rochester, N. Y.
Chase, R. G. Co., Geneva, N. Y.
Chase & Wyman, Rochester, N. Y.
Costich, G. A. Co., Rochester, N. Y.
Fairview Nurseries, Rochester, N. Y.
First National Nurseries, Rochester, N. Y.
Foster & Griffith, Fredonia, N. Y.
Davis Nursery Co., Franklin, Baltimore, Md.

Glen Brothers, Rochester, N. Y.
Griesa, A. C., Lawrence, Kansas.
Graham Nursery Co., Rochester, N. Y.
Harman Co., M. H., Geneva, N. Y.
Hawks Nursery Co., Rochester, N. Y.
Henby, J. K. & Son, Greenfield, Ind.
Herrick Seed Co., Rochester, N. Y.
Hooker, Wyman & Co., Rochester, N. Y.
Jewell Nursery Co., Lake City, Minn.
Knight & Bostwick, Newark, N. Y.
McGlennon & Kirby, Rochester, N. Y.
North Jersey Nurseries, Springfield, N. J.
Perry Nursery Co., Rochester, N. Y.
Spaulding Nursery & Orchard Co., Spaulding, Ill.
Standard Nursery Co., Rochester, N. Y.
Stark Bros. Nurseries & Orchards Co., Louisiana, Mo.
Van Dusen Nurseries, The, Geneva, N. Y.
Western New York Nursery Co., Rochester, N. Y.
Whitney, G. W. & Co., Dansville, N. Y.
Willett, Eugene, North Collins, N. Y.

Respectfully submitted,

L. R. TAFT,
Inspector of Nurseries.

Agricultural College, June 30, 1906.

REPORT OF SUPERINTENDENT OF FARMERS' INSTITUTES.

To the President:

The institute year now closing has been marked by a number of special features and by the interest and greatly increased attendance noted at the various meetings that have been held in the state.

As required by the law under which the institutes were established, county institutes have been held wherever there is a regular organization for the purpose, except in Monroe county, from which the invitation came too late to receive attention. In addition to the above there has been much greater call for one-day institutes than ever before. The number asked for was so great that owing to lack of funds a considerable reduction had to be made. As compared with the previous year the attendance at the county institutes was 65,285 in 1905-06, while in 1904-05 it was only 49,425, an increase of more than thirty per cent. In the case of the one-day institutes the per cent of increase was even better as it amounted to 42,376 in 1904-05 and 57,154 in 1905-06.

In nearly every place where the meetings were held, the reports from the state conductor and the officers of the institute society expressed themselves as well pleased with the success of the meeting. Reports to the effect that "it was the best institute ever held in the county" were quite common. This was largely due to the interest taken by the local officials, as it is nearly impossible to have a meeting of this kind properly worked up unless there is someone on the ground to give the matter attention. With few exceptions the executive officers of the county societies perform their duties in a very creditable manner and this was true to a large extent with the vice presidents who acted as local managers. In a considerable number of cases the local managers for one reason or another failed to advertise and make arrangements as they should have done and in these instances partial failures were recorded and these were practically the only ones except where severe storms made it almost impossible for people to reach the place of meeting.

The topics that seemed to bring out the most interest were those relating to corn growing, potato culture, dairying, clover, good roads and schools, although, of course, in many sections other topics were of especial interest.

In arranging the institutes the plan that has been followed for quite a number of years was made use of. The one-day institutes, which usually preceded the county institute from one to three weeks, were held upon consecutive days and a single state speaker was furnished. He was taken in charge by the county secretary who arranged his itinerary and who was himself present at most of the meetings. In several counties all of the meetings were also attended by the president of the institute society but in most cases only one or two of the institutes were attended by the president. Three regular speakers were furnished for each of the county institutes and in some cases one or two special lecturers were sent. The total number of county institutes has been seventy-three, while two hundred and fifty-three one-day institutes have been held.

In addition to ten members of the college faculty and of the staff of the experiment station it was necessary to employ a number of other speakers. For the most part they were successful Michigan farmers, only one, W. G. Farnsworth, of Waterville, Ohio, coming from another state. Considerable help upon educational topics was furnished by Hon. P. H. Kelley, Superintendent of Public Instruction and his assistants and by the faculties of the normal college at Ypsilanti and the normal schools at Mt. Pleasant and Kalamazoo. The State Forestry Commission and the Dairy and Food Commission also furnished valuable assistance. Above all, however, we were indebted to Hon. H. S. Earle, State Highway Commissioner, who devoted nearly three months of his time to speaking at farmers' institutes, while his deputy, Frank F. Rogers, spent nearly an equal time.

During the state fair at Detroit last September arrangements were made for demonstration lectures by several members of the college faculty, including Prof. C. D. Smith, Prof. R. S. Shaw, Dr. Geo. A. Waterman, Mr. L. B. McWethy, who took Prof. J. A. Jeffery's place upon the program, Mr. F. O. Foster and Mr. T. A. Farrand of the South Haven station. It was planned to have two talks in the forenoon and three in the afternoon upon the three principal days of the fair, each speaker occupying one-half hour. While the results in general were quite satisfactory, it is believed it will be better to take one or two topics only and, instead of giving a set talk, have someone to merely explain the apparatus, of which there should be sufficient to thoroughly illustrate the subject. In this way it will become a sort of continuous performance and, as nearly every farmer in attendance will pass through the building in which the demonstration is to be given, there will be few who will not have an opportunity, if they wish, to listen to the demonstration.

Just previous to the opening of the institute season, plans were made for the holding of a normal institute here at the college. With one or two exceptions all of the regular speakers were in attendance for the greater part of the four days that the meeting lasted. It afforded opportunity for the members of the college faculty to explain some of the more recent discoveries in agricultural science and their adaptation in practical farming. The lecturers were also expected to furnish outlines of at least two of the talks they were to give during the coming winter and these were presented and then discussed by the other lecturers. It also afforded opportunity for the state lecturers to inspect the work of the different departments of the college and render themselves better able to reply to questions that might be asked them during the institute season.

Another special feature of the institute year was the corn train which was run for nine days with the co-operation of the Lake Shore & Michigan Southern, and the Michigan Central railroads. This consisted of two passenger coaches in which the meetings were held and a baggage car for the exhibits and apparatus. The Michigan Central railroad also furnished a private buffet car in which meals were served throughout the trip upon that road. Forty-nine meetings were held during the nine days. The stops averaged about one hour each and the time was taken up by talks upon corn culture and the selection and improvement of corn, and the inspection of the exhibits in the baggage car. These consisted of a collection of typical ears of the varieties of corn grown in Michigan, a model of a drying rack for seed corn, germinating boxes for testing corn and a large number of pans in which corn was growing, the seed having been selected in various ways. The principal points brought out by the exhibits were the importance of thoroughly drying seed corn before it is exposed to frost, and the careful testing of four or five kernels taken from different parts of each ear to be used for seed purposes.

The attendance at most points was even larger than had been expected and the only places where it was disappointing were a few where the meetings were held at 8 a. m., and others where there was no local manager.

A rural progress institute was held at Hanover, Jackson county, October 13, under the direction of J. W. Hutchins. The speakers, who were volunteers from among the state lecturers, gave addresses upon the progress that was being made in their respective branches. Among them were Prof. J. A. Jeffery, Agricultural College, upon Corn Improvement; Colon C. Lillie, Deputy Dairy and Food Commissioner, Dairying; Frank F. Rogers, Deputy Highway Commissioner, The Improvement of Country Roads; Professors Delos Fall, D. B. Waldo and Ernest Burnham and Hon. D. E. McClure, Education and Social

Economy. The institute lasted two days with a good attendance throughout and those present seemed well repaid. An interesting feature of the meeting was an exhibit of farm crops and relics of pioneer days.

The round-up institute at the Agricultural College drew out a very large attendance from all parts of the state, nearly all of the counties south of the straits being represented. There was also a large number of farmers present from the surrounding townships, many of whom have seldom attended such meetings, but who returned for several of the sessions this year.

Aside from the regular lecturers, we were favored by the presence of Prof. Thomas Shaw, of Minnesota, who gave three very valuable addresses; Prof. R. A. Moore, of the University of Wisconsin, whose talks upon corn improvement and corn culture were very well received; Prof. W. J. Green, of the Ohio experiment station, who spoke upon spraying and orchard management, and Prof. C. B. Lane, of the Dairy Division, U. S. Department of Agriculture, who explained the work of the division and gave an interesting address upon forage crops for dairy farmers.

During the institute several conferences with the delegates from the county institute societies and the state lecturers were held, at which the work of the year was reviewed and plans for carrying on the institutes during the coming season were considered.

From the discussions at the conferences it would appear that the general plan under which the farmers' institutes in Michigan are conducted has been satisfactory, both to the officers of the county institute societies and those who have taken part as state lecturers. Several of the delegates, however, expressed a desire for more addresses by the women speakers and for an increase in the number of one-day institutes. If either of these requests is granted, it will necessitate the expenditure of a larger amount for the institutes than is now available. At the close of the round-up institute the committee on resolutions, which consisted of one representative each from among the delegates of the county institute societies, state lecturers and farmers in attendance, reported in favor of an increase in the amount set aside for the purpose by the State Board of Agriculture.

During the progress of the institute, opportunity was afforded to those in attendance to note the work being done by the different departments and those who had not previously visited the college, as is always the case, expressed themselves as greatly surprised with the completeness of the equipment and more than pleased with the work that is being done.

The eleventh annual institute report was issued at the close of the year in an edition of 9,000 volumes. These were distributed to the members of the county institute societies as provided by law.

Respectfully submitted,

L. R. TAFT,

Superintendent of Farmers' Institutes.

Agricultural College, June 30, 1906.

REPORT OF THE MICHIGAN WEATHER SERVICE FOR THE YEAR ENDING JUNE 30, 1906.

Hon. C. J. Monroe, President State Board of Agriculture:

Sir—The work of the Michigan Weather Service during the past fiscal year has been carried forward on lines similar to those of preceding years.

C. F. Schneider, Section Director, U. S. Weather Bureau, has continued in charge and the location of the headquarters of the service has remained at Grand Rapids.

The service has in operation a total number of 119 stations. In addition, there are nine regular weather bureau stations, making a total of 128 places at which meteorological records are made.

The state is fairly well covered with stations, so that almost any locality can secure records, which, if not taken exactly at that place, are for some nearby point which is fairly representative. All of the important cities and villages of the state have their own station except the village of Ionia.

With the present calendar year the Michigan Weather Service will complete the twentieth year of its existence, and at no time in its previous history has there been such a constant and increasing call for weather statistics. The demand for knowledge of what the weather has been comes from widely varying sources, and asks for meteorological data of almost every conceivable kind. During the past year the greatest call for data has been in connection with proposed water power projects. The topography of Michigan and its numerous freely and constant flowing rivers and creeks makes this state one which is particularly adapted to the very general and extensive use of water power. One of the principal advantages of devoting an appropriation for the weather service many years ago was, that statistics, which would be compiled from year to year, would become constantly more valuable, as the period of observation increased, to just such demands as are now constantly being made in connection with these proposed water power projects.

An engineer who constructs these water power plants must know not only the drainage area and amount of water flow, but more important than all, the amount of annual precipitation over the water shed drained which is to furnish the power. A constant remark from these engineers now is, that the record is not long enough and that it is deplorable that observations did not begin even before they did.

To the residents of the upper peninsula who are each year looking more toward agriculture, our records answer many questions. The popular belief that much of the northern part of the state was situated so far north that profitable agriculture was not possible is being gradually dissipated by our upper peninsula experiment station, and reference to the records of the Michigan Weather Service.

In the dissemination of weather forecasts and special warnings, the service has made a decided advance during the past fiscal year. As outlined in my last year's report, arrangements were being completed as rapidly as possible with all of the principal telephone companies whereby our forecasts are distributed to all of their exchanges before 11 a. m. each morning. By advertising in their directories, telephone subscribers are advised that by calling central any time after 11 a. m. they can secure the official weather forecasts "for tonight and tomorrow." During the year many independent companies adopted this scheme of forecast dissemination, the principal one being the Michigan State Telephone Company, and by their most cordial and business-like co-operation, we now reach over 1,000 exchanges of that company and over 100,000 subscribers.

The matter of placing weather forecasts before the farmer has always been one of the most difficult problems presented to this service, flags are costly and have proven a means which accomplish only limited distribution.

The rural mail carrier promised much better results, but unfortunately, the system of issuing forecasts in the weather bureau and the leaving time of most of the rural mail carriers prevented a general use of the rural mail route. Under the system which has become very permanently established in the weather bureau our forecasts are not available to the public until about 10 a. m.

The conventional leaving time of most of the rural carriers is between 7 and 8 a. m., so that a carrier is far out on his route before the weather forecast is available.

The telephone, however, has done much for the weather bureau in solving this problem. In most rural districts the time is close at hand when nearly every progressive farmer will have access to the telephone, if not his own, that of some nearby neighbor. In my own opinion the telephone and the improvement of our rural highways will do more for the farmer than any other two agencies. The Michigan farmer is realizing this fact more every day.

Outside of the collection of meteorological statistics and the dissemination of weather forecasts the central office has accomplished an immense amount of administrative work which is necessary in keeping this large machine in motion. The correspondence involved in receiving reports, furnishing instruments, stationery and instructions to 119 observers is great. Besides this, we furnish blanks for all of the various telephone exchanges, franked and printed cards to every forecast distributing center, of which there are over fifty.

The weekly, monthly and annual publications of the service have continued along the same lines as in former years. All data published is displayed in detail, and in the same form and style as the reports published in other states of the union so that it can be readily compared with any other report issued in any other state.

C. F. SCHNEIDER,
Director.

NINETEENTH ANNUAL REPORT

OF THE

EXPERIMENT STATION

OF THE

STATE AGRICULTURAL COLLEGE OF MICHIGAN

UNDER THE HATCH ACT

FOR THE

YEAR ENDING JUNE 30, 1906.

For members and organization of the State Board of Agriculture in charge of the Station, and list of officers, see page 9 of this volume.

EXPERIMENT STATION.

REPORT OF SECRETARY AND TREASURER.

The following account shows the receipts and expenditures of the Experiment Station for the year ending June 30, 1906:

		Dr.	Cr.
July 1, 1905	—To balance on hand	$1,259 27	
July 9, 1904	received from U. S. Treasury	3,750 00	
Oct. 6, 1904	received from U. S. Treasury	3,750 00	
Jan. 4, 1905	received from U. S. Treasury	3,750 00	
April 10, 1905	received from U. S. Treasury	3,750 00	
June 30, 1905	license fees on 143 brands commercial fertilizers	2,860 00	
	farm receipts	1,673 51	
	from State appropriation, So. Haven	1,498 14	
	from State appropriation for U. P. Experiment Station, current	2,032 03	
	from State appropriation for U. P. Experiment Station, special	5,000 00	
	So. Haven Experiment Station receipts	473 66	
	U. P. Experiment Station, receipts	462 93	
	from State appropriation for live stock	5,000 00	
	from State appropriation for poultry house	1,000 00	
	from State appropriation, poultry	1,000 00	
	by disbursement as per vouchers filed in the office of the State Auditor General		$33,129 53
	Balance on hand		4,130 01
		$37,259 54	$37,259 54

Forty-two thousand copies of each regular station bulletin are now issued, and the demand is increasing as farmers learn of their value. Several press bulletins have been issued and special information in bulletin form has been sent out by the station.

DISBURSEMENTS ON ACCOUNT OF U. S. APPROPRIATION.

Salaries:		
Director and administrative officers, No. employed 6	$2,454 37	
Scientific staff, No. employed 5	3,479 20	
Assistants to scientific staff, No. employed 5	1,216 80	
		$7,150 37
Labor:		
Monthly employes, 3; average rate, $44.58	$1,346 72	
Monthly, weekly, daily and hourly employes	2,597 44	
		3,944 16
Carried forward		$11,094 53

Brought forward		$11,094 53
Publications:		
Half tones, mailing list, etc	$210 65	
		210 65
Chemicals:		
Chemical supplies		152 36
Seeds, plants and sundry supplies:		
Agricultural	$108 44	
Entomological	72 48	
Miscellaneous	291 68	
		501 22
Tools, implements and machinery:		
Repairs	$10 85	
		10 85
Furniture and fixtures:		
One case	$16 60	
One case	27 00	
One shelf rack and cupboard	16 90	
Sundry fixtures	6 06	
		66 56
Scientific apparatus:		
One projection eye-piece	$10 50	
One centrifuge	43 88	
One balance	37 50	
Sundry items	140 01	
		231 89
Live stock:		
Horses	$2 70	
Cattle	779 95	
Swine	70 62	
		853 27
Traveling expenses:		
In supervision of station work	$89 23	
For other purposes connected with station work	143 29	
		232 52
Fertilizers		13 00
Building and repairs		111 16
Postage and stationery		451 07
Freight and express		139 82
Feeding stuffs		215 39
Library		554 24
Heat, light and water		161 47
Total		$15,000 00

DISBURSEMENTS OF EXPERIMENT STATION—MONEYS OTHER THAN RECEIVED FROM UNITED STATES TREASURER.

Salaries	$2,677 48	
Labor	6,857 39	
Furniture and fixtures	6 99	
Postage and stationery	126 70	
Freight and express	498 56	
Heat, light and water	34 57	
Chemical supplies	63 18	
Seeds, plants and sundry supplies	1,081 47	
Fertilizer	181 40	
Library	49 39	
Tools, implements and machinery	181 73	
Scientific apparatus	48 25	
Building and repairs	1,022 87	
Traveling expenses	661 46	
Feeding stuffs	1,921 17	
Publications	13 07	
Live stock	2,703 85	
		$18,129 53
Balance on hand		4,130 01
Total		$22,259 54

REPORT OF THE DIRECTOR AND AGRICULTURIST.

To the President:

During the year ending June 30, 1906 there have been issued by the experiment station the following bulletins:

No.	Title.	Author.	Department.
232	Fertilizer Analyses	A. J. Patten	Chemical.
233	Insects of the Garden	R. H. Pettit	Entomology.
234	Feeding Dairy Cows	C. D. Smith	Farm.
235	Succotash as a Soiling Crop	R. S. Shaw	Live Stock.
236	Spraying for Potato Blight	C. A. McCue	Horticulture.
237	Digester Tankage for Swine	R. S. Shaw	Live Stock.
238	First Annual Report of Grade Dairy Herd	R. S. Shaw and A. C. Anderson	Live Stock.

The fiscal year closing at the date mentioned above is not conspicuous by reason of any important changes either in the staff or in methods and equipment. The coming of Prof. S. W. Fletcher and his appointment as associate horticulturist has led to enlargement of the work in that department along lines certain to be of interest and importance to the state at large. The station is unfortunate in losing many of its younger men who go from the position of assistant here either to commercial work at a much larger salary than the station is allowed to pay or to some higher position at another station.

The money appropriated by the last legislature to the department of live stock of the college has become available and has made it possible to carry forward a series of very interesting experiments with cattle, especially the grade dairy cow. The barns in which the experimental animals are kept have been entirely remodeled during the year making the experimental work much more convenient and efficient. It is proposed to issue a later bulletin giving a description of the barns and the conveniences introduced. A discussion of the matter is therefore deferred until the appearance of the bulletin.

A somewhat radical change has been introduced into the work of the upper peninsula station. In preceding years the work has been directed towards discovering what would grow and do well in the peculiar climatic conditions in the upper peninsula. From now on the questions to be answered relate to methods of growing the crops selected by the work of previous years. The legislature has appropriated funds to be used for building new buildings and a house and a storehouse and implement room have been planned and are in process of erection. There are not far from forty acres clear of trees, stumps and stones, but much draining must be done before all of it will be available to crops.

At South Haven the plans adopted many years ago are being executed. The peach and other fruit trees are now in full bearing, teaching the peculiarities of each of the different sorts as well as their comparative merits.

No inconsiderable part of the time of the chemist is taken up by the routine work analyzing commercial fertilizers and issuing the report thereon. As the amount of fertilizers sold in the state increases this work assumes more and more importance. The amount of available phosphoric acid in the country is limited and the temptation to keep the amount supplied in a given fertilizer at least a little below the guaranty is very strong.

The bulletins announcing the results of the analyses are issued in editions of forty-five thousand and are widely scattered over the state preventing by this very publicity any successful attempts to defraud the people.

Our knowledge of the chemistry and biology of the soil is limited and uncertain. The chemist is therefore applying much study and thought to soil problems. He labors under the misfortune of not being able to bring forth results at once and the public must wait for repetition of trials before demanding conclusions. Much of this work he is conducting alone, part of it in co-operation with the bacteriological department and part of it with the farm.

The entomologist has had very limited time for consecutive and progressive work during the year because of the demands of the college on his time. He has issued a bulletin on insects of the garden which is in active demand. Another bulletin of the series will be issued during the coming year hoping to cover in the course of a few years the field of economic entomology. The entomologist has also been the botanist of the station and in that capacity has been called upon to examine a host of samples of seed, not only for purity, but for vitality and germination as well. The fungous diseases of the state are increasing in number and virulence as population becomes more dense and are assuming a first importance in the eyes of those chiefly interested in the agricultural prosperity of the state. Part of the diseases which affect plants and animals are bacterial in their origin, but there remain a large number which are purely fungoid in character. The mother beets in our experimental work were practically all destroyed by a fungous disease. No tree, and in fact, no crop is now immune. Much time of the botanist must therefore be devoted to this line of work.

The report of the bacteriologist will give a clear outline of the scope of the work he has performed. The station is doing practically nothing in the line of so-called practical dairy work, contenting itself with the work being carried forward by the bacteriologist in his studies of the bacterial flora of milk and the relation of different kinds of bacteria to the keeping qualities and the use of milk in the manufacture of butter and cheese. The biology of the soil must also be carried much farther than at present before we may rightfully expect correct answers to the problems now confronting us. The soil is an exceedingly complex material and the results of seemingly simple plot and pot experiments cannot be properly interpreted until we know more about the bacteria in the soil and activities. No small part of the time of the bacteriologist is taken up in the study of the diseases of animals and plants.

The live stock department has been peculiarly fortunate in receiving an appropriation from the state, part of which at least can be used for experiments. The report of Prof. Shaw, hereto attached, indicates the lines of investigation taken up, part of them already resulting in bulletins. Some questions confronting Michigan farmers are not easy of solution. Several years ago the station undertook to compare the relative merits of silage and field cured corn for fattening steers. The results one year pointed to the superiority of silage. The next year the advantage seemed to lie on the side of the shocked corn. In subsequent years the two methods have alternated in demonstrating superiority. As a result, no bulletin has been issued. Again, where the steers have been held over and given the same ration, all being fed alike the surprising result has been reached that the variation between lots was nearly as great as when they were fed different rations in the experiment itself.

It is difficult therefore to correctly interpret the facts brought out in feeding experiments. We are measuring results by gains of animals, taking into consideration the amount of feed required to make a pound of gain. Unfortunately our yard stick varies in length. On the same ration one animal will make a gain on a less quantity of food than will another. The personal equation is therefore an important factor, one hard to eliminate and not entirely disposed of when a large number of steers are fed.

By the use of the appropriation the work of this department has been greatly enlarged, placed in new quarters and more thoroughly organized.

On the station plots the work has been continued along lines already adopted, the enlargements being mainly in increasing the work on plant selection. Prof. Moses Craig now devotes his entire time to plant selection, cross-fertilization and plant breeding generally. He is working with the horticulturist in the cross-breeding of strawberries and tree fruits and with the farm department in the selection of cereals and legumes. The work with wheat has been continued for several years, resulting already in the introduction of better strains. Annually improved strains of standard varieties are sent out in smaller or larger quantities from the station. In addition to this work the department is now making tests of varieties originating in the state and giving promise of merit. These new varieties are rigidly selected and the results already attained demonstrate that before many years practically all of the wheat grown in Michigan will be from strains developed at the station.

Whether the soy bean is to prove a factor of consequence in Michigan agriculture is left an unsettled question. We are selecting it first to get a legume of greater foliage and value as a forage crop and, second to secure greater productivity. It is certain that it will not compete with clover as a general farm crop; it may surpass it for spring sowing where a heavy crop to plow under or a late summer crop for feeding is desired. The cow-pea will need fundamental changes in its habits and characteristics before it will be of great consequence to Michigan.

The continued studies of the relation of legumes to soil fertility have not resulted in the publication of bulletins. The matter must be kept in abeyance until more definite results are obtained. Several sorts of inoculating material were tried, but so far as appearance of plots or weight of yields were concerned no benefits seem to accrue from their use. The results with soy beans were quite contradictory. There are certain factors involved in the problem which are not yet recognized and have not been given due weight.

Much time and money has been spent in attempting to grow sugar beet seed capable of producing beets rich in sugar and of good tonnage. So far, it must be confessed the results have not been encouraging. The mother beets were practically all of them destroyed by a root rot, probably a rhizoctonia. This was true notwithstanding the fact that they were buried in dry sand in such a way as not to permit one beet to touch another. Again, notwithstanding the most careful selection by the test of the chemist it has not been possible to increase the per cent of sugar in successive crops of mother beets. The tendency has been rather downward than upward. It will be necessary to continue this investigation for a few seasons more before finally deciding whether to abandon the effort to grow beet seed in Michigan or not.

The work with alfalfa has also been continued. Here also the matter of inoculation has been retried. Certain plots were sown with seed inoculated with a culture sent on from Washington, the next plot inoculated with a commercial culture, a third uninoculated. But one crop has yet been harvested from these plots. The yields have shown no advantage on the side of the inoculated seed. The application of lime gave sometimes increased yields and sometimes no increase. So the application of potassic and phosphatic fertilizers gave no concordant results. No difficulty was experienced in getting a stand, nor did the alfalfa winter-kill badly except on the plots devoted to date seeding and to the test of seed from different sources. Seed was sown each spring, summer and autumn months in 1905. Of the several sowings the July seeding seemed to show the best growth in the spring of 1906. The

October and November sowing of 1904 were entire failures, so were the April, May, August, September and October sowings of 1905. On the larger plots the seedings of May and June were very weak and unsatisfactory. The July sowing was particularly fortunate in that the seed was sown just before a damp and warm period. Rain fell in gentle showers after the seed was sown and the weather kept moist long enough to prevent the formation of a crust. Every seed seemed to grow and the stand was very good indeed. Such conditions do not usually obtain in July and the good seeding obtained must be counted rather as an accident than otherwise.

As to the seed from the different sources, the fact that none of them made a good stand on the larger plots simply indicates that the experiment must be tried over again to bring forth any results. Of the foreign seed furnished by the department at Washington, several sorts are promising, others are of no value whatever. The work will be continued through 1906 before any definite report can be made.

The plots sown in the spring of 1903 had become so badly infested with blue grass as to make comparison of yields of adjacent plots useless. It must be remembered that to prevent the invasion of blue grass these plots have been treated for two successive years to crops of sugar beets and kept absolutely free from grass and weeds, just prior to sowing the alfalfa.

The department is carrying forward a large amount of co-operative work in a quiet way with various farmers, devoting this work to certain specific problems. On some of the very sandy loams fertilizing questions have been studied. The results will not be ready for publication until verified several times. So far commercial fertilizers have not exhibited great values on this class of soil but it is too early to speak with definiteness on the topic as the problem has not been studied in all its bearings. With twenty selected farmers, variety tests of corn and oats are going forward. With another class of farmers a study of selected seed wheat is being made. With still another farmer there is a fertilizer test with wheat. In this way studies are taken up which cannot be made on the college farm.

The station has begun with renewed vigor its selection with seed corn, taking up more especially the question of the best ear of the best variety. In this work it is receiving the aid of many co-operators in various parts of the state.

Respectfully submitted,

C. D. SMITH,

Director and Agronomist.

Agricultural College, June 30, 1906.

REPORT OF THE BACTERIOLOGIST.

Director C. D. Smith, College:

Dear Sir—The experimental work of this department for the current year has been a continuation of investigations begun two or three years ago. Several bulletins were published from this department at the close of last year, but nothing has been given out during the current year. Many data arising from our investigations are available for publication at the present time, but it is thought that we would serve our constituency better to withhold these data for the purpose of verification and also for further accumulation. Our studies of the association of bacteria in milk have been continued, and we have now planned for their completion. Much routine work is required in carrying out these researches, consequently the time of publication will be somewhat delayed. We propose, after finishing our association studies, to continue, however, work which is very similar to this, in the form of ascertaining as far as possible the influence of bacteria on the keeping quality of milk and butter.

What time has been available after carrying out the required work along milk lines has been given to the study of swine epidemics. This work we also propose to continue more vigorously during the coming year. In connection with the above work Mr. Bushnell has proved very efficient in rendering assistance.

Mr. Sackett is still at work upon the problem of bacterial action in the soil, and from the results already obtained, I feel confident that he will secure valuable scientific facts in this work. Besides the above study, Mr. Sackett has spent no little time in providing bacterial cultures for the cultivation of leguminous plants. This work requires much close attention and great care. As far as he has gone into the practical management of cultures his results prove encouraging.

Each new year brings with it much additional outside work, which consumes time and energy. Although we strive to cut out examinations of only private interest, there is much which pertains to the state at large and which we feel it our duty to properly analyze, for all analyses of general character contribute to an understanding of the actual state conditions; in other words, these examinations enable us to better understand and interpret the class of scientific phenomena in Michigan.

Very respectfully submitted,
CHARLES E. MARSHALL,
Bacteriologist.

Agricultural College, June 30, 1906.

REPORT OF HORTICULTURIST.

Prof. Clinton D. Smith, Director:

Sir—The work done by the horticulturist of the experiment station during the past year has consisted in supervising the work of the South Haven Sub-station and the co-operative work that is being done in various parts of the state, and replying to the numerous inquiries regarding horticultural matters that are addressed to or referred to this department.

THE SOUTH HAVEN STATION.

At the end of the year 1905, Mr. T. A. Farrand, who had been in charge of the sub-station for three years resigned and Frank A. Wilken, who had acted as foreman for Mr. Farrand for two seasons, was appointed to take his place. Before leaving, Mr. Farrand prepared a report of the work done during the year and it was issued as Special Bulletin No. 35.

This bulletin gives very complete notes upon the varieties fruiting in 1905, and especially upon those that had not borne in previous years. Considerable attention was also paid to the spraying experiments that were carried on in the station orchard and also in some of the commercial orchards in the vicinity.

The results of the work as published show the importance of spraying orchards of all kinds. For the most part the applications were made in accordance with the spraying calendars issued by this department. Although the season was very favorable to the development of fungous diseases, and equally unfavorable to success in the application of fungicides, excellent results were secured in every case where the standard remedies were used as recommended in previous bulletins.

Cherry Leaf-blight.—Nothing was more marked than the results attending the spraying of the cherry orchard. Applications of Bordeaux mixture and Paris green were made just before the blossoms opened and again as soon as the fruit was free from the calyx. A third application was made two weeks later. As was generally observed last year, nearly all of the leaves dropped from unsprayed trees, in the vicinity, by the middle of June, from the attack of various fungi commonly known as "leaf blight." The weather continued cold and wet, a condition favorable for the development of these fungi, and as the new leaves were also attacked as they came out, the trees remained almost bare of leaves. As a result of this, the fruit could not ripen properly and even though it became somewhat colored, it did not soften and was so bitter that it could not be used. Not only was the cherry crop lost entirely on unsprayed trees but, owing to lack of leaves, the wood did not ripen properly and thousands of trees in the state were killed by the winter. In fact it can be said that nearly every cherry tree in Michigan that was not properly sprayed was injured to a serious extent. The writer has seen a number of orchards that were in splendid condition previous to 1905 in which fully one-half of the trees were dead or dying, and the others had suffered severely either in trunk or branches. Had these trees received two or three applications of Bordeaux mixture in the spring of 1905 they would have not only matured a good crop of fruit, but would have been in splendid condition for a crop this year. Morello cherries in particular should never be allowed to go unsprayed and it will pay well with all varieties.

Spraying for Apple Scab.—The weather throughout the season was very favorable for the development of the apple scab yet, where the trees were thoroughly sprayed with Bordeaux mixture, an excellent crop was secured and the fruit was quite free from the effect of this disease. On the other hand, unsprayed trees produced very little fruit and, particuarly in case of varieties subject to the attack of the fungus of the apple scab, this was of little value for market, being very scabby and misshapen.

The cold, wet weather at the time the trees were in blossom caused the scab fungus to attack the flowers and flower stalks and, as a consequence, the trees that had not been sprayed set very little fruit and, as the attack continued, much of this dropped from the trees or was only fit for cider apples. The benefit from the early application had often been noticed in previous years but it was seldom so marked as in 1905.

One of the experiments repeated in 1905 was to determine the relative value of an application of copper sulphate solution, at the rate of two pounds in fifty gallons of water during the month of March or early April, as compared with Bordeaux mixture applied just as the blossoms were opening. This comparison had been made a number of times in previous years and, as a result, we had recommended the use of Bordeaux mixture as late as possible before the opening of the flowers, in order that the flower stalks might be coated with a fungicide during the blossoming period, as it had been observed that the entire crop of apples might be lost from the attack of the apple scab fungus at that time. From the fact that rainy weather at the time the application should be made, sometimes makes it impossible to use Bordeaux mixture as recommended, we have suggested the use of the copper sulphate solution, especially in large orchards that would require several days for spraying and in which the loss of the crop would amount to a considerable sum.

The result of the experiment in 1905 was unexpectedly favorable for the early application of copper sulphate solution, as the season being so favorable for the development of scab it was expected that far better results could be secured with Bordeaux mixture just before the blossoms opened. However, although the amount of scab upon the trees sprayed with copper sulphate was greater than where Bordeaux mixture was used, the difference was comparatively slight and it would not noticeably affect the grading of the apples. So far as the controlling of the injury from scab at the time of blossoming is concerned no difference could be noticed in the setting of the fruit. As a consequence, we shall still continue to recommend the early application of copper sulphate solution but think that, if conditions are favorable for spraying after the blossom buds appear but before the petals open, it will be well to go over the trees at that time with Bordeaux mixture, adding Paris green if there are canker worms or other leaf-eating insects in the orchard.

Copper Sulphate vs. Iron Sulphate.—Owing to the fact that sulphate of iron is produced as a by-product in many manufacturing establishments, and hence can be obtained at a comparatively low price, while on the other hand an increased demand for copper sulphate has caused it to advance from 100 to 150 per cent over the price charged for it fifteen years ago, many fruit growers are inquiring if sulphate of iron cannot be substituted for sulphate of copper. To test this question a number of trees of each of the different classes of fruit were sprayed with sulphate of iron during the spring and, later on, with iron-Bordeaux mixture formed by substituting iron sulphate, or green vitriol, for copper sulphate, or blue vitriol, in Bordeaux mixture. It formed an excellent spraying material and coated the trees very thoroughly, giving them a dirty, brown appearance but, as the season advanced, it was evident that its value as a fungicide was much less than that of the ordinary Bordeaux mixture. Apple and pear trees were considerably injured by the scab fungus, and cherries and plums suffered very seriously from the attack of brown rot, the injury being nearly as great as where trees were left unsprayed, while trees of the same varieties sprayed with Bordeaux mixture escaped with but slight loss from the attack of fungi. Small quantities of copperas were also used as a fertilizer upon the different kinds of trees, but no effect could be detected either upon the growth of the trees, the color of the foliage, or the amount of injury from fungi. Judging from this year's experience with sulphate of iron, it is not thought advisable to recommend it either as a fungicide or a fertilizer, although its germicidal qualities when used as a solution at the rate of five pounds in fifty gallons of water, during the dormant period, upon trees and vines where the spores winter upon the branches, may make it valuable for that purpose.

August Spraying for the Codling Moth.—The use of Paris green for the control of the codling moth was at first confined to one or two applications made within two or three weeks after the petals had fallen and before the basins were closed by the calyx. This proved quite effective for the destruction of the first brood, but it was known that a second brood developed in August and, although entomologists claimed that sprayings made after the middle of June would not be effective, it has been found in actual practice that if an arsenite can be used at about the time the second brood of larvae appear it will have a very marked effect in rendering the fruit free from worms. However thoroughly the trees may be sprayed in May and June some of the worms will certainly escape and, especially if there are unsprayed orchards in the vicinity, there will be a sufficient number of moths in August to provide eggs for a large proportion of the fruit. By that time the early applications will have been washed off and, unless something is done to destroy the second brood, serious loss may result to winter varieties.

Experience has shown that one or two applications of an arsenite during the first half of August will aid materially in saving the fruit. From the fact that Paris green or arsenite of lime are readily washed off, it has been found desirable to use arsenate of lead at this time, especially if only one application is made. This has greater adhesive qualities than either of the other arsenites and is less apt to injure the foliage. It can be used in water without the addition of lime which is not the case with the others. It will be well, however, especially if the season is wet and the varieties are subject to apple scab, to combine the arsenite with Bordeaux mixture, using for the latter about three pounds of copper sulphate and five pounds of lime in fifty gallons of water. Eight ounces of Paris green, or three pounds of Swift's arsenate of lead, or Disparene, will be required for fifty gallons of water, or Bordeaux mixture.

In case the codling moth has been troublesome in previous years, and especially if there are unsprayed orchards in the vicinity, it will be desirable to make one application about the first of August and another two weeks later for winter varieties. This treatment has been thoroughly tested for several years and where the work has been properly done has never failed to give satisfaction.

The Mulching of Orchards.—The orchards at the South Haven station have, from time they were planted, been cultivated during the spring and early summer and then sown to some cover crop. In the spring of 1905 one of the pear orchards, in which a cover crop of mammoth clover was growing, was allowed to go without plowing and the clover was cut and placed under the trees as a mulch. This treatment will be continued for several years and the results noted. One of the cherry orchards will also be treated in a similar manner. Last spring arrangements were made to handle in the same way newly planted trees of European and Japanese plums and peaches. For comparing the various methods the trees have been divided into a number of blocks, one of which will be cultivated and sown to a cover crop, and the others will be in sod but, in one block, the grass will be cut for a mulch, while the others in addition to this will receive respectively mulchings of straw and strawy manure.

Controlling Cut Worms.—Frequent inquiries are received regarding the best method of destroying cut worms. Our experience last year at the South Haven station, in what was a demonstration rather than an experiment since the method used has been known to be effective for many years, may be worth repeating. In May and June of last year considerable injury was done by cut worms to a field of recently planted strawberries. The larvae were evidently in the manure used upon the land which had been picked up about the village. When they first appeared the plants were sprayed with Paris green in Bordeaux mixture, but the numbers became so great that even this did not suffice to save the plants. Poisoned bran was then resorted to with complete success. The bran was first moistened with enough molasses to stick it together. Paris green was then freely added and the bran was made into small balls which were scattered about the fields. Thousands of worms were killed in this way and no further injury was noticed. If to be used where there is danger of poisoning poultry, freshly cut clover can be sprinkled with Paris green water and scattered where the worms are thickest. To get the best results this should be done in the early evening.

Spraying for the San Jose Scale.—For several years numerous remedies for the destruction of the San Jose scale have been tested in orchards infested with this insect in the vicinity of South Haven. The results have been published in the reports for 1904 and 1905, but as these had only limited circulation it is deemed best to briefly refer to them here. The best success has been secured with what is known as the sulphur and lime mixture, or the California wash. The use of fifteen pounds of sulphur and twenty-five pounds of lime in fifty gallons of water gave as good results as stronger mixtures and was more effectual than when smaller amounts were employed. A slight reduction could be made in the amount of lime, but it is deemed best to use the above amount as it makes a whiter mixture and thus makes it easier to determine the completeness of the spraying. The best results have been secured when the applications have been made during the month of April, although if it is known that the trees are infested in the fall it will be well to spray them as soon as the greater part of the leaves have dropped. As the results depend upon the thoroughness of the spraying, it will always be well to cut away any surplus branches, especially if they have been injured by the scale, and head back those that remain as it will nearly always be found that if any parts of the tree have been only partially sprayed it will be the ends of the sprawling branches.

If large quantities of this mixture are to be prepared it will be best to use a steam boiler, a traction engine answering very well for the purpose. Pipes and lines of hose can carry the steam to a number of barrels, or to a large tank, and a ten-horse power boiler can prepare enough material to keep two power spraying outfits in operation. When small quantities only are needed they can be prepared in large, iron kettles, as it will only be necessary to add twelve or fifteen gallons of water to the amount of sulphur and lime required for fifty gallons, until after it has been boiled. While heat is necessary to dissolve the sulphur it can be secured if necessary from the slaking of the lime. Warm water should be used to start the slaking and the sulphur should be gradually sifted in and mixed with the lime. Add only enough water to make a thick paste and if covered carefully to retain the heat the mixture will be in good condition for use in an hour or two. Ordinarily when steam or fire is used to cook the mixture the actual boiling need not occupy more than forty-five minutes.

Among the other remedies tested was Con-Sol. This was said to be a concentrated form of the ordinary sulphur and lime mixture and was claimed to be more effectual against the San Jose scale than any mixture that could be produced upon the farm. Although it was accompanied by the strongest testimonials, we were unable to obtain satisfactory results from its use. The tests in other states were no more successful and its manufacture has been abandoned.

Several remedies composed largely of petroleum in a form soluble in water were also tested. As a winter spray these seem to give better results than Con-Sol, but none of them equal those secured with sulphur and lime. They were also tested as a summer spray, but when diluted so that no injury was done to the foliage, they were only fatal to the crawling larvae and white sets. It sometimes is desirable to spray trees during the summer that are not known to be infested until after the buds have opened in the spring, when it is too late to use the sulphur and lime. For use under this condition we have been better pleased with an eight or ten per cent kerosene emulsion than with a two per cent soluble petroleum mixture, which is as strong as these commercial preparations can be used upon the foliage. In the case of large trees, it will often be possible to spray the trunks and main branches with sulphur and lime even after the leaves are out, if care is taken not to get very much upon the young growth. Treated in this way it will carry trees over until the fall or winter that without a summer application would be seriously injured.

CO-OPERATIVE EXPERIMENTS.

The work that has for a number of years been carried on in a co-operative way has been considerably extended and not only have new lines of work been taken up but the experiments have been distributed over the state, and more attention has been paid to the details of the work. To a certain extent it is of the nature of a demonstration than of original research, as the methods and remedies that are being tried have all been tested and found beneficial. The principal object of this work is, in addition to showing the farmers and fruit growers the methods of carrying it on and the results secured, to ascertain with a greater degree of exactness the extent to which the work can be carried with profit, and the results that can be secured in a commercial way under the various conditions of soil and climate.

In former years, the work has been along the line of variety tests with trees and plants furnished by the station, and of testing various fertilizers, insecticides and fungicides and methods of applying them, to orchard fruits. The new work has been along the following lines:

Orchard Culture Methods.—Although a large per cent of the acreage of the peach orchards are kept in cultivation, nearly all of the apple orchards are in sod and are used either as pastures or meadows. As a result, the trees make but slight growth and the fruit is generally lacking both in quantity and quality. Even in peach orchards that are cultivated, the results have not always been satisfactory, especially when the trees are located upon knolls from which the snow blows in winter and root-killing results. Unless cover crops are used, which is not always the case, the soil soon becomes deficient in humus and not only washes badly but suffers seriously in dry seasons. As a partial corrective of these difficulties, many fruit growers have adopted what they call a sod mulch treatment, that is, the trees are kept in sod and the grass is cut and either placed under the trees as a mulch or allowed to remain where it falls. In most cases this has failed to give the results desired, from that fact the mulch thus obtained is insufficient. To be effectual the mulch should be sufficient in quantity to prevent the growth of grass under the trees and for a short distance beyond the ends of the branches. To provide this mulch it will usually be necessary to use straw or other waste materials under the trees in addition to what can be grown between the rows. After the trees come into bearing, and even before if it is needed, a sufficient quantity of stable manure should be spread about the trees to enable them to make a growth of at least one foot and to develop the fruit crop to perfection.

When trees are mulched, care should be taken to protect them from mice which sometimes girdle large, bearing trees, and are very destructive to young trees. It is not only advisable to keep the mulch a foot or two away from the trunks, about which a mound of earth should be placed, but the trunks themselves should be wrapped with wooden veneers, building paper or similar materials.

Cultural experiments are being carried on in a number of orchards. Arrangements have been made to divide the trees into four to six plots, each of which is treated in a different way. The object of these experiments is to ascertain just which method will be found best for the soil and climate where the orchards are located. The growth of the trees, the quantity, flavor, color and shipping quality of the fruit will be noted.

Although it will be several years before final results can be reached, the experiments have gone far enough to show that under ordinary conditions the best results cannot be obtained in a sod orchard unless a sufficient amount of mulching material is provided to prevent the growth of grass under the trees.

The Prevention of Black Rot of the Grape.—Although this disease has been very troublesome in most of the states farther south it has done comparatively little harm in Michigan. For the most part the Michigan vineyards are upon elevated, rolling locations where the soil is of a sandy nature. The weather also during July and August is generally hot and dry, all of which conditions are unfavorable for the development of the fungus that causes black rot. During the last two years, however, the rain fall during the summer has been unusually heavy and there has been a considerable amount of hot, muggy weather. In 1905, the black rot appeared in several vineyards in the vicinity of Lawton and Paw Paw and reduced the crop to a noticeable extent. It is more than probable that, if the present season resembles that of last year, the vineyards in which the disease has appeared will suffer very seriously and it will most likely spread to others in the vicinity.

It has been known for nearly twenty years that if Bordeaux mixture is used in the vineyards the loss from black rot will be largely, if not entirely prevented. Several persons whose vineyards were attacked last year have obtained power spraying outfits and have already made two or three applications. Two of these parties have undertaken systematic experimental work in co-operation with the department to ascertain just when the spraying should be done to secure the best results and the number of applications that will be necessary.

The Potato Blight and Rot.—In a general way what has been said regarding the black rot of the grape applies to the blight of the potato. This disease seldom fails to do much harm to the potato crop in the eastern states but for the reasons given for the comparative freedom from rot in the Michigan vineyards it has only been during the last two or three years, when the summers have been unusually wet and muggy, that it has done noticeable harm in Michigan. This disease also yields readily to spraying with Bordeaux mixture and several parties are carrying on experiments to ascertain just how many applications may be made with profit, and the best time for spraying.

Numerous other experiments are being carried on in a co-operative way. They include fertilizer experiments in vineyards and orchards and a test of various insecticides for the control of the San Jose scale, rose chafer and other insects.

Correspondence.—A large amount of time has been used in answering letters of inquiry from correspondents. These covered almost every phase of horticulture and have included the treatment that should be given most of the common insects and diseases of orchards and gardens. In quite a number of instances when the letters have referred to matters that would be of general interest, they have been duplicated and answers have been sent to the agricultural papers and others that would be likely to give them space in their columns.

Respectfully submitted,

L. R. TAFT,
Horticulturist.

Agricultural College, Mich., June 27, 1906.

REPORT OF DEPARTMENT OF HORTICULTURE AND LANDSCAPE GARDENING.

Director C. D. Smith:

I submit my first report as associate horticulturist of the agricultural experiment station, including the work done from September 1, 1905, when my duties began, to July 1, 1906.

The associate horticulturist has been placed in charge of all horticultural experimentation at the college. During the year I have given much consideration to the general policy that should guide this work, with the following conclusions:

1. It is not expedient for us to devote much energy to testing new varieties of strawberries, apples and other fruits. The South Haven experiment station does that work admirably and its reports are of great practical value to the fruit growers of the state, especially of the fruit belt. Duplication of this work at the college would be valuable. but not in proportion to the expenditure; because we are not located in a fruit district and hence the results of our variety testing would have a more limited application, and because there are so many other lines of work to which we could give our attention more profitably.

2. The site and soil of the present horticultural grounds are poorly adapted for tree fruits, being low, poorly drained and, worst of all, underlaid with quicksand. For this reason it will not be wise to extend the present planting of tree fruits until more suitable land can be secured; an experimental orchard should at least have as good a site and soil as a commercial grower would select. Our land can be used to much better advantage for experiments with small fruits and vegetables, although lacking in uniformity. By far the most important small fruit in the state, commercially, is the strawberry. Attention should be given chiefly to this fruit, without neglecting the other small fruits that thrive on our soil.

3. I suggest that the dominating features of experimental work in horticulture at the college be two: cross pollination and plant breeding. This does not mean that other needed lines of investigation shall be entirely neglected, but that our energies shall be expended mainly upon these two subjects. These experiments are chosen from the many that might be undertaken with profit because of their interest to the practical horticulturists of the state and because the results may have great commercial value.

EXPERIMENTS IN PROGRESS.

These may be classified as follows:

1. Pollination Problems.
   - (a) Cross pollination of orchard fruits. In charge of Mr. Fletcher.
   - (b) Cross pollination of the strawberry. In charge of Mr. Fletcher.
2. Plant Breeding.
   - (a) Selection of seed potatoes. In charge of Mr. McCue.
   - (b) Breeding blight-resistent varieties of potatoes. In charge of Mr. McCue.
   - (c) The practical value of selection or "pedigree" in the propagation of the strawberry. In charge of Mr. Fletcher.
   - (d) A comparison of methods of propagating the strawberry. In charge of Mr. Fletcher.
3. Miscellaneous Experiments.
   - (a) Spraying for potato blight. In charge of Mr. McCue.
   - (b) Lettuce diseases. In charge of Mr. Fletcher and Mr. Gunson.

Pollination Experiments.—These are a continuation of work done by Mr. Fletcher for several years. Their main object is to determine which of the common commercial varieties of fruits are benefited by being planted near other sorts that can supply them with pollen and what varieties it is best to plant together. Incidentally the seeds of desirable crosses will be saved and planted in the effort to secure varieties that are an improvement on existing sorts in some important respects. In November we shall have ready for publication a bulletin giving the results of our work on Bartlett and Kieffer pears, Gold Drop peach and Spy apples. About 12,000 blossoms of these varieties were crossed this season, the pollenizers used being Anjou, Lawrence, Bartlett, Duchess and Garber on Kieffer; Anjou, Lawrence and Kieffer on Bartlett; St. Johns, Late Crawford and Lewis Seedling on Gold Drop, and Baldwin and Rhode Island Greening and Spy. The results indicate a marked difference in the value of these several varieties as pollenizers for the varieties under experiment, and these differences are of practical significance.

Three thousand strawberry blossoms were crossed with interesting results. The strawberry pollination experiments will be continued for at least another season before the results will be ready for publication.

Selection of Seed Potatoes.—Three-fourths of an acre was planted to

Rural New Yorker No. 2; these potatoes will be sprayed and given good culture during the season. In the fall each hill will be examined and a careful selection of seed will be made. The size, form, weight of tubers in a hill, number of tubers in a hill, and general thrift will be the basis of selection. Selected tubers will be used for planting in 1907 and the crop of that year will be selected likewise. The plan is to continue this selection for at least five years. The object is to determine how much it is possible to increase the yield of merchantable potatoes per acre by selection.

Breeding Blight-resistant Potatoes.—The endeavor is to breed up a blight-resistant variety of potato of good quality. About 100 varieties of potatoes are being grown this year, to ascertain their blight-resistant qualities. Many of these are the so called "blight-proof" varieties, secured from different parts of the country. Among the varieties are several obtained from Japan, and also a few hills of Solanum commersoni. Only the most promising varieties or hills will be saved for further trial. Crosses will be made between the most blight-resistant sorts, so as to give further opportunity for selection. Eight thousand potato seedlings are being grown in 1906 for the purpose of selection. If a potato is found that is blight-resistant, but of poor quality, it will be crossed with some variety of good quality, and breeding will be continued until the two desirable points are combined in one sort. We do not expect to accomplish these results in two years, and probably not in five years, but a good start may be made in that time. It is extremely important that the work may be pursued from year to year without deviation from the original purpose. The large potato interests of the state justify an adequate support of Mr. McCue in the three experiments he has undertaken.

Spraying for the Late Blight of Potatoes.—Experiments in spraying potatoes for the control of late blight are being conducted at the station and in co-operation with private growers elsewhere. The results of the experiments of last season are published in Bulletin No. 236. Two acres of potatoes are being grown at the station for this experiment in 1906.

Some of the different methods of spraying are:

1. Sprayed with Bordeaux mixture every 7 days.
2. Sprayed with Bordeaux mixture every 10 days.
3. Sprayed with Bordeaux mixture every 15 days.
4. Sprayed with Bordeaux mixture every 20 days.
5. Sprayed with lime water, 6 lbs. to 50 gals., every 10 days.
6. Sprayed with bluestone, 1 lb. to 50 gals., every 10 days.
7. Sprayed with Paris green alone every 10 days.
8. Sprayed with Paris green alone every 15 days.
9. Sprayed with Paris green alone every 20 days.
10. Sprayed every 15 days with fungicides recommended and donated by the Bowker Insecticide Co.

All seed was treated with corrosive sublimate.

The results are to be computed per acre and a careful account of expense of treatment kept.

Circular letters containing directions for co-operative work in potato spraying have been sent to about fifty growers in the state and fifteen have signified their willingness to co-operate and are now spraying according to our directions. Some of these fields will be visited in August, for the purpose of noting results.

"Pedigree Strawberries."—Eight thousand strawberry plants of five varieties, set in the spring of 1906, are being used in this work. Each of the plants is being subjected to the closest scrutiny, a record being kept of its habit of growth, resistance to disease, number of runners thrown out, number of crowns, hardiness, fruiting habit, productiveness, character of berry, and other points that are important in the commercial value of a strawberry plant. Each plant is allowed to set but two runners and the three are considered one plant in taking records. After fruiting, possibly two years, selection will be made and runners will be taken as follows:

1. Productiveness.
   (a) From the 50 plants of each variety bearing the most fruit by weight.
   (b) From the 50 plants of each variety bearing the least fruit by weight.
2. Season.
   (a) From the 50 plants of each variety bearing the earliest fruit.
   (b) From the 50 plants of each variety bearing the latest fruit.
3. Size of Berry.
   (a) From the 50 plants of each variety bearing the largest berries (total weight of berries divided by number).
   (b) From the 50 plants of each variety bearing the smallest berries.

Incidentally selection will also be made for other points, but these three will be given closest attention.

The runners taken from the several sets of selected plants will be planted and individual records of them kept as regards all the points concerning which the parent plants were examined. This process of selection should continue for at least five generations. The object of the experiment is to determine how much is gained by propagating only from the most excellent plants instead of from the bed at large, the common method today; in other words, of what practical value is the "pedigree" idea as applied to the strawberry?

Experiment in Strawberry Propagation.—This experiment on strawberry selection brings up the question of how to propagate from desirable plants. Here also there is need of a thorough experiment extending over a series of years. We have the following test under way: Two thousand plants have been planted, 500 each of Brandywine, Dunlap, Gandy and Aroma. One-third of the plants of each of these varieties will be allowed to make runners at will, but these runners will not be allowed to fruit, being taken up in the spring and set out for a new propagating bed. This is the common nursery method of propagating the strawberry. One-third of the plants will be allowed to make runner plants at will and to fruit in the spring of 1907. In the spring of 1908 runners will be taken that have been thrown out by bearing plants in this bed and these will be used to set out a new bed. This method of taking runners for a new planting from old beds that have supposedly been weakened by fruit bearing, is thought by some to be very injurious.

The third lot of plants will be grown in double hedge-row. A few of the most desirable plants will be staked. Runners from these will be separated from the mother plants as soon as they appear and rooted in the cold frame. These plants will be used to plant a propagating bed. They will be allowed to form runners at will, and these will be used for the larger commercial plantings of another year. If the experiment is to be conclusive, this sequence should be maintained, with each of the three lots of plants, for at least five generations.

Lettuce Diseases.—Last January the horticultural department received from several greenhouse lettuce growers of Grand Rapids samples of diseased lettuce. This was determined by Prof. R. H. Pettit to be Marsonia perforans, a fungous disease that has been quite serious in Ohio. A conference of the Grand Rapids lettuce growers was called by Mr. Gunson and plans laid for experimental work. It soon developed that other diseases, especially the "rot" or Botrytis are often very troublesome in Grand Rapids houses, and that the whole matter of culture, especially of watering must be investigated. Experiments were conducted in the college greenhouses and in the greenhouse of Mr. F. M. Strong of Grand Rapids, who has very kindly assisted us throughout the experiment. Both of the experiments were supervised by Mr. Gunson.

The experiment to control the lettuce diseases at Grand Rapids, briefly, was directed along three lines: First, to sterilize the soil through lines of drain tile sunk fifteen inches below the surface; second, to water the soil through lines of tile similarly placed, thus avoiding surface watering, which is conducive to disease; third, to manufacture an artificial soil that will hold enough moisture to carry out a crop without being watered while it is growing, similar to the famous Boston lettuce soil. Two crops of lettuce were grown on plats prepared for the above treatment. We are not yet prepared to report conclusions from the experiments, except to say that the great problem is that of watering. A practical method of watering below the surface the light porous soils of Grand Rapids lettuce houses would wonderfully reduce the amount of rot, rust and other diseases that injure the crop; to this end the experiments of another season will be shaped. At the college lettuce was grown on soil from Boston and from Grand Rapids lettuce houses, and also on several specially prepared soils containing varying amounts of humus and sand. The results were striking and will be of service to us in the work of another year, but we cannot make much headway in this work until we have a lettuce house with a ground bed similar to the Grand Rapids houses. At present only a raised bed and a bench are available. The magnitude of the lettuce interests in the state—1,000 tons of lettuce were shipped from Grand Rapids alone last year—make it desirable to give close attention to the problems of these constituents. Plans for next winter's work on lettuce are already under way.

During the year four of my students have done some very creditable experimental work which will be available for publication at some time. Mr. C. G. Woodbury, on "Methods of Spraying for the San Jose Scale;" Mr. M. J. Dorsey, on "The Cold Storage of Fruits;" Mr. T. H. McHatton, on "Cross-pollination of Strawberries;" and Mr. O. I. Gregg, on "Cross-pollination of Tomatoes."

THE ORCHARDS AND GARDENS.

During the year all of the east extension of the college orchard was removed. It consisted almost wholly of Russian varieties of apples, all of which, with one or two exceptions, have proved to be of little value here. Cions of a few of the best sorts were taken and were grafted this spring. Two-thirds of the south block of apples was thinned out, every other row being removed entirely, and every other tree in the rows remaining, leaving the standing trees two rods apart. Cions were taken of desirable sorts removed, and these were grafted. The remainder of the block will be similarly treated next winter, also certain portions of the middle block that are badly crowded. The peaches and sweet cherries east of the south block of apples have mostly died out; we purpose to fill out the block with sour cherries. The present orchards, with the exception of the block of old Spy apples, consist of one to four trees of a variety, not enough of any one kind to be useful for experiments, except as a variety test. Most of the varieties are new or worthless; we have very few standard sorts. We need a commercial orchard, consisting of not more than four standard varieties of each fruit, in which cultural experiments can be conducted. The total area of commercial planting need not exceed fifteen acres. We have no land in the department that a commercial grower would think of planting to tree fruits; it is mostly low, poorly drained, and has a quicksand bottom. I hope some way may be found to secure a site for a creditable commercial orchard that can be used for experimental work.

Respectfully submitted,

S. W. FLETCHER.

Agricultural College, Mich., June 30, 1906.

REPORT OF THE ENTOMOLOGIST.

Prof. C. D. Smith, Director:

Following is a brief report of the work done by the department of entomology of the experiment station during the year ending June 30, 1906, also of the work in botany.

One bulletin has been issued during the year, viz.: Bulletin 233, "Insects of the Garden," also a press bulletin on the joint-worm. The unusually wet weather which has prevailed for the past three seasons has developed an unusual number of scale insects, soft scales or Lecania on fruit and shade trees all over the state, it also brought an invasion of the army-worm in July, 1905.

The joint-worm of wheat is, at the present time, very destructive. Experiments were commenced last fall to determine the effect of soaking straw in the liquids of the stable. Quantities of the short segments of stems that were broken out during threshing, were subjected to the ordinary conditions of the stable when straw is used as bedding, and afterwards placed in cages, but no adults have as yet appeared. Strangely enough, none of the check cages, containing exactly the same sort of material except that it had not been used as bedding, yielded any adults, although cages containing the rye joint-worm, standing on the same shelf, produced a plentiful supply. The experiment will be repeated this fall if a supply of the larvae is to be had. It was found after diligent inquiry that wheat grown on soil manured in the fall with fresh manure (and straw) suffered the most. Fields fertilized with well rotted manure and old straw escaped with markedly less damage.

Trips have been made to several parts of the state to examine into and advise in special cases of insect trouble, one trip being made to the upper peninsula sub-station and the region thereabout to study the larch saw-fly which is proving very serious over large areas, defoliating the tamaracks and killing many of them.

Some time has been spent in studying the soft scales of the state, collecting and making careful studies of their structures in order to try to differentiate the different species.

It remains to thank my assistants, Mr. E. J. Krause and Mr. Moses Craig. Mr. Krause, whose work in rearing and preparing insects has been most satisfactory, and Mr. Craig for his aid in the botanical work, which latter he has attended to in large measure, determining plants, weeds, etc., and making many seed tests. The writer wishes to convey his sincere thanks and appreciation to both these gentlemen.

Very respectfully submitted,

R. H. PETTIT.

Agricultural College, Mich., June 30, 1906.

REPORT OF THE CONSULTING VETERINARIAN.

Director C. D. Smith:

Dear Sir—As consulting veterinarian for the experiment station my work for the past year has been principally the answering of inquiries from farmers with regard to diseased animals. So far as contagious disorders go, Michigan seems to be especially blessed. We are practically exempt from many of the serious contagious disorders from which many of the other states suffer. The contagious swine disorders cause some losses, but the losses for the most part are confined to rather small areas. In some localities quite a good many sheep have been lost, some from internal parasites, others from what seemed to be an incurable chronic indigestion, the exact cause of which could not be determined. The so-called "Grand Traverse" disease continues to cause losses in certain sections.

Respectfully submitted,

GEO. A. WATERMAN,

Consulting Veterinarian.

Agricultural College, Mich., June 30, 1906.

METEOROLOGICAL TABLES.

METEOROLOGICAL OBSERVATIONS.

Meteorological observations for the month of January, 1905, at Agricultural college, Lansing, Michigan.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind; direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches rain or melted snow.	Snow fall, inches.	
1	38	....	28.77	28.73	49	32	Cloudy	....	....	......	1
2	32	....	28.78	28.90	43	13	Cloudy	....	.15	1.5	2
3	6	....	29.04	29.03	17	5	P'ly cloudy	....	....	......	3
4	13	....	29.06	29.00	25	4	Cloudy	....	.50	5.0	4
5	20	....	28.99	28.99	23	18	Cloudy	....	....	......	5
6	20	24	28.92	28.72	24	19	Cloudy	....	....	......	6
7	21	20	28.58	28.63	25	18	Cloudy	....	....	......	7
8	21	12	28.93	29.20	23	12	P'ly cloudy	....	.10	1.0	8
9	16	9	29.14	29.16	28	3	P'ly cloudy	....	....	......	9
10	9	13	29.43	29.49	18	4	P'ly cloudy	....	....	......	10
11	15	32	29.37	28.75	32	10	Cloudy	e	....	......	11
12	30	19	28.82	29.20	35	19	P'ly cloudy	e	....	......	12
13	17	17	29.33	29.34	25	14	Cloudy	w	....	......	13
14	8	9	29.37	29.37	15	7	Cloudy	n w	....	......	14
15	8	16	29.15	29.11	16	2	Cloudy	w	....	......	15
16	20	17	29.11	29.06	21	15	Cloudy	w	....	......	16
17	14	25	29.10	28.96	28	13	P'ly cloudy	w	....	......	17
18	30	34	29.03	28.78	35	22	Cloudy	w	....	......	18
19	34	22	28.72	28.83	34	22	P'ly cloudy	s w	....	......	19
20	24	26	28.92	28.91	38	20	P'ly cloudy	w	....	......	20
21	28	16	28.90	29.07	28	14	P'ly cloudy	s w	.20	2.0	21
22	12	10	29.22	29.25	19	8	Clear	n	....	......	22
23	5	17	29.22	28.98	21	2	Cloudy	n w	.12	1.2	23
24	14	14	28.75	28.81	20	13	Cloudy	s	....	......	24
25	13	3	29.22	29.51	12	3	P'ly cloudy	w	....	......	25
26	1	16	29.53	29.24	20	-1	Clear	n	....	......	26
27	22	....	28.99	29.22	....	15	P'ly cloudy	w	....	......	27
28	2	5	29.14	29.20	22	0	Clear	w	....	......	28
29	10	7	29.25	29.29	19	1	Cloudy	w	....	......	29
30	0	12	29.36	29.33	19	-1	P'ly cloudy	s	....	......	30
31	12	18	29.16	29.00	26	10	P'ly cloudy	w	....	......	31
Sum	515	453	902.30	901.06	760	336	....	....	1.07	10.7	....
Average	16.6	18.1	29.11	29.07	25.3	10.9	....	....	....	......	....

Meteorological observations for the month of February, 1905, at Agricultural College, Lansing, Michigan.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind; direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snow fall, inches.	
1	13	4	29.16	29.18	14	12	P'ly cloudy.	w	....	......	1
2	-2	1	29.24	29.27	9	-5	Clear	w	....	......	2
3	-1	-2	29.39	29.40	8	-4	Clear	w	....	......	3
4	-2	8	29.43	29.40	16	-10	Clear	s e	....	......	4
5	11	10	29.27	29.11	15	1	Cloudy	e	....	......	5
6	12	7	28.98	29.22	17	6	P'ly cloudy.	w	.35	3.5	6
7	3	3	29.44	29.42	19	0	Clear	n	....	......	7
8	4	24	29.17	28.52	24	0	Cloudy	e	.40	4.0	8
9	23	20	28.70	28.77	29	20	Cloudy	w	....	......	9
10	15	12	28.99	29.19	15	14	Cloudy	s w	....	......	10
11	5	5	29.30	28.92	24	1	Clear	s e	....	......	11
12	24	11	28.75	28.69	26	11	Cloudy	s	.40	4.0	12
13	-8	-10	28.82	28.86	11	-13	Clear	s	....	......	13
14	-6	-4	28.76	29.05	10	-15	Clear	s w	....	......	14
15	-9	-2	29.21	29.30	8	-16	Clear	w	....	......	15
16	2	14	29.13	28.84	14	-6	P'ly cloudy.	s w	....	......	16
17	24	10	28.77	29.06	25	12	P'ly cloudy.	w	....	......	17
18	12	15	29.29	29.38	23	7	Clear	s w	....	......	18
19	21	23	29.42	29.35	34	10	P'ly cloudy.	s	....	......	19
20	31	32	29.18	29.17	36	20	Cloudy	s w	....	......	20
21	30	32	29.16	29.07	34	28	Cloudy	s w	....	......	21
22	32	30	28.99	29.07	33	28	Cloudy	w	....	......	22
23	27	30	29.20	29.21	31	25	Cloudy	s	....	......	23
24	29	31	29.17	29.05	32	28	Cloudy	s	....	......	24
25	32	26	28.75	28.79	38	26	P'ly cloudy.	n	.10	1.0	25
26	17	21	28.98	29.13	29	15	Clear	n w	....	......	26
27	12	32	29 00	28.74	32	8	P'ly cloudy.	s w	....	......	27
28	29	31	28.95	28.88	37	27	P'ly cloudy.	e	....	......	28
Sum	380	414	814.60	814.04	643	232	....	....	1.25	12.5	....
Average	13.6	14.8	29.09	29.07	23.0	22.9	....	....	....	......	....

Meteorological observations for the month of March, 1905, at Agricultural College, Lansing, Michigan.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind; direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snow fall, inches.	
1	26	21	28.99	29.13	32	21	P'ly cloudy.	e	....	......	1
2	15	30	29.11	29.00	35	11	P'ly cloudy.	s w	....	......	2
3	30	35	28.96	28.63	36	28	Cloudy	s w	....	......	3
4	23	33	29.02	29.02	33	21	P'ly cloudy.	n	....	......	4
5	22	26	29.05	29.17	35	17	P'ly cloudy.	n	....	......	5
6	20	24	29.34	29.24	30	13	Clear	e	....	......	6
7	26	27	29.10	29.02	35	22	Cloudy	e	....	......	7
8	27	28	29.06	28.91	37	25	P'ly cloudy.	n	....	......	8
9	31	31	28.79	28.80	43	24	P'ly cloudy.	w	....	......	9
10	12	17	28.92	29.10	29	9	P'ly cloudy.	w	....	......	10
11	13	16	29.25	29.27	28	8	P'ly cloudy.	n	....	......	11
12	23	18	29.35	29.39	30	11	Clear	w	....	......	12
13	13	23	29.40	29.30	25	11	P'ly cloudy.	n	....	......	13
14	21	16	29.34	29.38	30	19	P'ly cloudy.	e	....	......	14
15	20	33	29.43	29.34	36	12	P'ly cloudy.	s e	....	......	15
16	34	39	29.23	29.23	51	29	Cloudy	n	....	......	16
17	37	54	29.10	28.70	63	30	P'ly cloudy.	s e	1.43	......	17
18	49	46	28.73	28.73	59	35	Cloudy	s	....	......	18
19	29	22	28.78	28.93	29	22	Cloudy	n	....	......	19
20	26	26	29.03	28.99	34	21	Cloudy	n e	....	......	20
21	24	29	28.91	28.95	32	22	Cloudy	n e	....	......	21
22	33	39	29.06	29.02	48	26	Cloudy	e	....	......	22
23	42	48	28.98	28.70	60	34	Cloudy	s	.34	......	23
24	42	44	28.82	28.90	52	40	P'ly cloudy.	s	....	......	24
25	44	49	28.86	28.80	67	35	Clear	s w	....	......	25
26	46	45	28.79	28.74	51	34	Cloudy	w	....	......	26
27	48	60	28.85	28.81	60	38	Cloudy	s	....	......	27
28	56	69	28.76	28.76	77	46	P'ly cloudy.	s	.88	......	28
29	63	44	28.81	28.71	78	58	P'ly cloudy.	w	....	......	29
30	41	51	29.00	29.12	60	40	P'ly cloudy.	s w	....	......	30
31	49	46	29.23	29.26	56	41	Clear	w	....	......	31
Sum	985	1089	900.05	899.05	1371	803	....	....	2.65	......	....
Average	31.8	35.1	29.03	29.00	44.2	25.9	....	....	....	......	....

Meteorological observations for the month of April 1905, at Agricultural College, Lansing, Michigan.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind; direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snow fall, inches.	
1	41	41	29.39	29.23	42	34	Cloudy	n e	....	......	1
2	37	43	29.31	29.14	43	30	P'ly cloudy.	e	....	......	2
3	43	60	28.82	28.68	66	38	Cloudy	s	....	......	3
4	49	37	28.51	28.67	60	37	P'ly cloudy.	s w	.07	.72	4
5	35	34	28.78	28.74	....	30	P'ly cloudy.	w	....	......	5
6	31	35	28.71	28.72	44	30	P'ly cloudy.	n	....	......	6
7	29	30	28.75	28.79	39	27	P'ly cloudy.	n	.15	1.5	7
8	31	40	28.88	28.80	63	23	Clear	s w	....	......	8
9	45	60	28.78	28.65	70	31	Clear	s w	....	......	9
10	42	42	28.63	28.67	62	42	Cloudy	n e	.26	......	10
11	35	42	28.73	28.77	44	32	P'ly cloudy.	n	....	......	11
12	38	43	28.81	28.77	57	29	Clear	n	....	......	12
13	39	45	28.71	28.77	51	35	Clear	n	....	t	13
14	34	36	28.80	28.85	47	31	P'ly cloudy.	n	....	t	14
15	33	31	28.92	28.90	37	28	Cloudy	w	....	t	15
16	32	32	28.81	28.90	38	25	P'ly cloudy.	n w	....	t	16
17	35	35	28.91	28.95	42	22	P'ly cloudy.	w	....	t	17
18	30	36	29.10	29.10	45	25	Clear	w	....	......	18
19	43	55	29.01	28.84	61	30	P'ly cloudy.	s w	.13	......	19
20	50	51	28.75	28.68	57	47	Cloudy	s w	....	......	20
21	36	40	28.68	28.94	56	34	P'ly cloudy.	e	....	......	21
22	35	47	29.24	29.26	55	33	Clear	n w	....	......	22
23	45	45	29.43	29.31	61	34	Clear	w	....	......	23
24	46	56	29.15	29.15	66	34	P'ly cloudy.	n w	....	......	24
25	48	56	29.11	28.91	65	36	P'ly cloudy.	s e	....	......	25
26	50	53	28.71	28.61	57	46	Cloudy	s e	....	......	26
27	55	60	28.65	28.73	69	50	Cloudy	e	.18	......	27
28	63	70	28.69	28.46	76	53	Cloudy	s	....	......	28
29	50	53	28.57	28.61	63	47	P'ly cloudy.	w	....	......	29
30	45	40	28.97	29.10	52	40	P'ly cloudy.	w	....	......	30
Sum	1225	1348	866.31	865.70	1588	1033	....	....	.79	2.22	....
Average	40.8	44.9	28.88	28.86	52.9	34.4	....	....	....	......	....

Meteorological observations for the month of May, 1905, at Agricultural College, Lansing, Michigan.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind; direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snow fall, inches.	
1...........	30	47	29.22	29.04	47	38	P'ly cloudy.	e	....	......	1
2...........	47	71	28.90	28.74	72	42	P'ly cloudy.	s	....	......	2
3...........	65	75	28.71	28.70	82	61	P'ly cloudy.	s w	....	......	3
4...........	66	67	28.84	28.83	82	49	P'ly cloudy.	s w	.22	......	4
5...........	62	61	28.91	28.98	71	59	P'ly cloudy.	w	....	......	5
6...........	52	55	28.96	28.78	64	48	Cloudy.....	s e	.54	......	6
7...........	46	57	29.05	29.00	62	42	Clear.......	w	....	......	7
8...........	55	46	29.01	29.01	62	48	P'ly cloudy.	w	....	......	8
9...........	38	50	29.09	29.07	52	32	P'ly cloudy.	n	....	......	9
10...........	42	48	28.99	28.99	49	41	Cloudy.....	w	.92	......	10
11...........	53	62	29.03	28.77	62	50	Cloudy.....	w	....	......	11
12...........	59	59	28.86	28.96	62	54	Cloudy.....	w	.79	......	12
13...........	62	65	28.97	28.78	71	46	P'ly cloudy.	w	....	......	13
14...........	70	66	28.64	28.57	80	57	P'ly cloudy.	w	.25	......	14
15...........	52	62	28.65	28.74	68	50	P'ly cloudy.	s w	.06	......	15
16...........	59	58	28.66	28.63	68	50	P'ly cloudy.	s w	.45	......	16
17...........	53	52	28.56	28.61	64	46	Cloudy.....	s	....	......	17
18...........	46	55	28.72	28.81	58	44	P'ly cloudy.	w	.62	......	18
19...........	51	63	28.94	28.89	66	45	Clear.......	w	....	......	19
20...........	50	60	29.04	29.05	64	44	Clear.......	n	....	......	20
21...........	57	66	29.07	28.99	71	39	P'ly cloudy.	n	....	......	21
22...........	50	59	29.04	29.06	66	50	P'ly cloudy.	n e	.18	......	22
23...........	50	64	29.14	29.09	68	46	Clear.......	n e	....	......	23
24...........	56	67	29.07	28.84	72	43	Clear.......	s	....	......	24
25...........	60	58	29.09	28.74	78	56	Cloudy.....	w	....	......	25
26...........	46	59	28.99	29.04	62	41	Clear.......	n	.89	......	26
27...........	55	67	29.09	29.02	71	39	Clear.......	n	....	......	27
28...........	54	63	29.00	29.02	75	52	Clear.......	n w	....	......	28
29...........	55	56	28.81	28.85	60	54	Cloudy.....	n	....	......	29
30...........	53	61	28.96	29.01	65	50	P'ly cloudy.	n	.25	......	30
31...........	58	60	29.07	29.04	72	44	Clear.......	n e l	....	......	31
Sum..........	1652	1859	897.08	895.65	2066	1460	....	....	5.17	......	....
Average.......	53.3	60.0	28.94	28.89	66.7	47.3	....	....	....	......	....

Meteorological observations for the month of June, 1905, at Agricultural College, Lansing, Michigan.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind; direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snow fall, inches.	
1	62	69	29.02	28.86	76	43	Clear	w			1
2	57	66	28.98	29.06	69	54	Clear	n e			2
3	57	64	29.20	29.04	72	46	P'ly cloudy.	e			3
4	70	77	28.87	28.82	82	58	P'ly cloudy.	w	.11		4
5	66	76	28.79	28.63	86	61	Cloudy	e	.45		5
6	64	62	28.68	28.67	68	57	P'ly cloudy.	s e	5.47		6
7	53	57	28.79	28.97	64	53	P'ly cloudy.	n e			7
8	55	64	29.05	29.09	78	47	Clear	e			8
9	58	66	29.05	28.90	68	50	Cloudy	c			9
10	63	68	28.83	28.76	69	61	Cloudy	s	.52		10
11	65	66	28.79	28.82	72	62	Cloudy	n w			11
12	56	66	28.83	28.80	71	54	Cloudy	e			12
13	66	68	28.85	28.87	77	53	Clear	w			13
14	67	77	28.87	28.95	84	53	Clear	s e			14
15	77	80	29.00	28.94	87	61	Clear	e			15
16	68	76	28.94	28.87	82	66	P'ly cloudy.	e	.41		16
17	70	82	28.87	28.79	88	65	Cloudy	s			17
18	81	82	28.89	28.87	89	67	Clear	w			18
19	72	75	29.02	28.98	80	68	P'ly cloudy.	w	.19		19
20	70	75	28.96	28.57	78	58	P'ly cloudy.	n			20
21	69	73	28.86	28.77	82	62	P'ly cloudy.	n e			21
22	59		29.11	29.00	71	56	P'ly cloudy.	n e			22
23	57	67	29.09	29.05	72	50	P'ly cloudy.	n e			23
24	68	70	29.15	29.05	76	50	Clear	n			24
25	69	70	28.99	28.76	86	59	Clear	w	.05		25
26	61	65	28.49	28.98	69	58	P'ly cloudy.	n	.27		26
27	56	64	29.16	29.09	70	44	Clear	n			27
28	66	66	29.17	29.08	75	50	Clear	n e			28
29	64	71	29.08	29.02	78	50	Clear	n			29
30	67	76	29.00	28.85	83	55	P'ly cloudy.	s w			30
Sum	1933	2038	868.38	866.91	2302	1671			7.47		
Average	64.4	70.3	28.95	28.90	76.7	55.7					

Meteorological observations for the month of July, 1905, at Agricultural College, Lansing, Michigan.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind; direction.	Precipitation.		Day of month.
	7 a. m.	7 p m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snow fall, inches.	
1...........	64	71	28.77	28.73	83	61	Cloudy.....	w	.47	......	1
2...........	65	74	28.88	28.99	80	62	P'ly cloudy.	n	....	......	2
3...........	68	75	28.81	28.68	80	65	Cloudy.....	e	.22	......	3
4...........	74	72	28.65	28.63	81	69	Cloudy.....	s	.57	......	4
5...........	72	76	28.73	28.83	84	65	Clear.......	s w	....	......	5
6...........	69	69	28.98	28.85	82	62	Clear.......	w	.41	......	6
7...........	67	77	28.80	28.76	76	63	Cloudy.....	s e	1.17	......	7
8...........	66	69	28.83	28.86	75	61	Cloudy.....	n w	.02	......	8
9...........	64	66	28.97	28.98	70	58	P'ly cloudy .	n e	....	......	9
10...........	56	68	29.11	28.96	72	55	P'ly cloudy.	n e	.76	......	10
11...........	66	76	28.84	28.89	83	62	P'ly cloudy.	e	.31	......	11
12...........	70	72	28.93	28.88	85	63	Cloudy.....	s w	.12	......	12
13...........	70	75	28.87	28.98	80	61	Clear.......	s w	....	......	13
14...........	76	78	29.05	29.09	84	64	Clear.......	n w	....	......	14
15...........	66	73	29.25	29.14	84	55	Clear.......	n	....	......	15
16...........	69	83	28.96	28.85	91	62	Clear.......	n w	....	......	16
17...........	81	83	28.97	28.96	92	62	Clear.......	s w	....	......	17
18...........	81	86	28.96	28.93	91	71	Clear.......	n w	....	......	18
19...........	73	75	28.92	28.80	86	70	Clear.......	w	.19	......	19
20...........	72	68	28.99	28.97	80	62	Clear.......	n e	....	......	20
21...........	67	70	29.03	28.99	76	55	Clear.......	e	....	......	21
22...........	70	74	28.72	28.81	80	52	Clear.......	e	....	......	22
23...........	65	67	28.89	28.84	75	56	P'ly cloudy.	s w	....	......	23
24...........	60	64	28.93	29.03	67	52	P'ly cloudy.	w	....	......	24
25...........	60	71	29.22	29.07	74	48	P'ly cloudy.	w	....	......	25
26...........	68	72	29.13	28.95	77	49	P'ly cloudy.	w	....	......	26
27...........	65	76	29.07	28.98	83	49	P'ly cloudy.	n e	....	......	27
28...........	64	72	28.95	28.83	78	61	Cloudy.....	s e	.19	......	28
29...........	69	71	28.75	28.75	76	63	P'ly cloudy.	e	.72	......	29
30...........	68	73	28.84	28.98	76	59	P'ly cloudy.	n w	....	......	30
31...........	66	67	28.94	28.98	76	59	Clear.......	n	....	......	31
Sum..........	2111	2263	896.74	895.97	2477	1856	....	....	5.15	......	....
Average.......	68.1	73.0	28.93	28.90	79.9	59.9	....	....	....	......	....

Meteorological observations for the month of August, 1905, at Agricultural College, Lansing, Michigan.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind; direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snow fall, inches.	
1	64	66	28.88	29.02	68	56	Clear	n e	....	......	1
2	64	69	29.07	28.98	77	55	Clear	s	....	......	2
3	61	74	29.03	28.95	80	54	Cloudy	w	....	......	3
4	64	72	28.95	28.88	80	62	Cloudy	s	1.02	......	4
5	72	78	28.79	28.73	82	62	P'ly cloudy.	s w	.15	......	5
6	68	72	28.84	28.88	82	59	P'ly cloudy.	s w	....	......	6
7	69	74	28.93	28.94	82	57	Clear	w	....	......	7
8	71	75	29.02	28 92	82	56	Clear	s	....	......	8
9	71	79	28.89	28.89	86	63	P'ly cloudy.	s	05	......	9
10	72	74	28.98	28.99	87	64	P'ly cloudy.	s	....	......	10
11	73	80	29.02	29.05	90	68	P'ly cloudy.	s	....	......	11
12	76	78	28.97	28.96	89	66	P'ly cloudy.	w	....	......	12
13	65	68	29.07	29.06	80	62	Clear	n	....	......	13
14	63	62	28.92	28.75	72	59	Cloudy	e	1.07	......	14
15	60	61	28.74	28.81	64	59	Cloudy	n e	.73	......	15
16	60	63	28.99	29.09	74	52	Clear	n e	.02	......	16
17	62	68	29.07	29.05	77	51	Clear	e	....	......	17
18	65	76	29.00	28.88	83	50	P'ly cloudy.	e	....	......	18
19	70	69	28.68	28.76	74	68	Cloudy	s w	.82	......	19
20	70	71	28.93	28.90	80	55	Clear	w	....	......	20
21	70	77	28.96	28.85	84	65	P'ly cloudy.	s w	trace	......	21
22	71	75	28.99	28.96	84	64	P'ly cloudy.	n	.03	......	22
23	70	80	29.07	28.93	88	55	Clear	s e	....	......	23
24	69	63	29.02	29.05	80	65	P'ly cloudy.	n e	.03	......	24
25	60	65	29.16	29.20	74	50	Clear	n	....	......	25
26	76	64	29.23	29.18	79	51	Clear	n	....	......	26
27	74	63	29.18	29.14	74	68	Clear	s	....	......	27
28	65	70	29.14	29.07	80	68	Cloudy	w	....	......	28
29	60	76	29.08	28.93	85	62	Clear	n w	....	......	29
30	71	71	28.83	28.88	84	59	P'ly cloudy.	w	....	......	30
31	60	62	29.07	29.04	73	54	Clear	n	....	......	31
Sum	2086	2195	898.50	897.72	2474	1839	....	....	3.92	......	....
Average	67.3	70.8	28.99	28.96	79.8	59.3	....	....	....	......	....

Meteorological observations for the month of September, 1905, at Agricultural College, Lansing, Michigan.

Day of month	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind; direction.	Precipitaton.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snow fall, inches.	
1	61	62	29.32	29.32	75	54	P'ly cloudy.	s	....	......	1
2	63	64	28.83	28.89	77	69	Cloudy.....	w	.76	......	2
3	60	56	28.83	28.77	66	52	P'ly cloudy.	s w	....	......	3
4	55	58	28.92	29.08	68	53	Cloudy.....	w	.44	......	4
5	57	61	29.10	29.05	70	55	P'ly cloudy.	w	....	......	5
6	54	64	29.11	29.11	73	50	P'ly cloudy.	w	....	......	6
7	51	67	29.13	29.10	75	49	P'ly cloudy.	w	....	......	7
8	58	69	29.19	29.14	80	53	Clear.......	n	....	......	8
9	59	68	29.20	29.12	80	55	Clear.......	e	....	......	9
10	62	67	29.08	28.95	74	60	Cloudy.....	s e	....	......	10
11	60	69	28.88	28.91	80	59	Clear.......	n w	....	......	11
12	59	65	28.96	28.97	81	56	P'ly cloudy.	s e	.04	......	12
13	53	52	29.16	29.26	65	51	P'ly cloudy.	n	....	......	13
14	46	55	29.23	29.07	67	40	P'ly cloudy.	e	....	......	14
15	58	66	28.92	28.94	74	52	P'ly cloudy.	s	.05	......	15
16	60	69	28.98	28.85	72	52	Cloudy.....	s	....	......	16
17	65	67	28.80	28.85	74	63	P'ly cloudy.	s	1.74	......	17
18	62	75	28.91	28.86	80	60	P'ly cloudy.	s e	....	......	18
19	70	71	28.81	28.87	83	59	Clear.......	s	.18	......	19
20	57	72	28.98	28.89	70	56	Clear.......	w	....	....	20
21	61	69	28.85	28.89	76	51	Clear.......	s w	....	......	21
22	55	65	28.91	28.90	80	52	Clear.......	w	....	......	22
23	51	58	29.18	29.11	68	49	Clear.......	w	....	......	23
24	50	54	29.09	29.01	75	42	Clear.......	n	....	......	24
25	45	52	29.15	29.16	62	41	Clear.......	n e	....	......	25
26	47	56	29.20	29.02	62	39	Clear.......	s	....	......	26
27	58	68	29.00	29.07	81	54	Clear.......	s	....	......	27
28	63	72	29.03	29.12	88	59	Clear.......	s	....	......	28
29	62	76	29.05	29.01	89	57	Clear.......	e	....	......	29
30	64	72	29.04	28.08	83	61	P'ly cloudy.	e	....	......	30
Sum..........	1726	1939	870.84	869.37	2248	1603	....	....	3.21	......	....
Average.......	57.5	64.6	29.03	28.98	74.9	53.4	....	....	....	......	....

Meteorological observations for the month of October, 1905, at Agricultural College, Lansing, Michigan.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind; direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snow fall inches.	
1	66	67	28.97	28.87	70	64	Cloudy	s	.17	......	1
2	54	62	29.02	29.07	71	53	P'ly cloudy.	w	.31	......	2
3	53	62	29.09	28.94	74	48	Clear	s w	....	......	3
4	53	63	28.91	28.84	79	52	Clear	w	....	......	4
5	57	59	29.01	29.08	70	54	Clear	n	....	......	5
6	44	54	29.26	29.21	69	40	Clear	n e	....	......	6
7	49	64	29.48	29.06	73	45	Clear	s	....	......	7
8	63	62	29.08	29.05	82	53	Clear	w	....	......	8
9	59	70	29.09	29.01	83	53	P'ly cloudy.	s e	....	......	9
10	62	48	28.83	28.85	65	52	Cloudy	w	.03	......	10
11	42	37	28.79	28.46	47	36	P'ly cloudy.	w	.19	......	11
12	39	40	28.84	28.99	52	36	P'ly cloudy.	w	....	......	12
13	39	62	28.85	28.84	75	36	Clear	s w	....	......	13
14	54	63	29.04	28.89	69	53	P'ly cloudy.	s w	....	......	14
15	62	50	28.79	28.90	66	50	Cloudy	s w	trace	......	15
16	46	48	29.11	29.20	58	46	P'ly cloudy.	s	....	......	16
17	48	60	29.13	28.91	63	45	Cloudy	s e	.02	......	17
18	62	55	28.75	28.78	64	55	Cloudy	w	.80	......	18
19	49	58	28.98	28.76	59	49	Cloudy	s	.13	......	19
20	40	37	28.62	29.05	45	37	P'ly cloudy.	w	.01	......	20
21	33	40	29.17	29.08	47	36	P'ly cloudy.	n w	....	......	21
22	35	39	29.08	29.06	48	30	P'ly cloudy.	w	....	......	22
23	37	42	28.98	28.94	52	37	P'ly cloudy.	w	....	......	23
24	35	39	28.90	29.62	42	35	P'ly cloudy.	n	....	......	24
25	27	32	29.20	29.13	46	26	Clear	n e	....	......	25
26	29	47	29.08	28.96	52	28	Clear	s e	....	......	26
27	45	43	28.94	29.15	49	43	Cloudy	s w	....	......	27
28	33	30	29.34	29.49	42	30	Clear	w	....	......	28
29	32	28	29.47	29.40	44	20	Clear	n	....	......	29
30	27	37	29.36	29.21	45	24	Cloudy	s e	....	......	30
31	36	37	29.08	28.82	44	34	Cloudy	s w	.09	......	31
Sum	1410	1535	900.24	899.62	1845	1300	....	....	1.75	......	....
Average	45.5	49.5	29.04	29.02	59.5	41.9	....	....	....	......	....

Meteorological observations for the month of November, 1905, at Agricultural College, Lansing, Michigan.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind; direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snow fall inches.	
1	27	27	28.83	29.18	32	27	P'ly cloudy.	n w	....	trace	1
2	23	37	29.11	28.74	40	20	P'ly cloudy.	s	....	......	2
3	37	36	28.64	28.93	41	33	Cloudy.....	w	.05	.50	3
4	31	42	29.18	29.14	50	29	Clear.......	n e	....	......	4
5	37	43	28.88	28.59	44	33	Cloudy.....	e	....	......	5
6	37	39	28.79	28.76	44	37	Cloudy.....	w	1.11	......	6
7	34	34	28.74	28.70	35	34	Cloudy.....	w	.31	......	7
8	32	32	28.82	28.94	35	32	Cloudy.....	w	.03	......	8
9	29	31	29.04	29.19	36	28	Clear.......	w	....	trace	9
10	27	37	29.35	29.19	43	23	P'ly cloudy.	s w	....	......	10
11	34	49	29.14	28.99	51	27	Clear.......	s w	....	......	11
12	42	40	28.82	28.76	50	38	Clear.......	s w	....	......	12
13	35	33	28.72	28.95	44	32	P'ly cloudy.	e	....	......	13
14	15	27	29.08	28.87	33	12	Clear.......	s	....	......	14
15	35	37	28.44	28.40	43	27	Cloudy.....	s w	....	......	15
16	34	34	28.57	28.82	36	33	Cloudy.....	n w	....	......	16
17	35	41	28.80	28.81	55	32	P'ly cloudy.	w	....	......	17
18	24	38	28.96	28.99	47	24	Clear.......	n	....	......	18
19	36	33	29.09	29.16	45	23	Clear.......	n e	....	......	19
20	28	27	29.30	29.48	38	25	Clear.......	e	....	......	20
21	19	34	29.62	29.52	42	18	Clear.......	e	....	......	21
22	25	38	29.39	29.22	47	25	Clear.......	s	....	......	22
23	35	45	29.22	29.01	57	34	Clear.......	s w	....	......	23
24	47	39	28.58	28.60	51	39	Cloudy.....	w	.10	......	24
25	32	39	28.89	28.78	41	32	P'ly cloudy.	s	trace	......	25
26	36	32	28.79	29.03	41	32	P'ly cloudy.	s w	....	......	26
27	26	35	29.26	29.23	38	25	Cloudy.....	e	....	......	27
28	40	59	28.63	28.50	71	34	P'ly cloudy.	s	.65	......	28
29	36	21	28.60	28.99	36	21	Cloudy.....	w	....	......	29
30	14	14	29.51	28.63	20	14	Clear.......	e	....	......	30
Sum..........	942	1073	868.79	868.10	1286	843	....	....	2.25	.50	.....
Average.......	31.4	35.8	28.96	28.94	42.9	28.1	....	....	....	......	....

Meteorological observations for the month of December, 1905, at Agricultural College, Lansing, Michigan.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind; direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snow fall, inches.	
1	21	28	29.57	29.19	32	12	Cloudy	s			1
2	31	30	29.15	29.08	35	28	Cloudy	s w	.05	.20	2
3	19	20	29.14	29.08	25	19	Cloudy	w			3
4	18	25	29.22	29.37	30	16	P'ly cloudy	w	.80	.75	4
5	20	30	29.44	29.39	30	18	Cloudy	s			5
6	26	32	29.34	29.27	42	26	Clear	s w			6
7	30	38	29.22	29.17	46	28	Clear	s w			7
8	30	38	29.21	29.21	52	30	Clear	s			8
9	31	35	29.07	29.02	45	30	Cloudy	s w		trace	9
10	28	30	28.81	28.73	45	21	Clear	s w			10
11	36	35	28.62	28.67	40	30	Cloudy	w			11
12	27	36	28.66	28.81	44	27	Cloudy	w			12
13	27	25	28.06	29.19	31	25	Cloudy	w			13
14	14	23	29.36	29.39	29	14	P'ly cloudy	n			14
15	12	22	29.35	29.38	32	12	Clear	n e			15
16	21	26	29.27	29.28	36	15	Clear	s			16
17	31	33	29.09	29.41	33	17	Cloudy	s w			17
18	34	35	28.85	29.19	35	32	Cloudy	s			18
19	33	33	29.58	29.29	37	32	Cloudy	s			19
20	32	38	29.13	28.82	39	32	Cloudy	s e			20
21	33	35	28.20	28.41	39	31	Cloudy	w	1.44	2.00	21
22	34	32	28.77	28.88	39	30	Cloudy	s w			22
23	28	31	28.84	28.86	31	19	Cloudy	w		trace	23
24	15	21	29.41	29.07	28	12	Clear	w			24
25	24	23	28.84	29.02	29	18	P'ly cloudy	s w			25
26	27	39	28.79	28.73	41	18	Clear	s			26
27	23	38	28.80	28.84	43	23	Clear	s			27
28	32	39	29.10	28.48	40	31	P'ly cloudy	s w			28
29	38	31	28.15	28.35	41	31	Cloudy	w	.20		29
30	24	27	28.75	29.01	31	23	P'ly cloudy	w	.05	.50	30
31	27	26	28.90	29.08	28	23	Cloudy	w			31
Sum	826	944	898.69	899.67	1128	723			2.54	3.45	
Average	26.6	30.5	28.99	29.02	36.4	23.3					

BULLETINS

OF THE

AGRICULTURAL COLLEGE EXPERIMENT STATION

ISSUED DURING THE

YEAR ENDING JUNE 30, 1906.

EXPERIMENT STATION BULLETINS.

FERTILIZER ANALYSES.

ANDREW J. PATTEN, CHEMIST.

Bulletin No. 232.

The inspection and analyses of the commercial fertilizers offered for sale in Michigan are made under authority of an act of the Legislature approved March 10, 1885. The full text of the law is again printed since many inquiries are continually received concerning it.

SECTION 1. *The People of the State of Michigan enact*, That any person or persons who shall sell or offer for sale in this State any commercial fertilizer, the retail price of which exceeds ten dollars per ton, shall affix on the outside of every package containing such fertilizer a plainly printed certificate, stating the number of net pounds therein; the name or trademark under which such article is sold; the name of the manufacturer; the place of manufacture, and a chemical analysis, stating the percentage of nitrogen in an available form; of potash soluble in water and of phosphoric acid in available form (soluble or reverted) and the insoluble phosphoric acid.

SEC. 2. Before any commercial fertilizer is sold or offered for sale, the manufacturer, importer or party who causes it to be sold or offered for sale within this State, shall file with the secretary of the State Board of Agriculture a certified copy of the analysis and certificate referred to in section one, and shall also deposit with said secretary a sealed glass jar containing not less than two pounds of such fertilizer, with an affidavit that it is a fair sample of the article thus to be sold or offered for sale.

SEC. 3. The manufacturer, importer, or agent of any commercial fertilizer, the retail price of which exceeds ten dollars per ton as aforesaid, shall pay annually to the secretary of the State Board of Agriculture, on or before the first day of May, a license fee of twenty dollars for each and every brand of fertilizer he offers for sale in this State: *Provided*, That whenever the manufacturer or importer shall have paid this license fee his agents shall not be required to do so.

SEC. 4. All such analyses of commercial fertilizers required by this act shall be made under the direction of the State Board of Agriculture and paid for out of the funds arising from the license fees provided for in section three. At least one analysis of each fertilizer shall be made annually.

SEC. 5. The secretary of the State Board of Agriculture shall publish in his annual report a correct statement of all analyses made and certificates filed in his office, together with a statement of all moneys received for license fees, and expended for analysis. Any surplus from license fees remaining on hand at the close of the fiscal year shall be placed to the credit of the experimental fund of said board.

SEC. 6. Any person or persons who shall sell or offer for sale any commercial fertilizer in this State without first complying with the provisions of sections one, two, and three of this act, or who shall attach or cause to be attached to any such package of fertilizer an analysis stating that it contains a larger percentage of any one or more of the constituents or ingredients named in section one of this act than it really does contain shall, upon conviction thereof, be fined not less than one hundred dollars for the first offense, and not less than three hundred dollars for every subsequent offense, and the offender shall also be liable for damages sustained by the purchaser of such fertilizer on account of such misrepresentation.

SEC. 7. The State Board of Agriculture by any duly authorized agent is hereby authorized to select from any package of commercial fertilizer exposed for sale in this State, a quantity, not exceeding two pounds, for a sample, such sample to be used for the purposes of an official analysis and for comparison with the certificate filed with the secretary of the State Board of Agriculture and with the certificate affixed to the package on sale.

SEC. 8. All suits for the recovery of fines under the provisions of this act shall be brought under the direction of the State Board of Agriculture.

Twenty manufacturing firms have registered for sale in this State, during 1905, 120 different brands of fertilizers.

Of these various brands, 82 are complete fertilizers; of the others, 12 contain phosphoric acid and potash, without nitrogen; 11 contain phosphoric acid and nitrogen without potash; 12 contain phosphoric acid only; 2 contain potash salts only and 1 contains nitrogen only.

The Station has attempted, through its collecting agent, Mr. E. A. Boyer, to obtain samples of all these brands upon the open market, but in many cases it was not possible to find them. Unless otherwise indicated the analyses herein reported were made on the collected samples.

The analyses on the whole are very satisfactory for in but a few cases do the percentages found fall far below those guaranteed, and it is quite evident that no wilful attempt has been made to defraud. However some evidences of uneven mixing are apparent. Prospective buyers would find it much to their benefit to carefully study the accompanying tables before making large purchases. The following is a partial list of persons and places where fertilizers were found on sale this spring:

Adrian—Nathan Smith & Son.

Albion.—F. Steele.

Bay City—Jenison Hardware Co., R. C. Bialy, F. C. Goodine, Presley & Layer, G. H. Mosher, Mohr Hardware Co.

Belding—Weiter, Wise & Co.

Benton Harbor—B. N. Nowlen & Co., H. E. Boehn.

Birmingham—E. R. Smith & Co.

Bad Axe—Wright, Freemont & Co., Wm. Rapson & Sons.
Butternut—O. W. Wilson.
Caro—Caro Sugar Co.
Carsonville—C. J. Walker, Hartshorn & Anderson.
Chelsea—R. A. Snyder, Lime & Produce Co.
Charlotte—Webster, Cobb Co., Garber & Gibbe.
Clio—J. Wellman & Son, G. W. Hubbard & Co.
Denton—J. B. Schlicht.
Farmington—C. B. Pettibone.
Flint—Dane & Vermilya, Burroughs & Son.
French Landing—Detroit Sanitary Works.
Grand Haven—James Locke, J. A. Franks.
Grand Rapids—Jones Seed Co., Brown Seed Co., Hess & Thompson.
Holland—Keplar & Son, H. P. Zwemer.
Holly—M. N. Hudson.
Ida—Silas Crane, Mr. Snell.
Ionia—Spaulding & Merritt.
Jackson—J. E. Bartlett & Co., S. M. Isbell & Co., Reid Implement & Seed Co.
Kalamazoo—Woodhams Coal Co.
Lansing—H. P. Gladden, Owosso Sugar Co.
Lapeer—Robert King, Chase & Mitchell.
Marine City—Zimmerman Bros.
Marlette—W. H. Wilson.
Milan—W. H. Hack, W. P. Lampkin, Reeves & Son, Fred Hasley.
Mt. Clemens—C. Ancot, John N. Tucker.
Niles—S. E. Bolton.
Owosso—J. Brooks & Son, W. E. Payne & Co.
Petersburg—H. A. Logan.
Pontiac—E. Holland & Sons.
Plymouth—J. A. McLaren.
Romeo—Bliss & Bartholomew, McKay & Co., Hosmer & Powell.
Romulus—J. D. McClarien, T. W. McCloughy.
Royal Oak—Jacob Erb, J. M. Lawson.
Saginaw—Saginaw Beef Co., Saginaw Milling Co.
St. Louis—St. Louis Hardware Co.
St. Joseph—G. R. Pixley.
St. Johns—L. G. McKnight & Co.
Temperance—A. H. King & Co.
Sanilac Center—Wm. & Dell Dawson.
South Haven—Merrifield Implement Co.
Vassar—F. Miller.
Vicksburg—Vicksburg Lumber Co.
Wyandotte—Wyman Coal & Ice Co.
Ypsilanti—C. E. Thompson & Co.
Zeeland—Isaac Van Dyke & Co.

ACKNOWLEDGMENTS.

I desire to acknowledge the efficient assistance of Miss Dorothea Moxness, Mr. J. S. Shaw and Mr. E. A. Boyer, by whom the greater part of the analytical work herein reported was done.

Results of anlyses of commercial fertilizers

Laboratory number. A	Manufacturer	Trade Name
*931	American Agricultural Chemical Co., New York.....	Bradley's Alkaline Bone and Potash..
838	American Agricultural Chemical Co., New York.....	Bradley's B. D. Sea Fowl Guano......
839	American Agricultural Chemical Co., New York.....	Bradley's Dissolved Bone with Potash..
832	American Agricultural Chemical Co., New York.....	Bradley's Niagara Phosphate.........
*930	American Agricultural Chemical Co., New York.....	Bradley's Soluble Dissolved Bone.....
901	American Agricultural Chemical Co., New York.....	Crocker's Ammoniated Bone Superphosphate....................
*928	American Agricultural Chemical Co., New York.....	Crocker's Ammoniated Wheat and Corn Phosphate..................
*947	American Agricultural Chemical Co., New York.....	Crocker's Dissolved Bone and Potash..
874	American Agricultural Chemical Co., New York.....	Crocker's General Crop Phosphate....
883	American Agricultural Chemical Co., New York....	Crocker's New Rival Ammoniated Superphosphate..................
*929	American Agricultural Chemical Co., New York .	Crocker's Universal Grain Grower.....
933	American Agricultural Chemical Co., New York	Fine Ground Bone ....
872	American Agricultural Chemical Co., New York	High Grade Garden and Vegetable Fertilizer ....
852	American Agricultural Chemical Co., New York .	Niagara Dissolved Bone and Potash...
854	American Agricultural Chemical Co., New York.. .	Niagara Grain and Grass Grower......

*Manufacturers' sample.

for 1905, expressed in parts in a hundred.

	Nitrogen	Phosphoric acid			Potash soluble in water, estimated as K_2O
		Available	Insoluble	Total	
Claimed Found	....	11 **11.82**	.... **3.55**	12 **15.37**	2 **2.03**
Claimed Found	2.66 **2.02**	8 **9.23**	.... **1.35**	10 **10.58**	1.50 **1.16**
Claimed Found	1 **.97**	8 **9.50**	.... **3.63**	10 **12.13**	2 **2.17**
Claimed Found	.82 **.80**	7 **8.06**	.... **2.60**	8 **10.66**	1 **1.21**
Claimed Found	....	14 **14.55**	.... **2.45**	15 **17.00**	....
Claimed Found	2.46 **2.43**	9 **13.37**	.... **2.00**	10 **13.66**	2 **2.55**
Claimed Found	2.05 **2.01**	8 **10.10**	.... **1.15**	9 **11.25**	1.50 **1.57**
Claimed Found	....	10 **12.45**	.... **2.30**	11 **14.75**	2 **1.50**
Claimed Found	.82 **.85**	7 **10.36**	.... **.44**	8 **10.80**	1 **1.41**
Claimed Found	1.23 **1.33**	9 **9.97**	.... **3.06**	10 **13.03**	2 **2.22**
Claimed Found	.82 **.95**	8 **8.12**	.... **2.50**	9 **10.62**	2 **2.35**
Claimed Found	2.47 **2.91**	....	....	22.8 **30.04**	....
Claimed Found	2.08 **1.76**	8 **8.82**	.... **3.08**	.... **11.90**	6 **6.38**
Claimed Found	....	10 **10.27**	.... **3.45**	.... **13.72**	2 **1.98**
Claimed Found	.82 **.84**	7 **8.55**	.... **2.10**	.... **10.65**	1 **2.02**

Results of analyses of commercial fertilizers

Laboratory number. A	Manufacturer	Trade Name
842	American Agricultural Chemical Co. New York.....	Niagara Potato and Vegetable Fertilizer.
834	American Agricultural Chemical Co., New York.....	Niagara Wheat and Corn Producer....
*952	Armour Fertilizer Works, Chicago................	Acidulated Bone Meal...............
882	Armour Fertilizer Works, Chicago................	All Soluble.........................
*957	The Armour Fertilizer Works, Chicago...........	Ammoniated Bone with Potash.......
*946	The Armour Fertilizer Works, Chicago...........	Banner Brand.......................
875	The Armour Fertilizer Works, Chicago...........	Bean Grower.................. ....
*956	The Armour Fertilizer Works, Chicago...........	Bone, Blood and Potash.............
*954	The Armour Fertilizer Works, Chicago...........	Bone Meal..........................
823	The Armour Fertilizer Works, Chicago...........	Fruit and Root Crop Special..........
*744	The Armour Fertilizer Works, Chicago...........	German Kainit......................
817	The Armour Fertilizer Works, Chicago	Grain Grower.......................
818	The Armour Fertilizer Works, Chicago	High Grade Potato Fertilizer.........
*763	The Armour Fertilizer Works, Chicago	Muriate of Potash..................
*757	The Armour Fertilizer Works, Chicago	Nitrate of Soda.....................

*Manufacturers' sample.

for 1905, expressed in parts in a hundred.—Con.

	Nitrogen	Phosphoric acid			Postah soluble in water, estimated as K_2O
		Available	Insoluble	Total	
Claimed..........	2.06	8	....	9	3
Found...........	**2.56**	**9.25**	**2.50**	**11.75**	**3.64**
Claimed..........	1.23	9	....	....	2
Found...........	**1.29**	**9.16**	**3.40**	**12.56**	**2.36**
Claimed..........	1.65	....	....	18	....
Found...........	**2.15**	....	....	**20.88**	....
Claimed..........	2.88	8	....	10	4
Found...........	**3.14**	**8.44**	**3.52**	**11.96**	**4.38**
Claimed..........	2.47	6	....	8	2
Found...........	**2.48**	**6.98**	**1.55**	**8.53**	**2.58**
Claimed..........	....	10	....	12	8
Found...........	....	**12.27**	**.60**	**12.87**	**7.51**
Claimed..........	.82	8	....	10	2
Found...........	**1.10**	**9.73**	...... **1.70**	**11.43**	**2.90**
Claimed..........	4.11	8	....	10	7
Found...........	**4.17**	**9.33**	**2.95**	**12.28**	**8.22**
Claimed..........	2.47	....	....	24	....
Found...........	**2.86**	....	....	**27.30**	....
Claimed..........	1.65	8	....	10	5
Found...........	**1.52**	**10.28**	**2.25**	**12.53**	**4.96**
Claimed..........	....	....	....	....	12
Found...........	....	....	....	....	**13.44**
Claimed..........	1.65	8	....	10	2
Found...........	**1.64**	**8.55**	**3.25**	**11.80**	**3.13**
Claimed..........	1.65	8	....	10	10
Found...........	**1.63**	**10.14**	**2.96**	**13.10**	**8.13**
Claimed..........	....	....	....	....	48
Found...........	....	....	....	....	**51.34**
Claimed..........	15.63	....	....	....	....
Found...........	**15.40**	....	....	....	....

Results of analyses of commercial fertilizers

Laboratory number. A	Manufacturer	Trade Name
*953	The Armour Fertilizer Works, Chicago	Phosphate and Potash
*951	The Armour Fertilizer Works, Chicago	Star Phosphate
*955	The Armour Fertilizer Works, Chicago	Steamed Bone Meal
*950	The Armour Fertilizer Works, Chicago	Sugar Beet Special
879	The Armour Fertilizer Works, Chicago	Wheat, Corn and Oat Special
799	Robert Binder, Battle Creek	Blood and bone
*893	Buffalo Fertilizer Co., Buffalo	Ammoniated Bone Black
*889	Buffalo Fertilizer Co., Buffalo	Bone Meal
*888	Buffalo Fertilizer Co., Buffalo	Celery and Potato Special
*910	Buffalo Fertilizer Co., Buffalo	Farmers' Choice
*890	Buffalo Fertilizer Co., Buffalo	Garden Truck
*895	Buffalo Fertilizer Co., Buffalo	General Crop
*894	Buffalo Fertilizer Co., Buffalo	Ohio and Michigan Special
*896	Buffalo Fertilizer Co., Buffalo	Soluble Bone
*891	Buffalo Fertilizer Co., Buffalo	York State Special

*Manufacturers' sample.

for 1905, expressed in parts in a hundred.—Con.

	Nitrogen	Phosphoric acid			Potash soluble in water, estimated as K_2O
		Available	Insoluble	Total	
Claimed	....	10	....	12	2
Found	....	9.93	1.20	11.13	1.96
Claimed	....	14	....	16	....
Found	....	15.57	.68	16.25	....
Claimed	1.65	....	....	20	....
Found	2.73	....	....	24.35	....
Claimed	.82	8	....	10	4
Found	.89	8.80	.65	9.45	4.28
Claimed	.82	7	....	9	1
Found	.92	11.05	2.44	13.49	2.64
Claimed	5.25	....	....	13.17	.29
Found	5.25	....	....	13.17	.29
Claimed	1.23	8	....	9	2.50
Found	.93	8.40	1.20	9.60	1.98
Claimed	2.46	....	....	25	....
Found	2.77	....	....	25.60	....
Claimed	1.64	7	....	8	10
Found	1.79	7.63	2.15	9.78	10.21
Claimed	.82	8	....	9	5
Found	.73	9.21	1.25	10.46	5.53
Claimed	3.28	8	....	9	7
Found	2.81	9.17	3.30	12.47	8.36
Claimed	....	9	....	10	3
Found	....	8.59	5.60	14.19	3.51
Claimed	.82	11	....	12	1
Found	.97	13.27	2.15	15.42	2.10
Claimed	....	14	....	15	....
Found	....	18.43	.75	19.18	....
Claimed	1.64	9	....	10	5
Found	1.68	9.54	3.80	13.34	6.39

Results of analyses of commercial fertilizers

Laboratory number. A	Manufacturer	Trade Name
835	Central City Fertilizer Co., Jackson..............	Blackman Brand General Crop Fertilizer..........................
*948	Central City Fertilizer Co., Jackson..............	Blackman Brand Sugar Beet, Onion and Potato......................
862	Chicago Fertilizer Co., Chicago	Bone, Blood and Potash............
918	Chicago Fertilizer Co., Chicago...................	Potash Special......................
870	Chicago Fertilizer Co., Chicago...................	Wheat and corn Special.............
*934	Darling & Company, Chicago....................	Darling's Acid Phosphate...........
821	Darling & Company, Chicago....................	Chicago Brand......................
846	Darling & Company, Chicago....................	Farmer's Favorite Brand............
864	Darling & Company, Chicago....................	Darling's General Crop Brand........
840	Darling & Company, Chicago....................	Pure Bone and Potash..............
886	Darling & Company, Chicago....................	Pure Ground Bone.................
844	Darling & Company, Chicago....................	Sure Winner Brand................
861	Darling & Company, Chicago....................	Darling's Western Brand............
915	Grand Rapids Glue Co., Grand Rapids	Grand Rapids.......................
*925	Grange Fertilizer Co., Detroit....................	Complete Manure..................

*Manufacturers' sample.

for 1905, expressed in parts in a hundred.—Con.

	Nitrogen	Phosphoric acid			Potash soluble in water, estimated as K_2O
		Available	Insoluble	Total	
Claimed	1.25	7	....	9	1.25
Found	**1.66**	....	....	**14.67**	**3.01**
Claimed	2.50	10	....	10	3
Found	**2.18**	**6.38**	**10.30**	**16.68**	**3.00**
Claimed	1.23	8	....	....	2
Found	**.57**	**10.68**	**2.70**	**13.38**	**1.58**
Claimed	.82	8	....	....	4
Found	**2.13**	**10.20**	**1.80**	**12.00**	**6.23**
Claimed	.82	7	....	....	1
Found	**.34**	**10 67**	**2.46**	**13.13**	**.70**
Claimed	....	10	....	....	....
Found	....	**11.02**	**.60**	**11.62**	....
Claimed	1.65	8	....	10	2
Found	**1.87**	**7.60**	**5 25**	**12.85**	**2.56**
Claimed	2.47	8	....	10	4
Found	**2.41**	**8.14**	**7.22**	**15 36**	**4.86**
Claimed	.82	8	....	10	6
Found	**.90**	**9 75**	**2.45**	**12.20**	**5.78**
Claimed	2.14	....	....	20.13	6
Found	**2 09**	....	....	**23.50**	**7.99**
Claimed	2,47	....	....	23	....
Found	**2 37**	....	....	**26.95**	....
Claimed	.82	8	....	10	3
Found	**.99**	**7 83**	**2.65**	**10 48**	**3 56**
Claimed	.41	7	....	9	.50
Found	**.58**	**8.65**	**1 05**	**9.70**	**.98**
Claimed	2	8	....	15	1
Found	**3.34**	**8 90**	**12 60**	**21.50**	**2.12**
Claimed	.85	7	....	8	1
Found	**.93**	**10 60**	**.90**	**11 50**	**1.68**

Results of analyses of commercial fertilizers

Laboratory number. A	Manufacturer	Trade Name
*924	Grange Fertilizer Co., Detroit....................	Corn, Oats and Grass...............
*926	Grange Fertilizer Co., Detroit....................	Potato and Vegetable Fertilizer.......
*923	Grange Fertilizer Co., Detroit....................	Wheat Fertilizer....................
*927	Grange Fertilizer Co., Detroit....................	Wheat Fertilizer with Potash.........
939	Jarecki Chemical Co., Sandusky, Ohio...........	C. O. D. Phosphate. ....
940	Jarecki Chemical Co., Sandusky, Ohio...........	Fish and Potash Grain Special........
816	Jarecki Chemical Co., Sandusky, Ohio...........	Fish and Potash, Tobacco and Potato Food ....
824	Jarecki Chemical Co., Sandusky, Ohio...........	Lake Erie Fish Guano...............
815	Jarecki Chemical Co., Sandusky, Ohio...........	Number One Fish Guano...........
*937	Jarecki Chemical Co., Sandusky, Ohio.	Special Sugar Beet Grower. ....
938	Jarecki Chemical Co., Sandusky, Ohio...........	Square Brand Phosphate and Potash..
*680	Joseph Lister, Chicago	Bone Meal . ...
*942	Michigan Carbon Works, Detroit	Banner Dissolved Bone ....
847	Michigan Carbon Works, Detroit..	Dessicated Bone....................
837	Michigan Carbon Works, Detroit.................	Homestead Bone Black Fertilizer.....

*Manufacturers' sample.

for 1905, expressed in parts in a hundred.—Con.

	Nitrogen	Phosphoric acid			Potash soluble in water, estimated as K_2O
		Available	Insoluble	Total	
Claimed.......... Found............	1.64 1.30	8 9.80	.... 1.70	10 11.50	2 2.67
Claimed.......... Found............	.85 84	8 9.20	.... 2.30	9 11.50	4 3.17
Claimed.......... Found............	....	14 13.47	.... 1.90	15 15.37	....
Claimed.......... Found............	....	10 12.35	.... 2.15	11 14.50	2 1.45
Claimed.......... Found............	....	14 13.87	.... 3.00	.... 16.87	....
Claimed.......... Found............	1.25 1.33	9 11.27	.... 2.10	.... 13.37	2 3.94
Claimed.......... Found............	.83 .74	8 10.40	.... 1.85	.... 12.25	4 3.38
Claimed.......... Found............	.83 .83	10 9.98	.... 2.60	.... 12.58	2 1.87
Claimed.......... Found............	.83 .81	10 11.15	.... 3.60	.... 14.75	1 1.21
Claimed.......... Found............	.83 84	8 10.25	.... 2.00	.... 12.25	4 5.28
Claimed.......... Found............	....	10 11.77	.... 3.10	.... 14.87	2 2.49
Claimed.......... Found............	4.68 1.98	....	....	26.06 27.01	....
Claimed.......... Found............	....	30 27.68	.... 6.80	32 34.48	....
Claimed.......... Found............	1.24 1.47	....	....	25 32.12	....
Claimed.......... Found............	2.06 1.65	8 12.90	.... .40	9 13.30	1.50 3.80

Results of analyses of commercial fertilizers

Laboratory number. A	Manufacturer	Trade Name
833	Michigan Carbon Works, Detroit	Homestead High Grade Garden and Vegetable Fertilizer
831	Michigan Carbon Works, Detroit	Homestead Potato and Tobacco Fertilizer
881	Michigan Carbon Works Detroit	Special Beet Fertilizer
820	Michigan Carbon Works, Detroit	Homestead Sugar Beet Fertilizer
878	Michigan Carbon Works, Detroit	Pure Animal Bone and Potash
825	Michigan Carbon Works, Detroit	Red Line Complete Manure
*941	Michigan Carbon Works, Detroit	Red Line Phosphate
855	Michigan Carbon Works, Detroit	Red Line Phosphate with Potash
845	Michigan Carbon Works, Detroit	Special Fertilizer
873	Michigan Carbon Works, Detroit	Wolverine Phosphate
791	Natural Guano Company, Aurora, Ill	Dried Sheep Manure
*756	Natural Guano Company, Aurora, Ill	Dried Sheep Manure†
920	Northwestern Fertilizing Co., Chicago, Ill	Garden City Superphosphate
865	Northwestern Fertilizing Co., Chicago, Ill	Horseshoe Brand Acidulated Bone and Potash
921	Northwestern Fertilizing Co., Chicago, Ill	Horseshoe Brand Corn and Wheat Grower

*Manufacturers' sample.
†Water soluble phosphoric acid: claimed, 1.25; found, 1.18.

for 1905, expressed in parts in a hundred.—Cox.

	Nitrogen	Phosphoric acid			Potash soluble in water, estimated as K_2O
		Available	Insoluble	Total	
Claimed	2.68	8	....	....	6
Found	2 11	8.66	2 18	10 84	6.27
Claimed	2 06	8	....	9	3
Found	2 46	9 89	2.39	12 28	3 91
Claimed	1.64	9	....	10	5
Found	1.71	9.60	1 80	11 40	5 29
Claimed	1 23	9	....	10	2
Found	1 31	10 89	.88	11 77	2.42
Claimed	.82	....	....	22	10
Found	.88	....	....	25.00	12.17
Claimed	.82	7	....	8	1
Found	1.02	7 46	3.42	10.88	1 34
Claimed	....	14	....	15	....
Found	....	14 22	1.90	16 12	....
Claimed	....	10	....	11	2
Found	....	10 44	3 76	14 20	2.62
Claimed	....	....	....	14	10
Found	....	....	....	16 53	10.64
Claimed	....	10	....	11	....
Found	....	9.13	2 07	11.20	....
Claimed	3.25	....	....	1.50	1.75
Found	2.49	....	....	.93	1.79
Claimed	3.25	....	....	1.50	1 75
Found	2 35	....	....	2.14	2.18
Claimed	2 05	8	....	10	1.50
Found	2.22	8.92	1 45	10 37	2.20
Claimed	.82	10	....	12	1
Found	1 07	10 34	2 96	13 30	1.21
Claimed	1.64	8	....	10	2
Found	2.53	8.70	2 70	11.40	2 41

Results of analyses of commercial fertilizers

Laboratory number. A	Manufacturer	Trade Name
*935	Northwestern Fertilizing Co., Chicago	Horseshoe Brand Potato Grower
869	Northwestern Fertilizing Co., Chicago	Horseshoe Brand Quick Acting Phosphate
*936	Northwestern Fertilizing Co., Chicago	Horseshoe Brand Sugar Beet Fertilizer
*945	Ohio Farmer's Fertilizer Co., Columbus, Ohio	Ammoniated Bone and Potash
899	Ohio Farmer's Fertilizer Co., Columbus, Ohio	Corn, Oats and Wheat, Fish Guano
903	Ohio Farmer's Fertilizer Co., Columbus, Ohio	General Crop Fish Guano
827	Nathan Smith & Son, Adrian	Fertilene
898	Speidel & Swartz, Grand Haven	Celery Hustler
*943	Swift & Company, Chicago	Ammoniated Bone and Potash
*944	Swift & Company, Chicago	Swift's Bone and Potash
856	Swift & Company, Chicago	Onion, Potato and Tobacco
826	Swift & Company, Chicago	Pure Complete Fertilizer
813	Swift & Company, Chicago	Pure Sugar Beet Grower
819	Swift & Company, Chicago	Pure Truck Grower
900	Swift & Company, Chicago	Special Bone Meal

*Manufacturers' sample.

for 1905, expressed in parts in a hundred.—CON.

	Nitrogen	Phosphoric acid			Potash soluble in water, estimated as K_2O
		Available	Insoluble	Total	
Claimed	2.46	9	....	11	2
Found	2.57	9.62	1.00	10.62	1.98
Claimed	....	10	....	12	....
Found	....	10.31	2.12	12.43	....
Claimed	1.23	9	....	10	2
Found	1.28	10.13	.75	11.88	2.11
Claimed	.82	8	....	....	4
Found	.88	10.10	3.15	13.25	8.00
Claimed	1.23	8	....	....	2
Found	.63	9.95	3.55	13.50	2.50
Claimed	.82	7	....	....	1
Found	.23	10.97	2.65	13.62	1.12
Claimed	12	....	....	25	25
Found	12.52	....	....	21.40	28.26
Claimed	7.50	3.35	....	4.75	2.25
Found	5.63	4.35	.90	5.25	2.04
Claimed	4.75	....	....	16	3
Found	4.49	....	....	18.75	3.99
Claimed	2.50	....	....	23.50	3
Found	2.40	....	....	26.25	4.77
Claimed	1.64	8	....	11	7
Found	1.40	8.58	3.57	12.15	8.02
Claimed	1	8	....	11	1
Found	.98	7.81	3.75	11.56	1.26
Claimed	2.50	8	....	11	5
Found	2.89	7.95	3.55	11.50	5.66
Claimed	.82	8	....	10	4
Found	.87	8.80	3.98	12.78	4.14
Claimed	.82	....	....	27.50	....
Found	1.51	....	....	26.29	....

Results of analyses of commercial fertilizers

Laboratory number. A	Manufacturer	Trade Name
*787	Swift & Company, Chicago	Swift's Special Bone Meal
802	Swift & Company, Chicago	Superphosphate
877	Swift & Company, Chicago	Swift's Bone Meal
814	Swift & Company, Chicago	Swift's Pure Vegetable Grower
868	Swift & Company, Chicago	Special Phosphate and Potash
*962	Tuscarora Fertilizer Co., Chicago	Acid Phosphate
*959	Tuscarora Fertilizer Co., Chicago	Ammoniated Phosphate
*965	Tuscarora Fertilizer Co., Chicago	Bone and Potash
*968	Tuscarora Fertilizer Co., Chicago	Michigan Special
*966	Tuscarora Fertilizer Co., Chicago	Steamed Bone Meal
*970	Tuscarora Fertilizer Co., Chicago	Tuscarora Bone Phosphate
*960	Tuscarora Fertilizer Co., Chicago	Tuscarora Fruit and Potato
*967	Tuscarora Fertilizer Co., Chicago	Tuscarora Garden
*964	Tuscarora Fertilizer Co., Chicago	Tuscarora Standard
*963	Tuscarora Fertilizer Co., Chicago	Tuscarora Trucker

*Manufacturers' sample.

for 1905, expressed in parts in a hundred.—CON.

	Nitrogen	Phosphoric acid			Potash soluble in water, estimated as K_2O
		Available	Insoluble	Total	
Claimed	.82	....	....	27.50	....
Found	.97	....	....	33.35	....
Claimed	1.64	8	....	12	2
Found	1.52	7.10	4.88	11.98	2.24
Claimed	2.50	....	....	25	....
Found	2.40	....	....	26.33	....
Claimed	3.25	9	....	10	10
Found	2.89	10.02	3.85	13.87	10.60
Claimed	....	10	....	11	2
Found	....	10.66	.82	11.48	3.16
Claimed	....	14	....	16	....
Found	....	14.63	.75	15.38	....
Claimed	.82	7	....	9	1
Found	1.07	7.80	.78	8.58	1.07
Claimed	....	10	....	12	2
Found	....	11.05	.20	11.25	2.07
Claimed	1.65	8	....	10	5
Found	1.39	9.28	.50	9.78	5.15
Claimed	1.65	....	....	20	....
Found	2.78	....	....	24.58	....
Claimed	....	10	....	12	....
Found	....	11.41	.26	11.67	....
Claimed	1.65	8	....	10	10
Found	1.40	8.50	.85	9.35	5.34
Claimed	2.88	8	....	10	4
Found	2.73	8.90	2.83	11.73	4.28
Claimed	1.65	8	....	10	2
Found	1.80	8.52	1.63	10.15	2.12
Claimed	4.11	8	....	10	7
Found	4.17	8.03	3.80	11.83	8.49

Results of analyses of commercial fertilizers

Laboratory number. A	Manufacturer	Trade Name
*961	Tuscarora Fertilizer Co., Chicago..................	Wolverine Special....................
841	Wuichet Fertilizer Co., Dayton, Ohio.............	Onion and Truck Fertilizer...........
*784	Wuichet Fertilizer Co., Dayton, Ohio.............	Onion and Truck Fertilizer...........

*Manufacturers' sample.

for 1905, expressed in parts in a hundred.—CONCLUDED.

	Nitrogen	Phosphoric acid			Potash soluble in water, estimated as K_2O
		Available	Insoluble	Total	
Claimed	.82	8		10	4
Found	.90	8.62	.83	9.45	4.14
Claimed	1.50	8	....	10	8
Found	1.34	12.00	3.25	15.25	4.84
Claimed	1.50	8	....	10	8
Found	1.06	11.43	2.20	13.63	9.13

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INSECTS OF THE GARDEN.

RUFUS H. PETTIT.

Bulletin No. 233.

INTRODUCTION.

The present bulletin is the second of a series dealing with the insects affecting different classes of crops. It deals with the insects now affecting garden and truck crops in Michigan and some which are sure to be found in the State sooner or later. Only insects of importance or of interest have been included. Most rarities have been omitted in order to prevent confusion.

Many facts have been drawn from the writings of others, notably from those of the Department of Agriculture at Washington; from the bulletins of Professor Slingerland of Cornell University; from the Canadian reports; from the bulletins of many of our State experiment stations.

It must be borne in mind that insects affecting truck crops and those of the garden as well, very often work also in field crops and in grains. It is not the purpose of the writer to enter upon the subject of field and grain crops in the present bulletin, that phase of the subject being reserved for the future. Methods of use in small areas are often useless in large fields, thus in the case of sweet-corn it often happens that methods which would not pay in large fields, will be of good service in smaller areas where the cultivation is more intensive and the price received for the output will warrant more outlay in case of an emergency.

The illustrations are from various sources. Credit is given in each case where the source is known.

On pages 65 to 67 are given the methods of preparing the insecticides recommended in this bulletin.

The entomologist is always glad to receive specimens of insects or of their work, and in return to name them when possible and to give advice as to control. Send specimens, if possible, in tight tin boxes with few if any holes.

The first bulletin of this series dealing with fruit insects is number 24, special. This is to be had on application as long as the supply lasts. It is intended that other bulletins of like nature will be issued on field crops, pests of forest, shade and ornamental trees, etc., if there seems to be a demand for them, and these if preserved, with the rest of the series may prove useful for reference.

Always send specimens of insects to the

Entomologist of the Experiment Station,

Agricultural College, Mich.

INSECTS INJURIOUS TO ASPARAGUS.

AFFECTING THE TOPS.

The Asparagus-beetle (*Crioceris asparagi*).

At some time near the middle of the nineteenth century, there came over from Europe, a beetle which has gradually extended its range until at present it is pretty well known all over the United States and Canada. It reached Michigan about 1896, appearing in Berrien County. The insect under discussion is a dainty, neat little creature, brightly colored and polished. It is about one-fourth of an inch in length, the wing-covers being reddish-yellow and cream colored, marked with black; and the thorax reddish-yellow with black dots. The larvae are slimy olive-grey with blackish head and legs. The elongate, black eggs, about one-tenth of an inch in length, are set on end on the young shoots of asparagus. They hatch in about eight days, and the larvae excavate pits which become discolored and prevent the sale of the stalks. In about two weeks, the larvae become full-grown and go into the ground to pupate, emerging as adults after about eight days, the entire time required for the completion of the life cycle being about a month. This allows ample time for several generations each year. The winter is passed in the adult condition, under rubbish, loose bark, etc.

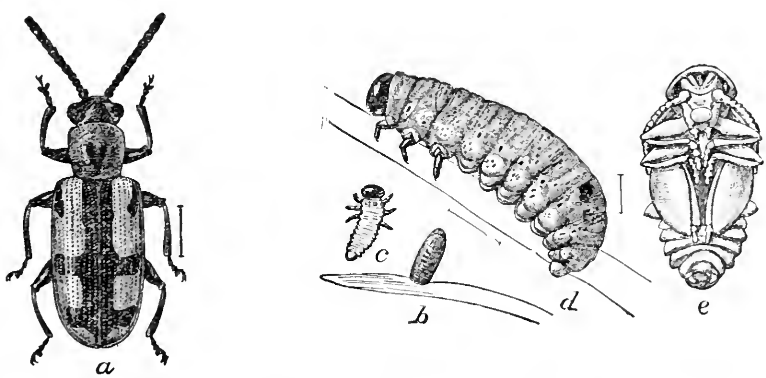


Fig. 1.—Asparagus Beetle; enlarged. a, adult beetle; d, larva; c, young larva; b, egg; e, pupa. (Chittenden, year book Dept. Agr. for 1896.)

REMEDIES.

Fields from which the shoots are being cut, should never be sprayed because of the danger to life. Leave some young shoots for the beetles to lay their eggs upon, and cut and burn these shoots before they are a week old, to destroy the eggs. If patches of such trap plants be systematically left over the field and carefully cut and burned just before the eggs hatch early in the season, there is usually little trouble as the season advances. As soon as the cutting season is over, the whole field should be sprayed or dusted with paris-green and lime. All seedlings and feathery plants should also be included in this general spraying. Late in the fall burn all rubbish on and about the field to kill the hibernating adults. Dry-slaked lime will kill the larvae if dusted on them, as will also Pyrethrum or kerosene-emulson if applied, but Pyrethrum is expensive and the emulsion is apt to scent the shoots.

INSECTS AFFECTING THE BEAN.

INSECTS FEEDING ON THE FOLIAGE.

Pale Striped Flea-beetle (see Insects Affecting Beets).
Cut-worms (see Insects Affecting Sweet-corn).
Blister-beetles (see Insects Affecting Beets).

INSECTS AFFECTING THE SEEDS.

Bean-weevil (*Bruchus obtectus*).

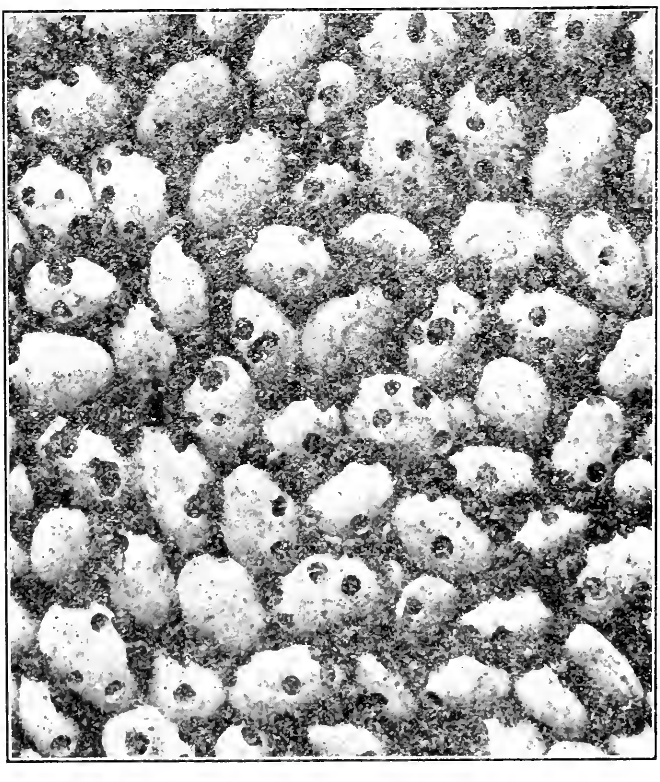


Fig. 2.—Beans infested with bean-weevil, slightly enlarged. Original.

The beetle of buggy beans, belongs, of course, with the insects affecting dried seeds and grains in a bulletin to come later, but as it also works in green beans, a short account is included here.

This pest which destroys such quantities of seed beans is only about one-eighth of an inch in length. It is brownish-grey in color with a greenish tinge. It carries its head bent at right angles to the body, and the wing-covers are somewhat shorter than the abdomen, lending to the beetle the appearance of wearing an outgrown coat. There are several generations each year, the eggs of the first generation being laid either on the outside of the pod or in slits cut with the jaws. The larvae immediately enter the pod and afterward the beans, sometimes several working in the same seed. When the beans are harvested and threshed, the beetles continue to work in the dried beans, and sometimes in dried peas, rearing several generations in the course of a year.

When the beetles are numerous their work results in the more or less complete destruction of the beans. Infested beans are not suitable for seed, as the beetles that come from them attack the green beans, furthermore such beans produce inferior plants when they do grow.

REMEDIES.

Fumigation of the seed with carbon bisulphide is the only reliable and efficient measure for this pest.

INSECTS AFFECTING THE BEET.

INSECTS WORKING ON THE ROOTS.

The Clover-root Mealy-bug (*Dactylopius trifolii*).

On one occasion, the writer found numbers of mealy-bugs working on the roots of small sugar-beets. Their presence was indicated by the unhealthy, yellow appearance of the beets affected, some of which died, but the trouble was of short duration and did not affect more than a single field. The field in question was preceded by clover which had been infested. For a description of this insect and its work see Bulletin 200 of this station.

White-grubs (see Insects Affecting Sweet-corn).
Wire-worms (see Insects Affecting Sweet-corn).

INSECTS WORKING ON THE FOLIAGE.

Plant-bugs (*Lygus pratensis*) et al.

A long list of plant-bugs have been seen to work on the beet, notably on the sugar-beet, but our worst enemy of this type is the common tarnished plant-bug. This bug is flattened in form, and a little less than one-fourth of an inch long, metallic brown, variably marked with yellow and black. The whole resulting in a surface resembling tarnished brass, hence the name. The young are greenish in color with five black dots on the back. There are several generations each year, the insect working from early spring until fall. The adults winter in rubbish and stubble, under fences, out-houses, etc.

REMEDIES.

Poisons like the arsenites are of no value against insects of this class owing to the fact that the bugs suck the sap from beneath the surface, thus escaping any coating that may be placed thereon. It is necessary to use something that kills by contact, and to make such a spray effective, each bug must be hit to be killed. Use kerosene-emulsion diluted about ten times when the bugs are young and make it strong as the plants will stand when the plants get older and more resistant. It may be preferable to use the Pyrethro-whale-oil kerosene-emulsion in some cases.

Clean culture.—As the majority of the adults pass the winter in rubbish, along fences, etc., it follows that clean culture and the late burning of such material will get rid of them. Burn as late as possible in order to catch these and many other pests after they have settled for the winter.

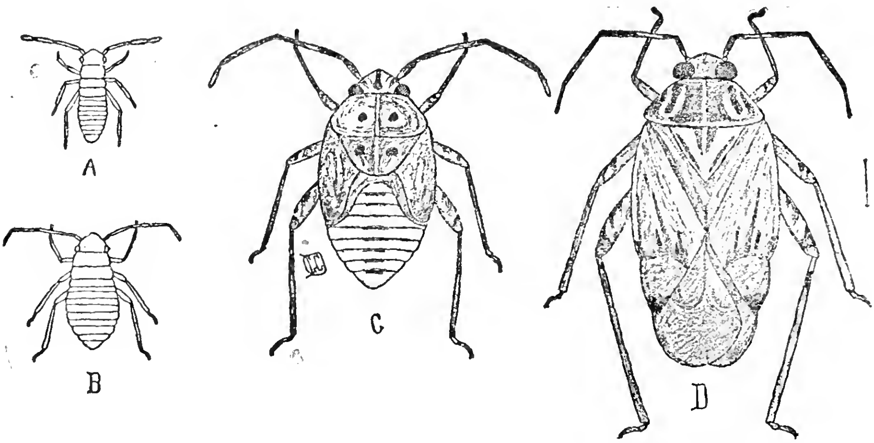


Fig. 3.—Tarnished plant-bug, showing various stages of growth, enlarged, (*after G. C. Davis.*)

Large-eyed Ground-bug (*Geocoris bullata*).

A short dumpy bug, of unprepossessing appearance, is often found in sugar-beet fields, its natural food being purslane, pig-weed, smart-weeds and others. In common with many other weed insects, it appreciates the beet for a change. The writer has never heard of serious injury by this bug. It is amenable to a spray of kerosene-emulsion.

Plant-lice (*Aphididae*).

Several species of plant-lice or aphids are to be found on the beet. In Michigan we have at least one species and probably more. Most of the insects of this sort feed also on weeds or on some other garden crop. The occurrence of plant-lice on beets has, thus far, been local and no very serious cases have been brought to the notice of the writer, except in the case of mother beets, or seed beets of the sugar producing type.

In such cases the lice have been readily killed by a spray of to-bak-ine, a tobacco extract containing about fifty per cent of nicotine. This has been put on at the rate of five teaspoonfulls to two gallons of water, and applied with a bucket spray. One application has been known to do a clean job with no injury to the plants. Doubtless some of the kerosene-emulsions will also kill them satisfactorily.

Leaf-hoppers (*Jassidae*).

A number of species of leaf-hoppers feed on the leaves of the beet.* All are small, rather slender, and all jump on the slightest provocation. They suck the sap from beneath the surface of the leaves, leaving a small dead spot to mark each puncture. This would ordinarily amount to little, but when the insects come in swarms, as is often the case, the aggregate amounts to a good deal. It is not possible to control these pests by spraying with poisons, as they pierce beneath the surface for their food supply. The contact insecticides will kill a certain proportion of them, but no spray yet devised is satisfactory unless used when the pests are small. They pass the winter in rubbish, under leaves, etc., therefore collect and burn all rubbish after cold weather sets in.

GRASSHOPPERS.

When, from time to time, grasshoppers attack the beets, they should be killed by poisoned baits, provided of course, that such baits may be used without danger to stock or poultry. Criddle mixture, a mixture of arsenic, salt and horse-manure, is highly recommended by several who have tried it. Bran and arsenic, or paris-green and bran, has the disadvantage that it is readily eaten by birds and poultry. For a further discussion of grasshoopers see Insects of Sweet-corn.

Beet Web-worm (*Loxostege sticticalis*).

From time to time we meet the beet web-worm, an insect that, on several occasions, has been very severe in its attacks. The eggs of the web-worm are laid on the leaves, and the larvae that come from them attack the foliage, either spinning small webs among the young and tender shoots at the center of the plant, or else feeding on the underside of the larger leaves, either protected by a small web of silk or else exposed, with no protection whatever. The caterpillars are pale yellowish-green, or reddish-yellow in color dotted with small black points, each of which bears a hair. They are about three-fourths of an inch in length. The head is yellowish-brown marked with brown spots; the prothoracic shield is somewhat lighter in color. The backs of the first two segments each bear four black dots; segments three to eight each bear six black dots, arranged in two triangles. Segment nine has one larger median spot with two smaller lateral ones and segment ten has the anal shield, dirty yellow in color, marked with brown spots. The under side is marked somewhat similarly with dirty spots, each spot being bordered indistinctly with pale. The legs are pale with darker markings.

The pupa of this moth is buried in the soil. The larva spins a slender

*See Forbes and Hart, Bul. 60, University of Illinois, Experiment Station.

silken tube about three-quarters of an inch long, and in this tube the pupal stage is passed. In the early broods the pupal stage is of short duration, but the members of the last brood remain in the tubes over winter. There are several generations each year.

REMEDIES.

Spray with paris-green on the first appearance of the larvae, using lime as indicated in the directions for preparing insecticides. Use one pound of the poison to one hundred and seventy-five gallons of water. Plow the field after harvesting the beets, so as to expose the pupae to the birds. In spraying, use a nozzle set at right angles to a short extension, so that it will be easy to spray upward from beneath.

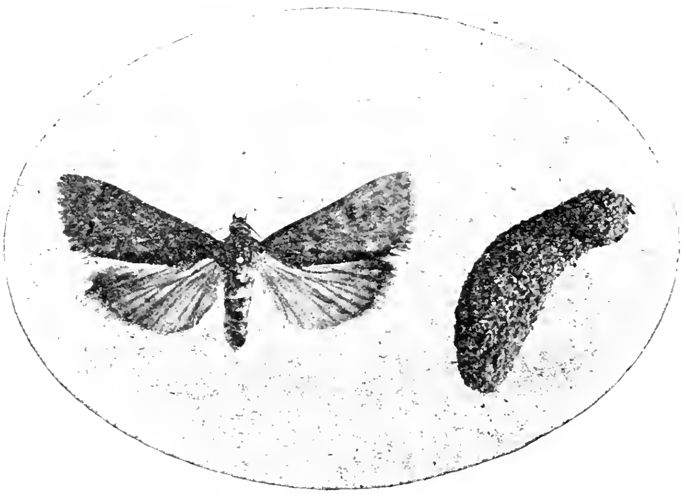


Fig. 4.—Beet web-worm, adult, and silken tube in which pupal stage is passed, enlarged. Original.

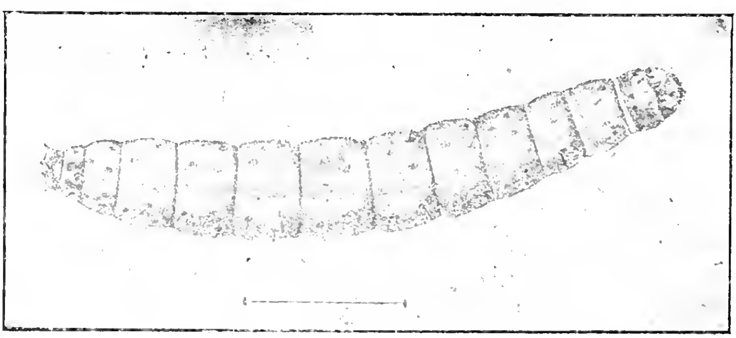


Fig. 5.—Beet web-worm, e arged. (Author's illustration.)

Zebra Caterpillar (*Mamestra picta*).

A very general feeder is the zebra caterpillar; cabbage, cauliflower and other plants of that type seem most to its liking, but the beet does not escape. The moth, shown in Fig. 6, is dark brown in color, except the hind-wings, which are pale yellowish. The eggs are laid in clusters on the foliage and the young larvae, at first hairy but later naked, soon scatter over quite wide areas. When full grown, the larvae are yellow in color with three broad, black, longitudinal stripes, those on the sides being cut up by fine white lines. The pupal stage is passed underground. Two generations are brought forth each year, the most destructive one in June and July.

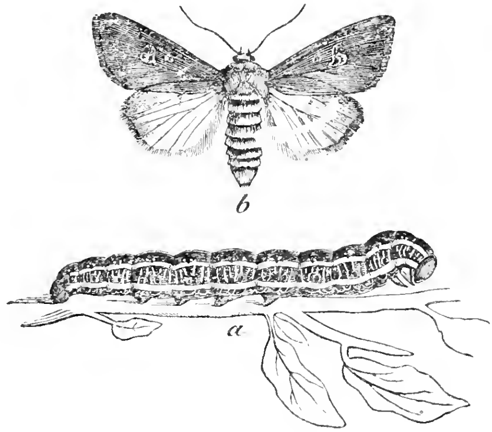


Fig. 6.—Zebra caterpillar. (After Riley, Second Rep. Insects of Mo.)

Cut-worms.

A goodly number of cut-worms feed on the beet. As yet, they have been but little studied in Michigan but all of them respond to the same treatment. See Insects affecting Sweet-corn.

REMEDIES.

Spray with paris-green and lime, using one pound to one hundred and seventy-five gallons of water. If the insect appears on cabbages or on some other vegetable where poison would not be permissible use Pyrethrum or one of the kerosene-emulsions.

Cabbage Plusia (see Insects Affecting the Cabbage).

Woolly-bear (*Spilosoma virginica*).

Oftentimes, one finds large, hairy caterpillars among the beets. They are light yellow in color and they eat the foliage of the beets voraciously. Such caterpillars turn into good sized moths or millers. Hand picking will usually be found to suffice for them, but when necessary, they may be kept in check with one of the arsenites.

Beet Leaf-miner (*Pegomya vicina*).

One often sees on the leaves of beets, raised or discolored blisters which on closer examination, are found to be made by insects that have tunnelled out passages between the upper and lower skins. Such blisters or tunnels are called mines, and the insects that make them are called leaf-miners. On the beet we have such leaf-miners, the larvae or maggots of which make irregular blotch mines of small size. When full-grown, the larvae usually desert the leaves and pass through the pupal stage under fallen leaves or in the soil. The adult fly, or parent form, looks very much like a house-fly except in size, being about half the size of the house-fly. There are a number of generations each year, the last generation passing the winter in the pupal stage.

Fig. 7.—Adult of beet leaf-miner, enlarged. (Author's illustration.)

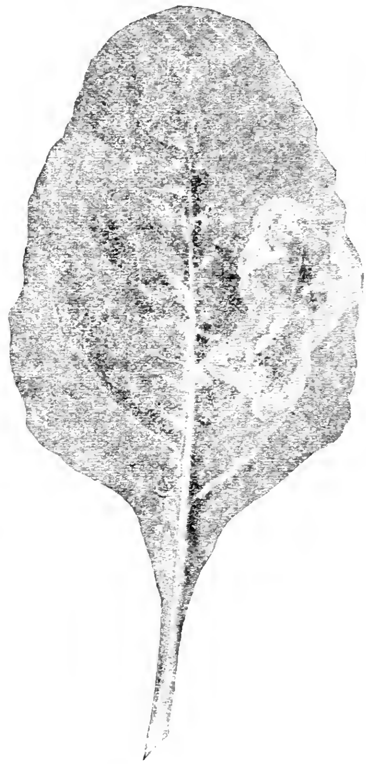


Fig. 8.—Beet leaf-miners. Mine in leaf. Original

REMEDIES.

The fact that the winter is passed under fallen leaves in the field, suggests the destruction of such rubbish by plowing immediately after harvesting the beets. No benefit seems to have resulted from sprays, thus far. Fortunately the damage is usually restricted to spoiling the tops for greens.

Blister-beetles.

Old-fashioned Potato-beetle (*Epicauta vittata*).
Ash-grey Blister-beetle (*Macrobasis unicolor*).
Black Blister-beetle (*Epicauta pennsylvanica*).
Margined Blister-beetle (*Epicauta cinerea*).

We have in Michigan four different kinds of blister-beetles, viz.: the ash-grey, the margined, the black, and the striped or old-fashioned potato-beetle. All of these blister-beetles feed on the beet and on various other plants. They seem to prefer members of the clover family; sweet-clover, vetches, etc., which they attack during the latter half of July and August. The black species is found on golden-rod in great numbers, late in the season. The appearance of a blister-beetle is shown in fig. 9, long, slender, and with graceful legs and form, a little more than half an inch in length. These four species differ markedly in color. The one figured, is known as the old-fashioned potato-beetle because of its well-known love for that plant. It is striped, yellow and black, with black legs. The black and grey species look very much like the striped one except for the color, and the margined beetle is dead black in color with the margins of the wing-covers grey. They all eat the foliage of beets when adult and often commit serious depredations. One word in extenuation before pronouncing sentence of death on these small

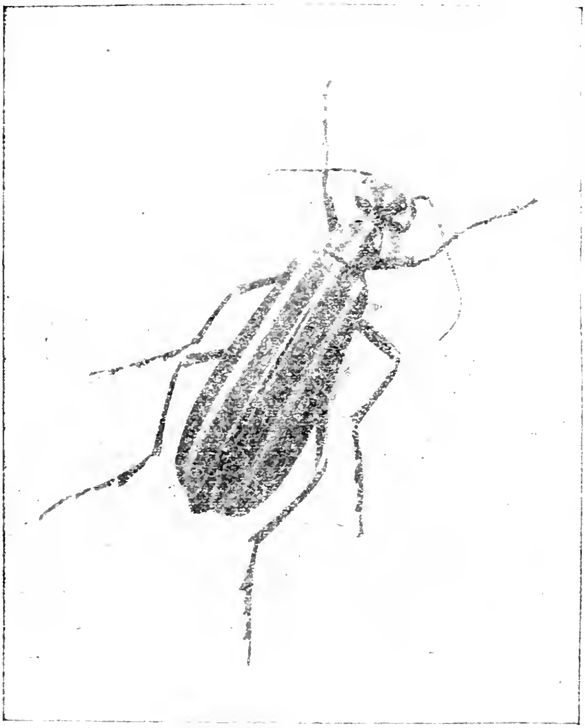


Fig. 9.—Old-fashioned potato beetle, enlarged. (Author's illustration.)

malefactors. Their larval stages, in all our common species except the steel-blue one, are passed in devouring the eggs of grasshoppers. In fact, the young blister-beetles of this group are not known to feed on anything else. The fact that the eggs of grasshoppers are laid in pods covered with water-tight shells, and containing from twenty to thirty eggs, makes it possible for the beetles to do a great deal of damage to the contents of the pods by devouring part of the eggs. If all are not eaten, fermentation and the consequent loss of the rest of the batch are sure to follow. From this we see that it is possible for the beetle to attain its majority only at the expense of many grasshopper eggs. The beetles then are our friends if they occur in anything like moderation but lest we be overrun by these well meaning but hungry allies, it is often desirable to get rid of them.

Fig. 10.—Margined blister-beetle, enlarged. (Author's illustration.)

REMEDIES.

Paris-green applied as a spray will kill them, although it works slowly. Before the days of paris-green, it was the custom of our forefathers, to drive the beetles, when they came in droves, by brushing them with the branches of trees, into windrows of dry straw, and then to burn them up. Dry-slaked lime, and paris-green, one part of the latter to fifty parts of lime, dusted through coarse cloth or burlaps, will kill some and drive many away.

The Pale Striped Flea-beetle (*Systena blanda*)

Flea-beetles, as the name implies, have strongly developed, jumping hind-legs, by means of which they are capable of taking long leaps after the manner of the common flea. They all belong to the family of leaf-beetles and feed on vegetation. The one in question, the pale, striped flea-beetle is very small, measuring about one-eighth of an inch in length, and is yellowish-brown in color. Down each wing-cover extends a yellow stripe. The prothorax is also yellow, the head brownish-red, the legs yellowish-red and the under side of the body black.

While pre eminently a pest of the sugar-beet, in Michigan, this beetle makes its presence felt very forcibly on the garden beet, as well as on corn, beans and potato. It dearly loves sorrel (ordinary red or horse-sorrel), pig-weed or lamb's quarter, rag-weed and a great variety of cultivated plants and weeds.

The slender, thread-like larvae of this beetle are said by Chittenden* to feed on the roots of corn, lamb's quarter, and probably also on the roots of Jamestown weed. They are white in color with a moderate number of hairs. They are pests of dry seasons, rarely doing serious injury during wet weather. The worst damage is done while the beets are small, usually when they have about two leaves. Under such conditions, the beetles sometimes spoil quite large areas, usually in sandy regions. When the beets are larger, the insects eat out the soft tissue

* Bul. 23, N. S. Bureau of Ent. Depart. of Agr.

in patches, either on the upper or under surfaces of the leaves, after which the remainders of the patches dry up and fall out leaving unsightly holes which increase in size as the leaf expands.

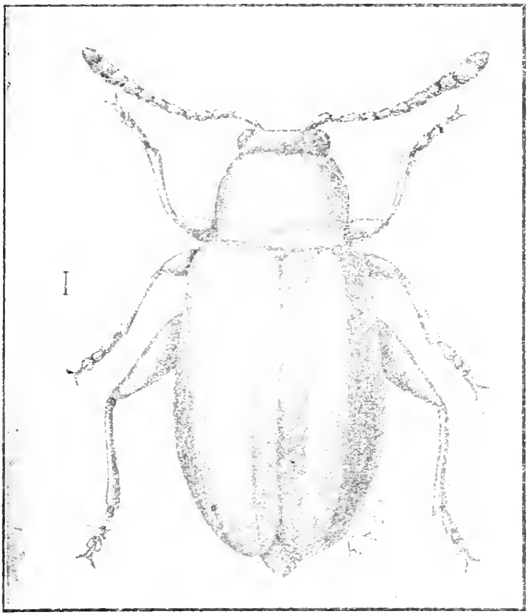


Fig. 11.—Pale, striped flea-beetle, enlarged. (Author's illustration.)

REMEDIES.

Spray with paris-green and bordeaux, using one pound of the poison to 175 gallons of the bordeaux, made in the ordinary way. The bordeaux is useful against this and many other flea-beetles, acting as a repellant rather than as a poison.

Dusting with dry-slaked lime and paris-green should prove very effective as all flea-beetles dislike lime. Use one part of the poison to one hundred of the lime and mix very thoroughly before applying. Clean culture and the destruction of all rag-weed, pig-weed, etc., in the fence corners, will tend to starve out this pest in common with many others.

The Triangle Flea-beetle (*Disonycha triangularis*)

The triangle flea-beetle is so named because of the three dark round spots placed in a triangular position on the orange prothorax. In size, this beetle varies from about three-sixteenths to one-fourth of an inch. It is blue-black in color with the exception of the orange prothorax before mentioned. It has the strong, jumping hind legs of its family. It works on the beet primarily, and is controlled by the same measures that govern the pale, striped flet-beetle. In fact it is usually found in company with the latter insect.

Fig. 12.—Triangle Flea-beetle, enlarged. (Author's illustration.)

Cucumber-beetle (*Diabrotica vittata*).

The cucumber-beetle occasionally feeds on the sugar-beet. It is controlled by the same methods as those used against the pale, striped flea-beetle. For a description of this insect see Insects Affecting the Cucumber.

Potato Flea-beetle.

Occasionally, this little pest attacks the beet foliage. For remedies, see Insects affecting the Potato.

INSECTS INJURIOUS TO CABBAGE.

AFFECTING THE ROOTS.

Cabbage Root-maggot (*Pegomya brassicae*).

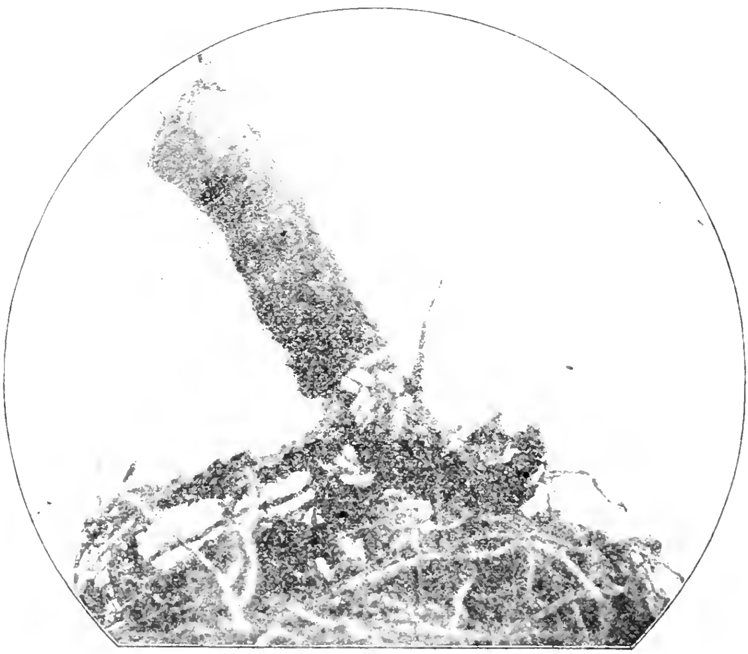


Fig. 13.—Cabbage maggot. Maggot in root, enlarged, after Prof. M. V. Slingerland.

Perhaps the most unsatisfactory insects of the garden are the root-maggots, and the one on cabbage is no exception to the general rule. The eggs of this fly are laid in crevices in the soil near the root. The fly resembles, more or less, the house-fly except in point of size, being about one-fifth of an inch long. The maggot that hatches from the fly, bores into the root of the young cabbage or cauliflower plant, and scrapes its way all through the tissue, forming tunnels or channels, and causing the root to rot. Sometimes several maggots attack a single root. In about three or four weeks, the maggot becomes full grown, then being about one-third of an inch in length. It then changes to a pupa, the larval skin becoming papery and forming a shell, inside of which the change occurs. After a short time, the adult fly cracks open the shell and emerges, and a new batch of eggs is laid. The worst injury is done to the young plants, before they attain much size. There are several generations each year. The winter is said to be passed for the most part, at least, in the pupal condition, although it is likely that some of the adult flies hibernate in sheltered places. For a minutely detailed account of this insect consult Bul. 78, of the Cornell Experiment Station by Professor M. V. Slingerland.

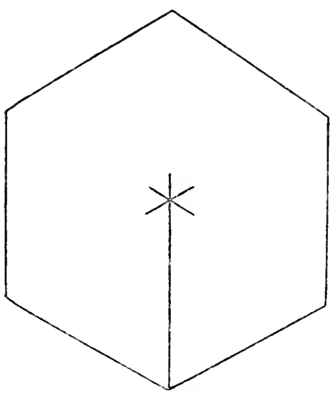


Fig. 14.—Card of tarred building-paper ready to place on stem of cabbage. After Slingerland.

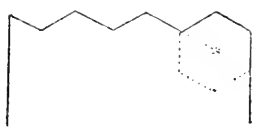


Fig. 16.—Diagram showing method of cutting. After Slingerland.

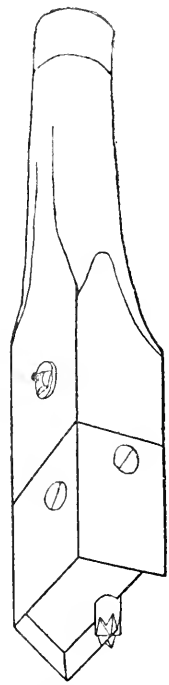


Fig. 15.—Tool for cutting cards of tarred building paper. After Slingerland.

REMEDIES.

Control of the cabbage root-maggot is best obtained by preventing the laying of the eggs, by means of a repellant. Professor Slingerland in his exhaustive experiments secured the best results by placing a small hexagonal piece of tarred building-paper, about two and one-half inches in diameter, about each plant shortly after setting time. Each piece or pad had a slit running to the center and a star-shaped cut at that point. It was pressed close to the ground and put on squarely so that it afforded almost complete protection to the crown of the plant, thus preventing the female from depositing her eggs. These pads were cut out of rolls of building-paper by a special hand tool and hammer. It really costs less than one would expect to treat an entire field, and succeeds in restricting the invasion of the maggots to a large extent.

We have succeeded in restricting their ravages materially by placing about a tablespoonful of tobacco dust about the stem of each plant, and this is common practice among some of our Michigan market gardeners, although the paper pads probably are more effective.

Professor Cook, formerly of this station, and afterward Professor Slingerland obtained quite satisfactory results with an emulsion of crude carbolic acid. Make it according to the formula on page 66, and dilute about thirty times with water. This should be applied about the base of the plant the day after setting and repeated every ten days until about May 25th, using about one-half teacupful to each plant and pouring it about the root with a sprinkler.

Fig. 17.—Spraying cabbage, with knapsack pump and short extension. Original.

INSECTS AFFECTING THE LEAVES.

The Cabbage Aphis (*Aphis brassicae*).

From mid-summer until fall, cabbages are subject to attack by plant-lice. Of course the lice are present earlier in the season but in such small numbers that they escape detection. Both winged and wingless forms occur, all of them being covered with a coat of fine waxy powder, very much like the bloom on the leaves of the cabbage on which they rest. This waxy bloom, no doubt serves as a protection by helping to conceal the insect, but when we come to spray we find that it helps very effectually to repel the liquid. Lying, as they do, in closely packed colonies, which sometimes cover almost the entire underside of a leaf, one would expect to kill them with ease. One finds, however, on trying to do so, that most spray mixtures slide from them like water from a duck's back. Furthermore it is very difficult to reach them when under the foliage. In order to overcome this last difficulty, we have used a short extension, about three and one-half feet long, with a Vermorel nozzle set at right angles to the extension. This makes it easy to reach the underside of the leaves and by simply turning the extension in the hand, one can spray downward on the head of the cabbage.

The best sprays for the lice that we have been able to find are tak-a-nap soap, used at the rate of one pound to four gallons of water, and Pyrethro-kerosene-emulsion made with whale-oil soap. This is diluted ten times. Both of these sprays killed apparently all the lice that were hit. The difficulty of hitting all the lice with a spray can be appreciated only by those who have made the attempt.

Cabbage-worms (*Pieris rapae, Pontia protodice, Pieris oleraceae*).

Three species of cabbage-worms or cabbage-butterflies grace the State of Michigan. They are, the Northern native white or pure white butterfly (*P. oleraccae*), the southern native white or checkered white (*P. protodice*), and the imported white or common cabbage-butterfly (*P. rapae*). The larvae or caterpillars of each of these butterflies feed on cabbage, rape, cauliflower and all of their near allies, with such enthusiasm that it will not be necessary to say more on that score. Before the advent of the now commonest species shown in fig. 18, the pure white cabbage butterfly* fed in peace in the northern United States, inflicting comparatively little damage. The southern cabbage-butterfly, with its checkered, black and white wings did likewise in the more southerly regions, the two species overlapping in a region that included our State. The accidental importation of the European cabbage-butterfly changed all this, for the native species could not compete with their more vigorous cousins; gradually they faded away before the advance of the aliens, until now they have almost disappeared from certain parts of the country.

When full grown, the larvae transform to naked pupae, remaining attached to the underside of the food-plants or on some nearby object, later changing to the butterfly stage.

The writer has seen all three species working together in large numbers in one field, in Alger County. The larvae differ somewhat, but all are readily recognizable as cabbage-worms.

REMEDIES.

From the nature of the case, it is not expedient to use poison on the cabbage, certainly not after the plants have shown a tendency to head.

* There is a spring form in which the veins on the under side of the wings are marked with gray scales.

Neither rape nor cauliflower suggest themselves as fit subjects for the arsenites. Hot water has been used extensively for killing the worms. The water is poured onto the plants through a sprinkler, held at just the right distance from the plant, the distance to be determined by experiment. It is possible to kill the worms without injuring the plants, when once the proper distance has been determined, depending upon the size of the holes in the sprinkler and the temperature of the water. However, the sprinkler method becomes very burdensome when used on a large scale. The use of Pyrethrum or of Pyrethro-kerosene emulsion is even more effectual and involves less labor. Pryethrum or Buhach if fresh and pure can be made to do all the work with very little labor. Apply with an atomizer, using one-half ounce to a gallon of water. We have used this with very gratifying results apparently killing all the worms that were hit. It is but fair to state, however, that the Pyrethrum used has been of the very highest quality, being that grown in California and kept in tightly sealed tin cans. This costs about 75 cents per pound, making the spray 2½ cents per gallon. A gallon will spray a large number of plants, so that after all it is not expensive.

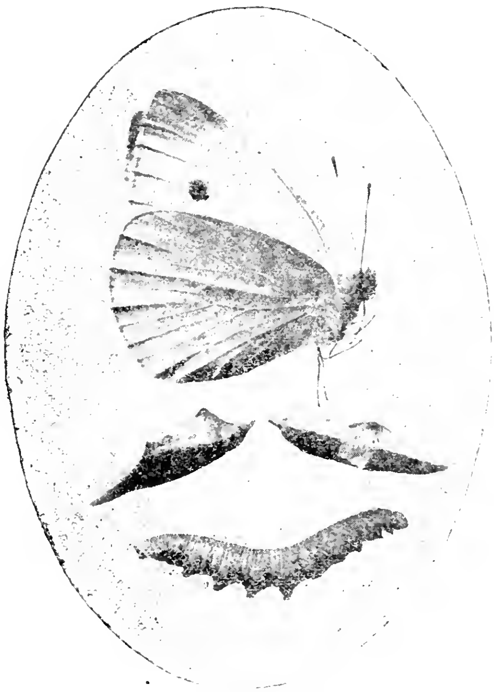


Fig. 18.—Imported cabbage-worm larva pupae and adult, slightly enlarged. Original.

Whale-oil Pyrethro-kerosene-emulsion, or emulsion to which Pyrethrum has been added (see directions for making insecticides) works very nicely, in fact nearly as well as the Pyrethrum alone and it costs only a little over a cent per gallon, if the materials are purchased in fairly large quantities. In fact if one can not procure the best of Pyrethrum to begin with, it is likely that the emulsion referred to will prove more uniformly successful. Dilute the emulsion about eight times with water. When diluted ten times, it failed to kill a few of the worms and when diluted only six times, it burned the foliage slightly.

The Cabbage-looper (*Plusia brassicae*).

Less conspicuous in its work, but nevertheless of much importance, is the cabbage-looper, so named because of the looping or measuring gait of the larva. This pale-green, almost translucent larva reaches a size slightly larger than the common "cabbage-worm." It is rather obscurely striped longitudinally. The larva walks with a looping gait owing to the fact that there are no legs for the middle region of the body.

When full-grown, the larva spins a white, silken cocoon, sometimes under a leaf blade, often on some other object near at hand. After a time, the adult makes its way out of the cocoon. It is a winged moth or miller which spreads about one and one-half inches from tip to tip

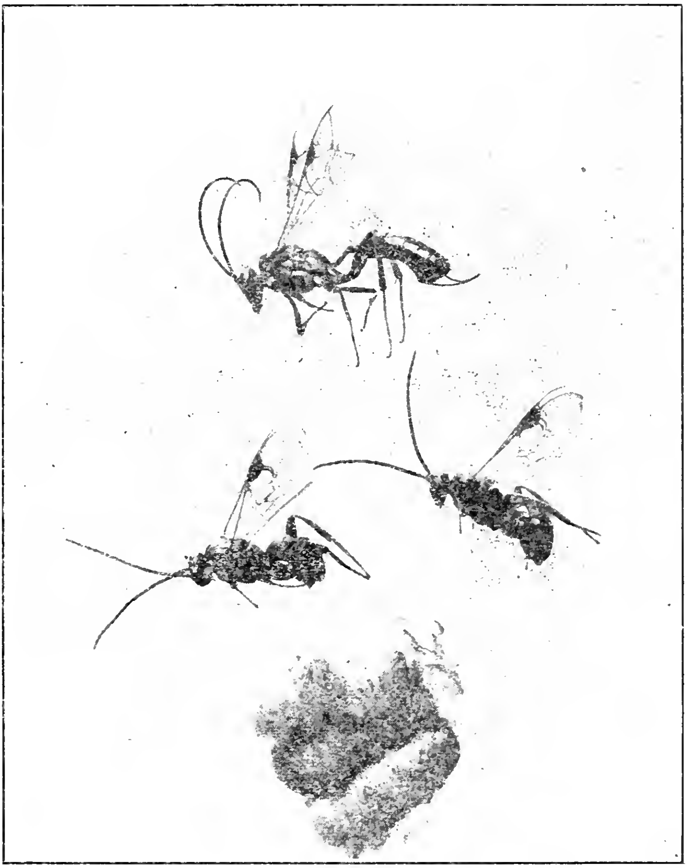


Fig. 19.—Parasites of cabbage-worm, with cocoons, enlarged. Original.

of the wings. It is brownish-grey in color, the front-wings being more or less transversely mottled, each front-wing bearing a small silver-white, well-defined spot, the hind-wings being lighter in color and without mottlings.

REMEDIES.

The same remedies that apply to the common cabbage-worm, will serve for the looper.

Diamond-back Moth (*Plutella maculicollis*).

A very small green larva or "worm" often works on the leaves of plants of the cabbage family, a worm exceedingly active when disturbed, one that will wriggle all over the hand in its efforts to escape when captured. Oft-times it lets itself down out of harm's way by spinning a silken thread from which it hangs suspended. The length of this little pest is about one-third of an inch.

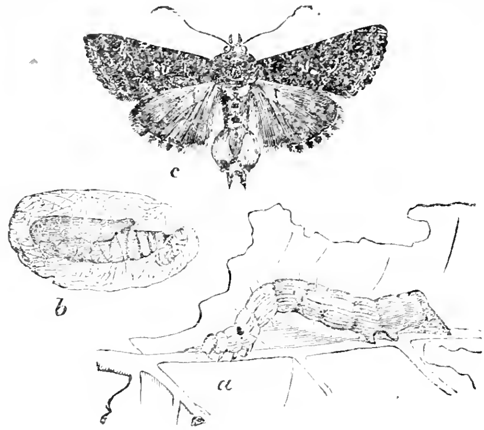


Fig. 20.—Cabbage-looper, after J. B. Smith, State Exp. Station of New Jersey.

When numerous these larvae eat holes in the leaves of the plants to such an extent as to disfigure the plants very appreciably. They eat the soft tissue from one surface of the leaf, leaving the exposed remnant to dry and fall out. When full grown, each larva constructs a beautiful little cocoon of white silk. Lace like in texture, it consists of gauzy open work, and inside may be seen the pupa, awaiting the time when the final transformation to the adult stage is to be made.


Fig. 21.—Diamond-back moth, enlarged. Original.

The moth may often be seen sitting quietly among the larvae. When disturbed, it darts away to some concealment. It is about one-third of an inch in length, and in general, is ash colored. There is a white stripe on the hind-margin of each front-wing, and these two white stripes lie together when the wings are closed, making a conspicuous white dorsal stripe bordered with darker on each side. The wings are folded roof-wise over the back, with an abrupt elevation at the posterior end. There are several generations each year. The same remedies that are used against the cabbage-worms will keep this little moth in subjection.

Cabbage Flea-beetle (*Phyllotreta vittata*).

Like all of the flea-beetles, the cabbage flea-beetle is small and inconspicuous, though very active, jumping long distances when disturbed. It is less than one-tenth of an inch in length, black in color, with a well-

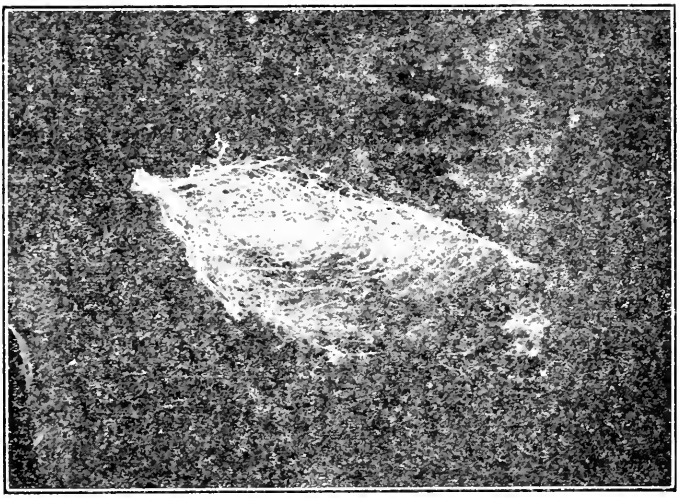


Fig. 22.—Cocoon of diamond-back moth, enlarged. Original.

marked yellowish stripe on each wing-cover. The larva is said to be long and slender, and to mine in the leaves of young cabbage plants.

REMEDIES.

The worst damage is inflicted by this little pest, when the plants are young and long before the heads are formed. At this time a spray of paris-green and bordeaux will serve to check them, the bordeaux acting as a repellant. It is probable that tobacco dust would also serve the purpose, if dusted on the young plants. After the heads commence to appear it is unsafe to use any of the arsenites.

Fig. 23.—Parasite of diamond-back moth, enlarged. Original.

Cabbage Curculio (*Ceutorhynchus rapae*).

A small beetle that tunnels in the leaf-stems, crown and larger veins of the cabbage, is described in Bul. 23, Bureau of Entomology, of the U. S. Department of Agriculture. The beetle is credited to Michigan among other states, having been found here by Professor A. J. Cook, many years ago. This beetles belongs to the curculios and is about one-eighth of an inch long, broadly oval in form, the color being black modified by fine light grey hairs. The species is carefully and fully described by Mr. F. H.

Chittenden in the bulletin cited. The damage brought about by this beetle is said to be largely due to its spreading the cabbage rot, a disease that causes considerable loss annually.

Fig. 24.—Cabbage flea-beetle, enlarged. (From Walsh and Riley, Amer. Ent., vol. 1, p. 158.)

REMEDIES.

The beetle is said to prefer wild hedge mustard and pepper-grass to cultivated plants. It is recommended that all such plants be pulled up and burned about the middle of June, after the eggs are laid. Arsenical poisoning is also recommended while the plants are very young and before they show signs of forming heads.

Cabbage Snakes (*Mermis albicans*).

Alarming stories relative to the poisonous properties of "long, slender, hair-like snakes" which are found in the cabbage, reach us from time to time. These "fearful snakes" are the same creatures that are found in watering-troughs and pools so frequently, they are then known as "hair-snakes," believed by the uninformed to be animated horse-hairs. They really are parasites from the bodies of grasshoopers, crickets, etc., which pass part of their existence in the soil or water, the eggs being hatched in the soil and the young gaining access to the bodies of grasshoppers or crickets early in their career. When a grasshopper is about to die from the drain put upon its strength by the parasite, the latter crawls out. Some fall into the cabbages on which the hoppers happen to be feeding when their strength fails. Such hair-snakes settle down into the cabbage head, finding a moist place wherein they manage to live for some time.

It is not at all likely that harm would result from eating a piece of hair-snake, although the writer has never knowingly tried it. When well cooked, there should be no reasons other than those of sentiment, for fearing them.

INSECTS INJURIOUS TO CELERY.*

AFFECTING THE TOPS.

Celery Aphis (*Rhopalosipum dianthi*).

Occasionally celery is infested by one of the plant-lice or green-flies. The writer has never seen any serious injury by these insects, but in case they become troublesome, kerosene-emulsion should prove effective as should also tobacco water.

Little Negro-bug (*Corymelaena pulicaria*).

Bulletin 102 of this station contains a description of an outbreak by the little negro-bug. This insect ordinarily seems to prefer weeds

* For further information on celery insects, see Bul. 102 of this station, published also in the nnual Report for 1894.

to celery, but on occasion, it has been known to overspread a celery field in late July, collecting in little clusers on the leaves, and playing sad havoc with the commercial fields. The outer leaves of the stalk suffer first, but later the inner, feathery ones that go to make the market head.

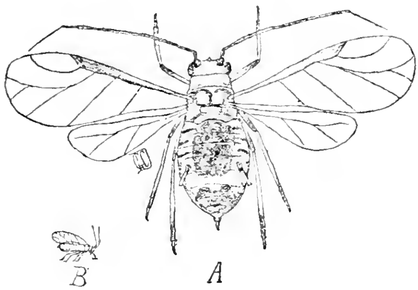


Fig. 25.—Celery Aphis, enlarged, after G. C. Davis.

The cause of all this trouble is a small, shining black bug, very convex and quite broad comparatively, the length being a little less than one-eighth of an inch. The insect is said to rear only one generation each year. It is known to work on strawberry, raspberry, grape, wheat, some grasses, and a number of weeds, including red-root and ground-nut, beggar-tick, plaintain, rag-weed and smart weed.

REMEDIES.

Mr. Davis recommends crude carbolic acid and water used at the rate of a teaspoonful to two gallons of water and sprinkled over the plants or else crude carbolic and air-slaked lime used at the rate of a teaspoonful of the acid to a bushel of lime, and dusted over the plants. The emulsion of carbolic acid described on page 66 and diluted so that the same amount of the acid is found in two gallons of water, will make a more even preparation and one would expect less danger from burning the plants than with the plain mixture. The writer has never had an opportunity to try this, however. Mr. Davis found that hot water killed the bugs when used at 155 degrees Fah. and that the plants were killed at 175 degrees. On a small scale, this can be applied with a sprinkler if care be taken to test the water with a thermometer carefully and at short intervals.

Clean culture.—The long list of weeds which serve as food-plants for this little nuisance, shows plainly that the removal of weeds from the vicinity of the celery fields will be the most effective preventive measure at our command. Clean culture is, after all, a measure which pays well.

Tarnished Plant-bug (see Insects affecting Beets).
Leaf-hoppers (see Insects affecting Beets).
Grass-hoppers (see Insects affecting Sweet-corn).

Celery Thrips (*Coleothrips trifasciata*).

Related to the onion thrips, and in many respects, closely resembling it, is the celery thrips. It is said to be the same species as the one so common in clover heads. Very small and active, this insect jumps and flies away on the slightest disturbance. For a more complete description of thrips, see Insects affecting the Onion.

Celery-looper or Plusia (*Plusia simplex*).

Closely related to the cabbage-looper is the celery-looper. The naked, green larva is marked by eight white lines. The moth closely resembles

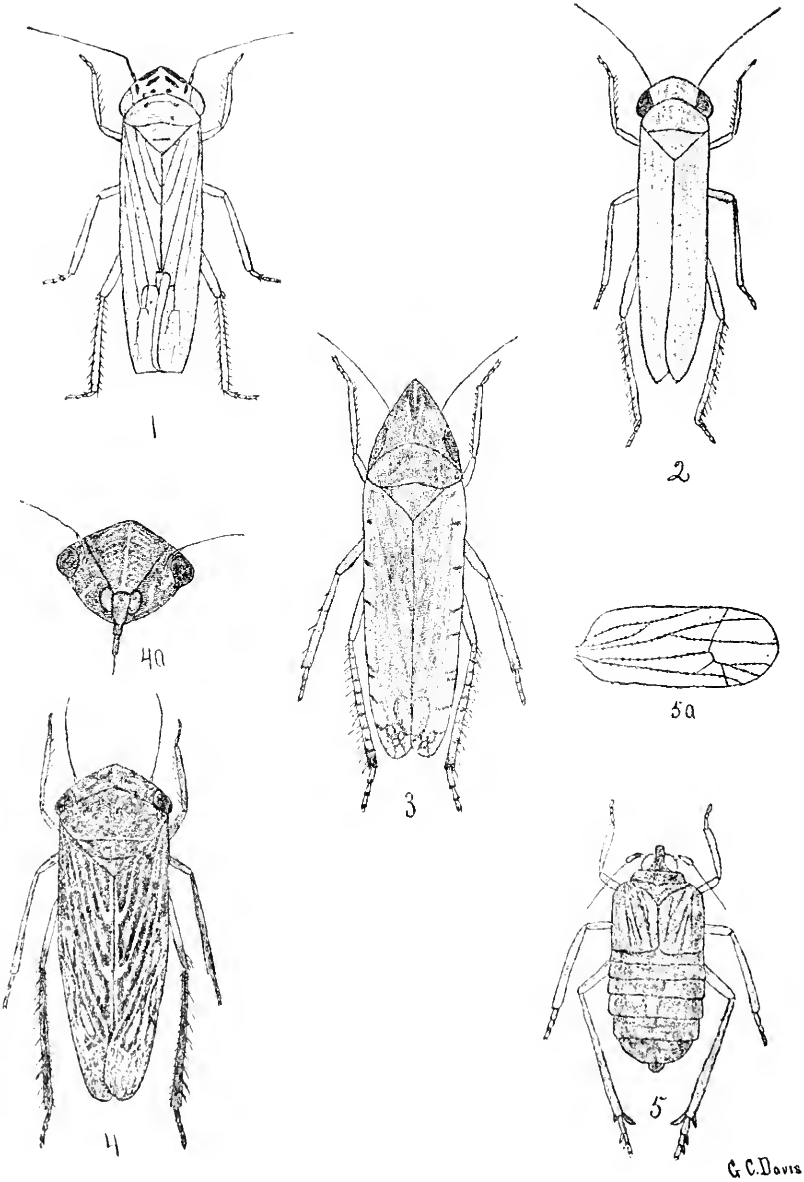


Plate 1.—Celery leaf-hoppers. 1, *Cicadula; 4—lineata;* 2, *Empoasca mali;* 3, *Platymetopius acutus;* 4, *Athysanus instabilis;* 5, *Megamelus picus*, all enlarged ten times. (After G. C. Davis.)

the cabbage-looper except that the fore-wings are marked with grey and seal-brown. The silver mark is hook-shaped, and the hind-wings are marked with a dark wash. See also cabbage-looper.

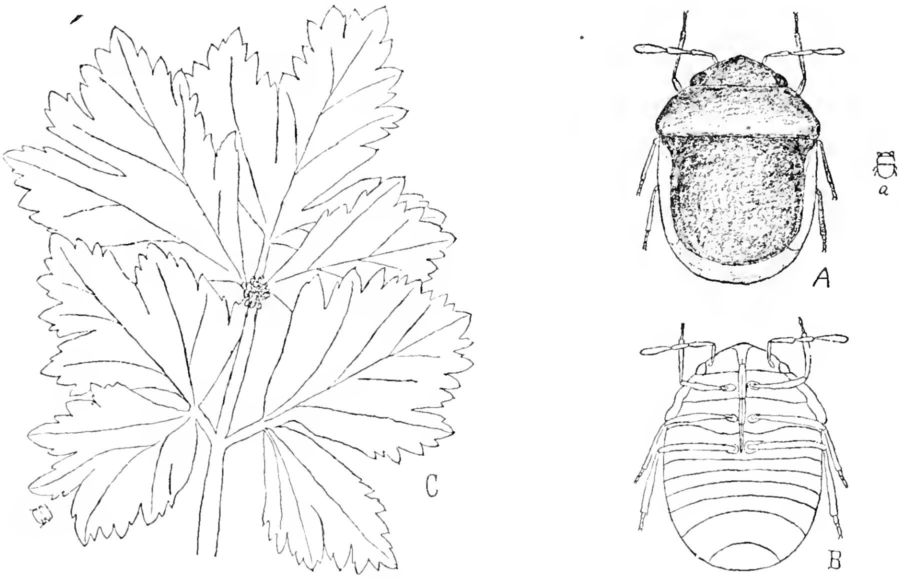


Fig. 26.—Little negro bug. A, upper side; B, under side, enlarged; C, leaf showing bugs at work (After G. C. Davis.)

REMEDIES.

Of course poisons should not be used, but Pyrethrum and water, applied with an atomizer, should answer all requirements. Apply as when used against the cabbage-worm.

Sulphur-colored Tortrix (*Dichelia sulfureana*).

Mention is made of this little moth in Bul. 102 of this station by Mr. G. C. Davis, formerly consulting entomogist of this station. Mr. Davis says in part: "There are at least two broods and probably three. The larvae are light green all except the tips of their mandibles, labrum, and front feet which are black, and the head and thorax which are lighter, almost a flesh color. They live in leaves drawn together by a web which they spin and feed on the adjoining leaves. They pupate in the same leaves in which they live. The little moths are bright sulphur-yellow with a net-work of small red lines and larger reddish-brown bands on the primary wings. The hind-wings are dusky. The band on the front-wings varies considerably."

REMEDIES.

Clear up all refuse material and burn in the fall. A spray of Pyrethrum-water should kill many if applied forcibly enough to penetrate into the rolls of leaves.

Celery Tortrix (*Sericoris bipartitana*).

Mr. Davis mentions this species as feeding on the leaves of celery. A gallery is made by drawing several leaves together. The larvae are said by Mr. Davis, to be small, slender, and quite active; dark, greasy brown in color, with a black shield on the thorax, and the legs and plate on the anal segment black. There are four shining dots on the upper part of each segment forming a square. The adult moth is black and white with dark posterior wings and light abdomen. The same remedies should apply as in the case of the sulphur-colored Tortrix, should there be sufficient need.

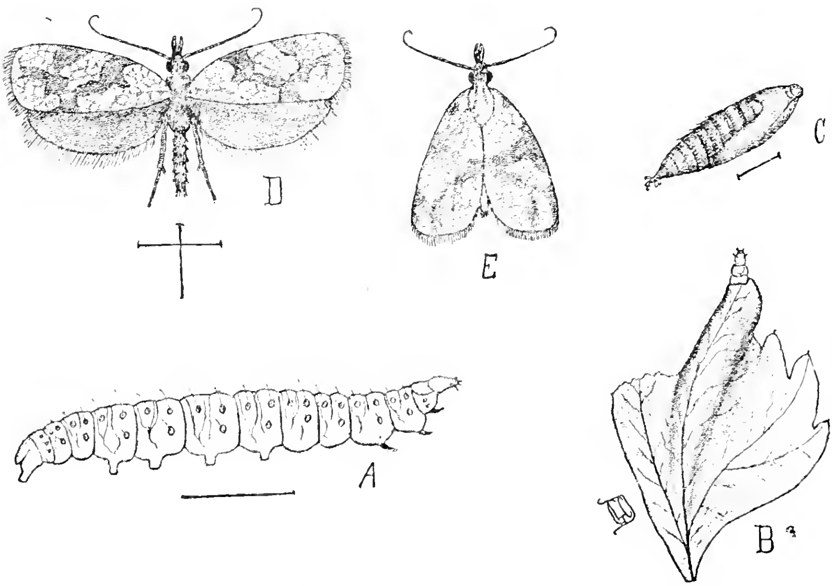


Fig. 27.—Sulphur colored tortrix, enlarged. After G. C. Davis.

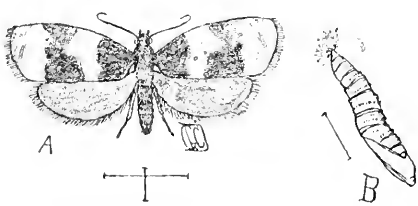


Fig. 28.—Celery tortrix, enlarged three times. A, adult; B, pupa. (After G. C. Davis.)

Celery Borer (*Phlyctaenia ferrugalis*).

In Bulletin 102 of this station, Mr. G. C. Davis describes the celery borer. This insect is said to bore into the crown and to feed on the leaves. The larva is described as being greenish, translucent and about one inch long. The pupal stage is passed in a cocoon or web among the leaves. Mr. Davis describes the insect as follows: "The full-grown larva is nearly an inch in length. Head and thoracic shield drab, with black markings as shown in the drawing. Along the body is a dark-green dorsal line on each side of which is a very faint almost obscure, dull white line merging to a translucent greenish and bordered by another dull white line. On each side is a very obscure yellowish-green line. There is a distinct caudal shield of white and dark-green. The caterpillar is sparsely covered with hairs. The moth is reddish-brown on the front-wings and greyish-brown on the hind-wings. Both have the faint markings shown in the drawing."

REMEDIAL.

As this insect is rather uncommon and as celery is not a fit plant on which to use the arsenties, it will be best to rely on hand picking.

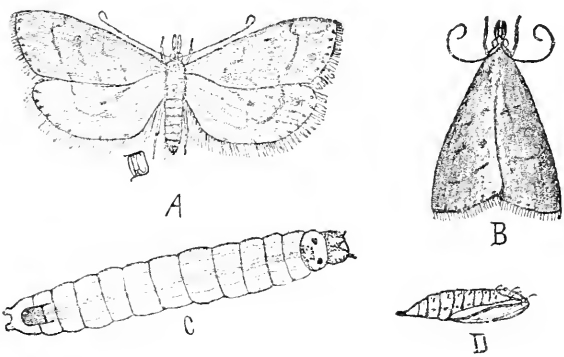


Fig. 29.—Celery-borer, twice natural size, after G. C. Davis.

Cut-worms (*Agrotis c-nigrum* et al.) (see Insects Affecting Sweet-corn).

Zebra Caterpillar (*Mamestra picta.*)

For an account of this insect see Insects affecting the Beet. Of course remedies that are used against this insect on beets, would be somewhat dangerous on celery. Hand-picking will ordinarily suffice, and when they are very plentiful, use a spray of one of the non-poisonous emulsions.

The Parsley Caterpillar (*Papilio polyxenes*).

A common caterpillar on celery, fennel, parsnip, carrot, caraway, etc., is the larva of the black swallow-tail butterfly known in the larval stage as the parsley caterpillar. This conspicuous, naked "worm" is nearly two inches long, green in color, with transverse black bands and spotted with yellow. When disturbed, the larva protrudes a Y-shaped yellow horn, from which emanates a sickening odor, presumably distateful to birds and other enemies. In the pupal stage, the insect is naked and fastened either to the plant itself or to some adjacent object. The butterfly that comes from the pupa, and which is the parent of the larva, is black, measuring when the wings are outspread, from two to three inches across. The outer margins of the wings are crossed by two rows of yellow spots. At the hind angle of each hind-wing is an orange spot with a black center. There are many irridescent blue scales near the outer margins of the hind-wings.

REMEDIES.

Hand-picking usually will suffice if the "worms" are on celery, but one of the emulsions should work to perfection, in case they ever become numerous.

Celery Flea-beetles (*Longitarsus melanurus, Crepidodera cucumeris Chaetocnema parcipunctata*).

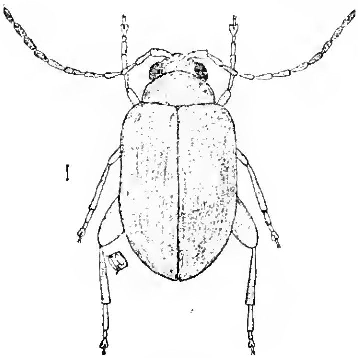


Fig. 30.—Celery flea-beetle (*Longitarsus melanurus*), enlarged. (After G. C. Davis.)

Several species of flea-beetles are known to be partial to celery, the three mentioned by Mr. Davis, are given above. These little creatures do the most harm when the plants are very young. At such times, a spray of bordeaux should act as a repellant if we may judge from its effects in the case of the flea-beetle on potato and others. A spray of tobacco decoction is said to be efficient. Tobacco dust should also prove of some use.

INSECTS AFFECTING THE CUCUMBER.

INSECTS WORKING ON THE FOLIAGE.

Melon-louse on Cucumber (*Aphis gossipii*).

At all times after cucumbers commence to "run" they are subject to attack by a plant-louse. The insect is blackish-green in color and both winged and wingless forms occur. They multiply so rapidly as almost to cover the under sides of the leaves in a short time. Ordinarily in large fields, the attack commences in certain small, well-defined areas, from which the trouble spreads rapidly in ever widening circles rendered conspicuous by the curled and discolored leaves. The source of the pests was for some time a mystery, but Mr. Theodore Pergande, of our National Bureau of Entomology, throws a great deal of light on the subject* when he explains that the same insect feeds also on cotton, orange, melons, strawberry as well as on a long list of our common weeds. In the light of this information, it is easy to see how the pest is kept alive until opportunity to attack melons and cucumbers offers itself.

TREATMENT.

The fact that the pests work almost entirely on the undersides of the leaves, where it is difficult to apply sprays, makes them very serious

* "Insect Life," vol. VII, p. 309.

pests to combat. The writer has made an effort to select a spray that will kill the greatest number of those hit, trusting to the operator to hit as many as possible and to repeat the application when necessary. Others have found it practical to place a low tent over the plants, and to fumigate with burning tobacco stems and other agents. Such fumigation has given partial success, but seemingly is little, if at all, superior to the sprays. The cost of fumigation is unquestionably greater. The spray that gave the best results with us was whale-oil soap kerosene-emulsion, with Pyrethrum added. (See directions for preparing insecticides.) This was diluted ten times. We succeeded in killing about 99 per cent of the lice, in one trial, doubtless all that were hit. In order to apply this spray with sufficient thoroughness, a knapsack pump was used. This was fitted with a short extension, about three feet long with a Vermorel nozzle set at right angles to the extension, making it easy to apply the spray sidewise and upward from beneath.

As stated, the lice usually start from one or two vines in a field. Careful watching will reveal these centers of infestation and prompt treatment should check their spread in the beginning. Of course it will be necessary to repeat the spray as often as the lice appear. As in the case of the lice on cherry, the difficulty lies in reaching the lice and not in making a spray that will prove effective.

Squash-bug (*Anasa tristis*).

Everyone knows the large black stink-bug or squash-bug of the garden and field. All of us have tried to kill it by sprays, dust-baths and what not, but still the stink-bug flourishes. There seems to be no wash or powder that will kill the bug without at the same time, killing the plants.

The eggs of these marauders are red in color, and quite large, they are laid in patches on the leaves, for the most part, on the underside. The young bugs that come from these eggs resemble the adults very much except in their proportions and in size, although of course they lack the wings. Not only do the bugs attack the vines, piercing them with their long beaks, and extracting the sap, which alone is enough to seriously injure the plants, but, at the same time, they carry the germs of disease from one plant to another, thus inoculating healthy plants with the wilt, and possibly with other diseases.

REMEDIAL.

Plants grown under mosquito-netting of course escape the bugs, but such a measure is very expensive except in unusual cases.

Clean culture.—In the autumn after the crop is secured, the bugs continue to feed on the old vines for some time before the vines dry up and die. The writer has collected large numbers in such situations. Young bugs, old bugs, and bugs half-grown. It is these young and vigorous bugs that hibernate and start new generations in the spring. The remedy is obvious—destroy all old vines, squash, pumpkin, cucumber and all vines of that family, just as soon as they have served their purpose, either plow or burn, and do it *then*.

On cool nights, the bugs love to hide under shelters. Old shingles, placed on the ground near the vines, harbor dozens of the adults over night. The lesson is obvious,—put out pieces of board and shingles and destroy the bugs early in the morning before they get to the vines. Jar the bugs off into pails of water having a little kerosene floating on it.

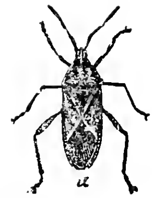


Fig 31.
Squash-bug.

Cucumber-beetle (*Diabrotica vittata*).

The cucumber-beetle, often known as the striped cucumber-beetle, is a small yellow and black creature a little over one-eighth of an inch in length, which feeds on cucumber, melon, squash, and all vines of this family, besides a host of other plants, including sugar beets. It is straw colored with three longitudinal black stripes.

Every owner of a garden is familiar with the little pests that come in great numbers just as the plants come up, eating holes in the young plants and often killing them before they even get a start. Furthermore the beetles lay their eggs on the stems just under the soil and the larvae or grubs that hatch from them, tunnel their ways through the roots, often killing the plants that escape the winged beetles.

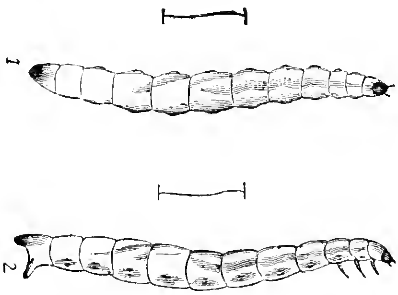


Fig. 32.—Cucumber beetle larvae, enlarged. (After Riley, Second Mo. Rep.)

REMEDIES.

Many growers start their plants in berry boxes under cover, and set them out in the field, after the vines commence to run. This helps out a good deal but does not entirely control the pests. Paris-green is rather dangerous and is apt to kill the vines, and their rapid growth makes it necessary to apply very often, causing the poison to accumulate on the older leaves, thus seriously endangering them. For this reason, it is

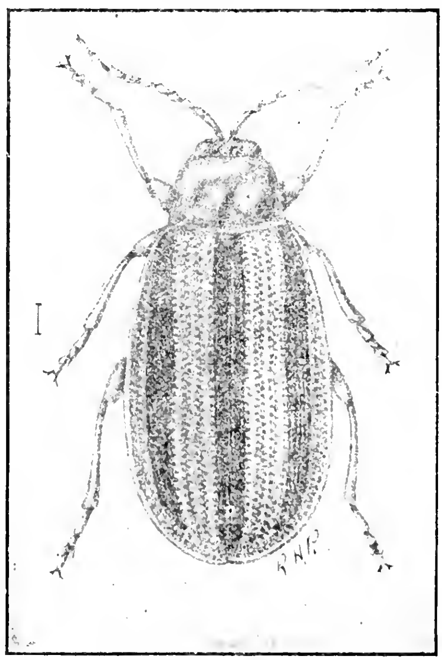


Fig. 33.—Cucumber-beetle, enlarged. (Author's Illustration.)

best to dust with something beside arsenicals. The writer has used dry-slaked lime and sulphur for many years and with very good results. Slake the lime dry (air-slaked lime is not as good, for it is not so caustic in its effects). See directions on page 66. Mix one pound of flowers of sulphur with every three pounds of dry-slaked lime and dust on through coarse cloth. Three or four thicknesses of mosquito-netting works better than anything else. Dust on liberally and repeat as the vines grow or rain washes off the old coating. The beetles detest the mixture and if the plants are kept covered, their work will be comparatively insignificant. Weekly applications are usually enough.

Tobacco-dust, or finely ground tobacco thrown about the roots, works very nicely. The writer uses half a handful to a plant. It can be obtained at from one to two cents a pound from the large tobacco factories in the South or from their representatives in the cities. Tobacco-dust is a valuable fertilizer besides killing many insects. By combining these two practices one should be able to raise good crops of cucumbers in spite of the beetles. As the beetles hibernate as adults, clean culture will exert a marked beneficial influence. Plow up the fields just as soon as the crop is gathered.

Cucumber Flea-beetle (see Potato Flea-beetle).

INSECTS AFFECTING THE HOP.

INSECTS AFFECTING THE FOLIAGE.

Hop Merchant (*Polygonia comma*).

The spiny caterpillar of the hop-merchant is known to all hop growers. After a time, these caterpillars change to the naked pupae which are marked with golden or silver spots. From these pupae come the adults, very pretty butterflies of a general brownish color, marked with darker brown and slate. On the underside of each hind-wing is a silver mark, shaped like a comma, from which the insect takes its latin name. The eggs are laid in strings on the leaves. Besides hops, the caterpillars feed on elm and nettle.

REMEDIES.

The only remedies are hand picking and spraying with arsenical poisons early in the season. After the hops form, no sprays should be applied because of danger from poisoning.

The Violet-tip (*Polygonia interrogationis*).

The violet-tip closely resembles the hop-merchant. It is, however, larger and the greys on the wings are apt to take on a more purplish tint. Each hind-wing is marked with a silver spot something like an interrogation mark. The larvae feed on nettle, elm and hackberry as well as on the hop.

REMEDIES.

The treatment is the same as that for the hop-merchant.

Hop-louse (*Phorodon humuli*).

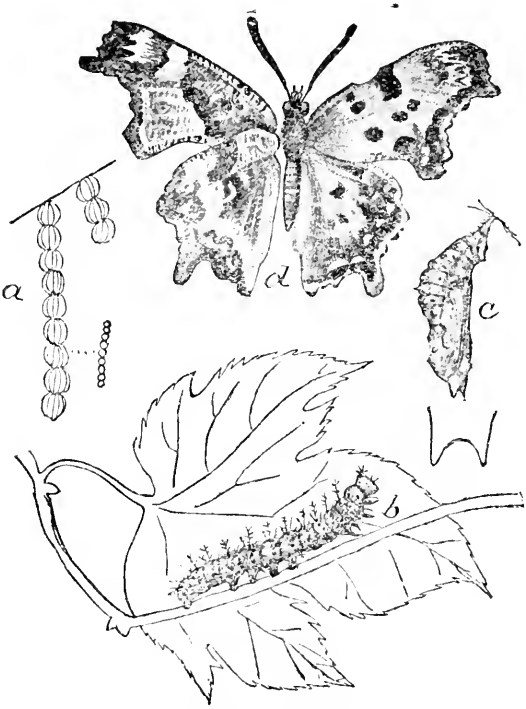


Fig. 34.—Hop-merchant, after Dr. L. O. Howard, Bul No 7, N Ser. Bureau of Entomology, U. S. Dept. of Agriculture.

Such a fragile creature as an aphid can hardly hope to pass the winter successfully on such a plant as the hop which is spread on the ground during the cold season. For this reason, a curious habit has been developed. Late in the season, winged sexual forms are developed from the non-sexual form of the lice that have been feeding on the hop all summer, and these sexual forms lay their eggs on the plum trees, where the eggs are in good high situations, safe for the winter except from birds and other enemies. In the spring, wingless forms are produced at first, and from these, winged females which migrate to the hop to become the parents of the myriads of lice which later appear.

REMEDIES.

The lesson to be learned from this life-history is very easy to see. Avoid having plum trees, either cultivated or wild, near the hop yards. If it is impossible to do this, then spray the plums with kerosene-emulsion, or tobacco-water just as soon as the eggs hatch, and spray with extreme care so as to hit as many of the lice as possible, before they migrate to the hops.

It will be necessary, in many cases, to spray the hops themselves, especially the vines on which the lice first appear, and which serve as centers of infestation for the rest of the field.

Kale (see Insects Affecting Cabbage).

INSECTS AFFECTING THE MELON.

INSECTS AFFECTING THE FOLIAGE.

Melon caterpillar (*Eudioptis hyalinata*).

An insect rather unusual in Michigan but more common south of us, is the melon caterpillar. The larva is said to be a little over an inch long, of a greenish-yellow color, and to be clothed with a few scattering hairs. They feed on both the leaves and fruit of plants belonging to the melon family, spinning their cocoons in folds in the leaves. The adults are among the most beautiful of our moths. They measure about an inch across the extended wings and are silvery white except for a border around the front and lateral margins of the wings which is black, the end of the abdomen ending in a buff tip, with black and white markings.

REMEDIES.

The best remedy for this worm will probably prove to be hellebore, a substance that should not injure the delicate foliage of the melon.

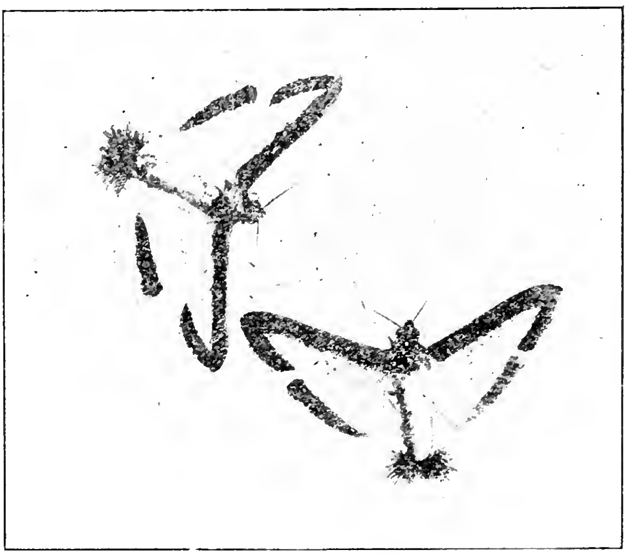


Fig. 35.—Adult moths of melon caterpillar, slightly enlarged. Original.

Melon-louse (see Insects Affecting the Cucumber).
Pale Striped Flea-beetle (see Insects Affecting the Beet).
Striped Cucumber-beetle (see Insects Affecting the Cucumber).
Cucumber Flea-beetle (see Insects Affecting the Potato).
Squash-vine Borer (see Insects Affecting the Squash).

INSECTS AFFECTING THE ONION.

INSECTS AFFECTING THE BULBS.

Onion-maggot (*Pegomya cepetorum*).

Besides the barred-winged onion-maggot, we have ranging from the Upper Peninsula to Indiana, the common onion-maggot, so well known and so much dreaded. This maggot is the offspring of a small fly very much like the house-fly in appearance, except for size, being only about half as large as the house-fly. It is a near relative of the cabbage-maggot and the work of the two is very similar. Unfortunately, some

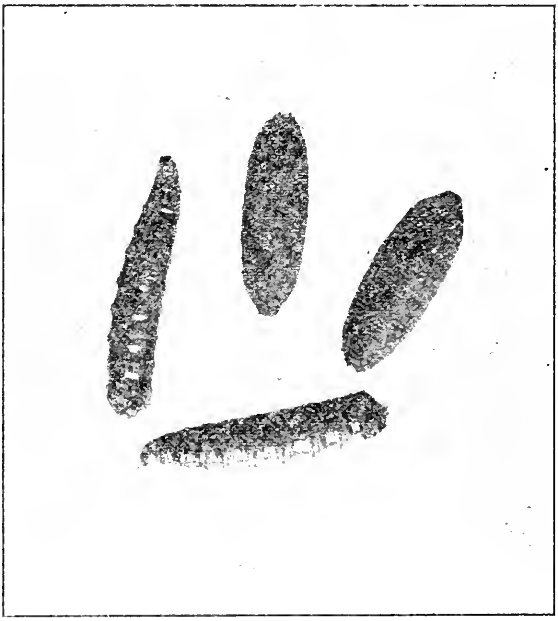


Fig. 36.—Onion-maggot, larvae and pupae, enlarged. Original.

of these onion-maggots pass the winter in the pupal stage and some as adults hidden away in sheltered places. This fact complicates matters somewhat for it necessitates methods of control other than that of merely destroying the pupae by fall plowing.

The eggs are laid on the young plants early in the spring, and the young maggots appear in a short time. When full grown, they go into the soil, change to pupae and later give forth the adult flies. These lay the eggs for succeeding generations, several of which are produced during the season. In the latter part of the season, the onions are each large enough to harbor a number of maggots, and the infested bulbs which are not killed outright, usually rot after harvest.

Fig. 37.—Onion-maggot, adult fly, enlarged. Original.

REMEDIAL.

The remedial measures consist in repelling the adult flies that come to lay their eggs and in stimulating the young plants to very vigorous growth by means of commercial fertilizers and cultivation. Pull out and destroy the young plants as soon as they show the presence of the pests, and do everything possible to stimulate the plants to rapid growth. The best repellant thus far discovered is carbolic-acid emulsion, diluted thirty times, and applied with a sprinkler. The formula for this is given in the directions for making insecticides. It will be necessary to repeat the application at intervals of about a week, but good work early in the season is sure to count in reducing the numbers of the flies later on.

Barred-winged Onion-maggot (*Chaetopsis aenea*).

Once a deceiver, always distrusted, applies to this dainty and really very pretty little fly. The adults of this insect are commonly seen sitting on corn or reed grass, sunning themselves and darting about, apparently for sheer enjoyment. From time to time, however, disquieting rumors have come in; accusations of transgressions in the wheat and oat fields, in the corn and the sugar-cane. Such reports naturally undermine the standing of our fraud, and it only remained for the accused to attack the onion crop in 1901, to prove his double dealing and to set the hand of man against him, at least in the regions of the rich muck land in the south-central part of the State where such quantities of onion seed are raised. On this occasion hundreds of bushels of onions were destroyed, rotted after harvest or were so wormy at harvest time that they were worthless. Since that time the pest has been so circumspect that we are able to prove nothing against it, although the rearing of adults from a large enough lot of samples, would likely bring some of the flies to light.

The flies themselves are about three-sixteenths of an inch in length and, with the wings at rest, about one-fourth of an inch from the front of the head to the tips of the wings. In color, the back is metallic blue-green except the head which is mostly hoary, with brownish-black eyes. The wings are transversely crossed by three smoky bands, the outer two coalescing at each end.

In our cages, the winter was passed in the onions, the maggots changing to pupae in the autumn, and the flies emerging early in the spring.

REMEDIES.

The fact that the insects pass the winter in the bulb, at once suggests the first measure to be taken. *Destroy all injured onions in the fall.* All young and growing onions should be pulled up and destroyed as soon as they show signs of infestation, and liberal applications of commercial fertilizers should be applied to stimulate rapid growth, for maggots always prefer slow-growing and sickly plants to vigorous ones.

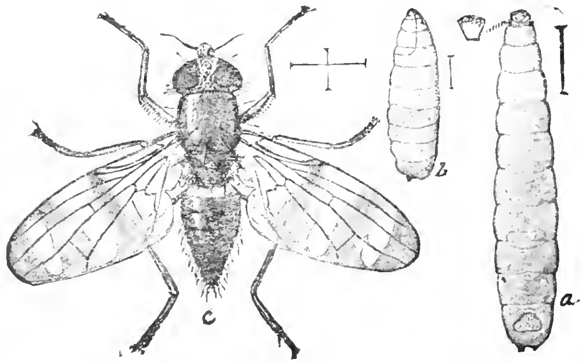


Fig. 38.—Barred-winged onion maggot, enlarged. (From Riley and Howard, Insect Life, U. S. Dept. of Agr., Bureau of Ent.)

Apply carbolic-acid emulsion diluted thirty times, along the rows as soon as the plants get nicely above ground. This has shown the best results and is highly recommended by Professor M. V. Slingerland against the common maggots. Repeat at intervals of about a week, as long as there is danger, and practice rotation on general principles. Commence early, just as soon as the first young onions show the presence of the maggots.

INSECTS AFFECTING THE TOPS.

Onion Thrips (*Thrips tabaci*).

Tiniest of all the insects mentioned in this paper, is the onion thrips. A little larger than a printed period and very active, it is so small and quick in its movements, that it is usually overlooked. The injury is brought about by the great numbers that collect on the plants. On the onion, the thrips prefer the axillary portion of the plant, where two leaves join. They scrape the soft material off the leaves, giving them a grey or hoary appearance, sometimes noticeable at quite a distance. The leaves or tops decay if the weather turns wet and the keeping qualities of the bulbs are impaired.

The immature insects are usually more abundant than the adults, they are about one-twenty-fourth of an inch in size, and yellowish-green in color. See fig. 39. The body is long and slender, with six legs and six-jointed antennae. The feet, like those of all true thrips are destitute of claws. The adult is shown in fig. 39, at rest with the wings closed, as that is the position in which it is most often seen. The general color is dirty yellow with dusky markings. The antennae are seven-jointed in the adult. The extremely narrow wings are fringed with long hairs giving them a feathery appearance. The time required for each generation is said to be about six days in the South. Here in Michigan, more time will, no doubt, be required, at any rate, a number of broods are developed each year.

An extended account of this pest is given by Mr. Theo. Pergande of the U. S. Department of Agriculture, Bureau of Entomology, in "Insect Life," Vol. VII., pp. 392-5.

REMEDIES.

Thrips feed by scraping minute particles off from the soft parts of plants, but as far as their control is concerned, they may be classed with the sucking insects, and we must resort to contact insecticides to kill

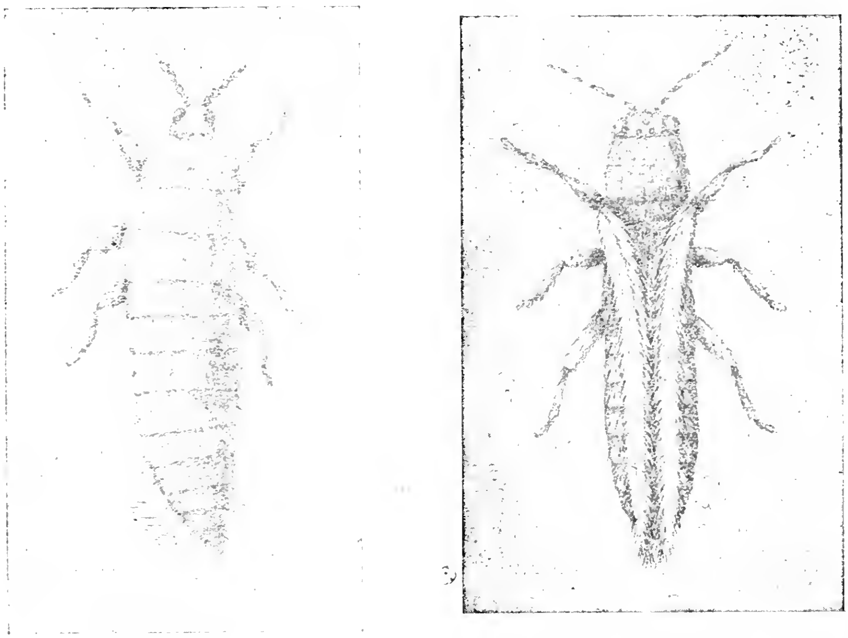


Fig. 39.—Onion Thrips, mature insect at left, and immature at right, greatly enlarged. (Author's illustration.)

them. Kerosene-emulsion, used at the rate of one part of the emulsion to ten of water will kill them. Tobacco water should also prove effective. Drenchings of cold water are said to be useful when practical, for thrips thrive best in a dry, warm atmosphere.

Cut-worms (see Insects Affecting Corn).

INSECTS AFFECTING THE PARSNIP.

INSECTS AFFECTING THE STEMS AND SEED-CLUSTERS.

Parsnip Borer (*Depressaria heracliana*).

At long intervals, we hear complaints from the growers of parsnip seed, of a "worm" that spins webs about the flower-heads, feeding therein, and later boring into the hollow stalk. When this insect

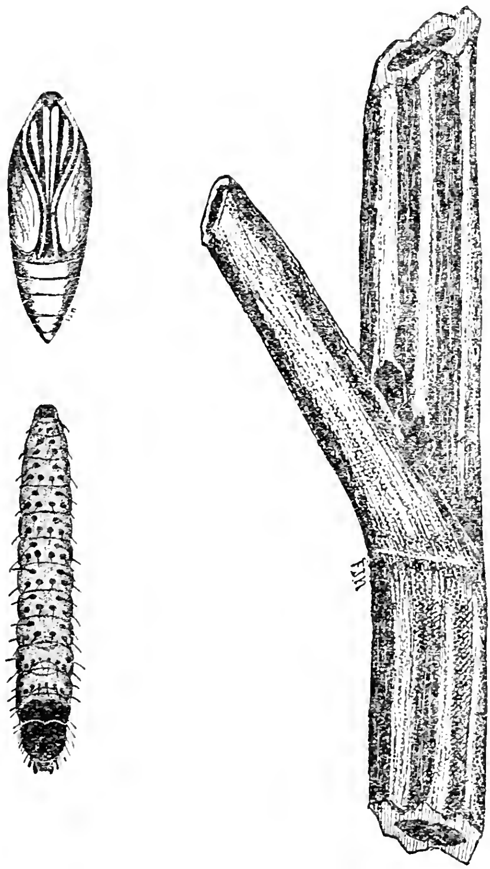


Fig. 40.—Parsnip borer. Pupa, larva and tunnel in seed stalk. (After G. C. Davis.)

appears at all, usually it is in goodly numbers, and the destruction wrought is pretty complete. Such ravages point to the presence of the parsnip-seed moth, also called the stem-borer. The larvae or caterpillars of this moth enclose the large umbels or flower-heads in webs. Such larvae are about three-fifths of an inch long, yellowish or greenish-yellow in color, with many small, black points on the body. Each point bears a short hair. The head, prothoracic shield and true legs are black. When nearly full-grown, the caterpillar descends to the axil or fork where a leaf is given off, and bores into the stem, where it changes to a brown pupa a little less than half an inch in length, from which the adult miller or moth appears in July. This moth is brownish-grey in color, with minute markings of black. It measures nearly an inch and one-quarter from tip to tip of the expanded wings.

REMEDIES.

When the larvae first appear, a spray of paris-green and lime, applied at the rate of one pound of the poison to two hundred gallons of water will kill them. If the application is delayed until the flower-heads are enclosed by the webs, then it will be almost impossible to reach their food with the spray. It will readily be seen that the spray must be put on early so that the "worms" will have only poisoned flowers and seeds to work on. Later after the larvae have bored into the stems, the knife is the only remedy. Cut out and burn the affected parts.

INSECTS AFFECTING THE FOLIAGE.

Parsley butterfly (*Papilio polyxenes*).

One of our most striking caterpillars is the parsley caterpillar which feeds on parsley, parsnip, caraway and other plants of the same family.

In color it is greenish, with transverse, velvety-black stripes many of which are decorated with yellow spots. This is the caterpillar that thrusts out a pair of orange colored horns from just behind the head when disturbed. The sickening odor from these horns serves to protect the caterpillar from many predatory enemies, and often from man. When full-grown, the caterpillar seeks some more or less secluded place and changes to an angular, naked, pupa, from which later emerges a

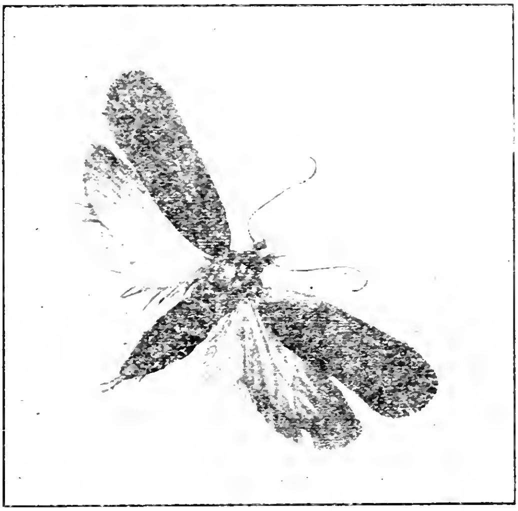


Fig. 41.—Parsnip-borer, enlarged. Original.

beautiful black butterfly having both front and hind-wings marked by two rows of yellow spots, the hind-wings each bearing a short tail. There is also a little blue on the hind-wings and an orange and black eye-spot at the inner angle.

REMEDIES.

In the case of such a conspicuous caterpillar, hand picking is all that is required.

INSECTS INJURIOUS TO PEAS.

INSECTS AFFECTING THE FOLIAGE.

Green Pea-louse (*Nectarophora pisi*).

The green pea-louse is a small aphid or plant-louse, that feeds on a variety of plants, notably clover, sherpherd's purse, the vetches, crimson clover and pea. The clovers, vetches, etc., usually sustain a moderate number of these lice, and it was not until the lice appeared in very great numbers on green peas, that attention was attracted to this insect as a first class pest. As the name implies, the insect under discussion is an aphid or plant-louse of a bright green color. It is of good size, some being winged and some wingless. The winter is passed on clover, preferably crimson-clover, and the winged females migrate to the peas early in the spring. Here they multiply, sometimes to an amazing degree. The loss from a bad invasion of this insect has been as much as half the crop, further south.

REMEDIES.

The methods of combating this insect in other states are two in number—first, the brush and cultivator method, recommended by Prof. W. G. Johnson, formerly State Entomologist of Maryland. When this is used the peas are sown in rows from 24 to 30 inches apart, instead of in drills as is ordinarily done. When the peas become infested and at intervals as required, the lice are brushed in between the rows from the vines and covered by a cultivator before they can get back on the vines. In order to do this, two boys walk in the open spaces between the rows. leaving one space between them, into this middle space they brush the lice with brooms made of fresh-cut pine branches. Just behind them in the middle space follows the cultivator, which buries the lice. If a hot day be selected a large proportion of the lice will be killed.

The other method is that of spraying. Prof. Sanderson, of the Delaware Station, describes* in detail the apparatus used by Messrs. Brakeley of Bordentown, N. J. The machine described sprays four rows at once, and has a device for lifting the vines and spraying from underneath as well as from above. Whale-oil soap is the killing agent used. It is dissolved in water at the rate of one pound of soap to six gallons of water. In hogshead lots, whale-oil soap can be obtained for three to five cents per pound, making the mixture cost less than one cent a gallon.

Experience has shown that this louse works worse on late peas than on early ones. In some places it has been found profitable to select early varieties for growing so far as possible. While the method of growing peas in rows is apt to cut down the yield in bushels, it allows of cultivation, which has many advantages when quality is an object.

Another item that must not be overlooked is the benefit derived from careful fertilizing. It is a general principle that a crop will withstand attacks by insects much better if in a vigorous, healthy condition. The sap does not seem to agree nearly so well with the insect constitution when the plant is strong as it does under other conditions. Especially is this true with plant-lice and scale-insects. Therefore fertilize well, cultivate well and be prepared to fight on the first appearance of the lice.

INSECTS AFFECTING THE SEEDS.

Pea-weevil (*Bruchus pisorum*).

Buggy peas, like buggy beans, are seeds scooped out by small beetles. The beetles working on these two plants being closely related, but quite distinct in their habits. The pea-weevil is larger than its relative of the bean, and what is more important, the pea-weevils do not continue

* Twelfth Annual Report Delaware College Agr. Exp. Sta. for 1900, p. 175.

to breed in the dried peas after they are gathered, as do those of the bean, but work singly in the seed while the pea is yet green. The eggs are pushed through inside the pod by the mother beetle. For this reason it is possible to control the pest by saving the seed over for two years, providing, of course, against the escape of the adult beetles when they come out of the seed. Under these conditions, all the beetles come out during the first summer, hence the seed will be free by the following summer. Such a course has its disadvantages because of the deterioration in the seed and usually it is found better to fumigate buggy seed with carbon bisulphide during a warm spell. Always select a warm time for this work as the beetles are more active and therefore more susceptible to the gas.

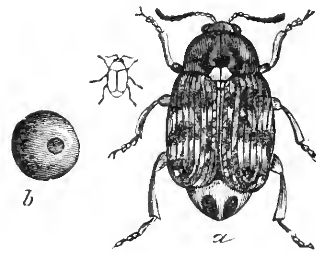


Fig. 42.-Pea-weevil, enlarged, and pea, showing work of beetle. (After Riley, Third Mo. Rep.)

INSECTS AFFECTING THE POTATO.

INSECTS AFFECTING THE TUBERS.

Fig. 43.—Mole-crickets. (Original)

Mole Cricket (*Gryllotalpa borealis*).

The northern location of our State is responsible for our escaping many of the bad pests of warmer regions. Many insects that are first class pests in the South do merely nominal injury here. It would be strange indeed if some of these advantages were not partially offset by a few distinctly northern forms. Such an enemy we have in the mole-cricket. We can hardly call this a serious pest, since its attacks are only occasional and for the most part, limited to damp, mucky soils. The mole-cricket is a large, burrowing insect, having its front feet fitted for rapid digging very much like those of the common mole. Like the mole, this cricket lives underground, from time to time appearing in large numbers. Nothing pleases the mole-cricket more than to have potatoes planted in his domain. The tubers are tunneled through and through, the blackened cavities sometimes leaving little more than a shell outside.

Fig. 44.—Work of mole cricket in potato. (Original.)

REMEDIES.

Owing to the fact that these crickets are so irregular in their habits, it has been difficult to carry on successful experiments with them. In Europe, pits are dug in the soil and filled with horse-manure. The pits are said to attract the pests by their warmth, and to shelter them during the late fall. On the outside are placed poisoned vegetables such as potatoes. It would seem that small pits filled with the tunneled tubers soaked in arsenic-water, to which has been added a little salt, should prove efficient. Of course it is well to avoid planting potatoes in ground stocked with the crickets.

Wire-worms (see Insects affecting Sweet-corn).

INSECTS AFFECTING THE TOPS.

Potato Lice.

Several species of plant-lice attack the potato and from time to time we hear from them in Michigan. Little is known regarding their life-histories, further than the fact that they sometimes appear in numbers to the serious detriment of the plants.

REMEDIES.

Some of the contact insecticides, such as kerosene-emulsion, tobacco-water or dilute whale-oil soap, should be applied in the form of a spray, always bearing in mind that such insecticides work by contact and that each insect must be hit to be killed.

Pale Striped Flea-beetle (see Insects affecting the Beet).

Old-fashioned Potato-beetle (*Epicauta vittata*).

Before the advent of the Colorado potato-beetle, the vines used to suffer from the attacks of a striped blister-beetle, now known to the older potato raisers as the old-fashioned potato-beetle. Since the arsenites have come into such general use, this creature has fared badly, many of them being killed unwittingly together with the Colorado beetles. For the life-history and methods of control of this insect, see Insects of the Beet.

Tomato Stalk-borer (see Insects affecting Tomato).

Potato Flea-beetle (*Epitrix cucumeris*).

Besides the Colorado beetle, one often meets the potato flea-beetle, sometimes called the potato-flea. Like most of the flea-beetles, it is a tiny creature which jumps with surprising power and suddenness.

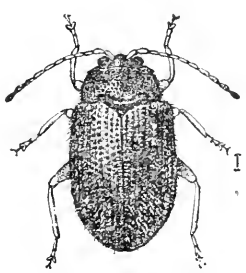


Fig. 45.—Potato flea-beetle, enlarged. After Chittenden, Bul. 19, N. Ser. Bureau of Entomology U. S. Dept. of Agriculture.

These little beetles riddle the leaves of the potato, tomato, egg-plant and other plants with small round holes. The beetles are very small, about one-tenth of an inch in length, and black in color. The larvae are said to tunnel in the roots of various plants and weeds, notably those of the nightshade or potato family, transforming to pupae in the soil and later emerging as adults. There are two or more generations each year, the adults of the last brood passing the winter among fallen leaves and other rubbish.

REMEDIES.

Clean culture destroys the winter quarters of this and many other pests. Rake up and burn all rubbish late in the fall during a cold spell.

Some years ago, Mr. E. G. Lodeman, then of Cornell University Experiment Station, discovered that potatoes sprayed with bordeaux mixture for the blight were avoided by the beetles. This led to some experiments which showed that a number of flea-beetles were repelled by the bordeaux. Use the ordinary mixture, the formula for which is given on another page of this bulletin, and add one-fourth pound of paris-

Fig. 46.—Colorado potato beetle. (After Walsh and Riley, American Entomologist.)

green to each fifty gallons of the mixture. The paris-green kills some of them and incidentally many other chewing insects. The cost of the paris-green is insignificant when compared with that of preparing and applying the bordeaux.

Potato-beetle (*Leptinotarsa 10-lineata*).

Pre-eminent among potato insects stands the Colorado potato-beetle. So familiar is this pest that no description is necessary, either of the yellow and black beetle with the ten longitudinal lines on the back or of the reddish-brown larvae that occur in such numbers on neglected potato plants. Up to the middle of the nineteenth century, this beetle was content to feed on weeds belonging to the potato or nightshade family in Colorado, but as farming progressed westward, the more choice and acceptable Irish potato reached the region inhabited by the beetle. The result was like spreading straw slowly up to a bonfire. When it once started, the spread was most rapid, the beetles invading more and more territory until now we expect to find the beetles wherever we find the potato.

Fig. 47.—Eggs of parasitic fly (*Phorocera doryphorae*), on potato beetle. Author's illustration.)

The life-history of this pest is quite simple,—the eggs are laid in patches on the potato tops, usually on the underside of the leaves, and the larvae feed openly on the foliage until full grown, descending into the soil to change to naked, yellowish or orange colored pupae. After a short time, these pupae transform into the adult beetles which ascend to the surface and feed with the larvae, laying the eggs for another generation, the last generation, for the most part remain in the soil over winter as adults, and come forth in the spring in time to attack the early potatoes just as they come up.

REMEDIES.

The ease with which the potato-beetle responds to the arsenites is so well known that it seems almost superfluous to discuss the question at all. Paris-green, arsenite of lime, Kedzie mixture and others work admirably. Paris-green may be used either as a spray or as a dry powder. The spray has been in favor for many years. It is economical, and when prepared with lime, about as safe as can be desired. It should be applied in rather a stronger mixture than when used for fruits—say one pound to 125 gallons of water or even 100 gallons. Arsenite of lime and Kedzie mixture are both cheaper than paris-green, but white arsenic looks too much like flour and other articles of food to be stored about the house, then too, the work of preparation counterbalances the saving unless the work is done on a very large scale, and in any case special keetles should be provided for boiling. London purple contains more free arsenious acid and is less apt to be uniform in composition than paris-green.

INSECTS AFFECTING THE RADISH.

INSECTS AFFECTING THE ROOTS.

Radish-maggot or Cabbage-maggot (*Phorbia brassicae*).

Everyone that raises radishes, knows of the little maggots that tunnel in the roots. These are the same maggots that work in cabbage roots, being then known as cabbage-maggots. For further information concerning the appearance and life-history of this insect see Insects affecting Cabbage.

REMEDIES.

The best remedy for the maggot when working in radish, seems to be the carbolic-acid emulsion, diluted about thirty times with water. Sprinkle this along the rows of radishes about once a week. The odor drives away many of the flies that come to lay their eggs.

In Canada, they have had some measure of success with cloth covered frames used as a protection. Light frames, three to six feet high, enclosed on all sides with cheese cloth, are placed over the beds. The flies are said to leave such protected plants alone. If this proves successful, it will solve the question in the small kitchen garden at least. In the large market garden it is possible that the expense may eat up the profits.

INSECTS AFFECTING THE FOLIAGE.

Cucumber-beetle (see Insects affecting the Cucumber).

INSECTS AFFECTING RHUBARB.

Tomato Stalk-borer (see Insects affecting Tomato).

Rhubarb Snout-beetle (*Lixus concavus*).

Rhubarb is usually free from insect pests, there is, however, a long, slender snout-beetle, which is to be found early in the spring and late in the fall, resting on the plants. It is dark grey in color and covered with a rust-colored powder that rubs off easily. This beetle is the parent of the white, grub-like borer that tunnels in the leaf and flower-stalks, and the eggs of which are laid in small cavities cut in the tissue of the plant. It is said that the practice of removing the old leaves regularly will take care of the pest, as the borers will in this way be destroyed just as fast as they come, and the new stalks will be found to be free after a little time. The insect also feeds on dock, and for this reason, it is well to destroy all the docks in the vicinity of the rhubarb plants.

INSECTS AFFECTING THE SQUASH.

INSECTS AFFECTING THE ROOTS.

Squash-vine Borer (*Melittia ceto*).

It often happens that squash-vines suddenly wilt, just as they are getting a nice start. This may be due to one of several causes, sometimes a bacterial disease is the cause and sometimes one of the fungus diseases, often, however, one finds on examination that there is a grub-like borer in the hollow stem, and that a tunnel has been gnawed down into the roots. Here the borer dwells, sometimes above and at others below the level of the soil. When full-grown, this grub leaves the tunnel and pupuates nearby in the soil. In the following spring the adult appears. The adult is a very pretty insect belonging to the family of moths known as clear-wings, because the wings of many of its members are partially transparent. The moth of the squash-borer measures about one and one-fourth inches across the extended wings, from tip to tip, the front-wings being green and the hind-wings clear. The body is reddish except for the basal part which is green like the front-wings. The hind-legs each bear a fringe of long hairs. The species is said to be single brooded in this part of the country. Further south it is double-brooded.

REMEDIES.

The remedies for this pest are three in number. The results are most satisfactory when all three are used together.

Trap plants.—Fortunately the borer works in summer-squash as well as in the winter varieties, the summer-squash planted between the rows of winter-squash, will attract the majority of the borers. Later, when they have all become settled in their burrows, the early varieties may be pulled up and burned leaving the later ones free from the borers. Many times it is possible to cut out the larvae by making a longitudinal slit in the vine.

Starting new roots at the joints.—Last, but perhaps best of all, the vines may be induced to put out roots at short intervals by placing a little soil over the joints, thus supplying plenty of food to the vine even after the tap-root has been destroyed. If the plant escapes until it has commenced to run well, it is easy to induce roots to grow by pulling a couple of hoefuls of soil over some of the joints.

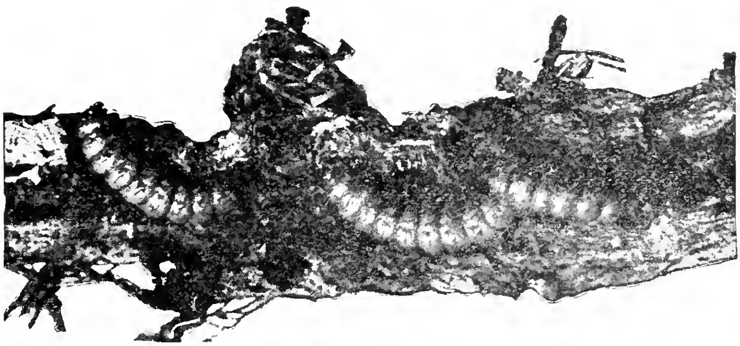


Fig. 48.—Squash-borer larvae in tunneled vine, enlarged. After Prof. J. B. Smith.

INSECTS AFFECTING THE FOLIAGE.

Cucumber-beetle (see Insects of the Cucumber).
Squash-bug (see Insects affecting the Cucumber).

INSECTS AFFECTING SWEET-CORN.*

INSECTS AFFECTING THE SEED IN THE GROUND.

Ground-beetles (*Agonoderus pallipes*).

From time to time, one hears that seed corn refuses to germinate, and whole fields have to be replanted. This usually occurs during a wet cold spring. A careful examination of such seed which has lain in the ground for some time, shows, in some cases at least, the presence of a small beetle in the kernel. Sometimes almost the entire contents of the kernel is found to be gnawed out, leaving a mere shell consisting of the hard, outer coat. This form of injury seems to occur over rather extended areas when it occurs at all. The writer had noticed very few instances before the spring of 1904, when a number of complaints together with specimens of the culprits came in. The beetles that do the injury are elongate, flattened, and of a brownish-yellow color. The

* As the aim of this bulletin is to cover garden and truck crops only, and not those of the field, only such are included as are likely to attack sweet-corn. It is intended to discusss methods such as can be applied satisfactorily on a comparatively small scale.

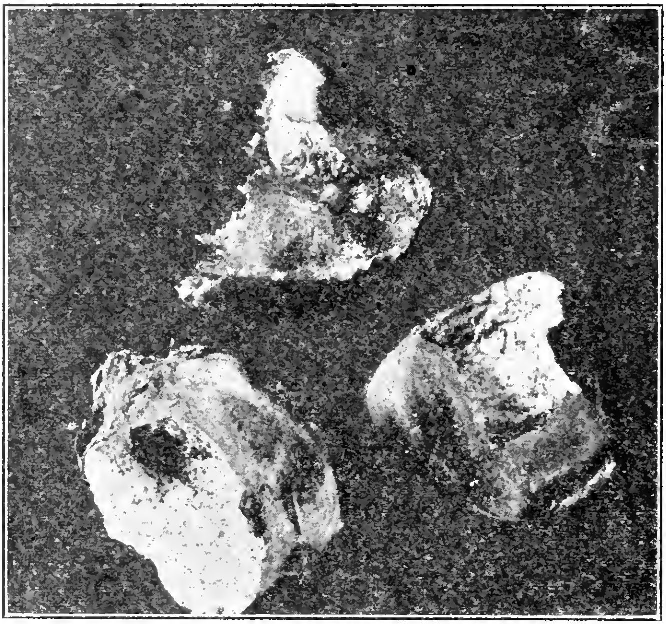


Fig. 49.—Work of ground-beetle (*Agonoderus*), in planted seed-corn, enlarged. Original.

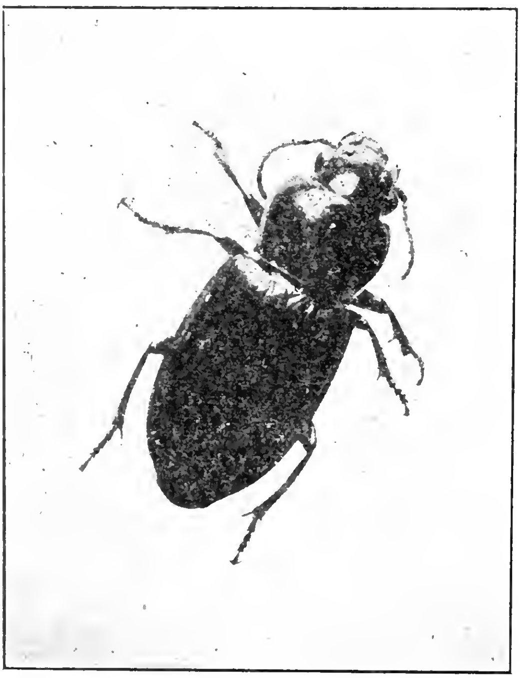


Fig. 50—Ground-beetle (*Pterastichus*), working with *Agonoderus*, in seed-corn, enlarged. Original.

thorax is reddish-brown and the head black, the middle part of each wing-cover being almost black. The legs are brownish-yellow.

This insect belongs to a family known as ground-beetles most of which are predatory in their habits, feeding on other insects and helping materially to keep our foes in bounds. The food of this species ordinarily consists of other insects, mites, etc., but for some reason, possibly because of the temporary scarcity of its customary food, it departed from its every-day habits in the manner described. Several other species of ground-beetles have been sent in with the guilty ones, but although they may have helped to eat the corn, there seems to have been no more serious charge yet proven against them other than that of being in very bad company.

REMEDIES.

Corn soaked before planting, and rolled in poison and dry-slaked lime or paris-green and plaster, should be immune to attacks by such pests.

(*Clivinia impressifrons.*)

This little ground-beetle, about one-fourth of an inch long, was found near Trenton, Mich., feeding on kernels of corn just after they were planted. Like the *Agonoderus,* this little creature belongs to the family of ground-beetles, and ordinarily feeds on living prey. However, in this case, it was doing serious injury, being present in a large proportion of the hills. It has been detected once before in like mischief, by Professor F. M. Webster in Indiana. At that time the trouble occurred about June 11th. The case near Trenton occurred about June 5th. The injury is described by Mr. John Gault, from whom the specimens were received. He says: "The corn is badly eaten and I took one of the beetles out of the small hole at the germ of one kernel. At the rate he was eating his way in, I am sure it would not take many days to destroy the entire germ." In company with the *Clivinia,* were two other species of ground-beetles, which, if not actually found to be partaking at least were open to suspicion. The trouble was found in field-corn but there is no reason to believe that sweet-corn would have escaped.

Fig. 51.—*Clivinia impressifrous,* enlarged. Original.

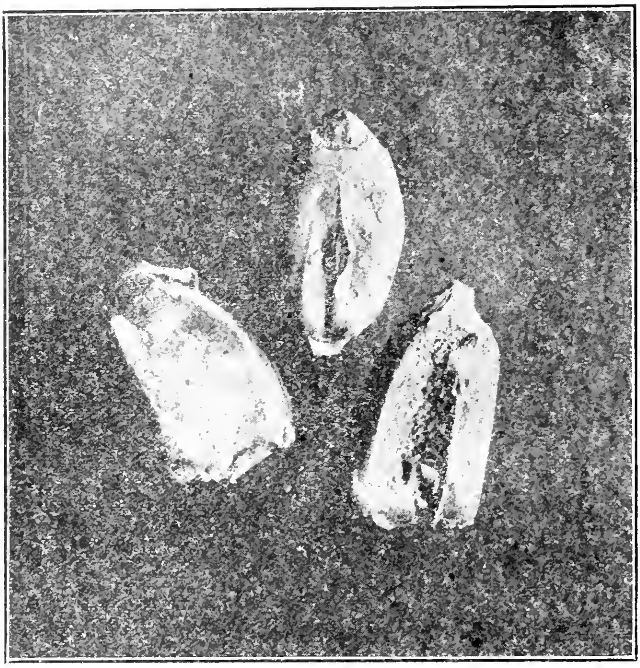


Fig. 52.—Works of *Clivinia impressifrons*, in planted seed-corn, enlarged. Original.

Wire-worms (*Agriotes mancus* et al.).

Low ground and more especially mucky ground, is apt to be infested with wire-worms. These are slender, yellow, little creatures, cylindrical in form, and in size varying from half an inch to more than an inch in length. All have hard, polished skins amounting almost to shells, and six short legs just behind the flattened head, besides a sucker-like false-foot on the last segment. Wire-worms usually feed on the roots of grains, corn and other grasses, though they will not refuse potatoes when occasion offers. There are many species to be found in Michigan, and while one may prefer corn, another wheat, and so on, they may all be considered as injurious, except those found in rotting wood, and treated together as far as we are concerned. The adults are the common snapping-beetles or click-beetles, the little fellows that jump up into the air with a click, when placed on their backs. These beetles lay the eggs from which the wire-worms hatch, and the wire-worms in turn become click-beetles after passing through a chrysalis stage in their little earthen cells in the soil. It is probable that two years are required by the larvae to attain maturity. The winter is passed in little cells in the soil in some cases, while in others the adult beetles emerge in the fall and hibernate.

Wire-worms are primarily insects of grassland and the fact that they require two or three years to develop helps to explain why it is that they are often worse the second year after grass than they are the first, most of them being full-grown at that time.

REMEDIES.

In corn, the most noticeable injury is to the seed after planting, though the larvae also feed on the roots after the corn is up. A long series of experiments by Professors Comstock and Slingerland of Cornell University, failed to show any practicable method of treating the seed so as to prevent injury by wire-worms. They did show, however, that late fall plowing killed many of the pupae and adults by breaking open the earthen cells in which they were. They failed also to kill the wire-worms by any of the commercial fertilizers or insecticides, unless these were used in excessive quantities.*

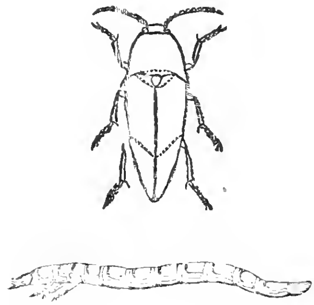


Fig. 53.—Click-beetle, adult of wire-worm and larva, slightly enlarged.

Professor S. A. Forbes, State Entomologist of Illinois, proposes a rotation of crops in which clover shall always follow grass, and corn shall always follow clover. Plow the grass in early fall, and sow clover, either with oats, wheat or rye. Allow the clover to stand two years and follow with corn.†

On general principles it is well to use wood-ashes where obtainable, because of their tonic effect on the plants. It is understood, of course, that these practices are recommended for aggravated cases of wire-worm infestation and not for regular use in the absence of the pest in dangerous numbers.

INSECTS AFFECTING THE ROOTS.

Corn-root Web-worm (*Crambus zeelus*).

Although Michigan has, thus far, escaped injury from this pest, Illinois and Ohio have not been so fortunate, and it would not be surprising to find it at work in our State at any time. The method of attack is quite characteristic of the pest so that it is not likely to be confounded with anything else. The little caterpillar or larva, works on the roots beneath the soil surface, and each larva is protected by a small web of silken material. The adult moth is white, marked with silvery bands. It is about three-fourths of an inch in length.

REMEDIAL.

The natural food of the corn-root web-worm is grass, and for this reason it is well to avoid planting corn on sod land in places where the pest abounds.

* Bul. 33, Cornell University Experiment Station.

† Rep. State Bd. Agr., 1893, p. 50, containing 18th Rep. State Ent. for 1891-2. A Monograph of Insects Injurious to Indian Corn, Part I.

Plant-lice on Roots (*Aphis maidi-radicis* et al.).

In his exhaustive report on Insects affecting Indian Corn,* Professor S. A. Forbes mentions six species of plant-lice which infest the roots of corn in Illinois. One of these, *Aphis maidi-radicis*, is considered primarily a corn insect. We have thus far failed to meet the pest in Michigan but we may do so at any time. Like most root-lice the species is associated with ants, in the absence of which the lice would probably do little harm.

REMEDIES.

Professor Forbes suggests several remedies,—change of crop after serious infestation, in a word, rotation. Plowing and thorough harrowing in the fall to break up the ant's nest, and starvation of the young lice that hatch out before the corn is planted. This is done by keeping down the growth of young weeds early in the season, especially smartweed and pigeon-grass.

June-beetles or White-grubs (*Lachnosterna* spp).

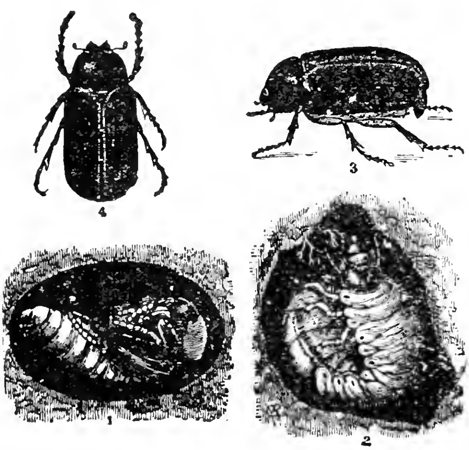


Fig. 54.—June-beetles. From Riley, Rep. State Entomologist of Missouri.

White-grubs are found in the soil under sod, among grass-roots, in corn-fields, strawberry plats and in a great variety of situations. They pass under a number of different names but are best known by that of white-grub. When at rest, they are curved in the form of a horse-shoe, covering an arc about as large as a five-cent piece. White and soft, except for the head and six legs, and a row of breathing pores along the sides, they are delicate, watery creatures, with awkward gait and feeble-powers of locomotion. The adults are snuff-brown beetles from one-half to nearly an inch in size; heavy bodied and blundering in flight. They come in swarms to electric lights and are also attracted to lamps in living-rooms. The grub feeds on the roots of grass and other vegetation, being especially fond of corn roots. The adults feed on the leaves of trees and other vegetation.

The eggs are said to be laid in grass land and the young probably require two years to develop, the pupal stage being passed in earthen cells in the soil.

REMEDIES.

Late fall plowing breaks up many of the cells and exposes the inmates to their enemies and to the weather. As they breed most freely on sod

* Twenty-first Ann. Rep. Ill State Bd. Agr.

land, it is well to arrange the rotation so as to avoid, as far as possible, bringing corn and grass together, in land subject to their invasions. They are especially apt to be killed off by diseases and natural enemies, so that they come and go with no apparent reason for so doing. They seldom remain very numerous in one field for more than one or two years, because of these enemies and diseases.

INSECTS AFFECTING THE STALK.

Corn-stalk Borer (*Helotrypa atra*).

In his report for 1888, Professor A. J. Cook records a corn-stalk borer from northern Michigan. He describes the injury as quite serious due to a longitudinal tunneling of the growing stalks. The larvae of this insect are said to be much like the ordinary army-worms, and the adults closely resemble the moths of the common cut-worms. The writer has not, as yet, seen this pest.

Barred-winged Onion-maggot (*Chaetopsis aenea*).

This insect is discussed among the onion insects. It has not, thus far, been found in corn in Michigan, but is recorded as having worked in corn-stalks in Maryland. As it is common in our State, its name should be included as a possible sweet-corn pest.

Bill-bug (*Sphenophorus sculptilis*).

Fig. 55.—Corn Bill-bug, enlarged. Original.

A few hundred miles to the south of us, the corn bill-bugs are not so uncommon as in our State. The season of 1904, however, witnessed the demolition of several large corn fields by this destructive pest. The first symptom of trouble is the wilting of the young corn. If an examination be made immediately, small black beetles, less than one-fourth of an inch in length, will be found boring into the plants just above the crowns. The beetles have long snouts like the curculio but are deep black in color. Fortunately there is but one brood each year, and the injury, as far as corn is concerned, is done by the adult beetles alone.

REMEDIES.

While the bill-bug is known best by its work on corn, it is really timothy that suffers the most from its ravages. Working as it does in the bulbous roots of the timothy, it is able to pass unnoticed unless it occurs in very large numbers. Here in the timothy bulbs, are passed the immature stages, the adults emerging at just the right time to attack the young corn. The moral is not to plant corn after timothy in places where one has reason to fear the presence of the beetles. When the beetles have once come out and done their work in the corn, there seems to be no danger from re-seeding, for there is but one generation each year and the beetles require timothy for their early development.

INSECTS INJURIOUS TO THE FOLIAGE.

Corn Leaf-aphis (*Aphis maidis*).

Seasons that open with a wet spring, followed by moist weather in early summer are usually aphid years. During such years, we usually hear from the leaf-louse of corn. Fortunately in Michigan its visits are not numerous, and when it does appear, it usually starts from some few points in the field, spreading slowly, and that too, after the plants have had a chance to get a good start.

Plants infested with such lice, are easily distinguished by their sickly appearance and by the numbers of lice on the leaves.

REMEDIES.

In the garden, prompt spraying of the infested plants with kerosene-emulsion or tobacco-water will check the lice and prevent their spread.

Grasshoppers (*Melanoplus atlanis, M. femur-rubrum, Camnula pellucida.*

Of the many forms of grasshoppers known in the United States, Michigan has less than half a dozen of real economic importance, and of these we may consider three as pests of the garden. They are, the lesser migratory locust, the red-legged locust, and the pellucid locust. Of these, the first two look very much alike, and as far as their appearance goes, they may be treated as one. They are both dull olive-green in general color, with an oblique yellow stripe under the wings. The hind-legs are red. The species look so much alike that it is an almost hopeless task for the farmer to distinguish between them; their habits however, are not quite the same. Grasshopper outbreaks, in our State, are quite likely to be due to large numbers of the lesser migratory species, rather than of the red-legged locust. The pellucid locust is smaller than the other two, and brown in color. The wing-covers have the basal half brown, and the apical half translucent except for spots of brown. In our State the pellucid and lesser migratory locusts sometimes work together, the most serious of the Michigan outbreaks being brought about in this way.

The life-history of our native hoppers is quite simple. There is but one generation each year, the young coming out in May or June. When first out of the eggs, the little creatures are so small that they easily escape detection, but as time goes on, and they become larger, they require so much food that their work becomes noticeable. When full-grown, the grasshoppers lay their eggs in pods in the soil, selecting dry situations in sod where possible. They like old slashings, lanes, etc. The eggs are laid in pods of twenty or thirty, each pod being coated with a thin covering of brittle material which consists of dried mucus ejected with the eggs. This covering is waterproof. It is replaced at the upper end by a plug of frothy material through which the young can make their way in the spring. The egg pods are placed in the soil or among the grass roots, never more deeply than the length of the mother's abdomen.

REMEDIES.

Three methods of combating grasshoppers are feasible in Michigan, each being suited to its own conditions. Other methods are practical elsewhere but do not seem to commend themselves in our State.

Fall plowing.—This is most efficient where it is possible at all. Plow the egg-pods under, burying some, and breaking open others so that moisture can get in, and exposing still others to the attacks of their enemies,—birds, shrews, etc.

Poisoned baits.—The second method is that of poisoned baits. Use either poisoned bran or the Criddle mixture. Poisoned bran can be used only in situations where stock and poultry are excluded. Neither should they be used where partridge and quail are likely to feed. It is merely bran poisoned with paris-green or arsenic, two pounds of paris-green to twenty-five of bran, moistened with water and a little molasses, so that the bran will just stick together when taken up with a spoon.

Criddle mixture is horse-manure mixed with arsenic and slightly salted. It is to be distributed about the fields in small masses. We all know of the fondness of grasshoppers for anything containing salt. They will even roughen fork handles in their efforts to get at the salt deposited on them with the perspiration. This mixture is recommended in Canada and in some of the western states. The proportions are about as follows: Paris-green, one pound; salt, two pounds; fresh horse-droppings, 100 pounds. The horse-droppings are usually measured out in a three-gallon pail. Five pailfuls being taken as the right amount for one pound of the poison. The salt is dissolved in a pail of water, the poison stirred in, and the whole mixed with the droppings in a half barrel. The writer has not had an opportunity to test this bait as yet, but if it turns out to be as effective as some have claimed, it should be preferable to bran, because of its comparative safety, if for no other reason.

Hopperdozers.—A hopperdozer is a long, shallow pan of sheet-iron, set on runners and having behind it a banner or sail made of canvas or muslin stretched on a wooden frame. The bottom of the pan is covered with rags or old carpet, previously wetted with water. When all is ready, a pint of kerosene is poured over the wet rags, and the banner of cloth is also moistened with kerosene. The dozer is then dragged on its runners over the field and the hoppers either jump in or try to jump over, in which case they strike the banner and fall back into the oil. A mere touch of the oil is certain death; it may take half a minute if the insect falls directly into it, or it may take half an hour if the insect simply alights on the banner moistened with the oil, but no matter whether the insect dies immediately or takes a little time, he is sure to die eventually. The great majority of the hoppers that jump into the pan, jump out again at once but they die just as certainly and almost as quickly as if they remained.

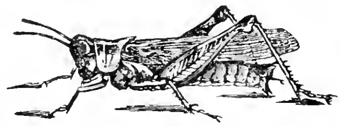


Fig. 56.—Red-legged locust. (After Riley.)

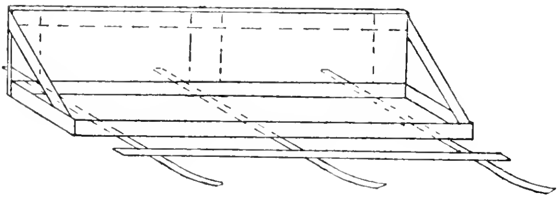


Fig. 57.—Hopperdozer. Author's illustration.

Cut-worms.

Just about the time that the danger from crows has abated somewhat, the young sweet-corn is often called upon to withstand an attack by cut-worms. There are striped cut-worms, dark, light, glassy, greasy and many other sorts, each belonging to a different species, and each developing into its corresponding moth. The moths or millers are nocturnal in their habits, and are spoken of as owlet-moths because of their habits and the shape of their heads.

Cut-worms naturally work on sod land, and for this reason, it is well to avoid planting corn, tobacco, tomatoes, or anything else especially liable to their attacks directly after grass. Then too, the great majority of our cut-worms pass the winter in a partially grown condition, and when spring comes, and the sod and roots are replaced by a comparatively smaller number of corn plants, the worms are hardly to be blamed for feeding on them. Sod land, then, has its disadvantages when used before a crop liable to attack by cut-worms. It is also a menace when adjacent to a corn-field, for the "worms" will travel quite a distance from their breeding grounds in order to get at their favorite food. They work at night, traveling on the surface of the soil, and cutting off the plants low down at or just below the soil level. They cut off much more than they can use and then retire before daybreak, burrowing lightly and hiding often near the plant just cut off. One "worm" will forage night after night and destroy many times as much food as could be eaten. One can not help wondering at its wasteful habits. It has been suggested that the food is cut in order to let it wilt before it is eaten. Wet food does not seem to agree with some caterpillars, neither does that which is too vigorous and turgid. It is not unreasonable to suppose that much of the food is cut in order that it may wilt and be ready for future use, rather than from mere wanton destructiveness. As has been stated many of the cut-worms pass the winter in a partially grown condition, just beneath the surface of the soil. Occasionally, in winter, during a sudden thaw, the larvae will crawl up on top of the snow, being driven upward by the water from the melting ice and snow. In such cases they seldom get back into winter quarters, but perish as soon as it freezes again. The writer has seen the snow thickly dotted with cut-worms on such occasions, both here and in Minnesota. Many parasites feed on them and shrews and birds devour quantities.

Fig 58.—Cut worms. Larva, adult, and pupa in earthern cell. From Saunder's Insects Injurious to Fruits.

REMEDIES.

The one measure that has been most successful in the past, is the use of poisoned baits, when the trouble is on a large scale. On a very small scale, other methods are more effective. Of the baits used, clover is the favorite. A goodly pile of clover should be cut, and while it is still fresh and green, it should be wet down with paris-green and water, using about half a pound of poison to a barrel of water, then, late in the afternoon, so that it will keep fresh as long as possible, twist bunches of this wetted clover in wads, more or less compact, and throw out over the field at short intervals. If the field to be protected be near a field in sod, then place an extra amount on the threatened side. The cut-worms love clover and oftentimes they will hide under such wads of fresh green food in the morning after a night's travel, eating a little of the poisoned food before hiding away. Poisoned pieces of turnip will do if clover is not to be had.

Poisoned bran, sweetened with a little molasses and made into moist balls the size of a plum, has been recommended, and Mr. Sirrene, of the New York State Experiment Station, recommends dry bran mixed with dry paris-green, sowed on the surface of the soil by means of a hand drill. In any case do not use such baits of bran unless stock and poultry are excluded or when partridge and quail are likely to get it, and do not expect to find the dead worms in the morning unless you are willing to sift the top soil for some distance about each bait, for the pests always bury themselves before dying. The only way to judge of the death of the larvae is by the cessation of their work.

In the garden, when tomatoes, cucumbers, etc., are attacked, they may be protected by placing a collar of stiff, smooth paper about the plant. Make a collar about two inches high and two inches in diameter, and set in about the plant, keeping it in place with a little dirt scraped up against it. Cut-worms do not climb well, and almost never touch

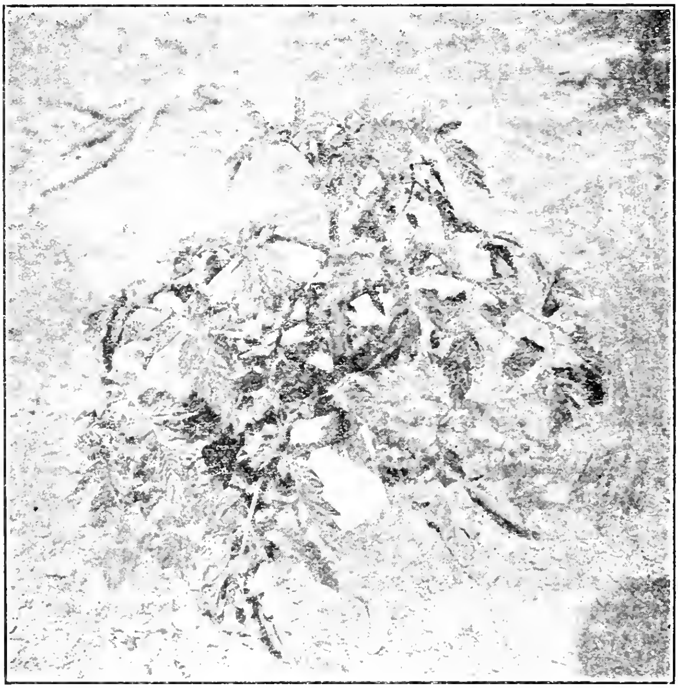


Fig. 59.—Tomato plant with collar of stiff paper for cut worms. Original.

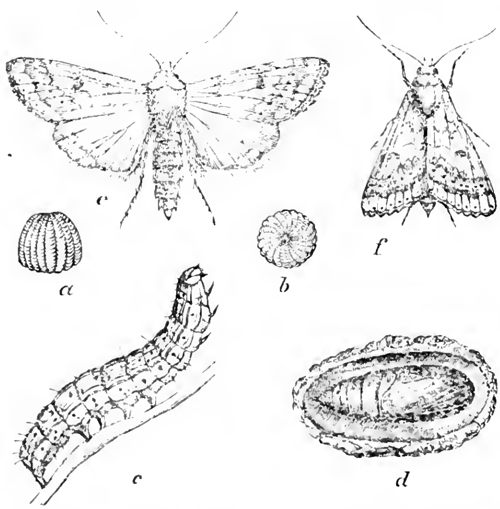


Fig. 60.—Boll-worm or corn ear-worm. (After Riley, Third Mo. Rep.)

a plant so protected. In the melon and cucumber fields, use berry boxes without the bottoms. They may be purchased cheaply in knock-down form.

Several species of cut-worms have the habit of climbing, and are spoken of as climbing cut-worms. They work on the buds of fruit trees early in the spring. For a discussion of these pests see Special Bulletin No. 24 of this station.

INSECTS AFFECTING THE CORN IN THE COB.

Corn Ear-worm or Cotton Boll-worm (*Heliothths obscura*).

Next to cut-worms, in point of importance to sweet-corn, comes the corn ear-worm, known also as the tomato-fruit-worm and in the South as the boll-worm. When our corn is "in the milk" one often finds, work-

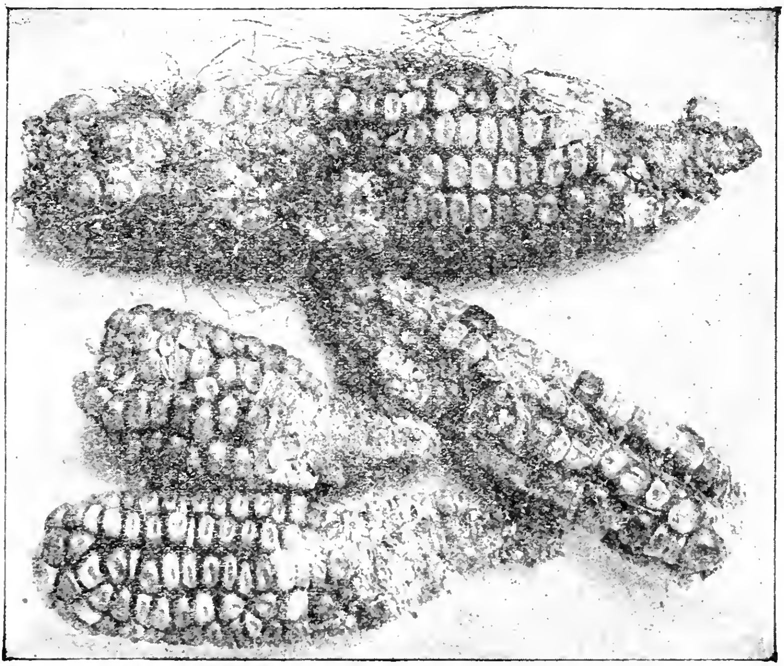


Fig. 61.—Work of corn-ear worm. From J. B. Smith, State Exp. Station of New Jersey.

ing either in the silk or in the soft kernels inside the ear, one or more almost hairless caterpillars or "worms" which tunnel about, destroying part of the juicy kernels, and leaving a disgusting, blackened furrow that ruins the entire ear for the market. When the corn becomes too hard for food, or where there are too many larvae in one ear, they eat one another. When full grown they are striped longitudinally and may be greenish or reddish in color and about one and one-fourth inches long. The pupal stage is passed underground, the moth that comes from the pupa, being dull, dirty-yellowish in color with a darker band just inside the border of the hind-wings.

REMEDIES.

As the insect passes the winter in the soil, it is possible to destroy some of them by late fall or early spring plowing, either burying them so deeply that they never get out, or exposing them to their natural enemies. This practice should be carried on over a wide area, however, if much benefit is to be received, for the adults can fly with ease from one farm to another.

Fall Army-worm (*Laphygma frugiperda*).

A close relative of the army-worm, but one sometimes exhibiting quite different habits, is the fall army-worm. The larva of this pest is about one and one-half inches long, striped longitudinally, with numerous raised, black points, from each of which springs a black hair. The head is marked with a V-shaped mark. There are several generations each year, the last one doing the most injury. Unlike the regular army-worm, this insect does not move in well organized bodies, but each larva migrates in its own way. In the northern part of this State, the writer has seen these caterpillars working in the ears of corn, very much as do the larvae of the boll-worm or corn-ear worm. One or more caterpillars tunnel in the green kernels while it is "in the milk." Here they render the sweet-corn unfit for market by eating out a portion of the kernels and soiling the rest in the vicinity of their tunnels.

REMEDIES.

Fall plowing is the only really sensible remedy. The greater part of these pests that live over winter, do so in the larval stage in the soil, and fall plowing destroys many of them while they are in their earthen cells.

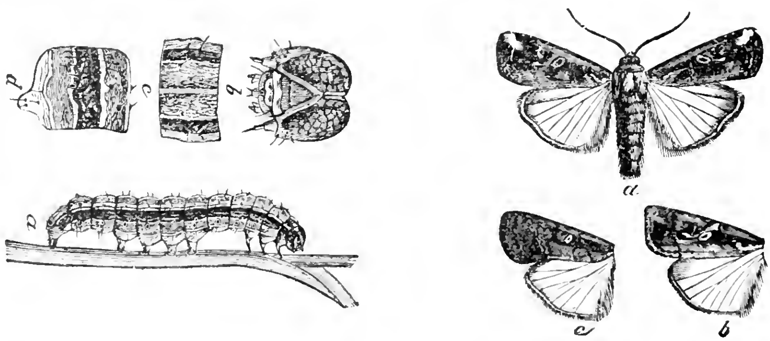


Fig. 62.—Fall army-worm, larva and adult, showing details. After Prof. Lawrence Bruner.

Bumble Flower-beetle (*Euphoria inda*).

This is a thick-set, awkward beetle of dull-yellow and brown color. It resembles somewhat the June-beetle in its habits, but unlike that well known insect this beetle does all its injury to crops in the adult condition. It attacks fruits and corn in September and October, making its way into the ears of corn, and feeding on the soft, pulpy kernels when they are in the milk. A few years ago, before evaporators came into use, and when it was customary to dry corn in the sun, this beetle was troublesome because of its habit of feeding on the drying corn. There is no remedy known other than hand-picking, but fortunately, the beetles are comparatively few in number, and do not, as a rule, execute so much harm as they threaten.

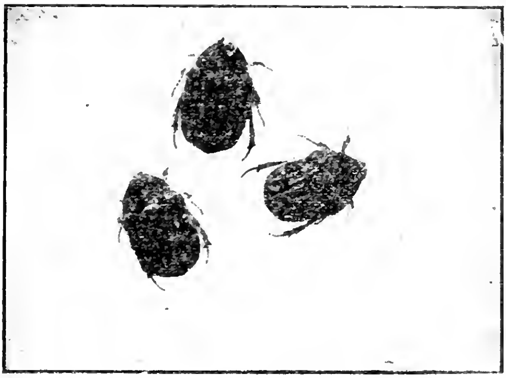


Fig 63.—Bumble flower-beetle, Author's illustration.

INSECTS AFFECTING THE TOMATO.

INSECTS AFFECTING THE STEMS.

Tomato-borer (*Papaipama nitela*).

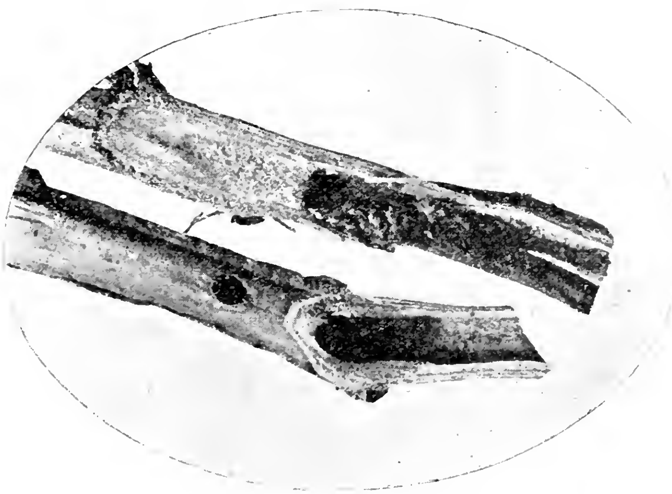


Fig. 64.—Work of tomato-borer in stalk of plant, slightly enlarged. Original.

For several years, complaints have come in of a borer that attacks potatoes, tomatoes and flowering plants, notably dahlias. The insect is found also in rhubarb, rag-weed, cockle-bur and corn. When the tunnel is cut open and the larva taken out, it is found to be about an inch in length, flesh-colored, with four longitudinal brown stripes extending from the head to the anal extremity. When ready to change to the pupal form, the larva deserts the tunnel that it has made and buries itself in the soil. After a time the adult emerges, as this takes place in the fall, it is likely that the adults hide away and hibernate in that form. There is reason to suppose that there is one generation each year.

REMEDIAL.

The life-history of this pest seems to reveal no weak points where a spray can be made to avail. The fact that it works on many of our common weeds indicates that clean culture over wide areas, will cut down the supply materially. Other than this we shall have to depend on cutting out the larvae, keeping close watch for wilting plants and examining all such systematically and regularly.

INSECTS AFFECTING THE FRUIT.

Corn Ear-worm or Tomato Fruit-worm (*Heliothus obscura*) (see Insects affecting Sweet-corn).

INSECTS AFFECTING THE FOLIAGE.

Tomato-worm or Tobacco-worm (*Phlegatontius sexta*).

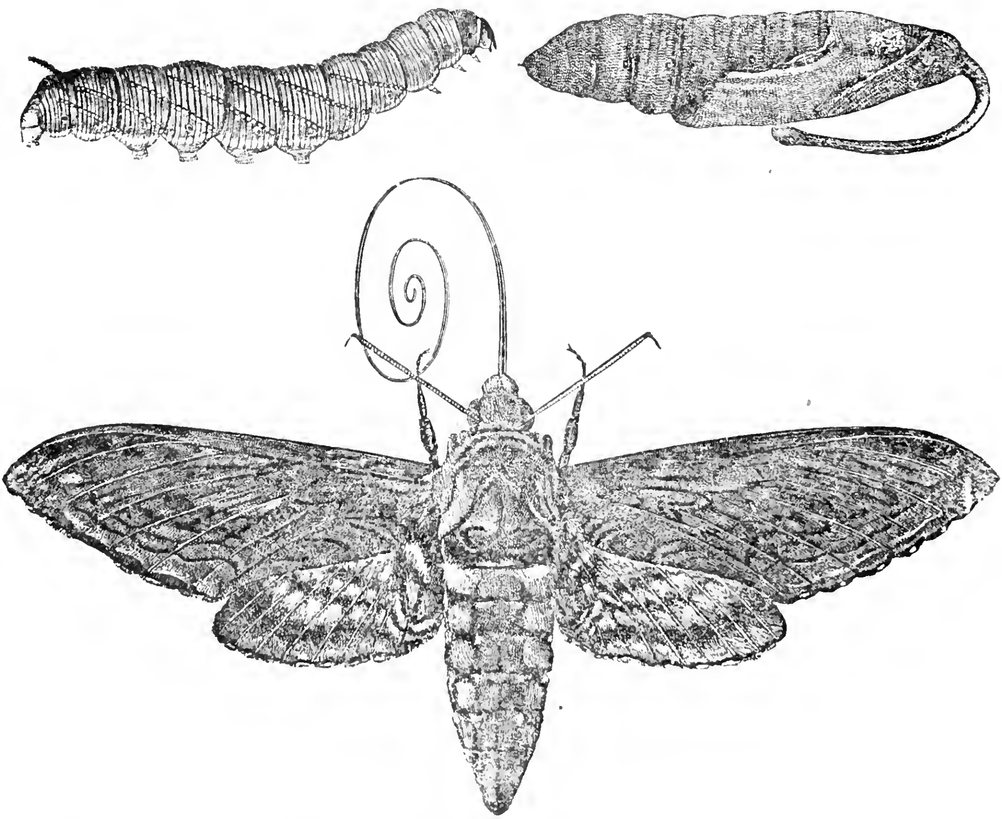


Fig. 65.—Tomato-worm or tobacco-worm, larva, pupa and adult. (After Walsh and Riley, Am. Ent.)

The larval stage of this insect is known as the tobacco-worm or the tomato-worm, depending on the host on which it happens to be feeding at the time. It is a naked, green caterpillar of large size and is feared because of the prominent curved spine at the posterior extremity. It is also found commonly on the potato. When full grown, it sometimes measures three inches in length. The pupal stage is passed in the soil. The pupa is remarkable for the jug-handle form shown in the figure. From this pupa comes the adult moth which is grey in general color, and is one of the hawk-moths or humming-bird moths so common about petunias, etc., at dusk.

REMEDIES.

This caterpillar is so conspicuous and its work so easily detected that there is usually little trouble in hand-picking. Paris-green will kill many of them in time but poison works slowly on these large insects and a good deal is required to kill them so that it is best to expedite matters by hand-picking. Then, too, paris-green is not safe on tomatoes after the fruit is well started.

DIRECTIONS FOR PREPARING INSECTICIDES.

Most insects may be classified either as chewing insects or as sucking insects. Beetles, grasshoppers, etc., chew their food, while bugs suck theirs by means of long piercing beaks with which they penetrate inside to the juicy parts of the plants. Moths and butterflies suck their food, when in the adult condition, but chew it when in the larval state. Now chewing insects, in many cases, eat foliage, fruit, etc., and if this food be treated with a coating of some arsenical poison, they get the poison in the ordinary course of events, and die. Many chewing insects, like some of the borers, are protected in their burrows and never eat at the surface of the plant except possibly, when just entering the plant.

Sucking insects are not affected by poisons of this nature, as they draw their supply of food from beneath the surface. With them it is necessary to use some substance like kerosene-emulsion, which kills by contact, but does not injure the plant. Special contact insecticides have been found to work well against special insects and at certain definite times, therefore the best results are obtained by using a variety of killing agents, each suited to a particular purpose.

While it is necessary to spray evenly and thoroughly with an arsenical poison, like paris-green, it is easily seen that the utmost care is required to obtain good results with a contact insecticide. Most beetles and caterpillars wander about more or less and some of them will find the poison themselves, on the other hand, each insect must be hit by a contact insecticide to be killed.

As everyone knows, the arsenical poisons are the cheapest when effective, and when nothing prohibits their use. Vegetables well advanced or those which ripen quickly, should not be sprayed with permanent poisons like paris-green. Hellebore has the advantage of losing its strength after a time, and may sometimes be used when paris-green would not do.

Now a word about applying the spray. In general use a nozzle that will produce a fine spray, one that will stick in minute particles to the plant and which will not go on in drops. Always stop spraying before the plant commences to drip. Paris green, and all the arsenites, remain in suspension in the water if properly prepared, and are not dissolved. These small particles of poison will settle to the lowest part of a drop of water, and remain on the plant as the water evaporates, if the drop be of small size. If, on the other hand, the drops are large enough or numerous enough to run together and drip off, most of the poison drips off first, leaving very little to dry down on the plant. It is therefore desirable to have the water evaporate as quickly as possible. This is best brought about in dry, sunshiny weather. Such weather is best for kerosene-emulsion also, because the oil is apt to injure the foliage if left on too long before evaporating. Therefore choose dry, sunshiny weather for spraying if possible.

CONTACT INSECTICIDES, FOR INSECTS THAT SUCK.

KEROSENE-EMULSION.

Place two gallons of ordinary kerosene in a warm place, either in a warm room or in the sun, and allow it to become as warm as possible without danger from fire. Boil one pound of laundry or whale-oil soap in a gallon of soft water until completely dissolved. Remove the soap solution from the fire, and while still boiling hot, add the kerosene and agitate for ten minutes, or until the oil is emulsified, with a spraying pump by forcing the liquid back into the vessel from which it was pumped. When the liquid is perfectly emulsified it will appear creamy in color and will flow evenly down the side of the vessel when allowed to do so. Care should be taken to completely emulsify the oil and this is accomplished much more easily when the mixture is hot. This strong emulsion may now be readily diluted with water and used, or it may be stored away for future use. When cold it becomes like sour milk in appearance and should be dissolved in three or four times its bulk of hot water before diluting with cold water. If the water is at all hard, "break" it by adding a little salsoda before putting in the soap.

Small amounts of this emulsion may be made by using the ingredients in small quantities but in the same relative proportion.

WHALE-OIL SOAP KEROSENE-EMULSION.

This is made with whale-oil soap in place of the common laundry soap. It is superior to the plain emulsion in some ways.

PYRETHRO WHALE-OIL SOAP KEROSENE-EMULSION.

To one gallon of the undiluted emulsion made with whale-oil soap, add one ounce of Pyrethrum. Stir well and dilute before applying.

WHALE-OIL SOAP.

This remedy has the advantage of being ready made, requiring no preparation other than that of dissolving. It may be used in winter or summer. In winter it should be put on warm. It costs from three and one-half to five cents per pound when purchased in quantity. For a winter spray, against the San Jose scale, or any other scale, it should be put on at the rate of two pounds to a gallon of water. Each part of the tree should be wetted by the liquid, and the work should be done toward spring if possible, but before the buds commence to swell. It sometimes kills the fruit buds of peach and plum, especially is this true if the spraying be done in the early or middle part of the winter.

A summer spray, against plant-lice, etc., is prepared by dissolving one pound of the soap in from four to six gallons of water, and applying as in the case of kerosene-emulsion.

INSECT POWDER, BUHACH, PYRETHRUM.

This valuable remedy has one drawback, its cost. It is too expensive for use on a large scale. It kills insects through their breathing pores, but is harmless to man and beast. It will kill many of the insects of the garden if dusted on or mixed with water in the proportion of one ounce to two gallons of water.

Use the powder when it is undesirable to use poisons, but never buy any unless it comes in tightly sealed packages. It loses its strength on short exposure to the air. An hour will suffice to weaken it. It must be applied from time to time as it quickly loses its strength.

TOBACCO.

Tobacco, in the form of dust, may be obtained of the large manufacturers at the rate of from one and one-half to two cents a pound. It is useful in destroying root-lice, especially woolly aphis, in young trees, and in keeping insects from garden truck. It should be worked into the ground liberally for root-aphis.

An infusion, or tea, made from waste, will kill plant-lice if sprayed on when they first appear. Steep in sufficient water to cover the waste stems and dilute until the color is that of strong tea.

DRY-SLAKED LIME.

Finely slaked lime is often useful because of its slight caustic properties. Against such larvæ of saw-flies and beetles as are sticky, for instance those of the cherry-slug and asparagus beetle, it may be used as a substitute for poison, if the latter, for some reason, is undesirable.

Stone lime may be slaked with a small amount of hot water, using just enough to turn it to a dry powder. Such slaked lime is as fine as flour and very soft to the touch having very little grit. Use a metal pail or kettle to slake in as the heat will set fire to wood. Do not use too much water, and where possible use freshly burned lime.

CARBOLIC-ACID EMULSION.

Hard soap, one pound, or soft soap, one quart.
Water (boiling) one gallon.
Crude carbolic-acid, one pint.

The soap is to be dissolved in the water and while it is still boiling hot the acid is added and the whole churned by forcing the stream from the nozzle into the kettle, just as is done in making kerosene-emulsion. Dilute with thirty times its bulk of water and apply. If any injury results from the use of this emulsion, dilute it still more. Use the *crude* carbolic-acid in making the emulsion as it is very much cheaper and just as good.

STOMACH POISONS, FOR INSECTS THAT CHEW.

PARIS-GREEN AND LIME.

Always use lime with paris-green, it makes the poison stick better, beside greatly reducing the danger of burning the foliage.

For spraying from a barrel, the writer has found the following method very useful.—Place from one-quarter to one-half pound of good quick lime or unslaked lime, in each of three or four tin pails which will hold about three quarts or less. Old cans or crocks will answer just as well. Add enough hot water to slake it into a thin cream or paste. Now add to each lot, one-quarter pound of paris-green, previously weighed out, and placed in paper bags, stir while the lime is hot and allow to stand for some time. Now measure out about forty-four gallons of water in your spraying barrel and make a mark that will show you how high it comes in the barrel, add the contents of one tin pail (viz., one-quarter pound of paris-green and one-half pound of quick-lime slaked) into the forty-four gallons of water in the barrel. Stir well and spray. The pails or crocks can be used one at a time and refilled occasionally so that the stock is always on hand ready for use. Keep the pails or crocks for this purpose alone.

KEDZIE MIXTURE (ARSENICAL).

This mixture, originated by the late Dr. R. C. Kedzie, of this station, is cheap, but it has the disadvantage of lacking a warning color. It is a good substitute for paris-green, but must be made with care, and stored in well labeled jugs.

Dr. Kedzie in giving directions for its preparation says: "Dissolve the arsenic by boiling with carbonate of soda, and thus insure complete solution; which solution can be kept ready to make a spraying solution whenever needed. To make the material for eight hundred gallons of spraying mixture, boil two pounds of white arsenic with eight pounds of sal-soda (crystals of carbonate of soda—'washing soda'—found in every grocery and drug-shop) in two gallons of water. Boil these materials in any iron pot not used for other purposes. Boil for fifteen minutes or until the arsenic dissolves, leaving only a small muddy sediment. Put this solution into a two gallon jug and label 'Poison,' stock material for spraying mixture."

"The spraying mixture can be prepared whenever required, and in the quantity needed at the time by slaking two pounds of lime, adding this to forty gallons of water; pour into this a pint of the stock arsenic solution. Mix by stirring thoroughly and the spraying mixture is ready for use. The arsenic in this mixture is equivalent to four ounces of paris-green."

"The pot, jug, etc., must never be used for any other purpose after using it for making this mixture."

If an additional pound or two of lime be added to the mixture it will help to make the application permanent and conspicuous without in any way interfering with its effects. In using it the extra lime should be added.

WHITE ARSENIC AND LIME.

White arsenic is much cheaper than paris-green and just as effective. The work of preparation is of course to be considered but the real reason why the writer hesitates to recommend its use is because of the similarity in appearance between arsenic, baking-powder, flour, etc.

It may be prepared in the following manner:—In two gallons of water, place two pounds of freshly slaked lime and one pound of arsenic. Boil from one-half to three-fourths of an hour. By this time the arsenic will have dissolved and united with the lime. When wanted for spraying, dilute with water and lime. The above pound of arsenic will suffice for four hundred gallons of water. In order to prevent the "burning" of the foliage, slake one pound of lime to every twenty gallons of water used for diluting. The above is for apple trees. Potatoes will stand the spray considerably stronger.

ARSENATE OF LEAD.

This poison, although not in general use throughout the country, has several advantages; it shows where it has been applied; it is light and does not require such vigorous stirring as paris-green; and it does not easily burn the foliage. To prepare it, dissolve four ounces of arsenate of soda, and eleven ounces of acetate of lead, each in a gallon of water. On mixing the two solutions together we shall get a milky precipitate, which should be stirred into 100 gallons of water. It is now ready for spraying. Of course, larger or smaller quantities may be made in the same proportion, and if this preparation does not seem strong enough, it may be applied much stronger with safety.

Its action is slower than that of paris-green, but the fact that it does not readily burn the foliage is an advantage when spraying various kinds of delicate trees with one mixture.

HELLEBORE.

White hellebore is the powdered root of a plant. It kills both by contact and as an internal poison. It may be applied either dry or in the form of a liquid. When used dry it should be mixed with three or four times its weight of flour or plaster and then dusted on the insects. Applied wet, one pound should be mixed with twenty-five gallons of water and this liquid applied as a spray. A convenient form of duster is made as follows: A tin box like a pepper-box, holding a quart or less, is fastened to a stick about six feet long by means of a screw running through the bottom of the box into the stick. The cover of this box should be finely perforated to allow the poison to come out very slowly when shaken. This box can then be shaken over the infested plants and the insects peppered or dusted with the poison.

Hellebore is especially useful against all moist-bodied insects, such as currant-worms, pear and cherry slugs, etc., for the poison sticks to their bodies.

BORDEAUX MIXTURE.

Copper sulphate, crystals (Blue vitriol)...	4 pounds
Fresh lime (unslaked)....................	6 pounds
Water	40 gallons

Dissolve the copper sulphate in a wooden pail of water, by suspending it in a coarse cloth near the surface of the water. In this way it will dissolve much more quickly than if allowed to settle to the bottom. Use wood as the copper will deposit out on metal thus weakening the solution.

Slake the lime, with hot water if possible, in any case if only a small quantity is to be used. Dilute the copper sulphate to twenty gallons in one barrel, and dilute the lime to twenty gallons in another, then dip alternately from each of these barrels into the spraying barrel, stirring the mixture all the time.

If large amounts are to be made, it is often expedient to make a stock solution of the copper sulphate using one pound to a gallon of water, then when ready to mix, dilute four gallons of the stock solution in place of four pounds of the crystals. The required amount of lime may be ascertained by slaking six pounds in a metal pail and noting just how full it fills the pail. The same amount may be measured each time from a stock of *freshly slaked* lime and diluted to twenty gallons before mixing. Larger and smaller amounts may be made in the same proportion.

TREATMENT FOR INSECTS IN STORED GRAINS AND SEEDS.

The treatment for dried grains containing insects is comparatively easy, providing the grain or seeds is in tight bins or barrels, capable of being tightly and quickly closed. Old carpets, blankets, etc., often will be found useful in helping to make the bins tight.

Measure the inside of the bin, counting in the air space above the grain, if the bin is not entirely full, and place some old pans or plates on top of the grain. Then for every cubic foot of space in the bin, put a dram of liquid carbon bisulphide in the pans and quickly close the bin. Thus a pound of the liquid will suffice for about one hundred cubic feet of space or a little more, or for about one hundred bushels of grain.

If the seed or grain is more than two or three feet deep in the bin, the liquid should be poured into it at some depth in order to insure its spreading evenly and filling all the space treated. This is easily done with a piece of gas-pipe fitted with a wooden stick for its entire length. The pipe with the stick in place is thrust down half way to the bottom of the bin, the stick withdrawn and the liquid poured down through the pipe. The stick merely prevents the pipe from becoming filled when thrust into place. The bin should remain tightly closed for from twenty-four to forty-eight hours, a longer exposure is likely to injure the germinative power in some seeds.

The liquid carbon bisulphide, on being liberated, will be quickly transformed into a gas, which being heavier than the air, settles to the bottom and fills all the air spaces between the seeds or kernels. The liquid costs about thirty cents for a single pound, or five pounds for a dollar. The work must be done in the day time, away from lamps, stoves or fire of any sort. No fire must be allowed to come near until everything has been thoroughly aired for the gas or fumes are very explosive when mixed with air. Grain should be shoveled over several times. Great care must be observed to breathe as little as possible of the fumes as they are very poisonous and will as easily produce death among men as among insects.

FEEDING DAIRY COWS.

(Review and partial reprint of Bulletin 149, Annual Report 1898, page 250.)

C. D. SMITH, DIRECTOR.

Bulletin No. 234.

There are several terms used in the literature relating to cattle feeding, the meaning of which ought to be clearly understood. Among these terms are, *dry matter, protein, carbohydrates,* and *digestibility.*

All of our cattle foods, no matter how dry they may seem, contain some water. If pulverized and exposed for a period to a perfectly dry atmosphere and a low heat all of the water in the original substance will be driven off. The residue is called *dry matter.* The water thus driven off by the heat and taken up by the dry air has no value for feeding purposes whether it comes from hay or from mangolds or turnips unless it be in rendering the material physically more readily digested. Roots are not primarily valuable because they contain water, but because of the amount and composition of the dry matter left when all the water is dried out of them. It is fair to compare stock foods on the basis of the dry matter which each contains, assuming that the water content has no food value whatever. This does not mean that the quality of succulence is not one to be considered or that domestic animals should not receive roots or some other succulent feed during the winter. Ruminants seem to be benefitted by roots or silage which exert a loosening effect upon the bowels, keeping the coat sleek and the animal in a thrifty condition. It is not yet shown that this succulent feed increases the amount of material digested from the ration.

The meaning of the word *protein* is a little harder to illustrate. A reference to the diet of men may aid in making its significance clear. No dinner seems complete without meat. Lean meat contains a large amount of water. If this be driven off, the dry matter would be found to consist of red muscle, fat and connective tissue. It is the red muscular tissue that is the characteristic constituent of lean meat. If meat is wanting, the housewife finds it possible to supply its place with eggs. One hundred pounds of eggs contain not far from 66 pounds of water and 34 pounds of dry matter. The dry matter is made up of many ingredients, chief among which are 9.5 pounds of fat and 13 pounds of a material having a chemical composition very similar to that of the dry red muscle of lean meat and called albumen. If eggs were not obtainable as a substitute for meat, its place might be acceptably filled by a sufficient quantity of cheese. Of Cheddar cheese, 100 pounds contain 35.6 pounds of water and 64.4 pounds of dry matter. The 64.4 pounds of dry matter contain 32 pounds of fat and 28.2 pounds of a substance having also a chemical composition very similar to that of the dry lean muscle of lean meat and called casein. Now the class of substances including dry lean meat, the albumen of the white of eggs, the casein of cheese is called *protein*. The chemist finds that this protein, derived from our usual cattle feeds, contains not far from 16 pounds of nitrogen per hundred weight, or, in other words, has 16% nitrogen. If, then, we remember that 16 multiplied by 6.25 makes a hundred we can see that it is possible to determine how much protein there is in a given material by multiplying its content of nitrogen by 6.25.

All of our cattle foods contain compounds having a composition similar to that of dry lean meat, the albumen of eggs and the casein of cheese and serving, for our domestic animals, the same purpose that the protein of meat, cheese and eggs does for human beings. It must not be understood that meat, eggs and cheese are the only articles of human diet that furnish protein. The truth is far otherwise. While meat has a larger proportion of protein than have most vegetables, the latter are by no means wanting in this food constituent. Even potatoes, a very starchy food, contain, when boiled, 2.7%* of protein. Beans have a much larger per cent, on the average 21.81 pounds of protein to the hundred weight. White bread shows fully 9.5% of protein. The limited number of experiments that have been tried on this point lead us to believe that a pound of protein derived from potatoes is equally as valuable as the same amount derived from the lean meat. This point has not been well established. Much will depend upon the digestibility of the protein in the two forms.

Turning now to cattle foods we find that some of them may be supposed to be related to the appetite of the animal in much the same way that eggs, cheese and meat are to the appetite of men. To this class would belong such feeding stuffs as cotton seed meal, linseed meal, gluten meal and buckwheat middlings. Cotton seed meal is richer in protein than cheese. It contains 42% of protein while cheese has but 28.2%. Linseed meal usually has 32% of protein while eggs have but 13%.

Protein is known by other names. Because it contains nitrogen, it is called *nitrogenous* substance. Because the protein compounds resemble the white of an egg they are called *albuminoids*.

Fat. The meaning of the word fat in relation to cattle feeding is the same as when used in ordinary conversation. The fat found by the chemist in corn meal, clover hay and other feeding stuffs is very similar in composition and in physical properties to the animal fat, lard, butter or tallow. The quantity of fat in the various feeding stuffs differs widely. Of the total weight of the seeds of flax and the cotton plant, fully one-quarter is oil, while straw and green fodder have relatively very little. The fact that nearly all of our fodders contain some fat is the one that it is important to remember.

Carbohydrates. Both protein and fat are essential constituents of the diet of animals and men, but these two factors together do not constitute a complete daily ration. The appetite calls for some starchy food. In the case of men this is usually supplied by potatoes or by

* The sign % signifies, of course, per cent.

some other vegetable. One hundred pounds of boiled potatoes would furnish 22.3 pounds of starch. Honey and syrups are composed almost entirely of sugar. In the animal economy it has been pretty clearly shown that the sugar and starch serve as sources of energy and that the two are of approximately equal value. Stock foods are rich in starch and sugar. The stems and leaves of forage crops are made up of starch in some of its many forms. Sometimes, in the economy of the plant, this starch is transformed into a woody fiber needful to the plant to hold it upright and give it a definite form resistant to wind and the action of the elements. When the plant is cured for hay this woody fiber forms part of it and when fed to the cow or sheep is partly digested, though never entirely digested. Even the woody fiber has some value in stock feeding. The chemist calls it *crude fiber.* Sugar dissolves readily when taken into the mouth and is quickly absorbed through the walls of the stomach and intestines. Starch is acted upon by the saliva and by the juices secreted by the stomach and intestines. The result of the action of these juices upon the starch is conversion into a form of sugar which is absorbed. The crude fiber, as far as it is digested, is also converted into a similar sugar by the action of the liquids of the stomach and intestines.

Because the starch, sugar, crude fiber, and other materials not containing nitrogen are similar in composition and converted by digestion into this form of sugar, the chemists have agreed to call the whole group *carbohydrates.* It is to be noted at once that the carbohydrates include a great many groups of dissimilar substances, alike in one respect alone, namely, that, when digested, they supply the body with a material either sugar or compounds similar to sugar in solubility and chemical composition.

Ash. The ashes remaining when the feeding stuff is burned have a definite and essential part to play in the nutrition of animals. There is usually no lack of ash, although sometimes, in case of young animals, fed largely on grain, the deficiency of ash manifests itself in a weak bony structure and general lack of thrift.

Digestibility. Cattle and sheep have four stomachs while the horse and the pig have but one. The animals that chew the cud are thus provided with digestive apparatus especially fitted to handle coarse fodder like hay and straw and extract from it as great a share as possible of the nutrients contained. The first stomach is simply a large reservoir into which the partly chewed fodder passes when swallowed, there to remain for an indefinite period to soak in the slightly acid liquids until again brought to the mouth for remastication. Even when swallowed the second time part of the "cud" returns to the first stomach. By this mechanism a thorough grinding of the food is assured. The material then passes to the third stomach where a set of hooks and a tough lining membrane again grind the food, acting upon it much as do the pebbles in the gizzard of the fowl.

From the third stomach the food passes directly to the fourth or true stomach, the organ which corresponds exactly to the stomach of the horse and the pig. The food comes to the stomach wet with saliva, softened and ground fine. The saliva converts a small part of the starch of the food into a kind of sugar. In the stomach the gastric juice converts part of the protein into a soluble form. In the stomach too part of the sugar may be absorbed and go directly into the circulation.

From the stomach the food passes into the small intestines. Here, after passing along a few inches from the stomach it is mixed with bile which comes through the bile duct from the liver. The contents of the stomach are acid, the bile is distinctly alkaline. Along with the bile, though discharged into the intestines through a different tube, comes a juice, perhaps the most important in its functions of any of the digestive fluids. This is called the pancreatic juice, a secretion of the pancreas.

It is the function of the bile to act upon the fats in such a way as to fit them to be absorbed. Just how it accomplishes this end is not fully known. Possibly it emulsifies them, that is, divides them into minute particles which are held in suspension and which may be absorbed. Next, the bile seems to exert an antiseptic influence on the contents of the intestines preventing decay. Third, the bile acts as a partial lubricant. Fourth, it prepares the partly digested food for the action of the pancreatic juice. Among the functions of the latter fluid possibly the most important, is the digestion of the protein. It converts the protein bodies into simpler compounds which are soluble and therefore capable of absorption. Next it transforms starch into sugar and other soluble bodies. Third, it breaks up the fats into glycerine and fatty acids.

There are other juices secreted by the walls of the intestines. They aid in digestion largely by converting the carbohydrates into a form of sugar in which form they are absorbed. The whole aim of digestion is to make soluble the food materials eaten. They are therefore ground by the teeth, then soaked in a succession of acid and alkaline liquids that, combined, act upon all of the food elements, rendering them soluble.

Notwithstanding the elaborate equipment for digestion furnished by nature, it must needs be that part of the protein, carbohydrates and fat taken in the mouth in the form of hay and grain, must escape digestion. As a matter of fact little more than half of some of the valuable nutrients of the forage crops are absorbed and become really useful to the animal.

It is evident that in estimating the value of a given cattle food, we ought to take into consideration the digestible part only. The share of the protein for instance that, under ordinary circumstances, passes through the cow undigested, is of no value as far as she is concerned and should not be counted upon in calculating the amount of material she would receive in her daily ration. In comparing two fodders, therefore, it is not enough to know how much of the total nutrients each contains, we must know in addition the share that is digestible. Having determined the proportion of digestible protein, carbohydrates and fat in each of our fodders we will thereafter take account of those digestible parts only.

FEEDING STANDARDS.

It is evident that tables which give, for the different feeding stuffs, the amounts of dry matter and of digestible protein, carbohydrates and fat, can be of but little use to the farmer who does not know how much of each of these materials a cow requires per day. These tables aid him by translating the various foods into terms common to all of them. A practical feeder has found that 35 pounds of silage, 10 pounds of clover hay and 10 pounds of wheat bran per day make a ration that keeps a thousand pound cow in good condition and allows a full flow of milk. A trial of this ration for a period of reasonable length, say for a whole winter, noting the results in the increase of live weight of the cow or in milk and butter yielded, is a valuable experiment. Other dairymen want to profit by the results of this experiment but one of them has silage and no clover hay, and another has clover hay but no silage. How can these cow feeders gain anything from the experience of the first dairman?

THE GERMAN STANDARD.

Beginning in Germany and France a host of experiments were performed with dairy cows in full milk. All sorts of fodders and grain feeds were used. A record was kept of the amounts of each consumed, the resulting yields in milk and butter were recorded, the various foods were analyzed and digestion experiments performed with them. From the results of multitude of such experiments performed partly by practical feeders and partly by the German Experiment Station, Dr. Emil Wolff, the Director of the Hohenheim Experiment Station, after careful study proposed a feeding standard for milk cows per day and thousand pounds live weight. Taking the average of a great number of experiments and practical feeding trials he found that the medium sized cows of Germany giving a satisfactory flow of milk, required sufficient food to furnish daily 24 pounds of dry matter; that in this dry matter there were two and one-half pounds of digestible protein. He found further that, with the ordinary feeding stuffs obtaining in Germany, 24 pounds of dry matter containing 2.5 pounds of protein would contain also 12.5 pounds of carbohydrates, and a little less than one-half pound of fat.

Prof. Wolff farther suggested that to secure the best results, for every pound of protein in the ration there should be fed about five and four-tenths pounds of non-nitrogenous material. It is believed that one pound of fat is equal in feeding value to 2.4 pounds of digestible carbohydrates. In estimating the non-nitrogenous materials to compare with the protein, the fat of the ration is multiplied by two and four-tenths and added to the digestible carbohydrates.

AMERICAN STANDARD.

In January, 1894, a bulletin, entitled "One Hundred American Rations for Dairy Cows," written by Prof. F. W. Woll, was issued by the Wisconsin Experiment Station. In this bulletin the author compiled the feeding rations used in over a hundred dairies scattered from the Pacific to the Atlantic ocean. After a study of the results, he wrote as follows: *(Wis. Bulletin 38, page 46.)*

"Combining all of the above 128 rations which have been fed by successful dairy farmers and breeders in the various parts of our continent we have the following average American ration, as it may be called, as against the rations published by German experimenters, and heretofore largely used in this country."

AMERICAN STANDARD RATION FOR DAIRY COWS.

	Dry Matter.	Digestible matter				Nutritive ratio.
		Protein.	Carbo-hydrates.	Fat.	Total	
Average for 128 herds.	lbs. 24.31	lbs 2.15	lbs. 13.27	lbs. .74	16.16	1:6.9

"This ration is practically the same as the one published in Bulletin 33 and in our 9th report; it is believed that it will be found correct for our American conditions, except perhaps for those of the Rocky Mountains and the Pacific States. While local conditions or the business methods of farming in some places may make a ration desirable which contains more protein than this and has a narrower nutritive ratio as a consequence, we feel confident that in the large majority of cases its adoption will give satisfactory results, and that it is preferable to the German standard ration so long placed before our stock feeders as the ideal one, the nutritive ratio of which is 1:5.4. It is the result of American feeding experience; the majority of our most successful dairymen feed in the way indicatd by the ration and we shall not go far amiss if we follow their example."

THE M. A. C. STANDARD RATION.

The records of the feeding and milk yields of the dairy herd at the College may be studied in reference to the average amount of dry matter, protein, carbohydrates and fat consumed per thousand pound live weight per cow per day, and thus some light may be thrown on the question of a standard ration for dairy cows suitable to Michigan conditions. The College herd has been managed not differently from other herds in the State except that the feed and milk yield have been weighed. It must be remembered in considering these records that to obtain them, it has been necessary to weigh all the coarse fodder, all the grain, and in fact everything eaten by each cow, to set down the dates of the birth of the calves, the weights of the cow at weekly intervals, and the weights of each mess of milk and its per cent of fat as shown by the Babcock test. This has involved an immense amount of labor, but it has been necessary to make the results accurate and trustworthy. The weights and other data concerning the relation of the quantity and quality of the feed to the quantity and quality of the milk were brought together into tables too long and complex for publication here. They were published in Bulletin 149 and reprinted in the Report of the State Board of Agriculture for 1898, pages 269 and 275.

A variety of feeds was used in studying the question of a normal standard. Most of these feeding stuffs were analyzed at this station. In other cases the analyses published in reports of the Department of Agriculture or in bulletins of experiment stations were used.

Silage formed the bulk of the ration. With the silage was fed a mixed hay composed of determined proportions of timothy and clover. Other coarse fodders, such as cornstalks, millet hay, alfalfa hay and small amounts of other fodders were occasionally used.

The grain ration consisted of various mixtures of corn, oats, bran, linseed meal, cotton seed meal, gluten meal, and occasionally small amounts of other commercial grains and by-products. The main grain ration for one winter consisted of one-half of a mixture of linseed meal, bran, oats, and corn, in the proportion of one part of linseed meal to two of bran, three of oats, and four of corn, and one-half of a mixture of bran and wheat, half and half. During another winter the usual grain ration consisted wholly of one part linseed meal, two of oats, three of bran and four of corn. In a third winter the grain ration was made up of one part linseed meal, two parts corn, three of bran and four of oats.

To give variety to the ration, roots were fed almost continuously during the winter months. These roots were for the most part mangolds, sometimes sugar beets or carrots.

The composition of the feeding stuffs being known, and the amounts fed daily having been carefully weighed, it was not difficult to determine the composition of the average daily ration of the various cows. This method of feeding differed somewhat from that generally used by experiment stations, but was the one adopted after considerable thought, and is one which is approved by farther experience.

The coarse fodders were weighed daily to each animal, the quantities given being gauged by the judgment of the feeder. Weights are taken on scales that read to half a pound. Variations of a less quantity in these cheap and relatively heavy fodders are not material. It was found, after trying the method for a year with a large herd, that to weigh the grain for each cow involved so many delicate weights and permitted so many errors that some other scheme had to be devised to insure accurate results. Therefore, a box large enough to hold two hundred pounds of the grain mixtures was provided for each cow. Into this box there was weighed weekly enough grain to more than last a week. At the close of the week the box and the grain remaining in it were weighed and that weight subtracted from the weight of grain and box at the beginning of the week. In this way the amount of grain consumed by the cow during the week has been accurately determined. This method is not applicable to experiments where results depend upon a knowledge of the amount of grain consumed each particular day, but recommends itself to conditions where the record of food consumption for a long time is contemplated.

While the composition of the grain ration was fixed in the office of the Farm Department of the Experiment Station, the amount to be fed each day to each cow was left to the judgment of the expert herdsman. This plan was inevitable. No cow wants day after day the same amount of food nor even the same mixture. When the weather is cold and keen, her appetite is more vigorous, even if she is kept in a relatively warm but well ventilated barn, than on a warm and murky day. The proportion of coarse fodders to grain may profitably be increased on such occasions. The quantity, therefore, both of the coarse fodders and of the grain feed and by-products was left entirely to the judgment of the man who fed the cows and who adjusted the quantity to the milk yield and the condition of the bowels.

In formulating the standard daily ration the cows were grouped into three lots, those weighing approximately 1,000 pounds, those weighing about 1,400 pounds, and cows not giving milk. From the data furnished by the weights of feed and of milk and butter fat yielded, the amount of dry matter, digestible protein, digestible carbohydrates and digestible fat were calculated.

The records showed the amount of fat secreted by the cows. The table below shows the average daily fat yield secured from the consumption of the ration by the cows under experiment. There is also given the average month in the period of lactation and the average weight of the cows.

M. A. C. STANDARD RATIONS, PER 1000 LIVE WEIGHT.

	Dry matter.	Digestible protein.	Digestible Carbo-hydrates.	Digestible fat.	Daily fat.	Average month.	Average Weight.
	lbs.	lbs.	lbs.	lbs.	lbs.		lbs.
1,000 pound cows	23.57	2.06	12.50	.89	1.21	3.8	982 8
1,200 pound cows	22.11	1.89	11.23	.67	1.027	6	1,396.68
Dry cows	15.20	1.09	8.20	.49	.23	9.8	1,373.5

The nutritive ratio of the standard ration suggested for the thousand pound cows is 1:7.1, that of the larger cows 1:7.21, and that of the cows in the very latest months of the period of lactation is much wider, being 1:8.53.

The tables from which these feeding standards were derived, conclusively demonstrate the limitations of the use of the feeding standards. They show that it is entirely wrong to assume as Wolff does to set up a stated amount of dry matter and of protein as correct for a cow of given weight, or to graduate the amount of dry matter and of protein, which a cow should receive, by her live weight alone. One cow has a greater capacity to consume, digest, assimilate, and economically utilize food than another of the same weight. Again, the same cow requires a different amount of dry matter at one time than at another. In the early months of the period of lactation, when her yield is at the maximum, she requires a much larger amount of feed than later, when the draft upon her body of milk constituents is lessened by the smaller yield. Take the case of a certain Guernsey cow, Aida II, for instance. In January, 1896, although weighing but 915 pounds, her daily yield of fat was 1.42 pounds. Her average daily ration for the month supplied 29.31 pounds of dry matter per thousand pounds live weight, containing 2.56 pounds of protein, 15.42 pounds of carbohydrates, and .97 pounds of fat, with a nutritive ratio of 1:6.9. On this ration the cow continued her maximum yield through the month, and at the same time made a gradual gain in weight. The watchful eye of the feeder noted this fact, and slightly reduced the amount of dry matter in the ration. This was accomplished without changing the weight of the materials fed, by feeding silage with a much lower per cent of dry matter. The dry matter fed per day to the cow was kept considerably above the standard to warrant the large yield of fat, during the five early months of the period of lactation.

Standing by her side was a mature Jersey cow, College Pogis, which had a tendency to lay on fat. She was giving a large flow of milk and was, in January, 1895, in the fourth month of her milking period. Her ration was below the standard recommended. Her weight remained practically constant and her yield of fat gradually declined, as was to be expected from the lapse of the period of lactation. During the next winter her flow of milk and yield of fat daily was promising at the outset, and she was given 25 to 26.5 pounds of dry matter per day, with 2.36 pounds of protein. Her daily yield of fat kept constant for the three months of winter at 1:8 pounds or slightly more than 2 pounds of butter per day. The grain ration was kept up during the summer, and by October the cow had made the phenomenal yields of 11,314.71 pounds of milk and 553.06 pounds of fat. It would have been sheer folly to measure her feed during the early months of her period of lactation by any standard based upon live weight alone or derived from the average feeding of average cows.

Still more remarkable is the consumption of dry matter and protein of College Pogis II during the winter of 1895-1896. Here we have a cow that weighed in January but 880 pounds, which was gaining in live weight because still young and which was turning out regularly nearly 2 pounds of butter per day. She required on the average for a whole month over 32 pounds of dry matter per thousand pounds of live weight per day, containing 2.75 pounds of protein. The cow weighed but 880 pounds, and this 880 pounds was made up largely of digestive organs, lungs and udder. In proportion to her live weight she could consume and economically utilize a very much larger amount of feed than could an animal with a massive frame and relatively small per cent of viscera and udder.

A study of the tables shows conclusively that an expert feeder varies the size of the ration, not according to the weight of the cow alone or primarily, but according to her capacity to receive and her ability to yield, and that, with the same cow, the ration is modified as the period of lactation advances, to conform to the requirements of the system.

What is true of the dry matter is true of the digestible protein. Where a cow is secreting a large amount of milk containing from one to two and one-half pounds of dry casein per day, her food must be relatively much richer in protein than when she has not this demand upon her system. The food requirements of the system to sustain the vital functions remain comparatively constant. To these requirements is superadded, in the periods of greatest milk yields, the demand for the butter and cheese in the milk. Protein is required not only to supply the casein of the milk, but to insure that active vitality of the whole nervous system which is involved in butter production. A farther discussion of the subject is not necessary to properly emphasize the fact that not only must a larger, but a richer ration as well, be given to a cow when giving a large yield than when comparatively dry.

As to the digestible fat, economic considerations demand that such a combination of foods be made, to furnish the requisite dry matter and protein, as will furnish as the same time fully .89 pounds of digestible fat per day for the smaller cows. But no definite amount of fat can be prescribed in the ration, first, because the word fat in this connection includes many dissimilar substances. A pound of digestible fat derived from silage or green fodder is a very different thing from a pound of digestible fat derived from linseed meal or any of the by-products. Again, using the feeding stuffs grown upon the farm for the largest practicable share of the ration it would be difficult to propose any economical combination that would not furnish more digestible fat than the standard of either Wolff or Woll calls for.

It is evident from a consideration of all the facts in the case, that a standard ration cannot be used as a fixed rule in determining the amount or kind of feeding stuffs that should be given a certain cow at a certain time. It can supplement and partially guide the judgment of the feeder, but it cannot take the place of judgment and experience.

A sufficient number of records are not submitted in the third division of the table, which gives the food consumption of the cows nearly dry, to warrant the statement of a definite conclusion. In each case there is a very evident increase in live weight, as there should be, when cows are approaching parturition. The fact that our cows gained regularly in live weight is good, but perhaps insufficient evidence that the ration here suggested is sufficient basal ration representing the amounts of dry matter and digestible nutrients required by the cow to sustain the vital functions.

Recognizing the just limitations of the application of the feeding standard the daily ration of 23.57 pounds of dry matter 2.06 pounds of digestible protein, 12.50 pounds of digestible carbohydrates and .89 pounds of digestible fat is suggested by the College herd, for cows in the third and fourth month of the period of lactation giving a good yield of milk. A knowledge of the feeding standard and the methods of computing rations is by no means all that there is of skillful cow feeding. That art is one which cannot be acquired without long experience in the stable, and one which involves the exercise of well trained powers of observation and, above all, well ripened judgment.

It is evident that the standard ration takes no cognizance of the relative money values of the various feeding stuffs. The practical feeder has to approach the question of what shall constitute his ration very largely from that side. He considers primarily not what combinations of food will cause his herd to yield the most butter, but what combinations he can bring together most economically, and by what combinations his cows will return the most net profit from the materials which his farm produces.

The standard ration fails to recognize the peculiarities of different feeding stuffs in the matter of their specific effects upon the quality of the butter produced or upon the health and condition of the cow. Some fodders, though showing a very high content of digestible nutrients, are nearly worthless because cows do not like them or because they seriously impair the quality of the products. It is not enough, therefore, to report the relation between the quantity of butter produced and the quantity of food consumed, when new forage plants are under discussion. The quality of the products and the relation of the material to the appetite of the cow must also be given, to round out and complete the proper history of the experiment.

COMPOSITION OF FEEDING STUFFS.

Chemical analyses have been made of all our common feeding stuffs either at this experiment station or elsewhere. The average of a large number of such analyses combined with digestion coefficients are given in the following table. This table sets forth the amount of dry matter and digestible material in one pound of each of the materials mentioned. The carbohydrates and fat are combined under one head, the fat being multiplied by 2.4 to reduce it to its equivalent value in units of carbohydrates. The nutritive ratio of the digestible material in a given fodder is also named. In the calculation of rations it is necessary to multiply the figures given in the table by the number of pounds of the material taken to find the weight of the ingredients in the material.

The table is compiled from various sources. Some of the analyses made at this station are brought into the table by the use of the proper ligestion coefficient. Others are taken from tables in Woll's Dairy Calendar and from Henry's Feeds and Feeding.

Dry matter and digestible material in one pound.

	Dry matter.	Protein.	Carbohydrates and fat.	Nutritive ratio.
Green fodder:—				
Alfalfa	.282	.0388	.132	3.4
Alsike clover	.252	.027	.1454	5.8
Cabbage	.097	.018	.0946	5.3
Corn fodder, Flint, cut early	.202	.0122	.132	10.9
Corn fodder, Flint, after glazing	.229	.013	.1484	11.4
Corn fodder, Dent, cut early	.21	.012	.1312	10.9
Corn fodder, Dent, after glazing	.26	.011	.1668	15.1
Cowpeas	.164	.0143	.0832	5.1
Green oats	.378	.026	.2438	9.3
Kaffir corn	.255	.005	.1480	29.64
Millet	.25	.018	.1252	6.9
Orchard grass	.27	.015	.1263	8.4
Peas and oats	.16	.018	.0758	4.2
Pasture grass	.20	.026	.1180	4.5
Pumpkins	.10	.01	.0652	6.5
Rape	.13	.02	.0858	4.3
Red clover	.292	.029	.1648	5.6
Soja beans	.25	.0321	.122	3.8
Sorghum	.200	.005	.1326	26.52
Sugar beet leaves	.12	.017	.0508	2.92
Sweet corn	.209	.012	.1316	10.9
Timothy, before bloom	.384	.012	.2468	20.5
Timothy, after bloom	.41	.014	.2288	16.3
Silage:—				
Alfalfa	.275	.03	.133	4.4
Apple pomace	.15	.006	.1036	4.4
Corn, mature	.20	.009	.1274	14.1
Corn, immature	.20	.004	.1274	3 8
Red clover	.28	.02	.159	7.9
Soja beans	.258	.027	.1182	4.4
Sorghum	.239	.006	.1538	25.6
Hay and dry coarse fodder:—				
Alfalfa	.916	.11	.4248	3.86
Alsike clover	.903	.084	.461	5.4
Bean pods	.85	.051	.3758	7.3
Buckwheat straw	.88	.014	.3696	26.4
Corn fodder, field cured	.578	.026	.3594	13.8
Corn stalks	.595	.02	.3484	17.4
Cowpeas	.893	.108	.4124	3.8
Hungarian grass	.923	.045	.488	10.9
Mammoth clover	.788	.057	.3656	6.4
Mixed hay	.84	.036	.451	12.5
Oat hay	.911	.042	.463	11.0
Oat straw	.908	.016	.4308	26.9
Orchard grass	.86	.049	.4336	8.8
Peas in bloom, field cured	.833	.094	.3694	3.9
Pea vine	.864	.043	.3432	7.9
Red clover	.847	.068	.3988	5.8
Soja bean straw	.899	.023	.424	18.5
Timothy, cut early	.85	.029	.4452	15.3
Timothy, cut late	.86	.024	.4847	20.2
Wheat straw	.914	.008	.3860	48.2
Roots and tubers:—				
Artichokes	.20	.02	.1728	8.64
Carrot	.114	.01	.0828	8.28
Flat turnips	.095	.01	0768	7.68
Mangolds	.091	.01	.0564	5.64
Parsnip	.117	.016	.1188	7.3
Potato	.21	.01	1624	16.24
Rutabaga	.114	.01	.0834	8.34
Sugar beets	135	.011	.1024	9.3
Table beets	115	01	.0904	9.0

	Dry matter.	Protein.	Carbohydrates and fat.	Nutritive ratio.
Grain:—				
Barley	.891	.087	.6944	8.0
Buckwheat	.874	.077	.5352	7.0
Beans	.678	.181	.3943	2.2
Corn, dent	.894	.078	.7702	9.8
Corn, flint	.887	.08	.7652	9.56
Corn, sweet	.912	.088	.805	9.1
Corn cob	.893	.004	.5322	133.0
Cowpeas	.832	.183	.5684	3.1
Oats	.89	.092	.5738	6.2
Peas	.895	.168	.5348	3.1
Rye	.884	.099	.7024	7.09
Soja beans	.892	.296	.5686	1.9
Sunflower seeds	.92	.104	.7548	7.2
Wheat	.895	.092	.6826	7.4
Mill products:—				
Buckwheat bran	.895	.074	.3496	4.7
Buckwheat middlings	.873	.22	.4636	2.10
Corn bran	.909	.074	.7084	9.1
Corn and cob meal	.849	.044	.6696	15.2
Corn and oats, equal parts	.892	.086	.6354	7.3
Flax, ground	.908	.206	.867	4.2
Flour, low grade	.876	.082	64.86	7.9
Middlings	.879	.128	6116	4.7
Oat feed	.923	.125	.5362	4.2
Oat hulls	.906	.013	.4154	31.9
Rye bran	.884	.115	.551	4.8
Wheat bran, spring wheat	.877	.123	.4334	3.5
By-products:—				
Apples	.152	.003	.1328	44.2
Beet pulp, fresh	.102	.006	....	12.1
Beet pulp, dried	.901	.075	.073	8.1
Beet, molasses	.792	.091	.614	6.5
Brewer's grains, wet	.243	.039	.595	3.2
Brewer's grains, dry	.918	.157	.4854	3.1
Buttermilk	.099	.039	.0664	1.7
Cotton seed meal	.918	.372	.4618	1.2
Gluten meal	.896	.258	.697	2.7
Gluten feed	.922	.204	.6952	3.4
Hominy chops	.889	.075	.7152	9.5
Linseed meal, old process	.908	.293	.495	1.6
Linseed meal, new process	.899	.282	.4682	1.6
Malt sprouts	.898	.186	.4118	2.2
Skim milk	.096	.031	.0662	2.1
Whey	.066	.008	.0542	6.7

CALCULATION OF RATIONS.

If our domestic animals were mere machines into which could be poured feeding stuffs of definite composition and which would produce from these materials definite and certain products, there would be no art of feeding. The whole matter would be mechanical and all problems would be solved by mathematical formulae. Animals are something more than machines. They must be treated as individuals and as sensitive beings, each with its own peculiarities of appetite and digestion. The following suggestions in regard to the calculation of rations are not intended to be a guide to the inexperienced but are put forth simply to help the man who already understands the nature of the animals with which he is dealing.

While a ration should be balanced in the sense that the relative proportion of the protein and carbohydrates should be normal, it by no means follows that because a ration is balanced it is therefore suitable to the animals to which it is to be offered or is the most economical to be constructed out of the materials at hand. There are other factors to be considered beside the chemical composition of the feeds. For economical reasons the animal ought to be urged to consume as much as it can well digest. The ration ought, therefore to be palatable. In the winter the digestive organs are apt to become partly clogged or to become constipated. The ration ought therefore to be succulent. Various combinations of given feeding stuffs are possible to form a balanced ration. Such a combination ought to be selected as will approximate the theoretical ration and yet will cost as little as possible. The farmer never feeds his stock solely to consider their physiological requirements. He feeds them to make money. The cost of the ration must always be considered. With these thoughts in mind the purely mechanical part of calculating rations is here given, taking the work with a dairy herd as an illustration.

A dairy herd is to be fed during the winter selecting from the following list of materials which the farmer has on hand, and supplementing these feeding stuffs with others selected from the list in the latter part of the table. The problem is to determine economical rations, selling grains grown on the farm and purchasing commercial feeding stuffs when it is economical to do so. The prices given are estimated and the rations determined are true for these prices alone. If the market values change and there is no large supply on hand it is probable that the farmer should change his ration for his herd to correspond to the new arrangement of prices.

FEEDING STUFFS GROWN OF THE FARM.

	Per ton.
Clover hay	$6.00
Timothy hay	8.00
Silage	2.50
Shelled Corn	20.00
Oats	20.00
Barley	17.50
Mangolds	2.50
Millet hay	5.00
Corn stalks	3.00
Oat straw	2.00

FEEDING STUFFS IN THE MARKET.

Linseed meal, o. p.	$28.50
Wheat bran	16.00
Wheat middlings	17.00
Gluten meal	24.00
Buckwheat middling	25.00
Malt sprouts	17.50
Cotton seed meal	26.00

The wise dairyman keeps a record of the amount of coarse feed he has on hand. He knows how many tons of silage he has. This stuff is not salable and must be fed. His clover hay he will feed to cows and sheep, his timothy hay to horses and, if there be a surplus, perhaps to his cattle, depending upon the cost of selling and hauling to market and hauling back some substitute. His corn stalks, millet hay, and possibly part of his oat straw he will feed. What the proportion of clover hay, millet hay and corn stalks in the ration shall be, will depend upon the quantity of each that the farmer has on hand.

For the purpose of illustration let us take the problem presented by a certain farmer in the State who had ten cows, fresh in the fall which he wished to feed to good advantage through the winter. His silo was large, but there was but thirty tons of silage available for his cows. Ten tons of clover hay, eight tons of corn stalks, five tons of timothy hay and an unlimited amount of oat straw constituted his roughage. He had on hand eight hundred bushels of oats and five tons of shelled corn. He could buy the feeding stuffs in the market at the prices mentioned. How shall he go to work to construct his ration?

Beginning at the first of November and feeding through to the tenth of May he would need to prepare for two hundred days. Leaving out his timothy hay he would find on hand enough roughage to furnish a daily ration, consisting of thirty pounds of silage, ten pounds of clover hay, and eight pounds of corn stalks for each cow. He would have shelled corn enough in addition to furnish five pounds per cow and oats enough, if he cared to feed them, to furnish fully twelve pounds per day. He can sell the oats at $20.00 per ton and he can buy bran at $16.00 per ton. Shall he sell the oats? Let us compare the grain feeds on hand and the feeds to be bought in the markets as to the value in dollars and cents of one pound of protein in each. Consulting the tables of analyses of feeding stuffs, it is found that one pound of linseed meal contains .293 lb. protein. A ton, 2,000 pounds, would therefore contain 2,000 times .293 lb. or 586 pounds. For the moment considering the other nutrients of no value and supposing the price per ton, $28.50 to be predicated solely upon the protein, we divide the $28.50 by 586 and find the cost of one pound of protein to be $.0486. Making similar computations for each of the grain feeds and the by products, the following table results.

Cost of a pound of protein in the grain feeds at the prices assumed.

In linseed meal, o. p.	$.0486
In wheat bran	.065
In wheat middlings	.0664
In gluten meal	.0465
In buckwheat middlings	.0568
In malt sprouts	.047
In cottonseed meal	.0349
In oats	.108

Under the conditions imposed, and at the prices named, it is evident that of the feeding stuffs offered the cottonseed meal furnishes the protein the cheapest. Linseed meal, gluten meal and malt sprouts follow, all supplying the protein at about the same price. As far, therefore, as these feeding stuffs can be substituted for oats, the latter had better be sold and these or some of them bought, since the protein in the oats is valued, under the market conditions assumed, at \$.108. per pound.

We are now ready to take up the calculation of the ration. It is put in tabular form, thus:

Material.	Dry matter.	Protein.	Carbohydrates and fat.	Cost.
	lbs.	lbs.	lbs.	\$
30 lbs. silage	6.	.27	3.82	037
10 lbs. clover hay	8.47	68	3.99	.03
8 lbs. cornstalks	4.76	.16	2.79	.012
2 lbs. cotton seed meal	1.83	.744	92	.026
3 lbs. corn meal	2.68	.234	2.21	[illegible]
	23.74	2.088	13.73	.135

Nutritive ratio 1 : 6.64.

Here we have a ration conforming very closely to the standard and costing but \$.135. Although the standard ration calls for but 23.57 lbs. of dry matter, experience has shown that a good dairy cow weighing half a ton and yielding a pound or more of fat per day will eat fully 26 lbs. of dry matter. It is possible to construct from the materials given a great variety of rations, putting 5 lbs. of timothy hay in the place of the 3 lbs. of cornmeal, for instance, thus making a cheaper but far less efficient ration. Or wheat bran may be substituted for the cotton seed meal and the cornmeal, making a more expensive ration but one possibly as efficient.

The ingenuity of the farmer may construct a great variety of rations which will comply with all the requirements of the standard but the cow must be the final judge as to their utility and efficiency. It should be the aim to construct the ration of the cheapest materials possible and yet have it conform in essential particulars to the standard ration. The grain feed should furnish at least four-tenths of the nutrients in order to economize the digestive work of the cow. The experience of the feeder must guide him as to the profitable quantity and the proper admixture of the constituent factors.

DISCUSSION OF FEEDING STUFFS.

LEGUMES.

Clover hay. Recent bulletins from this station have discussed the utilization of the free nitrogen of the air by leguminous crops. It has been shown that while the clover crop does exhaust, to some extent, the mineral constituents of the soil, it leaves a large quantity of nitrogen in the roots. As a matter of fact the soil is sometimes richer in nitrogen after growing the crop of clover than it was when the clover seed was sown. The early experiment in this matter was performed in 1897. A sandy loam was bearing a heavy crop of clover. A section of earth was dug about and left standing, a ditch being dug about it. By means of iron rods thrust through the mass of earth, the clover roots were held in place while the sand was washed away. The experiment was performed July second when the clover was in full bloom. The clean roots and green tops were weighed separately, the tops being cut off an inch above the crown. The tops weighed 2.44 lbs. and the roots 2.14 lbs. The dry matter in the tops weighed .99 pounds and the roots .656 pounds. A chemical analysis was made showing that the dry matter of the tops contained 2.48 per cent nitrogen, that of the roots 2.55 per cent. The tops were slightly richer in potash, 1.82 per cent as against 1.21 per cent in the roots. In phosphoric acid neither were rich, the top having .68 per cent and the roots .83 per cent.

The ground having been measured and the yield weighed, it is easy to compute the amount of these fertilizing constituents in an acre of the crop, separating the content of the roots from that of the tops. Such a calculation is dangerous because the area taken was small. The results indicated, however, that on an acre of clover in full bloom, the tops would yield 132.31 pounds of nitrogen and the roots 62.00 pounds. It would require something like seven tons of average barnyard manure to supply as much nitrogen as is furnished by these roots of the clover on an acre. If the whole crop were plowed under it would supply the soil with as much nitrogen as would be furnished by 21 loads of manure per acre. The experiment also illustrated the fact that a clover crop removes about 100 pounds of potash and 36 pounds of phosphoric acid from an acre. Naturally if the clover hay is fed on the farm, the manure carefully protected from washing and hauled back to the land, there will be no important loss of these important minerals. If clover hay is to be sold its content of nitrogen, phosphoric acid and potash is important.

Experiments were tried in the matter of putting clover in the silo. Early in July a small experiment silo, but ten feet deep and six feet in diameter was filled with green clover. It held 2,773 pounds. It was opened in September, found in excellent condition but the contents have shrunk in weight to 2,587 pounds. The cows were running on fairly good pasture but they ate the clover silage with avidity. To determine how much well cured clover hay was represented by the silage, 4,691 pounds of freshly cut clover was spread out to dry. Two days later it was cured enough to haul to the barn, weighing then 1,960 pounds. On the 12th of November, four months later, it weighed 1,740 pounds, 37 per cent of the original weight. The 2,773 pounds of silage therefore represented 1,026 pounds of well cured hay. The chief objection to putting clover in the silo is that it is slow and expensive work to draw so much water to the barn. The green clover is inconvenient to handle, is hard to rake up and is particularly disagreeable to pitch on and off the wagon. The comparative losses of field curing and siloing have not been determined.

Later the trial was repeated. The silage kept well and the cows liked it, but it is so much cheaper to allow the sun to dry the hay than it is to draw the heavy green forage to the silo, that clover ought to be cured as hay, except, perhaps, in extremely wet seasons.

Experiments were conducted to test the value of clover cut in the early autumn and grown from seed sown the spring of the same year. When the season was moist the yield was as high as a ton to the acre on the wheat stubbles. Neither cattle nor sheep seemed to like this fall crop although secured without exposure to rain. Chemical analysis showed that the nitrogen in the clover was largely in the form of amido bodies and not in the form of true protein.

The varieties of clover in general use in the state are the medium red clover, the alsike and the mammoth. The red and the alsike have furnished hay about equal in value. The mammoth gives a hay not eaten as clean as the medium because of the more woody stem. The alsike clover has yielded a large amount of hay per acre and has proven rather better for pasture than the medium, being more persistent. A certain field containing 34 acres was used as a pasture for 18 head of growing cattle. This quantity of stock was insufficient to keep the clover eaten off. Mowers were put in on the twenty-fourth of June and the hay was hauled on the thirtieth. The yield for the 34 acres was 36 tons of cured hay, most excellent in quality, green in color and free from dust. At other times alsike has given a very gummy hay resembling the second crop of medium clover. Alsike is apt to come up as a weed in subsequent crops of corn, but such weeds are not troublesome although they are plants out of place.

Crimson clover has not proven satisfactory to the station as a forage crop for dairy cows.

Vetches have been tried repeatedly but the hay has not been palatable to either sheep or cattle.

Peas have been sown on fall prepared ground, 2 bu. of seed to the acre at the earliest possible moment in the spring. From ½ bu. to 1 bu. of oats have been sown on a little later, just as the peas had germinated. Unfortunately careful records are not at hand to show the yield of hay from this crop nor have comparative feeding trials demonstrated the relative value of such hay compared with clover. The cattle have liked the hay and have eaten it in sufficient quantities to produce a full yield of milk. On several occasions the crop has been harvested into a silo making a silage richer in protein than other silage fed. Its per cent of dry matter when fed was 49.92 and its per cent of protein 4.5.

Alfalfa hay has never been produced in sufficient quantities at the station to test its feeding quality. Analyses have shown it to be richer in protein than red clover hay by nearly if not quite 50%. Cuttings have been made as early as the 25th of May and as late as the 5th of September. The hay from the first cutting has been the most succulent, that is contained the most water, while the hay from the last cutting, equally as rich in total nitrogen, has been less rich in true protein, the nitrogen being largely in the form of amids. It has been found somewhat difficult at times to cure the hay without the loss of leaves. It has been raked together when less dry than clover is usually raked. It is then left in bunches to sweat, the bunches being covered at night with hay covers. As reported in other bulletins, the yield of alfalfa per acre per year has been most satisfactory. It has been tried as a pasture, but not with satisfactory results. Sheep have shown a tendency to bloat, especially when the alfalfa has been damp by dews. The pasturing has not seriously injured the roots, however, although the plots pastured have yielded to the encroachments of the great enemy of alfalfa, blue grass, more readily than have the plots not pastured.

Soy beans have been fed as hay and as silage, in combination with corn. It was found no easy matter to cure the soy beans for hay, largely because they mature in the autumn when the weather is not dry enough and not hot enough to quickly dry the hay. The leaves break up and are lost leaving the very woody stems which do not make a palatable feed for cattle. Both cattle and sheep have eaten the straw from ripe soy beans after threshing, except the coarsest woody stems. Of the varieties of soy beans, the medium green is the most promising for hay or silage.

Cowpea hay has been grown for several years but not in large quantities. Like the hay from soy beans it matures in the fall and, where the crop is at all heavy, it is quite difficult to harvest and still more difficult to cure unless the weather be exceptionally favorable. Late spring and early fall frosts, both not infrequent in the State, make the growing and curing of cowpeas for hay too precarious to allow it to be added to our list of regular coarse fodder.

CEREALS.

Corn. As a forage crop corn has been fed both in the form of silage and as stover and grain. No experiments have been conducted to test the comparative merits of these two methods of preserving it. When the corn has been husked, the stalks have usually been shredded, largely to make them more easily handled and to keep the long coarse stalks out of the manure. It has been shown by other stations that there is a slight profit in shredding the fodder although the large per cent of crude fiber in the coarser parts of the stalk indicates that, although the chemist finds present no inconsiderable amount of carbohydrates, the cow finds that it requires about all the energy derived from the coarse material to digest it. It is therefore questionable whether there is much profit in expending human labor to gather and preserve the butts of the corn stalks except for manure. When shredded, the corn stalks may be used as an absorbent and thus come properly in the manure although containing but a small per cent of either nitrogen, phosphoric acid or potash.

An extended series of experiments and observations revealed the fact that whereas but 35.70% of the total weight of the corn plant was resident in the ears, 46.32% of the dry matter was found in the ears, 31.91% in the stalks and 21.77% in the leaves. The total protein content was distributed 50.60% in the ears, 32.30% in the leaves and 17.10% in the stalks. On the other hand when it comes to the ash it was found that just half of all the ash material in the entire plant was found in the leaves, 32.60% in the stalks and but 17.40% in the ear. The ears contain but 1.75% of ash, while on September 14, the leaves contain 10.92% of ash. Here is a reason for feeding the leaves and ears together. The statement so often made that shelled corn is weak in ash seems therefore abundantly justified.

Corn silage has been used as the basis of the dairy ration at the experiment station for years. The cows are universally fond of it and have eaten it to the full amount allowed. Very little, if any, refuse was left in the mangers. The milk from the silage fed cows has been sold to fastidious consumers and no fault has been found with the flavor. On certain occasions the milk has been sealed immediately after milking, and opened later in the presence of critical judges but it has not been possible to detect the difference between the milk made from silage and from dry feed. The butter made from silage fed cows has been of excellent quality, of the right consistency and body and free from any unpleasant flavor, traceable to the silage. This has been true although no special pains have been taken to ventilate the barn prior to milking.

Corn silage has been far from uniform in composition. That taken from the same silo the same year, made from the same corn and ensiloed at the same time has varied in water content from 68.62% of water on December 10 to 79.63% on the 24th of March following when the bottom of the silo was approached.

It was interesting to note in still another series of experiments that the per cent of protein in the silage increased as the distance between rows and hills in the corn field was increased. Where the corn was planted very thick the per cent of protein was as low as .98. When the rows were 14 in. apart the per cent rose to 1.06. When the distance apart of the rows was double, 28 in. apart, the per cent rose to 2.55. The teaching of the experiment was plain, that although drilling the corn very thick means a large crop as far as gross weight is concerned, it also means a low per cent in protein.

In the same series of experiments *sorghum* was compared with silage corn for the silo. When harvested the yield of green fodder per acre on the part of the sorghum was 38,676 lbs. while the gross weight of the silage corn was but 29,684 lbs. The materials were analyzed and the results showed that the yield of dry matter per acre were 8,655 lbs. for the silage corn and but 7,700 lbs. for the sorghum. This was true notwithstanding the fact that the sorghum had so much the greater yield per acre as measured by the scales. Turning to the protein the silage corn was found to produce 735 lbs. of protein per acre while the sorghum had but 429 lbs. So in the nitrogen free extract, the starch and sugar, where the sorghum might be expected to lead, it was found that the silage corn had 5,734 lbs. while the sorghum had but 4,237 lbs. In crude fiber the ingredient not alone worthless but often injurious by depressing digestibility, the sorghum led, yielding 2,169 lbs., while the silage corn had but 1,554 lbs. Sorghum did not compete with corn therefore as a plant for the silo. In fact sorghum showed at no point a superiority to corn as a forage crop. On the other hand, its low yield of protein and its very woody stems go far toward condemning it.

Our experiments do not warrant us in recommending the crop in any locality where Indian corn can be grown.

Kaffir corn. This plant is a sorghum, but one that does not produce a sufficient amount of sugar to make it valuable as a source of molasses or sugar. It is therefore called a non-saccharine sorghum. While growing in the field it somewhat resembles corn, although it bears its seeds at the top, and the ears on the side of the stalks are wanting. It yielded in early September, when harvested into the silo 34,360 lbs. The cows ate both the silage and dry fodder of Kaffir corn with good relish. The main objection to the plant is its stiff, pole-like, stems which the cows cannot eat. It is slow to start in the spring, makes a tall growth, and yields a large amount of forage to the acre. So far as the experiment at this station goes it cannot compete with Indian corn as a forage crop for Michigan.

Millet and Hungarian grass. In former bulletins of this station the investigations in regard to the methods of growing these grasses and the adaptability of the many varieties have been fully discussed. The millet grown on the farm has been fed, for the most part, as hay. On one or more occasions the green fodder has been put in the silo. The silage is liked by the cows and keeps up the flow of milk. It is unusually dry for silage, containing in one sample, but 57.10% of water. When pitched out of the silo it was very light and bulky, resembling hay rather than silage. It had a pleasant odor and kept with little or no spoiling. The millets mature in the fall, and where the crop is heavy, it is sometimes hard to cure the hay. In such cases the millets may be successfully stored in the silo. Millet is recommended for the consideration of dairy men because it can be sown late in the season after a crop of peas and oats has been removed or can be substituted for corn when the spring work has been so delayed as to make the planting of the latter impracticable.

Foreign grasses. Many English grasses have been tried at the station but the results have not been at all encouraging. The English grasses, the fescues and the rye grasses, have never done well either on the dryer or moister parts of the college farm, on the sands or sandy loams or on the clay. The summers are too dry and harsh. Timothy is the grass upon which dependence can safely be placed.

On the sandy soils, tall oat grass has been tried but it is hard to get good seed and the crop is neither permanent nor large. Bromus inermis, so successful in the west, finds no place on the farm of the practical dairyman in this state. Orchard grass has shown considerable value. A certain field was sown in 1895 and still maintains a fairly good sod although it has not been reseeded since. The crop has dwindled, as might be expected. The main difficulties with making the grass valuable come from the facts that it cannot be sown alone because it will not make a continuous sod but rather a series of hummocks and again it must be cut as soon as the heads are well formed or the hay is excessively woody. On the other hand the orchard grass has shown itself an excellent factor in a pasture as it revives quickly when eaten off and is exceedingly early in the spring to make a start. The seed weighs but fourteen pounds to the bushel.

ROOTS.

Mangolds, Carrots, Sugar beets and Rutabagas. Where silage is not used the dairman should provide succulence for the winter ration in the shape of some kind of roots. The three which suggest themselves as probably yielding the most value for the labor and money expended in growing them are mangold, sugar beets and carrots. Turnips and rutabagas may be used in the dairy but always with extreme caution, because of their liability to impart an unpleasant taint to the milk and to the products made from it. It is true undoubtedly that rutabagas can be fed to dairy cows in such a way as to avoid this taint in the milk. They must be fed after milking. Precautions as to manner and amount have to be taken and sometimes these precautions are apt to be neglected. The result is a sample of butter injured and perhaps a customer permanently offended. The reasonable use of other roots is attended with no such danger, and for this reason they are recommended. The area devoted to them need not be large, but roots add a needed variety to a winter ration, whether a silo is used or not. They repay their cost in the increased healthfulness of the cow as well as in the butter produced.

A comparison was made of the cost of growing and of the yields of ox-heart carrots, yellow tankard mangolds, long red mangolds and rutabagas. The yield per acre were as follows:

	Yield per acre.	Dry matter per acre.
Carrots	28,836	3,321.90
Long red mangolds	25,616	3,381.30
Tankard mangolds	21,744	2,111.30
Rutabagas	31,028	3,741.98
Sugar beets	28,320	5,346.80

The largest yields, both in gross weight and dry matter are given by the rutabagas, the long red mangolds following next. The average yield per acre of four acres of sugar beets grown on land adjoining the root field was, as given in the table, over fourteen tons per acre containing 5,346.80 lbs. of dry matter.

The mangolds were sown May 10, 9.6 lbs. of seed per acre. Two lbs. of carrot seed per acre were sown the same day. The rutabagas were sown a week later, 2.8 lbs. seed per acre. The cost of preparing the ground, marking, planting, cultivating, thinning and hoeing was practically the same for all roots and amounted to 32.8 hours for man and team and 209.9 hours for man per acre. At the prices prevalent at the college the cost of labor for growing and harvesting an acre was $28.55. The labor necessary to harvest an acre of mangolds was appreciably less than for an acre of sugar beets or carrots. The labor cost per ton of carrots was slightly less than $2.00 per ton of rutabages, $1.84, and of mangolds $2.51.

The roots have been stored both in the pit and in the root cellar adjacent to the cow stable. They have kept better in pits than in the cellar but an extra handling is necessary when so stored. It is undoubtedly wise to store the roots needed, for late winter feeding, in the pits. The roots are sliced before feeding and cows may be allowed any amount possible up to a peck or even more at a mess.

Three sets of experiments have been completed to test the influence of roots on the digestibility of the ration. The results coincide in showing that roots do not make the dry factor of the ration more digestible. They do increase the nutritive effect of the ration by economizing the amounts required to support the act of digestion. Their principal value to the dairyman lies in keeping the bowels well regulated and keeping the herd healthy.

Potatoes, while not roots are usually classified with them as far as their qualities are concerned. In a certain experiment they were fed to the dairy cows, but not in abnormal quantities. They did not much effect the quality of the butter although they seemed to make the cream froth quite badly in the churn and to hinder the coming of the butter. They did not demonstrate a high value as a dairy food.

GRAIN.

Corn. Corn meal has been an ingredient of nearly every grain mixture fed to college dairy cows. Silage has formed the bulk of the ration but even with silage some corn meal has been fed. While relatively low in protein, it can be used to good advantage with clover hay and wheat bran or oats.

Not infrequently the corn has been fed to cows unhusked and with the stalks. In that case the shocks have been hauled directly from the field, run through a cutting box and fed with wheat barn and clover hay. Where human labor is high and corn relatively cheap this method recommends itself although a good proportion of the kernels escape digestion.

Gluten meal and gluten feeds. These gluten feeds are not new to the State and several tons of gluten meal have been fed at the station. It is the residue from the manufacture of either glucose or starch, and differs in composition, according to the method of manufacture, and to the thoroughness with which the starch is extracted. The methods of manufacture differ very materially in their results, but they consist essentially in the separation of the outer coating of the kernel and the germ from the interior starchy portion. This is done by soaking the crushed kernels in water. In the process the germ may or may not be separated from the gluten and the skin. The gluten in the kernel resides in the layer of cells immediately beneath the skin. They are characterized by high content of both protein and fat. The germ occupies the point of the kernel, from which the sprout comes at germination. It is rich in oil and gluten.

Prof. E. B. Voorhees of the New Jersey Experiment Station, reports, in bulletin 105, of that station, page 7, the analyses of the kernel of corn, of the skin, of the germ and of the starchy and hard parts in the following table:

	Amounts secured from 100 parts of original corn.	Per cent of water	Fat.	Crude Fiber.	Protein.	Ash.	Carbo hydrates.	Nitrogen.	Phosphoric acid.	Potash.
Original corn	100.00	24.74	4.34	2.02	12.65	1.73	79.26	2.02	.83	47
Skin	5 56	15.29	1.59	16 45	6.60	1.27	75.36	1.06	23	.38
Germ	10 17	29 62	29.62	2.88	21 71	11.13	45.79	3.48	6.16	2.91
Starchy & hard parts	84.27	24.66	1.54	.65	12.23	.68	85.58	1.96	.35	.17

"The germ, although about only ten per cent of the whole kernel, contains 65% of the fat, 61.5% of the mineral matter, 71% of the phosphoric acid, 60% of the potash, and 16.33% of the nitrogen or protein. The remaining portions are characterized, the skin by the content of fiber, 51% of the whole, and the starchy parts by the carbohydrates, of which it contains nearly 90% of that in the whole grain."

It is evident from these analyses that the composition of the byproducts made from corn depends on whether more or less of either the germ, the skin or the starch is left in them. If the starch alone is removed the trade name of the product is gluten feed. The germ ground alone is germ meal. Formerly the gluten cells alone or with the germ was ground and sold as gluten meal. At present these names are used rather indefinitely and it is quite impossible to gather a correct idea of the composition of a given sample by the name it bears. Analyses have shown that gluten feed varies in protein content from 21% to 24% while gluten meal varies even more widely, from 30% to 42%.

At the prices at which they are usually sold the gluten meals may furnish protein as cheaply as any other byproduct. Cows, while not especially fond of them have seldom refused to take them when mixed with other feeds. At the college dairy barn it has been fed in amounts as high as four pounds per day with good results.

For two successive winters experiments were conducted to test the influence of gluten meal, when fed as a cheap source of protein, upon the quality of the butter. It was found that the butter was softer and the cream more difficult to churn when the cows had gluten meal. The per cent of fat in the buttermilk increased very perceptibly on the gluten meal ration.

Linseed meal. Two classes of linseed meal, old process and new process, are offered in the market. Both have been fed with good results. At the college they have served the double purpose of supplying protein and adding variety to the ration. The amounts ordinarily fed per day has been two pounds or less. When the roughage is largely cornstalks, timothy hay or straw, naturally constipating in character, linseed meal has been fed in preference to cotton seed meal. On the other hand where silage or other succulent food kept the bowels relaxed, cotton seed meal has usually supplied the protein more cheaply than the linseed. The cows prefer the coarsely ground oil cake, the so-called pea size old process, to the finely ground article.

No effect upon the quality of the butter has been noticed from the feeding of linseed meal.

Cotton seed meal. This byproduct heads the list as far as richness in protein is concerned. Its price is usually somewhat higher than that of linseed meal, but its greater richness in protein allows it to supply that needed ingredient at a less cost per unit than will either linseed or gluten meal. Experience in its use at this station will warrant recommendation to dairyman to be fed in amounts not larger than two pounds per day per cow. It should not constitute any part of the ration of the cow heavy in calf and its use must be discontinued for at least two months before the birth of the calf. In purchasing cotton seed meal, care should be exercised to see that the indigestible hulls have been removed.

Wheat bran. Letters received at the station indicate that in some parts of Michigan a prejudice exists against roller process wheat bran. Some farmers prefer finely ground bran, others are prejudiced in favor of coarser samples. The product of roller mills is not uniform in this respect. In some samples the germ is ground with the bran. In other mills the germ is found either in the flour or as a separate byproduct. To get some light on the relation of the composition of bran to its physical appearance, fourteen samples were analyzed, some of them from roller mills, some from burr stone mills, some from mills of large capacity and other from smaller establishments. The per cent of protein varied from 14.32% in the bran of a roller process mill with an annual output of twelve hundred tons to 19% in a first grade roller process brans from one of the immense mills in Minneapolis. Little variation was found in the composition of extremely coarse bran and the finer articles. The chemist says on this topic "The two extremes, the very coarse and the very fine, are of much the same composition, while neither shows the best sample so far as feeding properties are concerned. The medium grades generally show a better analysis than either of the extremes. Theoretically, the bran produced by the roller process should be more valuable than that produced by burr stones, as in one the germ, which is rich in fat, is separated out with the flour, and in the other this part goes into the bran. The roller process brans are all perceptibly higher in protein than are those of the burr stone process. It is not so much the amount of starch present in the bran, as the amount of protein and fat, that is of consideration to the feeder. The end for which the millers are constantly working in the milling process, the most complete separation of the starch possible and the needs of the consumer of the bran, a food rich in protein and fat, are identical. The new milling process, instead of supplying the feeder with an inferior grade of feeding stuffs, furnishes him with one much superior to that supplied by the old process."

SUCCOTASH AS A SOILING CROP.

R. S. SHAW.

Bulletin No. 235.

There may be some question as to the propriety with which the term succotash is used if the meaning, derived from its origin, is taken into consideration. This word was first applied to a dish used by the North American Indians, consisting of green corn and beans variously compounded. In recent years, however, agricultural and live stock experimenters have applied this term quite frequently to soiling crops consisting of mixtures containing corn, some legume, such as peas or beans and one or more cereals.

In the production of succotash crops numerous mixtures have been tried in different parts of the country with greatly varied success. The data hereafter given was secured in an endeavor to produce some satisfactory forage crop rotations for swine, designed to cover the greatest possible portion of the year. The first mixture, grown in 1903, consisted of corn, peas, oats and barley; though this combination produced a large tonnage of green food it made but one crop in the season, as all of the plants in the mixture failed to make a second growth after having been cut or grazed off. With the object of securing a second growth, in the season of 1904 the mixture was changed to the following, viz: corn, peas, oats, rape and millet. This combination was successful in producing a second crop of rape and millet when the first crop was cut with the scythe, but not when closely grazed off. Within eight weeks from the time of the first cutting this second crop was nearly knee high, but was mostly rape as the millet could not keep pace with it in growth. The success thus achieved in securing a second crop of rape and millet created the desire to combine some leguminous plant with the rape in place of the millet. As a result the four sowings of the spring of 1905 were made up as follows, viz.: corn, peas, oats, rape and clover. On two of these plantings the first crop was so heavy and badly lodged that the clover and rape did not succeed in making a second crop large enough to pay for pasture, but rallied sufficiently to make a good stand late in the fall. The other two sowings formed a thick mat consisting of both clover and rape by October 1st. The object now is to determine whether the rape and clover can be grazed moderately close in the fall and then secure a clover crop for soiling purposes the following spring, thus securing three crops from the one sowing. As it will require two or three seasons more experimenting to secure data relative to the last object sought it was thought best to report on the present progress of the work.

VALUE OF SUCCOTASH.

There is now no question in the mind of the writer but that the 1905 succotash mixture consisting of corn, peas, oats, rape and clover is an extremely useful combination and that it can be produced as regularly and successfully as any other crop or mixture if properly handled. It is especially valuable as a soiling crop for dairy cows because of the fact that it fills in a gap between the possible use of green clover and green corn. We have also found it highly satisfactory for young calves being housed during the heat of the summer. Though the first attempt was to use this mixture as a forage crop for swine it has not proved to be so valuable for that purpose as was expected. (By forage crops we mean those grazed off and by soiling crops those cut while green, hauled off the land and fed elsewhere.) When the succotash was grazed off by swine the losses were heavy from the trampling and wallowing of the animals, in fact so much so that it had to be hurdled off giving them access to but a limited area every few days and this is a somewhat expensive and troublesome method. (See illustration on cover.) When cut, hauled and fed in the hog lots or pens there was little or no loss. When the rape and clover plants were bitten off close to the ground by hogs many of them failed to grow again; when cut higher with a scythe they did not fail to grow. Succotash may be objected to for the dairy cow because of the large amount of water it contains, but it nevertheless furnishes the succulence so necessary to supplement her ration while on dry and exhausted pastures. This food was used for the college dairy herd during the season of 1905 between the time the silage was exhausted and green corn became available. The composition of succotash does not vary greatly from that of green corn in the earlier stages, when used for soiling purposes. The question naturally arises, would it not be better practice to supplement the failing pastures with silage rather than succotash? We should answer yes, providing one has the silage, but at the present time all dairymen are not possessed of silos and most of those in use are generally empty long before midsummer. Should succotash be grown for such emergencies and not needed it can be cut and cured for hay when the oats are in the milk or dough stage. The small amount of rape in the first cutting has not tainted the milk so far as used.

The second growth of rape and clover must needs be less of a certainty than the first crop of the original mixture, as favorable conditions for growth usually diminish as the season advances, owing to greater heat and lack of moisture. A lodged crop cannot remain in that condition long without injuring the clover and rape; for their benefit the crop should be cut as quickly as possible. If succotash is grown to any great extent for soiling purposes it should be sown at two or three different dates, the first late in April or early in May, the others following at intervals of ten days or two weeks. From the different dates of seeding some one or more of the lots is almost sure to produce a second growth suited for sheep or swine pasture and probably for some other classes of live stock also. The ability to secure a crop of clover on the same ground the next season, for pasture or soiling, is at present uncertain but is well worth trying for.

CONDITIONS SUITED TO THE GROWTH OF SUCCOTASH.

The ground upon which this crop is grown must be rich. We do not believe large tonnages can be secured from poor land except in unusual seasons when the rainfall is large and favorably distributed. It is not a difficult matter to properly enrich sufficient ground for the crop of succotash. A small area only is necessary, say from one to three acres, to tide the average dairyman over from clover to corn on a failing pasturage. Manure cannot well be used to better advantage than on this area. We have found that the manure for this crop should not be buried too deep, for the crop should be induced to start and grow quickly; it is short lived. Our best results have come from spreading a good coating of heavy manure (not strawy) on the land after plowing and before fitting for seeding; this manure is not allowed to lie on the surface of the ground but is worked into and incorporated with the top two or three inches of soil by means of the disk and harrow. This plan almost insures a quick and vigorous start of the small seeds such as clover and rape. After the seed bed has been thoroughly prepared, sow a good seeding of rape and clover mixed, broadcasting it and then follow with the seed drill burying the mixture of corn, peas and oats at the proper depth; the drill will cover the small seeds previously sown on the surface. In general the grain mixture should be sown at the rate of about two bushels per acre.

SUCCOTASH MAY VARY IN COMPOSITION.

Though the seeds of the various species of the mixture may be sown in definite proportions, at each seeding of the season, still, we should expect the relative numbers of plants of each to vary somewhat with peculiarities of climatic conditions, and the same results must be expected to follow as regards the relative development of the different sorts. This is illustrated quite markely by a comparison of illustrations Nos. 3 and 4.

RAINFALL.

In this publication attention is directed to the amount of rainfall during the growing periods of the several crops produced. This is done because of the fact that the seasons of 1903 and 1905 were extremely unusual in their large precipitation. Up to a certain degree the rainfall may effect yields favorably and beyond that may become injurious. For purposes of comparison we give the average rainfall for four of the summer months during the five years preceding 1903, as follows: May 3.39 in., June 3.8 in., July 3.91 in., and August 1.93 in.

SUCCOTASH.

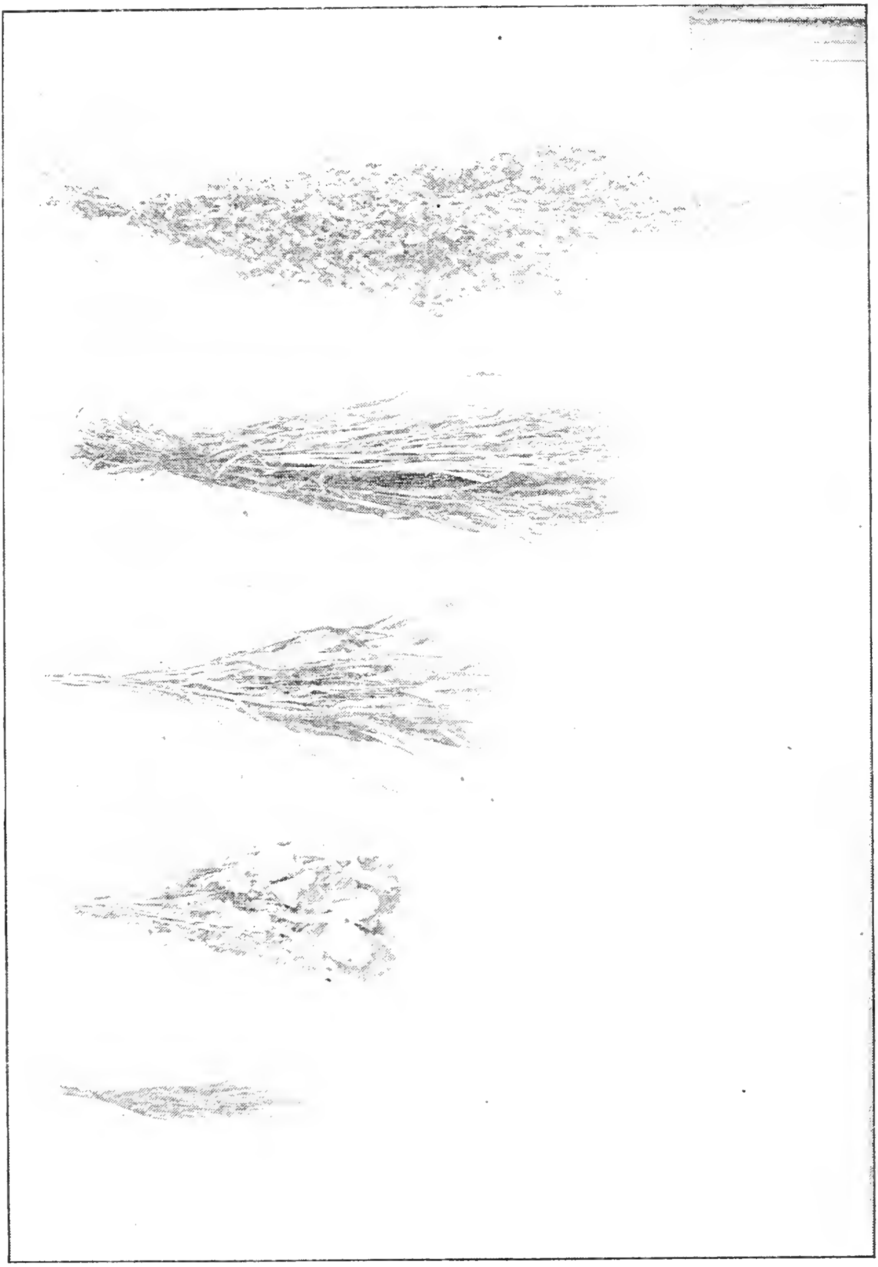
Report of first year, 1903.

This consisted of a one-third acre lot, one of several of the same area used to produce forage crops for swine. For several years preceding the date given these lots were used for hog runs. One-half of each lot is high land and somewhat heavy, sloping sharply toward the Cedar river; the lower ends of the lots are quite light and sandy and are usually submerged annually by the spring floods. Owing to the trampling received while wet the soil of these lots had been puddled and was not in the best physicial or mechanical condition to grow good crops the first season.

This crop was sown on May 8th, 1903. The mixture consisted of corn 1 peck, peas 1 peck, oats 1 peck and barley 6 quarts, and was sown by an ordinary grain drill at the rate of 2½ bushels per acre. This crop was not pastured off by hogs as intended, owing to inability to finish the necessary fencing before the succotash got too large to pasture. The cutting of this crop began June 24th, forty-seven days from the date of sowing and was completed twelve days later, viz.: July 6th. It was removed as fast as consumed by some pigs in pens. The entire yield of this green crop from the one-third acre was 7629. pounds, the weighing was done immediately after cutting. At this rate the yield per acre would have been 22,887. pounds or 11.44 tons. This yield appears phenomonal, but the ground was exceedingly rich and the rainfall during the fifty-nine days was unusual, amounting in all to 9.48 inches distributed as follows: May 8th to June 1st 2.5 in., month of June 6.28 in., and July 1st to 6th .7 in. The growth was exceedingly dense and tall; all the grain showed well except the corn which was apparently from poor seed. The greatest objection to this mixture was found in the fact that it did not contain plants of a sort capable of making a second growth after cutting.

Report of second year, 1904.

As in the case of the first sowing in 1903, part of this crop was grown on a one-third acre lot set aside for growing forage for hogs, but one which had grown a heavy crop of rape the previous year. Another lot of one-half acre was grown in field No. 5. The mixture used differed somewhat from the first one, consisting of corn, peas, oats, rape and millet sown in the following manner. After the ground had been prepared for seeding, a mixture of rape and millet, equal parts, was sown broadcast on the land by hand, using a pint of each to the one-third acre; the corn, oats and peas in equal parts by measure, were then mixed and sown by an ordinary grain drill at the usual depth, the same operation covering the rape and millet lightly. This seeding was made May 7th, 1904. All the plants of the mixture made a good even start except the millet which grew slowly, but some soon outdistanced the others. Illustration No. 1 shows the relative size and proportions in which the five kinds of plants grew in the mixture. The plants were secured by cutting out two or three small areas, representative of the lot, and then separating out the plants of the various sorts which were photographed for this illustration. The samples were taken July 12th, at which time the entire crop averaged three feet in height, but many of the pea vines were much longer than this. This lot of succotash was foraged off by sixteen young pigs weighing 1208 pounds, turned in on June 20th, 44 days from the date of sowing, and removed July 22nd, 32 days later. The pigs received some supplementary food. The illustration on the cover shows some pigs foraging on the 1904 crop. The picture was taken about July 1st. In this picture can be seen the hurdles used in restricting the pigs from foraging on but a limited area. The lower edge of the top boards of these panels is just three feet above ground. This one-third acre of succotash was completely foraged off seventy-six days from



Millet. Rape. Corn. Oats. Peas.

ILLUSTRATION NO. 1.

the date of sowing, May 7th. During this time the entire rainfall was 6.86 in., distributed as follows: May 7th to June 1st, 2.4 in., the month of June 2.49 in., and between July 1st and 22nd 1.97 in. The precipitation of this year, seemed to be sufficient for the satisfactory growth and best use of the crop. In both '03 and '05 the great excess of rainfall is believed to have been detrimental. The succotash grown in field No. 5 this season was cut and fed to the dairy herd, but no record of the yield was made. The second growth of rape and millet was good.

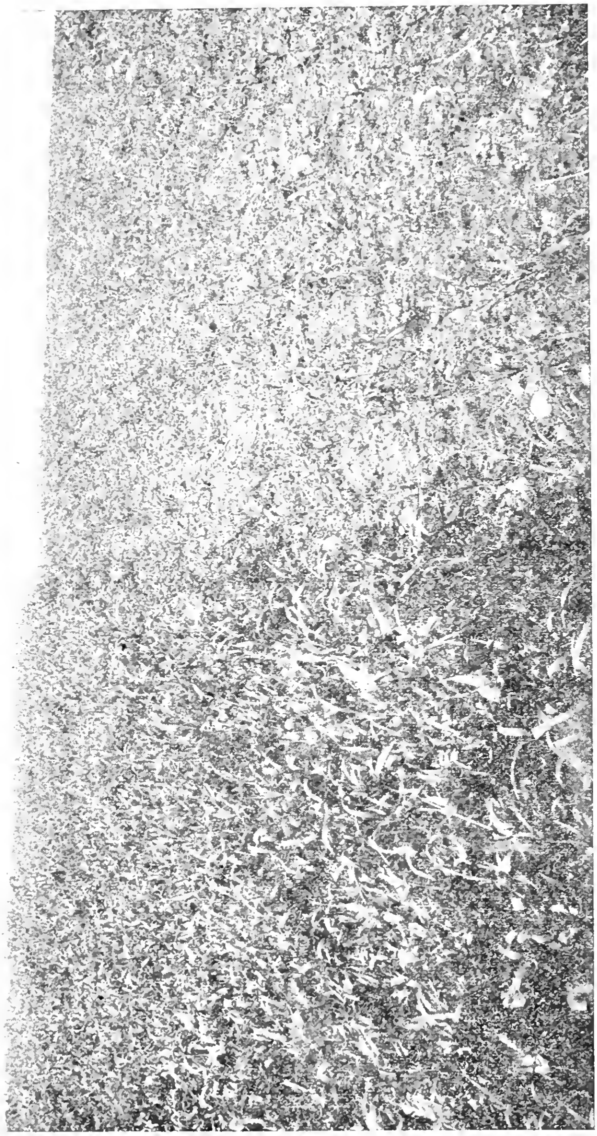
The following is the result of the analysis of the 1904 succotash mixture with the results expressed on "air dry" samples, by F. W. Robinson, Station Chemist.

No. B 632.

Moisture	8.30%
Ash	10.35%
Protein (total Nitrogenous)	15.09%
Proteids (true)	14.30%
Amido bodies	0.79%
Ether extract	5.45%
Crude Fiber	27.01%
Carbohydrates not fiber	33.80%

Report of third year, 1905. (First sowing.)

This year one acre of succotash in addition to the one third acre in the forage rotation for hogs was grown in field No. 5, which has been set off to the use of forage, root and soiling crops on a larger scale. This field comprises both high and low land; the high land is quite a good substantial loam but the low land is quite sandy; every acre strip contains some of both kinds of soil. The acre referred to produced a root crop in 1904. It was not plowed before being sown to succotash but was given a moderate top dressing of heavy manure after which it was disked and harrowed to form a seed bed. The succotash mixture used in this instance was similar to that of the previous year except that clover was put in the place of the millet. On May 1st a portion of this area was sown to corn, oats, peas, rape and clover, and the balance was left and sowed on May 20th. On June 6th an almost unprecedented flood occurred completely submerging the succotash on the low land, the water covering it for several days and entirely destroying it. Illustration No. 2 shows the stage of development of these two sowings on June 8th, the first one being about a foot in height. On June 20th that portion of the area drowned out was resown thus giving three dates of sowing. As these plantings were made with a view to furnishing green food for dairy cows they were all cut, hauled off the ground and fed in the stables. That portion of the sowing of May 1st on the high land, not drowned out, consisted of .161 acre or a fraction less than 1-6th of an acre. The crop was cut between July 10th and 17th beginning 70 days from the date of sowing. By this time the oats had lodged badly and made a second stooling, the sprouts from which were several inches high. Fully half the peas were in the cooking stage though blossoms were present on the ends of the



Sown May 1st, 1905 Sown May 20th, 1905.

ILLUSTRATION NO. 11.
Succotash.—Photographed June 8th, 1905

vines caused, undoubtedly, by the excessive rainfall; the oats had been headed out fully ten days. Before cutting samples were taken from four representative areas each two feet square; the plants of each species were separated into groups, weighed, photographed and turned over to the chemist for analysis. The number of plants of each species on these sixteen square feet was as follows, oats 61, peas 68, rape 55, and corn 22, and their weights were, oats 10.6 lbs., peas 4.2 lbs., rape 2.75 lbs., and corn .5 lbs. Illustration No. 3 shows this sample.

The total weight of succotash cut from this area of .164 acre was 3991.5 lbs., equivalent to 12.16 tons per acre. The crop would have been cut and fed earlier had it not been for the exceedingly wet weather. The clover did not make sufficient growth by the time of this cutting to be included in the crop. The later growth of the clover was seriously impeded by the smothering of the lodged crop but the heavy rainfall following on the other hand was favorable to it. By October 1st the clover and rape plants were a foot high. During this period of growth extending from May 1st to July 17th, seventy-seven days, the total rainfall was 17.29 in. distributed as follows, May 5.17 in., June 7.47 in., and July 1st to 17th 4.65 in. This is nearly double the average rainfall for these three months.

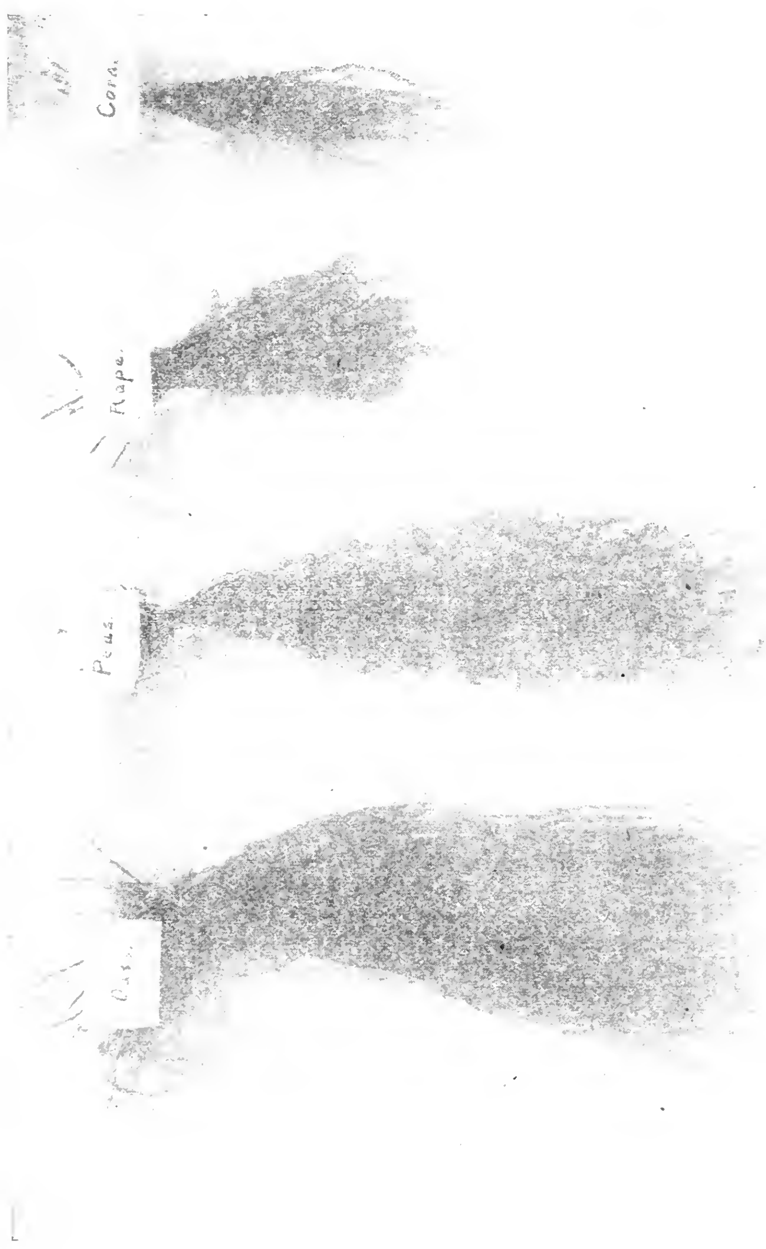
The analyses of the 1905 samples were furnished by Mr. A. J. Patten, Station Chemist. The following is the result from the analysis of the samples from the first seeding of this year:

	Air Dry Basis.	Fresh Basis.
Moisture	7.85%	89.90%
Ash	8.78	0.96
Total protein	11.94	1.31
Ether extract	2.70	0.30
Crude fiber	32.27	3.54
Nitrogen, free extract.......	36.46	3.99

Report of second sowing, third year, 1905.

This, the second part of the 1905 crop, was sown under the conditions already described, on May 20th, on ground planted to roots in 1904, top dressed in April, 1905, and then fitted for seeding with disk and harrow without plowing. The lower portion of this seeding was destroyed by the early June flood but the uninjured part on the highland comprised .32 of an acre, or a trifle less than one-third. On July 27th samples were taken from four representative areas including 16 sq. ft. From this area the following numbers of plants were secured, viz.: corn 74, peas 82, oats 43 and rape 10; the weights of these groups of plants on this date were corn 6.9 lbs., peas 1.7 lbs., oats 4.3 lbs. and rape .3 lbs. Later developments showed a greater number of rape plants many of which were too small to be included in the sample.

The cutting of this second sowing began July 22nd, sixty-two days from the date of sowing and was completed August 11th. The total amount of green food removed was 8285 lbs. from the .32 ac. At this rate the yield would be 12.62 tons per acre. The relative development of the various species in this sample is shown in illustration 4.



SUCCOTASH.—ILLUSTRATION NO III.

The total rainfall during this period of eighty-three days was 16.38 in., distributed as follows, from May 20th to June 1st 1.94 in., June 7.47 in., July 5.75 in. and August 1st to 11th 1.22 in.

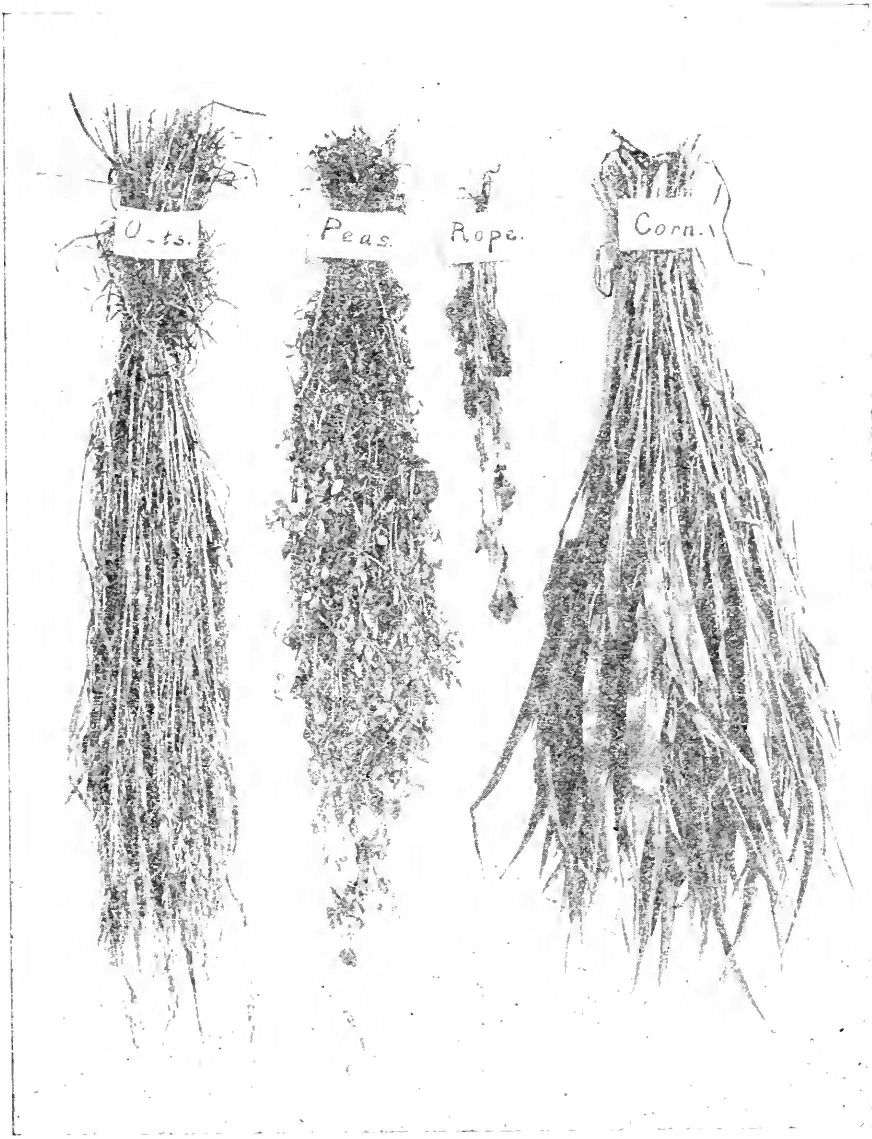
The following is the result of analysis of the sample from the second sowing of 1905:

	Air Dry Basis.	Fresh Basis.
Moisture	9.73%	84.80%
Ash	9.24	1.55
Total protein	10.09	1.70
(True proteids	6.85	1.15)
(Amido bodies	3.24	0.55)
Ether extract	3.00	0.50
Crude fibre	30.68	5.17
Nitrogen free extract.......	37.26	6.28

Report of third sowing third year, 1905.

As heretofore stated the lower portions of the first two seedings of 1905 were destroyed by flood. As the river was a long time reaching its normal level this low land remained somewhat wet and soggy until late in the season. It was June 20th before this ground could be fitted and sown but notwithstanding the late date of seeding, the soggy condition of the ground, and its sandy character, the growth was rapid and the yield fairly large. This area comprised .537 of an acre or a fraction over one-half. The cutting began August 16th, fifty-seven days after planting, and was finished August 31st, yielding 8033 lbs. of green food; at this rate the yield per acre was 7.47 tons. In this case the oat straw rusted quite badly but no bad effects were noticed on other plants of the mixture. The total rainfall during the growth of this cutting was 9.99 in.

The green food secured from these three sowings was used for three different purposes. A part was fed to dairy cows to supplement short pastures in the absence of silage; a part was fed to calves of both beef and dairy types confined in the stables during the greatest heat of summer and fly time; the balance was fed to hogs confined in pens. In every case the results were satisfactory.



SUCCOTASH.—ILLUSTRATION NO. IV.

SPRAYING FOR POTATO BLIGHT IN 1905.

BY C. A. M'CUE.

Bulletin No. 236.

For several seasons the potato growers of Michigan have suffered serious losses in their potato crops through the devastation wrought by late blight (*Phytophthora infestans*). The disease was particularly bad during the last season and the loss to growers of the State ran up into thousands of dollars.

The disease is prevalent in nearly all, if not all, parts of the State where late potatoes are grown. The history of the disease in other states seems to indicate that the trouble is here to stay and that we may look for it in every favorable season. It has been known for nearly two score years that spraying with Bordeaux mixture would prevent the blight to a greater or less extent, but it has been only within the last few years that the knowledge of this fact has been applied to commercial potato growing; and then only in a few localities. The practice is by no means common. In Michigan it is hard to find a grower who systematically sprays his potatoes for blight every year. The reason for this is not that the grower is careless and neglects the crop, but rather that he is ignorant of the cause of the trouble and is at a loss to know what to do to stop it. In the correspondence carried on by the author with a large number (100) of potato growers in the State it was astonishing to find the large number of growers who did not even known what Bordeaux mixture was; and the majority of them believed the blight to be incurable. The reasons why potato spraying has not been more generally practiced in the State might be stated as follows:

1. The grower is ignorant of the cause of the disease.
2. He is not aware that there is anything that will prevent it.
3. He does not believe that the results obtained would pay for the time and trouble of spraying.

The growers should be set right on these questions as far as possible: hence the mission of this bulletin. No new facts will be found in these pages, but an endeavor will be made to present the cause and the prevention of potato blight to potato growers of the state for their consideration.

I. THE CAUSE OF THE BLIGHT.

Late blight is caused by a fungous disease that works upon the tops of the potato plant and which also causes rotting of the tubers.

The disease is very energetic and spreads with great rapidity, sometimes ruining a crop within a few days. It usually makes its presence known soon after the 15th of August in this state and thrives best when the temperature is about 70° F. and the air is full of moisture. It is worse in wet than in dry seasons and the general opinion is that it causes more rotting of the tubers in clayey than in sandy soils. The fact that the disease flourishes best in wet seasons has caused many farmers to believe that "blight is caused by wet weather". This is true in part, in that the wet weather furnishes the ideal conditions for the rapid development of the fungous; but the real cause is the presence of the disease upon the plant when the wet weather comes along. We can have wet weather without having blight; and, vice versa, we can have blight without having wet weather. The two are not inseparable.

The disease usually appears on the lower leaves of the plant in the form of a yellowish-brown spot that rapidly turns brown and dies. The trouble rapidly spreads upon the plant until soon nothing green remains to be seen but the extreme top leaves. These too, soon succumb and the whole top dies and rots. If we examine one of these yellowish-brown spots on the leaves, early in the morning when the dew in on, we shall probably find a white mildew-like substance on the lower side of the leaf. If this is examined with a microscope it will be found to consist of a large number of egg-like spore-bodies on minute stalks projecting out of the leaf tissue. (See Fig. I.) These spores which correspond to seeds, soon fall off the parent stalk and either fall to the ground or are blown to a neighboring plant. If the spore finds lodgment on a potato leaf, and if moisture is present, it starts to germinate and sends out a slender, thread-like branch (mycelium). It is believed that this mycelium has no power in itself to penetrate the tissues of the leaf, so it grows on until it reaches some opening into the leaf. This opening may be one of the numerous breathing pores, (stomata), of the leaf, or it may be a hole made by some insect. On reaching such an opening the little branch enters and pushes its way between the cell walls of the leaf robbing them of their nourishments. Once in the plant this mycelium grows very rapidly, branching again and again and finally penetrating every part of the plant tissues, robbing them of their juices and causing them to decay. Occasionally a branch of the mycelium comes to the surface and sends out many fruiting stalks that bear myriads of new spores. These mature, fall off, and go on their mission of destruction.

If the spore falls to the ground and rains follow, it may be washed downward through the soil until it finds lodgment upon the tuber. Here it finds warmth and moisture and begins to grow, sending its mycelium into the tuber, robbing it of its starch, breaking down its tissues and causing rot. Here its action may or may not be rapid; the spore may sprout, enter the tuber, and make only a slow growth, not manifesting itself until the potato is dug and stored, or perhaps not until the tuber has been planted for the next crop. So the disease may be passed on from generation to generation of potatoes by means of infected seed potatoes.

We have seen that the disease passes a greater part of its life history within the plant tissues where it is safe from harm. To fight it successfully it must be attacked at some time when it comes to the surface, during the spore stage, or when the spore is germinating. So we see that any remedy used must be a preventive one.

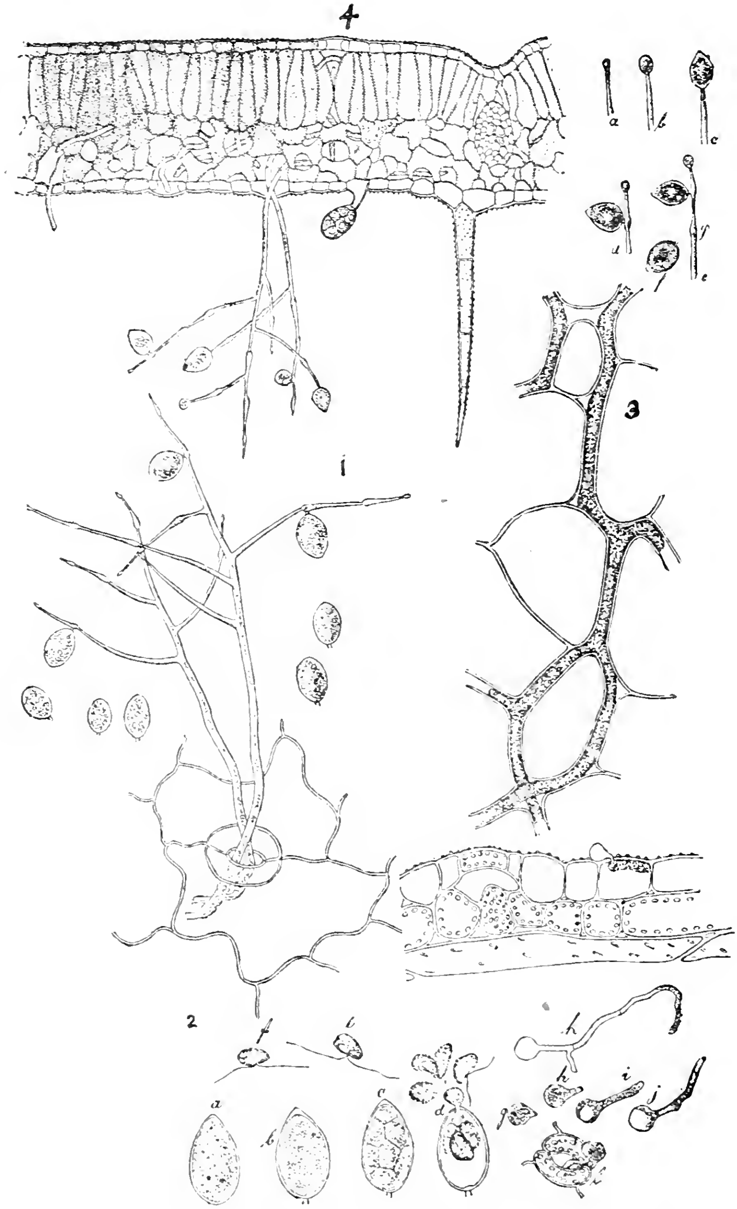


FIG. 1. THE FUNGUS OF THE LATE BLIGHT OF THE POTATO.
Phytophthora Infestans.
(After U. S. Dept. of Agr.)

1. Spore stalks showing spores falling off.
2. Spore cases bursting and spores germinating.
3. The mycelium passing between the cells of the leaf.
4. Section of Potato leaf showing the first bearing stage of the fungus appearing on the underside of the leaf.

II. EXPERIMENT AT THE COLLEGE IN 1905.

In the spring about 10 bushels of Rural New Yorker Potatoes were procured. These were badly infected by scab (Oospora scabies), and in many cases nearly the entire starch content of the tuber had been exhausted by the parasite. The potatoes were treated with Formalin for 90 minutes and planted. The ground selected was a flat, low piece of ground where an old plum orchard had been pulled out in the spring and the land was unsuitable for potatoes. The tubers were planted on the 16th of June in rows 3 feet apart and the seed 15 inches apart in the row. Owing to the late planting, the unsuitable soil and the devitalized condition of the seed the plants were nearly two weeks in appearing above the ground and at first only a feeble growth was made and the outlook was very poor for any kind of a crop.

The field was divided into sections of six rows each.

Rows 1-6 were to be sprayed every four days with Bordeaux mixture.

Rows 7-12 were to be sprayed every 4 days with the milk of lime alone, at the rate of 4 pounds of stone lime to 50 gallons of water.

Rows 13-18 were to be sprayed every 10 days with Bordeaux mixture.

Rows 19-24 were to be sprayed every 15 days with Bordaux mixture.

Rows 25-30 were to be sprayed every 20 days with Bordeaux mixture.

Rows 31-34 were to be sprayed every 14 days with Paris green at the rate of 1 pound to 75 gallons of water.

Rows 35-41 were to be left unsprayed as a check.

The plan outlined was carried out to the letter. The first spraying on every plot was given on the 22d of July. The Bordeaux mixture used was composed of 4 pounds Copper Sulphate, 4 pounds Lime and 50 gallons of water.

When the tops were thoroughly dead the different plots were dug. The four center rows only of each section were used in computing results in order that there might be no overlapping of spraying material. The tubers on each plot were graded into merchantable and small, and carefully weighed.

The table below shows the relative time of dying of the tops and digging of the different plots.

TABLE NO. 1.

Manner of Treatment.	*Pronounced dead.*	*Dug.*
Unsprayed	Sept. 13	Sept. 23
Sprayed with Bordeaux every 20 days	" 26	" 30
Sprayed with Bordeaux every 15 days	" 29	" 30
Sprayed with Bordeaux every 10 days	" 29	" 30
Sprayed with Bordeaux every 4 days	Oct. 4	Oct. 7
Sprayed with Lime every 4 days	Sept. 17	Sept. 23

The blight was first noticed on the unsprayed rows about August 10th, and was very conspicuous by the 15th. The 6 rows sprayed with Bordeaux every 4 days were but very little affected by the blight.

On digging the different plots a great difference in the yield was noted. The results were computed for an acre in each case and the cost of spraying was also kept. There was no need of spraying with an arsenite for bugs as only a few old ones were found on the vines, and they were picked off by hand in order that absolutely pure data might be obtained for each plot.

The following tables give the results obtained:

TABLE NO. 2.

Unsprayed.

Yield per acre of merchantable tubers	41 bu.
Yield per acre of small tubers	23 bu.
Total yield per acre	64 bu.
Gross receipts at 50 cents per bushel at time of digging	$20 50

TABLE NO. 3.

Sprayed with Lime Water Every Four Days.

Yield per acre of merchantable tubers	52.5 bu.
Yield per acre of small tubers	26 bu.
Total yield per acre	78.5 bu.
Gross receipts per acre at 50 cents per bu	$26 25
Gross gain in dollars per acre by spraying	5 75
Increase in yield by spraying	11.5 bu.
Number of times sprayed	14
Total amount of lime used per acre	42 lbs.
Cost of material	$0 19
Cost of application	7 42
Total cost of spraying per acre	$7 61
Net loss per acre	1 76

In the above table we see that while an increased yield was obtained it was more than offset by the cost of application. In order to make a profit the yield would have to be increased about 15 bushels of merchantable potatoes per acre.

TABLE NO. 4.

Sprayed with Bordeaux Mixture Every Twenty Days.

Yield per acre of merchantable tubers	68.8 bu.
Yield per acre of small tubers	15 bu.
Total yield per acre	83.8 bu.
Gross receipts per acre at 50 cents per bu	$34 40
Gross gain in dollars per acre by spraying	13 90
Increase in yield per acre by spraying	27.8 bu.
Number of sprayings	4
Amount of lime used per acre	12 lbs.
Amount of copper sulphate used per acre	10 lbs.
Cost of lime per acre	$0 05
Cost of copper sulphate per acre	70
Cost of application	2 12
Total cost per acre of spraying	$2 87
Net gain per acre by spraying	11 03

TABLE NO. 5.

Sprayed with Bordeaux Mixture Every Fifteen Days.

Yield per acre of merchantable tubers	73.5 bu.
Yield per acre of small tubers	15.8 bu.
Total yield per acre	89.3 bu.
Gross receipts per acre at 50 cents per bu	$36 75
Gross gain in dollars per acre by spraying	16 25
Increase in yield per acre by spraying	32.5 bu.
Number of sprayings	4
Amount of lime used per acre	12 lbs.
Amount of copper sulphate used per acre	10 lbs.
Cost of lime	$0 05
Cost of copper sulphate	70
Cost of application	2 12
Total cost per acre of spraying	$2 87
Net gain per acre	13 38

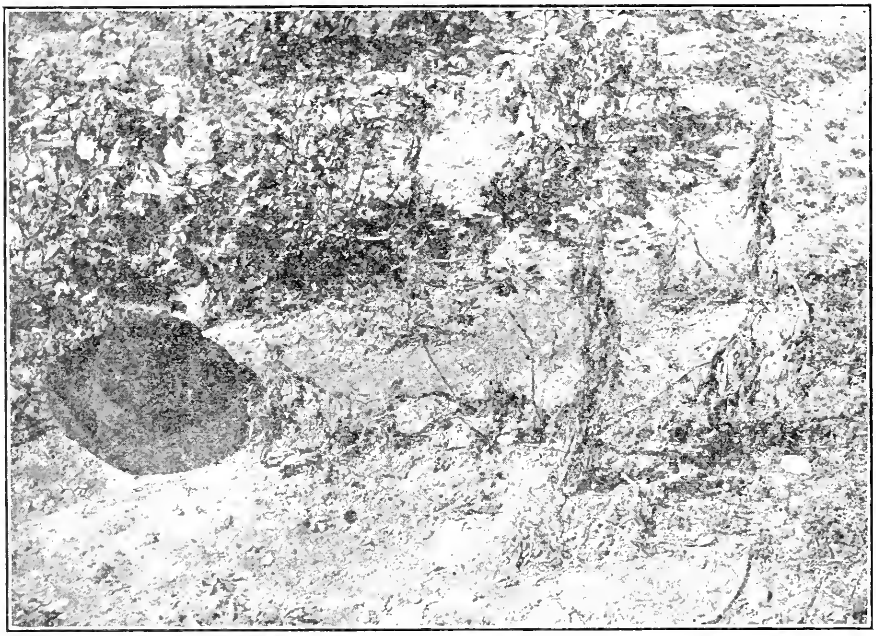


FIG. 2. The hill on right unsprayed: The hill on the left sprayed every 4 days with Bordeaux mixture. Photo taken Sept. 23, 1905.—Photo by Fletcher.

TABLE NO. 6.

Sprayed with Bordeaux Mixture Every Ten Days.

Yield per acre of merchantable tubers	80.5 bu.
Yield per acre of small tubers	19.2 bu.
Total yield per acre	100.7 bu.
Gross receipts per acre at 50 cents per bu	$40 25
Gross gain in dollars per acre by spraying	19 75
Increase in yield per acre by spraying	39.5 bu.
Number of sprayings	6
Total amount of lime used per acre	18 lbs.
Total amount of copper sulphate used per acre	15 lbs.
Cost of lime per acre	$0 08
Cost of copper sulphate per acre	1 05
Cost of application	3 18
Total cost of spraying per acre	$4 31
Net gain per acre	15 44

TABLE NO. 7.

Sprayed with Bordeaux Mixture Every Four Days.

Yield per acre of merchantable tubers	81½ bu.
Yield per acre of small tubers	21½ bu.
Total yield per acre	103 bu.
Gross returns per acre at 50 cents per bushel	$40 75
Gross gain in dollars per acre by spraying	20 25
Increase in yield per acre by spraying	40.5 bu.
Number of sprayings	14
Total amount of lime used per acre	42 lbs.
Total amount of copper sulphate used per acre	35 lbs.
Cost of lime per acre	$0 19
Cost of copper sulphate per acre	2 45
Cost of application	7 42
Total cost of spraying per acre	$10 06
Net gain per acre	10 19

According to the works of Millardet and Gayon,* the copper in Bordeaux mixture does not become soluble until the Hydrate of lime is changed to the Carbonate of lime, this process taking about ten days. In the above table it will be noticed that fresh Bordeaux mixture was applied every four days, thus keeping the copper in an insoluble form. The results go to show that it is not at all necessary for the copper to be in solution in order to kill the spores and check the growth of Blight (Phytophthora infestans).

From the preceding tables it appears that the most profitable results were obtained from those sprayed every 10 days with Bordeaux mixture or 6 times during the season (See Table No. 6).

The lime experiment (See Table No. 3) is interesting from the fact that it shows that the mere presence of some foreign substance on the foliage helps very markedly in retarding the growth of the disease. Further investigation along this line will be carried on during the coming season.

The condensed results of the experiment are fully shown in the table below.

*Millardet et Gayon, La bouillie bordelaise Celeste, Jour. d'Agr prat 54e Ann. T. I, No. 8, Feb. 20, 1890, p. 272.

TABLE NO. 8.

Condensed Results of Potato Spraying in 1905.

Manner of spraying.	Gain in yield per acre.	Gross gain in dollars per acre.	Net gain in dollars per acre.	Cost per acre.	No of sprayings.	Crop insured for.
With Bordeaux every 4 days. . .	40.5 bu.	20.25	11.90	10.19	14	1 year.
With Bordeaux every 10 days. .	39.5 bu.	19.75	15.44	4.31	6	3.5 years.
With Bordeaux every 15 days. .	32.5 bu.	16.25	13.38	2.87	4	4.7 years.
With Bordeaux every 20 days. . .	27.8 bu.	13.90	11.03	2.87	4	3.8 years.
With Lime every 4 days.	11.5 bu	5.75	Loss 1.76	7.61	14	. . . .

Cost per acre per application, 72 cents.

SPRAYING AN INSURANCE.

The last column of the above table shows how long it would be possible to spray an acre of potatoes upon the profits of this year's spraying and protect them against any possibility of blight, if there should be no blight during that time; or, in brief, in the case of the acre sprayed every ten days with Bordeaux mixture, enough profit was made to pay for spraying an acre of potatoes six times for three years and three times on the fourth year without extra cost.

The cost of 72 cents per application per acre is unusually large and would easily be less in large field operations. The writer believes that on areas of two acres or over the work could easily be done at a total outlay per application per acre of not over 55 cents.

III. RESULTS OBTAINED BY MR. W. A. SWAN, OTSEGO.

In reply to questions sent out in a circular letter to potato growers by this Department, Mr. W. A. Swan of Otsego answered the question, "Have you ever sprayed with Bordeaux Mixture for the blight?" by saying, "Yes, for the last five years, two years with a four-row sprayer." The next question asked was, "If so, has it paid you? Give figures if possible. Will you spray next year?" Mr. Swan answered, "Yes, last year (1904) my crop averaged 200 bushels per acre; 2 acres were sprayed six times and averaged 330 bushels per acre. This year I sprayed 27 acres; the average was 128 bushels.

One acre through the center of the field was not sprayed and gave 109 bushels.

Two acres on one side sprayed three times gave 124 bushels per acre.

Two acres on the other side sprayed four times gave 147 bushels per acre.

I figure my total gain this year at 700 bushels, at a cost in spraying of $70.00. I will keep on spraying.

Cost of spraying 27 acres:

450 lbs. Copper Sulphate	$30 50
2 bbls. Lime	2 00
Man 9 days (also board)	18 00
Horse 9 days	9 00
20 per cent interest on sprayer	10 00
Total	$69 50

Average cost per acre for single spraying about 45c to 50c. Our 9-acre field, planted May 20, was sprayed six times in the rainy season and the mixture was washed off every other day, no chance, in fact this field died early, September 20. The yield was 140 bushels."

The above statement of Mr. Swan goes to show that spraying for late blight is a sound business proposition.

IV. RESULTS OBTAINED IN OTHER STATES.

One of the first field experiments in spraying potatoes for late blight was made by Jones of the Vermont Experiment Station in 1889. Spraying experiments for blight at that Station have been kept up for a great many years and the results have always been the same; i. e., that it pays. Some of the results obtained in Vermont, picked at random from a long term of years, will be of interest to Michigan growers. Results obtained in 1892.*

Plots sprayed with Bordeaux mixture gave 324 bushels per acre.

Adjoining plots unsprayed gave 100 bushels per acre.

Gain from the use of Bordeaux mixture, 224 bushels per acre.

Results of 1893, a bad blight year:

Plots sprayed with Bordeaux mixture yielded 375 bushels per acre.

Adjoining plots unsprayed yielded 121 bushels per acre.

These gains by spraying are probably a great deal larger than could be obtained in large field experiments in Michigan.

In 1900 the Maine Station† experimented in spraying for blight in a small way and the increase in yield per acre for potatoes sprayed with Bordeaux mixture was 133 bushels per acre over those not sprayed.

Perhaps, however, the most extensive and the most carefully conducted experiments in potato spraying have been carried on at the New York Experiment Station, Geneva, N. Y. The results of their first year's experiments, 1902,‡ gave a yield of 317½ bushels per acre for rows sprayed three times; 342½ bushels per acre for rows sprayed seven times, and 219 bushels per acre for those not sprayed at all. Thus the seven sprayings gave an increased yield of 123½ bushels per acre and the three sprayings 98½ bushels per acre.

The following year, 1903,¶ the Geneva Station enlarged its field of work along this line and established a number of cooperative business experiments with farmers throughout the state.

"The farmers business experiments were designed to determine the

* Vt. Bulletin No. 72, p. 15.
† Bulletin 73 Maine, p. 57
‡ N. Y. Expt. Sta. Bulletin No. 221, pp. 235-6.
¶ For complete account see N. Y. Expt. Sta. Bull. No. 241.

actual profits in potato spraying under ordinary farm conditions." The total area thus treated in cooperation was 61½ acres sprayed in six experiments in different parts of New York. The total increase in yield due to spraying with Bordeaux Mixture was 3,746 bushels, or an average of 61.21 bushels per acre. The increase at the time of digging was worth $1,873; the total expense of spraying was $296.49, giving a clear profit, due to spraying, of $1,576.51, or $25.77 per acre.

In 1904 the work of the Geneva Station in potato spraying was continued and more cooperative business experiments were arranged;* also, a large number of volunteer experiments were reported to the Station by farmers.

"In fourteen† farmers' business experiments, including 180 acres, the average gain due to spraying, was 62¼ bushels per acre; the average cost of spraying $4.98 per acre; and the average cost for each spraying, 93 cents per acre; and the average net profit, based on the market price of potatoes at time of digging, $24.86 per acre."

"In forty-one farmers' volunteer experiments, including 363¾ acres, the average gain due to spraying was 58½ bushels per acre. In twenty-three of these experiments the average total cost of spraying was $3.91 per acre; the average cost for each spraying, 90 2-3 cents; and the net profit, based on the market price of potatoes at time of digging, $22.01 per acre."

It would seem fitting to record the results of one of these business experiments and the one chosen is known as "The West Henrietta Experiment." (For details see N. Y. Expt. Sta. Bul. No. 264, pp. 121-124.) The potato field used in this experiment was owned by Mr. Robert Dunn of West Henrietta, N. Y., and was composed of 12 acres. This field was sprayed eight times. Three rows through the middle of the field were left unsprayed. At digging time the center one of these 3 rows was dug separately, as were also the second rows of the sprayed potatoes on either side of the unsprayed ones. The yield of the unsprayed row was compared with the average yield of the two sprayed rows. The unsprayed row yielded at the rate 184 bu. 44 lbs. per acre, while the sprayed rows yielded at the rate of 314 bu. 43 lbs. per acre, making the increase due to spraying 130 bushels per acre. At time of digging the market price of potatoes was 50 cents per bushel, so the increased yield per acre was worth $65. The cost of spraying was $4.89 per acre, leaving a net profit of $60.11 per acre, or $721.32 for the 12 acres.

Mr. Dunn calculated his expense as follows:

400 lbs Copper Sulphate, at 6c	$24 00
8 bu. Lime, at 25c	2 00
14 lbs. Paris Green (for bugs), at 15c	2 10
80 hrs. labor for man, at 15c	12 00
80 hrs labor for team, at 15c	12 00
Interest and wear on sprayer	6 60
Total cost of spraying 12 acres 8 times	$58 70
Average cost per acre per application	61

* See N. Y. Expt. Sta. Bull. No. 264.
† Taken from N. Y. Expt. Sta. Bull. No. 264, p. 97.

Spraying experiments for blight have also been carried on in Rhode Island,* and in Ohio,† and in each case a marked increase in yield was noted.

These experiments from other states show that spraying for late blight pays there. Why should it not pay here in Michigan?

V. DIRECTIONS FOR SPRAYING.

Spraying for late blight should commence when the plants are about 12 inches high and should be repeated at intervals of 10 to 20 days, depending greatly upon the season. If the season should happen to be a wet one, a greater number of sprayings are necessary than if the season is an ordinary one. Advantage can be taken of the fact that the poison used in combating the potato bugs can be mixed with the Bordeaux mixture without impairing the value of either, so that when spraying with Bordeaux we can spray for bugs at the same time.

The Bordeaux mixture should contain at least 5 pounds of copper sulphate to 50 gallons of the mixture. The writer recommends the following formula for the Bordeaux mixture for use on potatoes: Five pounds Copper Sulphate, 6 pounds Stone Lime, to 50 gallons of water. These quantities are not arbitrary and doubtless many other combinations of the lime and copper sulphate can be used with success.

In order to get results, the Bordeaux mixture must be well applied and strike every part of the plant. If a crop sprayer is used, one should be selected that will throw the material up against the under side of the leaf and also give a mist-like spray.

A single spraying will be of benefit, but one must remember that in order to get control of the blight and make potato spraying pay, *the Bordeaux mixture must be on the foliage before the disease makes its appearance and that the supply must be kept up during the growing season.*

VI. WHEN SHALL WE DIG BLIGHTED POTATOES?

The rotting of the stored tubers is one of the most serious phases of the devastations wrought by the blight, and the question is often asked "Does it make any difference in the rotting if the digging is done before the tops are dead and dry, or will it pay to wait until they are?"

This subject has been investigated by Stewart and Eustace of the New York Experiment Station,‡ who say: "If the tubers are to be stored they should not be dug until the tops are dead and thoroughly dry, in order that the fungus spores may be given a chance to dry up and die. As long as the tops remain even partially green the spores of the blight fungus continue to live. In the process of digging, the tubers become covered with these live spores and if conditions are at all favorable more or less rot results. This explains why sprayed potatoes sometimes rot more in storage than unsprayed ones."

Precautions should be taken after digging not to cover the piles over

* R. I. Bull. No. 14, p. 187.
† September bulletin, Ohio Exp. Sta., 1889.
‡ Bulletin 264, pp. 202-203

night with tops that have been blighted as this would only result in additional infection with blight spores.

FURTHER EXPERIMENTATION.

It is the purpose of this Department to carry on the spraying experiments with late blight for at least five years. In order that the most reliable results may be obtained, and that the results may be spread broadcast among the potato growers of the State, it is desired that a large number of growers co-operate with the Department in this work. It is especially desired that every potato grower who sprays report his results to this Department. A certain number of experiments under the direction of the Station have been arranged for the coming season and a few more are desired. Any potato grower who wishes to enter into co-operation in this work may obtain explicit directions for carrying on an experiment by addressing the author. An endeavor will be made during the coming season to have a representative of the Station visit a number of these co-operative experiments.

Agricultural College, Mich., March 7, 1906.

DIGESTER TANKAGE FOR SWINE.

R. S. SHAW.

Bulletin No. 237.

The following report contains a brief statement of the results of investigations on the value of digester tankage as an adjunct to the ration in certain phases of swine feeding. The value and use of this material has been the subject of investigation elsewhere heretofore, in several ways, and has been reported on. One of the main objects in taking up this work was to secure a substitute for skim milk for young pigs from the time of weaning on to that stage of development where they are capable of using less concentrated rations containing smaller amounts of protein. An enormous quantity of milk leaves our Michigan farms annually to supply condensories, cheese factories, and city, town and village trade. Thus, many producers are left without skim milk for rearing young calves and pigs. It is generally conceded that the use of skim milk greatly simplifies the process of pig feeding from weaning time on; in fact, its use in the ration at this time is regarded by some as being indispensable. In the absence of skim milk probably the next best food factor for the young pig is middlings, but the supply and demand are frequently such that even this foodstuff is not available. These are some of the factors that led us to look for a substitute for skim milk for the young growing pig. While this work was in progress it also became possible to make some tests with tankage for the fattening hog. The tankage used had a guaranteed content of 60% protein, 10% fat and 6% phosphates. The price paid for it was $32.50 per ton. The question is frequently asked, what is tankage? It consists of refuse materials from slaughtering, such as digestive organs and their contents, flesh scraps and some blood, and condemned carcasses which cannot be used for human food. These materials are cooked under steam pressure and then dried and ground until almost as fine as middlings.

The prices charged for the foods used in this experiment are as follows, viz.: Corn meal $20.00 per ton, middlings $20.00, tankage $32.50, and skim milk 20c per hundred pounds.

The data given in this report shows that the work in each case was repeated a number of times. This duplication demonstrates marked uniformity of results in the comparative data. Our readers cannot help but note the fact that, in general, the average daily gains of the experimental pigs were not large. It is not reasonable to expect that gains from experimental animals should always reach the maximum for some rations are satisfactory and others less so. In order to test the comparative efficiency of rations, changes cannot be made in them, often for weeks at a time, whether the animals like them or not. In feeding for big gains only, the appetite of the animal can be catered to. In the case of some of these lots the pigs were on test from ten to fourteen weeks at a time. Considerable restraint is also put on experimental pigs by way of confinement in pens and yards. In all the cases reported the pigs were continuously confined in pens eight or ten feet by fourteen feet, with outdoor yards of the same width as the pens, but twenty-two feet long.

PART 1.

Digester Tankage vs. Skim Milk for Growing Swine.

This experiment consisted of a series of three tests, under practically the same general plan, so that the work may be said to have been repeated three times. The six pens of pigs reported in this experiment completed the feeding periods successfully. Additional pens were started but were discarded owing to the development of undesirable factors such as unthriftiness of an individual or other causes likely to affect the accuracy of the results. The surrounding conditions were alike in every respect except that the two pens of pigs of the first series were fed during the winter season and the others during the summer.

TEST NO. 1.

Digester Tankage vs. Skim Milk for Pigs Between Four and Six Months Old.

In this test the ration for lot I consisted of cornmeal 3 parts, middlings 3 parts and tankage 1 part, mixed with water; for lot II corn meal and middlings equal parts, fed with a little more than their own weight of skim milk.

The pigs used in this case were Yorkshires and Poland Chinas; the former were farrowed September 30th, and the latter September 15th, 1904. As this feeding period began January 25th and extended to March 22, 1905, covering fifty-six days, the Yorkshires were 117 days old at the start and the Poland-Chinas 132 days. There were five pigs in each pen consisting of four Yorkshires and one Poland China. The results are summed up in the following table:

Lot No.	Weight, Jan. 25, 1905. Pounds.	Weight, March 22, 1905. Pounds.	Gains. Pounds.	Food consumed.				Total cost of food.	Cost per cwt., gain.	Food per pound, gain.	
				Corn meal. Pounds.	Middlings. Pounds.	Tankage. Pounds.	Skim milk. Pounds.			Meal. Pounds.	Skim milk. Pounds.
I. Five pigs.....	313.3	621	307.7	420	420	140	......	$10.67	$3.46	3.18	......
II. Five pigs.....	323.0	654	331.0	461	461	......	980	$11.18	$3.37	2.78	2.96

During the 56 days of this test the five pigs of Lot I consumed an average of 3.5 pounds of meal mixture per head daily, while increasing in live weight from 62.6 pounds to 124.2 pounds at the rate of 1.09 pounds per head daily. At the same time, the five pigs of Lot II consumed an average of 3.29 pounds meal mixture and 3.5 pounds skim milk, while increasing in live weight from 64.6 pounds to 130.8 pounds at the rate of 1.18 pounds per head daily. Though the rate of gain and cost of production in this test are slightly in favor of the skim milk fed pigs, still, the margin of difference in both instances is extremely small. Throughout this test absolutely no difference could be detected between the two pens as to thriftiness and feeding quality.

TEST NO. 2.

Digester Tankage vs Skim Milk for Growing Swine Between 58 and 128 Days of Age.

In this test the ration for Lot III was made up in the following proportions by weight, viz.: Middlings 20 pounds, corn meal 10 pounds and digester tankage 3 pounds; the tankage formed one-eleventh of the mixture. To this food sufficient water was added to form a slop. Lot IV was fed a ration of the following proportions, viz.: Middlings 20 pounds, corn meal 10 pounds and skim milk 90 pounds, three pounds of skim milk being used to every pound of meal mixture.

The animals used in this test were the offspring of a Duroc-Jersey boar and Tamworth sow. Twelve pigs were farrowed March 12, 1905, but only eight were raised. On May 9th, when these pigs were 58 days old, they were weaned and divided into two lots of four each, according to weight and quality. There was one barrow and three sows in each pen.

The results of this test are summed up in the following table:

Lot No.	Weight, May 9, 1905. Pounds	Weight, July 18, 1905. Pounds	Gains. Pounds.	Food consumed.				Total cost of food.	Cost per cwt., gain.	Food per pound, gain	
				Corn meal. Pounds.	Middlings. Pounds.	Tankage. Pounds.	Skim milk. Pounds.			Meal. Pounds.	Skim milk. Pounds.
III. Four pigs....	159	443	284	266.7	533.3	80	......	$9.30	$3.27	3.09	......
IV. Four pigs....	152	463	311	245.5	491.0	......	2209.5	$11.78	$3.78	2.36	7.1

During the 70 days of this test the four pigs of Lot III consumed an average of 3.14 pounds of their meal mixture per head daily, while increasing in live weight from 39.7 pounds to 110.7 pounds at the rate of 1.01 pounds per head daily. At the same time the four pigs of Lot IV consumed on an average 2.63 pounds of their meal mixture and 7.89 pounds skim milk per head daily, while increasing in live weight from 38 pounds to 115.7 pounds at the rate of 1.11 pounds per head daily.

In this test the actual increase in live weight was a trifle greater for Lot IV receiving skim milk, but the cost of production per cwt. was 51c less for Lot III receiving tankage in the place of skim milk. No difference was apparent in the relative condition of the pigs in the two lots.

TEST NO. 3.

Digester Tankage vs. Skim Milk for Growing Swine Between 50 and 120 Days of Age.

In this test the ration for Lot V was made up in the following proportions by weight, viz.: Middlings 20 pounds, corn meal 10 pounds, and digester tankage 3 pounds; the tankage formed one-eleventh of the mixture. This ration was made into a slop by adding water. Lot VI was fed a ration of the following proportions, viz.: Middlings 20 pounds, corn meal 10 pounds and skim milk 90 pounds, three pounds of skim milk being used to every pound of meal mixture. These rations duplicate those of Test No. 2.

The pigs used in this test were the offspring of a Berkshire boar and Tamworth sow and were farrowed March 27, 1905. There were twelve pigs in the litter and ten were raised. On May 16th, when these pigs were 50 days old, about weaning time, they were divided into two lots of five each, there being two barrows and three sows in each pen. The results of this test are summed up in the following table.

Lot No.	Weight, May 16, 1905. Pounds.	Weight, July 25, 1905. Pounds.	Gains. Pounds.	Food consumed.				Total cost of food.	Cost per cwt., gain.	Food per pound, gain.	
				Corn meal. Pounds.	Middlings. Pounds.	Tankage. Pounds.	Skim milk. Pounds.			Meal. Pounds.	Skim milk. Pounds.
V. Five pigs.....	183	478	295	282.4	564.8	84.8	......	$9.85	$3.33	3.15	......
VI. Five pigs.....	184	523	339	262.7	525.3	......	2,364	$12.60	$3.71	2.32	6.97

During the 70 days of this test the five pigs of Lot V consumed on an average 2.66 pounds meal mixture per head daily, while increasing in live weight from 36.6 pounds to 95.6 pounds at the rate of .84 pounds per head daily. At the same time the five pigs of Lot VI consumed on an average 2.25 pounds meal mixture and 6.75 pounds skim milk per head daily, while increasing in live weight from 36.8 pounds to 104.6 pounds at the rate of .96 pounds per head daily. The results of this test agree exactly with those of test 2. Where skim milk was fed in this case the gains were slightly larger, but the cost of production where tankage was used was 38 cents less per cwt. gain.

CHECK TEST.

A check test was conducted for ten weeks, in which two lots of pigs of five each were fed on a ration consisting of middlings 2 parts and corn meal one part, made into a thick slop by adding water. Attention is called to the fact that this ration duplicates those of the previous tests, in-so-far as it contains middlings and corn meal in the same proportions as in tests 2 and 3, but does not contain either tankage or skim milk. The ration used in this case therefore serves as an indicator to the value of both skim milk and tankage.

The pigs used in this case were Yorkshire-Chester and Yorkshire-Berkshire crosses divided as evenly as possible as regards breeding, size and quality. These pigs went on feed at about the same average weights as those of the previous tests, but were some older and were fed seventy days.

The following are the results of this check test:

Lot No.	Weight, July 18, 1905. Pounds.	Weight, Sept. 26, 1905. Pounds.	Gains. Pounds.	Food consumed.				Total cost of food.	Cost per cwt., gain.	Food per pound, gain.	
				Corn meal. Pounds.	Middlings. Pounds.	Tankage. Pounds.	Skim milk. Pounds.			Meal. Pounds.	Skim milk. Pounds.
VII. Five pigs...	265	554	289	386.8	773.7	......	......	$11.60	$4.01	4.01	......
VIII. Five pigs...	258	535	277	386.8	773.7	......	......	$11.60	$4.18	4.18	......

In the three tests including tankage and skim milk, the average cost of production per cwt. with the tankage rations was $3.35, with the skim milk rations $3.62, and with the check ration of middlings, corn meal and water $4.09. In the three original tests the tankage ration pigs consumed an average 3.14 pounds meal mixture per pound gain, those receiving skim milk in the ration required 2.48 pounds meal mixture and 5.67 pounds skim milk per pound gain. In the check ration consisting of corn meal and middlings the average amount of meal mixture required per pound gain was 4.09 pounds. The average daily gains from the three tankage rations was .98 pounds, from the three skim milk rations 1.08 pounds, and from the check ration .8 pounds. Judging from these figures we are therefore quite safe in concluding that though the ration containing skim milk made a slightly greater gain than where tankage was used, the cost of producing this increased gain was somewhat greater. Also that the check ration of middlings and corn meal only, produced smaller gains at a greater cost than either of the others. The amount of dry matter required per pound gain with both tankage and skim milk rations was about the same; in the check ration it was somewhat greater.

PART 2.

DIGESTER TANKAGE FOR FATTENING SWINE.

This part of the report deals with the use of digester tankage in the ration for swine being fitted or finished for market; or, in other words, the development of the hog from say one hundred and twenty pounds weight to the weight and finish demanded by the market, between two hundred and two hundred and fifty pounds.

This experiment consisted of a series of four tests, with two pens of pigs in each case. The rations were not all alike. In the first two tests the rations were, on the one hand, corn meal and tankage, and on the other, corn meal only. In the other two tests of this series one ration was made up of corn meal, middlings and tankage, and the other of corn meal and middlings. Middlings were used more freely in the latter tests because they were considerably cheaper than corn at the time of purchase.

TEST NO. 1.

Digester Tankage and Corn Meal vs. Corn Meal Alone for Fattening Pigs.

The ration for lot IX consisting of tankage and corn meal was made up of 5 parts corn meal and 1 part tankage by weight; both this ration and the one consisting of corn meal only, for Lot X, were made into a thick slop for feeding, by adding water.

The animals used were purchased for the experiment and consisted of eight Duroc Jerseys farrowed in July, 1904; these pigs had been run on pasture during the open season with little grain feed and as a result only averaged 120.5 pounds per head when put on feed January 25, 1905, for the 70-day test.

The following table gives the results of this test:

Lot No.	Weight, Jan. 25, 1905. Pounds.	Weight, April 5, 1905. Pounds.	Gains. Pounds.	Food consumed				Total cost of food.	Cost per cwt., gain.	Food per pound, gain.	
				Corn meal. Pounds.	Midd-lings. Pounds.	Tank-age Pounds.	Skim milk. Pounds.			Meal. Pounds.	Skim milk. Pounds.
IX. Four pigs....	480.6	927	446.4	1,335	......	267	......	$17.69	$3.96	3.58	......
X. Four pigs....	484	865.6	381.6	1,426	......	......	......	$14.26	$3.73	3.73	......

Attention is directed to the fact that the tankage formed one-sixth of the meal ration for Lot IX, and because of its large proportion and greater cost, the cost of production was rendered greater despite the fact that the gains were larger. During the seventy days of this test the four pigs of Lot IX consumed on an average 4.76 pounds of corn meal and .95 pound tankage per head daily, while increasing in live weight from 120.15 to 231.75 pounds at the rate of 1.59 pounds per head daily. During this same time the four pigs of Lot X consumed an average of 5.09 pounds corn meal per head daily, while increasing in live weight from 121 pounds to 216.4 pounds at the rate of 1.36 pounds per head daily.

TEST NO. 2.

Digester Tankage and Corn Meal vs. Corn Meal Alone for Fattening Pigs.

In this case the ration for Lot XI consisted of corn meal 9 pounds and tankage 1 pound, the tankage forming but one-tenth of the entire ration. The ration for Lot XII consisted of corn meal only and both rations were fed as a thick slop by adding water.

The pigs used in this case were somewhat heavier than those of test one at the beginning of the experiment, averaging 155.25 pounds, but were fed to greater weights covering a period of eighty-four days.

The following table gives the results of this test:

Lot No.	Weight, Nov. 7, 1905. Pounds.	Weight, Jan. 30, 1906. Pounds.	Gains. Pounds.	Food consumed.				Total cost of food.	Cost per cwt., gain.	Food per pound, gain.	
				Corn meal Pounds.	Middlings. Pounds.	Tankage. Pounds.	Skim milk. Pounds			Meal. Pounds.	Skim milk. Pounds.
XI. Four pigs...	624	1,016	392	1525.5	......	169.5	......	$18.0[illegible]	$4.59	4.32	......
XII. Four pigs...	618	915.3	297.3	1,624	......	......	......	$16.24	$5.46	5.46	......

During the eighty-four days of this test the four pigs of Lot XI consumed an average of 4.54 pounds corn meal and .5 pounds tankage per head daily, while increasing in live weight from 156 to 254 pounds at the rate of 1.16 pounds per head daily. At the same time the four pigs of Lot XII consumed on an average 4.83 pounds corn meal per head daily, while increasing in live weight from 154.5 pounds to 228.8 pounds at the rate of .88 pounds per head daily. In this test and also in No. 1, it was a noticeable fact that the corn meal fed pigs kept pace with the corn meal and tankage fed pigs for a time, but the gains of the latter became increasingly greater as the feeding period advanced. We should not expect the advantages of the balanced ration to show markedly on a short feed.

Though absolutely greater, the comparative cost of production is less in test 2 where tankage formed but one-tenth of the ration than where it formed one-sixth in test 1.

TEST NO. 3.

Digester Tankage for Fattening Swine.

Tests Nos. 3 and 4, of part 2, differ only from Tests 1 and 2 in that middlings was introduced into both rations.

In this test the ration for Lot XIII was made up as follows: Middlings 20 pounds, corn meal 10 pounds and tankage 3 pounds, the latter forming one-eleventh of the ration; the ration of lot XIV consisted of middlings 20 pounds and corn meal 10 pounds.

The pigs of these two lots, a Duroc Tamworth cross, were put on feed at an average of 113.25 pounds, and weighed 215.5 pounds each at the end of fourteen weeks.

The following is a summary of the test:

Lot No.	Weight, July 18, 1905. Pounds.	Weight, Oct. 24, 1905. Pounds.	Gains. Pounds.	Food consumed				Total cost of food.	Cost per cwt., gain.	Food per pound, gain.	
				Corn meal. Pounds.	Midd-lings Pounds.	Tank-age. Pounds.	Skim milk. Pounds.			Meal. Pounds.	Skim milk. Pounds.
XIII. Four pigs..	443	876	433	577.5	1155.25	173.25	......	$20.14	$4.65	4.4	......
XIV. Four pigs..	463	848	385	613.7	1227.3	......	......	$18.41	$4.78	4.78	......

During the 98 days of this test the four pigs of Lot XIII consumed on an average 4.86 pounds of their meal mixture per head daily, while increasing in live weight from 110.7 pounds to 219 pounds at the rate of 1.1 pounds per head daily. At the same time the four pigs of Lot XIV consumed on an average 4.69 pounds of their meal mixture per head daily, while increasing in live weight from 115.7 pounds to 212 pounds at the rate of .98 pounds per head daily.

TEST NO. 4.

Digester Tankage for Fattening Swine.

This is a duplication of Test No. 3, Part 2, except that five pigs were used in each lot instead of four, and the experiment was one week later starting. The pigs in test 3 were Duroc Tamworth cross, those in 4 a Berk-Tamworth cross. The pigs of these two lots were put on feed at an average weight of 100.1 pounds and finished fourteen weeks later at an average weight of 179.5 pounds.

The following is a summary of the test.

Lot No.	Weight, July 25, 1905. Pounds.	Weight, Oct. 31, 1905. Pounds.	Gains. Pounds.	Food consumed.				Total cost of food.	Cost per cwt., gain.	Food per pound, gain.	
				Corn meal Pounds.	Midd-lings. Pounds.	Tank-age. Pounds.	Skim milk. Pounds.			Meal. Pounds.	Skim milk. Pounds.
XV. Five pigs..	478	927	449	586.7	1173.3	176	......	$20 46	$4.55	4.31	......
XVI. Five pigs...	523	868	345	630.3	1260.7	......	......	$18.91	$5.48	5.48	......

During the 98 days of this test the five pigs of Lot XV consumed on an average 3.95 pounds meal mixture per head daily, while increasing in live weight from 95.6 pounds to 185.4 pounds at the rate of .91 pounds per head daily. At the same time the five pigs of Lot XVI consumed on an average 3.85 pounds meal mixture per head daily, while increasing in live weight from 104.6 pounds to 173.6 pounds at the rate of .7 pounds per head daily. The appetites of the pigs receiving tankage in their ration was better than where corn only was used and their coats were smoother and more oily looking.

SUMMARY.

1. The indications from the results given in Part 1 are that digester tankage can be used successfully as a substitute for skim milk in the ration for the growing pig, from weaning time on.

2. In Tests 2 and 3, Part 1, the following rations were used, viz.: First, middling 20 pounds, corn meal 10 pounds, tankage 3 pounds, the last forming 1-11 of the ration; second, middling, 20 pounds, corn meal 10 pounds, and skim milk 90 pounds. In both cases the gains from the skim milk ration were a little greater. but the cost of production from the tankage ration was much less. This would seem to suggest that a slightly greater proportion of tankage than 1-11 of the ration could be fed, increasing the gains somewhat, and still keeping within the cost of production of the skim milk ration.

3. The check ration of middlings 20 pounds and corn meal 10 pounds mixed with water, produced smaller gains at a greater cost than either of the rations containing tankage or skim milk.

4. In Tests 1 and 2, Part 2, corn meal and tankage in the proportions of 5 and 1, and 9 and 1, were compared with rations of pure corn meal; in tests 3 and 4, the two rations were made up as follows, viz.: First, middlings 20 pounds, corn meal 10 pounds, and tankage 3 pounds, the last forming 1-11 of the ration, and second, middlings 20 pounds and corn meal 10 pounds. The following conclusions may be withdrawn:

(1.) The gains were greatest in every case where tankage was used in the ration, and

(2.) This was more and more noticeable as the feeding period was prolonged.

(3.) Test 2 was conducted 84 days, and in it tankage formed 1-10 of the ration; tests 3 and 4 were conducted 98 days and in them tankage formed 1-11 of the ration: in all three the cost of production was less where the tankage ration was used. In Test 1, conducted 70 days, with tankage forming 1-6 of the ration, the gains, though greater, were a few cents per cwt. more expensive in the tankage ration.

5. In general the figures given indicate that tankage can be used to good advantage in the ration for the fattening hog, as well as for the growing pig.

FIRST ANNUAL REPORT OF M. A. C.

GRADE DAIRY HERD.

R. S. SHAW AND A. C. ANDERSON.

Bulletin No. 238.

The plans for this work were established in 1904 and the herd of twenty cows purchased in October of that year. In September, 1905, Mr. Anderson was placed in charge of the herd and has compiled the data and prepared this report for publication.

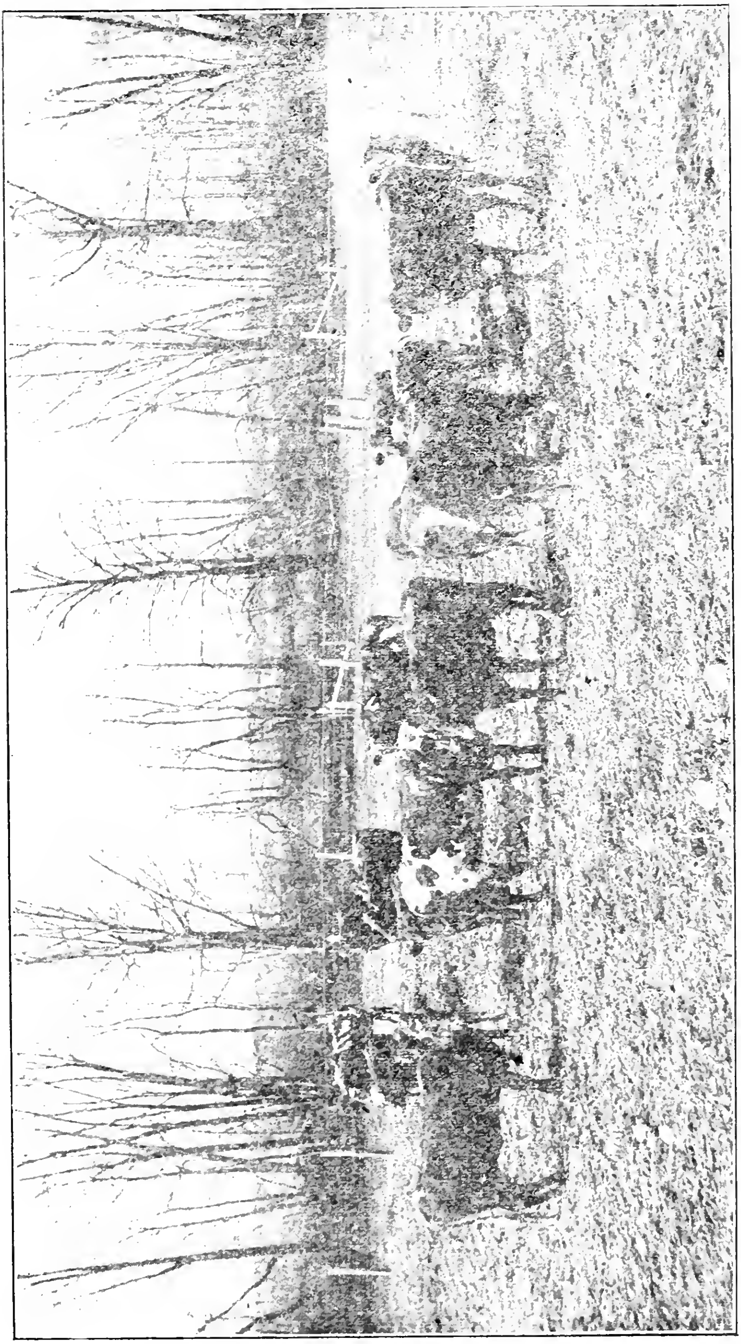
In maintaining a grade dairy herd at this institution two chief ends are sought. First and foremost to show objectively how the common dairy stocks of this state can be improved as to quantity and quality of milk production by a rational and continued system of up grading; and second to show the effect of careful feeding and management upon average, common, or even inferior dairy animals. While the stocking of farms with pure bred dairy animals is desirable and strongly advised, it is generally recognized that the great mass of improvement among dairy cattle must come from intelligent up-grading. In selecting the foundation stock for a grade dairy herd attention was given first to the health and general physical characteristics of each individual selected. It is preferable to start with animals of good constitution, even though they have only moderate tendencies to milk giving, than to sacrifice these features in any degree in the attempt to secure abundant milkers at the start. Care was also taken to secure animals which should be fairly uniform. To accomplish the desired ends with the material available in the Michigan markets it was thought best to purchase twenty grade Shorthorn cows. While none of these cows possessed a large percentage of Shorthorn blood, they all had enough to give the evenness and uniformity sought in the foundation herd.

These cows were purchased in the fall of 1904 and dropped their first calves early in the winter of 1904-5. Their first crop of calves was used for feeding purposes and formed no part of this experiment.

For breeding purposes the herd is divided into four groups or sub-herds of five animals each. One of these groups is to be bred continuously to Jersey bulls, and the female progeny bred in the same line. Another of the groups is to be bred continuously to Holstein bulls and the female progeny bred in the same line. The third group is to be bred in the same way to Guernsey bulls and the fourth to Shorthorn bulls.

As soon as the heifers come to maturity they will be used in the herd, and will gradually replace the older stocks.

The execution of these plans will require time, and the results will accumulate somewhat slowly. In the meantime, reports will be made annually of the milk and butter product, and the food consumption of the foundation herd.



It is the plan to so handle the herd that each animal will freshen once each year. But since this cannot always be brought about within exact dates, the year is taken as the unit of time instead of the period of lactation. The use of the yearly record is increasing among dairymen, and should be still more generally adopted.

THE MILK AND BUTTER PRODUCT OF THE HERD.

In Table I, which follows, the total yields for each cow for her first year are shown. In column one appears the number of the cow, the cows being numbered for convenience in keeping records. The second column gives the total days of lactation, out of a possible 365. In column three the total yield of milk is given. Column four shows the average percent of butter fat for the year; column five, the total pounds of butter fat; column six, the pounds of butter; and column seven the pounds of skim-milk.

The milk from each cow is weighed, recorded, and sampled, at each milking. The composite samples are tested for butter fat at the close of each week. The pounds of milk produced by a cow in a week multiplied by the per cent of fat gives the pounds of butter fat for the week. The pounds of butter fat increased by one-sixth of itself gives the pounds of butter. The skim-milk is estimated at 80 per cent of the whole milk. This estimate for skim-milk is rather low, it being customary at many creameries to allow 85 per cent of whole milk for skim-milk.

TABLE I.

Number of cows.	Days of lactation.	Pounds of whole milk.	Average per cent butter fat.	Pounds of butter fat.	Pounds of butter.	Pounds of skim-milk.
11	323	7,144	3.86	276.86	323	5,715
12	318	5,559	4.41	245.12	286	4,447
13	323	8,113	4.45	361.72	422	6,490
14	363	7,114	3.93	280.29	327	5,690
16	154	1,205	3.43	41.15	48	964
17	361	7,607	4.84	371.15	433	6,084
18	309	7,681	3.53	271.72	317	6,144
19	325	4,796	4.84	232.29	271	3,837
20	360	6,290	3.94	248.58	290	5,031
21	361	6,131	4.24	260.58	304	4,904
22	295	5,417	4.44	219.43	256	4,334
23	293	7,066	3.77	266.58	311	5,653
24	349	7,259	4.25	309.43	361	5,807
25	330	7,423	3.76	279 43	326	5,938
26	346	5,441	3.83	208.29	243	4,352
27	314	5,143	3.95	203.15	237	4,114
28	348	6,872	4.12	283.72	331	5,496
30	316	7,092	3.73	264.86	309	5,673
31	345	6,206	4.04	251.15	293	4,964
32	362	5,620	4.23	237.43	277	4,495
Average for herd	324	6258.9	4.08	255.65	298.25	5,007

It will be observed that No. 16 dried up after averaging less than eight pounds of milk per day for 154 days, or only about half an ordinary milking period and making about one-fifth as much butter as the next poorest cow. A dairyman would undoubtedly have eliminated her from the herd before the close of the season. There are, however, several reasons, from an experimental standpoint, why she should be retained in the herd. Notwithstanding this handicap the herd averaged 6258.9 pounds of milk per cow, with an average test of 4.08% of butter fat, equivalent to 298.25 pounds of butter. If the record of No. 16 were to be eliminated there would be an average of 6525 pounds of milk and 311.4 pounds of butter for each of the remaining nineteen cows.

VALUE OF THE PRODUCTS, COST OF PRODUCTION, AND PROFIT.

Besides keeping records of the amount of milk given by each cow, daily records were made of the amount of feed consumed by each, so that the entire cost of food for each animal for the year is known. While it would be possible to give the other items of expense entailed by the herd, as cost of care, et cetera; these are purposely omitted as is also the value of calves and manure. In dairy operations these two groups of items are commonly considered as balancing each other. This they have approximately done in the present case. But as the major item of expense in maintaining a dairy cow is her food, and in view of the extremely intimate relation of food and product, we have eliminated all minor matters in order to better contrast these two main features.

Instead of crediting the herd with the money actually received from the sale of the butter at the College Dairy, although more was really received for it than is credited here, the price of butter is fixed at 20c net per pound for the entire year. By 20c net is meant that this price includes the cost of making. It will be borne in mind that these cows freshened in the late fall and early winter, consequently the heaviest flow of milk was in the winter months when milk and butter were worth most. The leading creameries of the State, which receive a proportionate amount of winter milk report prices the average of which places the price assigned as a conservative one.

Skim milk is valued at 20c per cwt., this being the price charged for it in experimental feeding conducted at this institution.

The value of the products of each individual of the herd, as well as cost of production and profit are shown in Table II which follows. In column 2 will be found the value of butter, in column 3 the value of skim milk, while column 4 gives the total cost of food for each cow. The return for every dollar's worth of food consumed by the cow is shown in column 5, the food cost for every 100 lbs. of milk produced in column 6, and the food cost for every pound of butter in column 7. Column 8 gives the total value of products of the cow, being the sum of columns 2 and 3, while column 9 shows the profit or loss over food for the entire year.

In considering cost of food, the entire amount consumed by the animal during the whole year is taken, and not simply the portion eaten while in lactation.

TABLE II.

Number of cows.	Value of butter.	Value of skim-milk.	Total cost of food.	Return for $1.00 of food.	Food cost for 100 lbs. milk.	Food cost for 1 lb. butter.	Total value of products.	Profit over food.
11	$64 59	$11 43	$39 23	$1 93	$0 54	$0.121	$76 02	$36 79
12	57 18	8 89	29 00	2 27	52	.101	66 07	37 07
13	84 34	12 98	36 71	2 65	45	.087	97 32	60 61
14	65 93	11 38	38 47	2 01	54	.117	77 31	38 87
16	9 66	1 93	21 47	54	1 78	.444	11 59	— 9 88
17	86 64	12 17	38 52	2 56	50	.088	98 81	60 29
18	63 39	12 29	31 18	2 42	40	.098	75 68	44 50
19	54 12	7 67	33 02	1 87	68	.122	61 79	28 77
20	57 32	10 06	39 29	1 71	62	.135	67 38	28 09
21	60 79	9 80	36 30	1 94	59	.119	70 59	34 29
22	51 12	8 67	26 64	2 24	49	.104	59 79	33 15
23	62 29	11 30	31 76	2 31	44	.121	73 59	41 83
24	72 15	11 61	36 45	2 29	50	.101	83 76	47 31
25	65 22	11 88	34 29	2 24	46	.105	77 10	42 81
26	48 68	8 70	31 28	1 83	57	.128	57 38	26 10
27	47 46	8 23	29 09	1 91	56	.122	55 69	26 60
28	66 11	10 99	32 42	2 37	47	.098	77 10	44 68
30	61 80	11 35	29 14	2 51	41	.094	73 15	44 01
31	58 64	9 93	32 65	2 10	52	.111	68 57	35 92
32	55 46	8 99	34 51	1 87	61	.124	64 45	29 94
Average for herd	$59 64	$10 01	$33 07	$2 11	$0 52	$0.110	$69 65	$36 58

The above table shows that the value of butter produced by a single cow ranges from $9.66 to $86.64, the average being $59.64. The value of skim milk ranges from $1.93 to $12.98 with an average of $10.01. The average total value of products is $69.65. Of this sum $33.07 was paid out as the average cost of maintaining a cow for the year, leaving a profit of $36.58 for each animal.

That the prices allowed for butter and skim milk are not too high is shown by the fact that the milk produced by the herd would have given an equal profit on the basis of condensery prices.

The highest return per cow per dollar invested in food was $2.65 while the herd average was $2.11.

The food cost for 100 lbs. of milk was 52c, and for a pound of butter 11c.

The average food cost for every pound of butter-fat, while not given in the table, was 12.83c.

In proof of the fact that the herd has produced both milk and butter economically the reader is referred to Henry's Feeds and Feeding, section 689, where he gives the averages of herds reported by Wing of Cornell Station, Haecker of Minnesota Station, Soule of Missouri Station, and Linfield of Utah Station. The average cost of 100 pounds of milk at the four stations for the year was 55c and the cost of one pound of fat was 13.3c, while the average cost of 100 pounds of milk as shown by the table above has been 52c and the cost of one pound of fat 12.83c, although the schedules of prices of feeds reported in the four tests are considerably lower than those adopted here.

A STUDY OF GROUPS AND INDIVIDUALS.

Upon examination of the records of the several cows one is able to to arrange them into four somewhat general groups or classes.

The first group is composed of two cows, Nos. 13 and 17, each giving nearly 8,000 pounds of milk, making approximately 425 pounds of butter, with a profit of $60.00.

There are eight cows in the second group, each giving approximately 7,000 pounds of milk, making 325 pounds of butter, with an average profit of over $40.00.

In the third group there are nine animals giving between 5,000 and 6,000 pounds of milk, making approximately 275 pounds of butter, with a profit of $30.00.

The fourth group is composed of a single cow, No. 16, giving only 1,200 pounds of milk, making less than 50 pounds of butter, and being kept at a loss of $9.88.

For convenience in comparison these groups are shown in the following tables.

GROUP I.

Number of cow.	Pounds of whole milk.	Pounds of butter.	Cost of food.	Value of products.	Profit over food.
13	8,113	422	$36 71	$97 32	$60 61
17	7,607	433	38 52	98 81	60 29
Average	7,860	427.5	$37 61	$98 06	$60 45

GROUP IV.

Number of cow.	Pounds of whole milk.	Pounds of butter.	Cost of food.	Value of products.	Loss under food.
16	1,205	48	$21 47	$11 59	$9 88

Group IV is intentionally placed after Group I not to show the striking contrast, however apparent the contrast may be, but to enable the reader to take the average of the two groups. If the average of the three cows which make up these groups be obtained it will be as follows:

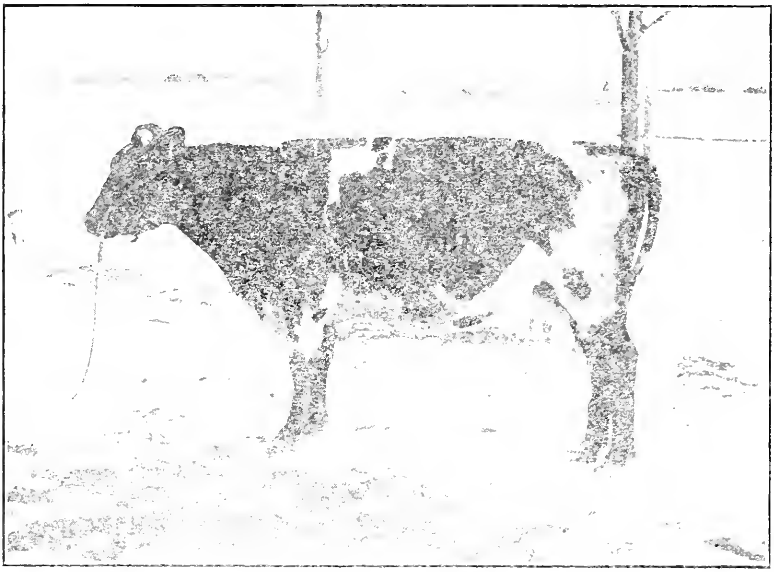
Pounds of whole milk.	Pounds of butter.	Cost of food.	Value of products.	Profit over food.
5,641	301	$32.23	$69.24	$36.94

The average for the same items for the whole herd is:

Pounds of whole milk.	Pounds of butter.	Cost of food.	Value of products.	Profit over food.
6,259	298.25	$33.07	$69.65	$36,58

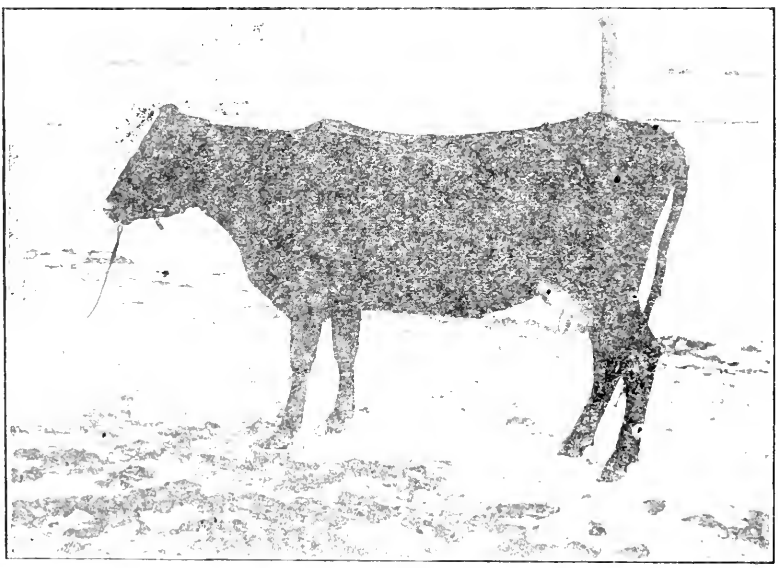
These averages are strikingly similar. Cow No. 16 not only failed to make a profit, but her deteriorating influence was sufficient to drag down not only one but two outstandingly superior animals to the common level of herd average.

While many dairy farmers realize, in a general way at least, the importance of weeding out their unprofitable cows, it is doubtful if they appreciate fully the extent of these impeding influences.



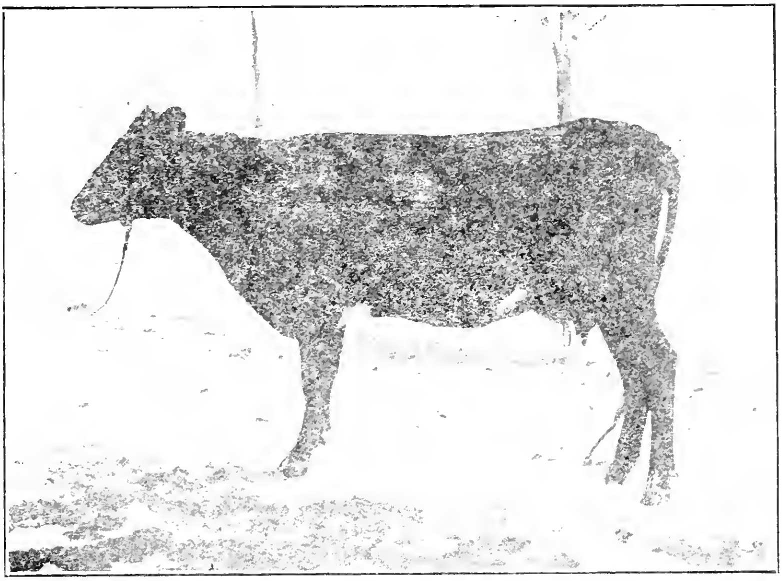
No. 17.

Gave 7,607 pounds of milk and 433 pounds of butter.
Total value of products was $98.81 with $60.29 net profit.

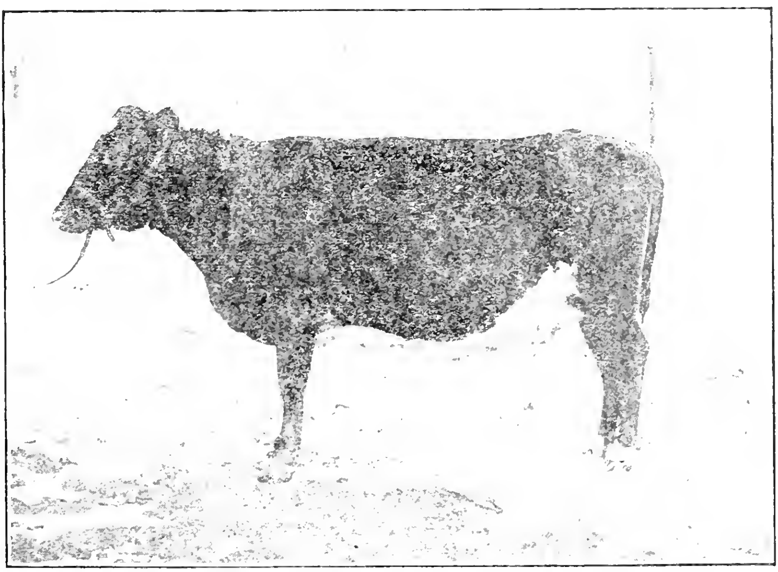


No. 13.

Gave 8,113 pounds of milk and 422 pounds of butter.
Total value of products was $97.32 with $60.61 net profit.



No. 18
Gave 7681 pounds of milk and 317 pounds of butter.
Total value of products was $75.68 with $44.50 net profit.



No. 16.
Gave 1,205 pounds of milk and 48 pounds of butter.
Total value of products was $11.59 with $9.88 net loss.

GROUP II.

Number of cow.	Pounds of whole milk.	Pounds of butter.	Cost of food.	Value of products.	Profit over food.
24	7,259	361	$36 45	$83 76	$47 31
28	6,872	331	32 42	77 10	44 68
18	7,681	317	31 18	75 68	44 50
30	7,092	309	29 14	73 15	44 01
25	7,423	326	34 29	77 10	42 81
23	7,066	311	31 76	73 59	41 83
14	7,114	327	38 47	77 31	38 87
11	7,144	323	39 23	76 02	36 79
Average	7,206	325.6	$34 12	$76 71	$42 60

GROUP III.

Number of cow.	Pounds of whole milk.	Pounds of butter.	Cost of food.	Value of products.	Profit over food.
12	5,559	286	$29 00	$66 07	$37 07
31	6,206	293	32 65	68 57	35 92
21	6,131	304	36 30	70 59	34 29
22	5,417	256	26 64	59 79	33 15
32	5,620	277	34 51	64 45	29 94
19	4,796	271	33 02	61 79	28 77
20	6,290	290	39 29	67 38	28 09
27	5,143	237	29 09	55 69	26 60
26	5,441	243	31 28	57 38	26 10
Average	5,623	273	$32 42	$63 52	$31 10

In view of the fact that these cows were purchased in the open market with no opportunity of ascertaining their previous yields, or their tests, their performance for the past year may be considered fairly satisfactory and creditable. Since in their breeding they do not represent any strictly specialized dairy beed, they may be classed as just common or mediocre cows such as almost any general farm of the State might furnish. Whatever product has been obtained above the ordinary is largely the result of feeding and management; careful attention being given not only to the amount of feed furnished and its chemical composition, but to its physical composition and variety as well.

FEEDING AND MANAGEMENT.

To enable the reader to answer many of the questions that will naturally arise relative to the feeding of the herd we shall take up this matter in some detail.

In conducting feeding experiments in which the cost of food is an item for consideration, especially if these experiments are to extend over a series of years, it is advisable to establish at the outset a scale of prices or values for the different feeds to be used. Market prices fluctuate with the season, the year, and the locality; but the price of each feeding stuff is usually found between fairly definite extremes. While the prices adopted are necessarily arbitrary they are intended to represent the average yearly prices that prevail in the Michigan markets.

SCHEDULE OF FEEDS AND PRICES.

Clover hay	$5 00	per ton
Corn silage	2 50	" "
Green corn	2 00	" "
Succotash	1 50	" "
Roots	2 00	" "
Corn meal	20 00	" "
Wheat bran	18 00	" "
Oats	20 00	" "
Dried beet pulp	15 00	" "
Dried molasses beet pulp	16 50	" "
Gluten feed	20 00	" "
Oil cake	28 00	" "
Pasture for season	5 00	

It has been the plan to handle the herd in as uniform a manner as possible, making variations only in amounts of feed as demanded by the milk yield, the stage of lactation, and the individual peculiarities of the animal. They were all kept in good milking condition, but were not allowed much increase in live weight except toward the close of their milking periods and while dry. So far as it could be controlled each cow was allowed to go dry from six to eight weeks.

The regular winter ration of the cows was corn silage, hay, and grain supplemented at times by mangolds. During the summer they had pasture and grain, supplemented by silage, succotash, or green corn as the condition of the pasture, the milk flow, and the maturity of the soiling crop dictated or permitted.

In Table III are given the pounds of food consumed by each cow, arranged as to kinds. The costs of grain, roughage, and pasture are given separately. For convenience roots are classed under roughage. By the use of the Schedule of Prices the cost of any item of roughage or grain for any cow may be obtained.

TABLE III.

Number of cow.	Pounds of foods consumed.										Cost of foods consumed.			
	Grain mixture No. 1.	Grain mixture No. 2.	Grain mixture No. 3.	Grain mixture No. 4.	Grain mixture No. 5.	Silage.	Hay.	Succotash.	Green corn.	Roots.	Cost of grain.	Cost of roughage.	Cost of pasture.	Total cost of food.
11	1,525	277	135	....	....	10,337	1,067	124	288	1,190	$17 13	$17 10	$5 00	$39 23
12	772	247	174	96	15	6,521	1,291	116	278	542	11 71	12 29	5 00	29 00
13	1,016	297	172	394	....	8,611	1,227	119	278	347	17 17	14 54	5 00	36 71
14	1,248	260	189	109	....	9,927	1,361	124	727	700	16 14	17 33	5 00	38 47
16	482	213	52	....	15	5,015	1,176	....	....	505	6 75	9 72	5 00	21 47
17	1,327	227	183	95	....	10,233	1,166	120	640	741	16 35	17 17	5 00	38 52
18	481	291	161	117	432	6,534	1,604	116	278	38	13 59	12 59	5 00	31 18
19	900	287	173	174	....	8,186	1,245	110	218	542	13 84	14 18	5 00	33 02
20	1,529	253	174	36	....	10,046	1,107	119	278	904	17 70	16 59	5 00	39 29
21	1,406	239	166	48	....	8,504	1,102	130	278	1,013	16 52	14 78	5 00	36 30
22	486	292	174	130	....	6,067	1,326	119	278	270	9 81	11 83	5 00	26 64
23	593	279	162	202	255	7,229	1,259	130	233	542	13 70	13 06	5 00	31 76
24	899	288	177	477	....	8,414	1,228	116	278	542	16 95	14 50	5 00	36 45
25	1,071	280	169	60	....	9,002	1,295	120	278	347	14 09	15 20	5 00	34 29
26	967	279	169	94	....	7,466	1,179	120	278	122	13 51	12 77	5 00	31 28
27	678	288	174	118	30	6,862	1,296	115	212	347	11 63	12 46	5 00	29 09
28	784	283	169	196	45	8,098	1,273	120	278	347	13 40	14 02	5 00	32 42
30	549	296	171	275	....	6,789	1,275	120	278	247	11 84	12 30	5 00	29 14
31	1,062	278	172	34	....	7,970	1,209	120	278	542	13 76	13 89	5 00	32 65
32	1,168	240	167	96	....	8,615	1,283	129	278	495	14 66	14 85	5 00	34 51
Average for herd	(Grain 1,554 lbs.)					8,021	1,248	114	296	516	$14 01	$14 06	$5 00	$33 07

GRAIN MIXTURE NO. I.

Dried beet pulp	4	parts
Oats (ground)	3	"
Wheat bran	2	"
Gluten feed	1	"

GRAIN MIXTURE NO. II.

Dried molasses beet pulp	2	parts
Wheat bran	1	"
Gluten feed	1	"

GRAIN MIXTURE NO III.

Dried molasses beet pulp	4	parts
Wheat bran	2	"
Oil cake	1	"

GRAIN MIXTURE NO. IV.

Corn meal	3	parts
Wheat bran	3	"
Oil cake	1	"

GRAIN MIXTURE NO. V.

Dried beet pulp	3	parts
Corn meal	3	"
Wheat bran	6	"
Oil cake	2	"

The composition of the different mixtures depended upon the feeding stuffs on hand, the proper balance of the ration, the kind of feeds immediately available, and in one or two instances the local prices. No attempt was made to demonstrate the superiority of one mixture over another. All cows were fed the same mixture while it was in use. Some cows are not charged with grain from mixtures four and five because these animals freshened first and had completed their year before these mixtures were fed.

The average amounts of feeds consumed expressed approximately in tons are:

Grain	.75	tons
Silage	4	"
Hay	.625	"
Green crops	.20	"
Roots	.25	"
Pasture	20	weeks

The cost of keeping the herd is not above those reported in the Creamery Patrons' Investigations and similar reports, published in the leading dairy papers. In fact it is considerably less than a large number of these. A detailed comparison of very many such reports with the foods used here will reveal the fact that a majority of the farmers fail to provide sufficient succulence and concentrates, and compel their cows to depend too much on dry, coarse feeds for their sustenance.

With no animal is liberal feeding so essential to profit as with the dairy cow. While some farmers feed wastefully at one season, and stintingly at another, a majority of those who fail, do so first because they do not supply sufficient foods, and second, because that which is supplied is lacking in variety and succulence.

CORN IMPROVEMENT.

J. A. JEFFERY.

Special Bulletin No. 34.

INTRODUCTION.

In 1904, Michigan grew 1¼ millions acres of corn, producing 37,000,000 bushels, worth $19,235,000.00.

The average yield for that year was 28.6 bushels per acre. The average yield for the ten years, 1895 to 1904, was 32.13 bushels per care. For the same period the average yield per acre,

for Kansas was	21.65 bushels.
for Nebraska was	28.00 bushels.
for Iowa was	32.47 bushels.
for Missouri was	27.68 bushels.

The average yield for the same period for the seven corn belt states was 30.00 bushels per acre.

Michigan uses practically all of her corn fodder, while most of the belt states use comparatively little, and in some cases almost none of the corn is cut for fodder or ensilage. This fact gives an added importance to the corn crop with us.

MICHIGAN CORN IMPROVEMENT ASSOCIATION.

In March, 1904, The Michigan Corn Improvement Association was organized. Its objects were "more and better corn for Michigan." It planned to have a corn exhibition each year at the time and place of the Round-up Farmers' Institute, with prizes offered for the best samples of corn exhibited. At the last show over five hundred dollars in cash, etc., were offered in prizes.

In numbers and in enthusiasm the growth of the association has been very marked. Its influence is manifested in the more intelligent selection of corn, and in the increased demands for information coming from different parts of the State, by increased demand upon Supt. Taft for institute work along corn lines, and by the local corn shows all over the State in connection with Farmers' Institutes.

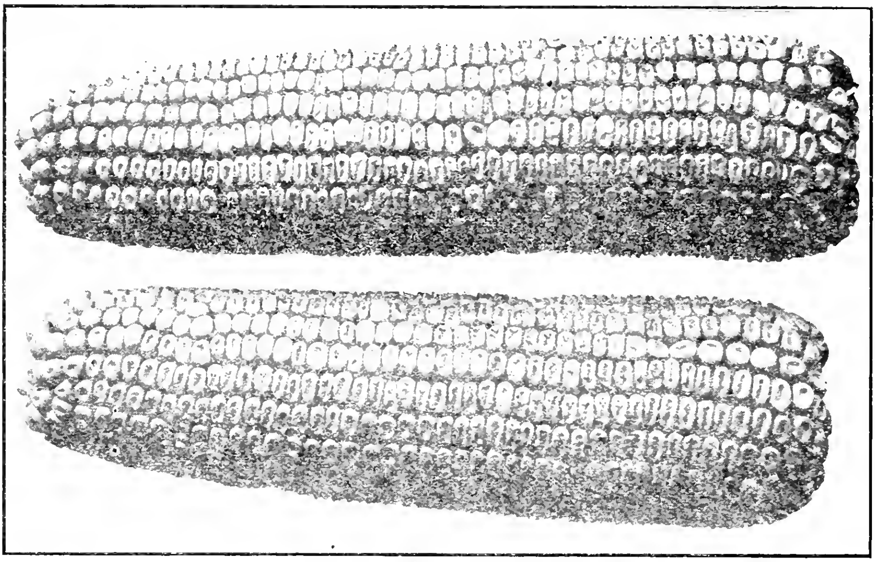


Fig. 1.—Two Michigan grown ears of Ried's Yellow Dent.

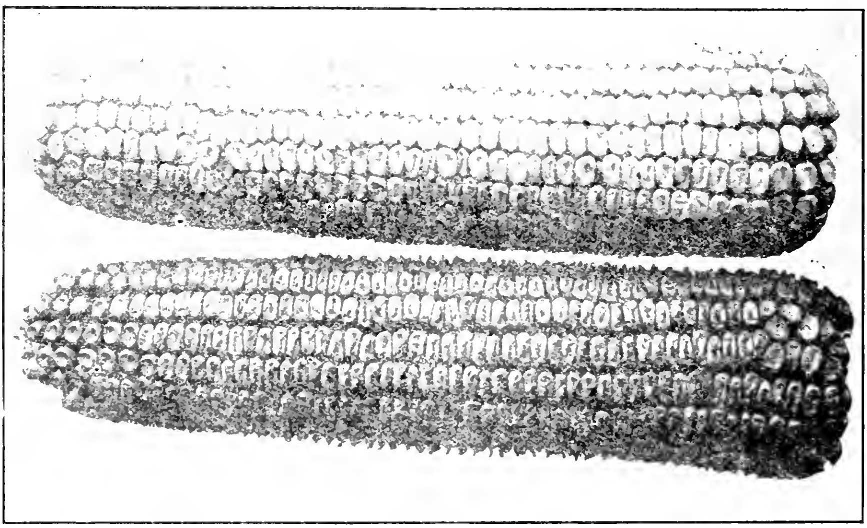


Fig. 2.—Two Michigan grown ears. The upper one is of the Hathaway's Yellow Dent.

To institute workers, to the experiment station, and to the farm department of the college, come questions something like the following:

(a) What breed of corn shall I grow?

(b) What are the best methods to employ in the growing of corn? and,

(c) Along what lines and in what ways may I improve my corn?

The thing sought is the largest possible yield of the best possible corn.

BREEDS OF CORN.

Comparatively few people grow pure breeds of corn. Indeed, comparatively few people realize that there are pure breeds of corn. With them a yellow dent is a yellow dent.

The number of breeds of corn grown in Michigan is not great, and in many cases these are not pure. They have either been crossed upon, or through carelessness or lack of knowledge have been bred away from the original type.

The following breeds are found to be grown in the State in fairly pure form:

Hathaway.	Ried's Yellow.
Pride of the North.	Leaming.
Hackberry.	Shenandoah Valley.
Mortgage Lifter.	Minnesota King.
Huron Dent.	Golden Ideal.

Of the white dents a number of very good samples have been found, but names seem to be unknown, excepting the Erie dent, grown in Genesee county.

Of the white cap yellow dents a number of good strains exist, but the Burpee is the only one so far found bearing a name.

Of the ensilage corn, the Giant Cuban, is the only one so far found.

Miscellaneous dents:

Calico (turkey track).
Red.
Strawberry.
California calico.

Of the flints:

Smut-nose.
Kind Phillip.
Yellow.
White.

"What breed shall I grow?" is a common question.

If you can find a breed in your own locality giving a good yield of corn, of good quality and strong type, such a breed would be excellent to begin with. With intelligent selection and good care it is possible to improve it in both quality and yield, considerably beyond what it now is, and is doing.

When a breed of corn is brought from one part of a state to another, experience seems to show emphatically that one or more years are required to bring it to the point of producing best yields, and then it may not be well adapted to the conditions of soil, etc., of the locality.

The breeds named above are distributed something as follows: The Pride of the North, an old and at one time very popular breed has been quite widely grown. So popular was it that the demand for it for seed led unscrupulous seedsmen to sell all kinds of seed corn under the name "Pride of the North." For that reason it is difficult at the present time to find this breed pure. From one farm in Livingston county an apparently pure sample has been secured.

The Huron Dent is found on one farm in Ingham county, from which it is sold in considerable quantities to all parts of the State for seed. It matures early, is small eared, well filled, and yields a large per cent of grain to ear.

The Hathaway, a breed originated in Michigan some years ago, seems to have been very popular at one time, and is found in several counties of the south central part of the State, including Jackson, Hillsdale, Cass, Ionia, Kent, etc.

The Mortgage Lifter has been found in Lenawee, Oakland and Oceana counties, varying in size with locality.

The Hackberry is an early maturing corn, and is widely distributed.

The Minnesota King, improperly called "Poney Dent," is a small, eight rowed, early maturing breed, and is found chiefly in Oceana and neighboring counties.

The Golden Ideal originated in Cass county, is grown in different parts of central Michigan. It is claimed for it that it will mature well north.

The Reid's Yellow Dent, Leaming and Shenandoah Valley are Corn Belt breeds, but do well in the southern tier of counties. They are desirable breeds. Last year the Reid's Yellow Dent was matured both at the college and in Livingston county. At the college the yield was at the rate of 148 baskets per acre.

The white cap yellows stand in high favor in certain parts of the State. They mature early, are not readily crossed upon by other breeds and yield well.

Of the miscellaneous breeds mentioned above, the Calico, or turkey track, has probably the most honorable record. It is now grown to a considerable extent in Jackson, Hillsdale, Branch and Calhoun counties.

The Flints are found everywhere in the State, but usually are not grown nearly so extensively as the Dents. They are well known and need no comment.

CORN CULTURE.

In the study of corn culture, the ultimate object is the largest possible yield. For this we must have:

(1) Vigorous active plants in,
(2) Full numbers,
(3) Producing good ears and fodder.

And this demands:

(1) Good seed corn,
(2) Good soil, and
(3) Good practice.

SEED CORN.

The most vigorous plant can be produced only from a high grade of seed corn. Such corn can be best selected from the stalk before harvesting. Seek for ears of:

(1) Good proportions,
(2) Properly situated on the stalks, not too high and not too low,
(3) With end turned down.

The parent stalk should be of good size and should have an abundance of foliage. In Michigan we grow corn not only for grain but for fodder.

PRECAUTIONS.

In selecting seed ears, remember that in drying they will probably shrink at least 10%, both in length and circumference, a 10-inch ear will shrink in drying to 9 inches.

It hardly seems wise to select the earliest maturing ears if they mature unduly early. It would seem better to select ears that mature just sufficiently early to be out of the way of the average early frost. In other words, the corn plants should use the longest safe growing season.

At least a sufficient amount of seed corn should be carefully selected in this way to plant a few acres from which to select the next year's seed. The rest of the seed may be selected, and often is, from corn husked from the shock, but that so selected, should be from the corn grown from the *carefully selected* seed of the previous year. All seed corn taken from the husked corn should be selected before freezing can occur. Authorities are agreed that the freezing of corn before it is thoroughly dry lessens its vitality.

DRYING.

All seed corn should be at once stored in a warm, dry, airy place to dry. A furnace room is good if it complies with the three named conditions. It may do to leave the corn in crates, but there is more or less of danger in the practice, and especially if the corn is over moist. The crate is *not* safe. Fig. 3 shows an excellent, cheap rack, with corn in place. The racks are 12 feet long and 10 feet high. The posts, which are of 2x4 hemlock, stand 4 feet apart. The strips are cut from sound hemlock or pine boards 1x7/8, and are set in pairs as shown. Each pair carries a tier of corn. The distance betwen any pair and the one above is 4 inches. Six penny nails should be used in nailing on the strips. The seed corn should be placed in rack as shown.

But wherever placed, the corn should be thoroughly and quickly dried. This removes the possibility of moulding and consequent lessening of vitality. A temperature a little above ordinary room temperature is suggested till the corn is well dried; then a temperature anywhere above the freezing point is considered satisfactory. It is thought by many that well dried seed corn will not have its vitality lessened by freezing. Others never allow seed corn, however well dried, to freeze. There can be no doubt that the latter practice is safe.

Seed corn taken from the crib in spring cannot have the vitality of properly cured corn, and this in face of the fact that the crib corn may show a hundred per cent of germination. The relatively damp condition, and the occasional or continued freezing of winter make perfect vitality

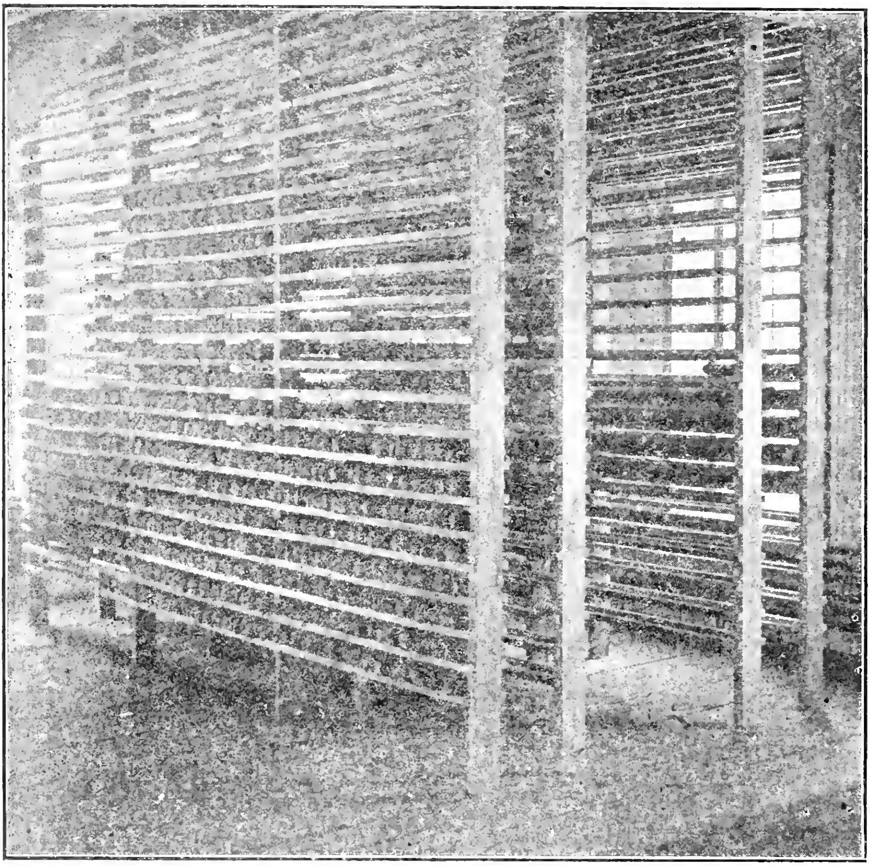


FIG. 3.—A practical rack for drying seed corn.

and vigor impossible. In a recent test, rack dried corn germinated 99%; crib corn tested 77%. The winter has been a very mild one, too.

TESTING OF SEED CORN.

It is good practice to test the germinating quality of every ear of the seed one is planning to sow. The undertaking is not a difficult one. Fig. 4 shows a germinator used by the farm department of the college. It is 11¼x17½ feet inside measure, and is 1 inch deep. It is made of galvanized iron, but any boy could make one of wood that would work just as well. The germinator is filled with sand, or sandy soil, and

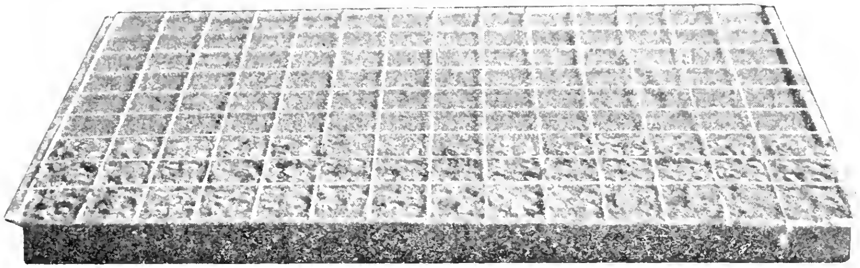


Fig. 4.—Galvanized iron germinator, described on p. 9. Small notches are cut in the rim at intervals of $1\frac{1}{4}$ inches to carry the string or wire which divides the germinating surface into $1\frac{1}{4}$ inch squares. This figure shows four rows of kernels in place.

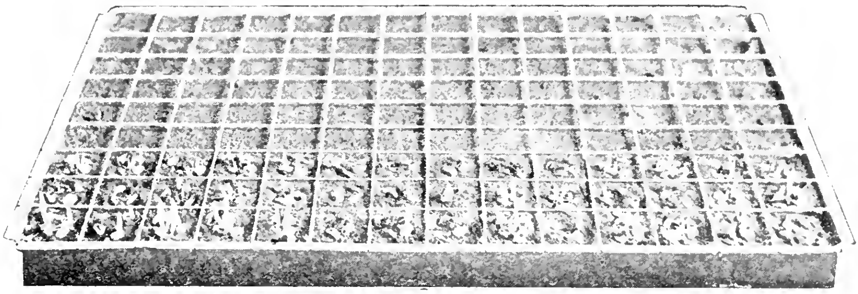


Fig. 5.—Same as Fig. 4, after four days.

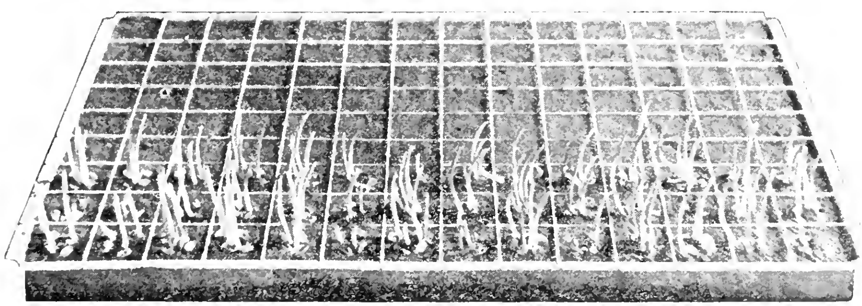


Fig. 6.—Same as Fig. 4 after seven days. At the end of seven days the young plants have made a sufficient growth to give some idea of their vigor. It is not sufficient that seed corn will germinate.

stricken off with a straight edge, and then lightly tapped to settle the sand. Strings are then stretched as shown, marking 1¼ feet squares. On the wooden tray drive tacks or very small nails into the sides (not the edges) of sides and ends 1¼ feet apart, to carry the strings. This gives 126 squares. Five or six such trays will hold the kernels for five to eight bushels of corn. One tray will hold the seed from 78 pounds of 10 ounce ears.

Now place the ears of seed corn in rows of 14 ears each, either on racks or elsewhere, i. e., as many ears as there are squares in one of the long rows in the tray, numbering the rows of ears to correspond with the rows of squares in the tray. Take each ear separately, remove four kernels from as many different points on the ear, and set them, small end down, in the square corresponding to the ear. Press each kernel down till its top is even with, or better, just below the surface of the sand, as shown in the figure. Each tray provides for nine rows of ears.

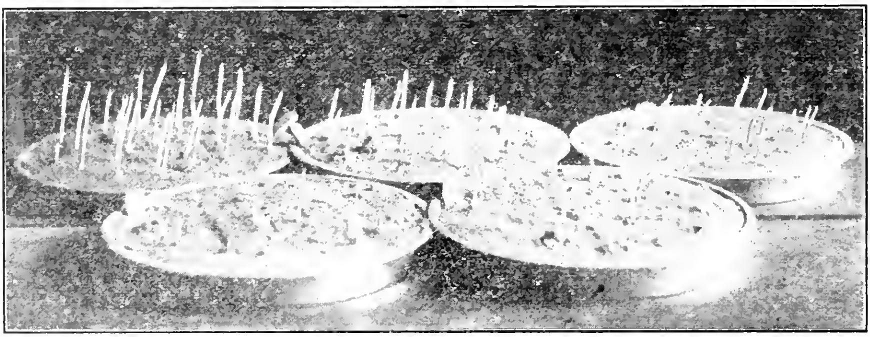


FIG. 7.—Twenty-five kernels of corn from each of five carefully saved ears of seed corn were planted in these five pans respectively. A careful examination reveals the fact that there is a great difference not only in the germinating qualities, but in the vigor of the resulting plants. We have, here an excellent illustration of the importance of testing seed corn by individual ears.

Now wet the sand in the tray thoroughly, and leave in a warm place, at room temperature, or slightly higher. See to it that the sand is kept well moistened, but not saturated.

Figure 4 shows the corn in place, Fig. 5 shows the corn germinated, and Fig. 6 shows the corn after some growth is made. It is only after the corn has had an opportunity to grow a few days that one can pass intelligently upon the vigor of the germinating kernel. It is not sufficient that a kernel of corn germinate. Discard all ears whose kernels do not *all* germinate *vigorously*, if you would have a perfect stand of vigorous plants. See Fig. 7.

TIP AND BUTT KERNELS.

Tip kernels should be removed far enough back to insure freedom from molds which are likely to be found where the ends of the husks have allowed moisture to enter before husking. Aside from this, tip and butt kernels are objectionable only so far as their presence interferes with

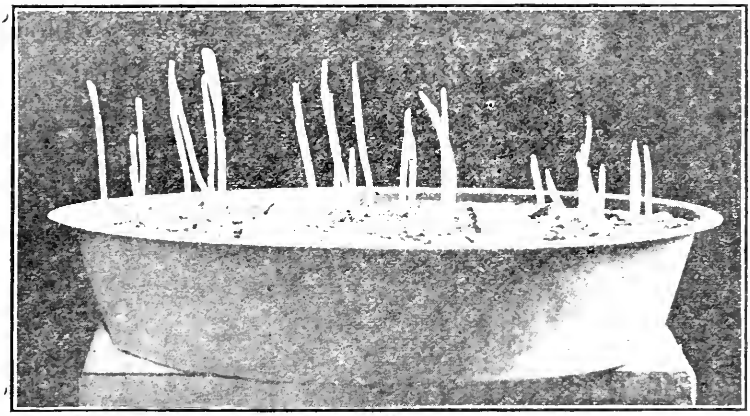


FIG. 8.—The young plants at the left are from tip kernels, those in the middle are from middle kernels, and those on the right are from butt kernels all from the same ear and planted at the same time.

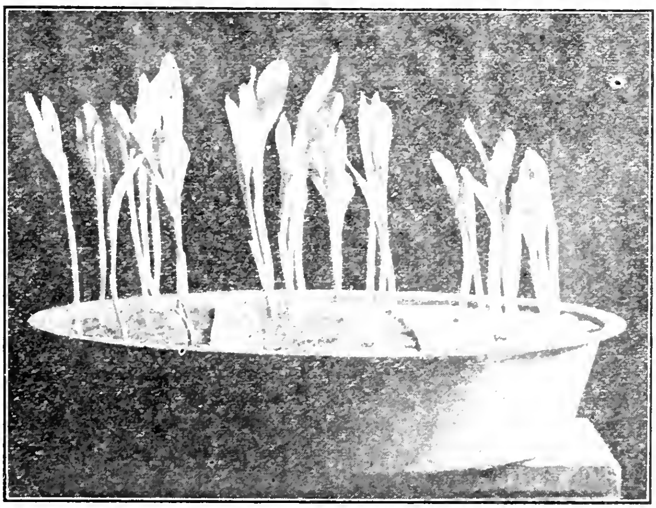


FIG. 9.—Same as Fig. 8 after four days.

an even stand, where planting is done with a machine. Grading, or screening the corn, insures an even stand where a planter is used.

Figs. 8 and 9 show the germination and growth of tip, middle, and butt kernels, and this is in accord with a considerable number of tests made by one of our college students, some years since.

THE SOIL.

Well manured, well prepared clover sod is the ideal place for corn. Timothy sod is objectionable in Michigan, for the reason, according to Prof. Pettit of the Experiment Station, that the timothy bulbs are the breeding places from which come the wire worm, the cut worm, and the corn bill-bug, all serious enemies of corn.

THE MANURE.

There is a difference of opinion as to when the manure should be applied to the clover sod. If the soil is reasonably good, the manure might profitably be applied to the pasture, thus giving the pasture the benefit of the manure. The corn will still profit largely from it also.

THE PLOWING AND OTHER PREPARATION.

Plow reasonably deep, in good time, at least two weeks before planting, and more if possible. Roll to bring the newly turned sod into contact with the lower soil. Disc or spring tooth well. Follow with a peg tooth harrow. Work often enough thereafter till planting time, to keep the soil thoroughly mellow to a depth of 3 inches. Early plowing and subsequent working promote proper conditions of moisture, ventilation and temperature, all of which are so necessary to an abundant supply of available plant food for the young crop of corn. Young plants as well as young animals profit by a good supply of food, and suffer as well when the supply is insufficient.

PLANTING.

Plant as early as soil conditions will permit. Plant only so deep as may be necessary to insure sufficient moisture to the germinating kernel. The kernel and the succeeding plant both need the warmth of the sun. The depth will be greater in sand than in clay.

Three kernels to the hill is considered good planting. If the seed is of high quality, and the ground well prepared, this should insure a good stand.

The question of hills as against drills is one that should be settled by each individual for himself. The use to which the crop is to be put must be a factor in deciding the question. It is generally thought that a given number of plants, distributed to one in a place, will give a larger yield than if planted in hills of 3 or 4 plants in a place, but occupying the same total area. This is denied by some good authorities. Try it. Why not?

After planting, harrow at least once before the corn comes up, to destroy starting weeds, and loosen the soil. Our best corn growers harrow once or twice more before the cultivator is started.

After the corn is well up, count the number of plants you have per row, divide by the number of hills in the row and decide whether you have a good average stand. If not, find out where the difficulty lies, and plan to remove the difficulty in the future. Note the number of hills (a) with no plants, (b) with one plant, (c) with two, and so on.

CULTIVATING.

Cultivate often enough to keep the soil free from weeds and thoroughly stirred to a depth of 2 inches up to the time of tasseling.

When the ears have well set, count and record the number of stalks bearing no ears. If there are many of the latter, some way should be sought to lessen the number in the future. The presence of such stalks may be due to at least two causes, (1) inherited barrenness, (2) to improper nutrition.

CORN IMPROVEMENT.

In the improvement of corn the following things are sought, and in the order named:

1. Increased yields.
2. Improved qualities.
3. Fixation of character, the power to transmit to succeeding generations certain well defined fixed characters and these within reasonably narrow limits.

INCREASED YIELDS.

In improving for yields merely, it is sought to increase the power of the plant to use larger amounts of food and produce more grain or fodder, or both. The plant must have more energy. To accomplish this end two lines of procedure are open to us:

1. Selection:
   - (a) general.
   - (b) controlled.
2. Cross fertilizing:
   - (a) general.
   - (b) controlled.

The real work of improvement in both cases will be done in plots, and as described here, may be taken up by any farmer interested in corn improvement.

SELECTION.

This work begins in the field of growing, ripening corn. The field is explored for the most perfect ears in size, form and depth of kernel found on the most perfect stalk as regards foliage, size, energy and time of maturing ear. Generally, not many ears will be found coming up to the ideal of the experimenter. These ears are carefully saved for planting.

(1a) The grain from these ears may be mixed and planted in an area by itself away from the rest of the corn on the farm, or the area may constitute a part of the regular corn field; but in the latter case it should constitute the southwest corner of the field, because the winds in Michigan are chiefly from the southwest, and while from that direction will not bring in pollen from the poorer parts of the field to cross upon the supposed better corn of the breeding plot. If, however, some neighbor is growing another breed of corn near by this southwest corner, it will not be practical to use this corner for the breeding plot, because pollen from the neighbor's corn is likely to be blown into the breeding plot.

At ripening time the best few ears of this plot are selected, as before described, for next year's breeding plot, while other good ears should be saved for a seed plot in the field for next year. Or, if this breeding plot be of considerable size, it might be possible to select seed enough for planting the whole field next year. This plan has been practiced in Michigan with good success.

(1b) Instead of mixing the corn from the several ears, the corn from each ear might be sown in a row by itself in the breeding plot. This gives a chance to study the progeny of each ear by itself and to select the best of the progeny of the best ears. There arises the difficulty in this plan, that the best ear from any row planted from the best ear, may be the product of the crossing of the pollen from a row planted from a very poor ear, as shown by its "performance," upon this row planted from the best ear.

CROSS BREEDING.

(2a) Two ears of apparently good quality may be selected for cross breeding, and with the idea of breeding ear No. 2 on ear No. 1. A block of land, say 5 rods by 3 rods, may be laid off and marked. In rows 1, 3, 5, 7, 9, 11 and 13. The grain from ear No. 1 is planted, while in the even numbered rows—2, 4, 6, 8, 10, 12 and 14—the grain from ear No. 2 is planted. At tasseling time the tassels are removed from the odd numbered rows as rapidly as they begin to appear. The ears forming on the stalks of the odd rows must be polinated by pollen from the even numbered rows. The matured ears on the odd rows are seen to be the result of cross fertilization—are the progeny of the crossing of ear No. 2 upon ear No. 1.

Prof. Williams of the Ohio Experiment Station very wisely calls attention to the fact that the productive qualities of these two ears so crossed the one upon the other were not known. He practices the following method:

(2b) After selecting ears from the field as described above, a part, less than half, only of the grain from each ear is planted in rows as described in (1b). The remaining portion of grain of each ear is carefully saved. The crops from the several rows so planted indicate the productive quality of the corresponding ears, and it is thus possible to tell which of these ears are most promising, and that portion of the grain from these ears which was saved, can now be planted in the blocks as described in (2a), thus crossing strong ears upon strong ears, or ears of known productive qualities upon ears of known productive qualities. Ears from these crosses may be tested and crossed in like manner, and so on, as far as the breeder cares to carry the work.

The value of such a system of cross-breeding is two fold:

(1) Cross-fertilizing of plants results in increased vigor; and,

(2) The bringing together of plants from ears selected for proven strong qualities ought to produce even greater vigor.

IMPROVING QUALITY.

This has reference to changing the physical characteristics of the ear and kernel and the chemical composition of the kernel. Physical changes are brought about both by selection and by cross breeding. At the present time selection is employed to accomplish chemical changes, and

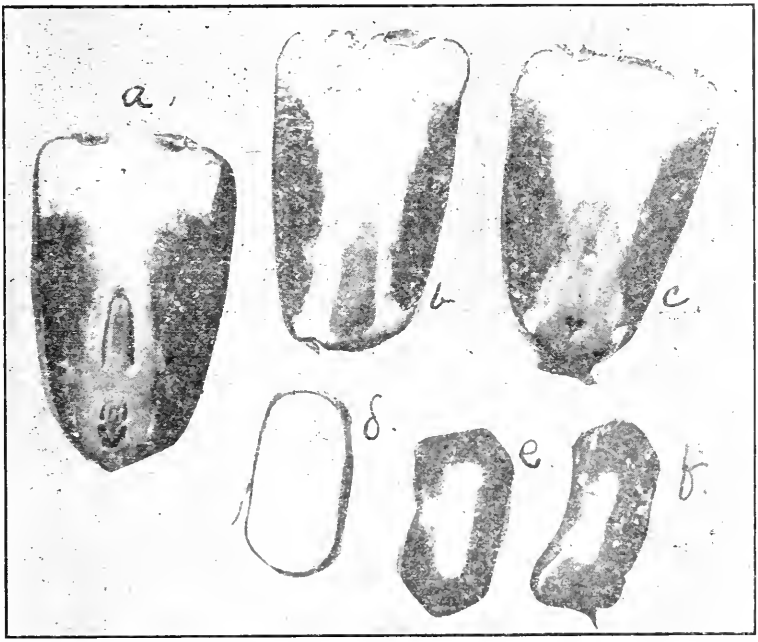


FIG. 10.—A study of the structure of the kernel of corn, showing the location of the germ with the embryo, and the distribution of the starch and the horny starch. The light portion is the starch. The very dark portion is the horny starch.
(a) Shows especially well the position and appearance of the embryo.
(c) Shows a larger proportion of horny starch than does (b).
(d) Shows a cross section of a kernel like (b) just above the horny starch.
(e) Shows a cross section of the same kernel just below the upper end of the horny starch.
(f) Shows cross section of the same kernel at upper end of germ.

the chemical changes usually sought are in the starch, oil and protein content, depending, of course, upon whether the corn is grown for feeding purpose or for the starch factory.

The oil is obtained from the germ, and the quantity of oil depends upon the size and upon the quality—chiefly on the size—of the germ.

Fig. 10 shows the structure of kernels of corn. The light portion of the kernel is the starch, the darkest portion is called the horny starch. The greater part of the protein comes from the horny starch; therefore, the greater the amount of horny starch, the greater the amount of protein.

If large oil content is sought, ears having kernels with large germs are selected for seed.

If large protein content is sought, the ears with kernels having a large amount of horny starch are selected for seed. It is claimed that in ears of the same breed, one has little difficulty in distinguishing with the eye, between kernels of high and kernels of low protein. By selecting corn of high protein content for seed, the average content has been raised several per cent in experiments conducted for that purpose.

FIXING CHARACTER.

The success attained in this is not always complete. One of the older and well known breeds of corn is rather noted for the number of ears it produces untrue to type. One Michigan breed produces at the present time too great variation in style of ears and of kernels. There is good reason to believe, however, that this variation both of ear and kernel can be greatly lessened and quite readily, too.

On the other hand other well known breeds, while they vary in size because of climatic and soil condition appear to produce ears remarkably constant in general appearance as regards shape of ear, color and shape of kernel.

Careful selection is the basis for work along this line. Controlled cross breeding should be very helpful in eliminating varations and in fixing definite character.

THE IDEAL OR PERFECT EAR.

It is not often found. It must possess certain physical qualities or characters:

1. Shape. In shape it should be cylindrical, or only slightly tapering. The very tapering ear is being bred away from. The rows should be straight, extending completely from butt to tip. See Figs (1) and (2).

2. Color. The cobs should be red for yellow corn, white for white corn, and red or white for the white caps as now bred, but all red or all white.

There should be no kernels present indicating by color or shape that cross polinating from another breed has taken place.

3. Tips. The tips should be well covered with kernels of uniform size, the rows remaining unbroken to the end. The question as to whether the cob may not protrude slightly is an open one.

4. Butts. See Figs 11 and 12. The butts should be well rounded as shown in the Fig. 11. The shank or ear stalk should equal about one-third the total diameter of the ear.

5. Kernels. The kernels should be wedge-shaped, so that they shall fill completely all space betwen the circumference of the ear and the circumference of the cob. See Figs. 13 and 14 and 15 (c). To examine kernels, remove two kernels side by side from the

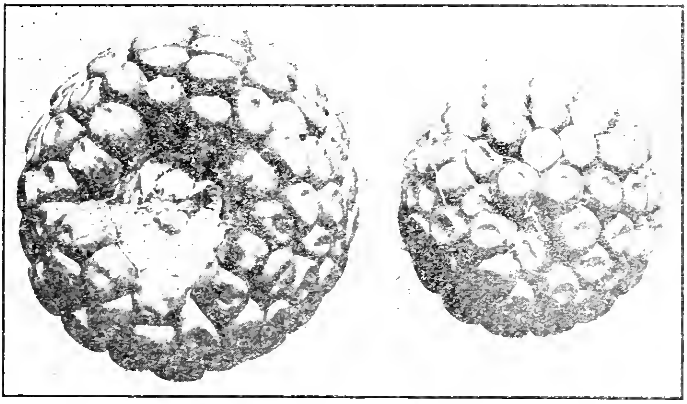


Fig. 11.—A very good butt and tip.

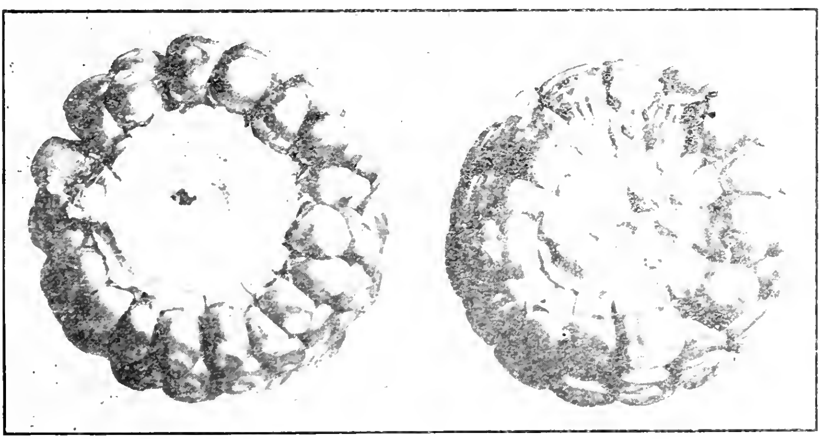


Fig. 12.—Two poor butts. The left one would be cut at at least a half point, while the right one would be cut at least three tenths of a point, under our rules for scoring.

cob, one-third or one-half the distance from butt to tip, and lay them on some flat surface, germs up in the same relative position they occupied on the cob.

6. Length and circumference. At the present time the standards of the Michigan Corn Improvement Association are 9 inches for length and 7 inches for circumference. The circumference is measured one-third the distance from butt to tip.

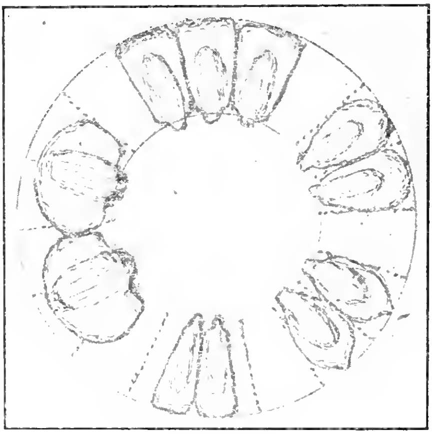


FIG. 13.—A study of kernels.
The upper three kernels are well proportioned and occupy completely the space between the circumference of the ear and the circumference of the cob.
The upper right hand two kernels are poorly shaped and leave a lot of unoccupied space.
The lower right hand two kernels show how the white rice popcorn kernels occupy the space.
The lower two kernels are of the shoe-peg type.
The left two kernels show the relative shape and position of flint kernels as compared with the upper three dent kernels.

It is thought by many that it would be better not to have definite arbitrary standards for length and circumference, but that it would be better to require a definite relation between length and circumference, with a stated definite minimum length of each.

7. Spaces. (a.) The outer spaces between rows should be small. With very rare exceptions ears have even numbers of rows, and the rows are in pairs. This distinctness of pairing of rows is considered one of the evidences of good breeding. The space between the rows in the pairs is smaller than the spaces between the pairs. (b). There should be no spaces between kernels as they stand in the rows. In Fig. 15 (a) these spaces are seen clearly between the lower one-fourth of the kernels. The spaces do not appear in Fig. 15 (b).

8. Per cent of grain to ear. The M. C. I. A. requires that 100 pounds of ears shall shell out 88 pounds of grain, and individual ears shall shell in that proportion.

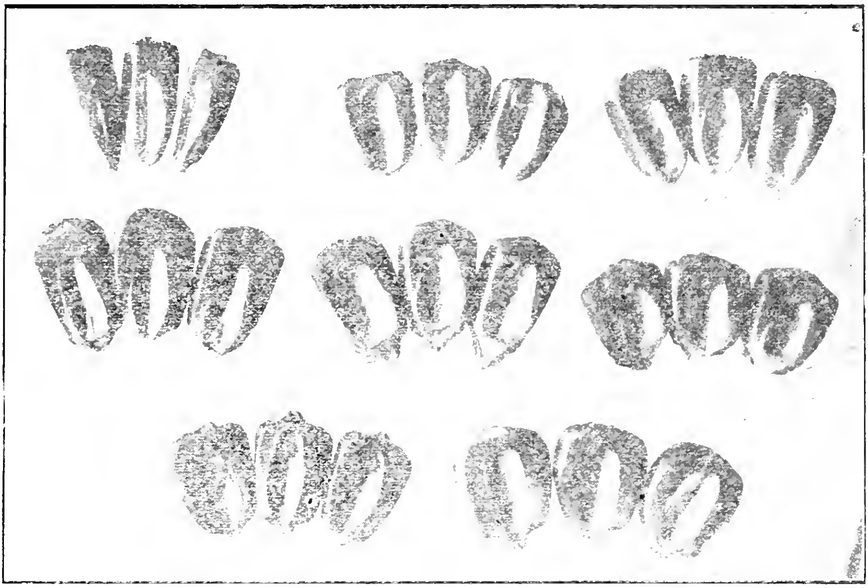


FIG. 14.—A study of kernels. The shoe-peg type is seen in the upper left hand corner. The three kernels in the upper right hand corner approach most nearly to the ideal shape. Note the unoccupied space because of the rounding edges most of the cases.

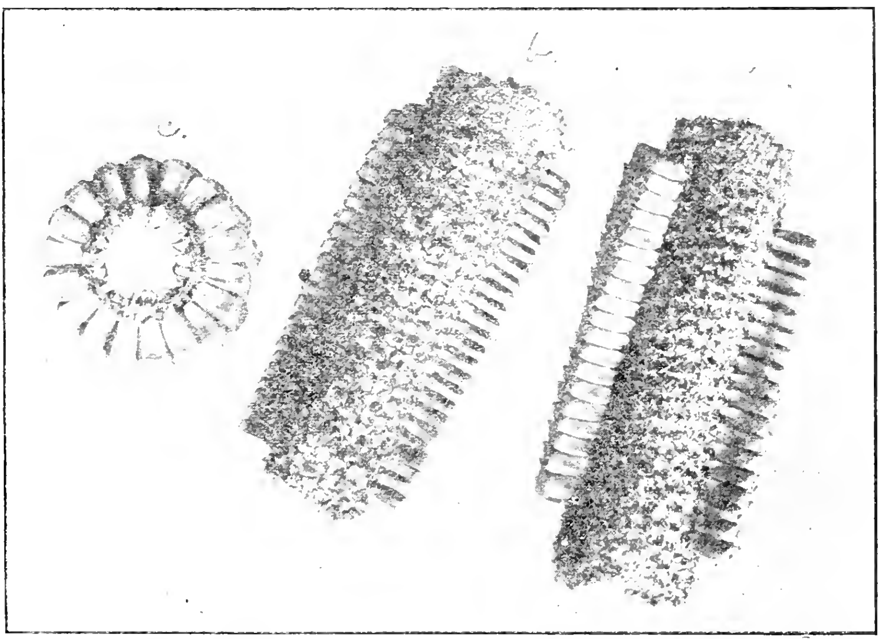


FIG. 15.—An examination of (a) reveals large spaces between the kernels in the row for ½ the length of kernel from the cob out. No such spaces are found between the kernels of (b). (c) is a cross section of a very good ear of Michigan corn.

In corn judging the following additional points are considered:

9. Trueness to type. It is not sufficient that the ears shall be properly shaped, etc.; they must have also the special characteristics of the breed to which they belong—the roughness or smoothness of kernel, the style of dimple, general outline of kernel, etc.

10. Uniformity. Ears may show that they belong to a particular breed, and yet lack in uniformity of appearance, just as a group of cows may leave no doubt as to what breed they belong, and yet may not be uniform in appearance in the group.

11. Market condition. This takes into account whether the corn is ripe, sound, free from disease and injury, bright in color, and of apparently good vitality.

12. Uniformity of kernels. Two kernels are removed from each ear as described above and the pairs placed in rows for comparison. Every pair should look like every other pair in shape and size.

CORN JUDGING OR SCORING.

In judging corn, 10 ears are studied, their defects determined and charged against them. The score card is a convenient form for use in this work.

CORN.

SCORE CARD.

	Scale of Points.	Standard.	Students score.	Corrected score.
1	Uniformity.			
	(a) Trueness to type	5	....	....
	(b) Uniformity of exhibit	5	....	....
2	Shape of ear	5	....	....
3	Color	10	....	....
4	Market condition	10	....	....
5	Tips	5	....	....
6	Butts	5	....	....
7	Kernels.			
	(a) Uniformity	5	....	....
	(b) Shape	5	....	....
8	Length of ear	10	....	....
9	Circumference of ear	5	....	....
10	Space.			
	(a) Between rows	5	....	....
	(a) Between kernels at cob	5	....	....
11	Proportion of grain to ear	20	....	....
	Total	....	....	....

Date ....

Variety ....

Weight of five ears ....

Weight of grain from these five ears ....

Proportion of grain to ear ....

The following outline of things considered and rules for cuts is found convenient for beginners in corn judging.

OUTLINE FOR SCORING DENT CORN.

Department of Practical Agriculture, M. A. C.

Perfect Score.	Things to Consider.	Rule for Cuts.
1 (a)	Nearness of approach to type as to general form of kernel, indentation, etc.	½ point off for each variation from type.
(b)	Likeness between ears exhibited.	½ point off for each odd ear.
2	Shape of ear. Arrangement and character of rows.	½ point off for each poorly shaped ear.
3	Freedom from cross-breeding. Trueness to variety color of kernel and cob.	10 points off for { red cob in white ear or white cob in yellow ear. 1-10 point off for each mixed kernel. ‡
4	* Ripeness, soundness, freedom from injury, brightness of color and vitality.	1 point off for every diseased, injured, chaffy, or immature ear.
5	Uniformity of kernels, regularity of rows, completeness of covering.†	¼ point off for every badly covered tip. ½ point off for every inch of exposed tip.— ⅛ point off for every ⅛ inch exposed tip.
6	Manner of rounding out and quality of kernels.	½ point off for every uncovered butt. 3-10 point off when butt is covered but kernels are flat.
7 (a)	Likeness in shape and conformity to type.	½ point for each set of kernels lacking in general uniformity.
(b)	Approach to ideal wedge shape.	½ point off for each set of poorly shaped kernels.
8	Variation from standard length.	1 point off for every inch of excess or deficiency in length of ear.
9	Variation from standard circumference.	1 point off for every 2 inches of excess or deficiency in circumference of ear.
10 (a)	Outer space.	No cut for less than 1-32 inch between rows. ¼ point off for 1-32 to 1-16 inch between rows. ½ point off for 1-16 inch between rows.
(b)	Inner space.	¼ to ½ point off for each marked case of space between near points of rows.
11	Per cent of grain to ear.	1 point off for each per cent short in weight of corn.

* Indicated by firmness of kernel on cob. † Does not have reference to length of cob.
‡ Kernels missing count as mixed kernels.

For Dent Corn ears should have length of 9 inches, circumference of 7 inches, and shell 88% grain.

REPORT OF THE SOUTH HAVEN SUB-STATION FOR 1905.

BY L. R. TAFT AND T. A. FARRAND.

Special Bulletin No. 35.

Prof. L. R. Taft, Horticulturist:

Sir: The following report upon the work at the South Haven Sub-Station for the year 1905, is respectfully submitted:

The work at the station has been carried out along the same lines as in former years, that is, variety testing and practical demonstrations, and experimentation in spraying and other cultural methods. That the work is highly appreciated is shown by the heavy correspondence and numerous calls made at the station for advice.

To those who visit the station, the work is more satisfactory in that they can compare the conditions here with their own and see some of the work carried out in detail, and also note the results.

The number of people investing in fruit farms is increasing and, to many of them, fruit growing as a business is new. For this reason and the farther one that the destructive insects and diseases are continually appearing in new places, a much larger amount of outside work has been done than in former years. By going out to the farms and observing the conditions, it is much easier to suggest the course that should be followed, than from mere description. It was impossible to respond to all of the calls but it was always done when the station work was in a condition to permit it. This line of work is always highly appreciated and no other has done more good, or proves more far-reaching in its results. To the beginner the question of getting started right is an important one as, in many instances, it means the difference between financial success or failure and, in the latter case, much hard work and time will be wasted.

Considerable outside work was done this season in carrying on spraying experiments, the details of which will be given later on in this report. This was necessary on account of the limited area of the station grounds and the small number of trees of each variety of fruit; for this reason, it would seem advisable to extend this line of work in the future. The results of experiments are often interesting and they are object lessons for the locality in which they are carried on.

The showing of fruit this season was on the whole much smaller than usual, more especially of the tree fruits, all kinds of which bloomed full, but the cold, dashing rains during the blooming period had much to do with the imperfect fertilization and consequent dropping of the fruit of the sour cherry and apples, although the unusually heavy crop of apples in 1904 had its effects in shortening the crop this year. There was a good crop of plums, sweet cherries and quinces, but a light crop of pears. Grapes also were light but bush fruits and strawberries did well. The peach crop was small as most of the original orchard has been removed and those remaining are mostly young trees of the newer kinds, a number of which died this season from the effects of the severe winter of 1903.

A new power sprayer was added to the Station equipment this spring. The machine is manufactured by the Niagara Gas Sprayer Co., Buffalo, New York. The machine consists of a 100-gallon boiler-iron tank with pressure gauge and hose connections. The power is furnished by pressure from a tube containing liquid carbonic acid. This pressure makes an ideal spray and has the advantage of having no pumps or valves to bother or get out of order. The outfit gave good satisfaction in every way except that the gas is rather expensive, and some difficulty was experienced in securing it when needed. As an enormous pressure is required to liquefy the gas, it can only be obtained in the larger cities. The cost of a 50 pound tube of gas is $3.00, besides freight one way, and this is sufficient for spraying out from 650 to 700 gallons of material. If, however, the cost of the gas or power can be lowered and the supply can be relied upon, it would prove a valuable addition to modern, power-spraying equipments.

With a view of determining some points of value in applying plant food to fruit trees in the form of chemicals, one tree each of a number of varieties of all of the tree fruits, with the exception of the peaches, were given an application of two pounds of nitrate of soda and four pounds of muriate of potash. The treated trees were from twelve to sixteen years old and well into bearing in most cases. No definite conclusion could be reached after observing the trees during the growing and fruiting season, as no effects could be seen which could be directly attributed to the application of this mixture. The fertility of the soil where the applications were made had been kept up by the use of stable manure every other year and turning under cover crops and, for this reason, it is not strange that no results were noticed the first year. An application of one pound of sulphate of iron was also given to one tree of all kinds of fruits and nothing beneficial or detrimental was noticed from the applications.

POTATOES.

Having a small piece of unoccupied land from which peach trees were removed, several varieties of potatoes were tested, using northern grown seed. There were ten varieties each of early and late kinds. Some were new while others were well-known varieties.

The soil was a sandy loam, well enriched with stable manure. Two pounds of seed of each kind were used and were cut into twenty-five pieces. The hills were eighteen inches apart in rows four feet apart, and one piece was placed in a hill. The early varieties were planted May 8th, and the late kinds June 10th. All were dug September 9th with the exception of a few hills of the early kinds, which were dug July 20th to note the marketable potatoes for early digging. Record was made of the gross and marketable weights of each variety. No rot made its appearance with any of the varieties and blight upon but two varieties, Noroton Beauty and Early Michigan, both early kinds, and the first named variety was quite badly affected. Three applications of air-slaked lime and Paris green were given to control the potato bugs.

Early Varieties.

Those planted for early kinds were Acme, Bovee, Crines Lightning, Early Michigan, Early Roser, Eureka, Manistee, Noroton Beauty, Triumph and White Ohio. Of these, Crines Lightning, Early Michigan, Eureka, White Ohio and Manistee gave the heaviest yields in the order named, the other kinds falling considerably below and running about equal.

Acme:—Of medium size only; seemed to run small this season. Form long, round, sometimes tapering to the seed end; color a very light shade of red; eyes numerous, rather shallow, making a smooth, nice looking potato; yield per acre 104 bushels.

Bovee:—Gave a poor yield this season; size medium; form long, flat, tapering at both ends; color nearly white, with numerous rather shallow eyes.

Crines Lightning:—This was the most productive of the early kinds, of good size and varying in shape from wide flattened, to long rounded; color, reddish, with deep-set, large eyes. Promising as an early, productive sort. Yield per acre 174.72 bushels.

Early Michigan:—Resembles Acme somewhat, but was more productive and ran a little larger in size. One of the best this season. Yield per acre 159.65 bushels.

Early Roser:—Size medium; form long, flat, tapering; color almost white. Is a smooth, nice-looking potato but was not very productive. Yield per acre 107 bushels.

Eureka:—This variety proved quite productive and is a medium-sized, white kind, resembling Carman in form. Varying in shape from short to long flattened. Being white, smooth and productive, is a promising sort. Yield per acre 149 bushels.

Manistee:—A large, light-colored potato with smooth surface and shallow eyes. Form long, flattened. Gave a fairly good yield. Yield per acre 138.75 bushels.

Noroton Beauty:—A small, round, red potato with deep-set eyes. Not attractive and gave a poor yield, which may be due to its susceptability to blight. Yield 104 bushels.

White Ohio:—This variety gave fairly good results. Size medium; shape elongated, round; color nearly white; pink eyes and has faint reddish splashes over the surface. Yield per acre 143.89 bushels.

Late Varieties.

Those planted for late kinds were Banner, Carman No. 3, Mark Hanna, Pat's Choice, Sir Walter Raleigh and White Victor. Those that gave the heaviest yield in the order named were, Carman No. 3, Pat's Choice, Sir Walter Raleigh, White Victor, Banner and Ionia. Mark Hanna gave a fairly good yield but Clinton, Vornehm and Livingston were below the average.

Banner:—Medium-sized, white, shallow-eyed, smooth, wide, flattened; characteristically blunt at base and slightly tapering to the eye. Flesh has a yellow tinge and many were found to be hollow, which is decidedly an undesirable characteristic, should it prove such after further trial. It is productive and otherwise is a promising market potato. Yield per acre 166.88 bushels.

Carman No. 3:—One of the well-known kinds; very productive, large, white, smooth, valuable. Yield per acre 210.70 bushels.

Clinton:—This gave rather a poor yield, yet a large per cent were of good size and salable. The potatoes are long, flat and white, with a rather rusty appearance, which is an objectionable feature.

Vornehm:—Not productive this season. Potatoes ran small to medium; color white, russeted; form wide, flattened, smooth, shallow-eyed. Yield per acre 123.34 bushels.

Ionia:—Productive, medium to large, very irregular in form. White, with scaly, rusty appearance. Pronged, not smooth. One of the poorest in appearance of any on trial. Yield per acre 159.17 bushels.

Livingston:—Only moderately productive; color white, with stripes and bands of red encircling some of the potatoes; form long, round; skin smooth, with shallow, pink colored eyes. Yield per acre 104 bushels.

Mark Hanna:—A large, flat, white, smooth potato. Is productive and has every appearance of being an excellent market potato. Yield per acre 143.89 bushels.

Pat's Choice:—This variety is especially promising for a red kind. The color, however, may be against it as a market sort. A number of the varieties were tried for table use and this variety was superior to anything tested. It was second in productiveness, and the potatoes run from medium to large and in form are long and round. Yield per acre 195.28 bushels.

Sir Walter Raleigh:—Resembles Mark Hanna and Carman No. 3 very much; with these varieties one of the best white kinds tested. Upon cutting them open, all of these kinds showed some hollow or black centers. Yield per acre 185 bushels.

White Victor:—Of the Carman type in color and shape, but did not run as large and was not so productive. Yield per acre 169.58 bushels.

REMEDIES FOR SAN JOSE SCALE.

To answer the many inquiries regarding the remedies recommended for use against the San Jose scale and to compare their efficacy with the recognized standard remedy, lime, sulphur and salt, a number of experiments were arranged, spraying from five to seven trees with each mixture.

Plot 1:—Lime, sulphur and salt, usual strength, boiled 35 minutes (25 lbs. of lime, 15 lbs. sulphur and 8 lbs. of salt with water to make 50 gallons).

Plot 2:—Lime and sulphur, usual strength (25 lbs. lime and 15 lbs. sulphur with water to make 50 gallons).

Plot 3:—Lime, sulphur and salt as above, boiled ten minutes.

Plot 4:—Lime 15 lbs., sulphur 10 lbs., salt 6 lbs., boiled 35 minutes with water to make 50 gallons.

Plot 5:—Lime, air-slaked, 40 lbs., kerosene 10 gallons, with water to make 40 gallons.

Plot 6:—Lime, air-slaked, 32 lbs., kerosene 8 gallons, with water to make 40 gallons.
Plot 7:—Scalecide 1 gallon, water 25 gallons.
Plot 8:—Scalecide 1 gallon, water 20 gallons.
Plot 9:—Con-Sol 1 gallon, water 50 gallons.
Plot 10:—Con-Sol 1 gallon, water 40 gallons.
Plot 11:—Kil-o-Scale 1 gallon, water 25 gallons.
Plot 12:—Kil-o-Scale 1 gallon, water 20 gallons.

The experiments were carried on in the peach orchard of Mr. J. Lindley, three miles south of South Haven, who kindly allowed us the use of such trees in his orchard as were needed for the test. The trees were from seven to eight years old, were reasonably well pruned, had never been sprayed and all were quite badly infested with the San Jose scale, furnishing ideal conditions for carrying on the experiments. The remainder of the orchard was sprayed by Mr. Lindley with the regular mixture of lime, sulphur and salt. The spraying was done on April 7th and 8th, 1905.

Kil-o-Scale is a patent mixture manufactured by the Thomson Chemical Co., of Baltimore, Md. It mixes readily with water and sprays freely through the finest nozzles. It is a soluble mineral oil.

Scalecide is a mixture sent out by B. G. Pratt Co., 11 Broadway, N. Y. It also mixes freely with water the same as Kil-o-Scale, which it resembles.

Con-Sol is a mixture put out by the American Horticultural Distributing Co., and is evidently a concentrated solution of lime and sulphur. It mixes readily with cold water and it gives little trouble in its preparation or application.

Kerosene and lime is an emulsion of kerosene and lime. It can be made with limoid, dry-slaked or air-slaked lime. In using the air-slaked lime, it took considerable stirring and pumping to secure a good emulsion.

The trees were examined on July 15th and again on November 28th and the following results were noted on those dates respectively.

Plot 1:—Lime 25 lbs., sulphur 15 lbs., salt 8 lbs., boiled 35 minutes. July 15th, no live scale found.

Plot 2:—Lime 25 lbs., sulphur 15 lbs., boiled 35 minutes. July 15th, no live scale found. Nov. 28th, a very few live scales found; very satisfactory.

Plot 3:—Lime 25 lbs., sulphur 15 lbs., and salt 8 lbs., boiled 10 minutes. July 15th, an occasional live scale found. November 28th, many live scales found; only fairly satisfactory.

Plot 4:—Lime 15 lbs., sulphur 10 lbs., salt 6 lbs., boiled 35 minutes. July 15th, a very few live scales found. November 28th, quite a good many live scales found.

Plot 5:—Air-slaked lime 40 lbs., kerosene 10 gallons, water 40 gallons. July 15th, an occasional scale found. November 28th, a few live scales found; quite satisfactory.

Plot 6:—Air-slaked lime 32 lbs., kerosene 8 gals., water 40 gals. July 15th many live scales. November 28th badly infested. Of no value at all.

Plot 7:—Scalecide 1 gallon, water 25 gallons. July 15th very few scales found. November 28th many live scales found. Only fairly satisfactory.

Plot 8:—Scalecide 1 gallon, water 20 gallons. July 15, very few live scales found. November 28, many live scales found. Only fairly satisfactory.

Plot 9:—Con-Sol 1 gallon; water 50 gallons. July 15, very few live scales found. November 28, many live scales found. Only fairly satisfactory.

Plot 10:—Con-Sol 1 gallon; water 40 gallons. July 15, very few live scales. Nov. 28, many live scales. Only fairly satisfactory.

Plot 11:—Kil-o-Scale 1 gallon; water 25 gallons. July 15, very few live scales. Nov. 28, many live scale. Fairly satisfactory.

Plot 12:—Kil-o-Scale 1 gallon; water 25 gallons. July 15, very few live scales. Nov. 28, many live scale. Fairly satisfactory.

On July 15, unsprayed trees were fairly alive with the yellow larvae, and in November had become nearly encrusted. In summing up the results it must be borne in mind that the trees were badly infested and the first conclusion arrived at is, that with the results as noted on July 15, all of the mixtures used are scale destroyers, to a more or less degree, and the results on Nov. 28 simply show to what extent this insect will breed and spread during the period from July 15 to November 1st, at which time the breeding will probably have stopped in this section. It should be noted that it was practically impossible to find a live scale upon Plots 1 and 2 upon which lime, sulphur and salt, and lime and sulphur were used respectively, and the number upon most of the other sprayed trees when examined in June was relatively small; but at the end of the season, such had been their reproduction that many of the trees in Plots 6 to 12 were badly encrusted. From this the importance of using the most effectual remedies only can be seen.

Second:—The lime (25 lbs.) and sulphur (15 lbs.) mixtures, either with or without salt, boiled 35 minutes as in Plots 1 and 2 were the most efficient remedies tried. These mixtures only cost about one cent per gallon and hence were much cheaper than any of the prepared remedies which cost $1.00 to $1.25 per gallon, making the diluted mixture cost from two to five cents per gallon. When the time of boiling was cut down, as in Plot 3, and the amount of material reduced, as in Plot 4, the results were less satisfactory although they were as good as with the manufactured remedies.

Third:—Aside from the regular lime and sulphur mixtures, the lime and kerosene used in Plot 5 was the most efficient and is the most promising of the new mixtures recommended for San Jose scale. Unless the work was not so thorough, the great difference in results shown between Plots 5 and 6, cannot be accounted for, as Plot 6 was the only one in which the trees were as badly infested at the end of the season as when sprayed.

Fourth:—Although the prepared mixtures, Scalecide, Kil-o-Scale and Con-Sol have proven efficient in killing large numbers of the scale, their effectiveness cannot be compared with that of the regular mixtures of lime and sulphur, or lime, sulphur and salt, and as they were more expensive they cannot be recommended in the place of this well-tried remedy. For a few trees in gardens and with no conveniences for boiling the mixtures, the kerosene and lime possibly furnishes the best as well as the cheapest of the mixtures tried. If, however, one does not care to bother with making the emulsion of kerosene and lime, the Kil-o-Scale or Scalecide will give very good satisfaction, if the strength is increased or if two applications are made.

To determine some of the effects of the remedies recommended for scale upon the different kinds of fruit trees when in full leaf, a number or experiments were carried on. For this a single branch only was taken and sprayed thoroughly with each of the following mixtures on July 20th, with the following results:

Lime, sulphur and salt of the usual strength:

Peach, the foliage was burned quite badly and many of the leaves fell off.

Pear; much injury to the leaves, but they did not fall off.

Sour cherry; foliage seriously injured and some of the leaves dropped.

Apple; foliage very badly burned.

Lime, sulphur and salt, one-half strength:

Peach; foliage burned nearly as much as with full strength.

Pear; foliage quite badly injured.

Sour cherry; foliage injured on tips and edges.

European plum; foliage quite badly burned.

Apple; foliage quite badly injured; trees slightly defoliated.

Lime and sulphur, usual strength:

Peach; leaves quite badly burned so that a few fell.

Pear; foliage seriously burned but it did not fall.

Sour cherry; foliage slightly injured.

European plum; leaves burned in spots.

Apple; foliage quite badly burned and branches were defoliated to some extent.

Lime and sulphur, one-half strength:

Peach; foliage slightly burned.

Pear; foliage somewhat injured but not as bad as with full strength.

Sour cherry; foliage very slightly burned.

European plum; foliage slightly burned.

Apple; foliage quite badly injured.

Con-Sol, diluted to 1 to 40 with water:

Peach; foliage injured so that much of it dropped.

Pear; foliage quite badly injured.

Sour cherry; foliage slightly burned.

European plum; foliage slightly injured.

Apple; foliage quite badly burned.

Kil-o-Scale, diluted to 1 to 20 with water:

Peach; foliage quite badly injured.

Pear; foliage slightly burned.

Japan plum; foliage slightly injured.
European plum; foliage slightly injured.
Sour cherry; foliage slightly injured.
Apple; foliage very slightly injured.

Scalecide, diluted to 1 to 20 with water:
Peach; foliage very slightly burned.
Pear; no perceptible injury.
Sour cherry; no injury observable.
Japan plum; very little injury.
Apple; no perceptible injury.

In examining the results it will be noted that the sulphur sprays, with the exception of Con-Sol, were used at full strength and half strength, while with the patented mixtures they were used full strength or as recommended for spraying in the dormant season. The sulphur sprays burned the foliage of the apple and pear worse than that of peach, plum or cherry, although the foliage of the latter are considered the more tender. The addition of salt to the sulphur sprays causes increased injury to foliage and in no instance was it shown that it is safe to apply lime and sulphur sprays at more than half strength and upon the apple and pear this is too strong. Of the manufactured mixtures, Scalecide when diluted to 1 to 20, caused the least injury to foliage and can be considered the most promising of any of the mixtures tested as summer spray for the San Jose scale so far as injury to tree is considered, and even this does some harm.

In the report of this Station for 1904, (Special Bulletin No. 30), details are given of several experiments with caustic soda, and of different methods of cooking the lime, sulphur and salt wash. The conclusions arrived at were that caustic soda was practically worthless as a scale destroyer, while no live scale were found upon the trees sprayed with the lime and sulphur sprays, regardless of the method of cooking or whether salt was added or not. At the time the examination was made, the trees sprayed with the caustic soda were so badly infested with the crawling larvae that it was thought best to try a summer spray of kerosene emulsion and accordingly the trees were sprayed, using one gallon of kerosene, one pound of soap to ten gallons of water. The trees were not examined again until March. The results were practically the same at all of the places, a very few living scale being found upon all of the trees in the different plots when the lime and sulphur sprays were used, regardless of the method of cooking the wash. However, there were so few scale that the owners decided to leave the trees without spraying this year and note the effects. Reports have been received from both parties. They agree that it was a mistake not to spray the trees last spring, and with even a few scales upon them such has been their reproduction that many of the trees are quite badly infested. It is probable that when trees are covered with this insect it will be better to spray the trees every year until at least the number of scale present is very small. Little difference was noticeable between the results secured with the different formulas and methods of preparing the sulphur and lime.

Spraying Experiments with Sulphate of Iron.

To test the value of copperas, or sulphate of iron, as compared with blue vitriol, or sulphate of copper, as a fungicide, it was used as a clear solution before the buds started and after the foliage was out united with lime the same as with copper sulphate. Upon all kinds of tree fruits and grapes, one tree of a variety was sprayed with copperas-Bordeaux mixture, and one with regular Bordeaux. As a Bordeaux mixture, the copperas was used at the rate of 6 pounds with 6 pounds of lime for 50 gallons of water, and the regular Bordeaux mixture contained copper sulphate 4 pounds, lime 5 pounds and water 50 gallons. The trees sprayed with the copperas-Bordeaux had a very characteristic rusty appearance. Apples, pears and plums received four applications, cherries three, peaches two and grapes three. The results were as follows: At the strength used, it is practically worthless as a fungicide. It did not control leaf-curl of the peach, the cherry foliage dropped much worse than on trees sprayed with regular Bordeaux mixture. The fruit nearly all rotted and the leaves all dropped in August from the plum trees and some of them started a new growth late in the season. When plum trees of the same varieties were sprayed with regular Bordeaux mixture, we were able to harvest most of the fruit and the trees held their foliage until well into the fall. The copperas also failed to control leaf-blight and the scab fungus of apple and pears. Neither beneficial nor injurious results were noted from its use.

STRAWBERRIES.

As a variety test the results were not quite as satisfactory as we should have liked because a uniform stand of plants was not secured, owing partly to the condition of the plants upon arrival. Second, the climbing cutworms did considerable damage, eating the foliage as well as the center of the blossoms, thus making many imperfect berries. The worms worked more in some spots than others and of course the injury was greatest to those that lacked in vigor. Aside from these troubles, the weather conditions were favorable during the fruiting season and a fairly good crop was harvested. The plantation kept over from 1904 for comparison between first and second year's fruiting made an excellent showing and had the advantage over the new plantation by escaping the attack of the cut-worms. The older plantation was plowed under after the fruiting season was over and the new fruiting bed was cleaned out and held over following the same plan of renewing as last year. Furrows were thrown away from the rows so as to leave a narrow strip of plants. These were then thinned out with a hoe and the furrows were cultivated down.

The results from the second year's fruiting as compared with the first year were noted. The plantation is small and contained 35 varieties, of most of which only twenty-five plants were set. In 1904 there were 761 pounds of berries picked and in 1905 814 pounds of berries were gathered, which leaves a balance of 53 pounds in favor of the second year's fruiting, but this does not prove that the second year's fruiting will always prove better than the first. The fruiting season of 1904 was dry and not quite so favorable as 1905, which partially accounts for the above figures being in favor of the second year's fruiting. The stand of plants was more uniform and the plantation was really better the second year than the first. The system of cleaning out or renewing as followed in this test and the practice of holding the strawberry plantations over for a second year's fruiting can be recommended. Under ideal conditions the results will generally prove slightly better from the first year's fruiting than the second. Among the other points which must be considered are whether it is the cheapest and most convenient to clean out the plantation in early July, which is an extremely busy season of the year, or setting a new plantation and caring for it up to midsummer, and these points must be determined largely by individual conditions and circumstances. With our method of clearing out it is cheaper than fitting the ground, planting and caring for the plantation. The usual system of holding plantations over consists in running a cultivator between the rows and leaving nearly all of the old plants, pulling out a few of the bunches of grass and weeds that can be got at most conveniently, but putting nothing back to replace the plant food which has been taken out, is to be deplored, as such plantations are exhausted and produce a small, inferior lot of fruit which is a damage when put upon the market.

In these old plantations there were two varieties which stood out as remarkably productive over all other kinds and these were Gersonda and Bederwood; Gersonda producing more fruit than any variety in either the old or new plantations. The other varieties which have the best results in the order named and ran very close were, Dunlap, Dewey, Warfield, Sample, Lady Thompson, Ernie, Seaford, Springdale and Brandywine. Other varieties which gave good yields were, Aroma, New York, Lincoln, Minute-Man, Excelsior, Clyde, Lyon, Bryan and Mrs. McDowell.

New Plantation.

The varieties that gave the heaviest yields in the order named were, Clyde, Parsons Beauty, Dewey, Bederwood, Warfield, Lucas, Sample and Dunlap; other varieties which gave good yields were, Aroma, Tilghman, New York, Early Beauty, Ryckman, Wonder, Corsican, Yant, Uncle Jim, Oom Paul, Olive's Pride, Lyon, Missouri and Ben Davis.

Notes on Varieties.

August Luther:—Perfect. An early ripening kind which gave poor results. Small, roundish-conic, regular; color light red with light red flesh. Medium firm. Quality, fair.

Aroma:—Perfect. One of the best medium to late kinds. Did not fruit as heavy as last season, but the fruit is large and firm. Plants strong and stocky, usually making enough plants for a good row.

Botham:—Perfect. Mid-season. Fruit large, roundish-oblate, slightly conic; color dark red; medium firm and of a good quality. Unproductive.

Ben Davis:—Perfect. Plants are good growers, making a nice row. Fruit above medium in size, round-conic, smooth; color dark red; firm;

flesh dark red; quality very good. Moderately productive and is a promising new variety.

Bubach:—Imperfect. A well-known kind; it has been a failure here for two years, but is considered one of the standard market varieties, by many growers.

Brandywine:—Perfect. A strong plant maker and quite productive. Fruit large and of good quality. A valuable medium late variety.

Bethel:—Imperfect. A medium-sized mid-season variety with irregular, oblate-conic fruit; color lustrous dark red; firm, rich and sweet. Makes a good fruiting row, but is unproductive.

Bederwood:—Perfect. Continues to stand at the head of the list in productiveness but is a soft, light-colored berry of poor quality and unattractive appearance.

Bryan:—Perfect. Fruit large, medium late and moderately productive. Color light and dark red; flesh light red and rather soft. Plants good growers and healthy. Not promising.

Cardinal:—Imperfect. Plants strong and healthy with long runners and scattering plants. Fruit large, regular, roundish-conical; color dark red; very firm; quality good. Lasts over a long season. A valuable variety if it proves productive.

Corsican:—Perfect. This variety and Yant, Wonder, Ryckman and Uncle Jim are very similar and one description will answer for all. Plants very strong growers, with an exceptionally healthy, rich green foliage. Season medium to late, ripening a large per cent of fruit in a short time. Fruit large to very large; form irregular, varying from long, wide, compressed and ridged, to roundish-conic; color mottled, light and dark red with very light red on the shaded side; flesh very light red, almost white at center; medium firm; flavor mild, not rich. Quite productive and desirable as a medium to late variety where large size is the chief point.

Commonwealth:—Perfect. Fruit large, oblate-conic; color dark red with dark red flesh; texture firm; flavor mild, sub-acid; quality good. Season late.

Clyde:—Perfect. The most productive variety in the new plantation. Fruit very large, smooth and regular. It is rather light in color, and too tender in texture for shipping.

Duncan:—Perfect. Plant a good grower, making plenty of plants for a good row. Gave a good average yield. Fruit of medium size, long-conic, regular; color dark red with firm, dark red flesh. Quality good. Mid-season. A promising variety.

Dewey:—Perfect. One of the most productive varieties. Plants strong growers but subject to rust. Fruit medium-sized, long-conic, necked. Color light red, with medium firm, light red flesh. Mid-season. Too light in color for a market berry.

Dunlap:—Perfect. Mid-season. Plants strong and healthy making numerous runners, and very productive. Fruit medium-sized, smooth, regular, dark red, and of good quality. A very reliable sort.

Ernie:—Perfect. One of the best last year and in the old bed this year, but it gave only an average yield in the new plantation, as the plants did not get a good start. It is handsome in appearance, the fruit being a dark glossy red, of medium size, very regular and firm. These very desirable qualities make it worthy of trial as a market sort.

Early Hathaway:—Perfect. Small to medium in size. Not as early as Excelsior and less productive this season.

Early Beauty:—Perfect. Ripens with Excelsior, which it closely resembles. Plants short and stout, making too many runners. Fruit small to medium, running very small after the first two or three pickings; color dark red; texture firm. Productive but on account of its small size is valuable only for early ripening purposes.

Excelsior:—Perfect. Well known as a standard early kind. The description for Early Beauty answers for this.

Fairfield:—Perfect. Ripens with Excelsior but is larger and less productive. The fruit is firm and dark glossy red in color.

Gandy:—Perfect. Fruit large; very firm; and being late in ripening, always sells well.

Gersonda:—Imperfect. A very productive late kind. Plants strong growers, making many plants. Fruit medium-sized, and small towards the end of season. Form roundish-conic, regular; color bright red; flesh light red, firm and juicy. A very good late kind except for the size of the berries.

Glen Mary:—Perfect. Moderately productive, of large size and attractive in appearance. A valuable variety for mid-season.

Howell:—Perfect. Mid-season. Berries of large size and of very good quality but the plants lacked in productiveness.

Kittie Rice (Downing Bride):—Imperfect. With the exception of Ernie, this was the most attractive in appearance of any on trial. Fruit large, roundish-conic, very smooth and regular; color dark, glossy red; texture medium-firm; quality very good. Season medium to late. Certainly a promising sort.

Louis Hubach:—Imperfect. Medium-early. Fruit small to medium, roundish-conic, irregular; color dark red; flesh red, firm, rather acid. Unproductive.

Lady Thompson:—Imperfect. A very productive medium-early kind. Berries above medium, but run small after the first few pickings; form roundish-conic; color dark red; texture firm. A fairly promising variety.

Lady Franklin:—Imperfect. A medium-sized, mid-season variety, which has given a very small yield for two seasons. Fruit medium, roundish-conical; irregular; color scarlet; flesh bright red; medium firm.

Lester Lovett:—Seems to be identical with Gandy.

Lincoln:—Perfect. A mid-season variety which has been one of the most productive sorts. Berries, medium-sized; roundish-conic, smooth; color dull red, with a very firm, red flesh. A very good variety.

Lyon:—Imperfect. A very productive early kind, but lacks the firmness and carrying qualities of Excelsior and has the same fault of running small after the first few pickings. Form long-conic, necked, sometimes compressed; color dark, shiny red. For some it might prove more satisfactory than Excelsior.

Lucas:—Perfect. One of the most productive of the mid-season kinds, but the berries did not hold up well in size. Size medium; form short-conic; color deep red, with dark red flesh. Medium firm; quality good. Worthy of further trial.

Missouri:—Perfect. Gave a good yield this season. Plants strong, sending out plenty of runners to make a good row. Above medium in size; roundish-conic; sometimes flattened; color bright red, with light red flesh; medium firm with a mild, pleasant flavor. A fairly good variety.

Mrs. McDowell:—Perfect. A productive, medium-sized berry of fair quality, but it is very irregular and rough. Not desirable.

Marshall:—Perfect. Gave a good yield for that variety and under favorable conditions where large size, attractive appearance and fine flavor are wanted, it is a desirable kind.

McKinley:—Perfect. Ripens with and is very similar to New York. Plants strong, stocky and healthy. Fruit large; form irregular; shape long, flattened, often wide, ridged and flattened. Color, dark red, or light red on shaded side; flesh medium firm, light red; quality good. Mid-season. Productive.

Marie:—Imperfect. Fruit large; form varying from roundish to oblate-conic; color bright red; flesh light red, tender. Quality fair. Mid-season.

Miller:—Perfect. Fruit above medium in size; short-conical; color dark red; flesh dark red, firm. Quality good. Mid-season. A good market berry if it proves productive.

Minute Man:—Imperfect. Plants strong, healthy growers. Berries above medium, roundish-conical; color bright, glossy red. Flesh light red, tender. Quality fair. Mid-season. Rather tender for a market berry.

New York:—Perfect. The description given for McKinley will answer for this variety.

Nettie:—Imperfect. A large, late variety which gave a very fair yield considering the poor stand of plants. Form irregular, conical, ridged and flattened. Color light red; flesh red, tender. Promising as a late kind.

No. 1:—Received from J. K. Bowman, Havana, Illinois. Perfect. Plant a strong, stocky grower. Fruit large, irregular, conical, compressed; color dark red; flesh dark red, firm. Quality fair. Mid-season. Not productive.

No. 2.—Imperfect. Received with No. 1. Plants good growers, making many more plants than No. 1. Fruit large, roundish, oblate, slightly conical; color red, with firm, light red flesh. Quality fair. More productive than No. 1 and a few days later. Worthy of trial.

Nick Ohmer:—Perfect. Fruit large, attractive, firm, late. Unproductive.

Olive's Pride:—Perfect. Plants good growers, making plenty of plants. Mid-season. Productive but the fruit runs small toward the end of the season. Fruit medium, conical, compressed, ridged, irregular. Color dark red, with light red flesh; medium firm; quality good.

Oom Paul:—Perfect. Large, long, compressed, irregular. Color dark red; flesh red, firm; plants large, vigorous, making plenty of plants for a good row. Gave a good yield and is deserving of trial, especially for market.

Parsons Beauty:—Perfect. Plants healthy and vigorous, making enough for a nice row and very productive. Berries medium-sized; form conical, compressed, irregular; color bright red; flesh red, firm; quality good. Mid-season. Can be safely recommended.

President:—Imperfect. Plants moderately vigorous, but send out few runners. Not valuable where a matted row is wanted. Fruit large, roundish-conical; color bright, rich red; flesh bright red and rather tender; medium late. Unproductive.

Ponderosa:—Imperfect. Plant slender growers, but making many plants. Very productive. Berries medium-sized, running small after the first few pickings; form conical, roundish; sometimes with neck; color dark, glossy red; flesh firm, dark red, rather sour. Medium early.

Ridgeway:—Perfect. Fruit medium to large, roundish-conic, very smooth and attractive in color which is bright, shiny red; flesh red, rather tender with a sprightly, pleasant flavor. Mid-season to late. Well worthy of trial.

Rip Snorter:—Perfect. A strong plant maker and quite productive. Fruit medium, roundish-conic; color bright red; flesh light red, very firm. Mid-season.

Rough Rider:—Perfect. A large, dark red, late-ripening variety of good quality. Not productive.

Sample:—Imperfect. One of the very best either for home use or market. Foliage healthy. Fruit large and noticeably even in size, regular in form and of good quality. Of a handsome scarlet color and fairly firm.

Springdale:—Perfect. One of the most productive varieties, but the fruit runs small towards the end of the season. Plants strong growers, making plenty of plants. Fruit medium to large; short, conic; color light, bright red; flesh light red; rather tender; quality good. Mid-season. Quite promising.

Seaford:—Imperfect. A medium late kind, which gave a heavy yield this year. The fruit is large and holds up well in size; form long, compressed, sometimes necked; color a handsome dark red; quality very good. A very safe variety for its season.

Samson:—Perfect. Plant a strong, stocky grower which sends out plenty of runners. Berries long-conical, sometimes compressed; color dark red; flesh red, firm; quality fair. Fully as late as Gandy and should it prove productive will be a valuable kind.

Sutherland:—Imperfect. Plants strong, thrifty and numerous. Quite productive, but the fruit is rather tender, and inclined to run small towards the end of the season. Mid-season.

Tilghman:—Imperfect. Plants good growers and numerous. Very similar, if not identical, to Haverland. Very productive; fruit long-conic; color bright red; flesh light red; medium firm; quality fair to good. Mid-season.

Warfield:—Imperfect. A very popular canning berry on account of its dark color and firmness. Medium-early and was one of the most productive, but the fruit was small and imperfect after the first three pickings.

CURRANTS.

The currants did well considering the broken condition the plantation is in. There is practically no change in the standing varieties over former years. London, Wilder and Cherry still lead, of the older kinds. Red Cross, a new variety, has not borne enough as yet to determine its standing. Comet is a promising new sort of the Cherry type in both fruit and foliage. The berries are large, stems short, and stocky.

GOOSEBERRIES.

The crop of nearly all of the kinds was exceptionally good. Frequent sprayings with Bordeaux mixture and liver of sulphur kept the mildew from making its appearance. The English kinds, such as Chautauqua, Keepsake, Triumph and Columbus were exceptionally large and fine. The only serious objection to the English kinds is the lack of vigor in the plants. Their susceptibility to mildew is of little consequence as it can be controlled. Champion is a small-sized gooseberry, which is a good, strong grower and very productive. Downing, Pearl and Josselyn are among the best of the American kinds, and all did well this season. There are no new kinds fruiting. Not only are the European varieties two or three times as large as the American gooseberries, but they are superior in flavor and as they are fully as productive and bring a higher price, they are well worth planting if they can have proper conditions and care.

RASPBERRIES.

The new plantation of raspberries and blackberries has made a good growth and the first fruit was picked from it this season. It contains the best of the old kinds together with a very complete collection of the newer sorts. Most of the plants made a good growth but the young shoots of several varieties suffered considerably from the attack of climbing cut-worms, which appeared in countless numbers. Moistened bran and Paris green were used with good results in destroying them. To prevent poisoning birds or chickens, fresh-cut clover leaves might be treated with Paris green and used as a substitute.

Of the red raspberries, Cuthbert, Marlboro, Phoenix, Loudon, and Miller did especially well, while Thompson and Early King gave less satisfactory results. Of the purple-caps, Columbian gave the heaviest crop of anything in the plantation, although Haymaker followed closely. Both are strong, vigorous growers and quite productive. Haymaker is poorer in quality than Columbian and less firm, but otherwise they resemble each other very closely. Cardinal is inferior to both of the above varieties.

Black Caps.

While Black Diamond gave the best yield, Cumberland, Gregg, Kansas, Mills and Conrath all gave good results.

In the old plantations the crop was very good upon both red and black raspberries. Conrath, Kansas, Cumberland and Gregg are four of the best black kinds. Of the red kinds Coutant is very large and produced the heaviest crop, but it crumbles when picked, making it a rather undesirable kind. Marlboro gave the best results with Cuthbert and London following in the order named. Turner is hardy but too small. Neither Brilliant nor Bradley have made a satisfactory showing.

BLACKBERRIES.

Of the standard sorts, Snyder gave the heaviest yield and made the most vigorous growth, but the berries are too small to make it a satisfactory market berry for this section. Rathbun, Eldorado and Wilson produced a few very fine berries. Rathbun and Wilson seem to be identical. The canes are quite tender and they cannot be relied upon without protection. The fruit is large, handsome and firm. For this section, with protection, there is no equal in our collection for market or home use. Eldorado can be safely recommended as an all-round berry and is especially adapted for home use or near the market.

GRAPES.

The grape crop was light and unsatisfactory with the exception of a few of the standard kinds. Some powdery mildew made its appearance on some of Rogers' hybrids, which are very susceptible to that disease.

Varieties for Market and Home Use.

Brighton:—A large, red grape of fine flavor and desirable for the home garden. Needs thorough spraying as it is subject to the attack of mildew.

Concord:—The leading market variety in Michigan. It succeeds well in nearly all sections and gives more baskets to the acre than any other sort. Although not an ideal shipping variety, its other good points place it at the head.

Campbell Early:—This early black grape has given excellent results some seasons, but it cannot always be relied upon. It has the advantage of being tough skinned so that it is adapted for long distance shipping, or hanging on the vines without shelling off. As a rule, it yields less than half as many baskets per acre as Concord.

Delaware:—As a high-class dessert grape, the Delaware holds first place and is equally valuable for both home use and market. Under favorable conditions it often equals Concord in yield and brings a higher price per basket.

Diamond:—This white variety ranks fully up to Niagara as grown here. Desirable for both home and market.

Guinevra:—A large and productive white grape. Bunches and berries large. It is subject to the attack of anthracnose and requires thorough spraying.

Moores Early:—An early ripening black grape that is valuable for nearby markets and home use. It is tender-skinned for long distance shipping.

Niagara:—The leading white grape but is much more susceptible to black rot than the Diamond.

Ulster:—This is a medium-late variety for the garden. It is very productive, but it does not always ripen its fruit evenly. The bunches are medium-sized, short, compact; berries medium in size, red, very sweet.

Winchell:—A small, early, white grape of very good quality. Productive and on account of its earliness is especially desirable for home use.

CHERRIES.

The crop was very good on most of the sweet kinds but lighter than usual on the sour varieties. The season was an unusually hard one upon the foliage, judging from the many inquiries which came to the stations from the different sections regarding the falling of the foliage during the last of June and early July before the fruit ripened. The sour kinds such as Early Richmond, Montmorency and English Morello were especially injured by the leaf-blight. It is needless to state that these trees were not sprayed or at least the work was not properly done. At the Station the regular spraying for fungi and insects was attended with the usual good results in holding the foliage upon all varieties. No difference was noted in the health of the foliage between trees sprayed early with copper sulphate solution (2 lbs. to 50 gallons of water) and those sprayed just before the blossoms opened with Bordeaux mixture. All the trees were sprayed three times; two applications of Bordeaux mixture being given after the blossoms had fallen.

Sweet Varieties.

The kinds which bore full crops this season were Napoleon, Windsor, Yellow Spanish, Rockport, Ida and Coe; while Early Purple, Mezel, Gov. Wood, Tartarian and Badacsony gave nearly full crops. Those that have been most satisfactory for commercial purposes are Napoleon of the light-fleshed, and Windsor as a dark-fleshed variety. Others which have given very good results and are considered valuable kinds are Yellow Spanish, Black Tartarian, Ida and Governor Wood. Kirtland Mary and Rockport are also two very good kinds. Plymouth is a newer light-fleshed variety which is proving to be productive, but the cherries are too small to make the best market kind. Dikeman is a new dark-fleshed kind which seems to lack size as yet.

Dukes.

Montrueil stands at the head with these kinds. Other varieties of merit are Carnation, Eugenie, May Duke and Magnifique.

Morellos.

Those that gave the heaviest crop were Minnesota, Montmorency, Suda and Northwest. The varieties which have given the best results for a number of years are Montmorency and Suda. Other kinds which have given good results are Dyehouse, Early Richmond, Weir No. 2 and King Amarelle. The Minnesota is a dark-fleshed kind which has proved fairly productive and with a different soil and a location more suitable for it, it might prove a valuable kind.

PEACHES.

The older trees have all been removed and those on the grounds at present range from one to five years old with the exception of four or five varieties and there is only one tree of some of these. Nearly all of the trees of bearing age bloomed full and at first it looked as though there was going to be a large crop, but most of the fruit dropped in June and the crop on most varieties was quite small.

Spraying for Leaf-Curl.

Sulphate of copper has always been found effective against leaf-curl, but last spring a number of trees were sprayed with sulphate of iron, 2 pounds to 50 gallons, before the buds started and other trees of the same varieties were sprayed with copper sulphate, 2 pounds to 50 gallons of water. The results were that some varieties showed no leaf-curl, while others showed a small number of diseased leaves on the tree sprayed with the sulphate of iron, but none when sprayed with copper sulphate. Although it gave better results against leaf-curl than with the other diseases, sulphate of iron cannot be recommended as a fungicide in the place of copper sulphate. In one block the trees were sprayed with lime, sulphur and salt, except two that were left unsprayed to note the results. The trees sprayed showed no diseased foliage while those unsprayed had a considerable amount of leaf-curl, indicating that the above wash is a reliable remedy for leaf-curl. In fact, although the expense of the sulphur and lime mixture would prevent its use for this purpose only, if the trees are infested with the San Jose scale one application will suffice for both.

The varieties that made the best showing were Triumph, Brunson, Waddell and McIntosh. Triumph is the earliest yellow variety, but is rather small and inclined to rot. Brunson is similar to Kalamazoo and is a valuable, medium late sort. Waddell is a very hardy and productive, white peach, ripening about August 15. It is of good size and quality but rather tender in texture for shipment. McIntosh is one of the newer kinds and is proving very hardy in bud, but is white-fleshed and hence of doubtful value.

The following are the more promising of the new varieties:

Admiral Dewey:—The earliest, yellow freestone. It is of good size, yellow, with a handsome red cheek; flesh yellow, of fair texture and flavor. It seems to be larger and less subject to rot than Triumph but is slightly later in ripening. It appears to be quite hardy and if sufficiently productive it will be a valuable sort.

Emma:—A large, yellow, handsome freestone, ripening the last of September, which seems to be a promising variety.

Frances, Worth and Matthews are all large, yellow freestones ripening a few days in advance of Emma. While they appear to be desirable sorts, further trial will be needed to determine their comparative merits.

Banner:—Ripens with Smock. Although slightly smaller than that variety, it is of better flavor and appearance and even more hardy and productive.

Welch:—A large, handsome, yellow freestone ripening in early October on young trees. It promises to be a valuable late sort.

PLUMS.

The plums made the best showing of any of the tree fruits, many of the varieties requiring heavy thinning to keep the limbs from breaking. The spraying to control the curculio and brown rot was attended with the usual good results. One of the most marked examples of the value of Bordeaux mixture in controlling brown rot on the plum was shown this season in the test between copper sulphate and lime, or the regular Bordeaux mixture, and sulphate of iron and lime, the latter showing practically no benefit. In another experiment a number of trees were sprayed before the buds started with copper sulphate solution, using 2 pounds to 50 gallons of water, and check trees of the same varieties were sprayed with Bordeaux mixture just before the blossoms opened. There was no noticeable difference in fruit or foliage between the trees upon which the different mixtures were used. The varieties which gave the heaviest yields this season were Lombard, Monarch, Coe, Field, Archduke, Grandduke, Spaulding, Agen, Burbank No. 7, Hungarian, Kingston and Middleburg. Many other varieties gave partial crops.

New Varieties.

Three varieties fruited for the first this season:

October Purple:—Received in 1900 from D. Wiley and Co., New York. A Japan plum originated by Luther Burbank of Santa Rosa, California. Fruit large, roundish, slightly conical; color purplish with numerous yellow dots. Flesh yellow, clinging to the stone, firm; flavor sweet, pleasant. Ripe September 20. Its large size, handsome appearance, good quality and late ripening make this a very promising new variety.

Apple:—Received in bud from Stark Brothers, Louisiana, Mo., in 1900. A small, red, Japan plum; form oval; tapering to the apex; texture tender, juicy, with a pleasant, vinous flavor; flesh yellow, semicling. Ripe August 15.

Foote:—Of the Damson type, being larger than Shropshire and resembling French Damson in color, shape and size. Form roundish-oblong; color black, with blue bloom; texture firm; flesh rather dry, greenish-yellow. Cling; pit small, oval. Ripe September 5. Requires further trial.

The following varieties have given the best results for home and market purposes:

Japan Varieties.

Red June, Abundance, Burbank and Satsuma, Climax and October Purple. The two last named are among the most promising new kinds of this type of plums.

European Plums.

In this class the more desirable are Field, Bradshaw, Lombard, Fellenburg, Giant Prune, Shropshire Damson, French Damson, Archduke, Black Diamond, Kingston, Grank Duke, Bavay and Monarch. Other varieties which might be added to the list are: Lincoln, Murdy, Yellow Egg, Spaulding, Columbia and Coe. These are given in about the order of their ripening, and all have proven valuable.

PEARS.

The pear crop was very good considering the heavy crop of 1904. Some of the newer kinds that bore last year failed to fruit this season. All of the trees were sprayed the same as the apples for the scab and worms; three times for the early kinds and four for the late, and the results were very satisfactory. The pear psylla made its appearance again this season and was treated with kerosene emulsion, using kerosene one gallon, soap one pound and water ten gallons. In making the emulsion as strong as this, however, care should be taken to have it thoroughly emulsified, otherwise it will separate and burn the foliage. It would be better to recommend for general use one gallon of oil to twelve of water. The treatment, which was made soon after the leaves appeared, was quite effectual.

Spraying.

A few trees were sprayed with copper sulphate solution, using 2 pounds to 50 gallons of water, before growth started and trees of the same varieties were left unsprayed until blossoms began to show color when they were sprayed with Bordeaux mixture and Paris green. The copper sulphate failed to control the leaf-blight as well as the Bordeaux mixture, although there was but a small number of diseased leaves upon any of the trees. Several trees were sprayed in April with sulphate of iron (2 lbs. to 50 gallons of water) and afterwards, just before the blossoms opened and again after they had fallen, they received an application of sulphate of iron and 6 pounds of lime in 50 gallons of water. Other trees of the same varieties were sprayed with the regular Bordeaux mixture. No scab made its appearance on any of the trees treated with either mixture, but leaf-blight was quite plentiful upon two varieties sprayed with the sulphate of iron solution. As a fungicide the sulphate of iron upon pears, as upon other fruits, is practically worthless.

Varieties.

Nothing new has developed to change the standing of the varieties recommended in previous reports. Of the newer kinds, Conference is especially recommended as worthy of trial for both home use and market. Danas Hovey, although an old sort, is but little known, but it is a productive variety and on account of its flavor and keeping qualities should be in more of our commercial orchards and gardens. The following varieties have been tested and will be desirable in most sections, They ripen in the order named: Giffard, Clapp Favorite, Bartlett, Flemish, Howell, Bosc, Seckel, Angouleme, Danas Hovey, Kieffer. Anjou and Sheldon would be valuable market varieties, but they are very slow in coming into bearing.

APPLES.

The apple crop was lighter than for some years past, although quite a number of varieties bore full or nearly full crops of fine fruit. A large per cent of the trees blossomed full but the fruit failed to set, owing probably to two conditions. First, the very heavy rains while the trees were in bloom and, second, to the very heavy crop last year. The cold and the excessive moisture in the early part of the growing season was exceptionally hard on the foliage, particularly to those varieties susceptible to scab fungus, and while the spraying controlled it upon the fruit, it did not always do so upon the foliage.

Spraying.

For several years we have recommended spraying apple trees with Bordeaux mixture just before the blossoms opened, for the purpose of preventing the scab upon the blossoms and the small fruits, but as it is not always possible to do this, we have suggested the use of copper sulphate solution (2 pounds to 50 gallons of water) before the leaf-buds open. To determine the comparative merits of these treatments a number of trees were sprayed with the copper solution in April, and other trees of same varieties were left unsprayed until the blossoms began to show color, when they were sprayed with Bordeaux mixture and Paris green. When the fruit set, very little difference could be noticed, but there was rather more scab fungus upon the fruit and slightly more upon the foliage of the trees sprayed with copper sulphate, than upon those sprayed with Bordeaux mixture just before the blossoms opened. While a difference was noticeable in favor of the Bordeaux, the spraying with copper sulphate gave good results and ordinarily can be depended upon and, as it is cheaper and easier to prepare and apply, it is well worth using to control the scab fungus. The fruit showed no scab, except on varieties susceptible to the disease, when either mixture was used. When it is possible to get over the orchards just before the blossoms open with Bordeaux mixture, it will give a little better result in controlling scab fungus than the early spraying with copper sulphate, especially in wet seasons and on varieties subject to the attack of the fungus. A number of trees were sprayed with sulphate of iron, both in a clear solution and with lime, making the applications at the time of the regular sprayings. No beneficial results were noted with the exception that this solution did not russet the fruit as did the regular Bordeaux mixture, while it failed to control the scab and hence cannot be recommended in the place of the copper mixtures.

Russetted Fruit.

In some years considerable harm is done to apples, and especially those intended for a fancy trade, by what is known as the russetting of the fruit, when the trees are sprayed with Bordeaux mixture. It has been ascribed to various causes, including the lime, and the arsenic or Paris green that are used in Bordeaux mixture. While the exact cause is not known, it has been noticed that it is most troublesome in seasons when there are frequent showers in July and August. Then the injury was far more severe in 1905 than in 1904.

The indications are that the trouble is due to the copper sulphate which becomes soluble in some way and causes the injury to the epidermis, when the climatic conditions are correct. That this is the case, rather than that the injury comes from the lime or Paris green was shown quite conclusively during the last year when it was noticed that trees sprayed with sulphate of iron, Paris green and lime did not show it, while the russetting was quite noticeable where sulphate of copper, lime and Paris green were used. The only difference was the substitution of the sulphate of iron for sulphate of copper. The remedy appears to be to lessen the amount of copper sulphate used after the first of July.

The varieties that are very easily injured by russetting are Jonathan, Ben Davis, Wagener, Longfield, Minkler and Smokehouse; others that are quite likely to show it are Rhode Island, Grimes, Mason Orange, Gravenstein, McIntosh and Wealthy. Those that seem the most resistant are Oldenburg, Titovka, Borovinka, Gideon, Hubbardston and Morris.

Notes on Varieties.

Only a few new varieties fruited for the first time this season. The following varieties gave good yields this year: Oldenburg, Gideon, Longfield, Wealthy, Washington Strawberry, McMahon, No. 1 New, Thompson No. 29, Wagener, Grimes, Hubbardston, Munson, Water, Stuart, Rambo, Tolman, Stark, Indian, Walker, Dickinson and Mason Orange. Excellent results have been secured from the following well-known sorts: Summer—Yellow Transparent, Oldenburg; Fall—Wealthy, Gideon, Washington Strawberry, Gravenstein and Bailey Sweet; Winter—McIntosh, Wagener, Hubbardston, Grimes, Jonathan, Rhode Island, Morris, Indian, Ontario and Tolman. Trees of Northern Spy planted in 1888 have failed to fruit as yet and Red Canada, another most excellent winter kind planted at the same time has borne but very little. These varieties while late in coming into bearing are excellent winter sorts and could be planted to advantage by setting them forty feet apart each way for permanent trees and using varieties like Yellow Transparent, Oldenburg, Wealthy, and Wagener as fillers. Some of the more promising of the newer kinds just coming into bearing are: For summer—Bath, Benoni and Dudley; for fall—Fanny and Glowing Coal; for winter—Arkansas, Boiken, Milwaukee, Arnold, Doctor, Sutton, Beauty, Stuarts Golden, Hyde King and Sweet Orange.

New Varieties.

Black Ben Davis:—From Stark Brothers, Louisiana, Mo., in 1900. Of medium size, roundish, oblate-conic. Basin quite deep, abrupt; cavity deep, narrow and russetted; stem of medium length, slender. Color, handsome, dark red over the whole surface. Flesh yellowish-white, firm, moderately juicy; flavor mild, sub-acid, pleasant, not rich, but better than Ben Davis and more attractive in appearance. It closely resembles Gano, if not identical with that variety as claimed by some. Superior to Ben Davis in every way. Ripe Dec. 15.

Arkansas Beauty:—Planted in 1895. Trees moderately vigorous, upright, slightly spreading. Fruit above medium in size, roundish-oblong, tapering slightly to the eye. Color greenish-yellow, nearly covered with bright red, some stripes. Basin small to medium, shallow, corrugated; cavity small, slightly russetted; stem long, slender. Texture firm; flesh juicy, fine-grained, greenish-yellow; flavor sprightly, sub-acid, pleasant; quality good. Promising for winter.

Arkansas:—This variety is very different from Arkansas Beauty. In size about the same; form roundish-conical; color light and dark red; flesh very firm, moderately juicy, fine-grained, breaking; quality fair. It falls far below Arkansas Beauty in quality.

Akin:—Size medium; form oblate-conic; color yellow, overlaid and striped with bright red; texture firm, fine-grained, crisp, very juicy, with a pleasant, sprightly flavor; quality good. Requires further trial.

Fulton:—From the late B. Hathaway in 1895. Tree rather a slow, spreading grower. Fruit large, oblate. Basin large, of medium depth, corrugated; cavity narrow, close; color yellow, nearly covered with a light red blush. Texture tender, fine-grained, melting, moderately juicy, mild, sub-acid, pleasant, not rich; quality fair to good. Season November to January. Promising.

Winter Banana:—From Greening Brothers, Monroe, Michigan, in 1895. Trees moderately vigorous, upright-spreading, making a round head. Fruit large, round flattened, slightly conical; color clear yellow, with a light blush on the exposed side. Texture firm, medium juicy, fine-grained, yellowish-white. Flavor mild, sub-acid and with a rather indistinct "banana" flavor. Is a handsome apple and of some promise for dessert purposes.

QUINCES.

Fuller, Alaska, Missouri, Rea and Champion all bore good crops. Missouri and Rea have given the best results. The quinces seem especially sensitive to the attack of twig blight and each year a considerable amount has to be cut away.

NUTS.

The pecans have not borne as yet and the English walnuts are a failure. The Japan walnuts bore a lighter crop than usual this year but are valuable from coming into bearing earlier than our native butternuts, which they slightly resemble in several respects. Of the filberts, Kentish Cob bore a much heavier crop than Cosford Thin-shell, but both are valuable kinds and should be in every collection. This nut should succeed well in all parts of the "peach belt," and as they bear early and produce abundant crops, there is no reason why they should not be profitable. The nuts are large and compare well in size and flavor with those sold in the stores.

Chestnuts.

Of these, the Paragon is far ahead of anything on trial on account of its productiveness and early-bearing tendencies. Comfort is fully as large and of the same quality but is not as productive and is much slower in coming into bearing. From the behavior and quality of the Japan chestnuts they could scarcely be recommended for commercial purpose but they make handsome, dwarfish trees and bear early.

COVER CROPS.

A number of plots were sown in August, 1904, and duplicate plots were sown by Messrs. George E. Chatfield and Frank Warner. The amount of the seed of the oats and barley was cut down one-half when the clovers were sown with them, while in the others the full amount was used whether sown alone or mixed.

The plots contained one-fourth acre each.
Plot 1, Barley ½ bushel.
Plot 2, Barley ¼ bushel, crimson clover 1 quart.
Plot 3, Barley ¼ bushel, mammoth clover 1 quart.
Plot 4, Oats ½ bushel.
Plot 5, Oats ¼ bushel, crimson clover 1 quart.
Plot 6, Oats ¼ bushel, mammoth clover 1 quart.
Plot 7, Crimson clover 2 quarts.
Plot 8, Mammoth clover 2 quarts.
Plot 9, Sand vetch 6 quarts.

In addition to the clovers, oats were sown upon one-half of Plots 7, 8 and 9. Plots 2, 3, 5 and 6 gave fairly good results but were not as strong as Plots 1, 4 and 7, 8 and 9. The Mammoth clover made a little the best growth of the two clovers, but Crimson clover made a much better growth than in 1903 and 1904, as it lived through the winter in good shape. Barley also made a better growth than oats, although both did well in the fall and for cover-crop purposes alone, are the best we have ever tested, with barley in the lead. The halves of Plots 7 and 8 which were sown to oats and clover were superior to the other halves which did not have the oats, and when a leguminous crop is wanted to turn under in the spring, the clovers as shown in Plots 7 and 8, with oats or barley, can be highly recommended and in a three years' test have given the best results. Mammoth clover is the best of the clovers for this purpose. Sand Vetch gave good results but should have the barley grown with it. It is especially adapted to high, sandy places where the clovers are hard to get started and in old orchards where a great deal of tramping is necessary in harvesting the fruit.

At Mr. Warner's, Plots 7, 8 and 9, with the oats sown with clover, did the best. No difference was noticeable this season between the growth of Mammoth and Crimson clovers at plowing time and there was an equal stand with both. Vetch did well but seed is high-priced. Mr. Warner likes oats better than barley. Barley seed is not only higher in price, but oats are easier to get and are often grown on the farm.

Mr. Chatfield reported as follows:

Plot 1. Barley grew to a height of ten inches and about 25 per cent lived through the winter and stood knee-high on May 15, at the time of plowing.

Plot 2. Barley made quite a showing in the fall and some of it lived through the winter. The crimson clover did well and seemed to be neither improved nor injured by the barley. It lived through the winter and made a fair cover, but not so good as in Plot 7.

Plot 3. Could see very little difference in Plots 2 and 3.

Plot 4. Oats came up well and grew from one foot to sixteen inches high.

Plot 5. Oats made a good growth, none lived over. Crimson clover made about the same growth as in Plot 2.

Plot 6. About the same as in Plot 5 only that Mammoth clover did not mature as early as the Crimson clover.

Plot 7. Crimson clover made a good growth in the fall and lived through the winter. It covered the ground well and stood knee-high at time of plowing.

Plot 8. Mammoth clover got a good foothold in the fall; lived through the winter well and made a good cover for the ground but the plants were not so high nor as nearly matured at the time of plowing as Crimson clover.

Plot 9. Vetch came up well but did not make much growth in the fall. It lived over winter and grew very rapidly in the spring, and, at the time of plowing, covered the ground very thoroughly, some plants reaching a length of six feet. It was very difficult to turn under with an ordinary plow.

The oats sowed over half of Plots 7, 8 and 9 made a good growth in the fall and although they were killed by the early frosts, they stood up well and aided materially in holding the leaves and snow. At the time of plowing in the spring, very little difference in the growth of the clovers could be noticed between the sections where oats were used and where the clover was sown alone.

The soil in which the vetch was sown was sandy loam of good fertility. The remaining plots were on rather heavy clay, and a crop of fruit was gathered from the trees about three weeks after the seed was sown, which injured it somewhat. The seed of the cover crops was sown on August 28th and the land was plowed about May 15th.

T. A. FARRAND.

MICHIGAN

STATE AGRICULTURAL SOCIETY

MICHIGAN STATE AGRICULTURAL SOCIETY.

ANNUAL REPORT FOR THE YEAR ENDING JUNE 30, 1906.

OFFICERS FOR 1905.

President—Eugene Fifield, Bay City, Bay County.
Vice-President—Stephen Baldwin, Detroit, Wayne County.
Secretary—I. H. Butterfield, Detroit, Wayne County.
Treasurer—C. W. Young, Paw Paw, Van Buren County.

EXECUTIVE COMMITTEE.

Term ending January, 1906.

E. W. Hardy	Howell, Livingston County.
Frank Maynard	Jackson, Jackson County.
H. R. Dewey	Grand Blanc, Genesee County.
H. H. Hinds	Stanton, Montcalm County.
F. E. Skeels	Harriette, Wexford County.
F. G. Jacobs	Pontiac, Oakland County.
W. W. Collier	Detroit, Wayne County.
Byron E. Hall	Port Huron, St. Clair County.
John Marshall	Cass City, Tuscola County.
Geo. H. German	Franklin, Oakland County.

Term ending January, 1907.

John McKay	Romeo, Macomb County.
John A. Hoffman	Kalamazoo, Kalamazoo County.
A. E. Stevenson	Port Huron, St. Clair County.
W. P. Custard	Mendon, St. Joseph County.
W. E. Boyden	West Bay City, Bay County.
Wm. Dawson	Sanilac Centre, Sanilac County.
J. E. Rice	Grand Rapids, Kent County
Lawrence W. Snell	Highland Park, Wayne County.
Geo. Kelly	North Branch, Lapeer County.
Geo. G. Winans	Hamburg, Livingston County.

EX-PRESIDENTS.

Members Ex-Officio.

T. W. Palmer	Detroit, Wayne County.
I. H. Butterfield	Detroit, Wayne County.
M. P. Anderson	Midland, Midland County.
John T. Rich	Lapeer County, P. O. Detroit.
E. Howland	Pontiac, Oakland County.

OFFICERS FOR 1906.

President—Fred Postal, Detroit.
Vice-President—Stephen Baldwin, Detroit.
Secretary—I. H. Butterfield, Detroit.
Treasurer—John McKay, Romeo.

EXECUTIVE COMMITTEE.

Term ending January, 1907.

J. F. Brand.......Saginaw, Saginaw County.
Jason Woodman.......Paw Paw, Van Buren County.
A. E. Stevenson.......Port Huron, St. Clair County.
C. A. Tyler.......Nottawa, St. Joseph County.
W. E. Boyden.......West Bay City, Bay County
Wm. Dawson.......Sanilac Centre, Sanilac County.
J. E. Rice.......Grand Rapids, Kent County.
Lawrence W. Snell.......Highland Park, Wayne County.
Geo. Kelly.......North Branch, Lapeer County.
Geo. G. Winans.......Hamburg, Livingston County.

Term expires January, 1908.

A. J. Doherty.......Clare, Clare County.
W. J. Galbraith.......Calumet, Houghton County.
Wm. J. Terney.......Roscommon, Roscommon County.
Herbert E. Powell.......Ionia, Ionia County.
F. B. Ransford.......Caro, Tuscola County
W. W. Collier.......Pontiac, Oakland County.
L. R. Taft.......Agricultural College, Ingham County.
Geo. B. Horton.......Fruit Ridge, Lenawee County.
D. D. Aitken.......Flint, Genesee County.
B. E. Hall.......Port Huron, St. Clair County.

EX-PRESIDENTS.

Members Ex-Officio.

T. W. Palmer.......Detroit, Wayne County.
John T. Rich.......Lapeer County, P. O. Detroit.
I. H. Butterfield.......Detroit, Wayne County.
E. Howland.......Pontiac, Oakland County.
Eugene Fifield.......Bay City, Bay County.

PROCEEDINGS OF THE EXECUTIVE COMMITTEE.

Executive committee met on the fair grounds, August 15th, at 9 o'clock a. m., and after looking over the grounds and work under construction informally, came to city and at 2 o'clock p. m. was called to order by the president at the Griswold House, Detroit.

Roll called, the following members present:

The President, Mr. Fifield, and Messrs. Baldwin, Butterfield, Young, Hardy, Dewey, Hinds, Skeels, Jacobs, Collier, Hall, Marshall, German, McKay, Hoffman, Stevenson, Boyden, Dawson, Snell, Kelly, Winan, Rich.

Reading of minutes of last meeting dispensed with.

The president stated that to consider any business that might come before it.

On motion of Mr. Hall the Griswold House was made hotel headquarters during the fair.

It was moved that the business committee secure, if possible, a special car for transportation to the fair grounds each morning during the week of the fair.

Carried.

Mr. Dewey moved that the business committee be instructed to secure possession of the property of the society now stored on the fair grounds of the Oakland County Agricultural Society at Pontiac, in such way as in their judgment may seem best.

Carried.

Mr. Dawson moved that treasurer be instructed to sell membership tickets previous to the fair, and allow twenty-five per cent commission for selling.

Motion lost.

The treasurer was authorized to sell season tickets good for six daily admissions at ($2.00) two dollars each.

Mr. A. E. Stevenson moved that the buildings be opened evenings during the fair and that proper lighting be provided in buildings and on the grounds.

Carried.

Mr. Stevenson moved that evening admissions after five o'clock p. m. be twenty-five (25) cents each.

Carried.

Mr. Stevenson moved that all superintendents be requested to be present to attend to their respective departments as early as Thursday morning, September 11.

Carried.

On motion, adjourned.

Meeting of the executive committee called by the president at the Griswold House, Detroit, Thursday, September 7th, at 8 o'clock p. m.

Present—Messrs. Hardy, Dewey, Hinds, Boyden, Dawson, Kelly, Winans, Custard, Hoffman, Stevenson, Rich, Anderson, Rice, Fifield, Young, Skeels, McKay, Butterfield.

Reading of minutes of last meeting dispensed with.

Mr. Stevenson moved that the rule for admission of vehicles be amended and that vehicles and automobiles carrying paid passengers be admitted free.

Lost on aye and nay vote as follows:

Ayes—Messrs. Hoffman, Dawson, Stevenson, Anderson, Rice, Butterfield, Winans.

Nays—Messrs. Hardy, Dewey, Hinds, Boyden, Custard, Fifield, Young, Skeels, McKay.

On motion, adjourned.

Meeting of the executive committee called by the president to meet at the Griswold House, Monday evening, September 11th, at 9 o'clock.

Roll called, quorum present.

On motion L. E. Wise was appointed chairman of the board of judges of election.

J. E. Barringer, of Armada, was appointed second member of the board of judges of election.

On motion, M. P. Anderson, of Midland, was appointed third member of the board of judges of election.

It was moved that the caucus of the society be held at the Michigan building at 9 o'clock a. m., on Wednesday, September 13th.

Carried.

It was moved that annual election be held in the button tent on the grounds.

Carried.

The chairman of the business committee presented the matter of insurance of buildings of the society.

Mr. Dawson moved that the business committee be instructed to insure the Michigan building at eighty per cent of its value, and take such an amount on the other buildings as may satisfy the bond holders.

Carried.

On motion, adjourned.

CAUCUS.

The caucus of the society for the nomination of officers was held as directed, at the Michigan building, Wednesday, September 15th, at 9 o'clock a. m.

On motion of Mr. Winans, President Fifield was called to the chair and I. H. Butterfield was elected secretary.

On motion, the president was instructed to appoint two tellers. M. P. Anderson and L. W. Barnes were appointed.

The following persons were nominated for respective offices:

President—C. W. Young, Paw Paw.

Vice President—W. W. Collier, Oakland county.
Secretary—I. H. Butterfield.
Treasurer—John McKay.
Members of the Executive Committee for two years term—E. Wilson Hardy, Howell; Thos. M. Sattler, Jackson; Hezekiah R. Dewey; Henry H. Hinds; Fremont E. Skeels; Lorenzo W. Barnes; Chas. A. Waldron, Tecumseh; Byron E. Hall; John Marshall, Cass City; Frank H. Lessiter, Orion.
On motion, adjourned.

ANNUAL ELECTION.

The annual election of officers of the society was held as directed by the executive committee at the button booth tent, on the fair grounds, on Thursday, September 14th, from 9 o'clock a. m. to 5 o'clock p. m.

Mr. J. E. Barringer, one of the judges appointed, was not present and the president appointed J. Q. Cochrane, of Midland, to serve in his place.

Mr. M. P. Anderson, another of the judges appointed, not being present, the president appointed J. E. Rice to serve in his place.

The judges took the following oath of office:

The undersigned having been duly appointed judges of election of the Michigan State Agricultural Society for September 14, 1905, do hereby swear, each for himself, that he will support the constitution of the United States, the constitution of the State of Michigan and the constitution and by-laws of the Michigan State Agricultural Society, and discharge the duties of the office of judge of election of this society to the best of my ability.

LESTER E. WISE,
J. W. COCHRAN,
J. E. RICE.

Sworn and subscribed to before me, a notary public, this 14th day of September, 1905.

M. P. ANDERSON.
My commission expires January 10, 1909.

Report of the inspectors (judges) of election of the Michigan State Agricultural Society, held on the fair grounds September 14, 1905.

The board was organized by electing Lester E. Wise chairman. Called to order at 9 o'clock a. m. by President Fifield. The polls were open at 9 o'clock a. m., and continued open until 5 o'clock p. m. Notice being given of the opening and closing of the polls from the voting booth by the president of the society.

The following officers and members of the executive committee were voted for at said election, as follows, to wit:

The total number of votes cast, 1,097, which were divided as follows:

For president for the term of one year:

Fred Postal of Wayne county	981
Chas. W. Young of Van Buren county	112

For vice president for term of one year:

Stephen Baldwin of Wayne county	976
William W. Collier of Oakland county	117

For secretary for one year:

Ira H. Butterfield of Wayne county	1,097

For treasurer for one year:

John McKay of Macomb county	1,092

For members of the executive committee, term of office expires January, 1908:

Wm. J. Galbraith of Houghton county	978
E. Wilson Hardy of Livingston county	118
Thos. M. Sattler of Jackson county	115
Herbert E. Powell of Ionia county	977
Hezekiah R. Dewey of Genesee county	116
William W. Collier of Oakland county	1,094
Henry H. Hinds of Montcalm county	114
Byron E. Hall of St. Clair county	1,090
Fremont E. Skeels of Wexford county	118
Alfred J. Doherty of Clare county	975
Lorenzo W. Barnes of Shiawassee county	116
Frank B. Ransford of Tuscola county	973
Charles A. Waldron of Lenawee county	117
David D. Aitken of Genesee county	974
John Marshall of Tuscola county	118
Levi R. Taft of Ingham county	977
Frank H. Lessiter of Oakland county	118
Geo. B. Horton of Lenawee county	967
Henry Bowen of Lenawee county	5
William J. Terney of Roscommon county	975

At 5 o'clock p. m. said polls were closed and a canvass of the votes cast was made by the inspectors and Eugene Fifield, president of the society, the result of which is above set forth.

The said election was conducted fair, and according to law, and regulations of the society.

LESTER E. WISE,
J. W. COCHRANE,
J. E. RICE,
Inspectors of Election.

EUGENE FIFIELD,
President.

Correct: I. H. BUTTERFIELD, Secretary.

On Wednesday, September 13th, by invitation of the art superintendent and committee, exercises were held in the Michigan building and busts of J. L. Hudson, Mayor Codd and I. H. Butterfield were presented the society, Hon. W. C. Maybury making the presentation address, and speech of acceptance by President Eugene Fifield.

Hon. Henry Chamberlain, of Three Oaks, the only living member of the society who took part in its organization in 1849, being present as guest of the society, was invited to address the meeting.

Mr. Chamberlain responded as follows:

ADDRESS OF MR. CHAMBERLAIN.

Mr. President, Ladies and Gentlemen—With my father's family, nearly sixty-two years ago, I came to the southwestern part of Michigan.

In the township in which I settled it was heavily timbered, the stumps yet standing in all the clearings and girdled trees were yet standing on all the cultivated lands. With a few exceptions there were no highways; we followed blazed trails or rode in wagons drawn by oxen over corduroy roads.

I planted my first corn in Michigan in the spring of 1844. The timber had been cut in winter and the brush burned in the spring. We planted the corn with axes, with the logs lying upon the ground. We cut down the weeds with a heavy hoe, and gathered in due time reasonable crops. Threshing was done with a flail or the grain was tramped out by horses. The small grain was cut with a sickle or cradle. We knew nothing of the modern improved implements of husbandry which are upon the farms today.

But skipping the preliminaries and getting down to the point. I was elected in 1848 a member of the legislature which assembled at Lansing in January, 1849. It was the second legislature which had assembled at Lansing. Lansing was then in a primitive state, the capital having been established there only two years before, when there was but one house and a sawmill in the township.

With the exception of a few people who were residing there, the legislature made up the larger portion of the population. Governor Ranson who had been a judge on the bench was the owner of a fine farm lying within the present limits of the city of Kalamazoo and was taking great interest in the improvement of the agricultural industry of Michigan.

There were several preliminary meetings to talk over the question of forming a State agricultural society, which finally resulted in a meeting held on March 7, 1849, at which it was voted to organize. Gov. Ranson was presiding and I was secretary of the meeting. It happened to be on the twenty-fifth anniversary of my birthday. St. Patrick's day in the morning.

The important question at that meeting aside from deciding to organize was whether to hold a fair that year or not. During the meeting Lieut. Gov. Fenton, who was not only an able man, but an eloquent orator, opposed holding a fair. At the conclusion of his remarks everything was quiet. I heard a little rap on the desk behind me. Gov. Ranson, knowing that I had taken an interest in having the fair held that year, plainly intimated to me that I had better answer, which I did and it was voted to hold a fair in the city of Detroit.

The fair was held on the Cass farm and it is probable that any school district in a settled part of Michigan could today make a better exhibit than was there shown.

With two or three exceptions I have attended all the State fairs that have been held since that time, and have seen the growth and increase of value in products of the farms of this State. One principal cause why we have not been more successful has been the moving from place to place and the heavy expenses incident thereto.

The fair now being permanently located in Detroit, much to my satisfaction, I have reason to believe that it will meet with the approbation of the farmers of Michigan, and continue to be a great success. (Applause.)

A vote of thanks was extended to Mr. Chamberlain for his presence at the fair.

WINTER MEETING OF THE EXECUTIVE COMMITTEE OF THE MICHIGAN STATE AGRICULTURAL SOCIETY.

The president called the annual winter meeting to meet at the Griswold House, Detroit, on Monday, January 8th, at 8 o'clock p. m. A quorum not being present the meeting was adjourned to meet at the same place on Tuesday, January 9th, at 8 o'clock p. m.

Tuesday, January 9th, at 8 o'clock p. m. the committee met at the Griswold House, Detroit. Called to order by the president. Roll called. The following members answered to their names: Messrs. Fifield, Baldwin, Butterfield, Young, Hardy, Dewey, Hinds, Skeels, Collier, Hall, McKay, Hoffman, Stevenson, Custard, Boyden, Dawson, Rice, Snell, Kelly, Winans, Rich, Anderson. Absent—Messrs. Maynard, Marshall, Palmer, Howland, Jacobs, German.

Minutes of meeting of May 24th read and approved.

Minutes of meeting of August 15th read and approved.

Minutes of meeting of September 7th read and approved.

Minutes of meeting of September 11th read and approved.

The business committee presented its report as follows:

Mr. President and Members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—Your business committee being entrusted with the duties of arranging for holding the State fair in Detroit from September 11 to 16, 1905, together with erecting buildings, making race track, and preparing the grounds in suitable condition for holding the fair, beg leave to submit the following report:

It is well understood by all of you that the president and business committee were authorized to make a loan of one hundred thousand dollars for this purpose. Arrangements were made with the Union Trust Company, of Detroit, to sell one hundred thousand dollars in bonds, secured by first mortgage on the real estate of this society, interest at five per cent, payable semi-annually. Eighty-five thousand dollars of the bonds were sold by the Union Trust Company and a loan of fifteen thousand dollars was consummated with the Kalamazoo National Bank at six per cent, due October 1, 1906, with fifteen thousand dollars in bonds as collateral security to the loan, thus making the Michigan State Agricultural Society one of the bond holders to the extent of fifteen thousand dollars. It was found when we acquired the fifty acres additional land that it would be necessary for the Grand Trunk side track to enter the grounds at the extreme south side and we were compelled to contract for a small parcel of land south of Barnum avenue thus saving a large portion of our own ground for show purposes. The contract price was five hundred and seventy-five dollars of which seventy-five dollars has been paid, leaving a balance of five hundred dollars for a term of years if so desired by this society.

On April 18, 1905, a deed was delivered to the Michigan State Agricultural Society by the Detroit State Land Co., and work was started at once with a view of building a half-mile track and erecting buildings. It then became evident to the Detroit citizens' committee that we should have more land and after a conference jointly of your business committee with the Detroit citizens' committee, it was agreed that the Detroit citizens' committee would buy fifty acres adjoining the ninety-six acres on the north for twenty thousand dollars, the society paying ten thousand dollars and the citizens' committee the balance. Thus we were enabled to build a mile track. The chairman of your business committee immediately telephoned President Fifield and outlined the proposition briefly. The president made a prompt call for a meeting on the 24th of May when another deed for fifty acres was turned over to the society by the Detroit citizens' committee. Then work began in earnest. From that date we had ninety-eight days including Sundays to arrange for the fair. During this period your committee met with much to discourage them, one of the important items was forty days of rain, but they kept up courage, remembering their promise to you, that we would hold a fair on the new fair grounds in Detroit in 1905 if we were obliged to do so under canvas. The result you all know. I do not think there ever was a fair ground put in condition to hold a fair in the same length of time in the United States, especially of such magnitude. The Michigan State Agricultural Society should congratulate itself on having a permanent location in the most beautiful city in the United States. There is but one Belle Isle in the world and last but not least, the only Woodward avenue in the world. At one time during the fair there were ten thousand people in transit between the city hall and the state fair grounds.

I wish to thank the executive committee, the Detroit citizens' committee and the advisory committee, also my associates on the business committee for their kindness. You have honored me with three terms on the business committee and one year as general superintendent, enabling me to assist in managing the most successful fair ever held in the history of this society.

JOHN A. HOFFMAN,
A. E. STEVENSON,
I. H. BUTTERFIELD.

The following is a summary of the amounts charged to the several accounts, and showing the amounts chargeable to the expenses of the fair of 1905, and amounts charged to permanent building and improvement of grounds:

Executive committee	$539 66
Business committee	784 83
Other committees	280 88
President's office	286 76
Secretary's office	1,662 96
Treasurer's office	1,263 12
Postage	299 27
Printing and stationery	1,773 71
Advertising	5,073 36
General expense	5,838 94
Telegraph and telephone	119 33
Freight and express	96 98
Diplomas, ribbons and badges	273 74
Attractions	10,010 02
Sundry expense	598 13
Cattle department	167 16
Horse department	68 49
Speed department	6,515 96
Sheep department	132 78
Swine department	89 10
Poultry department	157 50
Agricultural department	72 25
Dairy department	115 15
Farm implement department	88 28
Vehicle department	63 13
Main building	88 90
Art department	402 66
Needlework department	246 70
Horticultural department	196 28
School department	104 88
Concessions and privileges	208 93
Police	1,010 51
Marshals	102 00
Gates	588 55
Sundry labor, repairing grounds, cleaning, etc	2,362 51
	$41,683 41

EXPENDITURES FOR PERMANENT IMPROVEMENTS—FAIR 1905.

Buildings.	
Michigan	$16,808 77
Speed barns, closets, dining-room and all other small buildings	11,949 35
Grand stand	55,227 46
Horse barns	31,144 39
Water	3,400 38
Sewer and drainage	3,650 88
Fence	1,158 72
Track	7,777 96
Electric lights	6,449 94
Grading and cinders	2,460 03
Material on hand	1,814 89
Paid on land, abstracts, interest, etc	10,574 78
	$183,928 63

PROCEEDINGS OF THE BUSINESS COMMITTEE.

Meeting July 12th, 1905.—The business committee met at the office in Detroit, July 12th. Present.—Mr. Stevenson, Mr. C. W. Young acting for Mr. Hoffman, the secretary.

It was agreed to order three fire hydrants.

A proposition having been made by the board of water commissioners of the city of Detroit to put in water mains on the fair grounds at cost of material and labor. The proposal was accepted.

The secretary was authorized to sell the old buildings on the fair grounds. These were subsequently sold for $200.00 to Louis Schnell.

Bids having been received for the construction of an exposition building from the Vinton Company, Robt. F. Teakle and A. J. Smith & Son.

A. J. Smith & Son being the lowest bidder the contract was awarded to them at $28,448.00, and the secretary authorized to sign contract.

It was arranged with the Union Trust Company to sell bonds of the society as trustee, a mortgage for $100,000 to be made on the property of the society to secure said bonds, said mortgage to run to the Union Trust Company as trustee.

The issuing of such bonds being authorized by the executive committee at its meeting of May 24, 1905.

Business committee, July 26, 1905. All members present and the president.

It was agreed to call a meeting of the executive committee to meet August 15, 1905, 9 o'clock a. m. at the fair grounds.

The secretary was authorized to engage Mr. L. D. Burch as foreman to construct speed barns and other sundry work on the fair grounds.

Mr. T. Brown was engaged to do some grading on the grounds under the supervision of Mr. Snell.

Agreement was made with the Lion Fence Co., of Adrian, to furnish fence for the grounds. T. Shoulters & Co. to erect the same.

Also contract with McCleary Electric Co. to erect electric light plant on grounds.

Contract was entered into with the Detroit United Railway leasing a strip of ground on the north side of the Woodward avenue frontage for the purpose of constructing tracks and passenger freight station for use of the railway in connection with transportation of passengers and freight to the fair grounds.

The report was received and referred to the finance committee.

Mr. Dewey of the advertising committee made a verbal report. Mr. Collier of the committee stated that the committee met and considered scheme for advertising the fair which was approved by the committee and by the business committee and the secretary authorized to carry it out.

The reception committee, the chairman, Mr. Stevenson, made verbal report and recommended that the feature inaugurated last year of entertaining be continued and enlarged. The report was received and referred to the executive committee.

The secretary reported as follows:

RECEIPTS BY SECRETARY FOR 1905.

Collected advertising 1903-1904	$170 00
Hay from grounds 1904 sold	56 73
Collected premium list advertising, 1905	639 20
Program advertising, 1905	667 70
From C. L. Benjamin, entrance Hal Sphinx	15 00
American Trotting Association, collection, J. H. Brown	25 00
F. E. Skeels, nails sold	12 80
Detroit Journal, overpaid on bill	45 00
Walker & Co., overpaid on bill	10 00
American Shorthorn Association, special prizes	276 67
Admissions to fair paid	4 00
Old buildings sold	200 00
From F. E. Skeels, collected for electric light	14 75
From sundry exhibitors for electric light	25 85
From Bert Kline, for electric light	50 00
From rent, office and telephone, October and November	32 22
From John Finn, cement sold	35 70
From Louis Schnell, hay	100 00
From Louis Schnell, overpaid on order No. 161	2 00
From memberships	1,947 00
From stall fees	444 00
Amount to correct sundry vouchers	6 16
Total	$4,779 78

SECRETARY'S REPORT OF ENTRIES AND AWARDS IN THE SEVERAL CLASSES AND DIVISIONS AT THE FAIR OF 1905.

CATTLE.

Class.	Division.	Entries.	Am't offered.	Am't awarded.
1	Shorthorns, open class	80	$450 00	$420 00
1A	Shorthorns, Michigan	65	450 00	410 00
2	Polled Durhams, open class	9	286 00	111 00
2A	Polled Durhams, Michigan		219 00	
3	Herefords, open class	35	287 00	241 00
3A	Herefords, Michigan	17	221 00	175 00
4	Galloways, open class	25	285 00	233 00
4A	Galloways, Michigan	23	222 00	206 00
5	Aberdeen Angus, open class	25	285 00	249 00
5A	Aberdeen Angus, Michigan	16	222 00	175 00
6	Jerseys, open class	9	285 00	111 00
6A	Jerseys, Michigan	9	222 00	103 00
7	Guernseys, Michigan	16	222 00	181 00
8	Holstein-Friesien, open class	27	285 00	278 00
8A	Holstein-Friesien, Michigan	23	272 00	222 00
9	Red Polled, open class	21	285 00	219 00
9A	Red Polled, Michigan	10	222 00	142 00
10	Fat cattle, open class	19	108 00	108 00
		449	$5,028 00	$3,584 00

HORSES.

11	Standard bred breeding stock	16	$291 00	$195 00
12	Roadsters, open class	18	165 00	70 00
13	Carriage and coach, open class	24	288 00	165 00
14	Saddle horses, open class	2	122 00	26 00
15	All work horses, open class	9	260 00	37 00
16	Cleveland bays, open class	2	265 00	37 00
18	Hackneys, open class	2	265 00	28 00
19	Percheron, open class	2	265 00	28 00
20	Clydesdale or Shire, open class	4	265 00	54 00
21	Suffolk Punch, open class	2	265 00	22 00
22	Grade Draft, open class	2	258 00	18 00
23	Shetland Ponies, open class	13	199 00	92 00
24	Park or combination ponies, open cl.	8	69 00	22 00
		104	$2,976 00	$794 00

SHEEP.

25	Merino A. Wrinkley, open	32	$138 00	$131 00
25A	Merino A. Wrinkley, Mich	25	138 00	109 00
26	Merino B. Type, open	38	138 00	135 00
26A	Merino B. Type, Mich	36	138 00	128 00
27	Merino C. Delaine Type, open	33	138 00	109 00
27A	Merino C. Delaine Type, Mich	30	138 00	111 00
28	Rambouillet Merinos, open	44	138 00	131 00
28A	Rambouillet Merinos, Mich	46	138 00	138 00

Class.	Division.	Entries.	Am't offered.	Am't awarded.
29	Lincolns, open	25	$126 00	$121 00
29A	Lincolns, Mich.	25	126 00	126 00
30	Leicester, open	28	126 00	121 00
30A	Leicester, Mich.	30	126 00	126 00
31	Cotswold, open	24	126 00	114 00
31A	Cotswold, Mich.	16	126 00	102 00
32	Shropshires, open	43	138 00	138 00
32A	Shropshires, Mich.	57	138 00	138 00
33	Hampshires, open	40	126 00	132 00
33A	Hampshires, Mich.	24	126 00	126 00
34	Oxfords, open	24	126 00	121 00
34A	Oxfords, Mich.	8	126 00	64 00
34½	Southdowns, open	24		112 00
34½	Southdowns, Mich.	16		109 00
35	Horned Dorsets, open	16	126 00	118 00
35A	Horned Dorsets, Mich.	16	119 00	108 00
36	Fat Sheep, open	15	48 00	34 00
37	Angora Goats, Reg., open	15	111 00	111 00
37	N. E. Goats			5 00
		730	$3,044 00	$3,018 00

SWINE.

Class.	Breed.	Entries.	Am't offered.	Am't awarded.
38	Berkshire, open class	60	$139 00	$133 00
38A	Berkshire, Michigan	38	139 00	134 00
39	Poland China, open class	29	139 00	134 00
39A	Poland China, Michigan	22	139 00	122 00
40	Essex, open class	9	139 00	33 00
40A	Essex, Michigan	9	139 00	65 00
41	Suffolk or small Yorkshire	10	139 00	74 00
41A	Suffolk or small Yorkshire	10	139 00	67 00
42	Chester White, open class	48	139 00	136 00
42A	Chester White, Michigan	24	139 00	130 00
43	Large Yorkshire, open class	34	139 00	108 00
43A	Large Yorkshire, Michigan	15	139 00	67 00
44	Victoria, open class	10	139 00	13 00
44A	Victoria, Michigan	10	139 00	74 00
45	Duroc Jersey, open class	77	139 00	139 00
45A	Duroc Jersey, Michigan	57	139 00	135 00
		462	$2,224 00	$1,564 00

POULTRY.

47	Poultry competition, open	791	$1,015 50	$500 00
47A	Poultry competition, Michigan	730	1,023 50	488 00
		1,521	$2,039 00	$988 00

FARM AND GARDEN PRODUCTS.

48	Grains and seeds	176	$293 50	$223 00
49	Roots and vegetables	352	307 00	285 00
50	Special county exhibits	11	180 00	320 00
		539	$780 50	$828 00

DAIRY PRODUCTS, ETC.

Class.	Breed.	Entries.	Am't offered.	Am't awarded.
51	Butter and cheese	95	$300 00	$289 46
	Diamond Crystal Salt special		27 35	
52	Sugar and bread	30	57 50	25 00
53	Bees, honey and apiarian implements	36	133 00	92 00
		161	$517 85	$406 46

ART.

60	Paintings, drawings and photos	221	$529 50	$434 00
61	Paintings and drawings, amateur	103	168 50	127 50
62	Applied arts	142	323 00	214 50
	Non-enumerated	43		55 00
		509	$1,021 00	$831 00

NEEDLEWORK.

63	Professional fine sewing	104	$239 50	$94 00
	Non-enumerated	7		9 50
64	Amateur fine sewing	365	184 50	148 00
	Non-enumerated	39		41 50
		515	$424 00	$293 00

HORTICULTURE.

65	Special county exhibit, fruit	17	$400 00	$470 00
66	Collections	45	342 00	292 00
67	Single plates of fruit	777	316 00	240 50
68	Dried, canned, pickled and preserved fruits, jellies and vegetables	231	175 00	169 50
69	Plants and flowers	18	191 00	124 00
70	Cut flowers by professionals	12	109 50	71 00
72	Cut flowers by amateurs	37	45 00	37 50
	Special preserved fruits	28		28 00
		1,165	$1,578 50	$1,432 50

SCHOOL.

72	High school	11	$83 00	$19 00
73	Grammar schools	187	203 00	200 00
74	Primary schools, 3 and 4 grades	63	84 00	84 00
75	Primary schools, 1 and 2 grades	65	66 00	66 00
76	Kindergarten	19	33 00	30 00
77	Manual training department	23	144 00	29 00
78	Graded or village schools	5	54 00	12 00
79	District schools	8	100 00	35 00
		381	$767 00	$475 00

Report accepted and referred to the Premium List and Finance Committee.

PREMIUM VOUCHERS PAID—1905.

No.		
1	B. B. Johnson, Atlanta, Ind	$121 00
2	G. W. Grim, Fremont, Ind	49 00
3	P. W. Artz, Osborne, Ohio	83 00
4	W. Squire, Amherstburg, Ont	55 00
5	A. E. and E. G. Stevenson, Port Huron, Mich	318 00
6	Frank H. Hawley, Leroy, Ohio	141 00
7	J. F. and E. W. English, Clarksville, Mich	183 00
8	John Lessiters Sons, Orion, Mich	237 00
9	John Lessiters Sons, Orion, Mich	30 00
10	Owen Taft, Oak Grove	129 00
11	Harvey S. Day, Ypsilanti	151 00
12	J. H. Chapman, Pontiac	54 00
13	Michigan Premium Stock Co., Davisburg	269 00
14	J. M. Linson, South Solon, Ohio	73 00
15	J. T. Smith & Sons, Caledonia, Mich	240 00
16	Martin Richardson, Walled Lake, Mich	55 00
17	Louis Norton, Quimby	163 00
18	E. J. Haskins, Pittsford, Mich	59 00
19	Wolcott & Plumb, Concord, Mich	202 00
20	U. I. Moore, Jonesville, Mich	27 00
21	J. B. Hillgrass & Son, Anderson, Ind	55 00
22	L. C. Kelley, Ypsilanti, Mich	20 00
23	W. H. Lessiter, Pontiac, Mich	39 00
24	M. T. Story, Lowell, Mich	110 00
25	Fred Simpson, Ypsilanti, Mich	7 00
26	O. G. Brisbin, Tecumseh, Mich	22 00
27	Edwin Miller, Birmingham, Mich	97 00
28	Geo. W. Prescott, R. F. D. No. 12, Grand Rapids	5 00
29	J. D. Hamilton, Pontiac, Mich	57 00
30	E. G. Buck, Moline	38 00
31	Geo. C. Hupp, Birmingham, Mich	84 00
32	Woodcote Stock Farm, Ionia	120 00
33	Wm. Newton, Pontiac, Mich.	125 00
34	Louis Newton, Pontiac, Mich	115 00
35	Louis Newton, Pontiac, Mich	47 00
36	Robt. Knight & Son, Marlette, Mich	140 00
37	W. R. Montgomery, Hillsdale, Mich	85 00
38	F. F. Ingram, Detroit, Mich	67 00
39	F. F. Ingram, Detroit, Mich	7 00
40	F. F. Ingram, Detroit, Mich	170 00
41	Dawson & Son, Sanilac Center, Mich	28 00
42	Wm. Morgan, Jr., Saginaw, W. S., Mich	46 00
43	Morgan Bros. & Co., Saginaw, W. S., Mich	65 00
44	Joseph S. Steele, Saginaw, W. S., Mich	19 00
45	John W. Worthington, Oak Grove	212 00
46	B. E. Bullock, Temperance	11 00
47	A. B. Donelson, Pontiac	11 00
48	J. Y. Porter, 50 Lincoln Ave., Detroit	26 00
49	W. W. Collier, Detroit	192 00
50	F. B. Lay, Kalamazoo	14 00
51	Chas. E. Freese, 807-808 Chamber of Commerce	6 00
52	M. A. Bray & Son, Okemos	25 00
53	B. F. Miller, Flint, Mich	125 00
54	E. E. Leland & Son, R. D. No. 9, Ann Arbor, Mich	46 00
55	E. E. Beech, Brighton, Mich	14 00
56	J. C. Barney & Renshaw, Coldwater	24 00
57	Clyde C. Godfrey, Jonesville	15 00
58	E. Knight & Son, Gagetown	93 00

No.		
59	Jno. Marshall & Co., Cass City, Mich	$139 00
60	Jno. Marshall & Son, Cass City, Mich	68 00
61	Jno. H. Eberly, Wauseon, Ohio	61 00
62	Herbert E. Powell, Ionia	125 00
63	E. F. Cilley, Clarksville	138 00
64	Wm. Grimes, Melvin	14 00
65	Geo. C. Woodman, Owosso	158 00
66	Etzler & Moses, Conway, Ohio	74 00
67	T. F. Marston, Bay City	214 00
68	J. H. Kroh, Hillsdale	113 00
69	Wm. Newton, Lake St., Pontiac	45 00
70	Mrs. A. S. Brown, 201 Harrison Ave., Detroit	17 00
71	Otto B. Schultze, Nashville	65 00
72	T. H. Brown, Highland Park	8 00
73	W. J. Hemkel, Detroit	22 00
74	A. W. Freer, 24 John R., Detroit	15 00
75	B. F. Smith, Hillsdale	19 00
76	Herbert L. Ladd, 177 Scranton Ave., Detroit	67 00
77	Comstock & Ordway, Byron	53 00
78	D. H. Bryce, Port Huron	32 00
79	Fred E. Gregory, Dearborn	7 00
80	Fogo & McFall, Amanda	24 00
81	Jos. C. Reed, Oxford	21 00
82	J. W. Ash, Napoleon	29 00
83	R. B. Pinkerton, Essex, Ont	14 00
84	Hibbard & Brown, Birmingham	97 00
85	D. B. Watt & Son, Hernia	85 00
86	S. P. Shafer, 211 Avery Ave., Detroit	13 00
87	Mrs. Irene McGill, Trenton	10 00
88	M. L. Schenck, 36 Baker St., Detroit	2 00
89	D. V. Miller, 277 Field Ave., Detroit	20 00
90	J. A. Gibson, Belleville	14 00
91	Chas. H. Hutchinson, White Pigeon	64 00
92	C. Hintz & Son, Fremont, Ohio	56 00
93	C. Hintz & Son, Fremont, Ohio	62 00
94	C. W Hintz, Fremont, Ohio	94 00
95	Patterson & Cole, Fayette, Ohio	65 00
96	Wm. Clark, Kimble, Ohio	111 00
97	Wm. Clark, Kimble, Ohio	17 00
98	Willis S. Meade, Grand Blanc	30 00
99	Ed. Curran, Sand Hill	8 00
100	John Walton, Rosebush	78 00
101	L. B. Lawrence, Grass Lake	16 00
102	Isaac Kellogg & Son, Reading	66 00
103	Swarts Bros., Hotel Cadillac, Detroit	25 00
104	C. H. Bell, Ashley, Ohio	138 00
105	W. H. Compton & Son, Monroe, Ohio	100 00
106	R. D. McGonagin & Son, Ashley, Ohio	32 00
107	J. L. McMurray, Montgomery, Mich	141 00
108	Harry Prescott, Grand Rapids, Mich	5 00
109	Geo. W. Prescott, Grand Rapids, R. D. No. 12	14 50
110	Daniel Thomas & Son, Pontiac, Mich	13 50
111	S. D. Lapham, Dearborn, Mich	6 50
112	Jack Kinne, Jr., Three Oaks	84 00
113	I. F. Schleede, Ann Arbor, Mich	4 50
114	Dr. J. P. Letts, Romeo, Mich	4 00
115	Fred E. Simpson, Ypsilanti, Mich	13 00
116	Fred E. Simpson, Ypsilanti, Mich	9 50
117	L. M. Olds, Ypsilanti, Mich	9 50
118	Joe. F. McGuire, Denver, Colo	9 00
119	P. T. Hutton, Durand	2 50
120	Wm. P. Stonehouse, Highland Park, Mich	2 00
121	W. H. Lessiter, Pontiac	5 50
122	A. L. Emerson, Inkster, Mich	3 00

No.		
123	Edwin J. Lohr, 1609 Jackson Ave., Ann Arbor	$11 00
124	Wesley A. Elliott, Ypsilanti, Mich	9 50
125	L. L. Conn, Durand	7 00
126	C. Sherrick, Howlett, Mich	3 50
127	W. H. Hill & Son, 232 Labrosse St., Detroit	37 00
128	Dr. H. C. Judson, Detroit	2 50
129	J. F. Watrous & Son, Chelsea	25 00
130	L. C. Kelley, Ypsilanti	11 00
131	Gerald C. Connor, 450 Grand River, Detroit	5 00
132	Mrs. Mary Dowling, 20 17th St., Detroit	3 00
133	Mrs. Sarah McKinnin, 1330 16th St., Detroit	50
134	E. Hailey, Detroit, 166 Antoinette St	16 50
135	J. M. Rohrer, Grass Lake, Mich	3 80
136	Mrs. M. G. Northrup, Waterford	1 66
137	Miss Van Alstine, Inkster, Mich	50
138	F. E. Stafford, Vicksburg	7 60
139	Chas. M. Pike, White Pigeon, Mich	3 80
140	Thos. Stacey, North Branch	3 80
141	Dr. R. J. Palmer, Detroit	2 00
142	B. Schroeter, 59 Miami Ave., Detroit	145 00
143	J. C. Herriman, New Haven, Mich	2 26
144	Chas. J. Miller, Mason	78 50
145	Mrs. Jno. McCormick, Orchard Lake	2 96
146	Mrs. F. E. Sheldon, 37 Leverette St., Detroit	4 00
147	Mrs. Baisch, 1168 Military Ave., Detroit	1 00
148	Mrs. A. G. Comstock, 573 Cass Ave., Detroit	3 00
149	A. D. Benham, Milford	14 50
150	C. J. Phelps, West Branch	80 00
151	E. J. Rice, New Hudson	2 98
152	Henry Wellington, 91 Brainerd St., Detroit	4 00
153	Mrs. Caroline Masser, 226 Howard St., Detroit	2 00
154	Miss Alice B. Lee, 126 Lincoln Ave., Detroit	5 00
155	Albert Stoye, 442 John R. St., Detroit	5 00
156	Geo. T. Yetter, Eau Claire, Mich	3 42
157	L. Griggs, 1611 Woodward Ave., Detroit	20 25
158	W. D. Soper, Jackson	1 66
159	Van Buren Creamery Co., Belleville	3 04
160	A. C. Seibert, Richville	2 26
161	Marcia Munsell, 334 Merrick Ave., Detroit	2 00
162	Lawrence Creamery Co., Lawrence, Mich	2 26
163	Mrs. U. S. Foster, 301 Woodward Ave., Detroit	10 00
164	Mrs. F. F. Wallace, 412 14th Ave., Detroit	2 00
165	Jas. Fraser, Port Huron, Mich	5 00
166	Ida White Williams, Hillsdale	3 33
167	Archie R. Pierce, Dorr	4 57
168	South Haven Pom. Society, South Haven	60 00
169	Mrs. W. H. Carson, 507 Mullett St., Detroit	3 50
170	Mrs. H. J. Hoyt, 805 Kerchival Ave., Detroit	5 00
171	Elon Holmes, Greenfield	2 77
172	Libbie J. Rice, 170 Pingree Ave., Detroit	6 00
173	Emma Boylan, 97 Calumet St., Detroit	4 50
174	S. R. Miles, Buchanan, Mich	5 22
175	Mrs. W. Q. Hunt, 1105 Jefferson Ave., Detroit	2 00
176	Mrs. Walter J. Bell, 258 Van Dyke Ave., Detroit	1 00
177	Lydia M. Kurz, 433 17th St., Detroit	3 25
178	Lillie Dowler, 661 Congress St. E., Detroit	1 00
179	R. G. Sortor, Henderson, Mich	7 60
180	Ida W. Beal, Elsie, Mich	50
181	Mrs. A. O Wilburn, Romeo, Mich	1 50
182	M. L. Lavery, 54 Perry St., Detroit	3 00
183	Mrs. L. D. Bingham, 193 Stanley Ave., Detroit	2 00
184	J. D. Moleskey, 221 Bagg St., Detroit	3 00
185	Mrs. Jas. Chase, Northville, Mich	8 50
186	Marshall Creamery Co., Marshall, Mich	5 22

No.		
187	Chatfield & Son., South Haven, Mich	$20 00
188	Oscar Dennison, Yale, Mich.	3 04
199	Katherine M. Brooks, 51 E. Alexandrine Ave	1 50
190	Mrs. Albert Potter, 192 Meldrum Ave., Detroit	2 75
191	Freeport Creamery Co., Freeport, Mich	3 42
192	Mary C. Heideman, 96 Forest Ave., Detroit	3 50
193	James S. Rogers, 1185 Third Ave., Detroit	4 50
194	S. Amanda Beardsley, 91 Alfred St., Detroit	8 50
195	Mrs. C. T. McClintock, 421 Second Ave., Detroit	5 00
196	Bertha E. Lloyd, 97 Watson St., Detroit	13 00
197	Mrs. Wm. R. Fisk, 129 Baltimore Ave., Detroit	3 00
198	Mrs. Leo Miller, Leland	6 50
199	Grace P. Pettee, 224 Ridge St., Marquette	4 00
200	Jessie E. Palmer, 224 Ridge St., Marquette	4 00
201	Mrs. Hannah Adams, 53 Piquette St , Detroit	3 75
202	Mrs. S. M. Reynolds, Howell	2 00
203	Patrick Milett, R. F. D. No. 2, Perry, Mich	98 00
204	Frank J. Horn, 383 Michigan Ave., Detroit	2 00
205	L. W. Mouat, South Haven	2 00
206	O. S. McKinney, Pittsford	4 44
207	Mrs. F. W. Peabody, 349 Theodore St., Detroit	3 00
208	Mabel Guess, Highland Park, Mich	2 50
209	E. L. Tomlinson, 545 Vinewood Ave., Detroit	5 00
210	Mrs. E. Stevens, Kraft	5 50
211	Ironwood School, Ironwood	35 00
212	Carlo Romanelli, 23 Van Husen Bldg., Detroit	20 00
213	Mrs. Nellie Cox, Scotton & McGraw, Detroit	11 25
214	Miles J. McGuire, 689 W. Fort St., Detroit	12 00
215	Geo. Skene, Novi, Mich.	12 00
216	J. H. Thompson, Ann Arbor, Mich	16 00
217	Nellie Rae, 226 Howard St., Detroit	3 00
218	Ida J. Ulrich, 319 Cass Ave., Detroit	2 00
219	Mrs. D. F. Casey, 41 Milwaukee Ave. E	6 50
220	Lynn H. Peck, Dryden	13 27
221	John Stout, South Haven	5 50
222	Mrs. H. B. Seagrave, Pontiac	16 00
223	Mrs. H. B. Seagrave, Pontiac	4 50
224	Mrs. E. A. Cross, West Branch	27 00
225	Mrs. W. T. Lewis, Pontiac	24 00
226	Mathias Alten, Grand Rapids	174 00
227	Mrs. Ebb Voorheis, Pontiac	3 00
228	Mrs. Ebb Voorheis, Pontiac	53 00
229	H. E. & E. M. Moore, Orchard Lake	7 00
230	Clark J. Beattie, Orchard Lake	2 50
231	H. F. Baker, Weadock	60 00
232	Ernestine Johnson, 580 John R. St., Detroit	4 00
233	Addie Lockwood, 1713 University St., Ann Arbor	2 00
234	Wm. F. Johnston, Roscommon, Mich	70 00
235	Mrs. H. E. Golden, Traverse City	64 50
236	Mrs. Anna Prescott, Grand Rapids	7 50
237	Mrs. G. K. Wainwright, Benton Harbor	27 00
238	Mrs. Helen M. Woodruff, Reed City, Mich	3 50
239	Miss U. M. Stevens, Berlin, Mich	22 50
240	Miss U. M. Stevens, Berlin, Mich	105 50
241	J. C. Hunt, South Haven	2 00
242	Bay City School, J. A. Stewart, Supt., Bay City	30 00
243	Addie Higham, 37 Stimson St., Detroit	2 00
244	Frank Gutheil, Port Huron, Mich	10 00
245	Miss Anna Meyn, 426 Gratiot Ave., Detroit	3 00
246	Mrs. Adda I. Wales, 136 Rosedale, Detroit	3 00
247	M. A. Payne & Son, 308 Philadelphia St., Detroit	25 00
248	Mrs. Jas. Harris, Traverse City	3 05
249	Wm. Kennedy, Greenfield	3 00
250	Daniel Robertson, Mikado	26 23

No.		
251	L. L. Kelley, Farwell	$30 00
252	Wm. Nemitz, 35 Waterloo St., Detroit	3 00
253	Bertha Scruggs, Flint	50 00
254	K. Shearer, 148 Seyborn Ave., Detroit	5 00
255	Mrs. E. A. Parks, Birmingham	7 00
256	Wm. Pomeroy, Downington	8 00
257	Thos. Gowanlock, Highland Park	7 00
258	Chas. B. King, care of Northern Mfg. Co., Detroit	10 00
259	Geo. A. True, 169 McDougall Ave	12 00
260	Geo. G. Booth, Detroit, Cranbrook Press Wks	16 00
261	Bessie Warren Kanady, 626 Trumbull Ave., Detroit	5 00
262	Miss A. L. Siess, 305 Watson St., Detroit	1 00
263	A. B. Smith & Co., Farmington	19 32
264	Highland Park School, Wm. Harris	14 00
265	W. R. King, Waterford	12 50
266	Mrs. L. R. Carrothers, Woodmere	6 00
267	J. J. Marshall, Romeo	65 00
268	Jas. Kennedy, Greenfield	2 00
269	W. D. Soper, Jackson	62 00
270	Robert Lathers, Dearborn	4 50
271	G. W. Griffin, South Haven	3 00
272	Will H. Horne, Newark, N. J	19 00
273	Mrs. Katherine Hare, 819 Washington St., Bay City	33 50
274	Mrs. Katherine Hare, 819 Washington St., Bay City	4 00
275	E. W. Jewell, Pontiac	13 00
276	Emma Perrault, 232 Baldwin Ave., Detroit	6 00
277	Mary E. Peacock, Pontiac	20 33
278	Clara A. Peacock, North Pontiac	19 00
279	T. F. Marston, Bay City	4 50
280	F. M. Warner, Farmington	81 70
281	W. K. Munson, Grand Rapids	17. 50
282	Newton & Son, Hart, Mich	287 50
283	Robt. J. Dowling, Coloma	12 00
284	W. B. Brown, 308 Woodward Ave., Detroit	15 00
285	L. T. Curtis & Sons, Flint	125 50
286	E. W. Owen, Ypsilanti	20 00
287	G. W. Heskett, Fulton, Ohio	60 00
288	L. J. Patterson, Tawas City, Mich	50 00
289	Barbara Stoll, 108 10th St., Detroit	12 00
290	Wm. Lightbody, Higgins School, Woodmere	81 00
291	Emma Z. Warn, Pontiac School, Pontiac	203 00
292	Mrs. M. Bigler, Pontiac	42 75
293	Andrew Ferguson, Collins & Farnsworth, Detroit	12 00
294	H. E. & E. M. Moore, Orchard Lake	114 00
295	H. E. & E. M. Moore, Orchard Lake	137 00
296	H. E. Moore, Orchard Lake	42 00
297	H. E. & E. M. Moore, Orchard Lake	149 00
298	H. E. & E. M. Moore, Orchard Lake	140 00
299	H. E. & E. M. Moore, Orchard Lake	1 00
300	H. E. Moore, Orchard Lake	3 50
301	Mabel E. Cooper, Pontiac	23 00
302	Mich. Premium Stock Co., Davisburg	37 00
303	Mich Premium Stock Co., Davisburg	62 00
304	G. A. Terpening, Reading	6 00
305	G. A. Terpening, Reading	33 50
306	F. A. Limbeck, Dowagiac	38 00
307	C. S. Bartlett, Pontiac	17 50
308	Forrest E. Mann, Grand Rapids	10 00
309	Silas Nye, Romeo	22 50
310	W. F. Bird, Ann Arbor	181 50
311	A. W. Jewett, Mason	226 00
312	Jas. A. Tucker, Concord	217 50
313	S. E. Wurst, Elyria, Ohio	181 50
314	Mrs. Volney Miller, Birmingham	8 20

No.		
315	Mrs. Volney Miller, Birmingham	$1 50
316	R. Crossfield, Oshtemo	3 80
317	S. J. Whitmore, Horton	58 00
318	Mrs. Mary Crandall, 1696 Russell St., Detroit	2 25
319	Robt. M. Cauffman, Centerville	6 10
320	E. E. Beach, Brighton	17 00
321	E. J. Haskins, Pittsford	212 00
322	Helen G. Cable, Northville, Mich	10 50
323	Chas. O. Conat, Hickey	7 00
324	Mrs. C. B. Western, 288 2nd St., Jackson	17 50
325	John Leisering, Eaton Rapids	30 00
326	Floyd Miller, Mason	20 00
327	Mrs. C. W. Burton, 38 Brainers St., Detroit	13 50
328	Miss M. L. Pillow, Louvillard Villa, St. Augustine, Fla	8 50
329	Alfred H. Gillingham, 289 Glynn St., Detroit	2 00
330	Edith Neill, 387 E. Larned St., Detroit	3 00
331	Fannie L. Teal, 756 Trumbull Ave., Detroit	5 50
332	Mrs. F. F. Humphrey, 573 3rd Ave., Detroit	5 00
333	Alexandrine Mc Ewen, 432 Jefferson Ave	9 00
334	J. A. Polley, Alamo, Mich	1 00
335	Pierson & Nyeswander, Leslie, Mich	17 50
336	Mrs. G. W. Ross, Highland Park	3 50
337	E. B. Payne, Cloverdale	4 50
338	Lillian Clark, 72 Garfield St., Detroit	3 00
339	Adams Bayley, Birmingham	8 89
340	H. H. Ismond, Houghton Lake	2 00
341	Mich. Prem. Stock Co., Davisburg	39 50
342	Myrtle Israel, Birmingham, R. D. No. 1	3 25
343	Chas. R. Hamp, Jackson, Mich., R. D. No. 8	3 33
344	Mrs. L. M. Buell, 562 Broad St., Beloit, Wis	10 00
345	Ethel Spencer Lloyd, 97 Watson St., Detroit	18 50
346	Grace R. Conover, 25 W. Elizabeth St., Detroit	24 00
347	Clara L. Smith, Miller School, Sta. 2, Detroit	12 00
348	Mrs. Mark Donelson, 1660 Jefferson Ave., Detroit	11 37
349	Grace C. Jones, 113 Lothrop Ave., Detroit	3 00
350	Amelia Van Buren, 106 Miami Ave., Detroit	5 00
351	Jessie Wilkinson, 106 Miami Ave., Detroit	18 50
352	Lulu G. Emmons, 280 Warren Ave., Detroit	16 00
353	W. H. Hill & Son, 232 Labrosse St., Detroit	2 50
354	Mrs. Isabella G. B. Lothrop, 440 Jefferson Ave., Detroit	5 00
355	J. Calmus, 103 Michigan Ave., Detroit	5 00
356	A. B. Sloer, Trenton, N. J	44 00
357	Martin Keenan, Redford, Mich	1 50
358	John Hoye & Son, 108 Spruce St., Detroit	34 00
359	W. H. Bechtel, Caro	4 18
360	John P. Terns, 250 Labrosse St., Detroit	7 00
361	H. E. Johnston, 1554 Russell St., Detroit	6 00
362	L. M. Churbuck, Brockton, Mass	35 00
363	Mrs. E. Schramm, Royal Oak	2 00
364	Mrs. H. L. Bingham, 128 Westminster Ave., Detroit	10 50
365	Irene Louise Getty, Kalkaska School, Kalkaska	35 00
366	N. J. Ellis, Clarkston	48 00
367	Alice R. Glenny, Buffalo, N. Y., Amherst Ave	10 00
368	Wm. J. Bailey, Henderson	50
369	Maud Myers, 32 W. University St., Columbus, Ohio	28 00
370	Margaret E. Barnard, 63 Bagg St , Detroit	8 00
371	Margaret E. Barnard, 63 Bagg St., Detroit	10 75
372	M. L. Candler, 6 Adams Ave., W. Detroit	11 00
373	Ada Gilmore, 737 Academy St., Kalamazoo, Mich	9 00
374	Albert Vogel, Cass City	2 00
375	Mrs. J. E. Lumley, 281 Christiancy St., Detroit	1 50
376	Mrs. M. M. Bramlett, Palmyra, Mo	11 75
377	L. D. Burnett, 14th Ave., Horse Market, City	27 00
378	Marcia Richardson, Pontiac, Mich	11 00

No.		
379	A. E. & E. G. Stevenson, Port Huron, Mich.	$5 00
380	F. M. Benham, Milford, Mich.	98 50
381	C. E. Lockwood, Washington, Mich.	9 00
382	Chas. Bogula, 294 Military Ave., Detroit, Mich.	12 00
383	Upper Peninsula Agrl. Assoc. Iron Mountain, Mich.	200 00

The committee on transportation reported as follows:

To Eugene Fifield, President, and members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—According to custom and the by-laws of this society, I hereby make my report as superintendent of transportation.

First, will say that the arrangements with the railroads in the passenger department has not been as satisfactory as I think it should be for the reason that the railroads have gotten into a certain manner in doing business in connection with the state fair, and they do not realize and appreciate the difference with the state fair located at Detroit and being located in the smaller cities as it has been in the past. I was unable to persuade them to run a number of cheap rate excursions, the railroads seeming to think that with carrying facilities in the usual manner it would be sufficient and I believe now that they have seen what can be done towards securing an attendance to the state fair from outside cities that with this matter taken up early with the roads we can secure the running of several cheap rate excursions and in this way very materially increase the attendance from the rural districts.

In connection with the handling of freight, I would recommend that the business committee be requested to have the Grand Trunk place and put in a separate switch at the north end of the grounds running into the stock stables for the purpose of handling stock, the present switch is too far away from the stock barns and it is very unhandy and causes exhibitors considerable trouble, and if a separate switch was put in so that the stock could be handled more quickly and removed from the grounds without any delay and at the same time the machinery and other goods could be handled from the other switches as now placed, which would make it much better for the railroad company and much more expeditious for the shipper, and believing that we should make it as handy as possible for the shippers, not only for getting into the grounds, but for getting out, I make this recommendation.

As to handling the city traffic, I desire to express my appreciation for the manner in which the D. U. R. transacted their business, the facilities under the conditions were most excellent, and they did everything they could to assist us in getting ready to handle the people at our grounds after they had delivered them there. I would further recommend that the office of superintendent of transportation be abolished and that the duties pertaining to that office be transacted by the business committee.

Respectfully submitted,
A. E. STEVENSON,
Superintendent of Transportation, Michigan State Agricultural Society.

Report accepted and referred to the committee on rules.

The Superintendent of Cattle reported:

Mr. President and members of the Executive Committee:

Gentlemen:—As superintendent of cattle at the Michigan state fair, Detroit September 11-16, 1905, I present the following report:

The cattle show at our state fair of 1905 while not large in number was very creditable in quality. Being favored with ideal fair weather during our last fair, the showing under canvass passed off very pleasantly.

The expenses of the department tend to increase, from the fact that nearly all the different breeders feel that their exhibits should be judged by recognized judges of their breeds, which necessitates more judges and necessarily more expense.

As superintendent of cattle I issued orders for pass butons 47. Orders for 148 bales of straw.

All of which is respectfully submitted.

W. E. BOYDEN,
Superintendent of Cattle.

Report accepted and referred.

The Superintendent of the Horse Department reported as follows:

Detroit, Mich., January 9, 1906.

Mr. President and Gentlemen of the Executive Committee of the Michigan State Agricultural Society:

As superintendent of the department of horses other than speed at our 1905 state fair, I beg to present the following report:

The secretary's report I believe goes into details of expenses and other disbursements incident to this department.

The list of entries were small, there being but 104 entries altogether as compared to 273 in 1904 and 244 in 1903. The entries in the various classes are detailed in the secretary's report, so I omit them here. The cause of the decrease in entries was undoubtedly due to the fact that there was much doubt and apprehension among breeders and exhibitors generally as to whether our stables and grounds would be completed in time for the fair. Many exhibitors present told me that they had no idea that our equipment was so complete, and assured me that they would be on hand at the fair next fall.

One exhibitor from Canada, who had one at 1905 fair, agrees to bring a car load this year.

The largest exhibit was among trotting horses as you have observed by the secretary's report.

I desire to commend particularly the efficiency of the work done by Dr. C. A. Waldron of Tecumseh, who did the principal part of the work superintending the horse department during the fair. He was on hand constantly looking after the interest of the fair and the exhibitors.

I beg to suggest that for coming fairs the premiums be enlarged, so that they may approach more nearly to the premiums offered at the Toronto exposition and in our neighboring states, which I am sure will largely increase the quality and quantity of our exhibits in this department.

Some alterations should be made in the stables, which I have outlined in a letter to the chairman of your business committee and to your incoming president.

I believe it would be a pleasing feature and facilitate a satisfactory showing of the different classes if the horses were judged on the infield opposite the grand stand. All of which is respectfully submitted.

Yours truly,

W. W. COLLIER,

Superintendent Horse Department.

Speed department Michigan State Fair 1905.

Statement of entrance money paid in each class and purses paid out. Division of purses, 50, 25, 15 and 10 per cent.

Tuesday, September 12th.

Race No. 1, 2:16 class pacing; purse, \$500.—Number entries, 9; entrance paid, \$325; purses paid, \$500. Time, 2:15¼, 2:12¼, 2:14½, 2:17¼.

No. 2, 2:20 class trotting; purse, \$500.—Number entries, 10; entrance paid, \$350; purses paid, \$500. Time, 2:19¼, 2:20, 2:19¼, 2:20¼, 2:20¾, 2:18¼, 2:22¼.

No. 3, Michigan bred and owned, two-year old class, pacing; purse, \$500.—Did not fill.

No. 4, Michigan bred and owned, two-year old class, trotting; purse, \$500.—Did not fill.

Wednesday, September 13th.

No. 5, 2:30 class, pacing; purse, \$500.—Number entries, 10; entrance paid, \$350; purses paid, \$500. Time, 2:21¼, 2:18¼, 2:16¾.

No. 6, 2:28 class, trotting; purse, \$500.—Number entries, 9; entrance paid, \$325; purses paid, \$500. Time, 2:20¼, 2:21¾, 2:22¼.

No. 7, 2:10 class, pacing; purse, \$500.—Number entries, 4; entrance paid, \$200; purses paid, \$500. Time, 2:16, 2:14¾, 2:13¼.

Thursday, September 14th.

No. 8, 2:23 class, trotting; purse, \$500.—Number entries, 6; entrance paid, \$225; purses paid, \$500. Time, 2:22¼, 2:21¼, 2:19¼, 2:22, 2:22, 2:19¼, 2:20½.

No. 9, 2:15 class, trotting; purse, \$500.—Number entries, 5; entrance paid, \$225; purses paid, \$500. Time, 2:19½, 2:18½, 2:19¼.

No. 10, 2:22 class, pacing; purse, \$500.—Did not fill.

Friday, September 15th.

No. 11, 2:13 class, pacing; purse, \$500.—Number entries, 7; entrance paid, \$275; purses paid, \$500. Time, 2:14¼, 2:12¼, 2:12¼.

No. 12, 2:24 class, pacing; purse, \$500.—Number entries, 9; entrance paid, \$325; purses paid, \$500. Time, 2:20¼, 2:20¼, 2:21¼, 2:20¾, 2:20¼.

No. 13, 2:35 class, trotting; purse, $500.—Number entries, 9; entrance paid, $325; purses paid, $500. Time, 2:25¼, 2:20½, 2:21¼.

Saturday, September 16th.

No. 14, 2:35 class, pacing; purse, $500.—Number entries 5; entrance paid, $225; purses paid, $500. Time, 2:17¼, 2:15¾, 2:18¾.

No. 15, free-for-all class pacing; purse, $500.—Did not fill.

No. 16, Michigan bred and owned, three-year old class, trotters; purse, $300.—Did not fill.

No. 17, Michigan bred and owned, three-year old class, pacing; purse, $300.—Number entries, 2; entrance paid, $60; purses paid, $225. Time, 2:21½, 2:24¾.

Additional entrance money was received as follows:

Clarence B.	$12 50
Dingline	15 00
Royal Regent	25 00
	12 50
There was paid the secretary for Hal Sphinx	15 00
There was paid the secretary for Johnny Schmoker	25 00
Total entrance paid	$3,315 00

The total expenses of the department including care of track during the fair:

Paid in purses	$5,725 00
Other expenses charged	690 96
	$6,415 96

A balance sheet showing the actual financial cost of the department would show as follows:

Total cost of the department		$6,415 96
Receipts, entrance paid	$3,315 00	
Receipts, pool and score card	970 00	
One-half day receipts grand stand	2,900 00	
		7,185 00
Balance to credit of department		$769 04

H. H. HINDS, Supt.,
GEO. S. WARD, Clerk.

The report was received and referred to the finance committee.

The Superintendent of the Sheep Department reported:

To the President and Members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—I have the pleasure to report that the year of 1905 has been one of most successful and satisfactory results in the sheep industry. The exhibit at the state fair, held on the Detroit grounds, for the year as above stated, has been all that could have been expected or asked. The classes were well filled with animals of high quality which speaks well for the intelligence and ability of the breeder, eliciting expressions of admiration from the visitors, all of whom seemed to be in good spirit and well pleased with the prospects of the future.

The exceptional high prices for both pure bred and grade animals, has given to the breeder an encouragement and an impetus to the sheep business generally, which makes a year of great success.

I regret to state that there was much disappointment and anxiety by the failure of the judge on Middle wools to appear for his work, according to agreement, delaying the work until the last of the week, but thanks to the patient breeders who came to my relief and cheerfully consented to press into service an old breeder who reluctantly consented to help us out with ability and fairness, giving general satisfaction.

The number of entries was 763; amount of awards, $3,020.

For a more detailed statement I refer you to the report of the secretary on same matter.

All of which is most respectfully submitted.

H. R. DEWEY,
Superintendent of Sheep.

Dated, Detroit, January 9, 1906.

Report received.

The Superintendent of the Swine Department reported:

Mr. President and Members of the Executive Committee:

Gentlemen—As superintendent of swine, I beg leave to report as follows:

The exhibit as a whole was very good and the judging passed off very pleasantly.

All of which is respectfully submitted.

GEORGE KELLY,
Superintendent of Swine.

Report accepted and placed on file.

The Superintendent of the Poultry Department reported:

To the President and Board of Directors of Michigan State Agricultural Society:

Gentlemen—As superintendent of poultry department, I beg leave to submit the following report:

The entries in this department were about 1,200. I was somewhat crowded for space but all exhibitors seemed to be willing to make the best of the situation and did all they could to assist me and all seemed pleased with the judging.

I think there ought to be a building erected for the poultry exhibit, as all the farmers in the State are interested in poultry and the people of the towns and cities of the State are more interested in poultry than any other agricultural exhibit at the fair.

I also wish to present to the board a petition signed by fifty-nine exhibitors asking that a suitable building be erected for the poultry exhibit this year, which I hope you will give favorable consideration.

GEORGE G. WINANS,
Superintendent of Poultry.

The report was accepted and referred to the business committee.

The Superintendent of Farm and Garden Products reported:

To the President and Members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—As superintendent of farm and garden products, I beg to report as follows:

The exhibit in division F, class 48, was fully up to former years, but is being monopolized by one or two exhibitors and is having a bad effect and should be remedied in some way.

Class 49 was very well filled and some very fine specimens of roots and vegetables exhibited.

Class 50, special county exhibit, was away ahead of anything we ever had in that class before and a very keen interest was taken in the several county exhibits by the visitors at the fair.

All of which is respectfully submitted.

JOHN MARSHALL,
Superintendent of Farm and Garden Products.

The report was accepted and referred to the committee on premium list.

Report of the Superintendent of the Dairy Department.

To the President and Members of the Michigan Agricultural Society:

Gentlemen—It is my privilege to bring before this body a few suggestions for your careful consideration.

The dairy department, housed in a spacious tent, was a decided success both in regard to exhibits and attendance, and I feel assured that our next year's fair will excel the past.

One novel feature which proved a very attractive as well as instructive department of our dairy exhibit was the "exhibits" given by the State Dairy and Food Commission and the Detroit Board of Health. This exhibit enabled the people of the State of Michigan to see the workings of the State laboratory and gave them an opportunity of having their own dairy products tested or analyzed, thus giving all an opportunity of seeing just how the board detect impurities and defects in the dairy products. This was greatly appreciated, as many throughout the State brought their own samples to be tested, and after knowing just the real merit of their product could return to their respective homes to profit by instructions here obtained.

I should recommend that on all exhibits for which there is no premium that medals or diplomas be awarded. The reason for this suggestion is that all manufacturers of dairy supplies and sundries come from great distances and are under considerable expense. At the time of departure they have nothing to show as to the standard of their own articles. If these goods could be properly classified and rated, I think it would be a great incentive for more manufacturers to attend the fair and display their respectives wares, feeling that they would know at least just how their goods compared with the majority.

The judging of the dairy exhibits was done by the courtesy of the State Dairy and Food Commission, which proved very satisfactory to those interested.

I should recommend changing the premium on creamery butter from $90 to $100, and adding a new class in cheese to be known as "Soft

Michigan," and reducing the premium on "Cheddar" cheese to $45; Michigan cheese to $45; Soft Michigan to $45, and Young America to $10.

Bee and Honey Department.

I recommend that the premiums for this division be increased and the classification changed so as to make it most attractive to the general public, at the same time demonstrating the magnitude of the industry. Also the attracting of exhibits from the smaller bee keeper is kept in mind.

That special attractions be used in the way of lectures, etc., on bee keeping, and that these be advertised in the premium list.

As a closing suggestion and one which I consider as important as any, I would recommend that a uniform time should be slated for the moving, tearing down or in any way disturbing any of the exhibits at the fair, and such time should be one and the same time for all departments.

By establishing this precedent it will prevent any one department being disrupted before the entire fair is at its close.

The report was accepted and referred to the premium list committee.

The Superintendent of Vehicles reported:

To the President and Members of the Michigan State Agricultural Society:

Gentlemen—As superintendent of the carriage and vehicle department, I am pleased to report a very satisfactory showing. While not as many exhibitors as in previous years, those that did, exhibited on a much larger scale, therefore making a very satisfactory showing.

I have the promise of many more new and old ones this year, and would ask for one block to be added to the carriage department on the north side. During our last exposition I was obliged to call upon friend Hoffman (superintendent of machinery) to help me out for space.

Respectfully yours,
J. E. RICE,
Superintendent Vehicles.

Report received and referred to the business committee.

Superintendent of Farm Implement and Machinery reported:

Mr. President and Members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—As superintendent of the farm implements and machinery department I wish to report a large number of exhibitors, about 100, and I do not remember ever seeing a greater variety of implements on the state fair grounds since I have been connected with this fair. I required about forty acres of space to accommodate them.

Respectfully submitted,
JOHN A. HOFFMAN,
Superintendent Farm Implements and Machinery.

Report accepted.

Superintendent of Needlework Department reported:

To the Executive Committee:

Gentlemen—

I paid out for help	$118 05
Amount of premiums offered	424 00
Amount of premiums awarded	293 00
No. of entries	515 00

I recommend that the premium list be revised and that it be distinctly understood that in no case a premium be awarded for any article in excess of the value of the article itself.

WM. DAWSON,
Superintendent of Needlework.

Report received and referred to the premium list committee.

The Superintendent of Art Department reported:

Port Huron, Mich., January 1, 1906.

To the Officers and Members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—As superintendent of art, state fair, held at Detroit, Mich., September 11 to 16, inclusive, 1905, I submit to you my report of division N, class 60, 61 and 62, entry number 1,298 to and including 1,448. Total number entries, all classes, 400.

We were favored with a very fine loan exhibit from some of the best artists in the State as well as outside, and the best class of work, which added largely to the display. For this we are under obligations to Prof. A. H. Griffith, Miss Clara Dyar and Miss Helen Plumb of Detroit.

While the total expenses in this department were larger than previous years, I believe the unusual expenditure has so distributed knowledge of the department among the people of the State that the benefits will extend to the present and even succeeding years, which I believe its value will warrant the extra expense.

We are also under obligations to the citizens' state fair committee, of Detroit, to Prof. Carlo Remanelli and the citizens of Detroit, for the presentation to this department, the busts of J. L. Hudson, chairman of the citizens' committee, and I. H. Butterfield, our secretary, and the tablet to his honor, George P. Codd, mayor of the city of Detroit.

I have no special recommendations to make at present.

All of which is respectfully submitted.

BYRON E. HALL,
Superintendent of Art.

Report received and referred to the business committee.

No report was received from the Horticultural and Needlework Departments.

Superintendent Main Building and Concessions reported:

Officers and Members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—As superintendent of concessions for the fair, 1905, I would submit the following report:

The total receipts from all sources of the department were $8,764.30.

The concessions can be classified as: Concessions for which the society furnished shelter; concessions working on percentage basis, and the miscellaneous concessions for which the grantee pays cash at a fixed rate of price per foot frontage.

We furnished shelter in grand stand for:		
Swan & Norton	$2,000 00	
Geo. Young	770 00	
Jordan & Bernstein	200 00	
Dan O'Connor	100 00	
C. A. Everett	30 00	
		$3,100 00
In dining hall for:		
Swan & Norton	$500 00	
Main Building, 61 concessions	651 80	
Check room tent	82 77	
Dairy tent, dairy lunch, Lawrence Snell	50 00	
		1,284 57
Total from concessions furnished shelter		$4,384 57
Concessions on per cent basis:		
H. A. Kline, tent shows	$796 23	
Sign writing	42 89	
Anderson Lumber Co.	35 25	
Detroit Lumber Co.	16 00	
Berger & Anderson, photos	6 00	
Johnson Tent Co.	5 65	
J. C. Goss Tent Co.	32 65	
Barber shop	20 00	
		$954 67
One hundred and nine miscellaneous concessions, the society furnishing ground only	$3,402 26	
Collection from sale of old material	22 80	
Total receipts from the department		$8,764 30

These receipts total an amount double those of any year in the history of the society except the last year held on the old exposition grounds in this city, where, with a ten day's fair, the South Sea Islanders and other World's Fair attractions, the receipts reached a little over $8,000, but not as high even then as last year.

It was the intention of your superintendent to entirely eliminate the gambling game feature from the grounds and so far as known nothing of the kind existed.

The amusements furnished by the vaudeville shows were of a varied nature intended to please the public in general, how well they succeeded is shown in receipts several times larger than we have ever before received from a similar source. The receipts from this class of concessions and from allowing gambling should have been increased to over $20,000 had we allowed all who wished to work in these lines to enter.

The concessions working on percentage, other than the shows, were concerns who came to do work for or furnish material for exhibitors or other concessionaries, as the lumber companies, tent and awning people, sign writers, etc. The recipts from these firms are small but we believe the only fair basis for charging them a fee is a certain percentage upon the amount of business they do.

The miscellaneous, general stand people, the people who put a sandwich into the multitude here, a glass of red lemonade there, bedeck therein with glittering jewels and eye glasses in another place, were very much in evidence, but so far as known the multitude still survives and is ready to try it again.

The displays in the main exhibition building were very fine considering the fact that the building was not entirely completed when the exhibits began to arrive. No objection was made whatever to charge for floor space and a building of much greater capacity could have been filled.

Many concessions that could be worked in this building, if there was room, were kept away all together because of lack of shelter.

Respecfully,

F. E. SKEELS,

Superintendent.

Report received and referred to the finance committee.

The Superintendent of Gates reported as follows:

To the President and Members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—Being superintendent of gates, I make the following report: I employed 22 men to take tickets, that included Grand stand and airship men. Paid $3 per day and $1 for evening labor, making $4 per day, and railroad fare at excusion rates making a total of $507.07.

Owing to the fair not closing until Saturday evening, and employing more help, made my pay roll larger than in 1904.

All of which I respectfully submit.

W. P. CUSTARD,

Superintendent of Gates.

Report received and placed on file.

Superintendent of Police reported:

To the President and Members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—As superintendent of police, I submit the following report: On account of the diversity of opinion of the fair managers as to what would be recognized, I came to the fair, 1905, unprepared to fulfill the duties pertaining to this department, which later developed. With the able assistance of Sheriff Burns and his regular deputies, also Detective Troy, from the auditor's office, good order was maintained throughout the fair.

Would recommend that the fence enclosing the fair grounds be so improved that less men would be needed to guard against fence jumping. An arm extending out from the top of the post 18 or 20 inches, strung with three barb wires and well secured, I think would save two-thirds the men now required and be more satisfactory, also that no man be employed unless he remained through the day, as the eight hour system as practiced in Detroit, caused confusion and annoyance and was detrimental to the society.

Total number of men employed	40
Total cost to the society	$747 47
Fines collected	90

Respectfully submitted,

E. W. HARDY,

Superintendent of Police.

Report received and referred to the business committee.

The business committee presented claim of Martin Kennan for damages for loss of potatoes on exhibition at the fair. On motion the claim was not allowed.

The secretary presented a protest of A. D. Benham against award of second premium in lot 11,712, county exhibit of fruit. The protest was referred to the incoming executive committee.

Ajourned to Wednesday, January 10th, at 9 o'clock.

Wednesday, January 10th, 9 o'clock a. m.

Committee met. Roll called. Quorum present. Minutes of the last meeting read and approved.

On motion the reference of protest of A. D. Benham to the incoming officers was considered. Prof. Taft who was judge in that class made some explanations regarding the same.

On motion the award as made to Mr. C. T. Bartlett was sustained.

The Treasurer reported as follows:

To the Members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—I herewith present my report as treasurer of this society for the year of 1905.

Balance on hand January 9, 1905	$17,005 23
Received from general admission	51,847 65
Grand stand	11,599 25
Air ship	906 00
Privileges	8,764 30
Secretary	4,779 78
Speed	3,350 00
Railroad coupons	8,358 50
Miscellaneous	25 90
Detroit citizens' committee	35,000 00
Union Trust Co., sale of bonds	85,000 00
Kalamazoo National Bank	15,000 00
	$241,636 61

Expenditures:

Paid on premium orders	$14,415 38
Paid on business orders	225,619 31
	$240,034 69
Balance on hand	$1,601 92

All of which is respectfully submitted.

C. W. YOUNG,
Treasurer.

We, your committee on finance, beg leave to report that we have made a careful examination of the treasurer's account as rendered, checking up all stubs and receipts and find the account as rendered to be correct and recommend its adoption.

JOHN McKAY,
M. P. ANDERSON,
WM. DAWSON,
Finance Committee.

Report accepted and adopted.

The chairman of the finance committee was instructed to destroy the tickets on hand, both used and unused.

The Finance Committee reported as follows:

To the President and Members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—We, your committee, to whom was referred the reports of the secretary, business committee, treasurer, speed and concessions, beg leave to report that we have made a careful examination of all vouchers and stubs and find the different reports to be correct as reported.

In the matter of superintendent of concessions the stubs were checked up to the amount of $8,170.83 on September 19th, since then he reports the loss of the stub books. The $8,170.83 was for concessions sold and paid for in full, in accordance with the stubs at that time. He also informed the committee that there were some unsettled concessions on the percentage plan.

We find no numbers upon the concessions issued and would recommend that numbers should be both on the concession and the stubs.

The total amount paid to the treasurer, $9,764.25, shows that the unsettled concessions at date of September 19th, amounted to $593.42.

Respectfully submitted,

JOHN McKAY,
M. P. ANDERSON,
WM. DAWSON,
Finance Committee.

The report was accepted and adopted.

Mr. John A. Hoffman presented his resignation as member of the executive committee.

Mr. President and Members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—I herewith present to you my resignation as a member of the executive committee of this society to take effect immediately.

Respectfully,

JOHN A. HOFFMAN.

The resignation was accepted.

Mr. W. P. Custard presented his resignation as member of the executive committee.

To the Executive Board of the Michigan State Agricultural Society:

Gentlemen—I hand you my resignation as member of this board to take effect at once. Please accept and oblige.

Yours respectfully,

W. P. CUSTARD.

The resignation was accepted.

Mr. Fifield made remarks as follows:

Gentlemen—I have been with the Michigan State Agricultural Society for twenty years and one year as president. I have labored hard to make the society a success and must admit that at times we have been very blue and thought that this society would not exist.

Thanking you gentlemen for the courtesy you have given me for the past twenty years, I retire, turning this office over with thanks to the entire committee.

On motion, adjourned, sine die.

The officers elect for 1906 met at the Griswold House, Detroit, on Wednesday, January 10th, at 10 o'clock p. m.

Roll called and the following answered to their names: Messrs. Postal, Baldwin, Butterfield, McKay, Stevenson, Boyden, Dawson, Rice, Snell, Kelly, Winans, Galbraith, Powell, Doherty, Terney, Ransford, Aitken, Taft, Collier, Hall, Rich, Anderson, Fifield. Absent—Horton, Palmer, Howland.

President Postal delivered his address as follows:

PRESIDENT'S ADDRESS.

Gentlemen—I realize that I have been greatly honored in being elected president of the State Agricultural Society of the State of Michigan, and I desire at this time, upon assuming the duties of the office, to earnestly assure you and the people of the State of Michigan that my best time and efforts will be always at the disposal of this society, to upbuild it and make it ever more and more important along the lines for which it was founded, namely: A fair for the agricultural interests of the State. I believe that there are in the minds of certain friends of this society some misgivings as to the course its officers will follow now that the fair is permanently located at Detroit. For the benefit of these, I would state that so long as I am president of this society, my first efforts will be to improve our fair as an agricultural exhibit, of which neither the patronage nor the influence shall be local or confined to any section of the State. I wish to see the Michigan state fair reach out to every corner of the State of Michigan and beyond; from our neighboring states and from Canada we should be able to draw exhibitors and spectators in substantial numbers without departing from our policy of making the fair primarily an agricultural exhibit.

In considering the new duties devolved upon the president of this society, I have been led to believe that the details of the management of the society require your serious consideration, and I desire to present a few suggestions that have occurred to me.

I would recommend a radical change in handling the finances of the society. I am credibly informed that for the year 1904 no written reports have been made to your business committee or your executive committee concerning the receipts from concessions and privileges; and for the year 1905 no detailed reports of the superintendent of concessions has been furnished the business committee and said committee has no knowledge as to receipts from concessions, privileges and contracts pertaining to his department. It has also been stated by those who assume to know the facts, that it has been the custom of the superintendent of concessions and privileges to deposit all his receipts in his own name in any bank of his own choosing. If my information in regard to either or both of these conditions is true, I would urge upon you to adopt regulations which will prevent such loose business methods. Therefore, I believe that the office of superintendent of concessions and privileges should be abolished. The duties of the superintendent are so multifarious and his authority so far-reaching and important that they should be placed in the hands of the business committee and the president of the society, to whom all persons connected with this work should be responsible or directly report.

In looking over the different officers and superintendents to be appointed by your president, I find a chief marshal and a superintendent of police, and it occurs to me that the duties of these officers could be combined under one head and prove more efficient and economical than by having two officers. Therefore, I recommend that the office of superintendent of police be abolished and the duties heretofore performed by the superintendent of police be performed by the marshal, and that we have no such officer as superintendent of police.

I am also informed that the treasurer of the society has in the past deposited the moneys of the society in his own name and that he has been given the right to draw the interest on such funds for his own use and benefit. The simple statement of this condition, I am sure, will be sufficient to have such an improper and unbusinesslike practice stopped at once. The money of the society should be placed to the credit of the society and the treasurer should be required to file a proper bond guaranteeing the society against loss. If the salary of the treasurer is not sufficient, it should be made so. And in this connection, I would say that the society has been very lucky and is to be congratulated upon its good fortune in having had for many years a treasurer who has been absolutely honest. My criticism is not directed against any individual, but against the method.

At the close of the fair of 1905 bills amounting to hundreds of dollars were presented for payment, and neither the president, secretary, nor any member of the business committee had any knowledge of the same. To prevent the possibility of loss from the repetition of such a condition, I would recommend that the secretary procure proper order blanks, and that all orders for supplies, or other matter which in any manner would cause any financial liability to this society, must come through the office of the secretary, and that no officer be permitted to create any financial liability against this society except upon the written order of the secretary, issued upon request of the proper officers. It must occur to you that unless some such system is adopted the society is liable to have improper bills presented.

In visiting the officers of other fair associations, I learn that our premiums are lower than those of nearly all other fairs, and I desire to call the attention of the premium committee to this fact and to recommend that so far as possible our premiums be increased, particularly in the stock and agricultural classes.

While at Toronto for the purpose of securing what information might be of assistance to me as your president, I learned that it was the practice of the Toronto Exposition Society for a limited time to sell tickets at a reduced rate, and the past year, before the gates of the fair were opened, they had sold and received on same $35,000; thus assuring the financial success of the fair for 1905. Therefore, I would recommend that you authorize your president and business committee to take such steps and proceedings as they deem best for the year 1906 and to sell such tickets in advance and at such price as they shall deem for the best interests of the society, such sale of tickets to close the Saturday preceding the opening of the fair.

I would recommend that the committee on rules make a careful revision of the by-laws and rules of the society, eliminating obscure and useless rules and substituting changes in acordance with improved methods as indicated by experience and observation.

I understand that for some years some attention has been given in the premium list toward aiding the newer counties of the State by offering premiums for county exhibits of agricultural products from those counties, and that the people of some of those counties have taken such interest in this matter as to make appropriations through their board of supervisors to aid in making such exhibits at the state fair.

I recommend that these premiums be continued on a liberal scale with the purpose in view of aiding in every way possible the development of the northern portion of our State.

In addition to what may be done for the upper peninsula in the direction of agricultural exhibits, I would suggest that steps be taken to secure from that section a creditable mineral exhibit at the fair of 1906, and that such a department be created with a superintendent, as in other departments.

Now that this society has a permanent home and during the past year has built and placed upon the grounds of the society a number of very costly and beautiful buildings, it occurs to me some steps should be taken at once with a view of beautifying and improving the appearance of the grounds so that they will be in keeping with the location and general appearance of the buildings. Therefore, I would recommend that the business committee do all they possibly can along this line during the coming year.

Respectfully submitted,
FRED POSTAL,
President Michigan State Agricultural Society.

The president appointed the following standing committees:

On Rules—Galbraith, Terney, Dawson.

Premium List—Stevenson, Butterfield, Powell, Collier, Taft, Terney, Kelly.

Finance—Doherty, Fifield, Aitken.

On motion of Mr. Aitken the president was requested to appoint a committee of three to whom the address of the president be referred for consideration and reference of recommendations to proper committees.

The president appointed as such committee: Messrs. Terney, Winans and Boyden.

On motion, a recess was taken for twenty minutes.

After recess. Called to order by the president.

The committee on president's address reported as follows:

We, your special committee, to whom was referred the president's report, recommend that that part of the report on page two treating of superintendent of concessions and privileges be referred to the committee on rules and regulations, also that the recommendation on page two referring to the office of marshal and chief of police.

We further recommend that part of the report commencing on page two and continuing to page three relating to the office of treasurer and depositing of moneys be referred to finance committee.

We further recommend that part of report on page three suggesting an increase of premiums be referred to committee on premium list.

We further recommend that that part of report on page four referring to the sale of tickets in advance be referred to finance committee.

We further recommend that that part of report on page four suggesting changes in rules, etc., be referred to the committee on rules.

The balance of the report relating to suggestions on county exhibits, etc., be referred to premium committee.

And that part of report on page five, suggesting improvement of grounds be referred to the business committee.

All of which is respectfully submitted,

W. J. TERNEY,
GEO. G. WINANS,
W. E. BOYDEN.

A recess was taken until 1 o'clock p. m.

One o'clock p. m., January 10th, the executive committee convened.

Mr. John McKay having been elected treasurer, presented his resignation as member of the executive committee.

Detroit, January 10th, 1906.

To the Michigan State Agricultural Society: Mr. President and Executive Committee:

Gentlemen:—Please accept my resignation as member of the Executive committee, to take immediate effect.

JOHN McKAY.

The resignation was accepted.

The finance committee reported as follows:

To the Executive Committee of the Michigan State Agricultural Society:

Gentlemen:—Your committee on finance, to whom was referred that part of the president's address relative to deposits of funds belonging to the society and sale of tickets previous to the fair, would respectfully recommend that all deposits of funds be made in the name of the treasurer of the Michigan State Agricultural Society, in such banks of the city of Detroit as shall be recommended and designated by the business committee. On the question of selling tickets prior to the opening of the fair, your committee would ask for further time.

Respectfully submitted,
A. J. DOHERTY,
EUGENE FIFIELD,
D. D. AITKEN.

The report was accepted and adopted.

On motion of Mr. Aitken the president was requested to designate the names of two persons whom he desires elected members of the business committee.

On motion of Mr. Fifield, a committee of five was appointed by the president, to nominate suitable persons to fill the vacancies existing on the executive committee.

The president appointed as such committee: Messrs. Fifield, Doherty, Taft, Collier, Powell.

A recess was taken for ten minutes.

Convened after recess.

The committee on nomination for vacancies on executive committee reported as follows:

Gentlemen:—Your committee to report three names to the executive beg to report the following names: Mr. J. F. Brand, Saginaw, Mr. Comfort A. Tyler, Nottawa, Mr. Jason Woodman, Paw Paw.

Respectfully submitted,
EUGENE FIFIELD,
A. J. DOHERTY,
H. E. POWELL,
W. W. COLLIER,
L. R. TAFT.

The report was accepted, and on motion, the persons named were unanimously elected members of the executive committee.

The committee on by-laws and rules reported a revision of the by-laws as follows:

BY-LAWS.

No. 1. The annual meeting of the executive committee of this Society shall be held, commencing on the second Monday in January in each year at 8 o'clock p. m., of that day, and at such place as the president shall appoint; and the president shall notify the secretary at least two weeks before the day of the meeting of the place where the meeting will be held and the secretary shall give to each member of the executive committee ten days notice by mail of the time and place of the meeting and also send a copy of such notice to at least five leading papers of the State.

No. 2. The president of the society shall preside at all meetings of the executive committee or of the society at which he may be present, but he may call the vice president or any other member to the chair in his discretion.

In the absence of the president the vice president shall preside, and if both the president and the vice president are absent such member of the committee as shall be chosen, shall preside.

No. 3. At each annual meeting of the executive committee there shall be appointed by the president, standing committees as follows:

a. Finance committee of three members.

b. A committee on by-laws and general rules of three members.

c. A committee on premium list and rules for exhibiting of five members.

d. A committee on reception of five members.

e. The president, chief marshal and business committee shall be a committee on program and exercises during the fair.

f. The business committee constituted as directed by the constitution.

The president of the society shall be ex-officio a member of each of the foregoing committees, in addition to the other members. Special committees shall be appointed by the executive committee as may seem best, and charged with duties as the executive committee may order.

GENERAL RULES OF COMMITTEES.

No. 4a. The finance committee shall provide for and take charge of all admission tickets, except complimentaries, before the beginning of the fair; opening an account with the treasurer and charging him with all tickets delivered to him and giving him credit for all tickets unsold and returned to the committee by him. The superintendent of gates, shall at the close of each day, turn over all tickets taken at the gates and grand stand, to the finance committee who shall have custody of same. The committee shall file with the secretary and the treasurer at the close of the fair, or as soon thereafter as the count can be completed, a statement of the amount charged the treasurer on account of admissions, grand stand and all other receipts and the number of coupons issued by each railroad or transportation company which have been received, and shall also make a full report to the executive committee at its annual meeting, of the number and value of all tickets received and all other receipts reported.

The reports of the secretary, treasurer and the business committee and all other financial reports shall be referred to the finance committee who shall examine the same and report to the executive committee at such time as the executive committee directs.

b. The committee on rules shall at each annual meeting of the executive committee report on revision, amendment, or changes in the by-laws and general rules and regulations if deemed advisable, and all reports and recommendations relating to rules shall be referred to this committee who shall report on the same to the executive committee. All rules relating to classification, arrangement or condition of exhibits shall be within the province of the premium list committee to report to the executive committee.

c. The committee on premium list shall at each annual meeting consider the revision of the premium list and report to the executive committee when directed.

d. The committee on reception shall look after the entertainment of guests of the society, and the general reception of strangers and others who may call at the headquarters.

e. The committee on program shall arrange the order of exercises during the fair, the order of judging in consultation with the several superintendents as to their respective departments, and have charge of all public exercises. This committee shall arrange for one or more live stock parades during the fair.

It shall have charge of the grounds and buildings, and all other property of the society (except the money in the hands of the treasurer) and shall properly care for the same, and of all business transactions of the society, including rents and privileges, being subject to the instructions of the executive committee and the constitution and by-laws of the society.

It shall keep a record of all accounts allowed, and shall allow no accounts except such as show the items and appear to be correct and duly authorized.

It shall make a full report to the executive committee at its annual meeting of all accounts allowed and paid, and of all business transactions during the year, and shall prepare an inventory of all property on hand belonging to the society which inventory shall be a part of the annual report.

The business committee with the president may issue complimentary tickets in such form and number as in their discretion may seem best for the interests of the society.

No. 5. The president shall appoint a chief marshal, also a superintendent of each department of exhibit and administration as follows: Cattle, horses, speed, sheep, swine, poultry, agricultural products, dairy and apiary, farm implements and machinery, vehicles, miscellaneous and manufactured goods, art, needlework, horticulture, school work, gates, mines and minerals. Such appointments to be confirmed by a vote of the executive committee. The chief marshal shall be superintendent of police during the fair and shall also have charge of the seating and preservation of order on the grand stand. Superintendents of departments may, with the consent and approval of the president and business committee in writing, appoint such assistants and employes as may be necessary for the proper management and control of their respective departments. The compensation of such assistants and employes shall be fixed by the president, business committee and superintendent of each department. Pay rolls for help in each department shall be presented by the superintendents giving the names, character of work, time employed and the rate of compensation, which pay roll shall be certified by the superintendent, to the secretary, and when approved by the business committee the secretary shall pay the account, drawing an order on the treasurer for the proper amount to cover the same, which order shall be approved by the chairman of the business committee in the usual manner.

No. 6. Superintendents of departments of exhibits shall have headquarters at the buildings and places designated for the exhibits in their several departments from Friday morning of the week before, and during the fair, for the purpose of arranging exhibits and caring for the same. They shall have charge of the arrangement of exhibits and their exhibition, and the interpretation of rules for their department, and the decision of the superintendent shall be final, subject to an appeal to the executive committee.

The president and business committee with the superintendent of each department shall select the necessary judges for that department and fix the compensation of the same, and the superintendent shall certify a bill for the expenses of said judge or judges to the business committee, which bill shall be charged to the department where the services are rendered.

It shall be the duty of each superintendent in charge of a department at the annual fair of the society, to send to the secretary within ten days after the fair, a written report upon the exhibits and conduct of his department with such recommendations as he may desire to make, such reports to be a part of the proceedings of the society. The chairman of each standing committee shall also report, within ten days after the close of the fair on the work of his committee during the year. Such reports to be a part of the proceedings of the executive committee. The secretary shall furnish to the president, at his request, copies of such reports.

No. 7. The secretary and the treasurer shall each give bonds, at such times and in such sums as shall be determined by the executive committee in compliance with article 13 of the constitution, and all other persons authorized to receive money for the society shall give bonds in such sums as the executive committee may direct.

No. 8. The secretary of the society shall act as secretary of the executive committee and also of the business committee and shall perform such duties without additional pay other than his salary. In case of his absence, inability or refusal to act, the committee or either of them may appoint a secretary pro tem., the expense to be deducted from the salary of the secretary.

No. 9. The secretary shall sell membership tickets to persons who wish to become members of the society and at the close of the fair he shall report the number sold to the finance committee.

No. 10. No pecuniary consideration or inducement other than the premiums offered shall be paid to exhibitors entering for premiums.

No. 11. Except for legitimate expenses of members of the executive committee no obligations against the society shall be created by any officer of the society or member of the executive committee without an order from the president or chairman of the business committee, and all orders for supplies or materials, etc., shall be given in writing by the secretary who shall keep proper order books for such purpose.

No. 12. All moneys received by any officer or member of the executive committee belonging to the society shall, as soon as practicable, be paid over to the treasurer and his receipts taken therefor and at the same time such officer or member shall report same in writing to the chairman of the finance committee, and a report of such receipts and payments shall be made by each officer as well as the treasurer, to the executive committee at the annual meeting. For all money paid on behalf of the society a duplicate itemized voucher shall be made which shall be certified by the officer ordering the expense and approved by the business committee, and attached to each voucher shall be an order signed by the secretary and countersigned by the chairman of the business committee drawn on the treasurer for payment of the amount of said voucher. Said vouchers shall be consecutively numbered beginning with number one in each year.

No. 13. Except for investment and orders for premiums duly awarded, no orders shall be drawn on the treasurer, except on accounts duly audited and allowed by the business committee, and such allowance endorsed thereon by a majority of said committee. No funds for any other purpose shall be drawn from the treasury of the society except upon a majority vote of the executive committee.

No. 14. An appeal may be taken in all cases from the action of any standing or special committee or any superintendent to the executive committee, but the decision of such committee or superintendent shall be considered the rule governing the case until the executive committee shall otherwise order.

No. 15. In all cases where no other provision is made, the said executive committee shall be governed by the rules of parliamentary law, as laid down in Jefferson's Manual.

No. 16. The order of business at each meeting of the executive committee shall be as follows:

a. Calling the roll.
b. Reading and approving the proceedings of the last meeting.
c. Address and communications from the president.
d. Reports from executive superintendents.
e. Reports from standing committees.
f. Reports from special committees.
g. Hearing of appeals and considering same.
h. Unfinished business.
i. General business.
j. Motions and resolutions.
k. Notices.

This order of business may be suspended or changed, for that meeting only, by two-thirds vote of the members present at any meeting of the executive committee.

The premium list committee reported verbally through the chairman, that the committee had gone over the list carefully and would recommend that the classification on live stock be retained as at present with some few additions, adding in cattle a class for Brown Swiss and changing the classification of horses,—the double classification in cattle, sheep and swine to remain, provided the State appropriation for premiums be secured by the society. If not, that but one class be made for each breed. Second, that the premiums on cattle and horses be materially increased to the extent of about 25 per cent. That there be but one class for poultry to be confined to the State and that the premiums be increased. That the list for all other departments be revised and somewhat enlarged.

Mr. Stevenson moved that the premium list committee be instructed to prepare a complete report to be presented to the president and business committee with discretion to revise the list in accordance with the verbal report made and the president and business committee have full authority to adopt this report and incorporate it in the premium list.

Motion carried.

It was moved by Mr. Stevenson that the dates of the fair be August 30th to September 7th, inclusive. After full discussion the motion was carried.

It was moved that the amount of $7,600 be appropriated for speed purses, the schedule of races to be arranged by the president and business committee.

The salary of the treasurer was fixed at $400, the society to pay for the bond.

The salary of the secretary was fixed at $1,200 and the members of the business committee the same as least year, $300 and $100, respectively.

On motion, the bonds of all officers required was left to be fixed as to amount, by the president and business committee, the cost to be paid by the society.

Mr. Doherty moved that the business committee be authorized to incur obligations not to exceed fifty thousand dollars ($50,000) in new buildings and improvements on the grounds.

Carried on yea and nay vote as follows: Yeas—Messrs. Postal, Butterfield, McKay, Stevenson, Boyden, Dawson, Snell, Kelly, Winans, Galbraith, Powell, Doherty, Terney, Ransford, Aitken, Taft, Hall, Anderson, Fifield. Absent—Messrs. Baldwin, Rice, Horton, Collier, Palmer, Rich, Howland, Brand, Woodman, Tyler. Yeas, 19; nays, none.

It was moved that the business committee be instructed to make all closet and sanitary improvements permanent.

Carried.

The committee on finance reported asking further time on the recommendations of the president regarding advanced sale of tickets of admission with a request that the committee be authorized to report to the business committee and that committee have full power to act on the report.

Carried.

The president appointed standing committees and executive superintendents as follows:

Business Committee—A. E. Stevenson, Lawrence W. Snell, I. H. Butterfield.

Finance Committee—A. J. Doherty, Eugene Fifield, D. D. Aitken.

Reception Committee—John T. Rich, W. W. Collier, S. Baldwin, D. D. Aitken, Geo. B. Horton.

EXECUTIVE SUPERINTENDENTS.

Cattle—H. E. Powell, Ionia.
Horses, except speed—J. F. Brand, Saginaw.
Speed—W. J. Snyder, Detroit.
Sheep—W. E. Boyden, Bay City, W. S.
Swine—Geo. Kelly, North Branch.
Poultry—Geo. G. Winans, Hamburg.
Assistant Superintendent—Daniel Thomas, Pontiac.
Grains and Vegetables—W. J. Terney, Roscommon.
Dairy, Bees and Honey—Lawrence W. Snell, Highland Park.
Farm Implements and Machinery—Jason Woodman, Paw Paw.
Vehicles—J. E. Rice, Grand Rapids.
Main Building and Miscellaneous—C. A. Tyler, Nottawa.
Art—M. P. Anderson, Midland.
Needlework—Wm. Dawson, Sandusky.
Horticulture—L. R. Taft, Agricultural College.
Educational—Geo. B. Horton, Fruit Ridge.
Assistant Superintendent—Thos. M. Sattler, Jackson.
Mines and Minerals—W. J. Galbraith, Calumet.
Gates—B. Ransford, Caro.
Chief Marshal—Byron E. Hall, Detroit.

The president announced his desire to have Mr. A. E. Stevenson elected general superintendent.

A ballot was taken and Mr. Stevenson had 17 votes, the whole number cast.

The president announced Mr. Lawrence W. Snell as his choice for second member of the business committee.

A ballot was taken and Mr. Snell received 19 votes, the whole number cast.

Mr. Stevenson and Mr. Snell were called on and both addressed the committee.

The appointments of standing committees and superintendents were confirmed by unanimous vote.

President Postal made some remarks as follows:

Gentlemen—I have had the honor of being elected president of this society but this is only a temporary honor. I trust that the executive committee will be with me in helping to demonstrate to the people of the State that we can make a success of our fair of 1906, and honor will come later, but we will have to get together and I want every man on this board to help pull and make a success of this fair of 1906 and I think the society will suggest having the men pull with me.

I thank you for your kindness and will try and do my best to make a success of the Michigan state fair.

On motion, adjourned.

I. H. BUTTERFIELD,
Secretary.

MICHIGAN STATE GRANGE AND FARMERS' CLUBS.

REPORT OF MICHIGAN STATE GRANGE FOR THE YEAR ENDING JUNE 30, 1906.

During the past year the work of organizing has been carried on with the following results: Four county, or Pomona, thirty-nine subordinate and four juvenile Granges. The strengthening of existing Granges, by grounding them in more systematic and thorough following of the great lines of work recommended by State Grange, has been continued with gratifying results.

Contracts for the purchase of goods, made by the State Master, have been maintained with marked effect on general prices in the State for such commodities as have been more directly used. Especially is this true of binder twine and wire fencing. The problem of co-operative selling is being studied and some advance is being made in certain localities. Through the State Grange information bureau a large number of transfers of property of various kinds have been made between patrons and others to the mutual advantage of both.

The lecture hour is improving in general under the careful direction of the State Lecturer in conferences with lecturers, in bulletins and in personal correspondence. A quiet, but strong, current of educational uplift is thus kept active in hundreds of rural communities and in thousands of country homes.

In regard to the condition of the order at large and particulary in Michigan, Master G. B. Horton in his last annual address says:

"We should glean satisfaction from the fact that the order Patrons of Husbandry throughout the whole country is in a prosperous condition and that it is held in highest respect. Wherever its national meetings are held, officials of highest note, the public press, and the people in general are lavish in their favorable consideration and efforts to make welcome and to entertain. In our own State the order is progressive and is characterized by its good works. Farmers, their wives, and grown-up children take pride in being enrolled as members. The high standard of the Grange in our own State furnishes a conspicuous object lesson in proof of the saying, that we merit and gain the respect of others by learning to respect ourselves."

JENNIE BUELL,
Secretary.

MICHIGAN STATE ASSOCIATION OF FARMERS' CLUBS.

Report of the Michigan State Association of Farmers' Clubs for the year ending December 15, 1905.

Officers for 1906.

President—L. W. Watkins, Manchester.
Vice President—Mrs. Sarah Taylor, Novi.
Secretary—Mrs. Geo. H. Anton, Clyde.
Treasurer—Mrs. John Snyder, Fowlerville.

Directors.

L. D. Lovewell, South Lyon; Z. W. Carter, Lake Odessa; James B. King, Marshall; Rev. J. B. Reynolds, Hartford; Hon. W. A. Reed, Hanover; Frank Clark, Vernon.

This year of 1905 has not only written broadly upon the pages of international history but it has also marked another milestone in the steady advance of our club movement.

The work which our local clubs have done the past year proves to us that they are ready to add their strength toward the uplifting of this motto above the portals of our association. Loyalty and devotion to the farmers' clubs of Michigan. I think we may all be justified, if in our hearts we are just a little proud of being a part of this great organization, which has accomplished so much for the farmers in our State.

This system of reports, which we adopted last year, has more than repaid us for the time spent upon it. It has not only supplied us with data absolutely necessary to our life as an association, but it also binds and unites the clubs together with the invisible links of kindred interest and the common good.

In 1894 the State association was first organized with only thirty-five loyal male representatives from twenty clubs in the State. I can say that truly this little handful of men, "They builded better than they knew," since that date twelve associational meetings have been held and each in succession has shown a wonderful growth over its predecessor.

I feel that it would not be out of place to mention here the foundation that was laid at our annual meeting one year ago for "Memory Day," for better care of our rural cemeteries. The action of the State Association of Farmers' Clubs at this time was endorsed by the State Grange, this with every effort available being put forth by ex-President Danills and others for the establishing of memory day, has brought forth the desired results and "Memory Day," September 30th, has become a law.

Yearly report blanks were mailed to the secretaries of 194 clubs, also to others. I mailed 794 letters, 398 pamphlets of the annual meeting of 1904, 250 Michigan Primary Laws, 337 credential blanks, 366 programs, 82 local club constitutions and by-laws, 84 circulars, 36 constitution and by-laws of the State assosiation; 91 inquiries were received from different localities asking for information in regard to organizing new clubs, 49 as to joining the State association and club fairs; 162 active clubs are now on the revised membership roll, 20 more than was listed on the roll last year, four of these have been newly organized to date; two clubs have disbanded. The association has representatives in 35 counties of our State; 97 active clubs filled out and returned the yearly report blanks to me as requested, making the total yearly reports compiled from reports received to date as follows: Number of club members, November, 1904, 6,524; number of club members, November, 1905, 7,440, making an increase of 1,116 members during the past year; 973 club meetings were held with an average attendance of 46; 69 of these hold an annual picnic; 77 clubs use monthly programs; 20 yearly ones; 90 elect officers annually; 7 semi-annually; 71 discuss the associational question at their regular meetings; 37 deaths were reported from these clubs; there were still 65 clubs whose report did not reach me in time to be included in this report.

In presenting this report I have endeavored to make everything plain and I cannot but feel that it will be received with the same spirit of genuine pleasure which it gives me to present it, as I now return to you the trust you gave me in December, 1904. I wish to thank you for the honor conferred and feel that again at the expiration of another year I can return it to you as statistics show with a larger membership and an organization recognized everywhere as second to none in the interest of farmers.

MRS. GEO. AUTEN,
Secretary.

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