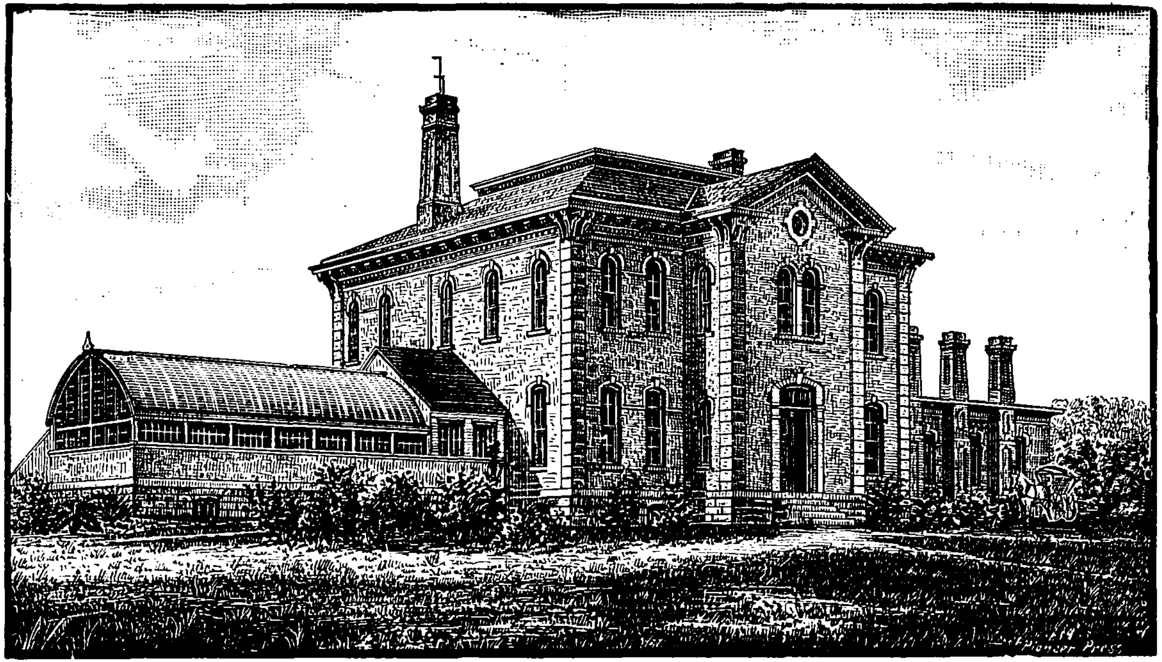


COLLEGE OF AGRICULTURE OF THE UNIVERSITY.

REPORT

OF THE

DEPARTMENT OF AGRICULTURE

OF THE

UNIVERSITY OF MINNESOTA.

EDWARD D. PORTER,
PROFESSOR IN CHARGE.

SUPPLEMENT I

TO THE

FOURTH BIENNIAL REPORT

OF THE

BOARD OF REGENTS.

ST. PAUL, MINN.:
THE PIONEER PRESS COMPANY,
1887.

CONTENTS.

1½

THE BOARD OF REGENTS

OF THE

UNIVERSITY OF MINNESOTA.

The board of regents is composed at this date of the following gentlemen:

The Hon. GREENLEAF CLARK, M. A., St. Paul........Term expires in 1889.
The Hon. CUSHMAN K. DAVIS, St. Paul.................Term expires in 1889.
The Hon. JOHN B. GILFILLAN, Minneapolis...........Term expires in 1888.
The Hon. KNUTE NELSON, Alexandria....................Term expires in 1887.
The Hon. JOHN S. PILLSBURY, Minneapolis...........Term expires in 1887.
The Hon. HENRY H. SIBLEY, St. Paul.....................Term expires in 1888.
The Hon. THOS. S. BUCKHAM, M. A., Faribault......Term expires in 1888.

AND EX-OFFICIO,

The Hon. LUCIUS F. HUBBARD, St. Paul,
The Governor of the State.

The Hon. DAVID L. KIEHLE, M. A., Minneapolis,
The State Superintendent of Public Instruction.

CYRUS NORTHROP, LL. D., Minneapolis,
The President of the University.

OFFICERS OF THE BOARD.

H. H. SIBLEY .... *President.*
D. L. KIEHLE .... *Recording Secretary.*
H. P. BROWN .... *Treasurer.*

EXECUTIVE COMMITTEE.

J. S. PILLSBURY, *Chairman.*
CYRUS NORTHROP, *Secretary.*
J. B. GILFILLAN.
D. L. KIEHLE.

COMMITTEE ON COURSE OF STUDY.

C. K. DAVIS.
GREENLEAF CLARK
CYRUS NORTHROP.

COMMITTEE ON AGRICULTURAL FARM.

J. S. PILLSBURY.
L. F. HUBBARD.
CYRUS NORTHROP.

COMMITTEE ON LIBRARY AND MUSEUM.

D. L. KIEHLE.
GREENLEAF CLARK
CYRUS NORTHROP.

AUDITING COMMITTEE.

THOMAS S. BUCKHAM.
J. B. GILFILLAN.

THE FACULTY

OF THE

COLLEGE OF AGRICULTURE.

CYRUS NORTHROP, LL. D.,
President.

EDWARD D. PORTER, M. A., PH. D.,
Professor of the Theory and Practice of Agriculture.

JAMES A. DODGE, PH. D.,
Professor of Chemistry.

JOHN F. DOWNEY., M. A., C. E.,
Professor of Mathematics and Astronomy.

WILLIAM W. FOLWELL, LL. D.,
Professor of Political Science.

CHRISTOPHER W. HALL., M. A.,
Professor of Geology, Mineralogy and Biology.

HARRY P. JUDSON, M. A.,
Professor of History.

GEORGE EDWIN MacLEAN, PH. D.,
Professor of the English Language and Literature.

HENRY F. NACHTRIEB., B. S.,
Assistant Professor of Biology.

WILLIAM A. PIKE. C. E.,
Professor of Engineering and Physics.

MARIA L. SANFORD,
Professor of Rhetoric and Elocution.

*

REPORT.

My reports for the years 1881 and 1882 having been presented more as memoranda than formal reports, were not included in the published documents of the university for those years, but as they are necessary to make a connected record of the work of this department I herewith introduce them.

COMMUNICATION TO THE BOARD OF REGENTS OF THE UNIVERSITY OF MINNESOTA, DEC. 22, 1881.

To the Honorable the Board of Regents:

GENTLEMEN. My connection with the university has been too recent, and the plans for the development of the department of agriculture not sufficiently matured to render a formal report advisable, but with your permission will present a synopsis of my work for the past season, and some suggestions for the future.

As there were no classes organized in my department requiring instruction, I devoted my time before spring in attending the meetings of all the recognized agricultural organizations in the State, such as the State Agricultural Society, State Horticultural Society, Amber Cane Association, Wool Growers Association, Dairymans Association, Grange organizations, and the State Forestry Association. Attendance upon these meetings and upon the sessions of the state legislature made me acquainted with the representative men of the State, in these several departments of argriculture, with their views and wishes as to the relations of their industries to the state university, and gave me an opportunity of meeting their objections and securing, I think, their earnest co-operation in our work. It is vitally important for the future of the department of agriculture that an intimate relation be secured and maintained with all these organizations, — such relations now exist. I have had the honor of membership in all of them, have served as the secretary and scientific expert in one of them for the past year, have been charged by all with the duty of perfecting a plan for the more intimate union of these societies in *one* state society, have been appointed by the State Agricultural Society, the State Horticultural Society and the State Amber Cane Association to represent their interests in the approaching national convention of agriculturists, called by Commissioner Loring at Washington in January next,—permission to attend which has been granted me by your executive committee. If this work meets your approbation it will be continued.

With the opening of the past season I commenced work on the experimental farm, but owing to the many adverse criticisms which I had heard from our best farmers as to its adaption for the purposes designed, and as I found the executive committee were doubtful as to the policy of retaining it, I limited my operations to clearing up the patches of underbrush, pruning the trees of the orchard, nursery and avenues, repairing the fences and implements, and testing the capacity of the farm in the production of the entire range of farm crops and garden produce. In addition to this general work, I conducted a series of comparative tests, with thirty-seven varieties of potatoes, thirty-four varieties of corn, and seven varieties of amber cane, with very satisfactory results. The gross receipts from the farm, for the season, in sales, produce on hand, and labor performed for other departments of the university, amount to about $1,400.

Early in the season I became convinced that the desolate and forbidding appearance of the portion of the university campus surrounding the college of agriculture rendered it very important to devise measures for its improvement. In view of the fact that a portion of the work had been authorized some years ago, and that cultivation of the grounds would be a necessary preparation for the reception of the new buildings contemplated, and that such cultivation and improvement could be rendered not only educational and ornamental but partially remunerative, I proposed to the executive committee a plan for making these waste grounds our experimental and exhibition horticultural grounds, embracing our plant and propagating houses, an arboretum for the growth and exhibition of specimens of every tree, shrub, plant, flower, and vegetable that can be grown in our

State, and nurseries for small fruits and seedling trees, to be propagated here, where we can insure the necessary conditions, and transplant to our farms for continued cultivation, thus furnishing the best practical training for our students in these several branches, beautifying these otherwise unsightly grounds, and, from its public exposure, cultivating a taste for horticulture among the masses, thus extending the usefulness of the university.

My reasons for this use of the grounds are, that at present they are useless and unsightly, and located as they are on the most important avenue to the city, and surrounding the agricultural college, whose province it is to especially attend to such matters, their further neglect would be a strong arugment against the utility of such a department. Again, such use of the grounds will be in the line contemplated by Mr. Cleveland, your landscape gardener, and receives his cordial approval. The work done here will do more to bring this department of the university before the public than double the amount elsewhere of the same kind, it will benefit the entire body of students in attendance, as well as the public at large, who receive as much benefit from such object lessons, and passive absorption as from didactic instruction. Again, this is the most suitable place for the location of such work, as we have there already our greenhouse, propagating house, laboratory, museum, lecture rooms and apparatus, and can there secure an abundant supply of water and fertilizing material, thus commanding two most important elements for success in our climate, and on *such* a soil. Having a market at our doors for surplus products of flowers, plants and vegetables we can make this department partially if not entirely self-sustaining.

These plans have been examined and indorsed by the executive committee and work commenced in their execution. With the approval of President Folwell and the committee, I secured in the fall the services of Mr. Jame Bowen as superintendent of the plant house, propagating house and ornamental grounds. Mr. Bowen was for two years in charge of the Chicago Botanical Gardens, four years at the famous Kew Gardens of England, and for six years in charge of the grounds and gardens of Phœnix Park, Dublin. He is most cordially indorsed by Mr. Cleveland, who knew him in Chicago. His work thus far has been highly satisfactory, and his practical skill and experience must prove a valuable acquisition to the university.

I have graded down the hills of drifting sand and filled up the unsightly hollows over a large portion of the grounds designed for cultivation, and covered them with over five hundred loads of stable manure, which we obtain in the vicinity for the hauling. This work will be continued until spring, whenever the weather will permit and our teams are at leisure. With the approval of the executive committee I have built an addition to our plant house sixteen by forty-six feet, and have it nearly ready for use. This will give us a much needed room at a comparatively small cost, and will double the working value of the green house, so necessary for class instruction in botany, vegetable physiology and practical horticulture.

In the line of theoretical agriculture, I have given instruction to two classes, the junior and senior of the regular undergraduate course of the college of agriculture, in the studies as prescribed in the calendar for the current university year, embracing "composition and physiology of plants," "meteorology and climatology," "soils and fertilizers," and "comparative anatomy and physiology." This instruction will extend throughout the year, in these and kindred subjects. I regret to say these classes are small, only ONE STUDENT in each, but as they are young men of character and ability, and expect to graduate in this college, we will hope for increased members in the future.

In addition to this class-room work, I have visited and addressed a number of farmers' clubs and organizations, in various portions of the State, and propose continuing this work, as time and opportunity will permit.

As the requisite number of names of persons not members of the university have been handed in, warranting the organization of a "*farmers' lecture course*," authorized by your board, such a course will be given, commencing Jan. 31, 1882, and extending through the month of February, and we hope this plan for interesting and benefiting the agricultural classes (long offered, but never called for) may be eminently successful.

In view of the work of the past season and the plans contemplated for the future, I beg leave to present the following suggestions:

First — The experimental farm.

The result of the season's work has compelled me to change my opinion as expressed at your meeting in June last. I thought then that it could be made to serve the purposes of the university as an experimental farm, but I am now convinced that it can not be made to do so, without an unwarranted expenditure of labor, time and money. The soil is poor and not a fair specimen of Minnesota farming land. It is either sand or a peat bog, not the diversity of soil or exposure required for an experimental farm. There is not an acre on the farm naturally adapted for the growth of wheat, corn, rye, oats or barley, or for fruit tree or forest culture.

Owing to the manner in which the farm is cut up by recently constructed railroads and avenues, it is impossible to divide it into suitable fields and plats for experimental work. Its proximity to the city exposes it to the trespasses, pilferings and depredations of the lawless classes always found in its vicinity. It has been almost impossible to secure matured products of either field, orchard or garden during the past season and this difficulty will increase with the growth of the city. Within a very short time the farm will be surrounded by a suburban population, whose demands for increased facilities for communication will require new streets and avenues to be opened up for their use, and our experimental farm will be left but a collection of detached building blocks.

For these reasons I would advise the early abandonment of the present farm and the purchase elsewhere of a more suitable tract of land, and the earlier such a change can be effected the better it will be for the interest of the university, as good locations are being devoted to other uses and are rapidly enhancing in value.

Second—While these changes in our experimental farm are being made I would devote the most of the time and expenditures thought best for this department to the development of our horticultural work on the campus, and for this purpose need authority to close up the roads and streets now passing in every direction across the grounds, and make them conform to the adopted plans of Mr. Cleveland for permanent improvement. We also need authority to inclose as much of the grounds as are put under cultivation, so as to secure our trees, plants and shrubbery from injury from stock and other sources of depredation.

Third—I would suggest that a course of lessons in practical horticulture be offered the young ladies and others of the university during the spring term, as an elective study, such a course as will render them familiar with the selection, habits of growth, and culture of our flower garden, and conservatory flowers and plants, proper selection and preparation of soil, and the operations of planting, budding, grafting and other methods of propagation. We have all the facilities for such a course, and it would no doubt be highly appreciated by the class of students for whom it is designed.

Fourth—I would respectfully suggest that the farm house, the erection of which was provided for in the appropriation for university buildings, be built on the portion of the campus devoted to our horticultural work, and for the following reasons:

1. As the professor of agriculture is in immediate charge of labor and the distribution of work on the campus, at the plant house, on the horticultural grounds, and at the farms, he should be where he can give such direct personal supervision, and where he is readily accessible, at all times, to the employes. Work each day must be changed, to suit the varying conditions of weather, and supply of labor, and this can only be done by being personally on the ground.

2. There are several branches of work in the department of practical agriculture which I wish to keep under my personal direction, and which can only be properly conducted near my own residence:

1. *The Apiary.*—Illustrating the varieties, habits, economy, and management of the honey bee, a department considered of so much importance in Michigan Agricultural College as to claim almost the entire time of one professor (Prof. Cook).
2. *The Poultry Yard.*—Exhibiting the breeds and management of domestic poultry. Both these departments can be organized and managed with but trifling expense, and great credit to the department, and with immediate results.
3. *The Vineyard.*—Where we shall illustrate the varieties, cultivation and training of the grape vine, a growing and important industry in our State.
4. *The Beds of Small Fruits.*—Strawberries, raspberries, gooseberries, and currants, their varieties and management.
5. *The Nurseries.*—Of seedlings and plants, of fruit trees, ornamental trees, shrubbery and forest trees—preparing them for transplanting to the fruit farm at Minnetonka.
6. *The Vegetable Garden.*—Where I design to exhibit the cultivation of every variety of garden vegetable that can be grown in this climate.

All these branches require constant personal attention, day and night, and in all conditions of weather, and this can only be given by one residing on the spot. I desire to take charge of these branches, for the reason that I have made them a specialty for years past, and Mr. Bowen will be fully engaged with the greenhouse and kindred work.

My work in connection with the university embraces a wide field of labor. In addition to the regular class-room work of my department I am expected to take charge of the experimental farm, the fruit farm, the improvements of the campus and the horticultural work, and it is impossible for me to reside near them all. I should like to be near the largest amount and most important work, and this, for several years, will be on and near the campus.

When our experimental farm is permanently located and the work there requires the personal supervision of the professor of agriculture, the needs of the university will require the department of horticulture to be placed in charge of a separate professor, and he should reside on the horticultural grounds and the proposed house will be ready for his use.

There is a most suitable site for the location of such a house as is required on the grounds, out of the way and not otherwise needed for the contemplated improvements, and such use of the grounds will be in the direction of such improvements.

If it is thought expedient by the regents to take action in this matter, it is very desirable, in view of next season's work, that such action should be taken at an early day, so as to take advantage of the season and accomplish the work in the best and most economical manner.

To sum up the points upon which I would ask definite action by the board of regents at the present session, in order to enable me to arrange the work of my department for the ensuing year in a satisfactory manner:

1. A decision as to what shall be done with the experimental farm.
2. To authorize the erection of the farm house, either on the site proposed or on the farm.
3. To authorize the closing of the vagrant roads over the campus and the opening of such permanent drives as the executive committee may think best.
4. To authorize the inclosure and protection of so much of the campus as may be required for horticultural work.

5. To authorize the offer of a course in practical horticulture as an elective study in the third term to the proper classes in the university.

Respectfully submitted,

EDWARD D. PORTER,
Professor of Agriculture.

MINNEAPOLIS, MINN., Dec. 28, 1882.

To the President of the University of Minnesota,

SIR: I have the honor to present the following condensed report of the department of agriculture of this university up to the present time.

Condition of the department when I was placed in charge:

1. Work in both instruction and experimentation had been suspended nearly one year.

2. No students in agriculture in the university.

3. Farm condemned, by the best farmers of the State, as unsuited for the purposes, from both character of soil and location.

4. Campus and grounds adjoining college of agriculture, broken, barren and unsightly.

5. A general feeling of uneasiness and dissatisfaction among the farmers of the State, and a tendency to criticize the management of the university in this department.

My first year's work consisted in making myself acquainted with:

1. The farmers of the State, through their recognized organizations, as the

   1. State Agricultural Society.
   2. State Horticultural Society.
   3. State and county granges.
   4. Amber Cane, Dairymens and Wool Growers associations.

2. To familiarize myself with the past work of the department, and the wants of the class for whose benefit it was organized.

3. To test by personal examination the adaptation of the experimental farm, plant house and grounds to the wants of the department.

4. To devise such plans, and to make such suggestions as observation and experience deemed necessary to give the greatest efficiency to the department. Among these plans proposed and sanctioned by the board of regents, were

   1. Sale of experimental farm.
   2. Purchase of new farm for experiment station.

3. Erection of addition to plant house.

4. Inclosure and improvement of campus.

5. Establishment of illustrative horticultural grounds, and arboretum on grounds so inclosed and improved.

6. Organization of "Farmers Lecture Course and Institutes."

Results of second year of work—

1. As much work of experimentation carried on as the uncertain possession of the ground and its unfit condition would permit.

2. The employment and instruction in practical agriculture and horticulture, of twenty-three students.

3. The instruction in the "course in agriculture" of two students, and the graduation of one with degree B. A.

4. All the regular organizations of farmers of the State met with, and their good will and co-operation secured, and hostility disarmed.

5. The old experimental farm has been surveyed, platted, put into the market, and about one-half of it sold, realizing an amount sufficient to purchase and thoroughly equip the new farm.

6. A tract of land, admirably adapted for the purposes of an experimental farm and station, has been selected and purchased. It has been visited and examined by committees from the state grange, the county grange, and the State Horticultural Society, and its selection most heartily approved.

7. The addition to the plant house has been completed, and under the careful and intelligent management of Mr. S. Bowen, is accomplishing the objects of its erection, in a manner creditable alike to him and the university.

8. About twenty-five acres of the campus have been inclosed by over four thousand feet of neat and durable steel wire fencing. The unsightly hills of sand and the hollows have been graded down and filled, and over two thousand loads of manure have been hauled, composted and spread; one crop of Hungarian grass has been grown and plowed under for fertilizing purposes, and the ground seeded with winter rye, preparatory to permanent seeding to grass. Two hundred and thirty shade trees, one-half elm and one-half box elder, have been planted, of which two hundred and twenty-five are living and in good condition.

9. Four acres of the above inclosure have been heavily fertilized, all stones removed or sunk beneath the plow, the ground subsoiled, the city water introduced and distributed so as to

thoroughly irrigate the whole tract, and upon this was grown for illustration, every variety of garden vegetable adapted to the soil and climate of Minnesota.

10. The public grounds of the university have been kept free from grass and weeds, a portion of the trees have been trimmed — holes and old foundations filled up, walks arranged, graveled and sodded, flower beds and stands made and filled and kept in order for the decoration of the grounds and buildings, walks and roads kept free from snow and mud, and over eight hundred cords of wood hauled from the piling ground to the university.

11. The old farm has been operated up to date of sale, yielding, in addition to the experimental work, about fifty tons of hay, one hundred and fifty bushels of oats, and one hundred bushels of corn, and one hundred and ten bushels of onions, most of which are yet on hand.

12. As the new farm is yet in possession of the tenant of the previous owner, we could only operate certain portions of the ground, and by his permission; but I have seeded down six acres to clover and timothy, have raised three hundred bushels of potatoes, one hundred bushels corn, ninety bushels varieties of seed wheat, have cleaned up and grubbed out eight acres of thicket, in fields and along the roads, have leveled the ground, prepared the foundations, and have hauled stone for the commencement of the farm buildings, and under the direction of the executive committee have contracted for five hundred perches of stone, and they are now being delivered on the grounds for next season's work. The farm produced this year, under the management of the tenant, about nine hundred and seventy-five bushels of wheat, one thousand bushels of oats, three hundred bushels of potatoes, and twenty tons of hay, three hundred bushels of corn, one-third of which belongs to farm. A portion of the wheat has been sold and the balance of the crop has been reserved for next season's seed and feed.

13. Since the sale of a portion of the old farm, I have had all the fencing removed from the ground sold, and hauled out to the new farm, thus saving several thousand feet of fencing, and a large lot of good posts for future use.

14. A very full exhibit of plants, seeds and garden products was made at the state fair at Rochester and received the most flattering notice from the press of the State, and the State Agricultural Society passed a series of resolutions, thanking

the university for its exhibit, and strongly indorsing the department of agriculture, and asking the board of regents and the legislature to thoroughly equip the new experiment station, in buildings, stock and machinery, for work that shall give honor to the university and confer lasting benefits upon the State.

15. *"The farmers' lecture course"* has been organized, and the results of this first effort were eminently satisfactory. Instead of a membership of thirty, as required before the commencement of the course, two hundred and fifty-five persons, other than those already in connection with the university, were in attendance upon the lectures. The interest manifested and the encouragement given by the large attendance warrant further efforts in this direction,— and arrangements have been perfected for a more extensive course of lectures this present winter, commencing January 16th, and extending through four weeks, the details of which will be given through the public press.

In conclusion permit me to indicate the line of work in this department for the ensuing year, and of which I respectfully ask your approval.

1. The continuance of our work around the agricultural college, making the grounds, now prepared for the work, the arboretum of the university and illustrative of the work in the department of horticulture, reserving the experimental work in this line for the experimental farm.
2. The removal of all the old barns and stables and houses from the campus.
3. The removal of the barn from the old farm to a lot contiguous to the campus and fitting it up for the university barn, where the teams, tools, seeds and feed, constantly needed on these grounds, may be securely and conveniently housed and protected.
4. The immediate and thorough equipment of the new experimental farm with all the appliances of buildings, fences, stock and machinery necessary to make it a first-class experiment station and a credit to both the university and the State of Minnesota, and which, by its management, will command the confidence and respect of all agricultural interests.

As soon as we are prepared to carry on the legitimate work of an experiment station, combined with practical and theoretical instruction in agriculture, attention will be attracted to the work, interest will be excited among farmers; they will see how their sons and daughters and themselves can be benefited by the work of the university, and our agricultural class rooms will no longer present a "beggarly array of empty benches."

Permit me to call your attention to another matter in connection with our experimental farm.

The acquisition of some additional land, either by purchase or condemnation, for the following reasons:

1. Within less than five years we shall badly need the additional land for our work.

   1. We have now one hundred and fifty-five acres; eighty acres of this will be used at once for illustrating the best methods of culture and rotations of farm crops, wheat, corn, rye, oats, flax, barley, beans, beets, potatoes, sugar corn, and the whole range of grasses.
   2. We shall use twenty acres at once in experimental plats which can never be used for general farming.
   3. The remaining fifty-five acres is in woodland, and should not be cleared off but retained for our buildings, nurseries, work in forestry, and kept for our sheep range.
   4. Leaving us no ground for permanent meadow or pasturage, and no facility for stock or dairy.

2. Within five years it will be impossible to obtain suitable land contiguous to the farm, as it will be all occupied for businets or residence purposes.

3. Land can now be purchased adjoining the farm, and most admirably adapted to our purposes, at a very moderate price.

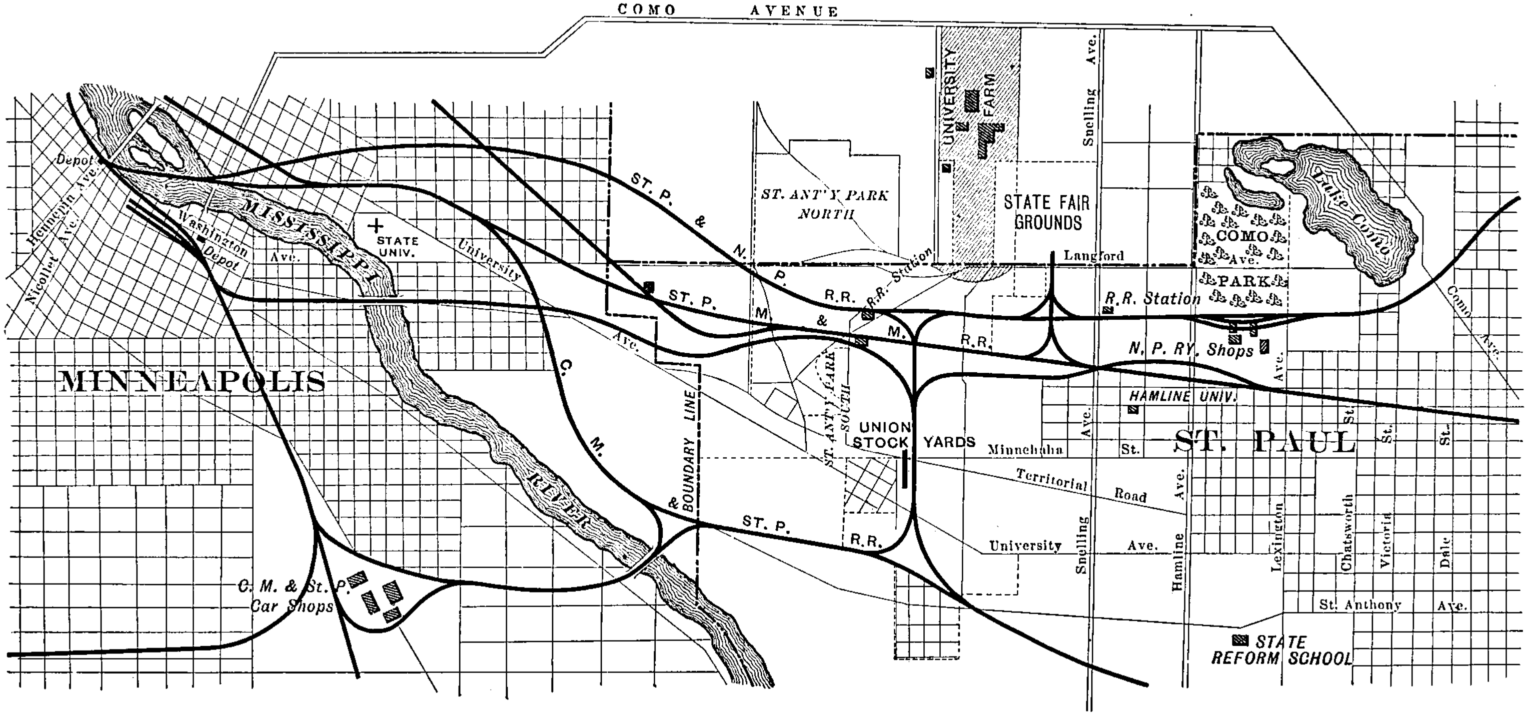
4. One tract of five acres is needed to square out our front on Como Avenue. This will require condemnation.

5. Law authorizing the sale of the old farm requires money received to be reinvested in the purchase and equipment of new farm, and such investment will be the best possible use of the money.

Respectfully submitted,

EDWARD D. PORTER.

In addition to the foregoing reports, verbal communications have been made from time to time to the board of regents, but as the work for the years 1883 and 1884 consisted chiefly in the sales of the old experimental farm, the clearing up of the new farm, the erection of the farm buildings and the arrangement of the new plant for the work of the department and especially owing to my absence from the State in the winter of 1884–5 in charge of our exhibit at New Orleans, no formal report was made for those years.



MAP SHOWING THE LOCATION OF THE EXPERIMENTAL FARM.

THE EXPERIMENTAL FARM.

In accordance with the suggestions contained in the previous reports, the board authorized the sale of the old experimental farm and in 1882 approved my selection of the tract of land now occupied and purchased the first portion, containing one hundred and fifty-five acres, and in 1883 secured an additional tract of ninety-three acres adjoining it on the south; both purchases were made subject to the rights of the tenants, who held under contract with previous owners; these rights expired the next year after purchase, so we came in full possession in 1883 and 1884.

The location of the farm, its relation to St. Paul and Minneapolis, and the roads and avenues by which it is reached, are clearly shown on the accompanying map.

Considering its location, midway between the two commercial. political and educational centres of the Northwest, its convenience of access, its diversity of soil and exposure, and its peculiar adaptation for the purposes designed, the selection can not be duplicated in Minnesota.

Of the first purchase of one hundred and fifty-five acres, fronting on Como Avenue on the north, about one hundred acres consists of a smooth tract of cleared land gently sloping to the south, with a soil of dark prairie loam, and a subsoil of gravelly clay, underlaid with sand and gravel. The remaining fifty-five acres consist of a high, wooded bluff, sloping from the north and northwest to the south and southeast. The soil on the northern slopes is heavy clay and clay loam, while on the south is a light, sandy loam. The timber is mostly of recent growth. The land embraced in the second purchase of ninety-three acres, south of the first tract, is gently rolling, with a heavy fall to the south, when it shades off into a series of small lakes and marshes, susceptible of complete drainage and conversion into the best permanent meadows.

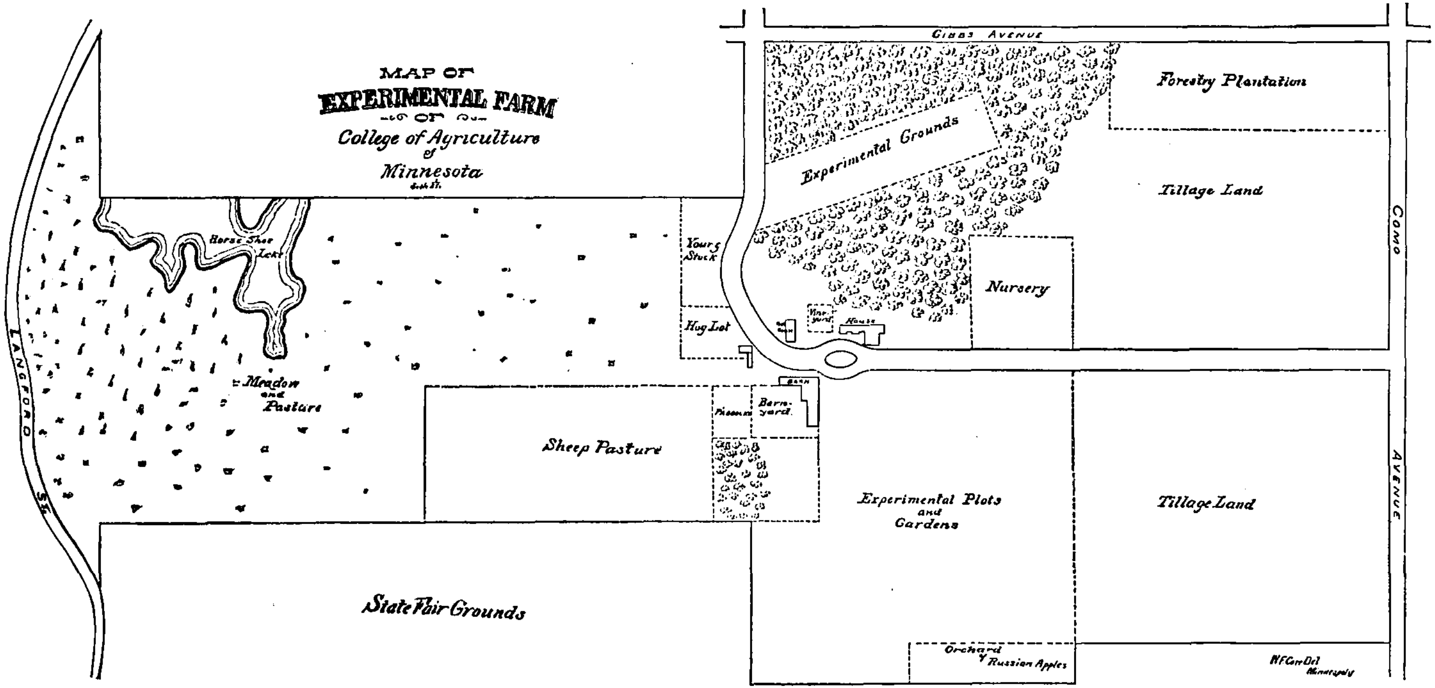
The plat of the farm is herewith given, showing its subdivisions into fields and their uses, and the location of the buildings.

The land was originally covered with heavy timber, and was cleared up about thirty years ago. The owner had never resided upon it, and his tenants had farmed it continuously for wheat and oats, and while the soil was naturally of the best quality, the continued cultivation of these two cereals for twenty-five years, without other rotation or the application of fertilizers, had not only exhausted the soil of the elements necessary for the production of remunerative crops, but had favored the introduction of the noxious weeds and insects which ripen with, and prey upon, such crops, to such an extent that I found it necessary to introduce a complete change in order to clear the land of these pests, and to prepare it for the work of an illustrative farm and experiment station.

My first work on the farm embraced the clearing up of the hedge rows surrounding the fields, many of them from four to six rods wide, and extending around the entire farm, and preparing for the necessary lines of fencing. My first crop of wheat averaged eight bushels per acre, and at certain periods of its growth a person could not tell whether we were attempting to raise wheat or wild mustard. I knew the land was foul, and did not expect a crop of wheat, but sowed it in order to seed down to clover and timothy. This I did with one hundred and forty acres in 1884, and in 1885 we cut nearly four hundred tons, in first and second crops, of the best quality hay,—the first clover ever grown on the farm,—showing that however much the soil had been exhausted of its elements of fertility for *wheat*, it retained everything necessary for the production of maximum crops of the grasses.

This land has been kept in grass, for the most part, up to the present time, for the purpose of starving out the "chinch" bug, subduing noxious weeds, renovating the soil and furnishing a supply of hay and pasture for our stock.

The entire farm has been repeatedly passed over the last three seasons, and every vestige of "wild mustard," "wild oats," "wild buckwheat," and other weeds removed by hand, and during the season of 1886 not a single plant of these noxious weeds was permitted to go to seed on the farm. Any farmer who knows by experience the vigor and persistency of growth of these plant pests in Minnesota soil and climate, will appreciate the amount of time and labor necessary to do such work on one hundred and eighty acres of ground. I do not claim to have entirely cleaned the land; this can only be done by a thorough system of rotation, embracing hoed crops with clean cultivation. This work we deemed of prime importance, not only because it is "good farming," and a compliance with state laws, but as we are preparing to send out from our experimental grounds seeds and plants for test and approval by the farmers of the State, it is all important that we guard against the dissemination of those of a noxious character.


MAP OF
EXPERIMENTAL FARM
OF
College of Agriculture
of
Minnesota
Gibbs Avenue
Como Avenue
Langford St.
Forestry Plantation
Tillage Land
Experimental Grounds
Nursery
House
Young Stock
Hog Lot
Barn
Barn-yard
Horse Shoe Lake
Meadow and Pasture
Sheep Pasture
Experimental Plots and Gardens
Tillage Land
Orchard of Russian Apples
State Fair Grounds

The tract of ninety-three acres, constituting the southern portion of the farm at the time of purchase, had recently been cleared of its growth of trees, and a portion of it broken up. This has since been cleared of its grubs, stumps, and stones, thoroughly broken up, and seeded down with six varieties of grasses for a permanant pasture, and the last season, notwithstanding the severe drought, it carried over our entire stock, consisting of seventy-two head of cattle and horses, and one hundred and seventy sheep.

In addition to clearing up these ninety-three acres I have cleared off, grubbed out, broken up, and put under cultivation ten acres of heavily timbered land, four of them on the northern slope of the hill for nursery and the remaining six on the southern slope for horticultural grounds, making altogether over one hundred acres of new land brought under cultivation.

During the winter season, for three years past, our teams have been employed in hauling manure from Minneapolis and from the transfer stock yards, and this material, with the heavy crops of green clover plowed under, have enabled us to thoroughly fertilize the forty acres designed for our experimental grounds, so that last season we brought our yield of wheat up to twenty-five bushels, oats seventy-five bushels, mangolds and sugar beets to 1,000 bushels, and corn silage to twenty-five tons per acre. Besides this work of preparation we have hauled and prepared the material and built nearly four miles of fencing, as the farm was entirely destitute of this protection when purchased. A portion of this fencing is board, a part barbed wire, but the larger portion of it is a combination of boards and wire, but all of it built in the most substantial and attractive manner.

THE FARM BUILDINGS.

The only buildings on the place, when purchased, were a one-story farm house containing four rooms, a lean-to stable with stalls for four horses, and two cows, and a small granary—all poorly built originally and in a dilapidated condition.

The first duty devolved upon me by the executive committee of the university was to arrange for the erection of a group of complete farm buildings. In the discharge of this duty I have kept clearly in view the following objects:

1. To plan such buildings as would furnish ample accommodations for the superintendent and his family, the assistants em-

ployed, the working force of the farm, and for the proper protection of its produce, stock, implements and machinery.

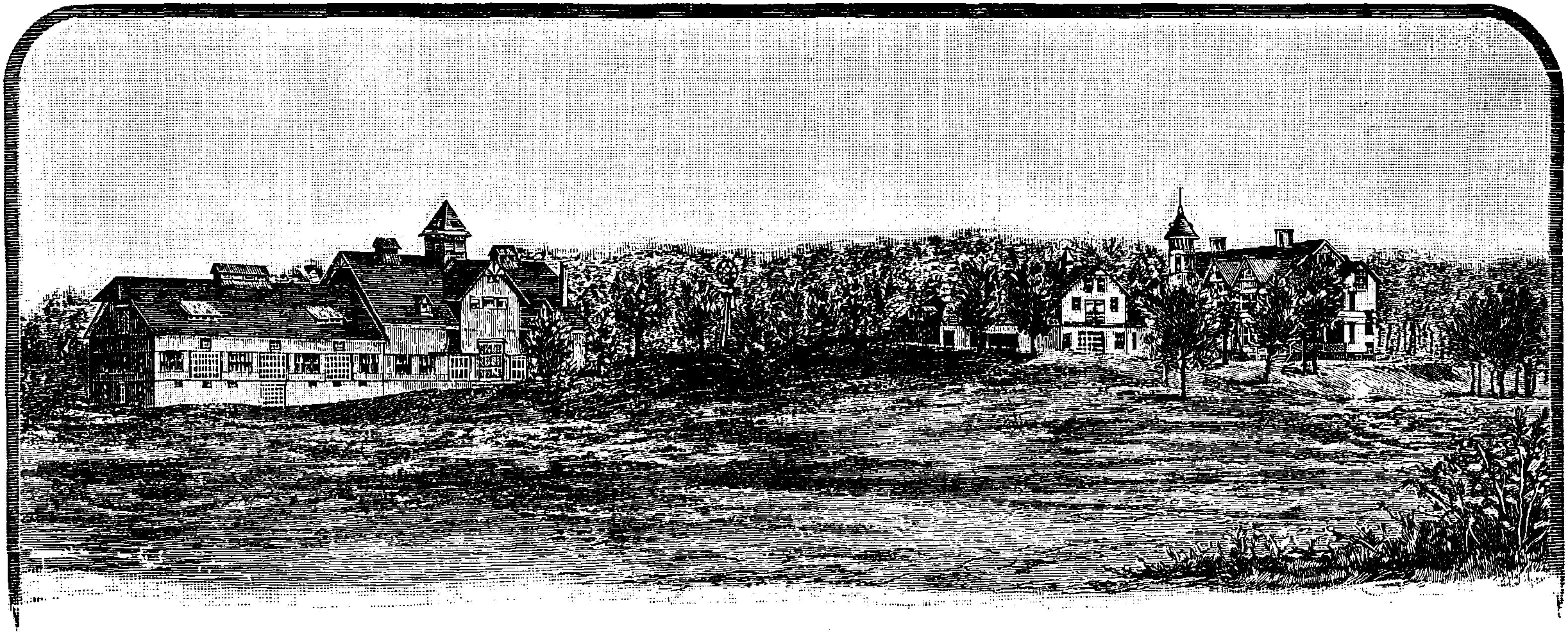
2. By their arrangement to secure the greatest economy of administration in the labor of the farm.

3. To secure such buildings, or by their plans and practical workings would not only accomplish the above objects but be creditable to the agricultural interests of the State here represented.

How far we have succeeded in accomplishing these objects, the following illustrations and descriptions, and personal inspection, must answer.

The site selected for the buildings is most admirably adapted by nature for the purpose. It is on the southeastern slope of the bluff, on a plateau about thirty feet above the level of the tillage land, sheltered on the north and west by the hills, which furnish a site sufficiently elevated to permit the water drawn from the storage cistern, there located, to be carried by gravity to every portion of the buildings and farm. The buildings are not only well protected, but are located where most thorough drainage is secured, and such drainage is utilized for the enrichment of the soil. This site is also at the centre of the farm, and on the dividing line between the tillage lands, on the north, and those devoted to stock and dairy purposes, on the south. In addition to these material advantages, the location commands a magnificent landscape, covering the whole range of country between Minneapolis and St. Paul, as far as Fort Snelling, and embracing Hamline University, Macalester College, Union Park, Como Park, Meriam Park, St. Anthony Park and the Minnesota Transfer and stockyards, as well as the beautiful farming lands of Ramsey County, on the north.

The plans for the buildings were approved by the executive committee, and their erection commenced in April, 1883. The first structure built was the one designed ultimately for the carriage house, stable and farm office, but was used nearly two years for a workshop and sleeping rooms for mechanics, and for the storage of building material. The farm house was commenced in June of the same year, and was under roof in August when I moved into the back building, yet unfinished, that I might be near the work. The house was finished in February, 1884, and the foundation for the barn was put in and the work commenced, but the building was not ready for use until the summer of 1885, when we stored in it our first crop of hay and grain, and filled



VIEW OF EXPERIMENTAL FARM BUILDINGS.

the stalls with stock. The silos were not finished until September, 1886, and there still remains some work to do to carry out the original plans.

This delay in the completion of the equipment of the farm was due to the fact that there was no specific appropriations for the work. The regents of the university were empowered to sell the old farm and reinvest the proceeds in the purchase and equipment of the new one, and all the money expended came from this source; not one dollar was furnished from the state treasury. It required time and skill to make judicious sales and collect the proceeds, and when funds were in hand they were expended where they would do the most good. The management of the finances was exclusively under the control of the executive committee of the board, and all my authority for work and expenditures came from them, through their chairman.

The plans and arrangement of details for all the buildings, the selection and purchase of materials, the employment of labor, inspection and superintendence of the work, and general supervision devolved upon me.

The drawings of the plans, the designs for the exteriors, and the details of construction were the work of Mr. L. S. Buffington, of Minneapolis. The carpenter work, from the beginning to the end, was in charge of Mr. Thomas H. Goodale, of Minneapolis, and the stone masonry was put in by Mr. S. J. Peterson, of the same city; and to all these gentlemen and their assistants I take pleasure in acknowledging my obligations for the courteous and faithful manner in which they discharged their duties.

The perspective and floor plans of these buildings are herewith given, from which their appearance, location and uses can readily be determined.

They represent the best material and workmanship suitable for such structures, and are pronounced by those having extended experience to be the best set of farm buildings in this country for the purposes designed.

FARM IMPLEMENTS AND MACHINERY.

The farm is now equipped with a complete assortment of implements and machinery of the latest and most approved patterns, including steam engine for driving all the stationary machines, such as thresher and separator, ensilage and fodder cutters, and for pumping and heating water for stock; plows, harrows, cultivators, roller, mowing machines, reaper, self-binder, carts, wagons and, in short, everything needed for the work of a practice farm and experiment station. Many of these implements have been contributed either in whole or in part by their manufacturers, who find it to their interest to place meritorious machines where they can be seen and tested by the hundreds of progressive farmers who are annually visiting the farm. I have set apart a large room in our barn where it is ultimately designed to store and exhibit all such contributions and in time to secure a museum of the most approved agricultural implements, and where tests and trials can from time to time be made and reported upon for the information and benefit of the farmers of the State.

STOCK.

It is designed to gradually secure on the farm representations of all the leading breeds of domestic animals, such animals to be used, *First*—To illustrate to the classes of young men, who are receiving a course of instruction in practical agriculture, the peculiarity and value of the different breeds for the soils, climate and markets of Minnesota, and to give them practical training in their management.

Second—To furnish stock for the experimental work in feeding, breeding, management and dairying, and,

Third—To distribute their increase among those interested in stock and dairy management.

In carrying out these objects we have, from time to time, during the past two years, purchased very fine specimens of Shorthorn and Holstein-Friesian cattle, Shropshire Down sheep, Berkshire, Poland-China and Duroc or Jersey Red swine, Plymouth Rock chickens and Bronze turkeys. In addition to these "thoroughbreds," we have raised from grade heifers, a herd of thirty young cows now coming into profit, and from which we have made the past season 3,000 pounds of butter. We have now on the farm nine horses, including teams, driving horses and brood mares; forty cows, including blooded stock and grade heifers, four blooded bulls, eight thoroughbred calves, eight three-year-old feeding steers, twenty-four thoroughbred Shropshire sheep, twenty-four grade Shropshire lambs, one hundred native ewes (feeding for mutton), twelve breeding sows, seventy-five Plymouth Rock fowls and sixteen Bronze turkeys.

OBJECTS OF THE FARM.

The objects contemplated in the organization of the farm are:

First—To do for agriculture what the laboratory does for the chemist, the workshop for the artisan and the hospital for the physician, furnish a school of practical agriculture, where the instructions of the text-book, teacher and laboratory may find practical illustration in the fields, orchards, nurseries, gardens and stables of a well-appointed farm.

Second—To train young men in all the details of farm life—where they will have the benefits of the best methods of cultivation, aided by the most improved implements and machinery.

Third—By making the labor performed on the farm both educational and remunerative, and thus aid young men in defraying their expenses while acquiring an education.

Fourth—To carry on the work of an agricultural experiment station, and to assist by scientific investigation and experiment in determining the adaptation of new varieties of grains, grasses, fruits and vegetables to the soil, climate and wants of Minnesota, and to distribute the results of such investigations among the farmers of the State.

It was to prepare the farm for properly carrying out and meeting the above objects that all the time, labor and expense of the past five years have been devoted, and during the past year, work, aiding in the accomplishment of these objects, has been successfully prosecuted.

In May, 1886, the school of practical agriculture was opened. The following circular was issued in April and given general circulation through the press of the State:

THE SCHOOL OF PRACTICAL AGRICULTURE IN THE UNIVERSITY OF MINNESOTA.

This school will be opened for the reception of students on and after May 1, 1886. No fees or examinations will be required.

The design of this school is to give young men a thoroughly practical knowledge of American agriculture in all its branches and to illustrate the instruction of the class room and laboratory.

Pupils in this department will reside upon its university farm and be regularly employed in all the operations; they will not be required to engage in regular studies or recitations, but will have access to the library of the university and will be directed in their readings. Practical lectures and instructions will be given upon those branches of work which from time to time engage their attention.

Labor will be paid for at the rate of from five to fifteen cents per hour, depending upon the age, skill and industry of the pupil.

Board, washing, furnished room, fuel and lights will be charged at their cost and the balance to the credit of the student paid to him in monthly settlements. No student will be retained whose labor will not be equivalent to his board.

This school will open May 1st and close November 1st, but a limited number of students who wish to prosecute their studies in the winter management of stock and the dairy can remain the entire year.

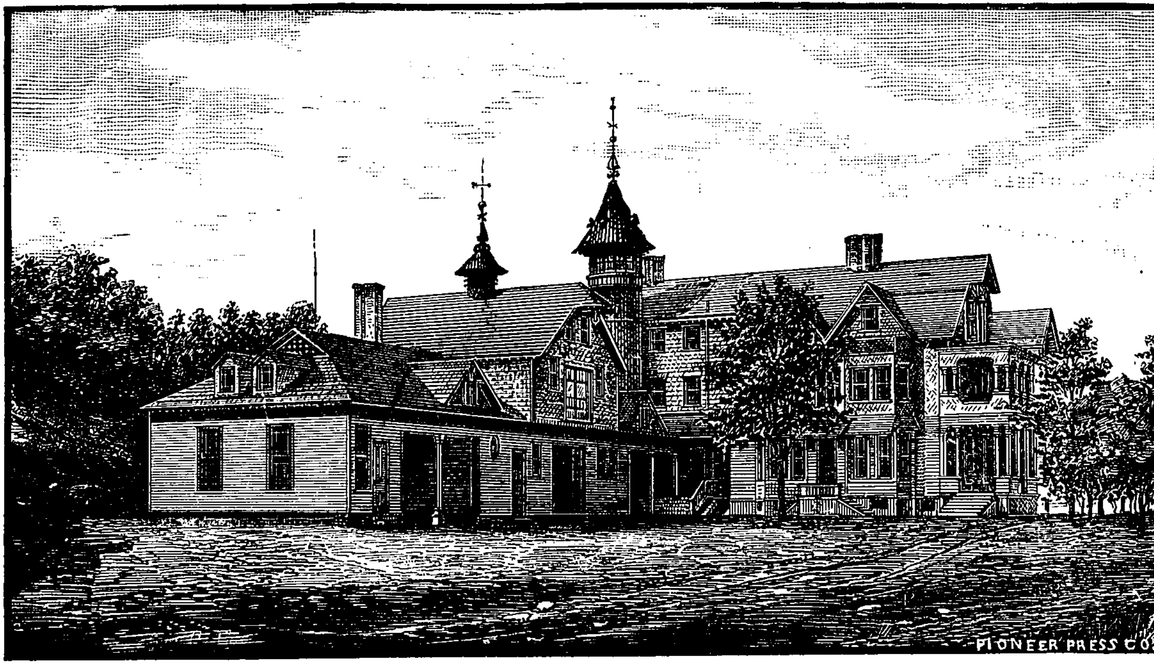
Regular and systematic labor will be required of all students on the farm and strict conformity to all rules and requirements.

All candidates for graduation in the college of agriculture will be required to take during their course the equivalent of two full sessions in this school.

In response to this notice the following young men were admitted during the season, and were regularly employed in all the operations of the farm:

Allen, Charles G.,	Washington County,	Minn.
Billsby, Eugene,	Browns Valley,	Minn.
Brown, William L.,	Granite Falls,	Minn.
Bryson, A. P.,	Montreal,	Canada.
Dougall, George M.,	Montreal,	Canada.
Gruenson, Christ,	Anoka,	Minn.
Heffron, Frank,	Ramsey County,	Minn.
Moldstadt, John,	Minneapolis,	Minn.
Oscar, Hans,	Minneapolis,	Minn.
Rogers, Clarence,	Minneapolis,	Minn.

These students received for their labor $411.46, besides paying all expenses for board, washing, fuel, lights, and furnished rooms, and in addition received practical training in all the details of farm work, including care and management of stock, milking and churning, work in the nurseries, vineyard and gardens, where they were made familiar with the appearance, habits of growth, cultivation and use of every variety of garden product grown in Minnesota, together with all the general work of the farm, including the cultivation and harvesting of the crops



FARM HOUSE OF THE COLLEGE OF AGRICULTURE.

of corn, oats, wheat, potatoes, ensilage, and the cutting, curing and storage of two hundred tons of timothy and clover hay.

While this class was small, it was an encouraging beginning; and I believe this school of *practical agriculture*, modified so as to furnish elementary instruction to a class of practical students not now taught in either the district school, on the one hand, or the high school or college on the other, will meet the wants of hundreds of farmers' sons who either do not wish, or can not spend the time or money to take a more extended course; while to the few who have the opportunity for a higher education, the college of agriculture, as now reorganized, furnishes all the facilities which can be found in any institution in the land.

This school of practical agriculture is accomplishing the first *three* objects of the organization of the farm, as above given. The fourth object, the work of an *experiment station*, has received as much attention as was possible to give with the limited means at my disposal and the multiplicity of other duties would permit. The results of my labor are given further on in this report.

THE EXPERIMENT STATION.

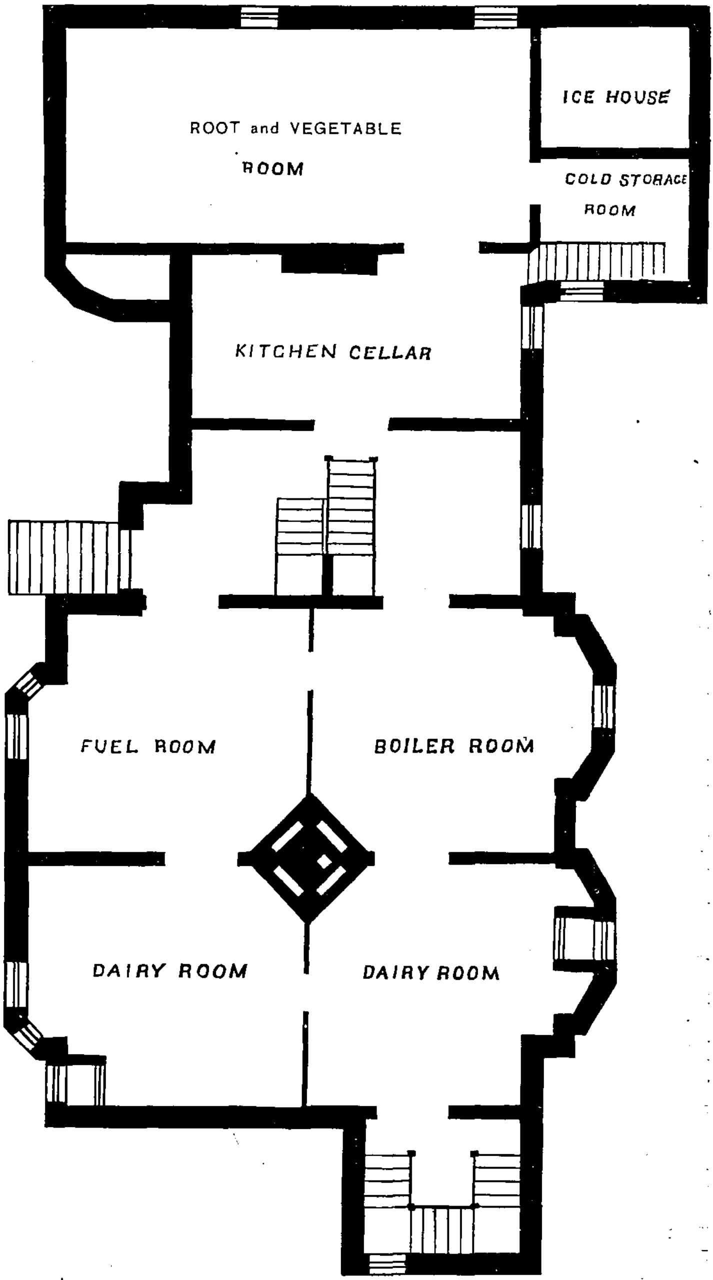
An agricultural experiment station is an institution provided with a suitable equipment of lands, houses, stables, plant houses, apparatus for testing seeds, laboratories for chemical investigations, farm stock, implements and machinery, and provided with a working force of intelligent, enthusiastic, scientific and practical men, well trained in the several departments of agriculture, horticulture, stock and dairy management, forestry, chemistry, botany, entomology, and veterinary science.

The object of such an institution should be to conduct original researches or verify experiments on the physiology of plants and animals, the diseases to which they are subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of different systems of rotation of crops; the adaptation of trees, plants and shrubs to the conditions of soil and climate of the locality of the station; the analyses of soils and water; the influence of drainage and irrigation; the chemical composition of manures, natural and artificial, and their adaptation to different crops; the composition and feeding value of different kinds of food for domestic animals; the scientific and economic questions involved in the production of milk, butter and cheese, and in general to conduct such other researches or experiments as bear directly upon the agricultural industries of the country. In addition to the above lines of direct work, these stations should become "bureaus of information," to which all classes of agriculturists may send their questions and secure information upon all subjects which come up in their daily experience on the farm, and where they may obtain counsel and be guided by the light and the results of the most recent achievements of science. Such aninstitution is not a "school of practice," on theone hand, or a "model farm," on the other. The design of the first is to teach young men the *art* of agriculture by making them familiar with all the processes of the farm, and is always accomplished by an expenditure of time, material and labor. The object of the second is to present the best application of the principles of farm economy, and its aim is practical success; such a farm is supposed to be located on the best land, equipped with the most approved style of buildings, implements and machinery, stocked with the best animals, worked, not by boys who come from towns and cities to learn farming, but by well-trained hands, whose labors yield the largest crops, and the best stock, and at the least cost.

The model farm should make money, but the experimental station should no more be expected to "pay," in the general sense of the term, than the laboratory or workshop of the industrial school or astronomical observatory, and just in proportion as pecuniary returns are made an object in its management, in the same proportion will it fail as a scientific or educational agency.

The growing appreciation of the value and importance of the work of the "agricultural experiment station" is shown from the fact that since the establishment of the first one, under the direction of Boussingault, in France, in 1839, and of Liebig, in Germany, in 1840, they have so rapidly increased in number that to-day there are over one hundred of these stations in Germany, forty-eight in France, sixteen in Austria, ten in Italy, six in Sweden, nine in Belgium, and from two to six in each of the smaller kingdoms of Europe, while far-off Japan, half civilized as we are accustomed to regard her, has recently established a station, most liberally endowed, and placed under the direction of one of the most eminent American agriculturists.

The first experiment station established in this country was



BASEMENT PLAN
OF
FARM HOUSE

by Connecticut in 1875; and since that time they have been established by state appropriation in Maine, Massachusetts, New York, New Jersey, Ohio, Alabama, North Carolina, Kentucky, Wisconsin, Tennessee, and Louisiana.

California, Pennsylvania, South Carolina, Georgia, Iowa, Kansas, Nebraska, Misouri, Mississippi, Texas, and Michigan have special departments for doing the whole or a part of the work of an experiment station at their universities and agricultural colleges. These stations are supported by annual appropriations of from $2,000 to $20,000, each, aside from incomes derived from national land grants, and appropriations for lands. buildings, and equipment.

The legislature of Minnesota, at its session in 1885, passed the following act:

"SECTION 1. It shall be the duty of the board of regents of the university of Minnesota, as soon as practicable after the passage of this act, to establish at said university an agricultural experiment station, for the purpose of promoting agriculture in its various branches, by scientific investigations and experiments; which station shall be under the control and supervision of the said board of regents, and of which the professor of agriculture shall be general superintendent."

"SEC. 2. This act shall take effect, and be in force from and and after its passage.

Approved March 7th, 1885.

"L. F. HUBBARD,
" *Governor.*"

The agricultural experiment station, above authorized, is virtually the experimental farm of the college of agriculture of the university of Minnesota, and it embraces in its lands, buildings stock, implements and machinery as heretofore described, everything needed except in some minor points, for both the school of practical agriculture and experiment station. Unfortunately there were no funds appropriated by the legislature to carry out the objects of the above act, and there were none at the disposal of this department for that purpose, and we have been in the condition of the manufacturer who has erected a well-appointed mill, but has no *power* to set it in motion.

The experimental work which is given in the following pages has been done, in the absence of specific appropriation, with limited and unskilled assistance, and in connection with a multiplicity of other duties, and it is to be hoped that with the splendid equipment now provided, the State of Minnesota will make such provision for the continuance and extension of the work she has authorized, as her growing and all important agricultural interests demand.

FARMERS' LECTURE COURSES.

When I assumed direction of the department of agriculture, in January, 1881, there were not any students in the college of agriculture to instruct; the experimental farm was worthless for the purposes contemplated, and my work for that year and the two following years is briefly outlined in the first portion of this report. The organization of the courses of lectures in practical agriculture, for the benefit of the farmers of the State, in 1882, met with such cordial indorsement, that the executive committee of the board of regents authorized their continuance, and in 1883 the following program was announced and carried out:

UNIVERSITY OF MINNESOTA.

COLLEGE OF AGRICULTURE,
MINNEAPOLIS, MINN., Jan. 1, 1883.

The regents of the university, encouraged by the attendance upon the course of lectures presented last year to the farmers of the State, propose to continue their efforts in this direction.

A course of lectures, addresses and discussions will be given through the College of agriculture, commencing Tuesday, Jan. 16, 1883, and extending through four weeks.

Two lectures will be given Tuesday, Wednesday, Thursday and Friday of each week, at 10 A. M. and 2 P. M., followed by discussions, questions and answers upon the topic of the lecture. These lectures are designed to be of a practical character, and will be given by the members of the faculty of the university and by gentlemen from other states who have become successful and noted in their special departments.

No fees, examinations or other conditions will be required for admission to this course, but its advantages will be absolutely free to all.

In order to add to the interest and attendance upon this course of lectures, the various state organizations, as the State Agricultural Society, the State Horticultural Society, the State Amber Cane Association, the Dairyman's Association, and the Wool Grower's Association, will hold their annual meetings during their continuance, and the topics selected for dicussion will be in harmony with the objects of these organizations.

The *first week* will be devoted to horticulture and the amber cane industry.

The *second week* to the breeding and rearing of domestic animals, their diseases and treatment.

The *third week* to dairy stock and dairy management, sheep and sheep husbandry.

The *fourth week* will embrace farm hygiene, forestry, cereals, soils and general farm management.

Programs giving details of each week's work will be prepared for the public press, and will be furnished upon application.

The following gentlemen will take part in the exercises of the course and will deliver from one to six lectures each.

Prof. William H. Brewer, Professor of Agriculture, Yale College.—"Principles of Breeding Domestic Animals."

Prof. L. B. Arnold, Cornell University, and President of the American Dairymen's Association.—"American Dairy Husbandry and Management."

Hon. J. J. Woodman, Master of the National Grange Patrons of Husbandry.—Subject to be announced hereafter.

Prof. E. A. A. Grange, V. S., Professor of Veterinary Medicine and Surgery, Ontario Agricultural College, Guelph, Ontario.—"Diseases of Domestic Animals and their Treatment."

Prof. Henry A Webber, of Illinois Industrial University.—"Manufacture of Sugar, Syrup and Glucose from Sorghum."

Prof. Melville A. Scovell, Illinois Industrial University.—"Importance of the Amber Cane Industry to the Northwest."

Hon. C. P. Baker, Topeka, Kansas, Forestry Expert from the Department of Agriculture at Washington.—"Forestry in the Northwest—What has been Accomplished."

Hon. Norman J. Colman, Ex-Governor of Missouri, President of Mississippi Valley Cane Growers Association.—"The Present Condition and Future Prospects of the Amber Cane Industry."

Hon. J. M. Smith, President of Wisconsin Horticultural Society.—"Market Gardening for the Farmer."

Geo. P. Peffer, Esq., Vice President of Wisconsin Horticultural Society.—"Studies in Apple Blossoms."

A. W. Johnson, Esq., Chili Station, New York.—"Historical and Experimental Notes on Potato Culture."

Hon. L. B. Hodges, author of Forest Tree Planters' Manual.—"Forestry and Ornamental Tree Planting."

Dr. Charles N. Hewitt, Secretary of the State Board of Health.—"Hygiene of Farmers' Homes."

Prof. C. W. Hall, University of Minnesota.—"Origin and Distribution of Minnesota Soils."

Prof. W. A. Pike, University of Minnesota.—"The Shop Work of the University."

Prof. John F. Downey, University of Minnesota.—"Practical Mathematics for the Farmer."

Prof. James A. Dodge, University of Minnesota.—"The Relations of Chemistry to Agriculture."

Prof. Edward D. Porter, University of Minnesota.—"Soils and Their Mechanical Treatment," and "Rural Economy."

It is expected that the railroads of the State will extend their usual courtesy of reduced rates of fare to all attending this course of lectures. Parties should inquire at their respective stations for such reduced rates or round-trip tickets. Certificates of attendance, to be presented at the offices of these railways, will be furnished by Prof. E. D. Porter, upon application.

A cordial invitation is extended to all persons interested in agriculture to attend this course of lectures, and to manifest by their presence their desire for the advancement of this industry, so important to the individual, the State and the Nation.

All members of this class are requested, on their arrival at the university, to hand to the usher in attendance at the door of the lecture room a card with their name and post-office address in full.

Any further information will be promptly furnished by addressing

EDWARD D. PORTER,
Professor of Agriculture, University of Minnesota,
Minneapolis, Minn.

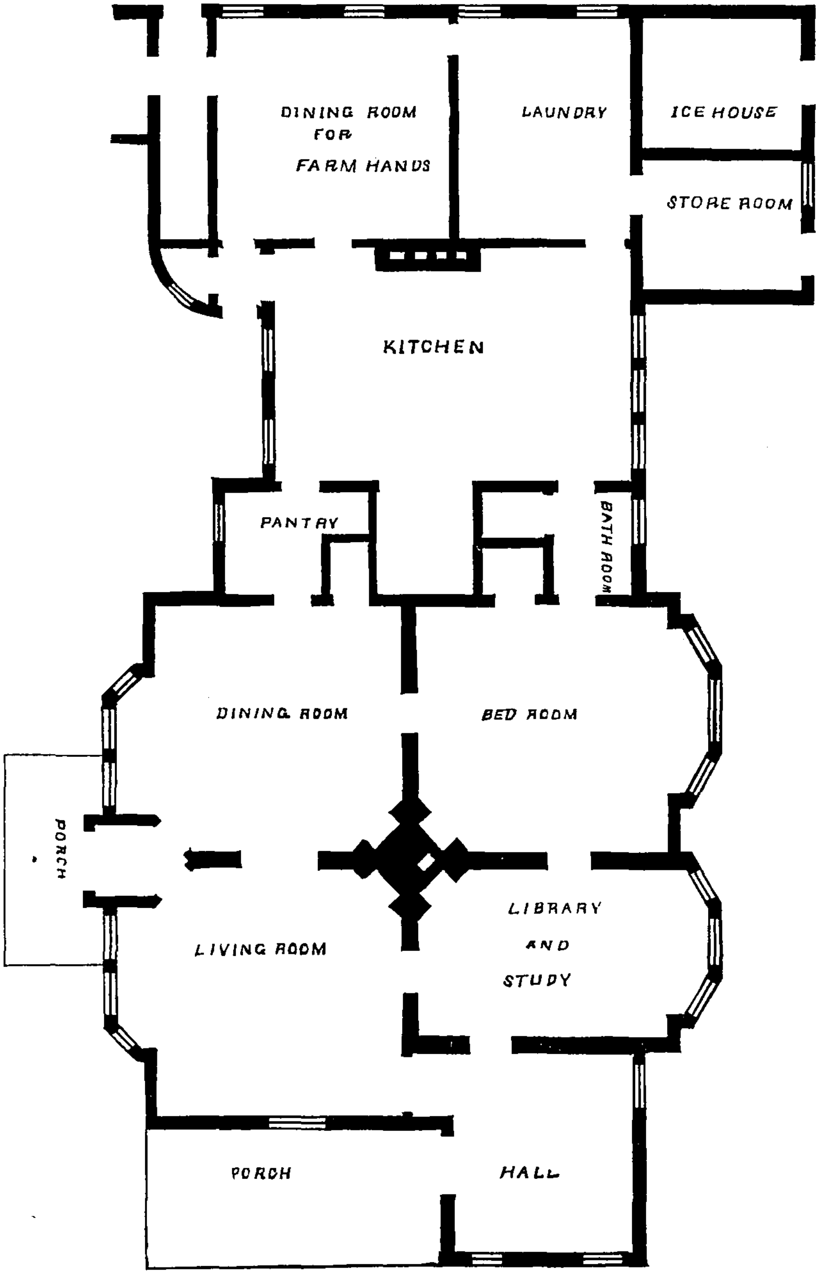
This course of lectures was most successful and was attended by three hundred and eight persons. Many of the addresses were valuable contributions to agricultural knowledge, and I have given in this report such of them as I could procure the manuscript of. Some of these addresses were printed in a previous report, but as the edition was a limited one, and many inquiries have been made for them, I have thought best to republish them in this report.

In 1884 the farmers' lecture course was again authorized, and as the previous courses had embraced topics almost exclusively interesting to men, I determined to give the women a fair show and for this purpose secured the services of Miss Juliet Corson, superintendent of the New York school of cookery, to deliver a course of lectures on domestic economy. This course was successful beyond our most sanguine expectations and was attended by 1,181 pupils. The lectures were carefully reported and are given in the appendix. The demand for these lectures has been so great that the commissioner of state printing authorized the printing of 2,000 extra copies for general distribution.

The result of these three years' experiments in attempting to reach and interest the masses by popular and scientific lectures on practical subjects has been highly satisfactory, so far as numbers and interest manifested were concerned, and has been invaluable as paving the way for more extended usefulness.

When I examined the list of names and residences of those in attendance I found that at least three-fourths of the entire 1,750 who attended the courses came from an area of twenty miles from St. Paul and Minneapolis. The great mass of the farmers of the State, their wives and sons and daughters either could not or would not leave their homes and business, incur the expense of time, travel and board to attend a course of lectures for two, three or four weeks at a distant point, however attractive and valuable they might be. It is for this reason I have thought it best to include some of these addresses in this report, that they might reach and benefit as many persons as possible.

I came to the conclusion, also, that the true course to pursue in the future would be to carry these courses of lectures to the people and meet them at their homes. My absence from the State for much of the time during 1885 at New Orleans prevented the execution of this plan, but in the early part of 1886 it was authorized by the executive committee and at once put into operation and a limited appropriation put at my disposal or this purpose.



FIRST FLOOR
OF
FARM HOUSE

THE FARMERS' INSTITUTES

thus organized have been held in the following localities, either wholly by our institute force or in aiding other organizations in the same line of work.

LIST OF INSTITUTES HELD OR ATTENDED IN 1886.

DATES.	PLACES.	DATES.	PLACES.
February 11th	Glencoe.	June 9th	Glyndon.
March 4th	Le Sueur.	June 10th	Hawley.
March 5th	Moorhead.	June 11th	Detroit.
March 18th	Montevideo.	July 7th	Otter Tail Lake.
March 23..d	Browns Valley.	July 15th	White Bear.
March 24th	Morris.	September 7th	St. Cloud.
March 25th	Graceville.	September 10th	Fergus Falls.
April 2d	Eyota.	September 28th	Red Wing.
April 29th	Eagle Lake.	September 30th	Benson.
May 1st	Cokato.	October 5th	Canton.
May 7th	Appleton.	November 15th	Windom.
May 8th	Delano.	December 10th	Winnebago City.
May 15th	Waverly.	December 14th	Luverne.
May 25th	Ortonville.	December 21st	Pipestone.
May 27th	Granite Falls.	December 28th	Lake Crystal.
June 8th	Moorhead.		

The sessions of these institutes extended from one half day to thee days each, depending upon the interest and attendance. There were generally three meetings held each day, morning, afternoon and evening. In some places the attendance was very small at the first sessions, owing to a lack of proper notice upon the part of the local committees interested, a lack of knowledge as to what the objects were, and a suspicion that there was some ulteri or political scheme behind the movement, but the number invariably increased from meeting to meeting, and in every community we received a most cordial invitation to return, and a pledge upon their part to do all in their power to make future institutes a grand success.

As showing the character of the work, and the estimation in which it is held, the following extract is given from the *Pioneer Press* of March 25, 1886.

FARMERS' INSTITUTES.

The popularity of those gatherings of persons interested in agricultural pursuits known as farmers' institutes is an evidence of their merit. Indeed, to anyone who has attended one of these interesting meetings there could be no question as to their usefulness. They are simply to the farmer what the more pretentious clubs are to professional and mercantile men—a place where they can meet to talk over their affairs, compare notes, interchange views, and generally to take such action individually and collectively as will inure to the benefit of their members and the community in which they reside.

The farmers themselves are shrewd enough to see the advantage to be derived from these institutes, and they are in consequence very largely attended. The independence and self-reliance of the farmer could nowhere be more fitly illustrated than in these gatherings, where he will rise up to ask a question or make a speech with the easy abandon of a professional orator, undismayed by the presence of professors, reporters or anyone else. It requires but a brief knowledge of the workings of these institutes, such as the one held at Montevideo last week, a brief report of which appears on the eighth page of this paper, to satisfy the most skeptical person that they are to play a highly important part in the cultivation of the soil in the near future. In union there is strength; in combination there is power; in admitting that you are never too old to learn there is wisdom. The farmers are becoming united in a desire to utilize their strength in aid of the best practical purposes; they are combining to advance their interest as far as it can be done by mutual assistance and protection; and they are rapidly learning from each other and from the teachers employed by the State all the best and surest methods of securing good crops; how the soil is affected by the different varieties of vegetation; how the land can be most cheaply renovated and fertilized; how the breeds of cattle can be improved; how the products of the farm and the dairy can most readily be brought to the mouth of the consumer; and how, in short, the lot of the farmer may be improved, his burdens lightened, and his life and that of his wife and children made brighter and happier.

The *Weekly Pioneer Press* devoutly trusts that these farmers' institutes may continue to increase in number and popularity; and as all now regret the unfortunate accident by which the last legislature failed to recognize these institutes in the contemplated appropriation for their encouragement, it is safe to say the next legislature will not repeat the blunder, but that a modest fund will be furnished to meet the necessary expenses of these invaluable meetings, which are no less advantageous to the communities in which they flourish than to the commonwealth at large.

Institutes are appointed for Spring Valley, Red Wing, Princeton and Owatonna, and asked for at Franklin, Carver, St. James, Browns Valley, Moorhead, Rochester and Le Sueur. It is to be hoped that at an early day the approaching legislature will make such appropriations for this work as will enable the superintendent to effect a thorough organization, and extend its benefits to every county in the State.

Wisconsin gave $5,000 annually, for two years, for this work, and held last year thirty-two institutes, and propose holding fifty-two the present winter and spring. I had but $1,000 placed at my disposal and have held thirty-one meetings. It would have been impossible to accomplish this amount of work had it not been for assistance rendered by a private individual deeply interested in the enterprise, the liberality of all the railroads of the State, who furnished transportation for our speakers, and the uncompensated labor of the gentlemen and ladies who have so generously contributed their time and energies to the success of the undertaking; and I hereby take pleasure in returning them my acknowledgments for their valuable assistance. Such acknowledgments are especially due to Mr. O. C. Gregg, of Marshall; Prof. Maria L. Sanford, of the university; Hon. J. S. Harris, of La Crescent; and Messrs. C. L. Smith and M. Pierce, of Minneapolis.

EXPERIMENTAL WORK IN HORTICULTURE.

RUSSIAN APPLES.

Undoubtedly the greatest horticultural need of Minnesota is a good list of hardy apple trees. Experiments with a view to filling this want have been conducted by private citizens and many creditable seedlings obtained — notably Mr. P. M. Gideon's Wealthy. But there is yet to be found a single late-keeping winter apple of even medium quality among the whole list of seedlings which will endure our severe test winters.

Experimentation of this kind requires not only a great deal of time and attention, but if any extensive work is done, more money is needed than private citizens care to expend. It is peculiarly the province of state institutions, therefore, to carry on this work. The state experimental fruit farm, at Minnetonka, under the superintendence of Mr. Gideon, is producing every year new seedlings which are full of promise. That branch of the work is progressing satisfactorily, as will be seen from the report. It was deemed best for this experimental department to take up the Russian apples, and endeavor to determine their hardiness, season, quality and adaptability to our climate.

It had been known for many years that the climate and soil of Central Russia corresponded in many particulars to that of the great central basin of America.

Like this region, Central Russia is a land of broad prairies, cut with many rivers whose banks are fringed with woodland. No mountains traverse the Russian plains, but the Urals on the east and the Carpatheans on the southwest find a counterpart in our Alleghany and Rocky Mountain systems. The climate is one of intense summer heat and severe winter cold; sudden and extreme changes are not uncommon. The rainfall averages about two-thirds as great as that of the Mississippi Valley — the air is dry — indeed in all things that go to make our climate severe, the Russian seasons are intensified.

It should be remembered in this connection that Russia is one of the oldest countries in Europe. Her people have occupied their lands for centuries. It is true she has not advanced as rapidly as Western Europe, but she was an agricultural country long before America was known. We might, therefore, reasonably infer, what Prof. Budd found to be the fact, that the Russians have grown the same varieties of apples for centuries.

This continued propagation and growth under peculiar conditions of soil and climate has a strong tendency, in plants as well as in animals, to fix certain characteristics so firmly in the variety or race, that they in time are transmitted to the offspring. And so Prof. Budd found, in his visit to Russia, that many of the varieties of apples were difficult to distinguish from their seedlings — certain peculiarities had become firmly established. Hence the Russian apples are largely classed in families — and the seedlings of these sorts closely resemble the parents.

Of course, hardiness, as well as other qualities, would become inherent in time, — for no variety of tree could stand centuries of the greatest extremes of heat and cold without becoming acclimated, — only the hardy sorts survive.

It was inferred, then, that if these apples were a success in the difficult climate of Russia, we might hope to find them adapted to the peculiar climate of the West. Acting on this inference, the national department of agriculture, in 1870, imported a large number of varieties of Russian apples. This importation was planted and propagated in the department's grounds at Washington, a city whose climatic conditions were as different from Russia as they well could be. Scions were soon distributed throughout the country, and some good things were discovered. But the nomenclature of the Washington importation was found to be in a hopeless muddle. As soon as the trees began fruiting it was discovered that the same fruit had been distributed under different names, and many so-called varieties proved to be identical.

To clear up these errors in nomenclature, to thoroughly study the Russian fruits in their own land, and to secure anything and everything of value that could be found, Prof. J. L. Budd, of Iowa, and Mr. Charles Gibb, of Canada, made an extended journey through the great central provinces of Russia, in the year 1882. To the very careful work and excellent reports of these gentlemen the public is indebted for the greater portion of the information available on this subject.

Prof. Budd, since his visit to Russia, has made large importations of what he regards as their best sorts, for American planting. Other importations of greater or less value have also been made, so that there are probably over five hundred varieties of Russian apples in this country to-day. The great majority of these will not prove equal to our need; many come from the coast sections of Russia; others, again, have grown where cooler summers were the rule, and thus their fruit is found to ripen too early here. As compared with the total importation, it is probable that very few will be found adapted to the peculiar requirements of this State. It is to determine which these few are that careful and intelligent experimentation is now being conducted. And if only one out of all the immense list we have is found to possess the necessary qualities, the expense and labor will have been amply repaid.

In the spring of 1885, after a season of unusual severity, preceded by the coldest winter the Northwest had known, we recieved from Prof. Budd scions of the following Russian apples. They were cut from trees which for the five consecutive years previous had been closely pruned for scion timber—the trees were in fact mere stubs, all the new wood being removed. The scions we obtained were the refuse—small branches which had not been considered good enough to use. Prof. Budd had grafted his entire stock earlier in the season, and it was only to assist his northern neighbors that he permitted his trees to be touched. The scions were cut after the middle of March, and all that showed even the slightest discoloration were thrown out. The winter had been very severe, the thermometer showing —35° F.

Discarding all injured varieties, the following list was secured:

RUSSIAN APPLE GRAFTS.

Made in March, 1885.

Great Mogul,	Bellordoskoe,
Anisomovka,	Karalovka,
Gipsy Girl,	Reinette Red,
Summer Calville,	Karitsnoe Potasdtoe,
Browery,	Gaine's Swedisher,
Aport Rother,	Grand Duke Constantine,
White Transparent,	Arabian,
Cardinal Cellina,	Yellow Transparent,
Ostronskoe,	Sklanka Bog,
Aport Orient,	Rinabouski,
Peter the Great,	Antinouka,
Groskoe Sklanka Gruner,	Charlottenthaler,

Gros Mogul,
Shining Aromatic,
Moskaroe,
Cardinal,
Moscow,
Vineuse Rouge,
61 Noble Redstreak,
70 Winter Pear,
105 Russian Gravenstein,
111
120
128 Sheepnose,
151 Sweet Miron,
153 Juicy Transparent,
157 Juicy White,
161 Longfield,
162 Buschbon,
164 Heidorn,
166 Summer Aport,
167 Yellow Sweet,
169 Green Sweet,
170 Revel Glass,
177 Green Streaked,
180 Negoloff,
181 Champagne Pippin,
184 Arabian,
185 Anisette,
187 Glass Green,
190 Tiesenhausen,
196 Sweet Stripe,
200 Red Repka,
202 Hare Pipka,
203 Arcad,
206 Czar's Thorn,
207 Stupka.
208 Korolevskoe,
210 Vinograd,
213 Stepanoff,
214 Garden,
215 Bushy,
217 Sugar Sweet,
224
230 Titovka,
240 Recumbent,
242 Broad Cheek,
243 Throne,
245 Borovinka,
246 Prolific,
247 Popoff,
252 Aport,
260 Winter Stripe,
262 Charlamoff,
264 Smelling,
265 Bitter Pipka,
267 Pear,
269 Rosy Aport,
272 Little Hat,
275 Zolotoreff,
276 Half Glassy,
277 Lead,
82 Veronesh Reinette,
285 Juicy.
286 Kremer,
290 Ukraine,
304 Switzer,
316 Red Queen,
317 White Pigeon,
321 Sweet Pipka,
322 Cinnamon,
323 Reponka,
324 German Kalville,
328 Peterhoff.
330 Juicy Streaked,
337 Grayest,
339 White Queen,
340 Lievland Raspberry,
343 Red Wine,
350 Burr,
354 Spiced Aromatic,
356 Round Borsdorf,
361 Pointed Pipka,
364 White Vochin,
365
367 Stripe,
371 German Skrute,
375 Cinnamon Pine,
378 Hibernal,
380 Moscow Pear,
382 Russian Green,
387 Good Peasant,
398 Enormous,
401
406 Sweet Pipka,
407 Blackwood,
408 Gen. Sreig,
413 Cross,
424 Bergamot,
427 Anissunis,
428 Fonaric,
432
437 Saxonian,
442 Yellow Calville,
444 Lubsk Reinette,
447 Kiev Reinette,
448 Cardinal,
450 Handsome White,
455 Berry,
457 Klineff,
461 Ribbed,
468 Pointed White,
469 Grandmother,
475 Holdfast,
476 Red Arkad
492
515
540
557 Streaked Revel,
565 Worgunok,
574
578 Leipzig Bordorf,
579 Summer Lowland,
585 Zusoff's Winter,

599	Romna,	Vor. 99	
874	Sweet Mushroom,	M, 4	Ostrokoff's Glass,
940		" 5	Royal Table,
962	Queen Muscatels,	" 30	Ledenets.
971	Vasilist Largest,	" 98	
975	Red Teat,	" 136	
977	Aromatic,	" 148	
984	Koursk Anis,	" 149	
988	Pineapple.	T, 1	
1260	Red Raspberry,	" 2	
Vor.	6	" 5	
"	9	" 11	
"	21	" 15	
"	38	" 18	
"	41	" 21	
"	50	" 25	
"	64	" 31	

These were root grafted at Ames between the twentieth of March and first of April. They were packed in sand two weeks, then repacked in sawdust and shipped to Minneapolis. They were again handled at the farm, being buried in a cool cellar and were not finally planted until April 28th, when the buds were quite swollen. From two to one hundred grafts of a variety were made, and considering their rough usage a very good stand was secured.

The above list includes, besides the scions cut on the Iowa Agricultural College farm, about a dozen varieties of imported scions which had just arrived from Russia.

In addition to these root grafts, the following trees were obtained of Prof. Budd at the same time. They were small two-year-old trees, and as soon as received at the station the roots were carefully pruned and puddled; they were then planted twenty-four feet apart both ways in the most exposed situation on the farm, with a view to giving them the severest test possible. This experimental orchard stands on an almost level pie ce of prairie, with a low wet spot in the centre—exposed on all sides to the winds.

List of Russian apple trees in experimental orchard, set in April, 1885:

Arkad,		Large Borsdorfer,
Antinovka,		Plodovitka,
Aport Orient,		Serinka,
Arabskoe,		Yellow Transparent,
Borovinka,	105	Russian Gravenstein,
Dobrin Krestiana,	122	Borsdorf Revel,
Early Sweet (Vor.),	169	Green Sweeting,
English Pippin,	177	Green Streaked,
Green Sugar,	185	Anisette,
Gruchevka,	187	Glass Green,

200	Rosy Little Turnip,
202	Hare Pipka,
206	Czar's Thorn,
252	O'Porto,
262	Charlamoff,
277	Wargul,
282	Woronech's,
284	Kremer's Glassy,
286	Kremer's (seedling),
316	Red Queen,
361	Pointed Pipka,
365	
375	Browny Pine,
382	Russian Green,
402	Borsdorf,
407	Blackwood,
410	Little Seedling,
413	Cross,
442	Yellow Calville,
447	Queen of Kiew,
447	Klineff's,
469	Grandmother,
477	Christ Birth,
502	Rus. Rambour Queen,
599	Omensk,
934	
984	Koursk's Anisette,
1277	
3 M	Lead,
4 "	Ostrokoff's Glass,
18 "	Anisim,
20 "	Kursk Reinette,
22 "	Blushed Calville,
5 Orel	(Names of Orel list all lost.)
21 Vor.	Yellow Calville,
56 "	Gipsy Girl.

The season of 1885 was favorable to tree growth, and the entire list lived, most of them doing remarkably well. The autumn of that year, however, was very wet and the frequent rains and warm weather induced a late growth, so that trees were not well matured when winter set in. This will account in some measure for the great loss sustained during the past winter. Many of the varieties were probably not hardy. Two trees of each kind had been planted, and where both were killed we may reasonably infer that the variety is too tender for us. The past winter brought the following results:

List of trees in experimental orchard killed during winter of 1885–1886.

3 M,	1 killed.
18 M,	2 "
5 Orel,	1 "
56 Vor.	1 "
105	1 "
122	2 "
169	2 "
185	1 "
202	1 "
206	1 "
252	1 "
262	1 "
282	1 "
316	1 "
365	2 "
382	1 killed.
402	2 "
410	2 "
413	1 "
442	1 "
Arabskoe	1 "
Serinka,	1 "
Large Borsdorf,	2 killed.
Dobrin Krestiana,	1 "
Green Sugar,	1 "
English Pippin,	1 "
Total dead,	37.
Total No. trees,	114.
Total varieties,	57.
Per cent of trees dead,	32½.

Of fifty-two Duchess apple trees—three years old, planted at the same time in the same orchard as the above, but five died,—or not quite ten per cent,—which would indicate that not more than one in three of the Russians is as hardy as Duchess. This showing, while it may be disputed by many friends of the

Russian apple, is far from being discouraging. A list of one hundred or more varities as hardy as Duchess would be most gratifying. However, the estimate, based as it is on the action of fifty-seven varieties during their first year's growth, is merely a slight indication of what we may expect and should not be considered as having much weight in view of the final results.

In this list those trees which up to the present time (December 1st), have made the best growth and seem best suited to the situation are as follows.

177	Green Streaked,
	Borovinka,
	Grucherka,
	Antinovka.
	Rulut's Nalin,
	Aport Orient,
934	
457	Klineff's Apple,
361	Pointed Pipka,
	Yellow Transparent,
200	Rosy Little Turnip,
496	Babuschino—Grandmother's,
	Arkad,
22 M,	Blushed Calville.

Late in April, 1886, the following sorts were set in place of the dead trees mentioned. Part of these were obtained from Prof. Budd and others transplanted from our own yearling nursery; in all cases the varieties had not been in the orchard previously.

List of Russian apples added to experimental orchard in spring of 1886.

4 M,	Ostrokoff's Glass.
24 M,	Sandy Glass.
29 M,	Melonen.
87 M,	Herren.
140 M,	Czar's Thorn.
149 M,	Revel Glass.
38 Vor.	Flat Varonesh.
50 Vor.	Cinnamon.
52 Vor.	
	Possarto Nalin,
	Sklanka,
	Simbrisk,
164	Heidarn's Streaked,
181	Champagne Pipka,
210	Cut Wine,
214	Garden Apple,
215	Bushy,
230	Titus,
243	Throne,
252	O'Porto,
268	Saccharine,
269	O'Porto Rosy,
275	Zolotoreff's,
282	Woronech,
290	Imperial,
304	Switzer,
315	Lord's Herrenapfel,
321	Sweet Pipka,
363	
365	
378	Hibernal,
437	Saxonian,
475	Holdfast,
984	Koursk's Anisette.

The orchard now contains eighty-one varieties of apples. As fast as any of these varieties die they will be replaced by a new sort and in this way it is hoped to test the hardiness of all.

The nursery is in a more sheltered position than the Russian orchard, and last winter the snowdrifts completely covered the young trees, so that they have not yet been subjected to very severe conditions.

About 2,000 of these trees will be ready for distribution in the spring of 1887. An effort will be made to send into each county of the State — north as well as south — trees of this first planting of the college.

Besides those varieties duplicated the following additional sorts were secured this year:

3 M, Lead.	Gruchevka.
87 M, Herren.	Harvey.
140 M, Czar's Thorn.	Dartt's Seedling.
184 M.	122 Borsdorf Revel.
52 Vor.	225 Getman's Bean.
428 Vor.	268 Saccharine.
Arabskoe Vor.	363
Plodovitka.	964 Autumn Streaked.
English Pippin.	982 Round White.
Arkad.	

LATE GRAFTING.

Late in the fall of 1885 half the yearling grafts were cut back for scions, so that this year's grafting has been largely to duplicate our previous list.

The scions thus cut were packed in maple and elm leaves, and placed in a cool cellar, where they remained until the sixteenth of April. They were then root grafted on stock secured from Bardwell & Haviland, Fort Dodge, Ia. The scions were made longer than usual — about six inches — the root piece about two inches long. The grafts were packed in slightly moistened ephagnum moss, on a cool, damp cellar floor. After two weeks they were planted, a subsoil plow marking out the rows as deep as it could be set. The grafts were set at a slight angle in the row, and were firmed very carefully, first by hand, after which the ground on either side was tramped hard. The stand was as good as is ordinarily obtained when the grafting is done at the usual time, in the late winter months. This result would indicate that it is not necessary, as is generally supposed, for grafts to callous before planting. Care in setting is of the greatest importance in graft culture.

THE RUSSIAN PEARS.

In the spring of 1885 there were planted on the experimental farm eleven varieties of Russian pears, viz.: Mos. 391, 439, 396, 17 Vor., 347, 358, 102 Vor., 343, 108, 27 Riga and 16 Orel.

Of these varieties eight were planted in the exposed experimental orchard, and four were set in the more sheltered hillside orchard.

Two trees of each sort were planted, and all grew. No. 17 Vor. did very poorly, the others making fair growth.

After the first winter all in the exposed orchard were dead except one tree each of Nos. 396, 347, 358 and 343 the last three of which have since died. No. 102 Vor. came through the winter in excellent shape, made a very good growth during the year, and was well matured when winter set in.

All the pears planted in the hillside orchard came through the winter with but slight injury; they are, Nos. 27 Riga, 16 Orel, Bessimianka, and 102 Vor. Bessimianka and 27 Riga were in especially fine condition.

We can scarcely hope for a pear that will stand our test winters, but the action of the four last named is certainly very encouraging. If they stand this winter we will propagate from them as rapidly as possible and send them out for trial in different sections of the State.

THE HILLSIDE ORCHARD.

This orchard, planted on a northeast slope, is protected on the south and west by a natural grove of oak; the ground was cleared three years ago and planted to rutabagas. The trees were set in the spring of 1885. The list is as follows:

APPLES.

10	Whitney's No. 20,
10	Tetofsky,
5	Rollins' Pippin,
39	Wealthy,
39	Duchess,
4	Giant Swaar,

CRABS.

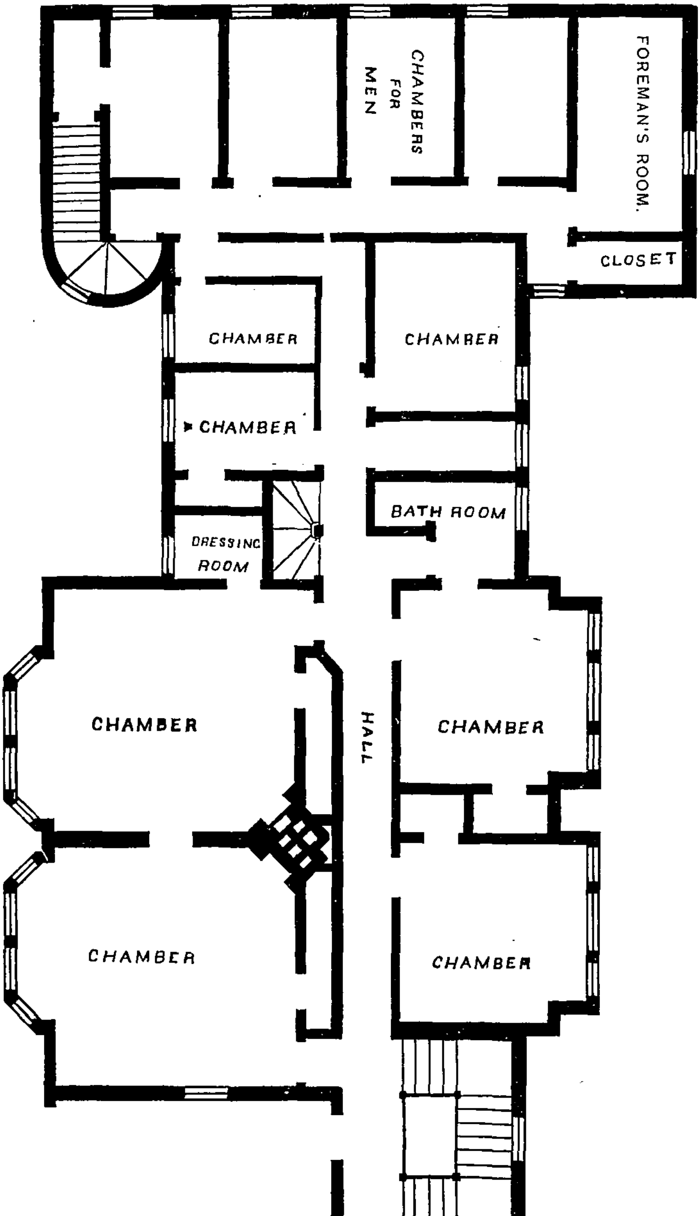
10	Orange,
9	Beecher's Sweet,
4	Power's,
3	Pearce's,
10	Minnesota,
10	Early Strawberry,

PLUMS.

4	Russian (all dead),
6	Rollingstone,
10	Desota,
10	Forest Garden,
10	Weaver.

The apples and crabs have all grown well — Duchess and Wealthy being very good.

The plums are planted in the highest part of the orchard where they have a light loam with sandy subsoil. The growth has been remarkable — the trees came through the winter with but very slight injury.



SECOND FLOOR

OF

FARM HOUSE

THE VINEYARD.

The vineyard was planted three years ago. It is purely an experimental collection of those varieties which would seem to be best adapted to growth and maturity in Minnesota. A small crop was grown last year, but the present season brought an abundant one, and afforded an excellent opportunity for judging the relative merits of the different kinds.

The collection consists of twenty-two varieties as follows: Concord, Niagara, Janesville, Pocklington, Delaware, Martha, Lady, Moore's Early, Ives' Seedling, Empire State, Hartford's Prolific, Worden, Brighton, Salem, Goethe, Wilder, Lindley, Agawam, Prentiss, Duchess, and Iona.

There were originally twenty vines of Iona, but they proved very poor growers and part of them were taken up, their places being filled last year with Empire State and Niagara.

The vineyard is situated on an eastern slope, the top of the hill is covered with a natural grove of oak, and the north side of the plantation is protected by the farm buildings, thus leaving a southern and eastern exposure.

In planting the vines each variety was put in a row by itself, extending up the slope, so that a person passing along the lower side is able to see the fruit of all.

The vines stand eight feet apart both ways and are trained to trellises running north and south. During the first half of the growing season very thorough cultivation is given with cultivator and hoe, and at no time are weeds or grass permitted to grow. There is nothing on the fruit farm that demands and so well repays good care as the vineyard.

Thus far we have practiced the long cane renewal system of pruning with very gratifying results.

At the beginning of the season three new canes are permitted to start from as near the base of the vine as possible, and are encouraged to make a strong, vigorous growth; all the other new wood is pinched back several times during the summer, throwing the strength of the vine to the fruit.

After the leaves fall in autumn the old canes are all cut away, leaving the three shoots of the season's growth; these are cut back to four feet and any laterals removed.

The canes thus prepared are laid on the ground, up the slope, and covered with earth, and remain thus until all danger of frost has passed the next spring. Great care is taken in removing the dirt and lifting the vines, as it frequently happens that the buds have swollen before being uncovered, and if many of them are broken off the vine will not only bleed badly, but bear a diminished crop.

We have endeavored to outline our method of cultivation and care thus fully because we have found that satisfactory results followed. Exactly the same treatment was given all varieties—a fact which should be borne in mind in considering the following notes and our comparative estimates of value.

Concord.—This variety has been justly called the "Grape for the million." It is hardy, having thick leaves that insure healthiness during the hottest summer, and is one of the most productive sorts known. Bunch and berry are large and beautiful. It bears shipping well. In flavor, while not by any means the best, it suits the majority of people and is hence a most valuable market grape.

It usually ripens up well during our season, though there is some danger of early frosts. This year our vines bore well and the fruit was well ripened September 25th.

While the Concord grape bears neglect better than any other variety—with the possible exception of the Clinton—it also is greatly improved by close pruning and thorough cultivation; not only is the size of the berry increased, but the flavor is heightened. There are many growers of Concords who have no idea of the perfection to which they can be brought.

Niagara.—This is a new white grape, for which great things are claimed. Our vines, set in the spring of 1885, have made excellent growth, and are perfectly healthy. The vine resembles the Concord, of which variety it is a seedling. It is not quite so strong a grower as its parent and the leaf, though good, is not as thick as Concord.

Our vines have not yet fruited.

Janesville.—This variety is one of the earliest in our collection and we hope to see it tested in the northern part of the State.

The vine is very hardy, a rather slender but vigorous grower, with thick, healthy foliage. The clusters are quite small, very compact, sometimes shouldered; berries medium or small, black, with some bloom. In flavor, as in size, it is much inferior to Concord, having a decided foxiness. It is at least two weeks earlier than that variety, however, and being a great improvement on the native wild grape, should be largely grown at the North, where the season is too short for Concord and other good varieties to mature.

Pocklintgon.—This is a seedling of the Concord, and at the time of its appearance, a few years since, was heralded as *the* white grape. It is a moderate bearer; the berries are large and of a yellowish white color, borne in medium to large shouldered bunches. The skin is tough and the pulp too solid; it wholly lacks that melting quality that is so noticeable in the Lady. The vine is a good grower, the canes being thick like Concord. Indeed, it resembles Concord in all save color and productiveness. There are other so-called "white" grapes that seem to be equally hardy that are more productive and of better quality. In season, it is with the Concord—possibly a little earlier.

Delaware.—The Delaware is one of the best grapes of our collection. It is a well-known variety and need not be described at length. It is not a strong grower, and in many parts of the country its thin leaves are liable to disease. During the past dry summer, however, it has been perfectly healthy here, and has matured a good crop; the bunches have been rather small, owing doubtless to the age of the vines, as the Delaware increases in size of fruit as it grows older.

The clusters are small, compact and shouldered. The berry is small, of a dark red color covered with delicate bloom. Skin thin and tough, pulp very sweet and melting. The Delaware is regarded by many good judges as the best American grape.

It is a rather shy bearer, and this is its greatest fault; otherwise it would be a most valuable market sort, as it always commands a high price.

Every grower should plant a few Delawares for home use. While not so prolific as the Concord, it is far superior in quality, and can be ripened wherever Concord can.

Martha.—The Martha has proven the most productive of all the "white" grapes in our list. In color it is a light green,—none of the "white" grapes showing that color in fact,—the bunches are medium in size, usually shouldered, compact. The berries are medium in size, having a very thin, tough skin. The flesh is not so sweet nor as melting as in the Delaware, but is better than the Pocklington. In season it is five days later than the later and may therefore be considered as on the verge of, if not beyond, its latitude. The vine is a good grower, with dark green healthy foliage.

Lady.—The Lady is by far the best of the white grapes, though with us not so productive as the Martha. The berry is almost as large as the best Concords, and when ripe is very light yellowish green in color. The bunches are rather loose, of medium size. It is a very sweet melting grape, and as it ripens a little earlier than Concord, may be safely planted in this section. It is not a good bearer and would not prove profitable for a market grape for that reason. The cane is almost as strong as Concord, and the leaf the best of all white sorts. Anyone wanting a white grape can find none better adapted to his needs than the Lady.

Moore's Early. — This is a comparatively new black grape, that is deservedly popular where known. It is, perhaps, the earliest grape in our vineyard; Janesville colors a few days sooner, but is not fully ripe a day before Moore's Early. It is a vigorous grower, giving heavy canes with large, thick leaves, which drop, long before all others, in the fall.

The clusters are rather small, but the berries are larger than Concord, of a deep black covered with beautiful blue bloom. This year it was ripe twenty days earlier than Concord.

This is an item of the very first importance to Minnesota grape growers, for there is too much danger of early frosts to make later varieties safe. In quality, Moore's Early surpasses the Concord, and is the best black grape in our vineyard.

Its greatest defect is that it is a poor bearer, and the berries do not cling well to the stems. We think this fault may disappear as the vines grow older.

All things considered, we regard it as the best grape for general planting in this State, and we hope to see it tested in every county.

Ives' Seedling.— In this variety we find little to recommend, for all of its good qualities are possessed by grapes that have none of its faults. It is a good grower, with deeply lobed leaves, which give it a distinct appearance. The bunches are loose, and many of the berries do not mature, indicating a lack of fertilization in the blossoms. The berries are medium in size, black, with no bloom, rather sour, with a strong, foxy flavor. It is earlier than Concord, but much inferior to that variety in quality. The roots of Ives' Seedling have been recommended as being a good stock on which to graft the Delaware; being very strong, they tend to impart more vigor to that excellent variety than it has when grown on its own roots.

Empire State.— Our vines of the Empire State were planted in the spring of 1885, and have not yet fruited. It is a fair, but not vigorous, grower, the leaves resembling those of the native wild grape more thanin any other variety.

Hartford Prolific.—This is a hardy, prolific bearer, of rather poor grapes. It ripens ten days before the Concord. The bunches are of good size, shouldered, with but few immature berries. Color black, with but little bloom, size not quite so large as Concord. The fruit is rather sour and quite foxy, and drops badly when ripe (this last is a very great defect). It bears very heavy crops, but being inferior in quality, can not be recommended for extensive planting.

Worden—Or Worden's Seedling, as it is sometimes called, is, after Moore's Early, the most promising of the newer black grapes. In habit of growth it closely resembles Concord, of which variety it is a seedling. It ripens earlier by ten days than the Concord, bears fully as well as that variety, and like it has large, more or less shouldered clusters. The berry is large, black, with fine bloom, sweeter, and rather less foxy than Concord. Our vines bore well the past season, and we can safely recommend it for planting in this State. It is to be preferred to Concord on account of its early maturity; in most other respects it resembles that variety, the difference in quality not being so great, in our opinion, as has been claimed for it.

Brighton. —If the past season is a fair one by which to judge we should pronounce the Brighton to be the best grape for all purposes in our vineyard. It bore a fine crop of very large, compact bunches; the berries of medium to large size, dark red, with delicate bloom. The skin is thin, and the pulp very melting and sweet, with a delicious vinous, slightly spicy flavor. It ripens a little earlier than Concord, bears fully as heavy crops, and brings a much better price. It is a good grower, though not so strong as Concord. The leaves are large, but rather thin, and evidently could not stand in so trying situations as the standard variety; however, with us it is an entire success.

It has been claimed that it can not be depended upon for self-fertilization, and for that reason should be planted in alternate rows with Concord or some other straight stamened variety; it has not shown this defect in the experimental vineyard, but in any case the remedy is easy.

The variety is worthy of extensive planting, both for home use and market.

Goethe.—This variety did not ripen this year; a good crop was set and the vine is strong and healthy, but the season was rather longer than usual and any variety that demands more time for maturing than this season afforded is valueless for Minnesota planting. For this reason it can not be recommended and should not be planted.

Prentiss.—The Prentiss has a wooly, rather small, light green leaf which distinguishes it from all others. It is not a strong grower and this season produced but a small crop of fruit. Bunches small and very compact; berries a little larger than the Delaware, of a light green color, slightly tinged with yellow when ripe. In flavor it is sweet, but rather insipid; the pulp is not so tender as in the Lady—in no way does it equal that variety.

Persons desiring to make a collection of grapes will, of course, include the Prentiss, but it can not be recommended for general planting.

Salem.—This variety and the next resemble each other in most respects. They have the heavy cane of the Agawam, but are much inferior to that sort in growth. The clusters of Salem are small and rather close; the berries large, of a very dark red color, with but slight bloom. They have the strong, spicy aroma and flavor peculiar to many of Rogers' hybrids, but this variety is very sweet and, when fully ripe, the pulp is quite tender.

It is about the season of Concord or a few days earlier. It is a shy bearer and for this reason is not a profitable variety.

Wilder.—The Wilder differs from Salem in being a little earlier, darker colored—almost black when fully ripe—and in its greater sweetness and tenderness of pulp. It is one of the best of the Rogers group in quality and is a healthy, though not a rapid, growing vine.

The bunches are too small and scarce for a valuable market sort, but for home use it will prove satisfactory where quality rather than quantity is sought.

Lindley.—The Lindley is a rampant grower, producing very heavy, healthy canes. It bears a fair crop of amber colored, slightly oval berries, borne in loose clusters. The vine is perfectly healthy. It is a little later than Concord, but matured with us this season. The flavor is very spicy and to many people is unpleasant. While adding to the interest of a large collection, its long season makes it undesirable for general planting in this State.

Agawam.— This is the strongest grower of the Rogers list, having heavy canes and large thick leaves. The fruit is a very dark amber color, large, with thick skin and juicy, rather tough pulp. The seeds are very large. There is a musky, spicy flavor in this grape more pronounced than in any other of the Rogers. The clusters are very loose and have a ragged appearance. It bore a heavy crop this season and was scarcely ripe when frost came.

There are none of the Rogers hybrids adapted to our State, for the reason that they demand too long a season for ripening. Some years, like the present, afford plenty of time, but usually a heavy frost comes before they are fully matured.

Duchess.—This variety was planted for the first time last spring. It grows well, but of course has not yet fruited with us.

Iona.—The Iona is an old variety, well known and highly esteemed in the East. It has been grown with some success at Minnetonka, but here it failed. After having taken up our vines, which were very weak, and resetting with other sorts, we last spring again set some Ionas; they made a very poor growth during the summer and we can not therefore recommend them.

I would advise the planting of the following varieties:

For the extreme north, Janesville and Moore's Early. For the State at large, for general market and home use, Moore's Early, Worden's, Delaware, Brighton, Concord.

It will be noticed that no white grape is included in this list of recommended varieties.

Those desiring a larger collection will find Lady, Wilder, Agawam or Lindley, and Martha, worthy a place in their vineyard.

GRAPE VINES FOR DISTRIBUTION.

There will be ready for distribution in the spring of 1887 about 2,000 one-year-old vines, from cuttings taken from our vineyard. The list includes limited quantities of all the varieties described above. It is hoped that every county in the State will secure some of this first stock, and that thorough cultivation and intelligent care will be given, and careful reports made to this department.

In this way the whole State will be benefited, and definite results will be quickly reached.

GRAPES GROWING FROM CUTTINGS.

The excellence of the vines grown this year on the experimental farm was remarked by many visitors. The method followed may be of interest.

The pruning of the vineyard is done as soon as the leaves have fallen, and before any severe freezing. As the wood is cut it is removed to a moist cellar, each variety being kept separate.

Then the cuttings are made. The lower end is cut just below a bud, the cut beginning opposite the bud and slanting downwards.

Two or three buds are allowed on each cutting, ten inches being about the average length. The upper cut is made an inch above the bud.

The cuttings are then made into convenient bundles, the butts being perfectly even.

A label, wrapped in oiled paper, is put in each package. They are tied with tarred rope or willow withes, and then placed, butts upward, in a pit in such a way that the butts are perfectly level.

Fine dirt is then sifted on, about two inches deep, and on top of this coarse manure is placed.

In the spring the litter is removed during the day, so the heat of the sun can reach the butts, thus inducing callous. On cold nights the litter is replaced.

The cuttings are not removed from the pit until all begin to strike roots — frequently not until late in May.

When the roots begin to appear, the ground for planting should be prepared, by thorough and deep subsoiling in the rows, and the cuttings then set like root grafts.

The young roots must not be exposed to the sun. They are kept under damp sacks and planted from pails of water. The ground is thoroughly firmed around the cuttings, and cultivation is begun as soon as the first leaf appears. Nothing responds so quickly to thorough culture as the grape.

Our cuttings were all taken from the pit the same day, and planted immediately.

The following table will show the results:

Table showing varieties cultivated, number of cuttings planted, number of good vines raised and percentage grown:

Number of Variety.	Number of Cuttings Planted.	Number of Vines Grown.	Percentage Grown.
Agawam	354	120	.33
Brighton	230	145	.63
Concord	462	160	.34
Delaware	362	60	.16
Empire State	27	......	......
Goethe	236	145	.61
Hartford Prolific	311	135	.43
Ives' Seedling	300	165	.55
Janesville	360	90	.25
Lady	183	25	.13
Lindley	345	125	.36
Martha	256	52	.20
Merrimac	114	35	.37
Moore's Early	332	130	.40
Niagara	62	7	.11
Pocklington	241	125	.52
Prentiss	124	25	.20
Salem	92	45	.50
Wilder	160	80	.50
Worden	471	170	.36

The small percentage of vines grown to cuttings planted was due to the immaturity of the wood when the cuttings were made, and the severe drought which set in soon after they were planted, and the very uneven numbers are accounted for by the fact that certain varieties—those of which the fewest vines were obtained—require more time for callousing and far better results would have been obtained had these sorts beeen left longer in the pit.

For the purpose of experiment, however, the method followed was a complete success, as it showed that the same treatment is not best for all varieties of the vine, and demonstrated what kinds need the most time for casting roots.

SMALL FRUITS.

STRAWBERRY.

The past season proved very trying for the strawberries, and resulted in an almost complete failure of the raspberry crop. We had no rain from the time the plants began blooming until near the end of the strawberry season.

The result of this was a fair opening of the season, with fine large berries. A few very warm days ripened much of the fruit prematurely, so that, with a glutted market and later on very small, immature berries, the crop was far less profitable than the first days of the season promised.

In order to test the relative merits of matted row and single planting, two beds had been set in the spring of 1885. The "matted row" bed contained the following varieties, so planted as to secure ample fertilization for the sterile sorts:

Crescent, Countess, Manchester, Chas. Downing, Windsor Chief, Captain Jack, Iron Clad, Minnetonka Chief, Ray's Prolific, Wilson, Glendale, Jas. Vick, Green Prolific, Jersey Queen. Of the last three varieties only a few plants were set. From one and a half to four rows, three hundred feet long, were planted with each of the other sorts.

When the plants fruited last spring it was found that certain sorts were badly mixed;—Countess and Crescent occupied the same row; Glendales proved in the main to be Crescents,—the other sorts being in the main true to name. Dealers and buyers can not be too careful in regard to this matter of keeping varieties distinct and true to name. As soon as the mixture was discovered labels were placed defining exactly its extent, and any further mistake thus prevented.

The following notes may be of value to new planters:

Crescent.—This is the most popular variety grown in the State. It succeeds well in a great diversity of soils, bears large annual crops, has a bright red color, and when fully ripe a pleasant flavor, though not so sweet as some others. It is sterile in flower, and must therefore always be planted with fertile sorts—that is, with varieties whose flowers have both stamens and pistils.

The best method is to plant every alternate row with the fertile kind, although it is not uncommon to secure good crops when only the fourth rows are thus set. It is one of the earliest varieties, and this, with heavy cropping, has made it the most valuable market sort grown.

Countess, or Downer's Prolific.—This berry is lighter colored than Crescent, and hence does not sell so readily. It is round, very tender, and when fully ripe has a fine, delicate flavor. It did not bear well for us, requiring a heavier soil.

The Manchester is one of the largest-sized berries grown. It produced the largest berries of any we have. In color it is very light—a coral red. It is flattish conical, oblate, and is not as good as Crescent, and a medium cropper.

Chas. Downing is one of the older sorts, justly celebrated for its sweet, delicate flavor. It is a dark red, rather long, conical berry. It bore a very light crop this year, and the fruit, which is only average in size at best, was very small. Later in the season the leaves were slightly troubled with rust.

Windsor Chief is a flattish, oblate berry, of very dark red color throughout. It is very rich, and in good seasons doubtless a good bearer, as much of the fruit was set which, owing to the dry weather, was very small and "knotty." The plant grows very close to the ground, and should be carefully mulched to keep the fruit from being soiled.

Capt. Jack was almost a failure this year. But little fruit set, and it was very small and crude. The plants are not healthy on our light wood loam.

Iron Clad—This variety has the best foliage of any in our list. It blossomed sooner than any of the others, but owing to the drought very little fruit was set, and it was of poor quality. It is doubtless a good variety.

Minnetonka Chief.—This variety gave great satisfaction. The bulk of the crop was gone when it began fruiting. It gives a large number of medium, even-sized berries — quite acid. When fully ripe and its high flavor surpasses the Crescent. It grows well, has good foliage, and is a very good late variety.

Ray's Prolific.—This berry is prolific only of plants—its fruit is too small and too scarce to be of any value. Not worth the ground it occupies, but we shall test it again next season.

Wilson's Albany.—This old-time favorite remains one of the best berries in the list. A row of Wilson and Crescent—about an equal mixture—gave a remarkable yield. The firmness of the Wilson and its bright color make it one of the best shipping berries grown. It is early, and is thus one of the leading sorts for the home market.

Glendale.—Our plants of Glendale nearly all proved to be something else. The few plants that were true to name gave large, firm fruit, of a rather dull red color. In size it is very good, and when fully ripe has an agreeable flavor, but it seems, from this year's test, scarcely equal to our other late sort—Minnetonka Chief.

James Vick, Green Prolific, and Jersey Queen.—Our plants of these varieties were too few to give a fair idea of their worth. None of them are as good growers on light loam as Crescent.

HILL CULTURE OF THE STRAWBERRY.

In the spring of 1885 a large bed was set from which the runners were carefully trimmed. Crescent, with every third row Wilson, was planted. The growth was very fine. The plants were set fifteen inches apart in the rows. In autumn they had filled the intervening space—all runners having been cut off.

The bed was given a light mulch of cornstalks in December. The snow drifted badly over it and in March a few weeks of freezing and thawing made ice cakes here and there over the patch. The result was that wherever the ice had thus formed the plants were killed. A very poor crop was obtained. During the past season the dead plants were reset with all fertile sorts and the bed changed to matted row system.

RASPBERRY.

The following raspberries were set in the tree rows of the hillside orchard in the spring of 1885:

RED: Superb, Cuthbert, Turner.
BLACK: Gregg, Doolittle.
YELLOW: Golden Cup.

To these were added in the spring of the present year:

Brandywine, Marlboro.
Tyler, Mammoth Custer.

As has been said of the strawberries, the dry weather prevented anything like a fair crop of fruit. In the autumn of 1885 the plants, which had been pinched back during the summer, were covered with earth. They came through the winter well and gave a great deal of bloom. During the blooming season of Superb and Turner the drought was so severe that no fruit was set. The Cuthbert, which is much later, gave a fair yield of very fine, large berries. The Cuthbert is much better for shipping than Turner because much more firm. In quality it is not so good, but still a very nice berry. It is a rampant grower and should be repeatedly nipped through the summer.

Neither the Superb or Turner, which resemble each other in their habit of growth, produces such strong canes as Cuthbert. Both are good healthy varieties and have made an excellent showing this season.

Only a few plants of Gregg lived, they being in very bad condition when received. Those few, however, were covered with fine, large berries of good quality.

Of the Doolittle none lived. The Golden Cups, while not so badly affected by drought as the Turner, yet showed in the small size of the fruit that the season was unfavorable. It would be unfair to condemn it under the circumstances. Should a good season bring no better results, however, it will be discarded.

BLACKBERRIES.

Owing to the very bad condition of our first setting when received very few lived. Those few, however, made excellent growth; they were covered with earth last winter, came out this spring in excellent condition and should give a fine crop another year. The variety is Snyder.

Last spring we planted Ancient Briton and Stone's Hardy, both of which have grown very well during the summer. There is scarcely any doubt but that all these varieties, with proper protection, will be successful here.

CURRANTS.

We have fruited this year Red and White Dutch and Black Naples currants. Red Dutch, one of the oldest varieties known, remains one of the best for general culture. It is a great bearer and stands the neglect to which the currant bushes are usually doomed better than any other sort.

We have added this year Stewart's Seedling and Fay's Prolific, both of which have done well, Stewart's being the more rapid grower.

FOREST AND ORNAMENTAL TREES.

There is a wide field for experimentation and trial in this line. The number of trees and shrubs indigenous to Minnesota is limited, and we must therefore search in other lands for additions to our list.

Nothing adds more to the attractiveness and money value of a farmstead than judiciously planted shelter belts and lawns. The action of forest trees, when planted on the bleak, treeless prairie, is very different from their natural growth along the streams. The farmer should choose those varieties which will not only grow rapidly, but whose timber will be valuable to him for other uses than fuel.

FOREST TREES.

During the spring of 1885 we received from Robert Douglass a shipment of yearling trees, with a few two and three year old evergreens. They were all planted in nursery rows and given thorough cultivation, being kept free from weeds the entire season, but no cultivating was done after the first of August. In the following notes their comparative growth is indicated:

Negundo Aceroides, box elder or ash-leaved maple. This is one of the best known and most widely distributed forest trees in America. It is found from Maine to the western boundaries of Kansas and Nebraska, and seems equally at home on river bank and prairie ridge.

During the summer of 1885 our trees, which averaged about six inches in height when planted, made but little growth, not averaging more than eight or ten inches. Many of them killed back a little in the winter, owing, doubtless, to not being well established in the soil.

The past summer has demonstrated their phenomenal growth; the increase this year will average three and one half feet, while many of the trees showed a growth of over six feet.

The wood of box elder makes better fuel than cottonwood, and with such rapid growth as the above indicates it is proven an excellent thing for wind-break planting. At least a dozen rows should be set for this purpose — the outer trees will throw out many lateral branches near the ground while the central ones will be forced to grow tall and straight — thus securing at the same time a good wind break and long, smooth logs.

Fraxinus Americana — White Ash. — Both the white and green ash (which are so nearly alike as to be only distinguishable to experts) show a surprising growth for the past summer, almost equaling, on an average, that of box elder. There are fewer extra sized trees, but the average is more uniform. When it is remembered that ash is the best timber grown for making and repairing farm machinery, not to mention its superior value as fuel, this rapid growth becomes a matter of great importance to the prairie farmer. The past season shows that, with the same cultivation, the ash almost equals the box elder in growth; hence, the farmer would do well to plant it in preference. It killed back slightly last winter, but when firmly established will doubtless prove hardy here.

Prunus Serotina — Black Wild Cherry.—The wild cherry grows in the woods on the experimental farm and so is no doubt hardy, but we question the advisability of planting it extensively in forestry; a few hundred trees in the nursery show good growth. In order to make them throw out a leader it was necessary to nip back the lateral branches repeatedly during the summer. The white flowers and the dark red fruit of this tree make it quite ornamental and desirable for lawn planting; it should be more generally used. The great mistake in ornamental planting — one to be seen in the city parks as well as rural homes — is a lack of diversity; the different varieties of native trees show many pleasing leaf forms and varied shades of green whose effectiveness is not appreciated until brought together, and one of the most beautiful of the entire list is the wild cherry.

Juglans Nigra — Black Walnut.— There is some doubt of the hardiness of this tree in this latitude, as it is not found native. The groves on the Minnesota River, further south, contain it, however, and it is worthy of trial here. It shows a very fair growth, though not equal to wild cherry. The timber of black walnut is the most valuable of all native trees and, though a slow grower, it should be planted extensively, if hardy.

The Poplars.—Through the kindness of Prof. Budd, of the Iowa Agricultural College, we have secured a number of varieties of Russian poplars and willows.

A liberal number of cuttings will be distributed in the spring of 1887.

The collection includes the following:

Populus certinensis is an erect form with broadly ovate, wavy leaves, lighter colored and more spreading than the Lombardy, which it resembles. It grows more rapidly than the common cottonwood, and we judge it to be in every way a better tree.

Populus laurifolia.—This is one of the most distinct varities in the genus. Its leaves are long, narrow and wavy, dark glossy green. It is highly ornamental and should be generally planted.

Populus nolester has long-pointed, ovate leaves, very dark green. It branches freely and in habit of growth is much like the common cottonwood.

Populus fastagata is considered by Prof. Budd the best timber tree in the list, It is somewhat erect, and has leaves much like the Lombardy, but they are lighter colored.

Populus alba, the Russian silver poplar, is much more beautiful than the native species. The leaves are more cut and it has the erect habit of the Lombardy poplar.

THE RUSSIAN WILLOWS.

Salix fragilis—*Red Willow.*—This variety is said to take the place of pine in many parts of Russia, the wood being light, strong and easily worked. It is a rapid grower, and is propagated easily from cuttings. The twigs are quite red in winter, whence the name.

Salix napoleonis is a drooping form of peculiar beauty. The leaves are small, linear, with a bluish green color. The branches are very slender. It has not yet been grafted, but when a good stock is found we will have no "weeping" tree superior to it. Perfectly hardy and easily grown from cuttings.

ALDER.

Alnus incana, the Scotch alder, is one of the little known ornamental trees, growing to a height of from thirty to fifty feet. Trees planted in the spring of 1885 came through the winter without injury. It is a rapid-growing, beautiful tree, with roundish, wedge-shaped, deeply netted leaves. Being perfectly hardy, it should be extensively grown.

Caragana.—This is a small tree with compound leaves, and small clusters of bright yellow, pea-shaped flowers. Young specimens passed through last winter without injury.

THE EVERGREENS.

Beside the white, Austrian and Scotch pines, the Norway and white spruces, and the balsam fir, all of which show excellent growth, we have a few varieties not so well known that deserve extensive trial in Minnesota. Our climate is peculiarly adapted to the growth of hardy conifers, and no class of trees, when judiciously planted, are more effective in the winter landscape.

Pinus resinosa—*Red Pine.*—This is one of the long-leaved pines, its "needles" measuring often nine inches. This long foliage gives it an entirely distinct appearance, and is very pleasing. Small trees (two years old) passed through the last winter without injury. We think it perfectly hardy.

Tsuga Canadensis, Canadian Hemlock.—This tree is known to all lovers of evergreens, but it is not planted as often as its beauty merits. The spray-like, graceful branches, with their fine dark foliage, make it one of the most desirable trees for lawn planting.

Our small trees grow only less rapidly than the pines and spruces.

Picea pungens — Menzie's Spruce, or blue spruce as it is sometimes called, is without doubt the most beautiful species of the genus. The rigid, slightly incurved leaves are thickly set on the branches, and their bluish-green foliage, when seen among the vivid green of the darker conifers, forms a very pleasing contrast. Our young trees have made excellent growth thus far, and are hardy and healthy.

Abies concolor—Silver Fir.—Our trees of this magnificent sort have not grown well thus far; the leaders die, giving the trees a ragged appearance. It seems a hardy variety, and probably will do better with age. The leaves are longer and wider than in balsam fir, are covered with a slight bloom, and incurved. Well-grown specimens would doubtless prove very beautiful.

Pseudo-tsuga Englemanni—Englemanni's False Hemlock, or spruce, as it is sometimes erroneously called, is a promising Rocky Mountain conifer. Its leaves resemble the Canadian hemlock, but are wider and lighter colored. They show a marked two-ranked arrangement. The young trees have made a good growth thus far, and seem well adapted to our climate.

Catalpa speciosa—The Hardy Catalpa.—In the spring of 1885 we planted a few trees of catalpa. They had been cut back repeatedly, and had very strong roots. During the summer they made a moderate growth, more than half of which was killed back last winter. The past summer they have grown well. The catalpa is evidently a little beyond its latitude here, and while its broad leaves and beautiful flowers make it a desirable ornamental tree, it should not be planted extensively until it has been well tested for this latitude.

Pirus Americana.—The American mountain ash has long been regarded as one of the most beautiful lawn trees, not only for its fine compound leaves, but more for the clusters of bright red and saffron berries which it produces in September. Our young trees have made a remarkably fine growth.

Acer dasycarpum — The Silver or White Maple — This is the common soft maple that is found along the river valleys. A row of fifty trees on the experimental farm illustrates well its virtues and vices, its rapid growth and symmetrical form, and its bad habit of breaking in a strong wind. In this state box elder can be substituted for soft maple, in all cases.

Ulmus Americana.—The white elm is the best tree for stree planting that we have. Its tall, clean trunk and graceful spread of branches make it particularly valuable for this purpose. Its wood is tough, and makes fairly good fuel.

Acerplatinoides.—*Norway Maple.*—A few hundred very small trees of this variety, planted two years ago, made a surprising growth the past season. Norway maple has always been regarded as a very slow grower, and the first year after planting these were true to their reputation; but this season, by keeping the laterals pinched back, we secured a growth, in some cases, of almost three feet. It is a very valuable variety of hard maple, having a round head and tall, clean trunk. Its deeply divided leaves and variegated foliage render it one of the most beautiful ornamental trees.

ORNAMENTAL SHRUBS.

The following flowering shrubs are now growing on the experimental farm. The list is small, as yet, the work in other directions having been deemed of greater importance:

Lilacs.—The *Persian, white* and *common lilacs* all succeeded well, and their beautiful, fragrant blossoms, appearing before the garden flowers begin to bloom, make them among the most valuable flowering shrubs. The lilac is one of the old-fashioned flowers which should be seen in every garden.

Flowering Currant.—This is another old favorite, whose spicy yellow blossoms are the first to appear in the spring. Unlike the lilac, it blooms every year, but, like that shrub, it bears neglect. It is one of the hardiest shrubs grown.

Spiræas.—This is a class of flowering plants that is not appreciated as it deserves. It contains many very beautiful specimens.

Spiræa triloba is a low form, not over three feet, whose graceful, drooping branches are quite hidden by the small clusters of fine, white flowers, distributed along the stem. It is perfectly hardy, of symmetrical shape, and is peculiarly adapted for bordering large clumps, or for single planting on the lawn.

Spiræa sorbifolia.—A vigorous grower, spreading by means of underground stems. Leaves compound, light green, fern-like, appearing earlier than in any other shrub. Flowers very fine white, in large plume-like clusters, often ten inches long, appearing in June. The fine foliage of this variety makes it beautiful throughout the season. It is perfectly hardy, one of the best species.

Spiræa nobleana.—A low form with lanceolate leaves and fine, delicate pink flowers, in broad, compound racemers. Blooms in July and August. Has not yet been thoroughly tested as to hardiness.

Spiraea amurensis — The Russian form of our S. *oppulifolia*, which it very closely resembles.

The leaves are broadly ovate, three lobed, about two inches long. The flowers cover the shrub in June, appearing in clusters of two inches diameter, in the axils of the leaves. The fruit of this variety is a bright crimson, papery capsule, making the shrub very interesting throughout the season. A strong grower, fully matured specimens reaching seven feet in height. Hardy and one of the best.

Spiraea lanceolata.— Is an erect form, resembling S. *triloba* in flower, but the clusters are larger. Blooms in June.

The family contains many more interesting species which will be secured and their hardiness determined.

Hydrangea paniculata.— This shrub is becoming very popular. Its large panacles of creamy white flowers appear in August and last far into September, after all other shrubs have ceased blooming. Our specimens were planted last spring, so we can not report as to their hardiness. If perfectly hardy, it should be widely planted.

THE ROSES.

Aside from the native wild rose, which certainly deserves a place in one corner of every garden, the rose family has but few members hardy enough to endure Minnesota winters.

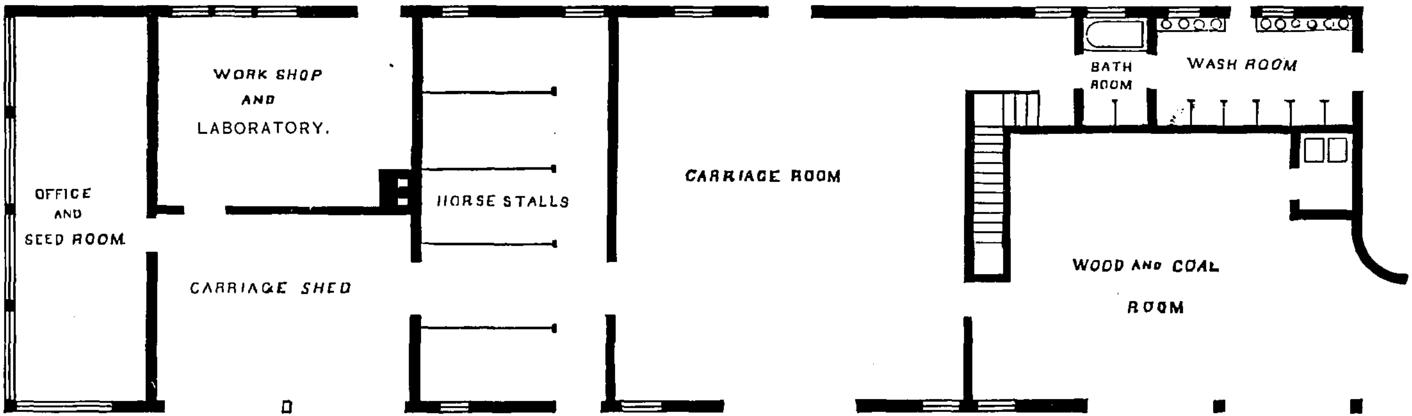
Several bushes of the old-fashioned "blush" rose planted in the shrubbery beds do fairly well, but the variety has a bad habit of blasting its buds, and but very few perfect flowers are formed. A pink moss rose gave beautiful buds this year, but it was covered deeply with snow throughout the winter — which was ample protection.

Through an oversight, about two dozen hardy perpetual roses, including several plants of General Jacquemenot, were left out all winter. The snow came in great drifts over the bed and gave ample protection; the plants nearly all came through the winter in good condition.

Two hundred plants, principally Hermosa, a "hybrid tea" rose, were taken up late in autumn, their remaining leaves removed, and they were then buried, root and branch, in the root cellar. On taking out the plants last spring, it was found that over half of them were badly injured — the cellar being too warm for them.

Probably the best method of winter protection for hardy, perpetual roses is to treat them exactly like grape vines, using rather more earth in covering.

Tea roses should be potted in winter and if no bloom is desired they may be set in a cool cellar; the earth in the pots being kept slightly damp but never wet.



FIRST FLOOR OF CARRIAGE HOUSE

WHEAT EXPERIMENTS.

For these experiments a piece of ground was selected which had been cropped consecutively for twenty-two years with wheat and oats until 1883, when it was seeded down with clover on the wheat of that season. In 1884 a heavy crop of hay was harvested, and the second crop plowed under early in the fall, In 1885 it was used for experiments with commercial fertilizers. and cropped with wheat, yielding twenty-six bushels to the acre. The ground was plowed in October, 1885. On May 4, 1886, the ground was well harrowed, and divided into exactly quarter acre strips for the following experiments. The seed used was "Blue Stem," and was all sown with a Hoosier drill with a "drill regulator attachment," by which both the quantity and the depth could be accurately adjusted.

SHALLOW AND DEEP SEEDING.

No. of Plat.	Depth of seed.	When sown.	When up.	When ripe.	When cut.	Total weight.	Weight of straw.	Weight of grain.	Yield per acre.
1.	1½ inch.	May 6.	May 13.	July 30.	Aug, 6.	900 lbs.	585 lbs.	315 lbs.	1,260 lbs.
2.	2 inch.	May 6.	May 14.	July 30.	Aug. 6.	802 lbs.	477 lbs.	325 lbs.	1,300 lbs.
3.	2½ inch.	May 6.	May 15.	July 30.	Aug. 6.	827 lbs.	522 lbs.	505 lbs.	1,220 lbs.
4.	3 inch.	May 6.	May 16.	July 30.	Aug. 6.	942 lbs.	640 lbs.	302 lbs.	1,208 lbs.
5.	3½ inch.	May 7.	May 17.	July 30.	Aug. 6.	1,045 lbs.	723 lbs.	322 lbs.	1,288 lbs.
6.	4 inch.	May 7.	May 18.	July 31.	Aug. 6.	807 lbs.	467 lbs.	340 lbs.	1,360 lbs.

THICK AND THIN SEEDING.

No. of Plat.	Seed per acre.	When sown.	When up.	When ripe.	When cut.	Total weight.	Weight of straw.	Weight of grain.	Yield per acre.
7.	1 bu.	May 7.	May 13.	Aug. 1.	Aug. 6.	830 lbs.	528 lbs.	302 lbs.	1,208 lbs.
8.	1¼ bu.	May 7.	May 13.	Aug. 1.	Aug. 6.	695 lbs.	422 lbs.	253 lbs.	1,012 lbs.
9.	1½ bu.	May 7.	May 13.	Aug. 1.	Aug. 6.	652 lbs.	378 lbs.	274 lbs.	1,096 lbs.
10.	1¾ bu.	May 7.	May 13.	Aug. 1.	Aug. 6.	770 lbs.	482 lbs.	288 lbs.	1,152 lbs.
11.	2 bu.	May 7.	May 13.	Aug. 1.	Aug. 6.	690 lbs.	462 lbs.	228 lbs.	912 lbs.

REMARKS.

These results are not to be regarded as establishing any rule for practice; such a rule can only be determined by a series of experiments extending through several years, so that the influence of heat and moisture of different seasons may be eliminated. The summer of 1886 was marked by unusual heat and a deficiency of rainfall; and these conditions, combined with the ravages of chinch bugs and grasshoppers, reduced the yield of the experimental plats far below what it would have been under ordinary circumstances. The importance of these experiments, as affecting this staple crop of Minnesota, demands their continuance, and I have made arrangements for their repetition the ensuing year.

EXPERIMENTS WITH VARIETIES OF GRAINS AND VEGETABLES.

The following varieties have thus far been experimented with, to determine the number of days between planting and maturity, in order to test their adaptation to the climate and season of Minnesota. The next series of experiments will be made with those of shortest season of growth, to determine their quality and yield, and thus their value for cultivation in this State.

WHEAT.

No. of Plat.	Name of Variety.	No. of days to ripen.	Remarks.
1	Australian Club	80	Beardless, soft variety.
2	Blount's Black Bearded	110	Too late for Minnesota.
3	Blount's Big May	....	Did not form heads.
4	Blount's Hybrid, No. 15	105	Long, smooth heads; late, but good.
5	Blount's Hybrid, No. 16	91	Promising variety, beardless.
6	Blount's Hybrid, No. 17	85	Bearded, plump amber grain, valuable.
7	Blount's Improved Fife	100	Long heads well filled; valuable.
8	Blount's Rust Proof	106	Good variety.
9	Blount's Seven Headed	85	Good grain, very prolific.
10	Blue Stem	79	Beardless, stiff straw, long head, well filled.
11	Canada Club	94	Beardless, white chaff, white berry.
12	Champlain	93	Bearded, soft variety.
13	China Tea	100	Bearded, long heads, stiff straw, soft.
14	Defiance	100	Smooth, soft grain.
15	El Dorado	99	Bearded, hard variety.
16	Egyptian	100	Bearded, branched heads.
17	Fish Pole	....	An Oregon variety; did not head.
18	Golden Drop	95	Smooth; short straw and head.
19	Golden Globe	97	Bearded, long heads, good yield.
20	Hallet's Pedigree	80	A new and desirable variety.
21	Pringle's Best	78	Large, full heads; a desirable variety.
22	Pringle's Hibrid, No. 4	78	Valuable.
23	Pringle's Green Mountain	76	Worthy of further trial.
24	Rio Grande	100	Bearded, stiff straw.
25	Russian Fife	95	Smooth, hard; good quality and yield.
26	Saskatchewan Fife	95	Smooth, hard; best quality and yield.
27	Sherman	90	Very poor in quality and yield.
28	Sibley's, No. 1	100	Well headed; full, plump berry.
29	Sonora	75	Earliest of all varieties tested.
30	Touzelle	92	Heavy bearded, red chaff, short heads.
31	White Fife	91	Straw medium, well headed and filled.
32	White Russian	92	Straw long and stiff, long heads well filled.
33	White Siberian	92	Similar to White Russian.

OATS.

No. of Plat.	Name of Variety.	No. of days to ripen.	Remarks.
1	Alvey	88	Plump grain, early, weak straw.
2	Brunswick	91	Not a good cropper.
3	Black Norway	96	Late; stiff straw, good yield.
4	Black Tartarian	99	Horse mane, heavy yield, coarse hull.
5	Canadian	86	Large yield; best variety in four trials.
6	Excelsior	89	White; plump grain, stiff straw.
7	Golden Russian	88	White; stiff straw, fine yield, desirable.
8	Holstein	86	White; stiff straw, well headed and filled.
9	Kamtchatka	96	Late, strong growth, white berry, weak straw.
10	Mediterranean	96	Late, stiff straw.
11	Probsteier	92	White, plump grain; one of the best.
12	Silver White	89	White; light straw, but stiff.
13	Waterloo	91	White; weak straw, heavy yield.
14	White Dutch	90	Straw short and stout, but poor yield.
15	White Schoenen	86	White; good quality and yield.
16	White Surprise	88	White; stiff straw, well headed and filled.
17	White Victoria	94	White grain, weak straw, good yield.
18	Dakota Chief	85	Weak straw, poorly filled heads.

BARLEY.

No. of Plat.	Name of Variety.	No. of days to ripen.	Remarks.
1	Chevalier	76	Good yield, stiff straw.
2	Four Rowed	70	Early, weak straw.
4	Maushury	68	Stiff straw, early; large yield.
5	Russian Melon	72	A choice new variety; large, full grain.
6	Russian No. 3	72	Very similar to the above.

SUGAR CORN.

No. of Plat.	Name of Variety.	No. of days from planting to table maturity.	Remarks.
1	Amber Cream	86	Well formed ear, fine quality; one of the best.
2	Brighton Orange	80	White cob and grain; very sweet and tender.
3	Black Mexican	90	White cob, black grain; fine flavor.
4	Crosby's Early	90	Small stalk and ear, but sweet.
5	Early Concord	88	Early but not equal to Minnesota.
6	Egyptian	91	White cob and grain; very sweet and of the very best quality.
7	Golden	81	White cob, golden yellow grain.
8	Mammoth Sugar	98	Very large ear; good quality but too late.
9	Marblehead Early	68	The earliest good variety.
10	Minnesota	72	Best early variety; cob and grain white.
11	Narragansett	77	Cob and grain red; fine flavor.
12	Potter's Excelsior	92	Cob and grain white, ears long; fine quality.
13	Ruby	78	Red grain, white cob; sweet and tender.
14	Stowell's Evergreen	96	The standard late variety.
15	Tom Thumb	70	Very early, but small stalks and ears.
16	Triumph	92	White cob and grain; a good late variety.

FIELD CORN — DENT.

No. of Plat.	Name of Variety.	No. of days to matur'y	Remarks.
1	Adam's Early	85	Small ear, shallow grains; the earliest.
2	Chester Co. Mammoth	120	The largest ears and stalks; too late.
3	Farmer's Favorite	105	Yellow, well-filled ears, deep grain.
4	Hundred Days	102	Yellow orange grain, red cob.
5	Leaming	110	Yellow grain, good ear, medium stalks.
6	Michigan Dent	98	Yellow grain, medium ears, good variety.
7	North Star	102	Yellow, well-formed ears, deep grain.
8	Queen of the Prairie	110	Long, well-filled ears.
9	Rural New Yorker	110	Long ears, deep grain, but did not ripen.
10	Sibley's Pride of the North	100	Bright yellow, small cob, deep grain.
11	Dakota Dent	95	Yellow, small cob, deep grain.
12	White Dent	110	Medium ears, well filled, good grain.

FIELD CORN — FLINT.

No. of Plat.	Name of Variety.	No. of days to matur'y	Remarks.
1	Canada	1^5	Eight rowed, shallow grain.
2	Compton's Early	105	Long ears, well filled, deep grain.
3	Dolly Dutton	96	Small ears, shallow grain, small stalks.
4	King Phillip	100	Copper red colored ears; early, desirable variety
5	Longfellow	105	Long ears, well filled, deep grains.
6	Pierce's Columbia	100	A very desirable early variety.
7	Rural Thoroughbred	115	Very long, eight-rowed ears.
8	Waushakum	118	Deep golden orange grains, small cob.
9	Self Husking	100	Open husks, small ears; no especial value.

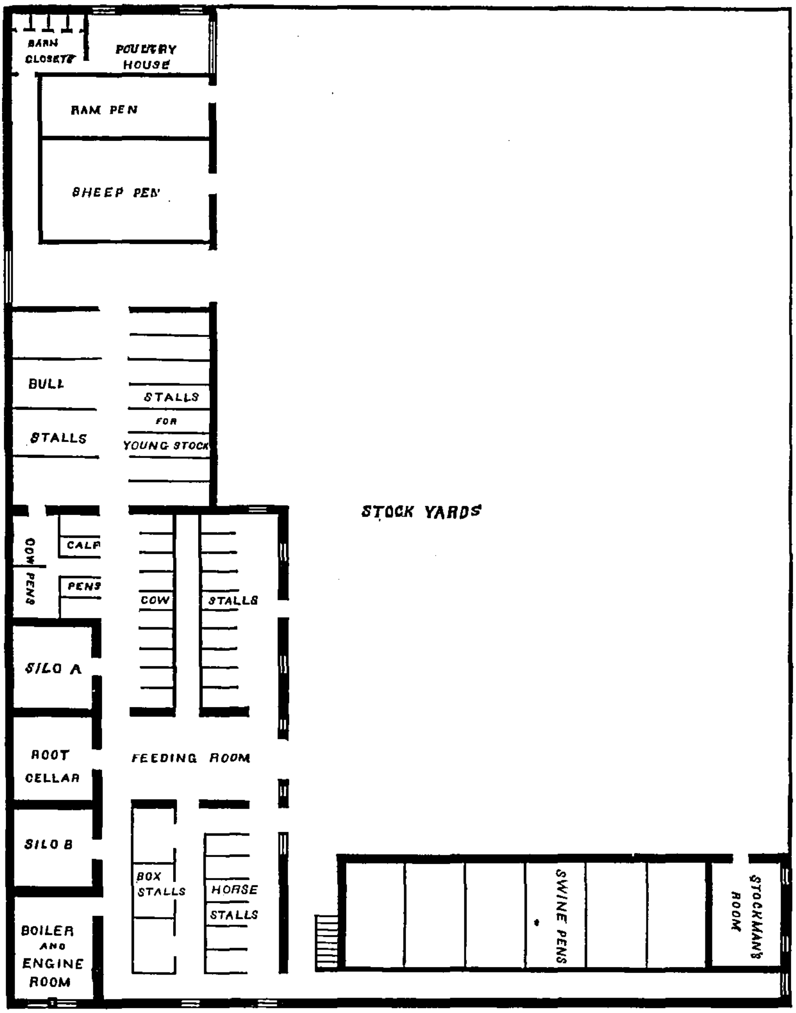
PEAS.

No. of Plat.	Name of Variety.	No. of days from planting to table.	Remarks.
1	American Wonder	60	Very dwarf, good yield, good quality, long season.
2	Canada Field	75	Medium yield, poor quality, good for stock.
3	Carter's First Crop	68	Good yield, medium quality.
4	Carter's Gem	71	Dwarf, and of good quality.
5	Carter's Surprise	72	Medium bearer, extra quality.
6	Cleveland's Best	60	Large yield, fine quality.
7	Cleveland's New Yorker	62	Long pods, well filled, fine quality, long season.
8	Champion of England	77	Good quality and long in bearing.
9	Dwarf Blue Imperial	75	Medium vine, best quality, liable to mildew.
10	Dexter	71	Medium yield, medium quality.
11	Dwarf Marrow	75	Medium yield, good quality, long in season.
12	Early Philadelphia	66	Standard early variety.
13	Early Caractacus	66	Medium yield, extra good quality.
14	Early Kent	72	Good cropper, medium quality.
15	Early Dan O'Rourke	68	Medium yield, poor quality.
16	Eugenie	79	Medium yield, extra quality, long season.
17	Fill Basket	75	Good yield, medium quality.
18	Gray Seeded Sugar	80	Large sweet, edible pods.
19	Kentish Invicta	77	Good yield, good quality, medium season.
20	Laxton's Prolific	75	Medium yield, good quality, large vines.
21	Large Gem	77	Medium yield, good quality.
22	Laxton's Superlative	79	Good yield, very poor quality.
23	Laxton's Alpha	55	Medium yield and quality, long season.
24	McLean's Advancer	70	Medium yield, good quality.
25	McLean's Blue Peter	58	Medium yield, very dwarf.
26	McLean's Little Gem	60	Good yield, good quality, very dwarf.
27	McLean's Premier	83	Medium yield, good quality
28	Marrow Fat, black eyed	75	Heavy yield, poor quality, very large vines.
29	Marrowfat White	83	Heavy yield, medium quality.
30	Napoleon	75	Medium in yield, good in quality.
31	Omega	75	Medium quality.
32	Popular	75	Medium quality.
33	Prince of Wales	70	Good yield, good quality.
34	Princess Royal	75	Very good quality, long in season.
35	Stratagem	70	Large yield, best quality, medium season.
36	Telephone	70	Good yield, first quality.
37	Tom Thumb	65	Medium yield, good quality, very dwarf habit.
38	Yorkshire Hero	75	Very large, good quality, large bearer.
39	Veitch's Perfection	80	Medium yield, extra quality.

Among these varieties, American Wonder, Cleveland's Best, Cleveland's New Yorker, Little Gem, and Philadelphia maintain their reputation for earliness; and Champion of England, Eugenie, Stratagem, Telephone, and Yorkshire Hero for quality and productiveness.

BEANS.

No. of Plat.	Name of Variety.	No. of days to table use.	Remarks.
	Field Beans.		
1	Early Manley	77	The best field bean for Minnesota.
2	Prolific Tree	84	Good bearer and good quality.
3	Navy	80	The standard bean for general culture.
4	White Kidney	95	Medium yield, best quality.
5	White Marrow	93	Medium yield, best quality.
6	White Medium	78	Heavy yield, good quality, popular in market.
7	Red Kidney	88	Good yield, good quality, color objectionable.
	Dwarf Beans.		
1	Cleveland's Valentine	53	Early and productive.
2	Dwarf Horticultural	69	Good for succotash.
3	Dun Cranberry	69	Quality good.
4	Early China	57	One of the best snap beans.
5	Early Mohawk	55	Light brown color, kidney shaped.
6	Early Rachel	55	Beans a dun color, kidney form.
7	Early Brown Six Weeks	55	Same as Mohawk.
8	Early Yellow Six Weeks	55	Strong grower, but not a pole bean.
9	Early Valentine	55	A reliable early snap bean.
10	Wax, Black	61	All the varieties of wax beans are of best quality and productiveness, but liable to rust in wet weather.
11	Wax, Golden	60	
12	Wax, White	60	
	Pole Beans.		
1	Carolina	70	Good quality and productive.
2	Concord	70	Productive and of good quality.
3	Horticultural	68	A reliable pole bean, very productive, good quality.
4	Dreer's Improved Lima	70	Best quality, very productive for Limas.
5	Large Lima	76	Full pods, best quality, but too late.
6	Small Lima	68	The Limas need a long season for growth.



FIRST FLOOR
OF
BARN

EXPERIMENTS IN POTATO CULTURE.

For four seasons we have grown a large number of varieties of potatoes and have added to the collection from year to year until the list given below is believed to embrace the largest number of those well-known and recognized produced by any one grower in this county. They have been cultivated for the following purposes:

First—To test their adaptation to the soil, season and climate of Minnesota.

Second—To determine whether our soil, season and climate will restore the lost vigor and productiveness to those varieties so popular years ago.

Third—To enable cultivators in Minnesota to properly identify varieties.

It is proposed to continue these experiments one year longer, under the most favorable conditions, and then tabulate and report the results.

Thus far our work would lead us to the following conclusions:

1. Out of the great number of varieties tested, but a few possess all the qualities desirable for a table or market potato in our State, however valuable they may be elsewhere. Among them I will mention as especially worthy, Beauty of Hebron, Burbank Seedling, Chicago Market, Clark's No. 1, Dakota Red, Early Household, Early Sunrise, El Paso, Garfield, Mammoth Pearl, White Star, and Snow Flake.

2. That change of climate, soil, and season will not restore the lost stamina of the older varieties, and we can never hope to regain for profitable cultivation the Fluke, Neshannock, Peachblow, Pink Eye, and Mercer of years ago, and that the quality and productiveness of even recently introduced popular varieties, are rapidly deteriorating. The Early Rose, Early Ohio, Early Vermont, Michigan White Sprout, and others are failing every year, and even the hardy Burbank is becoming pointed and watery at one end, and will, in a few years, be added to the long list of discarded varieties.

The potato crop of the United States is now over two hundred millions of bushels annually, and rapidly increasing. Its importance demands that careful investigations and experiments shall be conducted to determine the cause of deterioration, and the remedies. These are especially desirable for Minnesota for the reason that our soil and climate are peculiarly adapted for the growth of this crop.

At present the cause of this deterioration seems to be due to the loss of constitutional vigor in the plant, due to long continued propagation from the same stock, in which all the diseases and defects of years of cultivation have accumulated. The remedy indicated is to go back to the seed and develop new varieties, which, by careful selection, cultivation, and crossing, will be adapted to the peculiar conditions of respective portions of the country. This line of work will receive much attention at our station in the future.

A number of the following varieties of the most value and promise have been grown in considerable quantities and distributed throughout the State for trial; of the others only small quantities have been saved for the experiments of the next season. This collection was exhibited at the New Orleans Exposition and at our State Fair for three years past, and at all of them attracted marked attention. Persons having varieties not on this list will confer a favor upon the station, and aid in our work by sending a four-pound package by mail, or a small box by express, at our expense, for which due credit will be given in future reports.

LIST OF POTATOES GROWN ON THE EXPERIMENTAL FARM OF THE COLLEGE OF AGRICULTURE OF THE UNIVERSITY OF MINNESOTA, 1886.

Acme.
Adirondack.
Agawam.
Alaska Blue.
Alpha.
Amazon.
American Giant.
Andes.
Angola.
Ashleaf Fluke.
Ashleaf Kidney.
Badger.
Baldwin.
Banks.
Beauty.
Beauty of Hebron.
Bellaire.
Belle.
Ben. Merritt.
Berkshire.
Black Diamond.
Black Mercer.
Black Prince.
Bliss' Triumph.
Blue Kidney.
Blue Mercer.
Blue Neshannock.
Blue Seedling.
Blue Western.
Blush.
Bonanza.
Bradford Seedling.
Breadfruit.
Breakfast.
Bresee's Prolific.
Brimhall.
Brooks.
Brownell's Beauty.
Brownell's Best.
Brownell's Success.
Brownell's Superior.
Bucyrus.
Bulkeley's Seedling.
Burbank.
Busam's Early.
Busam's Late Prime.
Calico.
California.
Early Sovereign.
Early Sunrise.
Early Telephone.
Early Vermont.
Early York.
East Branch.
Eclipse.
El Paso.
Empire.
Empire State.
English Rose.
English White.
Eureka.
Excelsior.
Excelsior Kidney.
Extra Early Seedling.
Extra Early Vermont.
Field Crop.
Findlay.
Forest Rose.
Forfarshire Red.
Foster's Late Rose.
Fox Seedling.
French.
Garfield.
Garnet Chili.
Gem.
Gen. Grant.
German Russet.
Giant.
Gideon's Seedling.
Gilbert's Seedling.
Gilman.
Globe.
Golden Gem.
Gray Russet.
Greenfield.
Guernsey.
Hall's Peachblow.
Hamburg.
Hamilton.
Harrison.
Harlequin.
Hickory.
Hinman.
Holly Hock.
Huntington Seedling.
Hyde's Seedling.
Palmyra.
Paragon.
Patterson's Albert.
Patterson's Blue.
Patterson's Early White.
Patterson's Golden Don.
Patterson's Regent.
Patoka.
Peachblossom.
Pecan.
Peerless.
Philbrick's Early White.
Pigeon Eye.
Plymouth Rock.
Prince of Wales.
Pride of America.
Prince Edward.
Purple Blush.
Purple Mercer.
Purple Peerless.
Queen of the Valley.
Queen of the West.
Quinby's Seedling.
Rand's New Peachblow.
Rand's Red.
Raspberry-Leaved.
Red Climax.
Red Gem.
Red Jacket.
Red Kidney.
Red Orange.
Red Pachblow.
Red Streak.
Red Ulink.
Ridgefield Seedling.
Rochester Favorite.
Rochester Seedling.
Rocky Mountain Rose.
Rose of Erin.
Rose Bud.
Rose of the West.
Rosy Morn.
Rough and Ready.
Round White.
Roxbury.
Rubicund.
Ruby.
Rural Blush.

California (purple).
California Mercer.
California Peachblow.
Callao.
Campbell's Late Rose.
Carpenter.
Cayuga.
Centennial.
Chenery.
Chicago Market.
Chili No. II.
Clark's No. I.
Climax.
Colebrook.
Collum's Seedling.
Colorado.
Colorado II.
Columbus.
Compton.
Compton's Surprise.
Concord.
Conner.
Conn. Blue.
Conover.
Cornell's Kidney.
Cowhorn.
Cullock.
Dakota Red.
Davenport Seedling.
Davis Seedling.
Dover Seedling.
Dr. Bretonneau.
Dr. White.
Duke of Cumberland.
Dunmore.
Dykeman.
Early Blue.
Early Don.
Early Durham.
Early Essex.
Early Favorite.
Early Golden.
Early Household.
Early Harvest.
Early Indiana.
Early June.
Early Kidney.
Early Lilac.
Early Manly.
Early Mayflower.
Early Mohawk.
Early Ohio.
Early Peachblow.
Early Pinkeye.
Early Prince.
Early Queen.
Early Racehorse.
Early Rose.
Eerly Rose Seedling.
Early Scotch Cottage.
Early Shaw.
Ice Cream.
Improved Ashleaf Kidney.
Improved Gem.
Irish American.
Jackson White.
John Bright.
Jones' Seedling,
Jordan's Prolific.
Jumbo.
Kansas.
Keystone State.
King of Jacksons.
King of Sweden.
King of the Earlies.
Lackawanna.
Lady Finger.
Lang's Seedling.
La Plume.
Lapstone Kidney.
Late Pinkeye.
Late Rose.
Ledding's Seedling.
London White.
Magnum Bonum.
Mahopac Seedling.
Maiden's Blush.
Manhattan.
Massachusetts White.
Maso White.
Mammoth Pearl.
Massasoit.
Matchless.
Merino.
Miller.
Minnesota Seedling.
Missouri White.
Monas Pride.
Motley.
Mountain Blue.
Muldoon.
Nanuet.
Napoleon.
Neshannock.
New Hartford.
New Kidney.
Niggerhead.
Niggertoe.
Noblow.
Noyes.
Ohio Beauty.
Ohio Kidney.
Ohio Pinkeye.
Old Flesh-colored.
Old Kidney.
Old Pinkeye.
Old White.
Oneida.
Orono.
Palmer.
Palmer's No. 1.
Palmer's No. 2.
Samaritan.
Scotch Blue.
Scotch White.
Seedling Cusco.
Seedling Mercer.
Seedling No 2.
Seedling Peachblow.
Seedling Prolific.
Seedling Rock.
Shaker's Fancy.
Sheridan.
Silverskin.
Six Weeks.
Skerry Blue.
Snapdragon.
Snowball.
Snowflake Early.
Snowflake Late.
South Bend.
Starch.
Startler.
Stonehouse.
Strawberry.
Telephone.
Temple.
Tioga.
Tippecanoe.
Titicaca.
Topeka.
Tucker.
Tyrian Purple.
Utica Pinkeye.
Vanderveer.
Vermont Champion.
Vermont Seedling.
Wall's Orange.
Western Chief.
West Windsor.
Whipple's Seedling.
White.
White Apple.
White Cowhorn.
White Eyed Peachblow.
White Elephant.
Whiie Lily.
White Market.
White Mercer.
White Mountain Early.
White Peachblow.
White Rock.
White Rose.
White Sprouts.
White Star.
White Ulink.
Willard.
Wilson.
Wm. R. Prince.
Worcester.
York Seedling.

ENGLISH AND FRENCH VARIETIES.

Barrow's Perfection.	Marjolin Cetard.	Red Emperor.
Blanchard.	McKinlay's Lady Webster.	Red Fluke.
Bountiful.	Model.	River's Royal Ashleaf.
Coldstream.	Myatt's Prolific Ashleaf.	Rogmon Rose.
Excelsior Kidney.	Patterson's "The Queen."	Scotch Regent.
Fenn's Early Market.	Patterson's Victoria.	Sedila.
Fenn's Early White.	Porter's Excelsior.	St. Helena.
Fenn's Perfection.	President.	Stanton's Premier.
Fenn's White Kidney.	Prince Albert.	Sutton's Exhibition Kidney.
Hayes' Superb Kidney.	Prince Arthur.	Sutton's Red Skin Flower-ball
Headley's Nonpareil.	Prince Teck.	Wonderful Red Kidney.
Jersey Blue.	Prince of Wales Kidney.	Yorkshire Hero.
King of Potatoes.	Quarantaine Violette.	
Marceau.	Rector of Woodstock.	

GARDEN VEGETABLES.

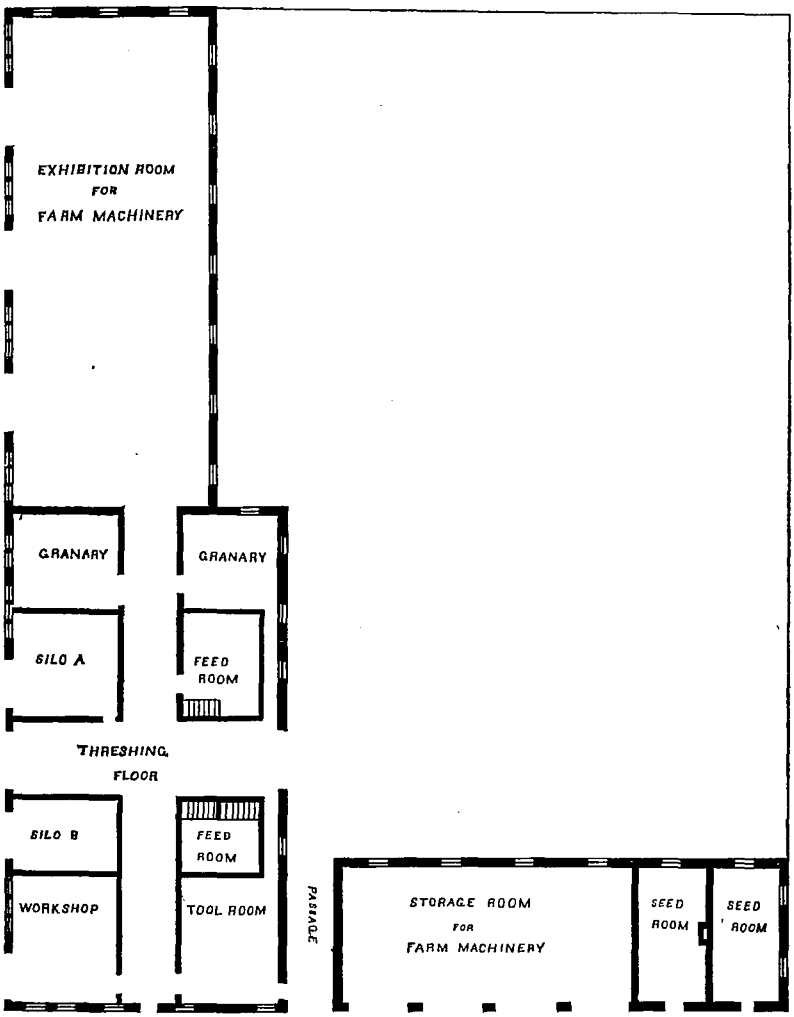
Every variety of garden vegetable grown in Minnesota has been cultivated on the farm the past year, chiefly as "object lessons" for the young men in the "School of Practical Agriculture," to familiarize them with the appearance, methods of culture, and uses of this class of farm products, and also to determine their adaptation to our soil and markets.

At the request of the commissioner of agriculture I have tested a variety of seeds of new vegetables, plants and grasses, some of which will, no doubt, prove of value to our section; but further trials are needed before expressing an opinion. Among them I may mention new watermelons and cucumbers from Russia and Siberia, new varieties of barley and oats from Russia, new forage plants from Russia, and ten selected varieties of tobacco. These will be grown next season, and the seeds of such as prove desirable will be distributed in limited quantities throughout the State for further trial.

EXPERIMENTAL GRASSES.

The rapidly growing importance of the stock and dairy interests of the State, the increase of settlement and cultivation, and consequent decrease of our native grasses, render it very important to determine the best varieties of improved grasses to introduce. For this purpose a strip of ground twelve hundred feet long and one hundred feet wide has been laid off in beds six feet in width and one hundred feet long, with an alley two feet in width between them. In these beds it is proposed to grow every variety of improved grasses and forage plants which can be grown in Minnesota. I had growing the past season:

Orchard Grass.	Timothy.	Italian Rye Grass.
English Rye Grass.	Fowl Meadow Grass.	Meadow Fescue.
Johnson Grass.	Rhode Island Bent.	Kentucky Blue Grass.
Sweet Vernal.	Alfalfa or Lucerne.	Alsyke or Swedish Clover.
Mammoth Red Clover.	Medium Red Clover.	White Clover.
Common Millet.	Hungarian Grass.	German or Golden Millet.
Spergulum Maxima.	Serradella.	Vicia Velosa.
Sesamum Oriental.	Blue Lupine.	Yellow Lupine.



SECOND FLOOR
OF
BARN

ENSILAGE EXPERIMENTS.

The process of storing green forage plants in pits called "silos," for stock feeding, has attracted so much attention for years past in Europe, and latterly in portions of our own country, that, considering the increased attention given to the stock and dairy interests of our state, I have thought best to institute a series of experiments to determine the value of this process to the farmers of Minnesota.

The term "silo" is applied to the pit, cellar; trench or bin in which the food is preserved; "ensilage" is the process of cutting and storing the article, and "silage" is the term used to designate the product.

There is good reason for believing that this process which is attracting so much interest and discussion to-day, like many other supposed achievements of the present century, was known and practiced by the Greeks and Romans over eighteen hundred years ago, and the writings of Cato, Columella and Pliny prove that this method of presvering green food was known and practiced by the inhabitants of Cappadocia, Thrace and Spain, at a very early period. Its modern use dates from the beginning of the present century; it has been known and practiced in Hungary for about eighty years, in Spain for fifty years, in Germany and France since 1855, and in our own country since 1876, when Mr. Francis Morris, of Oakland Manor, Howard County, Maryland, erected the first practical silo, and introduced this process to American agriculturists.

From this beginning the system has spread until at present silos are numbered by thousands, of many forms and sizes, in different parts of the country, chiefly in the Eastern and Middle States, and as far West as Nebraska. Experiments and investigations upon this subject seem to establish the following conclusions:

1. That all varieties of forage plants, including Indian corn, rye, oats, the different millets and clovers, field peas, the tops of beets, turnips and mangolds, and the various grasses, can be successfully preserved, but owing to the ease of cultivation, general adaptation, nutritive value and productiveness, Indian corn is the crop above all others best suited for this purpose.

2. That the silos may be built of any material, either entirely underground, partly excavated, or wholly above the surface, and of any form or location, to meet the wants of its builder, so that certain essential conditions are fulfilled. These are, that it shall be strong enough to hold its contents, estimated at fifty pounds per cubic foot, and a weight of from fifty to one hundred pounds per square foot placed on its upper surface. It should be made both air tight and water tight, and its inner walls should be vertical and smooth to permit the silage with its covering to settle easily and uniformly.

3. That the silage properly grown and preserved is a healthy, nutritious and economical food for all kinds of farm stock, but especially valuable for milk cows.

4. That as a cattle food, it forms a good and cheap substitute for root crops, but that to secure the best results, it should not be fed exclusively, but mixed with some other nutritious fodder.

THE FARM SILOS.

For the purpose of testing fully the adaptation of this process to the wants of Minnesota farmers, I have constructed two silos, in our barn, marked A and B, on ground plan No. 1; these are situated on the right and left side of the main threshing floor, and are 16 feet by 16 feet square, and extend from the level of the feeding floors of the basement stables, to the third floor of the barn, a height of 21 feet. Doors open into them from the threshing floor for filling, and out of them on a level with the basement for facility of feeding. The walls to the level of the second floor of the barn, 11 feet, are of stone, 18 inches in thickness,—above that, is double studded with 2x6 inch scantling, well "bridged." The floor of the silo was made with a bed of concrete, composed of one part of Louisville cement, and two parts of sand, with water enough to make the mixture the consistency of thick cream, then adding coarse gravel and small pebbles thoroughly incorporated until the mass was like stiff mortar, when it was spread evenly over the bottom of the pit and well rammed down, and finished off smoothly with a wooden float. A slope of one inch to the foot was given to the floor, towards the centre, where a well two feet in diameter and four feet deep, was sunk into the underlying gravel formation, for the purpose of giving thorough drainage to the silo. The sides of this well were cemented, but the bottom left open and then filled up to the level of the floor with pebbles the size of a hen's egg. The walls were listed up and down with 2x4 scantling, 16 inches from centre to centre, and boarded up with matched flooring— thus leaving an air space of two inches around all the sides. Over this covering I placed two thicknesses of tarred building paper, and over this a covering of matched flooring nailed on vertically. This construction gives an air-tight, water-tight, and frost-proof silo, and most conveniently placed for filling, feeding, and the preservation of its contents.

THE SILAGE CROP.

I selected a piece of old ground which had been run continuously for twenty-two years in wheat, oats and potatoes, without a particle of fertilizer, except one crop of clover, the second crop of which, was plowed down in the fall of 1884. Last year the plot was devoted to potatoes and corn. In the spring of 1886 I covered the ground with half-rotted barnyard manure, at the rate of fifteen tons per acre. The ground was plowed, harrowed and rolled, June 1st and 2d, and planted with Burrill and Whitman Southern ensilage corn June 3d. The seeding was most rapidly and satisfactorily done with a Buckeye grain drill, by "stopping off" two out of every three of the tubes, giving rows twenty-four inches apart, and dropping the seed quite uniformly three inches apart and two inches deep. The ground was well rolled after seeding; and, the weather being favorable, it germinated rapidly and evenly, and was all up June 10th. June 15th a fine tooth cultivator was passed between the rows, and again June 25th. At the last date the corn was an average of twenty-four inches in height, covering the ground, and received no further horse cultivation, but July 16th weeds and grass were removed by hand. The crop was seriously injured about August 1st by the "chinch bug," and was badly broken down by a severe storm August 15th, and was badly cut by hail September 16th; but, notwithstanding these drawbacks, by September 20th, when we began harvesting the crop and filling the silos, it averaged twelve feet in height, and on a large portion of the stalks the ears were formed and the grain in the milk. The corn was cut by hand, laid in bundles on the ground, allowed to wilt twenty-four hours, loaded on wagons and carefully weighed, on the road to the silo, cut with a Ross Ensilage Cutter, No. 14, A, into half-inch pieces, and fed into the silo as fast as cut, with one of Ross' Angle carriers, and packed as firmly and evenly as two men could handle it. The cutting was done very rapidly and satisfactorily by the machine, driven by one six-horse-power engine, placed in the boiler room, marked on Plan No. 1. The filling was done very gradually, the work being limited to the afternoon of each day for ten days, in order to allow farmers, stockmen and others interested, an opportunity of witnessing the work, which opportunity was taken advantage of by many visitors from this and adjoining states. Silo "A" was filled to a height of sixteen feet, with sixty tons of the cut corn, when it was covered with a flooring of two-inch plank; over this a double layer of tarred paper, and again with a covering of inch boards running parallel with the first planking, and on top of the whole was placed 31,000 pounds of building stone, or about 120 pounds to the square foot. Silo "B" was filled in the same manner with sixteen tons of corn silage, and covered in the same manner, but left without any weights, until October 6th, 7th and 8th, when the covering was removed, and nine tons of mangold and sugar beet tops, the product of one acre of these roots, were added, and the whole covered as before and weighted with forty barrels of sand and gravel, or about sixty pounds to each square foot of top surface.

The four acres of corn yielded, after being cut and wilted for twenty-four hours, seventy-six tons of silage,—five tons cut green and fed to stock in August, making at least twenty tons per acre. As all tests and analyses prove that *three* tons of corn silage are equal to *one* ton of best clover hay, this makes a return equal to six and two-third tons of best cured clover hay to the acre, besides furnishing a ration of succulent feed for stock at a season of the year when most needed and relished.

In order to examine the changes in temperature which take place in the silo during the period of "curing," if it may be so called, I placed a series of one and one-fourth inch gas pipes in a vertical position, two feet apart from side to side through the centre of the pit. The lower ends were closed by tightly fitting caps; the tubes were 16, 14, 12, 10, 8, and 6 feet in length, and thermometers were placed in each one, resting on the cap at the lower end; these were examined from time to time, and the temperature recorded, as also the amount of settling of the silage in the silo. The results are given in the following table:

The silos on the farm will be opened in January, 1887, and their contents examined, and fed to all the farm stock, and the results noted and reported. All persons interested are cordially invited to visit the station and examine this, and all other operations there conducted.

Table Showing the Changes in Temperature and Settling in Silo.

No. of the Thermometer.	Distance of the Thermometer from the Bottom of Silo.	Temperature at Different Periods.										
		Oct. 1.	Oct. 4.	Oct. 5.	Oct. 8.	Oct. 11.	Oct. 15.	Oct. 21.	Oct. 27.	Nov. 10.	Dec. 1.	Dec. 16
1	0 ft.	78°	79°	80°	80°	79°	78°	7[illegible]°	76°	75°	70°	66°
2	2 ft.	87°	88°	87°	87°	87°	86°	86°	85°	83°	76°	72°
3	4 ft.	93°	93°	93°	93°	94°	94°	95°	92°	89°	82°	76°
4	6 ft.	95°	9[illegible]°	94°	94°	94°	94°	92°	90°	85°	78°	72°
5	8 ft.	9[illegible]°	95°	92°	93°	94°	94°	94°	93°	90°	80°	78°
6	10 ft.	78°	82°	82°	83°	84°	84°	84°	81°	80°	74°	67°
Temperature of the External Air	....	27°	44°	41°	58°	59°	35°	34°	21°	28°	—24°	—20°
Amount of Settling.......... ..	in 16 ft.	3 ft.	3 ft. 10 in.	4 ft.	4 ft. 2 in.	4 ft. 4 in.	4 ft. 5 in.	4 ft. 6 in.	4 ft. 7 in.	4 ft. 8 in.	4 ft. 8½ in.	4 ft. 9 in.

EXPERIMENTS IN FEEDING WHEAT BRAN.

It is estimated that it requires annually 75,000 head of cattle to furnish Minneapolis and St. Paul with beef, and that at least 65,000 of them are raised and fattened outside of Minnesota, while millions of tons of good wild hay are allowed to go to waste every year, and ——— tons of feeding stuff are exported to Eastern points to build up the stock and dairy interests of other communities.

The question naturally arises, can not Minnesota raise her own stock, on her own prairies, and prepare it for market with the waste products of her own mills, and thus keep at home a large amount of capital now sent out of the State?

There is a prevalent impression among stock breeders and cattlemen that there is no feeding value in *wheat bran*, and it is regarded as little better than sawdust; but the following table of analyses, collated from the latest authorities, proves it to be relatively one of the best, and considering its market price in Minnesota, the cheapest, feed that can be employed for stock feeding:

1 Variety of Grain per 100 pounds.	2 Water.	3 Ash.	4 Albuminoids or Flesh Formers.	5 Fibre.	6 Carbo-Hydrates Starch, Sugar and Gum.	7 Fat, Oils and Wax.
Wheat, bran	11.53	3.94	12.57	7.29	61.20	3.47
Flint corn	10.85	1.45	10.87	1.61	70.29	4.93
Dent corn	11.23	1.48	10.49	1.91	70.15	4.74
Sweeet corn	8.81	1.87	12.15	2.31	66.87	7.99
Oats	10.56	2.95	11.41	9.01	61.10	4.97
Barley	11.09	2.47	12.41	2.89	69.32	1.82
Rye	11.77	1.86	10.66	1.67	72.43	1.61

In this table columns 4, 6, and 7 indicate the valuable feeding elements.

For the purpose of giving the feeding value of wheat bran a practical test, I purchased in June, 1886, a lot of ten medium grade steers, in the Southern part of the State. They were in ordinary condition for the season, were three years old, and were selected to secure as nearly uniformity in breeding, age, weight, and feeding quality as possible. The lot weighed, when received, June 13th, 10,300 pounds. They were placed at once in a good pasture of clover, timothy and orchard grass with an abundance of water and shade. They were taken up July 13th, and the lot weighed 10,774 pounds; a gain of 474 pounds in one month. The steers were then placed in stalls, under a large, well-ventilated shed, and fed three times a day with mixed clover and timothy hay and wheat bran. They were watered morning, noon and night, and had free access to salt. The bran and hay were weighed each day, and the steers were weighed every week, at the same hour. I commenced with six pounds of bran to each animal morning and night, with all the hay they would eat up clean, and after the first week gave the same amount at noon. This ration was continued until August 1st, when it was increased to eight pounds at each feed, for one-half the number, and continued at six pounds for the other half. This method of feeding and weighing has been continued up to date, and will be carried on to Jan. 1, 1887, when it is proposed to make a trial of mixing corn ensilage with the hay and bran.

The results of the experiments thus far are given in the following tables :

TABLE SHOWING THE RESULTS OF BRAN FEEDING AT THE EXPERIMENT STATION OF THE COLLEGE OF AGRICULTURE OF THE UNIVERSITY OF MINNESOTA.

Number of the Animal.	Weight of Each Animal July 13, 1886.	From July 13 to August 13.			From August 13 to September 13.			From September 13 to October 13.			From October 13 to November 13.			From November 13 to December 13.			Weight of Animals Dec. 13, 1886.	Total Gain in 153 Days.	Total Weight of Hay Consumed.	Total Weight of Bran Consumed.	Remarks.
		Gain.	Bran Fed.	Hay Fed.	Gain.	Bran Fed.	Hay Fed.	Gain.	Bran Fed.	Hay Fed.	Gain.	Bran Fed.	Hay Fed.	Gain.	Bran Fed.	Hay Fed.					
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs	lbs.	
1	1,162	100	588	300	98	720	300	42	720	300	63	720	300	92	720	300	1,557	395	1,500	3,468	
2	917	108	516	480	85	540	480	25	540	480	100	540	480	50	540	480	1,275	358	2,400	2,676	
3	1,227	48	588	300	85	720	300	57	720	300	70	720	300	63	720	300	1,550	323	1,500	3,468	
4	1,122	15	588	300	98	720	300	85	720	300	*70	720	300	83	720	300	1,333	211	1,500	3,468	Off feed in November. Slaughtered at close of fifth month.
5	1,132	110	588	300	88	720	300	42	720	300	73	720	300	60	720	300	1,505	373	1,500	3,468	Slaughtered at close fifth month.
6	875	65	516	480	80	540	480	50	540	480	....	540	480	35	540	480	1,100	225	2,400	2,676	Off feed in October.
7	1,107	*5	516	480	63	540	480	65	540	480	10	540	480	65	540	480	1,300	193	2,400	2,676	Off feed in October.
8	1,075	55	516	480	72	540	480	75	540	480	83	540	480	47	540	480	1,407	332	2,400	2,676	
9	1,002	30	516	480	98	540	480	52	540	480	68	540	480	37	540	480	1,287	285	2,400	2,676	
10	1,155	57	588	300	95	720	300	35	720	300	....	720	300	58	720	300	1,400	245	1,500	3,468	Off feed in November.
Total....	10,774	583	5,520	3,900	862	6,300	3,900	528	6,300	3,900	397	6,300	3,900	590	6,300	3,900	13,714	2,940	19,500	30,680	

* Loss.

NOTES.

The average daily consumption of bran for the entire period of five months was 20½ pounds, and of hay 13 pounds.

The average daily gain for the same time was 1.97 pounds or nearly 2 pounds per day. The average was reduced by the illness of Nos. 4, 5, 6, 7, and 10 in the months of October and November, during which No. 4 lost 100 pounds, but regained 30 pounds in the month, leaving an absolute loss of 70 pounds. At the time of last weighing all the animals were in perfect health, good appetite and digestion.

In order to render the report of these bran-feeding experiments as complete as possible, I herewith present, by permission, the results obtained by Mr. Fred C. Pillsbury and Mr. A. F. Pray, and reported in detail from time to time during the past season in the *Northwestern Miller* of Minneapolis. In June, these gentlemen sent to Granite Falls, this State, and bought 15 three-year-old grass-fed steers. They intended to get blooded stock, but could not do so, and the lot was therefore composed of common "scrub" cattle, thin in flesh, wild, and, with one exception, having no signs of good blood. The steers were stalled and carefully fed, being allowed no exercise save in a quarter acre yard littered with husks. Each steer was numbered, and the rations of bran were carefully weighed out each day. The hay was weighed the first few days, but this was found impracticable, so that the custom was discontinuated and only the gross amount for the month was weighed. The steers, although a hard looking lot, were, with one exception, in apparently good health when the experiment began, and the change of diet soon cured the ailing one, so that all were hearty and lively at the end of the first month. Mr. Pillsbury gave strict orders that the bran used should be of the very poorest quality to be found in Minneapolis, in order that there might be no question as to results, and these orders were well obeyed. Whenever an animal ate all of its feed, the ration was increased, this policy being followed all through. Hay was liberally supplied, water was given in a common trough, and salt licks were provided. Despite the dryness of their provender, the steers never visited the water trough until they had finished eating. The subjoined table shows the weight of each steer at the begining and end of the month, the weight of the daily bran rations of each, and the total quantity of bran fed to each steer.

It should be noted that the cattle mentioned above were fed three or four days before the test was begun, so it can not be said that the phenomenal gain is partially due to their "filling up" after their hard journey to Minneapolis. It should be further noted that the bran fed was that from the Pillsbury A mill, certainly as poor as the poorest in the city. It is cleaned until there is literally no flour left on it, and in the cleaning process it is badly cut up, no attempt being made to make "broad" bran in this mill, the sole aim being to get every vestige of flour out of it.

The figures are as follows:

Number.	Gain first month.	Gain second month.	Gain third month.	Gain fourth month.	Weight at commencement.	Weight at end of fourth month.	Consumed bran first month.	Consumed bran second month.	Consumed bran third month.	Consumed bran fourth month.
1	140	50	00	00	1,010	1,200	437	581	499	480
2	113	35	40	35	912	1,135	353	393	364	390
3	100	50	60	48	770	1,028	358	495	364	390
4	120	17	48	38	840	1,063	386	432	392	420
5	120	25	55	65	900	1,165	367	403	364	390
6	143	40	60	68	962	1,273	410	493	448	480
7	90	18	40	65	887	1,100	336	405	364	390
8	110	45	65	43	972	1,235	344	307	364	390
9	172	45	65	78	963	1,323	379	433	392	420
10	68	27	58	35	792	980	324	316	280	300
11	63	35	25	82	961	1,172	367	401	364	390
12	93	35	35	70	907	1,140	381	413	364	390
13	110	15	42	53	820	1,040	391	415	392	420
14	110	22	63	50	1,095	1.340	419	512	476	510
15	103	45	55	45	827	1,075	383	431	392	420

	Lbs.
Average consumption of hay first month	500.0
Average consumption of hay second and third months	475.0
Average consumption of hay fourth month	485.0
Average daily ration of bran each, first month	12.5
Average daily ration of bran each, second month	13.5
Average daily ration of bran each, third month	13.0
Average daily ration of bran each, fourth month	13.7
Average daily gain each, first month	3.6
Average daily gain each, second month	1.1
Average daily gain each, third month	1.6
Average daily gain each, fourth month, over	1.7
Average daily gain each, four months, over	2.0
Total bran fed	24,064.0
Total hay fed	28,925.0
Total gain in weight	3,545.0
Average gnin in weight, four months	236.3

Both these series of experiments, extending over five months, and embracing the hot weather of midsummer, the average season of early fall, and the severe cold of November this year, not only prove the nutritious value of wheat bran as a cattle food, but prove it to be both digestible and healthy when fed continuously and to an amount only limited by the appetite of the animal.

In determining the economical value of bran as an article of food, the value of the resulting manure as a fertilizer must be taken into consideration.

In this connection the following letter is interesting:

The *Northwestern Miller* states that experiments made during May and June last, on fifteen head of common stock, fed exclusively on hay, bran, salt and water, show the following results:

	Lbs.
Total hay consumed	14,620
Total bran consumed	11,065
Total gain, live weight	2,175

Now if we estimate the hay at $10 per ton and bran at $14 (for 2,000 pounds), the total cost of such feed, irrespective of labor, would amount to $145.55, or six and seven-eighths cents per pound gained, live weight. However, the manurial value of such feeding, although not alluded to by the *Miller*, is worthy of close attention wherever manure is needful. In the valuation lately published by Sir J. B. Lawes (see R. A. S. J., journal 1885, page 600), hay, mixed clover and meadow, fed to fall-grown fattening stock, leaves:

50.6 pounds of ammonia per 2,240 pounds of hay fed.
9.58 pounds of phosp. ac. per 2,240 pounds of hay fed.
34.75 pounds of potash per 2,240 pounds of hay fed.

These, at twelve cents for ammonia, six cents for phosp. ac., and five cents for potash, would make such manure worth $7.54 per 2,000 pounds of hay fed. The gross ton of bran fed leaves in the manure 64.2 pounds ammonia, 78.50 pounds of phosp. ac. and 31.21 pounds of potash, which gives a money value of $12.48 per 2,000 pounds of bran fed. The total manure value of hay and bran fed, according to such estimates, would amount to $124.11. The real cost of such beef production would thus amount to:

Food value	$145 55
Less manurial value	124 11
Total gain, 2,175 pounds beef, live weight	$21 44

Or about one cent a pound. To which must be added the cost of feeding, etc., which every farmer can estimate for himself. In all such calculations, however, the loss of manurial value, by rain, sun, stable absorption, etc., before its final covering up in the ground, should also be estimated. On this latter estimate, I hold that seventy-five per cent of deduction would have to be made in a majority of cases, through the utter neglect of manurial wealth by most farmers in this country! Here is loss, indeed.

ED. A. BARNARD,
Of Three Rivers, Q., Canada.

As showing the manurial value of wheat bran, in comparison with other animal feeds, the following table is appended as giving the latest determinations upon this subject by Prof. Armsby:

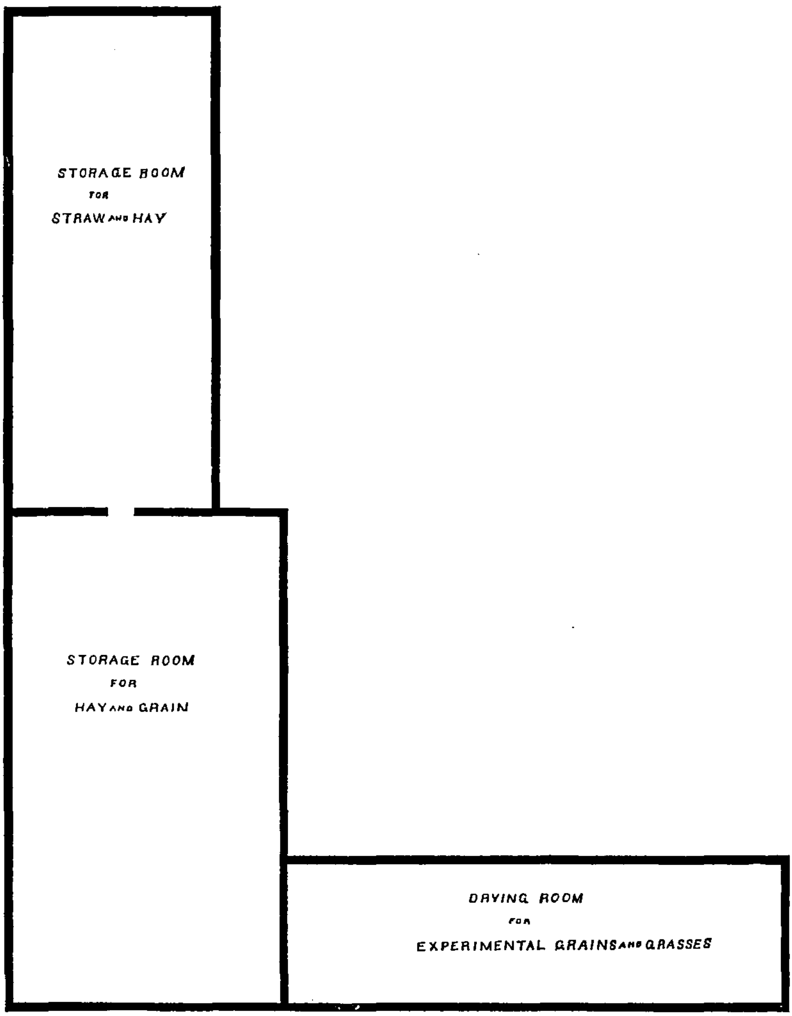
Article.	Value per Ton.
Corn ensilage	$1.34
Dry corn fodder	3.86
Mixed upland hay	5.30
Clover hay	7.61
Wheat straw	3.53
Beets	1.68
Oats	17.38
Corn	6.56
Wheat bran	13.36
Linseed meal (new process)	21.34
Linseed meal (old process)	20.19

The economy of using bran as an article for feeding stock will depend, like any other food, upon its cost in the local market, and the value of its product, but it would seem if dairy and stock men of the Atlantic States can afford to pay the first cost at the mills, profits of middlemen, and transportation for 1,500 miles, Minnesota farmers might find it profitable to retain this by-product of her mills for their own advantage.

TABLE SHOWING THE CHANGES IN WEIGHTS OF CALVES DURING THEIR FIRST YEAR'S GROWTH, ON ORDINARY PASTURAGE AND A SMALL QUANTITY OF WHEAT BRAN, DAILY, SEASON OF 1886.

FARM NO.	BREED.	SEX.	CALVED.	Weight May 20.	Weight June 20.	Weight July 20.	Weight August 20.	Weight September 20.	Weight October 20.	Weight November 20.	Age in days.	No. of days from first to last weighing.	Total gain.	Average gain per day from first to last weighing.
4	Holstein......	Bull	Feb. 21, 1886...	232	312	380	450	512	597	662	272	184	430 lbs.	2.39 lbs.
13	Holstein......	Bull	Jan. 4, 1886....	447	550	630	700	772	810	890	320	184	443 lbs.	1.38 lbs.
14	Holstein......	Heifer...	Dec. 14, 1885...	447	510	590	635	690	715	762	340	184	315 lbs.	1.71 lbs.
15	Holstein	Heifer,..	Feb. 14, 1886..	297	367	415	460	510	552	640	279	184	343 lbs.	1.86 lbs.
27	Shorthorn.....	Heifer...	Sept. 16, 1885..	....	551	615	640	715	765	815	414	153	264 lbs.	1.73 lbs.
50	Jersey	Heifer...	Apr. 4, 1886...	....	185	232	285	335	372	417	230	153	332 lbs.	1.52 lbs.
51	¾ Jersey	Heifer...	May 23, 1886...	....	....	180	225	280	342	412	181	123	232 lbs.	1.88 lbs.
92	Native.........	Heifer...	Dec. 10, 1885..	287	345	392	400	430	452	535	336	184	248 lbs,	1.34 lbs.

All the above calves received the same shelter, care and feed.



THIRD FLOOR
OF
BARN

INVESTIGATIONS OF SUPPOSED POISONOUS VEGETATION IN THE WATERS OF SOME OF THE LAKES OF MINNESOTA.

On July 8, 1882, I received the following telegram from Dr. Charles N. Hewitt, of Red Wing, Minn, secretary of the state board of health.

"A very fatal disease prevails among cattle and hogs at Waterville, Le Sueur County; will you go down to-night and investigate."

In answer to this request I went to Waterville at once, and found the following condition of affairs.

The town is located on a broad neck of land, between the lakes Sakatah and Tetonka, both beautiful sheets of water, with mostly gravelly beds and shores, and surrounded with cultivated fields and belts of woodland, and well stocked with bass, pickerel, pike and perch. These lakes are well drained into the Mississippi by the Canon River. The farms on the shores of the lakes have been occupied a number of years, and their owners have constantly used the waters of the lakes for their stock, and for domestic purposes since the first settlement of the county, without any injurious results. I found much excitement among the farmers who had recently met with heavy losses in stock, and were in doubt as to the cause.

On inquiry I learned that about June 25th, after the wind had been blowing for several days strongly from the south, cattle, horses and hogs which had been permitted to drink at the northern shore were suddenly stricken down in great agony, and died, some of them not even getting back to their yards, six hundred feet distant. In a day or two the wind changed, and stock used the water again without injury. A few days before my arrival the winds veered to the south, and the same results followed as in the first instance. These facts seemed to point strongly to the presence of poisonous material in the water, and on a close inspection I found the water of both lakes filled with floating particles of matter, which on examination with the microscope proved to be round masses of a vegetable origin, and differing from any which had previously come under my observation. I collected a quantity of this matter and on my return placed it in the hands of Prof. Arthur for examination, and his reports are given below.

In 1883 reports were again received of the death of stock in the same locality, and presumably from the same cause. A second visit and examination was made in July, but by this time the water of the lakes had became quite clear of the suspected vegetation, and nothing resulted from our investigations. Believing that the poisonous character of this water was due to the presence of this plant at a particular period of its growth, I made arrangements with gentlemen at Waterville who were deeply interested in the subject to inform me the next season by telegraph as soon as its presence was noticed.

In 1884, in anticipation of this notice, I secured the services of Prof. J. C. Arthur, botanist of the New York experiment station, and Prof. M. Stalker, state veterinarian of Iowa, and in company with these gentlemen went to Waterville, fully prepared to make an exhaustive examination of this matter if circumstances would permit.

The results of our efforts are fully set forth in the following reports of the above named experts, to both of whom I hereby tender my acknowledgments for the zeal, patience, and skill, with which they entered upon the work, and continued their investigations.

REPORT OF PROF. J. C. ARTHUR

ON

SOME ALGÆ OF MINNESOTA,

SUPPOSED TO BE POISONOUS.

About the middle of July (1882), four bottles of water containing minute water plants, and a small package of undried water weeds, were sent by Prof. Porter, of the college of agricultue, to the botanical laboratory of the university of Minnesota. They were obtained by him at Waterville, in the southern part of the State, and said to be fair samples of the water and vegetation of the lakes at that place. The motive for submitting them to botanical examination lay in the fact that a large number of domestic animals, mostly cattle, had recently died under peculiar circumstances, that cast suspicion upon them as the cause of the mortality.

A cursory examination of the specimens showed that the package of partly dried plants contained only fragments of common water weeds, belonging to the genera *Potamogeton*, *Myriophyllum*, *Anacharis*, and *Lemna*, all of which are accounted as innocuous as meadow grass. No specimens of the land plants growing along the borders of the lakes were sent, but a subsequent examination showed only familiar and harmless kinds.

The bottles contained small globular bodies about the size of turnip seed suspended in the water. One bottle nearly a quarter full of these little plant balls had been filled at a small bay where the scum was accumulated by wind, and from the same locality where several head of stock had died. The plants were beginning to decay, and had assumed various shades of reddish-brown — the same color being imparted to the water of the bottle. They largely settled to the bottom when at rest, and rolled upon each other lightly when agitated. Upon removing the stopper a very nauseating odor pervaded the room, which was not easily characterized, and none present could identify it with the smell of any well-known substance. The other three bottles had been filled some distance from shore, one of them being from near the centre of the lake. These contained a less quantity of the same globular plants, which were still green and floating and the water colorless and odorless.

It was easy to say from the general appearance that they belonged to the lowest great division of the plant kingdom. The microscope showed that they were members, furthermore, of the family of the Nostocs, and that they either belonged to the genus *Rivularia*, or to some genus closely related. It may be further said, as a passing explanation, that all plants belonging to the lowest divisions of the plant kingdom and containing leaf green are commonly known as algæ or sea weeds, of which there are both fresh-water and salt-water species in great abundance.

The deleterious properties ascribed to the little globular algæ at once aroused much interest among the workers in the laboratory. Few algæ are of special sanitary importance, and most of these belong to the Nostoc family. The record of harm done is meagre, which may be due to infrequent occurrence, but is probably better accounted for by the general ignorance respecting this class of plants. Several times a portion of the water supply of Boston has been rendered unfit for domestic use by a very offensive odor, described as "the pig-pen odor," that has been traced to the decay of an excessive growth of several species of algæ of the Nostoc family. The bad odor did not, however, appear to be associated with any property that endangered life.* Instances of the death of sheep in Massachusetts from drinking water containing algæ are reported, but not fully substantiated; and so far as the writer is aware, there is no authenticated record of the death of any kind of animal from a similar cause.

The little balls were now placed under the compound microscope, and each found to consist of a dense colorless jelly in which is embedded a great number of dark-green whip-shaped filaments. The filaments are approximately of the same size and length, straight, and lie regularly side by side radiating from the centre. The larger or butt ends are near the centre of the ball of jelly, and the attenuated or lash ends extend be-

* Remarks on some algæ found in the water supplies of the city of Boston, by W. G. Farlow, in Bulletin Bussey Institution, 1877.

Paper on some impurities of drinking water, by W. G. Farlow, in first annual report of Massachusetts State Board of Health, 1880.

yond its circumference. The single row of cells forming each whip-like filament are distinguishable by means of the delicate transverse division walls. The butt of the filament is encased in a thin, transparent close-fitting sheath extending nearly half the filament's length. This sheath can rarely be detected, except when fortunate pressure has squeezed the sheath empty. At the extremity of the butt of the filament is a spherical cell, like a knob on the handle of a whip. This frequently remains attached to the empty sheath. It will be seen from this description that the structure of these little plants is very simple. To repeat, each ball consists of a mass of colorless jelly with whip-shaped filaments imbedded radially, their free extremities standing out thickly over the whole surface. Looking at the balls with a common hand lens, they appear like little spherical burrs bristling with points.

This plant has been determined by Dr. Farlow, of Harvard University, to whom I am also indebted for the determination of the other algæ of this paper, to be *Rivulari fluitans*, Cohn. It was first observed by Cohn and Gobi in 1877 in Europe, and published in *Hedwigia* early in the following year; but has not been noticed before in this country.

This much was learned in the laboratory. The strong suspicion that the plants were the cause of serious mortality among stock, and, in a State filled with lakes, demanded as careful investigation of all the facts as could be made. Accordingly, at the close of the summer school I visited Waterville with a view of scrutinizing the evidences upon which the plants were suspected, and with the following results:

The lakes at Waterville are two beautiful sheets of water. Lake Sakatah is about three miles long, with an average width of half a mile, and extends east and west. The village is situated on its south shore, near the western end. Lake Tetonka lies directly west from Lake Sakatah, with the same general direction, and almost joins it. It has a more irregular shore line, is a mile longer and about the same width. Both have well-wooded banks and comparatively little marsh. They belong to the series of lakes through which the Cannon River flows—a circuitous stream of slow movement. At the time of my visit, which occurred about the first of August, the little burr balls—the supposed deadly algæ—had practically disappeared and could only be found sparingly by careful searching; it was maintained that with them all danger to stock had also vanished.

The vegetation along the shore, both on land and in water, was first examined and found to differ in no way from that elsewhere and quite wanting in dangerous sorts. It had been suggested that the water might have been poisoned. But the large volume of water and its drainage through the Cannon River and the absence of any assignable source from which the poison could come makes this highly improbable and warrants us in assuming that the water itself was of usual purity.

The spot where the largest number of cattle were lost was on a small bay on the north shore of Lake Tetonka, near the house of Mr. L. H. Bullis. On June 28, 1882, after two or three days of pleasant weather, the wind gathered a thick scum of algæ in the little bay. Four calves confined in a pasture near the house, with access to no water but that of the lake, were seen at noon apparently well, and at 2 P. M. were dead. On July 5th a number of cattle came down the public road to the lake shore that partly belonged to Mr. Bullis and partly to neighbors. They were noticed between 8 and 9 A. M., and within an hour afterwards three were dead and before noon three more. Four of these were cows of various ages, one a yearling and one a two-year-old. The two young cattle were examined shortly after death by Dr. E. B. Case and Dr. J. G. Bemis, resident physicians. Nothing seemed to be abnormal except the stomach, which appeared to have been affected by the algæ swallowed by the cattle. But this is a matter to be investigated by a skilled pathologist, and items and opinions need not be given here. The cattle did not appear to suffer pain, but lay down as if enervated and soon expired.

These instances were given me by Mr. Bullis, a careful and observant man of prominence in the community and a former member of the legislature. They were also vouched for by several residents of the village. I have omitted interesting details necessary to a full statement, but which do not properly belong to this report. I wish to take this opportunity to acknowledge my indebtedness to Mr. Hedger, as well as to Mr. Bullis and other citizens, for courtesies during my visit at Waterville. Mr. Bullis narrated the circumstances attending the death of several other head of stock, in all about twenty, all with the same symptoms and apparently from the same cause. All except two instances occurred upon the shores of lakes Tetonka and Sakatah, and these two were on lakes not far distant, also traversed by the Cannon River. The total includes at least two horses; several hogs might with fairness be added to the number. It is supposed that many other animals than those enumerated have died, or been sick and recovered, but without the cause being suspected. The victims have been observed from the time of drinking the water, thick with algæ, till their death, which usually occurs in from twenty minutes to an hour and a half, in but two or three instances. After all, the evidence that death resulted from partaking of the algæ are not conclusive; what is especially needed in an economical point of view is a carefully conducted series of experiments to establish the truth of the matter. Such experiments can, of course, only be carried on when the plants are in great abundance. Until they are made it would be well to restrain animals when the plants become numerous till they disappear, presumably a period usually of only a few weeks each season.

The amount of strictly botanical information given in this paper is, indeed, slight, yet the very paucity may do good service in calling the attention of botanists to a field of valuable research much neglected in America—a knowledge of the minute algæ.

Having given what is known with certainty about these plants, a few conjectures may be hazarded. It is probable that they pass the winter at the bottom of the lake, either as spores or partly disintregrated filaments. When the water is warm enough in spring, these very likely become buoyant, and attaching themselves to weeds and sticks in the water grow from single cells into the mature bur balls. When the balls have obtained full size they are detached and float free in the water. However, it may be that some of the plants are free during their entire life. The reasons that might be advanced to account for their excessive abundance are in the absence of data, so many that nothing is to be gained by naming them. The nearly simultaneous disappearance of the plants may be due to uniformity in maturing, while its suddenness may be brought about by the simplicity of organization which favors rapid decay.

After my return to Minneapolis from Waterville, I visited Lake Phalen, the source of the water supply of St. Paul, in company with Prof. Hall of the state university. The lake is small with considerable marsh. Dipping up some of the water and holding it toward the sun, the only visible impurity was innumerable fine floating specks which glittered in the sunlight with a silvery reflection. What these were, and whether they had anything to do with the disagreeable character of the water at the time, belongs to the chemist to determine. No floating plants were found either large or minute. The visit would have been without botanical interest, but that just before returning, minute bur balls were detected attached to various submerged weeds. These were of the size and appearance of those from Waterville, and differed only in being pressed tightly against the surface of submerged objects instead of floating free. Subsequent examination in the laboratory under a microscope showed no structural difference between them and the Waterville plant. Whether all the large vegetation of the lake was infested by the bur balls or not, can not be stated, as there was not time after the detection of their presence to make a careful search.

This discovery lends great additional interest to the real character of the Waterville plant. If that proves to be poisonous or otherwise harmful, and the two are identical, as they doubtless are, the investigation of their habits is a matter of pressing moment. In the present state of ignorance on the subject there is no predicting the time when the water supplied to the residents of St. Paul may not be filled with a fatal poison, and no assurance that such a calamity will not occur. Neither is it certain that another lake will be less likely to be affected, and therefore furnish a preferable supply.

It may be well to append to this report a short account of some other minute algæ seen in the lakes at Waterville. Although the bur balls had disappeared at the time of my visit, the waters were of an intense green color from the presence of another algæ. This plant was diffused through the water, and also collected as a scum two or more inches thick along the shore toward which the wind had been blowing gently for some hours. When dashed against any objects, as stones, piers, or clothing, it painted them a bright green which lasted for hours, but finally turned blue. This material under the microscope consists of irregular colonies of minute plants. Each colony inhabits a mass of thin, colorless jelly, and is made up of many separate oblong green cells placed some distance apart just beneath the surface of the mass of jelly. These cells are extremely minute, and when the colonies are flattened out under the microscope, they appear as green dots scattered about without order, the jelly being so transparent as to be nearly or quite invisible. As the colonies become older and larger they break up and coalesce, and form the shapeless masses of scum. This plant is *Cœlosphœrium Kuetzingianum*, Næg. It is popularly known in Germany, along with other species that form scums, as *wasserbluethe* or water flowers. No harm is known to result from it, although when in large quantities, in common with other nostocaceous algæ, its decay gives rise to a most nauseating odor. A minute quantity of this plant was detected in the four bottles containing the bur balls, but in the month which had elapsed between the time these were secured and my visit, it had increased enormously and quite replaced the balls. Associated with the bur-balls and water paint was a small quantity of *Anabæna circinalis*, Rabh., and possibly another species of *Anabæna*. These plants consist of a necklace of globular cells loosely coiled like a spring. It would be difficult to detect them without the aid of a microscope. At the time of my visit still another plant occurred in connection with the water paint, and in almost equal abundance. This resembled the small narrow leaves of wood mosses. Each was a centimeter or less in length, of appreciable width, and more or less pointed at each end. They were so thin and delicate as to collapse when taken from the water. Under the microscope each leaf form was resolved into many filaments of uniform diameter lying closely side by side. This is known as *Limnochlide flos-aquæ*, Ktz. Although in such large quantities it was not appreciably accumulated by the wind into a scum along with the water paint, but floated below the surface quite uniformly over all the lake. It however lodged in small quantities against water weeds and other anchored objects.

The algæ discussed in this paper are all members of the large Nostoc family; all give off an offensive odor when decaying, but no suspicion of any toxic or harmful principle hangs over any but the bur balls. It appears that during the last season there was a stated order of reaching their maximum abundance, but this may have been owing to local or accidental influences. It is not likely that a botanist will be on the ground through the coming season to study these plants. It is therefore desirable that observant persons should volunteer their services to secure specimens. These should be obtained at intervals and forwarded to a competent person for examination. Their preparation is very simple: Place the specimens in a bowl of clean water and float them out on pieces of mica or window glass, or, if these are not handy, on plain white paper, and let them dry. This is done by putting the mica or paper into the water under the little plant desired and gently raising it and allowing the water to flow away. When dry they can be sent any distance by mail at trifling cost and trouble. Sending them fresh in bottles of water is not a good plan unless the distance is short.

J. C. ARTHUR.

Iowa Agricultural College, Dec. 1882.

REPORT

OF

PROF STALKER ON THE WATERVILLE CATTLE DISEASE.

Prof. Porter, Professor of Agriculture, University of Minnesota,

MY DEAR SIR: I have the honor to make the following report on the cattle disease that has prevailed along the borders of lakes Sakatah and Tetonka, in Le Sueur County, Minn., for the past three years. The latter part of June, 1884, I was asked to come to Waterville to assist in making some experiments which might lead to the discovery of the cause and prevention of the disease. I arrived at Waterville on July 1st and proceeded to the work of investigation. The history of this enzootic is as follows: The past three years a highly fatal form of disease has made its appearance among the domestic animals along the shores of these lakes. The greatest loss has been in cattle, but swine and horses are not exempt. The greater loss among cattle is probably due to the fact that they are kept under circumstances that expose them more to the poisonous agent, whatever this may be. The disease first made its appearance in June, 1882, and has reappeared about this time, or a little later in the season, of each year since. Coincident with the loss of live stock, a peculiar vegetable growth makes its appearance in the water of these lakes and the testimony goes to show that only those animals which obtain water from the lake at this season are affected with the disease. This plant is the *Limnactis minutula*, of which mention has freqently been made under the head of Nostoc. Prof. Arthur, of Geneva, N. Y., has been employed on the investigation of this plant for the past two years. The plant is the one to which you drew public attention a year or two since. The professor is still engaged in his investigation and it is hoped he will in time be able to throw some important light on this, as yet, obscure question. I leave the scientific discussion of the vegetable growth to the professor and will only give such a description of it as will render the allusions to it intelligible. This plant is a low form of algæ or sea weed. It is spherical in form, of a green color and about the size of a pin head. It is first seen in the early part of June rising from the shallow portion of the lake, where there is much vegetation, and is freely suspended in the water in sufficient quantities to make it turbid. Later in the season these little green masses pass through various changes of color, begin to undergo decomposition and float on the surface in a thick scum. In this condition they will drift to the shore against which the wind is blowing and sometimes accumulate to the depth of an inch near the shore or in the protected portions of the lakes. The decomposition of the plant is always attended with a most sickening odor, which pervades the atmosphere about the lakes. The date of the appearance of the plant in the water and the subsequent decomposition are subject to variations in different years. The lake usually begins to emit the odor in the early part of July. The loss of stock ordinarily occurs some days earlier. The testimony of all farmers who have lost stock is to the effect that—

First—There have been no losses except among animals obtaining water from the lakes.

Second—In every instance where deaths have occurred the wind had for some days previous blown shoreward where the animals drank and carried the plants to the margin of the lakes in large quantities.

Third—No losses have occurred after the odor from the lakes became offensive.

These statements seem to be concurred in by all who have made observations on the subject. The course of the disease is rapidly fatal as may be illustrated from the history of Mr. Bullis' cattle. Mr. Bullis is a farmer living on the north shore of Lake Tetonka about a mile and a half from the town of Waterville. On the twenty-fifth of June, 1882, Mr. Bullis found four of his calves and one cow dead. This was at 2 o'clock in the afternoon. The cattle were seen at noon and known to be all right. At some time between these two hours they had been to the lake side and taken water. They were all found within a few rods of the shore. There was at this time large quantities of the *Limnactis* in the water of the lakes. On the fifth of July of the same year seven more cattle and two hogs died at the Bullis farm. The cattle had not been getting water at the lake for some time, but this morning they got access to it about 8 o'clock. By 9:30 the cattle were dead. In addition to these twenty hogs a number of cattle were affected, but finally recovered. Mr. Bullis' family physician made post mortem examination of some of these cattle. There were no peculiar pathological changes noticeable except in the first stomach or *rumen*. In this organ the line reached by the water was clearly defined. From all that portion of the stomach with which the water came in contact the mucous membrane was sloughing off as if it had been scalded. These statements were obtained from an interview with the physician. During the summer of 1883 a company of men employed in the construction a railroad were encamped on the shore of Sakatah. One evening very soon after the horses had been watered a number of them were taken violently ill. The fact was soon discovered that all the sick horses had received their water from the lake, while none of the animals watered at a brook a short distance from where it flowed into the lake were affected.

During the summer of 1884 Mr. Kerrick kept nineteen cattle in a pasture bordering on the south shore of Lake Tetonka. On the morning of June 10th eight of these were found dead close to the lake shore. These had probably been dead a day or two, from the appearance of the carcasses. In these last two instances the condition of the lake was the same as when Mr. Bullis' cattle died. These, with a number of similar instances which have occurred during the last three summers, make the case a rather strong one against the *Limnactis*, though additional experimental proof is needed to demonstrate the fact that the presence of the plant and the death of the animal stand in the relation of cause and effect.

On July 1st I commenced to collect the foregoing history and preparing for some experimental work by means of which I hoped to gain some confirmatory proof. A horse and a calf were placed at my disposal. These I proposed to furnish with a water supply charged with the suspected vegetation. I procured a large quantity of the plant by dipping and skimming from portions of the lake where it existed in the largest quantities. After keeping the animals from water for twelve hours, and until they were quite thirsty, I gave them all they would drink of this water. There was such an amount of the slimy plant present that it gave to the water the consistency of linseed oil. Though the horse drank between three and four gallons and the calf an equal amount in proportion to its size, not the slightest symptom of disease was produced. These animals were again prepared and a second experiment tried the next day which proved equally barren of results. I became convinced there was nothing poisonous in the plant during the stage at which I found it, whatever may be true of it at other seasons. The farmers about the lakes, however, all united in the opinion before the trial was made that it was now too late in the season; that as the "lake had begun to smell" animals could drink the water with impunity. Thus the experiment proved valueless so far as positive results are concerned. So far as I am able to learn no animals have died in the vicinity of the lakes since these experiments were made. The fact that cattle having free access to the lakes are not attacked after this season of the year does not disprove the existence of toxic properties in the earlier stages of growth.

Again, it may be found that the appearance of this little plant is but a coincidence and has nothing whatever to do with the real cause of the disease, which may have been overlooked in the presence of what at first appeared the obvious explanation. I had no opportunity to make post mortem examination or of seeing any animal affected with the disease, but according to the best history I could obtain the sudden death; preceded by profound coma and the peculiar lesions of the stomach, would not seem to furnish a parallel to any specific form of disease known to veterinary science.

During the month of July I found the *Limnactis* in the waters of West Okoboji Lake, Dickinson County, Iowa. It existed in limited quantities as compared with what I found in Sakatah and Tetonka. I have not been able to find it in the waters of any of the other Iowa lakes. Nor have I been able to learn of the loss of any stock under conditions similar to those affecting the Minnesota cattle. I propose to begin a more careful series of experiments early next summer with the hope of arriving at more certain results.

M. STALKER.

Iowa Agricultural College, Nov. 3, 1884.

SECOND REPORT

ON

SOME ALGÆ OF MINNESOTA

SUPPOSED TO BE POISONOUS.

BY J. C. ARTHUR.

The history of the investigation conducted in 1882 for the purpose of ascertaining the cause of a sudden mortality among domestic animals at Waterville, Minnesota, has been given in a former report. The facts elecited were that quite a number of the animals, largely cattle, had died at a time when the lakes at that place were filled with a minute alga (then called *Rivularia fluitans*, but now referred to *Glœotrichia Pisum*), disseminated through the water and forming a thick. dark-green scum when collected by the wind. That some of the animals had drunk of the water and scum a few hours only before they died was positively known, and that all had done so seemed from the circumstances quite probable. After the most careful examination the only plausible hypothesis that could be advanced to account for the death of the animals was that the algæ present possessed some toxic or other baneful properties sufficiently powerful to kill a cow in a half hour or more after drinking freely of it. The well-established reputation of all the algæ for innocuousness made this hypothesis appear from the very first extremely improbable, but for want of the slightest hint in any other direction it was thought worth while to bear it in mind, and to investigate the matter further.

In 1883 I again visited Waterville, but owing to delays did not reach there till July 26th, at which time the lakes had become quite clear of the suspected algæ. I found that two calves had died at Waterville on June 4th, and about the same time five cows at Cordova, twelve miles distant, on Lake Gorman. The most careful examination into the circumstances attending these cases threw no additional light on the subject. I arranged, however, to receive a prompt notice the next season, should any more cattle die in the same manner.

The middle of June, 1884, word was received that eight cattle had died on the shore of Lake Tetonka. I at once started for Waterville, arriving on the twentieth and found the algæ less adundant than in 1882, but still making the water green some fifty feet or more out from the shore toward which the wind had been blowing several hours. Although the conditions were not the most favorable, yet it seemed best to attempt a direct experiment by giving animals water charged with the algæ. After much delay the services of Prof. M. Stalker, state veterinarian of Iowa and professor of veterinary science in the Iowa Agricultural College, were secured to conduct the experiments. A horse and calf were employed. On June 30th Prof. Stalker, with the assistance of Prof. Edward D. Porter of the university of Minnesota, and in the presence of citizens of Waterville, made the tests, the writer being unable to remain. The animals had not been permitted to drink for some twenty-four hours previous, and were consequently thirsty enough to take a large amount of water well charged with the algæ. No bad results of any sort followed.

The thorough and able manner in which this test was made leaves no reasonable doubt of the perfect harmlessness of the algæ *in a growing condition*. I append this last clause, because the citizens of the place still believe that the algæ is at the root of the trouble, and that the tests did not show it because they were not made at the right stage of its occurrence. Although no sufficient study of the habits of this plant has yet been made to enable one to speak with certainty, yet it does not appear from present data that in some other stage it would give different results, unless it be when decaying, when it turns brown or reddish-brown and gives off a peculiar stench. At this time the microscope shows the cells of the algæ to be swarming with bacteria. Whether these are other than the common and harmless bacteria of putrefaction it is at present impossible to say. The probabilities are, however, entirely against the hypothesis that the decaying algæ or the accompanying bacteria have anything to do with the trouble.

We are therefore obliged to sum up the economic part of this investigation by stating that the death of the animals is probably not due to the suspected algæ, and that no clue to the real cause has yet been obtained.

The botanical part of the investigation has yielded more interesting results, although far from being complete. The description of the structure of the algæ, given in my first report, is sufficient for present purposes, if it be added that when the cylindrical spores are formed, not mentioned in my report, they occupy the base of the filaments, the single round cells at the end toward the centre of the mass being called heterocysts; or, to use a former illustration, if the filament be represented by a whip, the portion that the hand would grasp is the place where the spore forms, while the knob on the end is the heterocyst.

One of the methods by which such algæ multiply, besides the usual one by spores, is by the breaking of a filament into several parts, which then arrange themselves side by side, and grow into as many complete filaments. These fragmentary reproductive filaments are known as hormogonia.

At the time the algæ is most abundant and conspicuous the spores are usually quite immature; and, as this is the period at which specimens have usually been gathered, the comparative study of the forms from different localities is rendered very difficult and unsatisfactory. I can not do better in this connection than to give a translation of a portion of a letter from M. Bornet, of Paris, the most eminent authority on these plants, in which he has kindly noted the peculiarities of the specimens forwarded by Dr. Farlow and myself at various times, and which represent the several localities of Minnesota and Iowa.

1. Lake Minnetonka, Minn., Aug. 20, 1883. Plants young; the filaments are in abundant multiplication by hormogonia. The contents of the cells are granular and opaque. There is no trace of spores. It resembles a *Glœotrichia*, probably *G. Pisum*, yet I am not certain of it.

2. Lake Phalen, near St. Paul, Minn., Aug. 4, 1882. Conforms to the preceding; but its filaments are in a simple vegetative condition [i. e. not multiplying by hormogonia]. No spores.

3. East Okoboji Lake, Iowa, July 30, 1883. On *Utricularia*. This plant has commenced to form spores. The alga is still insufficiently characterized, but I have no doubt that it belongs to *Glœotrichia Pisum*.

4. Lake Tetonka, at Waterville, Minn., July 27, 1883. The spores of this plant are nearly full grown; they are short and

thick, as in the form of *Glœotrichia Pisum* that has been called *Rivularia minuta.*

5. Shallow water near Lake Minnetonka, Minn., Aug. 18, 1883. On *Naias flexilis.* Spores well formed but longer than in the preceding form. Length and thickness of the spores vary much in *G. Pisum.*

As their determination rests largely upon characters drawn from the spores, it can readily be seen how unsatisfactory such specimens are for comparison; and it is largely because such imperfect specimens have been used that authors have established so many so-called species from the single true one. Of the above specimens No. 5, having the lowest spores, was composed of the smallest individual masses of any that have been collected, while No. 3 had the largest masses. Nos. 1 and 4 are the usual floating form.

M. Bornet adds that "the researches which you propose to make on the floating *Glœotrichia* of your lakes are very interesting and instructive if you could follow the complete cycle of their existence and connect them with the fixed forms from which they were derived." It was with the hope of accomplishing this that several jars were sent, in June, 1884, from Waterville, Minn., with the floating form, and from Spirit Lake, Iowa, with the fixed form, to Geneva, N. Y., where it was intended to grow them in tanks supplied with spring water; but all perished without giving any results.

The sudden appearance and disappearance of immense quantities of these minute plants, by which large bodies of water are filled with them and turned green within a few hours, is ascribed by MM. Bornet and Flahault* in a recent paper on these plants to the action of sunlight. The plants lying at the bottom of the water are started into active assimilation by strong light, which causes bubbles of gas to be given off from the cells; this is held by the gelatinous substance in which the filaments are imbedded, and when enough has accumulated the balls are rendered sufficiently light to float. When, in turn, the light becomes feeble the gas escapes, its production stops, and the balls sink and disappear with the same suddenness with which they came into view.

More localities are now known for the algæ than at the time of my first report. The writer noticed in 1883 that the water plants of East Okoboji Lake in Northeastern Iowa were thickly covered with gelatinous masses. These were of various sizes up to a fourth

*Bull. Soc. Bot. de France, XXXI, p. 80.

of an inch in diameter, and often of irregular shape; otherwise they resemble the attached form of the algæ, mentioned in the previous report. There were practically no free floating balls present. In June, 1884, however, the same locality yielded plenty of the floating form, which differed in no appreciable way, not even in size, from the Waterville plant. The floating form was found in August, 1883, by Dr. Farlow, with several other members of the American Association then in session at Minneapolis, in Lake Minnetonka, although not in large quantities. It has also been reported as abundant in a lake in Minnesota (name not given) in July, 1880, and published under the name *Rivularia radians* Thur., var. *minutula* Kirch.* What is undoubtedly the same species is reported from Iowa City, Eastern Iowa, under the name *Glœotrichia Pisum* Thur.† An alga on leaves of water plants (*Potamogeton*) was found by Rev. Francis Wolle,‡ at Bethlehem, Penn., which may be the one under discussion, as it is given as *G. Pisum;* but if so it is the only Eastern station known to the writer.

According to our present information then the plant seems most abundant in the Upper Mississippi Valley, at least in its floating form. It is not, however, peculiar to America. The paper by MM. Bornet and Flahault § already referred to gives the result of an examination of the present sources of information regarding the Rivulariæ forming scums, all of which are referred to the single species *Glœotrichia Pisum* Thuret, the true members of the genus *Rivularia* being salt water alga. It was observed in the British Isles as early as 1804, and described and figured in Smith's English Botany under the name *Conferva* (*Rivularia*) *echinulata*, which was changed to *Echinella articulata* by Agardh.|| The next record ¶ of its occurrence is in a lake near Aberdeen, Scotland, in 1846-47-48. It was seen in the early part of July, and the description of its appearance corresponds essentially to its mode of occurrence at Waterville. Specimens gathered in Shropshire, England, are figured by Kuetzing,** and also by Phillips, †† from a later gathering. The similarity of our plant

* See Wolle, Bull. Torr. Bot. Club, VIII, page 38.

† Hobby, Proc. Iowa Acad. Sci.

‡ Bull. Torr. Bot. Club, VI, page 138.

§ Bull. Soc. Bot. de France, XXXI, page 76.

|| Syst. Alg., page 16.

¶ Dickie, Botanist's Guide to Aberdeen, etc., 1880, page 310; quoted by Cooke, Grevillea, X, page 112.

** Tabulæ Phycologiæ, page 4.

†† Grevillea, IX, page 4.

to the above was pointed out by Dr. Farlow.* Mr. Phillips stated that the fishermen believe it is useless to try to fish while it is abundant because the fish appear to be made sick by it, and will not bite. Prof. Cohn † describes its occurrence on the river Leba in Pomerania as seen by Dr. Schmidt; and the remarkable abundance and the suddenness of its appearance and disappearance are especially in accord with the observations at Waterville. He called it *Rivulariafluit ans.* Through the kindness of M. Bornet I have been able to examine authentic specimens from this locality and do not find then noticeably different from the Waterville plants. In the same year (1877), Dr. Gobi ‡ found a Rivulari on the coast of the Gulf of Finland and described it as *Rivularia Flos-aquæ.* He subsequently stated it to be the same as Cohn's plant. Dr. Gobi has also examined the Minnesota plant from specimens forwarded by Dr. Farlow, § and pronounces it to be the same as his *R. Flos-aquæ.* These, together with a single gathering in Sweden, comprise all the stations for the floating form at present known to the writer.

A phenomenon so conspicuous, and to the popular mind so mysterious, is deserving of careful study. Although the plants are probably not poisonous, a knowledge of their habits and mode of development may yet be of great value from a sanitary point of view.

CONCLUSIONS.

These reports are very complete and satisfactory so far as they relate to the points investigated, but from the opinions of these experts and from the reports received each season from different portions of the State of losses of all kinds of stock, it is evident that the subject demands immediate and thorough investigation, and this station proposes to continue this work as far as time, means at command, and other engagements will permit. In furtherance of this any information bearing upon this subject will be thankfully received, and due acknowlegment made.

---

* Bot. Gazette, VIII, page 246; Proc. Amer. Assoc. Adv. Sc., XXXII, page 306.

† Aster Jahres-Ber. d. Schlesischen Gesells. f. vaterl. Cultur. (1877), page 144; Hedwigia (1878), XVI, page 1.

‡ Hedwigia, XVI, page 37.

§ Bot. Gaz., VIII, page 224.

THE NEW ORLEANS EXPOSITION.

In June 1884, the "Minnesota state board of collective exhibits for the world's exposition at New Orleans," presented a request to the board of regents of the university, that I might be permitted to take charge of the collection and display of the agricultural productions of the State at that exposition. This request was granted, and as soon as other labor would permit I entered upon the task assigned me.

My first work was to issue the following circular and give it general circulation, through the press of the State, and correspondence.

To the Farmers of Minnesota:

At the request of the state board of collective exhibits for Minnesota, and with the sanction of the board of regents of the state university, I have undertaken the supervision of the collection and display of the farm products of the State, for the approaching "world's exposition" at New Orleans, and I confidently appeal to the public spirit, local pride and patriotism of the farmers of the State, to make this display of their productions alike an honor to their calling and locality. The time left for completing this collection is very short but by united and energetic efforts it can be accomplished.

It is proposed to arrange the products of the State by counties as far as possible, giving specimens of soils, woods, grains, grasses, fruits and vegetables, with statistics of population, wealth and productions, and illustrated with maps, charts, plats of towns and photographs of public buildings, manufacturing establishments and private residences.

Liberal contributions of all objects to aid in this work are earnestly requested.

For the guidance of collectors and contributors the following detailed instructions are furnished:

I. TIME ALLOTTED FOR THE COLLECTION.

All articles must be shipped from point of collection, on or before November 10th, as the trains of cars conveying Minnesota's exhibit to New Orleans will leave Minneapolis and St Paul promptly Nov. 15, 1884.

II. DIRECTION FOR SHIPPING.

The transportation companies of the State have generously offered to carry all articles designed for exhibition to Minneapolis and St. Paul, and from thence to Chicago free of charge. Ship all articles, securely packed in clean, tight boxes or barrels, well nailed and plainly directed thus:

ARTICLES FOR EXHIBITION

AT THE

WORLD'S INDUSTRIAL AND COTTON CENTENNIAL EXHIBITION,

NEW ORLEANS.

COLLECTIVE EXHIBITS OF MINNESOTA.

Consigned to Oliver Gibbs, Jr., U. S. Commissioner,

Care of Prof. Edward D. Porter, Superintendent of Agricultural Exhibits,

To be stored by the Union Railway Storage Company.

MINNEAPOLIS, MINN.

Shipping cards and tags containing full directions will be furnished on application. A letter should be sent, stating the date of shipment, by what route, name and address of collectors, contributors, and list of articles forwarded, with bill for any expenses incurred, which will be paid upon presentation.

III. ARTICLES DESIRED FOR EXHIBITION.

(1.) *Grains*—Such as wheat, rye, oats, barley, buckwheat, flax, hemp and wild rice, to be the best of their kind, well cleaned, put up in quantities of one bushel of each variety, in clean, sound bags, well tied, labeled with the name of the variety and address of the grower or contributor.

(2.) *Grasses* — To be collected, when possible, of full length including the roots, tied in bundles of about three inches in diameter, two bands at least, and packed in boxes in such a manner as to keep them straight. Grass seeds of all varieties, amber cane, broom corn, beans, peas, and vetches in quantities of four quarts, or more, if possible, can be put up in paper bags and packed in boxes.

(3.) *Indian Corn* — Is desired of all varieties, in stalk, husk and shelled — ten stalks of each variety, tied with three bands in such a manner as to preserve both leaves and ears. Fifty ears of each variety with the husks left on and one bushel of each variety of shelled corn, well cleaned and the tips and butts removed from the ear before shelling so as to secure the best formed grains.

(4.) *Vegetables* — Such as potatoes, beets, carrots, parsnips, turnips; rutabagas, kohl-rabi, horseradish and artichokes, and any other roots, should be secured in quantities of not less than one bushel of each variety, securely placed in boxes or barrels with alternate layers of damp (not wet) moss, from tamarack swamps, and so firmly packed that they will not get bruised in handling. These roots should *not be washed*, but have all dirt carefully removed with a brush, so as not to break the skin. Onions should be well dried in the sun and packed in slatted crates or boxes so as to allow a free circulation of air. Pumpkins and squashes can be shipped in barrels or boxes, well packed in dry shelled oats. Cabbage and cauliflower should be left with the roots and leaves on, pulled one day before packing, turned heads downward to drain, dry and wilt, and packed in open slatted boxes.

(5.) *Wool* — In fleece, flax, hemp and silk, both raw and spun, as well as the seeds of our native forest trees, are very desirable.

(6.) *Miscellaneous Articles* — Such as preserved and canned fruits and vegetables, domestic wines, vinegar, syrups, strained honey, pickles, catsups, and all articles contained in glass or earthenware, can be shipped in boxes, packed in oats. Honey in the comb can be sent in boxes as prepared for market.

Paintings, drawings and photographs of public buildings, private residences and manufacturing establishments are very desirable, as also objects of interest and curiosity, such as Indian relics, skins, skeletons and horns of wild animals, minerals, shells and petrifactions and objects representing pioneer life.

All articles contributed will be well cared for, and safely returned, when requested, free of expense. They will be exhibited with the name and address of the owner attached, and full credit given in the official report published by the State at the close of the exposition.

Premiums, amounting to *one hundred thousand dollars* ($100,-000) have been offered in the department of agriculture by the director general of the exposition, and farmers of Minnesota wishing to compete, can do so without expense, by sending their products to me, as directed above. Premium lists, containing full information, will be promptly furnished on application.

Every citizen of the State is most cordially invited to assist in this work; and, as the time is short, united and immediate effort will be required to enable Minnesota to make an exhibit of agricultural products, worthy of her fame and resources.

EDWARD D. PORTER,
Supt. Agricultural Exhibits and Chief of Installation for Minnesota.

In addition to this circular, I secured correspondents in each county in the State, who undertook the task of collecting and shipping the articles contributed by its citizens. As the season advanced, and the work of collecting material increased, the duty was devolved upon me of gathering up the exhibits from all portions of the State, storing them in the warehouses, protecting them from injury and shipping them to New Orleans. As the result of this work I loaded twenty-two cars as the contribution of Minnesota to this "world's exposition."

The names of all persons making contributions to my department, their addresses, and the articles furnished, are given in my report to the Hon. L. F. Hubbard, governor, president of the state board of collective exhibits, and will be published with the reports of the other superintendents in the final report of Oliver Gibbs, Jr., United States commissioner for Minnesota.

While a large quantity of farm products, from all portions of the State was sent in, owing to the neglect of the directions for packing and shipping, much of it arrived at their destination in a worthless condition and had it not been for the collection which I made from our experimental farm, Minnesota would have made but a sorry show with her sister states in many lines of agricultural production.

LIST OF ARTICLES FURNISHED BY THE

EXPERIMENTAL FARM

OF THE

UNIVERSITY OF MINNESOTA

TO THE

WORLD'S EXPOSITION AT NEW ORLEANS, 1884 - 1885.

Case containing two thousand specimens of the insects of Minnesota.

Collection of eighty specimens of our native grasses in bundles.

Herbarium of the grasses of Minnesota.

Collection of seventy varieties of the grains of the State, both in the straw, and grain in glass jars.

Collection of over one hundred specimens of beans and peas, in bottles and jars.

Collection of forty-one varieties of Northern sugar cane.

Collection of twenty-two varieties of corn in the stalk and ear.

Collection of nearly four hundred named and recognized varieties of potatoes.

One barrel each of ten varieties of beets, carrots, parsnips and turnips.

Collection of six specimens each of five varieties of squashes.

Collection of one bushel each of four varieties of onions.

Collection of two dozen each of six varieties of celery.

All the grains and grasses used in the decoration of Minnesota's exhibit at New Orleans.

With the exception of the celery and onions, all the above articles were unpacked at New Orleans in perfect condition and remained on exhibition until the warm weather and moist atmosphere of spring induced decay.

As the time for the opening of the exposition drew near, it became necessary to make arrangements for securing space for our exhibits and suitable provision for the comfortable accommodation of our working force, and for this purpose, at the request of Commissioner Gibbs, I went with him to New Orleans in October. While there I made myself familiar with the location of the buildings — their plans — the spaces allotted to the use of our State, and secured much valuable information which aided us materially in future work.

On our return I was requested by the "State Board of Collective Exhibits" to fill the office of "Chief of Installation," and to take the entire charge of the arrangement and display of our state exhibit at New Orleans. As to the manner in which I discharged this duty, I will leave to the testimony of the six thousand Minnesotians who visited the exposition.

Owing to the unfinished condition of the buildings, the distance of the grounds from the city, the incessant rains, the impassable condition of the streets and roads, the financial embarrassments of the exposition management and the difficulty of procuring material or mechanics, it was impossible for me to get our state collective exhibit in place so I could leave it until the middle of January, 1885. I came home at that time, and did not expect to return again until I did so to pack up our exhibit and bring it home at the close of the exposition.

Shortly after I left, United States Commissioner, Oliver Gibbs, Jr., was requested by the board of management to go to Washington, in their interest, to urge upon congress, then in session, the necessity of additional appropriations. His earnest, untiring and successful labors in this direction resulted in a severe, and for sometime supposed fatal, illness. In this emergency, Gov. Hubbard requested me to go immediately to New Orleans, take charge of our state interests there, and discharge the duties of commissioner. I did so, and remained in that position until the last of March, when returning health and strength enabled Mr. Gibbs to resume his duties, and I came home. In the month of June, a few days before the close of the exposition, I went again to New Orleans, and as soon as we were permitted to do so, packed up every article that had been placed in my charge, saw them loaded on the cars, and consigned to their starting point in Minnesota, where they arrived the last of the month, and from whence they were returned to their owners.

One year of my time was thus given to this enterprise and when it is considered that I was not released from a single duty at home, was carrying on the equipment and buildings of our new farm, and the experimental work of the station, and not only received no compensation for my services, but even paid a portion of my expenses from private funds, for the purpose of serving the State, and making a creditable display of the work of my deparement, there may be some excuse for a little "pigeon grass" among the beans, and a few "bugs" on the potatoes.

I can not close this brief report without making due acknowledgments for the earnest and faithful services of those who aided me in making our work at the New Orleans Exposition a grand success. To Mr. Jesse C. Wilson, my farm foreman, who aided in selecting, preparing and packing our farm products, and who gave most faithful care and attention to the farm management, during my absence; to Mr. O. W. Oestlund, who collected, prepared, and arranged our collection of insects and grasses and the herbarium; to Mr. W. W. McNair, who had charge of the collection and loading of the entire exhibit, and who took charge of the train to New Orleans; and to my daughter, Miss M. Estelle Porter, who acted as my secretary, conducted my correspondence, kept up the records, and took charge of my department at New Orleans during my absence. All the above named, with Mr. Berry, of Minneapolis, rendered valuable assistance at the exposition, in setting up and decorating our state exhibit.

DISPLAYS AT STATE FAIRS.

At the special request of the board of management of the State Agricultural Society and the Northwestern Industrial Exposition, I made exhibits of our farm products in 1882, 1883, 1884 and 1885, and had charge in 1886 of the department of farm products at the state fair. This work received the highest commendation from the boards of all these organizations, and from the general public.

THE FARMERS' LECTURE COURSE.

ADDRESS OF HON. W. W. FOLWELL, PRESIDENT OF THE UNIVERSITY OF MINNESOTA, ON THE OPENING OF THE FARMERS' LECTURE COURSE, AT THE COLLEGE OF AGRICULTURE.

This is an important day in the history of the agricultural college. During the twelve years which have passed since the college was organized, large sums of money have been annually expended, and extraordinary efforts put forth to render the department efficient and attractive.

The average attendance has not much exceeded one student per year. Yet, throughout this whole period the majority of our students, ranging in number from 200 to 350 per annum, have been the sons and daughters of farmers, who have deliberately turned aside from the doors of this college.

The meaning of this fact is that the farmers will not have an agricultural education, but prefer to follow a general scientific or literary course of studies. The regents and faculty are powerless to prevent this state of things. Turning to other states and examining the institutions and departments organized under the act of Congress of 1862, we shall find the same fact. That the agricultural colleges, or departments connected with state universities, have attracted but very few students, is a matter of notoriety, and is vigorously urged by some as a reason why the colleges should be separated from the universities. The separate agricultural colleges enroll and instruct large numbers. An inspection of these institutions, however, will show that but a small proportion of the students are pursuing courses of study in scientific agriculture, with the view of becoming actual farmers. These schools are mostly excellent scientific and technical establishments, carrying on also a considerable amount of classical or literary work. Some of their friends claim in justification that they are thus carrying out the law in its proper intent—that they are, and always ought to be, schools for farmers, not schools of farming.

This university is such a school—its chief business is the education of farmers.

It is not, then, a local, it is a general, fact, that very few young men can be induced to pursue long and regular courses of study in scientific agriculture. Out of the many reasons for this fact only two may be mentioned:

1. It is the sons of small farmers, who, foreseeing that there will soon be no room for them on the quarter section, go to college. Such persons inevitably choose those callings in which an education is itself a capital.

2. Should any of them, however, by science and practice, through a term of years, fit themselves for scientific farming what could they do? Can a man farm without land, animals, and machinery? In Europe the graduate of the agricultural college expects to enter the service of some lord proprietor as a salaried expert or manager.

We have no such landlords, unless they be our "bonanza farmers." Believing in the supreme advantage to a state of a yeomanry of small holders, I can not wish permanent success to this kind of agriculture. I am convinced that the training of experts in scientific agriculture, by long and graded courses of studies, is to be but a small part of the work of the agricultural college. I am a firm and steadfast believer in agricultural, technical, and art education. There is work for the agricultural college, work of many kinds. If there were time I would like to remark upon that of experimentation, and to commend the excellent service performed by Prof. Chas. Y. Lacy, during his connection with this college.

In order not to be a misnomer the agricultural college must be a professional school. I never thought it either profitable or honest to give students in general science a homeopathic dose of one or two agricultural studies and dub them "agricultural students." What would be thought of a law or medical school which should undertake to teach ancient history, the theory of equations, or the nebular hypothesis? The agricultural college may leave to the schools and colleges the general education. The importance of this day to our agricultural college lies in the circumstance that we are inaugurating a new departure in the proper professional work of the college; not by undoing anything or recalling any advantages heretofore offered, but by adding to our numerous courses of instruction a new one—the "Farmers' Lecture Course." It has long been a wonder with me why the founders of agricultural colleges have not taken a lesson from the organizers of law and medical colleges. These colleges have never undertaken the impossible task of combining a general education with a professional course, in a graded course extending over three, five, or seven years. What have they done? They have collected a body of students from all classes and grades of society, with all shades and varieties of preparation, and proceeded to instruct them, as best they could, in the things lawyers and physicians need to know. I can not commend all that these schools do, but it is plain, I think, that their founders were wise in their generation. Why shall we not derive from them what is good in their system and apply it in agricultural education? Here are on the one hand a goodly number of men of science who actually long for the opportunity to communicate their knowledge to men so much needing to use it. On the other hand, a vast body of working farmers, gardeners, dairymen, etc., are just as eager for the light of science. It is respectfully submitted that it is a suitable function for the agricultural college to bring these consenting parties face to face. This is what we are doing to-day.

For many years we have waited for such a consummation. That we see it now is due to the intelligence and activity of Prof. E. D. Porter, who has organized and will conduct the work of the course. The lectures will be open to all persons without fee, examinations, or other conditions. The daily programs will be published in the journals of the city.

We presume upon the success of this course. There must be many gentlemen and ladies who can make it convenient to attend upon the lectures of the accomplished and distinguished instructors who have been engaged, and announced success this year means a still wider and richer course next year. The board of regents will spare no pains nor expense within their reach to serve and subserve the farmers of Minnesota. They will gladl y set the table if the farmers will clear it. It is a happy omen that the farmers' lecture course is opened by the United States commissioner of agriculture. That the distinguished gentlemen now filling that office should be willing to break away from his multitudinous engagements and travel 3,000 miles to give us this "send off," may assure us of his interest in, and appreciation of, our enterprise.

I have the honor, ladies and gentlemen, to present the Hon. Geo. B. Loring, of Massachusetts, United States commissioner of agriculture.

ADDRESS

OF

HON. GEORGE B. LORING,

United States Commissioner of Agriculture.

MUTUAL RELATIONS OF AMERICAN INDUSTRIES.

GENTLEMEN: I have been induced to leave for a time the immediate duties of my department and join you in your deliberations, by a deep desire to encourage in every way the industry which you represent, and to assure you that the good will of the federal government is with you in all your endeavors. You will not expect me to discuss in a general assembly like this, any one specific question of practical agriculture, surrounded, as I am, by those whose success indicates a thorough understanding of their business, and whose presence here is a proof of their determination to investigate and collate and compare. I read on the fields about me the record of the farmers of the Northwest, and the lesson they have learned by experience, and have taught their country. While I congratulate you on the progress of agriculture here, and the advancement of the farmer in his work, on the tribute which science is constantly paying you, and the growing confidence you feel in the results of scientific examination and experiment, on your skill in managing your crops and in caring for the animals which constitute so large a share of your wealth, I beg you to bear with me while I call your attention to the relations which exist between your controlling industry and those great occupations which constitute the prosperity and power of the American people.

THE RAPID GROWTH

of American industry constitutes one of the most important and interesting chapters in the history of civilization. The stories of discovery and conquest, of commercial adventure and military power, have charms which more prosaic occupations are not expected to possess. And yet they all sink into insignificance before the recital of the steady and triumphant march of that vast army of busy and devoted sons of industry who have cleared the land and opened the mines, and chained the waterfalls, and stretched the great highways of travel and transportation over valleys and through mountains, and created churches and school houses, organized cities and towns, and fed and clothed and educated themselves, and have filled the commerce of the world with the fruits of their toil. The chosen career of the American people has been a career of peaceful industry, and their achievements on this field have won the admiration of the world from their infancy to their years of maturity and strength. More than three-quarters of a century ago, Sheridan exclaimed in the house of commons: "America remains neutral, ,prosperous and at peace. Turn your eyes to her; view her situation, her happiness, her content, observe her trade and her manufactures, adding daily to her general credit, to her private enjoyments, and her public resources, her name and government rising above the nations of Europe with a simple but commanding dignity that wins the respect, the confidence and the affection of the world." And contemplating the genius of our institutions and the vital force of our republic, De Tocqueville declared, "Then will there ccme a time when there will be seen in North America 150,000,000 of men equal among themseves, who will all

BELONG TO THE SAME FAMILY,

who will have the same point of departure, the same civilization, the same language, the same religion, the same habits, the same manners, and among whom thought will circulate in the same form and paint itself in the same colors. All else is doubtful; but this is certain. Now, here is a fact entirely new in the world, of which imagination itself can not grasp the import." Unchecked by war, and defiant of all disaster, this republic has increased in population at the rate of a million a year during the last ten years, rivaling now every country in the world except Russia, and attracting to her shores vast communities of people from those impoverished and crowded nationalities. Thriving states and prosperous towns spring up here like magic. The products of new and fertile lands are borne to the great centres of trade which are created everywhere by the necessities of a teeming population. The civilization which is advancing with such rapid strides from sea to sea is indeed a civilization of thrift, intelligence and morality. Prosperous industry is here the pioneer of education; the cultivated farm and a profitable mill preparing the way for the library and the lyceum, the school house and the meeting house. Conscious of the responsibilities and duties which attend them wherever they go, and proud of that individuality which freedom bestows upon every man who enjoys her influence, this aspiring and industrious people of ours has endowed schools and colleges on every hand, has established more than 70,000 churches, has provided places of worship for more than 20,000,000 of worshipers, and has church property valued at more than $300,000,000. You will pardon me, I am sure, if I rehearse to you that

WONDERFUL DEVELOPMENT

of industry out of which this mental and moral and religious culture has grown, and for the encouragement of which you have assembled in one of the great agricultural centres of the great agricultural section of our country. I would avoid this array of figures were it possible to present in any other way a picture of which every American ought to be proud, and which naturally belongs to a proper delineation of the relations which all our industries bear to each other in their united efforts for American growth and prosperity. In agriculture the increase has been astonishing, and accounts for that vast internal and foreign commerce out of which has grown so much of our financial success. It is not necessary to go back a half century or even twenty five years to obtain the most gratifying evidence of our progress in the work of tilling the soil. But starting in 1870, at which time we had reached an enormous production in proportion to our population, and making our comparisons with the returns of 1880, we may learn what can be accomplished in a single decade by a people constantly increasing in numbers and occupying new lands. In 1870 the amount of cotton produced was 4,352,173 bales; in 1880, more than 6,000,000 bales. In 1870 the amount of Indian corn raised was 760,944,549 bushels; in 1880, 1,754,449,435 bushels. In 1870 the wheat crop was 287,745,626 bushels; in 1880 it was 459,667,043 bushels. In 1870 the crop of oats reached 282,107,157 bushels; in 1880, 407,859,033 bushels. In 1870 the tobacco crop amounted to 262,735,341 pounds; in 1880, it amounted to 473,107,573 pounds. The increase of agricultural products was nearly 100 per cent in these ten years. And in the

LAST YEAR OF THIS DECADE,

from 1879 to 1880, out of this vast increase of our crops and products, our cattle export rose from $13,000,000 to $14,000,000; corn from $43,000,000 to $50,000,000; wheat from $167,698,000 to $90,546,000; flour from $35,000,000 to $45,000,000; cotton from $209,852,000 to $245,534,391; beef from $7,000,000 to $12,000,000; lard from $28,000,000 to $35,000,000; and pork from $5,000,000 to $8,000,000. Mark, also, the growth of American manufactures in half a century. In 1830 the amount invested in cotton manufactures was a little more than $40,000,000; the number of spindles was a million and a quarter. The number of males employed was 18,539, and the number of females was 38,927. The amount of cotton used was 77,759,316 pounds. Fifty years have passed away, and the number of spindles has increased to 10,769,-

147. The amount of cotton used in 1880 was 793,240,500 pounds. The number of persons employed is 181,628, and the amount of capital invested in mills and subsidiary work is more than $225,000,000. Of our woolen manufactures the statistics are more imperfect. But I have ascertained that in 1840 the capital invested in this enterprise was $15,765,124, the number of pounds of wool used was 50,808,524; the number of hands employed was 21,342; and the value of the product was $20,696,699. In 1880 the value of woolens, worsteds, carpets and hosiery produced was $234,587,671, the amount of wool used was 187,616,605 pounds; the wages paid amounted to $45,959,012; the total value of the materials used was $145,141,798. The product increased from 1870 to 1880 nearly $20,000,000. In 1870 the silk productions of the United States were valued at $12,210,662; in 1880 at $34,410,463.

FIFTY YEARS AGO

the shoe and leather industry had hardly a national reputation. In 1870, however, there were 4,237 tanneries in the United States employing 20,784 hands, using a capital of $42,710,505, paying in wages $7,934,416 annually, producing leather valued at $86,169,883, using more than $9,000,000 worth of bark, nearly 9,000,000 hides, and 9,664,000 skins. There were also 3,085 currying establishments, employing 10,000 hands, absorbing $12,000,000 capital, and producing $54,191,167. There were, moreover, 3,151 establishments for the manufacture of boots and shoes, employing 91,702 hands, with a capital of $37,519,019, paying in wages $42,504,444 annually, using $8,502,718 worth of leather, manufacturing boots valued at $50,231,470, and shoes valued at $93,846,203, with a production valued at $146,704,000.

The growth of the iron and steel industry has been equally remarkable. In 1810 we produced but 50,000 tons of iron and our largest furnace could yield but 1,500 tons annually. In 1830 the product was 165,000 tons; in 1840 315,000 tons; in 1848, 800,000 tons; 1860, 1,000,000 tons. In 1880 the iron and steel works of the United States produced 7,265,100 tons, as against 3,655,215 in 1870. The capital invested was $230,971,884; the number of hands employed was 140,978; the wages paid amounted to $55,476,785; and the value of all the products was $296,557,685.

In the manufacture of machinery the capital invested has increased from $15,000,000 to $40,000,000 in twenty years, and the annual value of the product is more than $20,000,000.

The aggregate annual product of the manufacturing and mechanical industries of the United States is now more than $6,000,000,000. Of this vast product less than $200,000,000 are exported. And of the $9,000,000,000 produced by agriculture less than 10 per cent is exported. On the self-supporting power of the American people and on the mutual relations existing between our industries we can dwell as Americans with the most profound satisfaction, I have alluded to

THE PRODUCING POWER

of the American people, but in order to understand the relations which exist between our industries we should not forget our consuming capacity also. Of the $15,000,000,000 produced by our various industries, nearly $14,000,000,000 are consumed at home. It is the home market to which the American producer turns most naturally, let his industry be what it may. In fact the law of our largest and most widely diffused industry, agriculture, is the cultivation of those crops which are adapted to a local market, and the occupation of lands lying near that market. Not yet has this law become universal, it is true: but it applies to all the older and thickly settled sections of our land, and goes with diversified industries wherever they create large cities and towns. Fifty years ago the farmer was compelled to seek his market near home, on account of the difficulty which attended the transportation of his crops. But the settling of new and remote lands and improved methods of transportation rendered the growing of the great staples a necessity, and corn, wheat and provisions occupied the farmer's attention, and opened to him remote and even foreign markets for his grains. This frontier farming, however, is but temporary, and must be followed by that systematic husbandry which constitutes the legitimate business of the American farmer and carries him back to those days when agriculture was almost the sole business of the country, and when a farming community was uniformly prosperous, when prudent and industrious. While our large towns and our manufacturing states, therefore, provide markets for a large portion of the products of the pasture and grain fields of the West, they also support that more profitable system which consists in a careful cultivation of the soil and in the economical management of small farms. The trade of this home market to which I have alluded is immense, and the sources of supply in all their variety form an interesting

TOPIC FOR CONSIDERATION.

New England requires about 20,000,000 bushels of wheat, and produces only 1,250,000. New York uses 30,000,000, and grows about 12,000,000. The supply of this deficiency comes from the West, from the Ohio Valley and the prairies west of the Mississippi and the Missouri, and costs from $40,000,000 to $50,000,000 in years of good production, but still more in this year of comparative scarcity. To assume, however, from the fact that New York goes West for six-tenths of her wheat supply, that wheat growing is an unprofitable industry there, would be an unsafe and unreliable conclusion. There are eight counties south of Lake Ontario which yielded in 1879 6,087,876 bushels on 377,269 acres, or 18 6-10 bushels per acre, or more than 50 per cent above that of Minnesota or Dakota, and somewhat higher than that of California for the same year. Thus, an important part of the deficiency of other counties in New York was supplied by the surplus grown in the Seneca Valley and its neighborhood. There is another district lying eastward toward the Hudson, and southward toward the Delaware, that finds a greater profit in the dairy —making a production in butter and cheese worth far more than the grain procured from the West. Not only are the home wants in the dairy products supplied, but a large share of the 120,000,000 to 140,000,000 pounds of cheese exported from year to year is credited to this district, bringing a vast amount of money from Europe, a part of which only is contributed to the aid of the Western wheat growing. Going still nearer the seaboard, to Dutchess and Westchester and the fruitful land of Long Island, we find more people and less wheat and a soil devoted to market gardening, yielding, under the most favorable circumstances

A GROSS PRODUCT

worth $1,000 per acre, enough to buy a quarter section of superior wheat land west of the Mississippi. In the immediate neighborhood of New York City the product of market gardening swells to millions of dollars. Ten years ago the census reported more than a million dollar's worth in Queens County alone, and the present enumeration must, when tabulated, show an immense increase for this surburban district. The neighborhood of Boston and Philadelphia and every other large city is monopolized by market gardens, and the country about Norfolk, Va., is mainly devoted to fruit and vegetables for Northern consumption. The fruits of the country, a perishable commodity, must be produced as near as possible to the point of principal consumption. The domestic fruits alone furnish a trade of large volume and value. New York City has a trade in domestic fruits of more than nine millions of dollars. Chicago, which supplies the great Northwest, has about as much; and the other large cities of the country would swell the total amount to about $60,000,000, including the great amount now sent from our Southern latitudes. Could all the fruits sold in smaller cities and villages be added, and those consumed on farms or village lots be enumerated, it is probable, judging from careful deductions from available data, that the annual value of the fruits of the United States would not fall much below $200,000,000. Thus, the distribution of farm products is found to arise from a multiplicity of causes, soil, climate, nearness to large cities, prices of land and labor, facility for obtaining labor at required times or seasons, skill in special industries developed by long practice, conservative persistence in time-honored usage, and many other causes, serve to distribute in patches, large or small, the crops which furnish the products of American agriculture. The great cereal crop of the country, Indian corn, which is only exceeded by grass in universality of distribution, constitutes more than 1,700,000,000 of the 2,000,000,000 bushels of grain of 1879. It is found in every state and in every territory with one or two exceptions. Yet this crop can not escape the law of special local attraction. The three states, Illinois, Iowa and Missouri, yield 800,000,000 bushels, or 45 per cent of the crop, and only seven states, including Indiana and Ohio on the east, and Kansas and Nebraska on the west, have ever any considerable surplus above the requirements of home consumption. The remaining thirty-one states and all the territories produce together but 37 per cent of the crop, at only the rate of nineteen bushels per acre, but half the rate of the yield of the corn belt. The receipts at the seaboard cities for exportation and consumption, including all kinds of grain, ground and unground, aggregated 352,921,452 bushels in 1879, and 369,559,607 in 1880. The

WHOLE EASTERN MOVEMENT

of Western grain, including shipments to interior points on the Atlantic slope, must somewhat exceed 400,000,000 bushels, not more than one-sixth of the total production of an abundant year, and less than one-fourth of the lightest crop the most disastrous season is likely to yield. The relations which are thus established between the agricultural and manufacturing interests of our country, not only affect the material prosperity of the farmer, but they provide him with that social enjoyment upon which the happiness of an educated people largely depends, and rouse him to that energetic action which gives strength to all his powers. The isolation of farm life incident to sparsely settled regions is one of the trials which the American is anxious to avoid; and when he leaves the outlying farm and secures a home nearer the haunts of men, he places himself within reach of the lyceum and library and easy and convenient intercourse with his fellow men. The comforts and adornments of his home are increased; and farming becomes to him an occupation analogous to those branches of business which tempt men away from the loneliness of the country to the pleasures and opportunities of the town. The tendency of the rural population of some sections of our country to abandon the exhausted farms and seek lands nearer a populous market is by no means an element of agricultural decline. It indicates rather a disposition to take advantage of those circumstances which lead to more active industry and more profitable labor. It is the same spirit of enterprise which has induced many farmers to abandon general agriculture and devote themselves to special crops, and has led the casual observer to infer that the cultivation of the soil was being abandoned. I have known the statistical returns of many evidently thrifty and prosperous communities to indicate a reduction of the products of the farm, and to lead to the supposition that because the cereals and annual products were diminishing the lands were deserted. But a more careful examination has always revealed the fact that it was a change in the industry alone which had taken place, and that those crops which met with competition from the cheap and fertile land of the West had been substituted by the products of the market garden with all the profit which goes with this mode of manipulating the land. As

THIS SYSTEM EXTENDS.

and manufacturing cities and towns multiply, the returns of our farms will be largely increased, and the average yield of our land per acre will be greatly enlarged. It is the intimate relation between agriculture and manufactures which makes general farming what it is and will gradually make American farming what it should be. Now, the relation existing between the cotton plantations and the market created by American manufactures is so deeply interesting to every agricultural association which would consider the wants, necessities and chances of the entire country, that I trust you will allow me to consider it here. Of the total crop of 1870 and 1871, of 4,352,317 bales, 1,110,196 bales were consumed in the United States. Of the total crop of 1874-75, of 3,852,961 bales, 1,193,005 bales were consumed in the United States, and of the crop 1880-81, of 6,605,750 bales, 1,938,937 bales were consumed in the United States. The increase in home consumption during the ten years from 1870 to 1880 was 828,741 bales. The increase is of the greatest importance considering the fact that the expenses on cotton sold in the English market are nearly two cents per pound in freight, port charges and loss of weight, and the average price in 1880-81 in Liverpool is 6 48-100 pence, and in New York 11 34-100 cents per pound, the advantage of the American market being nearly 2 cents per pound to the producer. This important relation will continue to increase in value as American manufactures extend, and the home market is enlarged, and will, undoubtedly, produce an increase in the average yield of cotton per acre, and in the ultimate uniformity of the crop in the cotton states, allowance being made for the difference in soil and climate. This, added to a

WIDE DIVERSITY IN FARMING

which will be adopted, will do much to develop the agriculture of the Southern states. It is undoubtedly true, now that the cotton belt needs variety of crops to fill the vast unoccupied areas not suited to the cotton plant. Nine-tenths of the superficial area of these states yield no production in agriculture, except in a limited degree in pasturage and wool product. But three acres in every hundred are in cotton, which occupies one-third of the breadth of the land actually cultivated. The cotton area in 1879 was 14,462,438 acres. The area of ten cotton states is 456,000.000 acres. The cotton crop is not evenly divided in these states. It is almost unknown in the mountain system of the South, slopes as well as summits, and broad tablelands of high elevation, suited only to the products of high, temperate latitudes, mixed farming, grain growing, dairying, and orcharding. It is grown mostly on the alluvial soils of the great rivers, the limestone belt of Southwestern Georgia, Central Alabama and Western Mississippi. In general terms, one-tenth of the counties yielding cotton produce half that crop. The largest average yield per acre, according to the census, discloses the local belt of greatest productiveness, as follows: The richest cotton land in the states is on the Mississippi above and opposite Vicksburg. The highest county averages in three states unite to prove the superiority of this district; East Carroll, in Louisiana, Chicot, in Arkansas, and Washington, in Mississippi, respectively, stand for the largest rate of production in these states and in the cotton belt, yielding in 1879 but little less than a bale per acre.

Consider now the benefit which the manufacturer derives from his free and intimate relations with the agriculture of the country. On the one hand, drawing his raw material largely from the immense and various resources of our country—iron, cotton, wool, hides—and on the other hand, finding a home market in the great agricultural regions, the American manufacturer possesess

OPPORTUNITIES AND ADVANTAGES

hardly known to any other country on earth, and illustrating most forcibly the self-supporting power of our people. So closely are these interests united that what affects one naturally affects both. The same policy which has been extended over our mills has been extended also over our fields, and the results in both cases demonstrate its true value. While the American manufacturer has furnished the American farmer with almost all his necessary articles, such as cotton goods and fabrics, shoes and boots, axes, forks and spades, shovels, hoes, harrows, plows, rakes, cultivators, reapers, mowers, wagons, tinware, glassware, cheaper than they can be purchased in the English market, the American farmer has furnished his products, wool, cotton, provisions and grain, at rates established by our own supply and demand, and not in accordance with rates fixed abroad. The traffic is free and equal, and it is between parties enjoying equal privileges and opportunities, rates of interest, wages of labor, taxes, social and civil expenses, all being regulated by one system, and varying only with different localities. As the two great pillars of American industry, they have received equal consideration from the government. Not only is a duty laid on goods of foreign manufacture, but there is also laid on all animals a duty of 20 per cent; on wool from 10 to 12 per cent per pound, and from 10 to 12 per cent *ad valorem* added; on sugar from 2 to 5 cents per pound; on corn 10 cents per bushel; on barley 15 cents per bushel; on wheat 20 cents; on oats 10 cents; on butter and cheese 4 cents per pound; on tobacco leaf, unmanufactured, 35 cents per pound; and the American farmer may well remember that under this policy the clip of wool in this country has risen from 60,000,000 pounds in 1860 to 250,000,000 pounds in 1870, and that in our advancing agriculture we have devoted to wheat 50,170 square miles, to corn 80,610, to oats 20,500, to barley 2,810, to hay 42,080—the corn and wheat alone covering a larger area than the United Kingdom of Great Britain and Ireland. And these two great producing industries, engaged in supplying each other with all that enters into the material comfort and welfare of life, at the lowest possible rates, may also remember that their products are now transported on American steel rails costing $60 per ton, as against $140 per ton when furnished by the rolling mills of England, and with freight rates reduced accordingly; and let me say you are going to make it still better before your mountains of iron are exhausted. When these two

IMPORTANT AND FUNDAMENTAL

industries united in the work of developing American resources, it is not to be supposed that they who laid the foundations of this Union anticipated the great and radical change which has taken place since their day. They could not have foretold the ocean-defying steamship and the land-defying railroad and the time-defying telegraph. They could not have listened amid the quiet repose of their luxuriant farms for the busy hum of great cities. But they performed their work well in their day and generation, and they set an example of industry and foresight which we may well follow. And I am compelled to believe that they anticipated the time when the people of this country would be engaged in mutual industries for mutual support, and when the 12,000,000 of people of their day would become the 50,000,000 of our own, busy and consuming in the great commercial and manufacturing centres, busy and producing in the great agricultural regions, each industry leaning on its fellow, and all united in establishing American supply for American markets and regulating the prices in accordance with the wants of American labor and the value of active American capital. The production of supplies and the existence of a market have always created a necessity for a system of transportation which constitutes one of the co-operative industries of society. The modern methods of transportation by steam, both on land and water, have given new value to lands, new opportunities to mills, new markets and values to crops, and it may be safely said that the addition of a powerful and rapid means of transportation has not only given new life to all the old industries, but has added a new one of inestimable value and importance. The labor and expense of exchanging commodities have been so far diminished in our day that every producing industry is now able to employ its time and means to the best possible advantage. No time is now wasted by the manufacturer in traveling from his mill to his market, none by the farmer in transferring his crops from his fields to the consumer.

NO LIMIT

is now put to the capacity of the mill, the capital absorbed and the hands employed, by distance and obstacles on sea and land. The farmer whose time and means and horses were fully employed in hauling the crops of a hundred acres to market fifty years ago can now employ his force at home in increasing the crop of ten times that area of land, while it is harvested and borne to market by machinery. Lands which were once useless to the cultivator are now brought by rail to the very doors of the market required by their crops. And not only is the transporting capacity of each individual increased, but the force which can be retained for work on the land is vastly enhanced, as well as the profit on the crop itself. When, many years ago, the railroad from Springfield, Ill., to the Illinois River was opened, it was announced in a leading newspaper of that day: "One week before the railroad was finished corn could be had here in any quantity at 15 cents per bushel; now not a bushel can be had for less than 25 cents." With a system of farming which I have defined and a system of transportation which we possess, the producing power of American labor and land is almost unlimited.

The relations which have been established between these active and vigorous industries to which I have alluded have produced upon society, moreover, a degree of mental energy and general intelligence never equaled in any age of the world. In the affairs of life now a man's head is considered to be worth as much as his hand. The relative market value of these two commodities have materially changed since the "common and concurrent mind" began to assert its supremacy. The

NECESSITY FOR ECONOMIZING

and utilizing labor in every department of business has created a necessity for clothing labor with some degree of intelligence, and out of this elevation of practical service has grown that active, vigorous and untiring faculty for invention which forms one of the striking characteristics of the present age. Mark the amount of intelligence required to manage and run our railroads—the foresight, prudence and comprehension of the president, the watchful, systematizing power of the superintendent, the activity and self-possession of the conductor, the headlong courage of the engineer, who plunges through mountains and overrides valleys in his career, the laborers who grow intimate with the vast and intricate mechanical forces employed in this great civilizing business, and it is easy to see why it should demand and create intelligent labor, an aggregation of active and untiring intellects, all acting on each other, from the highest to the lowest, in a way unknown to slower and more circumscribed systems of travel and transportation. The constant and rapid intercourse of the present day—passage by steam and communication by magnetism, the subjugation and use of mechanical forces in all their might and in all their delicacy, by superior and commanding minds—has inspired and elevated the observant and co-operative masses of men to a degree hardly surpassed by the training of our public schools. While, therefore, the business of life, as represented by our railroads, steamships, telegraphs, mills and improved modes of agriculture demand intelligent labor, it joins hands with the schools and does its share of the work of education. Before the incessant activity and extended relations created by all the accelerated business methods of modern days—by transportation which opens the markets of the East to the living products of the pastures of Illinois, and carries the laborer in a day from the locality where he is not wanted to the locality where he is wanted—by machinery, which creates faster than

A DESTRUCTIVE AND EXTRAVAGANT PEOPLE

can consume, and casts the printed page broadcast over the land, driving the distaff and spinning wheel into seclusion, and working the tedious toil of the hand press, we can not, if we would, become stationary in our habits and deliberate under our necessities. To pause now is simply to be trampled on by the multitude. We must travel by steam, we must send our wool to the mill, our milk to the factory, we must know how much gold there is in Colorado, and silver in Arizona, and coal in Pennsylvania, and copper at Lake Superior; we must have read the last message of the president, the last speech in Congress; we must know something about Mr. Gladstone, and Gambetta, and John Bright; something about Chili and Peru, and whether the statemanship of New Jersey or the statesmanship of Maine is to apply to the adjustment of their difficulties; we must use a steel pen, and a mowing machine, and a horse hoe, and a tedder, and a horse rake; we must exchange photographs with our friends, and recognize in every way the marvelous diligence of man in his use of light, and heat, and air, and earth, and sea for his own comfort and convenience, or make up our minds to live in the world as not being in it. We must believe in the relations of our industries, the combination of industrial forces which make modern society what it is, if we would perform our part well, and comprehend the genius of the age in which we live.

And now, gentlemen, I submit these suggestions with regard to the relations you hold to the business of the country, and the active energies by which you are surrounded, with a deep consciousness of my own inexperience, but with a deep sense, also, of my obligations to the work in which I am engaged. My agricultural labor and observation have been confined to that section of our country in which a hard soil and severe climate have compelled the farmer to toil with the utmost diligence and to calculate with the utmost economy; that section in which small farms and diversified agriculture have rewarded the industrious and sagacious husbandman. But I see no reason why my education in that field should be inappropriate elsewhere, inasmuch as good cultivation, a wise choice of land, a proper selection of seed, the skillful preparation and use of fertilizers, the breeding and feeding of well-chosen animals, are profitable everywhere in this country, and the economy of a farmer's home and a farming community is the same throughout the entire land. I am anxious, as the United States commissioner of agriculture, to encourage every step toward

SYSTEMATIC AND PROFITABLE FARMING,

and to support the judicious views of all local authorities who are working in the same field with myself. The business of the department which I represent is largely auxiliary, and can best be conducted by stretching forth a helping hand to all who are endeavoring to increase the products of our soil and to improve the condition of the vast animal kingdom upon which the farmer so largely depends for his subsistence By the introduction of new seeds, submitted to the test of the farmer's experience, and by recording the results of such test for the instruction of the public; by encouraging agricultural education in all its branches; by rousing a vigorous attention to the work of making our farms attractive; by scientific investigations into the quality of soils, the constituents of the various articles of food used by man and the domestic animals; by an intelligent study of the American forests and tree culture, much may be done to aid the farmer in his work, and much to lead him away from enterprises which are impracticable and visionary. In order to accomplish this I have submitted the important problems which have come before me to accomplished commissions, or to careful investigation, on which we can rely.

The viniculture and grain growing of the Pacific Coast, the supplying of the arid regions with artesian wells, the mode of conducting forestry schools and experiment stations in Europe, have all been submitted to competent agents for examination and report. The question of cattle disease on board the steamers transporting cattle to Europe has been presented to the privy council in England, and much has been done to satisfy the English public that the American animals shipped are free from contageous diseases. I have taken especial care that the seed distributed by the department shall be of the best quality. The agricultural department should undoubtedly be the nucleus around which can be gathered those associate industries which depend on agriculture for their existence, and in turn make agriculture profitable and in many sections possible. Statistical returns of our manufactures, with an illustrative display of their products, would do much to establish a uniform system of land and water carriage among us. Accurate surveys and returns of our mineral lands with the industrial processes employed in working them, are of vast importance. A well organized and consolidated inquiry into the extent of contageous diseases among animals, the best methods of prevention and extirpation, can not be too thoroughly and promptly organized, and without considering for a moment the political status of such a department, I think you will agree with me that the time has come for its organization. An active, industrious, intelligent body of American citizens and producers are entitled to it, as a branch of government whose value can not be overestimated.

The encouragement of all industrial endeavor in this country has a deep significance, growing out of the relations existing between the producing classes here and the system of state and society in which they live. In England the model farm selected for the inspection of Elihu Burritt, consisted, he tells us, of 3,000 acres on which "mèn of skill and experience, who n America would conduct farms of their own and could not be hired at any price, may be had in abundance for foremen at from twelve to fourteen shillings, or from three to four dollars a week, they boarding themselves." The wages of manufacturing labor in the great towns of England and France are equally insignificant, an adult earning in England, under the best circumstances, about eight dollars per week, and in France seventy to eighty cents per day of twelve hours. A careful investigation into the system of small land-holding in France has satisfied Mr. Howard, an agent sent there to investigate it by the London Farmers Club, that such a system is a failure, and contrary to the social and civil system there, and Dr. Playfair, speaking of England, says: "Our country has shown little inventiveness and made little progress in the peaceful arts since 1862. Not so, however, here. America is the paradise of the small land owner. Labor is so well requited that its earnings constitute a large share of the deposits in our savings banks. The inventive arts are devoted to the business of easy and profitable production. A woman with her needle earns a mere pittance in a long and weary day, in which necessary confinement and toil destroy that very physical energy upon which she depends for a subsistence. With a sewing machine she easily earns an ample income. A machinist with the tools of half a century ago could reap but a small reward, and no farmer could afford to pay the current prices for agricultural labor in harvest time were he thrown back upon the scythe, the sickle and the flail. But a man armed with ingenious machinery becomes hundred-handed, and can earn accordingly. He becomes a part of society, in which he can exercise his taste as well as supply his wants. It is not the cost of a mere subsistence that we are to calculate in this country, but the amount of comfort and taste which every man can reach—good food, good clothing, a good dwelling, adorned simply or elaborately according to his means.

Fortune does not smile on all men here, it is true, but when she does smile the cheer which follows in this country is unsurpassed. Aided by the arts of life which surround him, the American takes his place in society, performs his civil duties, pays his taxes, aids his churches, builds his school houses, educates his children, builds and beautifies his home and endeavors to perform his part in life with no recognized barrier between him and the object of his ambition which industry and perseverance can not overcome. For him, for his opportunity, for his inheritance as a citizen and laborer in this republic, I would encourage every industry, stimulate every mental and moral faculty, and build up and support every institution which can aid him in his work.

SYLLABUS OF LECTURES

ON THE

PRINCIPLES OF STOCK BREEDING,

BY WM. H. BREWER,

PROFESSOR OF AGRICULTURE IN YALE COLLEGE.

LECTURE I.—The Law of Likeness.

Thursday, January 25th, 10 A. M.

Introduction.—The Breeding of Domestic Animals may be practiced as an art or studied as a science.
Heredity; definition and explanation.
The basis of the existence of Species, Races, Breeds, and Tribes.
Heredity of Individual Peculiarities.
Prepotency.
Causes which modify the force of Heredity.
What Characters are most often transmitted.
Relations of Heredity to antiquity of Race and Character.
Relations to purity of Breed.
Heredity of Disease.
Heredity of Acquired Characters.
Relation of this to Education, Training, and to Instinct.
Atavism or Reversion.
The argument of averages.
What is meant by Constitution.

LECTURE II.—Variation; Breeds.

Thursday, January 25th, 2 P. M.

Variation as universal as heredity.
Plasticity or the capability of being moulded.
Variations induced by food, drink, climate, soil, etc.
These usually slight in a single generation, but very important in results.
"Adaptation," to outward conditions;—acclimation.
Variation induced by domestication.

Artificial selection.
Variation incident to a widely crossed ancestry.
Variation is more rapid when varying parents are selected.
Variations resulting from causes or conditions not yet understood.
The sudden and wide variation known as "sporting."
Any character once acquired may be transmitted by heredity.
All of the characters acquired in any individual by variation are never entirely transmitted, and hence infinite variety; — individuality.
The special peculiarities of sports are often transmitted entire, if transmitted at all.
Breeds originating in sports.
Definition of breeds, races, tribes, and varieties.
The origin of breeds.
Wherein *uniformity* in a breed is desirable, and wherein *flexibility* is desirable.
Pedigrees — uses and abuses.

LECTURE III. — Close Breeding.

Friday, January 26th, 10 *A. M.*

Relation of purity of blood to special excellencies and to success in practical stock breeding.
Bakewell's experiments and experience.
Breeding "In-and-in."
Relations to atavism.
Illustrations from Shorthorns.
Illustrations from Setter dogs.
Alleged benefits and why practiced.
Limitations.
Alleged effects on constitutional character.
Suggestions from Nature.
Relation to sanitary problems in human society.
Breeding in line, and in tribes.

LECTURE IV. — Crossing — Breeding to Points.

Friday, January 26th, 2 *P. M.*

Various uses of the term "crossing."
Relations of out-crossing to vigor and fertility.
Conflicting hypotheses as to breeding between like parents.
"Nicking."
Hybrids.
Violent crossing; its relations to vigor and fertility.
Difference between first cross breeds and their descendants.
Relations of wide-crossing to atavism and to spontaneous variation.
Instability of grades and cross breeds.
Crossing for new breeds and for special purposes.
Relations of crossing to temper, docility, courage and disposition.
Breeding to points; definition and illustration.

Specialization of characters.
Selection and "weeding."
Whatever the origin of breeds, this the common method of improvement.
Scales of points.
Ideal Types.
Breeding from Winners.
Illustrations from swine.
The Wild Boar, how changed to the domestic hog.
What changes have been produced in structure, form, habits, instincts, size and fertility.

LECTURE V.—Sundry Topics.

Tuesday, January 30th, at 10 A. M.

The biological laws which underlie and control all the phases of breeding are general, but the practical details of the breeding art vary widely in actual practice, differing with different species and even with different breeds of the same species.
What qualifications are necessary for eminent success as a breeder.
Disposition, capacity for education, temper, and instincts as points to be bred for.
Bad points and characters may be as surely bred to as good ones.
The useful character of breeds may be impaired by too much attention being paid to "fancy" points, or to local fashions as to "style."
The element of time in the improvement of breeds.
Degeneration of breeds.
Limitations of breeding to special points.
Improvement or change can not be continued indefinitely in any one direction.
Correlations of growth.
Physiological conservation of energy.
How defects may be parallel to and incident with improvements.
Illustrations where such correlations are from obvious causes or of obvious dependence.
Correlation where the cause and dependence are not obvious.
Outward signs of qualities.
Antenatal influences.
Influence on the offspring, of fright, fear and mental emotions in the dam.
Alleged mental influences and "maternal impressions."
Influence of previous sires.
Attempts to control the sex of offspring, and theories pertaining to it.
The best breeding age of animals.
Influences which modify fertility.
Relative influence of sire and dam.
Their relative influence on the improvement of a herd, or on the stock of a district.
The sire most potent in such improvement in all polygamous breeds.
Their relative influence on the individual offspring.
Various hypotheses and theories that have been proposed.
The theory of Linnæus and its extension by Orton.

LECTURE VI.—The American Trotting Horse.

Wednesday, January 31st, 10 A. M.

The horse of antiquity and of the Middle Ages.
Why the trotter was not then bred.
Influences that led to breeding trotters.
History of the process.

LECTURE I.

THE LAW OF LIKENESS.

GENTLEMEN: For one of the few times in my life I failed to come to time, but I hardly feel that it was my fault; I may rather state that it was my ignorance. I made my arrangements to be here on Saturday, but I took the wrong road, and have been detained ever since.

The breeding and rearing of domestic animals is probably the most ancient of all human industries. I say is probably, because if we go back in history we are lost in the fog. Whether it is the most ancient or not, it is certainly at the present time the most universal. The two great ends of modern agriculture, as we practice it, are the production of grains and the production of animals. In the system of agricultural life that we have in this country, these two are mutually dependent upon each other; they go along together, and we can not say that one of them is more important than the other; we can not get along without grain, and we can not get along without animals. Our agriculture is, as I have said, about equally divided in its aims between these two productions; but it is not so all over the world. It is very possible that a larger number of people can be supported from a small patch of rich ground by agriculture proper, without domestic animals, as we have in some portions of China and India, but this must go along with a semi-barbarous condition of society. For a civilization like ours, for an enlightenment like ours, we need a form of agriculture that is founded essentially upon domestic animals. They not only aid us in the production of crops, but they give value to the land. They not only feed us quite largely, but they largely clothe us also. Animal power is used in a multitude of cases, and they give a money value to the land.

I have not time to dwell, of course, on these interesting points that suggest themselves, but I need only call your attention to the difference in the agriculture and the difference in the civilization and in the wealth of those countries of Europe where their agriculture is founded on the keeping of domestic animals, and those in which it is not. The cradle of our civilization was the Nile. It is an exceptional country. The land is manured there by the annual overflows from the river. The agriculture of the ancient Egyptians was essentially an agriculture without animals; they had a few animals, but it was not founded upon animals as ours is. The agricultural methods of Egypt spread to the other regions round about the Mediterranean, and we have abundant historical evidence as to what the fertility of ancient Syria, Palestine and the Holy Land, of Mesopotamia, of Greece, of Italy, and even of Spain was. We know that lands that once produced their hundredfold, their fiftyfold, their fortyfold of the seed sown are to-day practically barren; whereas, in Northern Europe, in Holland, in England (emphatically in Holland, where their agriculture is founded on domestic animals), where they can manure their soil with the manure of these animals and retain its fertility, where they get the benefit of the growing plants through more months of the year than the crops of grain are growing—there we find land of the highest value, there we find the greatest concentration of both commercial and agricultural wealth, and there we find the greatest density of populalations. We find in portions of Holland an agricultural population nearly, if not quite, as dense as any that we find in India or in China, and vastly better supported; and the foundation of that is their cattle.

It is not scientific to predict, so I will be unscientific and predict. I will venture to say that the change that will come on in the West here, as your farms become smaller and your population becomes denser, will not be in the decrease of your domestic animals as related to your grain growing, but will be in the increase of that department of agricultural production. In ancient times breeding was only an art; practical breeding is only an art still. Now, breeding may be practiced as an art, as it has been from remote antiquity, or it may be studied as a science; but practical breeding is, as I have already said, strictly speaking, an art. We can speak of breeding as a science, in the same sense in which we can speak of agriculture as a science; of breeding as an art in the same sense in which a chemical industry is an art. Telegraphing is an art; lighting by electricity is an art; but those, we see, are founded upon science. Now in the case of breeding, the same as in agriculture, to attain the highest results the man who practices the art wants to make all the use that he can of those who have studied it as a science.

It has been many years since I have been a practical breeder, and the most of the study that I have given to it has been since that time. I do not stand, therefore, before you as a practical breeder; I do not speak to you as a practical breeder; I simply come before you to speak of those general laws of nature, those biological laws, which are applicable; and there are certain biological laws which apply to all living beings, no matter how high nor how low they may be. I purpose to speak of it as a science, for you to make the applications in the art. Because I wish especially to put myself on the right record here. I believe that this art, like all other arts, this industry, like all other industries, may be enormously the gainer by studying the scientific principles upon which it may be conducted.

Now I do not purpose to go into any general classification of domestic animals, or speak of them in detail. I do not know how many kinds of animals we have domesticated, but their number is very small. Naturalists tell us that of the animals that suckle their young, the mammalia, as they call them, there are about 1,200 species in all. I question if more than thirty have ever been domesticated, or are domesticated as useful animals. We have only about ten that we are familiar with: the horse, ass, cow, sheep, goat, swine, dog, cat, rabbit, and guinea pig. Then we have the camel, yak, zebu, buffalo of the Cape of Good Hope, water cow of India, reindeer, ferret, alpaca, vicuna and a few others, but I can not enumerate as many as thirty out of all those 1,200 that are known to me. Now, what constitutes the difference between a wild animal and a domesticated one, not only, but between a wild animal and a tamed one, I shall bring up a little later, which is one we do not often consider. What is the difference between a tamed animal and a wild animal? Between a tamed animal and a domesticated animal? There is not a species known that can not be tamed, but only a few have ever been domesticated; very few indeed. I shall come back to that later.

Then among our domestic animals — I use the word in its broadest sense — we have eight or nine species applying to birds, ordinary fowls and turkeys; and there are two or three species of ducks, and one or two or three species of geese, and then there are peacocks, guinea-fowls, canary birds, and you have about exhausted that list. Ostriches are now being domesticated in certain countries. Then you have got bees and silk worms, and one breed of fish; so that the number of domestic animals is comparatively small.

Now, for the definition of a few words which I shall have to use from time to time. We speak of *breeds* of animals. I hardly need define it to you; still I shall have to. I mean by a breed a number of animals — I am now speaking in an agricultural sense — a number of animals having certain desirable qualities alike, which qualities or characters are transmitted from generation to generation. I do not care what those characters are, I do not care what those qualities are, but as long as it is something that we want to breed for, and it is perpetuated by heridity, we call that a breed. In our language we have three words meaning the same thing. We have one word applied to animals, a second word applied to man, and a third word applied to plants. We speak of a *breed* of animals, a *race* of men, a *variety* of plants. There are certain languages that do not make that distinction. In some of the languages of the continent there is no difference between a breed and a race. There is just that difference between the breeds of domestic animals that there is between the races of mankind; and there is the same difference between them as there is between varieties of wild animals, and varieties of plants, where the characteristics are transmitted by heredity. There is no difference in nature between a breed and a race and a variety. Some persons have tried to make a distinction, and call a breed one thing, and a race another. Those words grow largely out of the richness of our language. Our language is so constituted that very frequently we apply one name to man and another name to similar parts of an animal; we speak of a man's month, and the snout of an animal, etc, etc.

Sometimes we have a particular portion of a breed descended through the same common ancestors and family, and we call those a family, or a tribe, or a strain. All of our domestic animals are polygamists. With mankind, even when he is polygamous, we speak of families as descending through the male line, of tribes as being founded on the male line. But with our domestic animals we generally speak of a family as following the female line. Hence, the various families of Shorthorns are those which descended especially through the female line. This is so strictly marked that in the cases of horses, certain of the authorities of our sporting papers deny that two foals out of the same stallion, but by different mares, are brother and sister. They are only brother and sister—so they claim—if they are out of the same dam. Look at the "*Spirit of the Times*" for instance; it has over and over again answered that question of inquirers, that it does not consider two foals of the same sire brother and sister. But for purposes of convenience in my lecture here, where I have to use the terms of relationship, I shall use just the same terms that we apply to the human race; as a matter of convenience, without discussing at all the taste of the thing, or whether two foals of the same stallion are brother and sister or not. For our purpose is is better to consider them as they are.

The word *thorougbred* I shall use as it is used by stockmen, in two entirely distinct senses; in the first it means the English racehorse. The thoroughbred horse; strictly speaking, means the English racehorse with a pedigree, all of whose ancestors are recorded in the English Stud Book. But we also use it in a technical sense, as meaning any pure-blooded animal; and according to the rules in this country, differing a little with different breeds, an animal in which all of the male ancestors are thoroughbred back to recorded animals, and all of the females back to the fourth or the fifth generation, as has been agreed upon; we call that thoroughbred. In a general sense we use the word *blood* as synonymous with improved blood. We speak of a horse having "blood" or any animal having "blood," when it has more or less of the blood of some improved breed. "Blue blood," and "warm blood," and so on, is frequently used in precisely the same sense.

A few fundamental truths, which are the expression or the application of a law of nature, lie at the foundation of the successful breeder's art. The theory upon which the art is founded is essentially that which, when applied to creatures in a state of nature, unrestricted by man, is the Darwinian theory. The Darwinian hypothesis may be stated in four proportions, but for my purpose it may better be stated in six what might be called fundamental truths.

1. Every animal must have two parents. That is the truth of course, in all of those that we have to deal with. And every animal resembles its parents and ancestors in most of its characters; this we call the law of heredity. There is a force, as it were, a tendency to keep offspring like their parents, to keep descendants like their ancestors; and we give the name of heredity to this.

2. No two animals are alike or identical in all respects, hence

offspring are never precisely like their ancestors. The first was that they are like them in most of their characters; the second, that they are not like them in all their characters. The second one we speak of as variation.

3. Vastly more animals are produced than are needed for breeding, and only those having their highest aggregate of good points should be used to breed from; we call this selection.

4. That by training, environment, and by selection in pairing the form may be modified, and the relative value of the various points or characters changed so as to better suit the uses or the fancy of the breeder; we call this breeding to points.

5. That by breeding to special points these characters may be increased beyond what they were in the ancestry; we call this improvement of breeds.

6. And lastly: That the more uni form the ancestry in character and the more restricted in numbers, the more uniform and certain the resulting descendants. And the converse of this is, that the more diverse and varied the ancestry the more uncertain and varied the characters of the descendants. On these six fundamental rules is founded the whole of the art of breeding. The remainder of this lecture will be given to the consideration of the law of likeness, or that which we call heredity.

Heredity is comparatively a new word; you will only find it in the supplements of our large dictionaries. It expresses a very bold fact. By this term we mean the tendency of any living thing to grow, to develop, into the likeness of its parents and ancestors. I shall follow this through in such a way as seems best to an understanding of it. The term heredity has been largely introduced into common literature. I may say was made popular by Darwin—I don't think he invented it, I don't know who invented it; possibly it came from the French. My impression is that Darwin first popularized the term. Ribot, one of the most famous writers on that subject, defines it as "that biological law by which all beings endowed with life tend to repeat themselves in their descendants; it is for the species what personal identity is to the individual; by which," he says, "the groundwork remains unchanged amidst constant variation; by which Nature ever copies and imitates herself." Hartmann, a German writer, describes it as the "predisposition of the egg to develop in a particular and determined direction, which was the direction the parents developed by."

I need not multiply definitions. It is the inherent biological law which is to the living world what gravitation is to the dead world; it tends to keep living things in a certain prescribed course; to keep generation after generation alike. If it alone were considered—although it is the most important law which the stock breeder has to consider, the law of likeness, that like begets like—yet, if it alone were the only force at work there never could be improvement, there never could be change, there never could be any new breeds made or any old breeds bettered. Ribot lays down what he calls four laws of heredity; I shall use them as only two, for my purposes. 1. Direct heredity; where the child resembles the parents. As I have said before, I shall use the terms used in human relationships. I use the word child in the sense of foals, or calves, or chickens, or what not; anything that has been brought into being. 2. The second is, where it resembles some ancestor or ancestors more remote, more closely than it does the parents themselves. We call the first direct heredity; we call the second atavism, or reversion. Atavism is the old name, from the Latin, for ancestor of grandfather. Reversion is the name which has been introduced by modern writers, and upon the whole I like it better; it *reverts* to something more remote.

I need not dwell at all upon the heredity of specific characters of breeds or races; because species and breeds and races seem to depend upon it. Without it, there could be no such thing as a species; there could be no such thing as a breed, nor a race, nor a variety. Their very foundation is upon heredity; and therefore it is not necessary to dwell any further upon this. We mean by it, breeding a succession of animals whose characters are preserved by heredity. They have a certain form because their parents and ancestors had that form, and not for any other reason; it is the foundation of all of them. I need not, therefore, dwell on that in the least; but when it comes to the individual, the heredity of individual characters, that is a matter of considerably more interest. Wherever we have any individual character, I do not care how it appears, accidentally or by education, or how it appears; once appearing in the parent it is liable to continue. The handing down of personal peculiarities, what we call family traits, is a thing that everybody has noticed in human families; in certain families of which we have a long history, we frequently have very curious cases of it. Take, for instance, in the reigning house of Austria, some 400 or 500 years ago a particular princess had a particular kind of nose, and that nose has come to be the distinguishing feature of that house. And I rather think that the house is known among the ruling families of Europe more for its nose than it is for its ability; and however it may differ in that, that nose continues. There is an illustration of a family trait.

But it is specially important that we consider that of individuals. Now, if we come to read the literature of heredity, we find that it is very abundant in books and works relating to heredity and the phases that it assumes in mankind. I need not show here that man has an animal as well as a spiritual nature; and in all that relates to man the animal, to his frame, to his person, to him as an animal, the same laws govern man and brute alike. In all that pertains to heredity, in all that pertains to variation, in all that pertains to any of the points that I have mentioned here; the same laws apply to man and brute alike; the same natural laws. Now, it is upon the subject of human heredity that we have the most abundant literature; and most largely on the heredity of diseases, of which more anon.

But the heredity of personal peculiarities: we shall see in the next lecture that from time to time there is some departure from the type; some individual has a peculiarity that none of the parents, and it may be, none of the ancestors, so far as we know, possessed. In the last century there was a man exhibited in Europe know as the "porcupine man;" his name was Lambert; he had a rough skin, with scales upon it. I don't know why it should be called porcupine; it was more like the scales of the alligator than anything else. These were shed from time to time, and he was exhibited as a curiosity, a traveling show. He was studied a great deal because of the number of generations which his children had that peculiarity. His descendants, I might say, each time, of course, married with some one who had not that peculiarity, but it descended three or four generations. There are numbers of cases where there has been some particular phase of the hair, and where in the same way it would descend generation after generation; or teeth, or something of that kind, in which there would be some constantly acquired character on the part of the individual that would continue in that way for a long time.

Now, sometimes strange breeds are formed in that way, and if there is any reason why a particular peculiarity should be bred to, why then we save such individuals. Take, for instance, the color of horses. Among us, all over the Eastern states, in England, in France, we may say that horses of solid colors, in fact, all domestic animals of solid colors, are at the present time fashionable; but let any fashion spring up by which horses are required to be spotted, and they are bred spotted; the few having spots are saved to breed from, and in other ways introduce spots. Take it in any country where horse stealing is fashionable, these spotted horses are fashionable. It is an element of identification. As a consequence, you go into Indian countries, and you find more spotted horses; you go out on the plains and you will find more spotted horses; you take it in California earlier, in Arizona to-day, and you will find ten spotted horses where you will find one in Minneapolis. It is for purposes of identification. They are preserved because of those peculiarities in some of the foals, and the foals are preserved for breeding. Sometimes particular spots, particular kinds of marking.

Some animals have a power of transmitting their own characters with more force than others; and if they happen to have any such peculiarity, it is curious to see how long that will stick. We call this power of transmitting its peculiarities prepotency; unusual power; more than power, literally; the power which an animal or a breed has of impressing its qualities on its offspring, more than the other parent or the other breed has. All animals, in short, do not transmit their characters alike; all parents do not transmit their characters alike. Those which have an especial power in transmitting their characters we call prepotent. I can illustrate that better by taking a particular case. Prof. Fleissman, a German writer, tells of a breed of coarse-wooled German sheep that they tried to improve by breeding on the Merino. He says that the coarse-wooled German sheep had 5,500 fibres per square inch. They were bred with the Merino, which had from 40,000 to 48,000 fibres per square inch; suppose 40,000. Theoretically you ought to have an offspring that would have something midway between the two; say, for instance, that the offspring should have had about 24,700; if this had been crossed on the Merino we should have had three-quarters Merino and one-quarter coarse-wooled sheep; then we should have had 34,375 per square inch. And at the next generation we should have had 39,000; at the next generation 41,000; at the next generation 42,000; at the next generation 43,400 and so on. But instead of that, after breeding 20 generations there was but 27,000 per square inch. That is, that the miserable qualities of that old German coarse-wooled sheep were vastly more potent than the good qualities of the Merino. This is an interesting case to illustrate what I want to; and we can illustrate half a dozen points with it before we get through. The history of breeding is filled with such.

If we happen to have some especially good ancestry that is especially prepotent, that ancestor may occupy a very important position in the improvement of the breed, or even in the making of a breed. The old bull "Favorite," of Collins', early in the present century; it is probable that his blood to-day courses in the veins of ninety-nine hundredths of all the Shorthorns in existence; and it is probable that that bull had more to do with the Shorthorn breed as we now know it than any other three or four or five animals. In the history of the English racehorse, old "King Herod" begot, it is said, 497 winners. We have in the history of our American trotters a case in Rysdyk's "Hambletonian," and the large number of breeding animals which are descendants of that stallion. There are instances in which the animals themselves were excellent, and they had great prepotency. There has been a good deal of discussion as to the cause of pre potency. This discussion has a certain amount of value, but not enough for us to follow it. Practical breeders who are "down on" theoretical men are frequently the most intensely theoretical men that I have ever known. They come across a certain fact and frame a theory for it, and they hold to that strongly; they *know* it; and they have a very low opinion of anybody who doesn't think just exactly the same way that they do. There is somebody else that will have the opposite opinion, and he is just as sure as his neighbor. Now I may say that we do know certain things that increase the prepotency; breeding "in-and-in" does; and it does it because of a natural law, as we will see a little later. But the actual cause of prepotency we are as ignorant of as we are of any other change; we don't know; and there is no probability that we ever will know why Rysdyk's "Hambletonian" happened to be the horse that should beget so many more trotters than any other of the descendants of "Messenger," or even of "Abdallah." We know the breeding of "Hambletonian," we know the breeding of "Favorite;" but we do not know why "Favorite" should have been such an excellent animal. It belongs to that class of qualities that arise out of variation. You may take in any herd, in any flock, and you will find some animals better than others, for no known reason or cause. There is probably a law at the bottom; but we haven't got at that law yet. There is something left for us to find out yet, in science, and in art, and in practice.

There are various things which modify sexual vigor, health, and so on, and each of these have been used by some one or another theorist to account for prepotency. We may say that, as a rule, thoroughbred animals of any kind are more potent than mongrels. That is a very general rule; and, for reasons that we will see a little further on, old breeds are generally more prepotent than new breeds. Climatic influences, nervous influences, "in-and-in" breeding, thorough breeding, etc., are all of them causes which have been claimed for prepotency. Now, what characters are most often transmitted? As a great rule, the characters that have been longest bred are most often transmitted; the characters which have appeared in the largest number of parents are most often transmitted. And that brings us right down to what we have just left. I said that pure-bred animals we generally more potent than others. What do I mean by "Shorthorn?" I mean not only an animal that has certain characters, but his parents and his grandparents and his great-great-great grandparents, and so on back, had certain characters. And the only value of a pedigree is to show what ancestors the animal had, and that this large number of ancestors for a large number of generations had the same characters which we wish to perpetuate in after generations. Fashion and fancy had a great deal to do with it; nevertheless, there was a real value in the pedigree of those Shorthorns that were sold a few years ago at New York at such fabulous prices —$40,600, $30,-600 for a cow — but they were animals all of whose ancestors for fifteen, sixteen, seventeen generations were known. Take those very cattle — those Shorthorns — how they carry the excellence of their blood wherever they go! We breed them on the Texas cattle, on the cattle of the plains, on the common scrubs of the Southern states; they go to Australia and the Hawaiian Islands, to the ends of the earth, and they carry their characters with them and impress them on the mongrel stock wherever they are bred with. Why? Because they have certain characters which have been selected from generation to generation — ten, twelve, fourteen, sixteen, eighteen, twenty generations — and that has become so potent, it has been so long bred and so surely bred that it is carried on to other blood.

The English thoroughbred horse, in the same way. The English thoroughbred horse was made out of two or three oriental breeds; we speak of it as an oriental horse, but there were two or three or possibly four quite well-defined breeds that originally went to make up the English thoroughbred. There was the Arab and the Turkish and the Barb, and if you see fit to call the Persian a separate breed, the Persian horse. The blood of all those mingling, and then breeding from the winners, introducing no fresh blood—it was a long time in forming, this breed—there has been but one animal introduced into the herd book since 1767, so the books say at least—I never studied the matter up—but now you have got a lot of characters that have been long bred, you have been breeding towards a certain class of points; and the English thoroughbred, wherever it is carried, takes its blood with it and impresses it upon whatever it is bred with. I do not say that it always improves the stock for that locality; I do not say that the Shorthorn always improves the stock for that locality—you may go where the climate is at fault—but it certainly impresses its character on the stock. It may not be able to stand all the vicissitudes of climate, but it carries the character with it. So with the English thoroughbred; it may not give us a horse that we want, but it gives us the English thoroughbred character. As a great rule, then, those characters which have been longest bred are those which are transmitted with the most certainty; those which have been longest bred, and have appeared in the largest number of ancestors are most often transmitted.

It does not require any further development of this idea to illustrate what the value of race, or the value of antiquity of race or breed or character is. It is very well for us right in this connection, however, to continually bear in mind that bad traits are just as apt to be transmitted as good ones; and, I think, a little more apt to be. Very frequently undesirable characters and bad traits in domestic animals are those which were held by the animal in the early stage of its development; and under such circumstances the bad traits are very apt to be transmitted, indeed. I don't believe in breeding from vicious animals. I don't care how fine they may be; there has got to be some good, strong reason for breeding from vicious animals. I will venture to say that among the farmers here present each one could bring up instances that have come under his observation, of this man who had a whole strain of breechy cattle that would go over anybody's fence, that followed through from generation to generation; somebody else had a breed of balky horses, in which mother and child and grandchild, I don't know how far down were balky or breechy or vicious in some other form. Clumsiness, any form of badness, is as liable to be inherited, transmitted from generation to generation, as goodness. I recollect very well, when I was a boy my father bought an English mare, very vicious, known to be tricky. He had a good opinion of his ability to manage horseflesh; she was a fine-looking mare, and he bought her for breeding, and we bred from her, and a nice time we had of it. The first colt was balky and good for nothing except for a riding animal, and we sold her for a riding animal to another person who thought he was wise. The next generation I lost sight of, but, for all I know, I suppose somebody is breeding balky horses there yet. Big head, clumsy bones, any form of badness that you can pick out, if you only breed from it you will get it. And that is equally true in human society. One of the most notable books published in modern times, it seems to me, is one of those that have been produced by a person connected with the New York state board of charities. They have been following up for six generations a noted family of paupers, thieves and prostitutes of Eastern New York, and a precious lot they have found.

When it comes to heredity of disease, we have here an enormous literature. That diseases are transmitted in a general way, everybody allows, nobody disputes it. I shall, therefore, not dwell largely upon it. I may simply state that the heredity of diseases assumes three distinct phrases: the first and the rarest one is the one in which the offspring may have the disease of the parent at the time of its birth. There are numerous cases on record of where certain diseases appeared; contagious diseases, and often others, in the human family, have been found on the children at the time of birth. With our domestic animals that is not a common form of the heredity of diseases. It more often takes the form of what we might call a weakness, in which the same disease with which the parent was afflicted crops out at the same or an earlier age in the offspring; and when it comes to that form, there is no disease known, except the contagious ones, that may not be hereditary, even those that are produced by accident, heaves, ring-bone, spavin, blindness; the foal may not be spavined nor ring-boned nor blind; but it is more apt to become so. There is a weakness inherited from the diseased part of the parent which makes it more liable to it. I think there is no one point upon which veterinarians are more unamimous than that; and the literature of the subject is enormous, both as applied to the domestic animals and the human race. Where we have an unsound animal of some kind, of which the foal may look very well, you may go on to the same age or a little younger — the tendency is for the disease to appear in the offspring younger — and you will be apt to find it reappearing.

Talking with an officer of the United States army some years ago, who retired from the army and went to a place that was supposed to be peculiarily free from consumptive diseases, he said that he went there simply to save the last of his children. He says: "My wife's grandmother died of consumption at the age of 70; my wife's mother died of consumption at the age of 50; my wife died of consumption at the age of 36, and I haven't brought any of my children past the age of 22, and I am now going to a place where they don't have consumption in the hope of saving the lives of the rest of them." Now we pity a man exceedingly under such circumstances, but that is the way that Nature takes to get rid of her weaklings. It is a part of the inexorable, cruel law of Nature, by which she weeds out the weaklings; it applies in wild animals, in domestic animals; it applies to man. Now, with domestic animals, they are not only subject to diseases and difficulties and troubles which wild animals have, but to large numbers of them which are incident to the artificial life they live. They inherit a certain weakness in the part which was diseased in the parent, and that part is especially apt — I don't say it always takes place — it is apt to be troubled in the same way that the parent was.

I said it assumed three forms; the other is in which there is a weakness transmitted which shows itself in the offspring in a different way from what it was in the parent. A diseased parent transmits a weakness to the offspring, and in after generations it shows itself in some other form. In the case of the human family medical works and the works on heredity are filled with examples, in which a person may have some form of disease, in which the children and grandchildren will not have the same form, but in which they will all be out of sorts in some way or other, and some of them very much out of sorts. And many a family dies out from a variety of diseases, which diseases, although differing from each other, are really largely due to weaknesses inherited from some one disease held by the parent. Ribot thinks that is the most common form. However interesting it might be to follow that up now, I have to pass it by, because the most interesting phases of that are found in the human family, and are at the present time profoundly affecting the investigations that are going on in connection with many of our charitable institutions in one form or another.

I was in a doctor's office not a great while ago as a patient went away, a little child; the doctor, whom I know very well, said: "I know that case just as well as if I had been personally acquainted with all of the family. Here is a child afflicted with sore eyes. She has a bad constitution. Well," say he, "there is one comfort about it—she will probably die before she grows up. Very nice mother, but a scamp of a father, with syphilis." Now, here is a contagious disease which has undermined the constitution of the father; he does not transmit the same disease to the child, but he does transmit a weakness. One of the most serious troubles we are having with the Shorthorns is that they have been so pampered that they run into a variety of diseases; tuberculosis springs up among them, and they take a variety of diseases; they run into diseases, so to speak, very easily. If any of you are interested in this, to see in what curious directions this may show itself, I think you may be rather astonished by it. It is not an unfrequent thing that where there is some marked peculiarity in either parent or in both parents, that this peculiarity is not transmitted in the same form, but takes the form of some diseases. Take the Siamese twins; they were reasonably healthy, but abnormal. I have forgotten how many of their children are imperfect, but, according to the newspapers, there were several of them either deaf or dumb or half-witted or half imbecile or something of that kind.

Modern sanitary science has a good deal to do with this class of evils to which human society is subject. In the investigation two years ago next month, by the legislature of Massachusetts in Boston, on matters pertaining to their charitable institutions, incidentally the question of the injurious heredity influence of strong drink came up. We all know that especially drunkenness weakens the constitution, and there were quite a number of persons whose opportunities of observation were specially good, who considered that the children of drunkards were especially liable to disease of one kind and another; not always showing itself in the hereditary tendency to drink, but in some form of physical degeneracy; and all you have got to do is to visit any of our lunatic asylums, any of our asylums for idiot or feeble-minded children, to see what a very large number of persons have had imperfect or debased parentage. Incidental to this is the weakness that may come from the overuse of males. This may be apt to come about from the overuse of rams, or goats or stallions; with goats more than anything else. In the furor that sprang up in the West for breeding Angora goats, the males are exceedingly amative, and a good many were injured by excessive use, so that the young were very weak and very feeble. I suppose all of us have known cases where stallions have been taxed beyond their strength. Frank Forester gives numbers of cases where the use of too old stallions has been attended with results that were not good; but that does not appear to be uniform. There have been some stallions that in extreme old age have begot exceedingly good colts, but there are others where this is not the case; and the number of cases that have been recorded of where foals have had the evidence of age, such as the dots over the eyes, eyes deeply sunken, etc., where they have been sired by very old sires, the number of cases of that kind that you may find in the literature of the subject is really quite large.

Several of our authorities on fighting cocks claim that to have a good vigorous fighting cock, that has courage to fight, and pluck to endure the punishment, he should be bred from a cock of vigorous age and never from an old one. Longevity is hereditary, and there are several life insurance companies that have considered that and looked it over with a good deal of insight. If any of you have had an especially old ancestry, and that fact is known, if your old father is living, ninety or one hundred years old, if you lived in an Eastern state you would have had to carry on a war with life insurance agents for years.

Mutilations are generally not hereditarily transmitted. The tails of sheep may be cut off from generation to generation, and the lambs are dropped with tails just the same. Man has shaved more or less for a long time; but he is born with a beard still. And so on. Various kinds of mutilations may be practiced, so far as we know, almost indefinitely without transmission. Perhaps the most marked case of which we have any historical evidence is in the practice of circumcision; although that has been practiced now for so many thousands of years, I am not aware that it is in any sense hereditary. Yet the number of cases of hereditary transmission of injuries, of individual cases, is quite large. We can draw this line: An injury which is hereditary and which affects the health of the creature injured is very liable indeed to be transmitted. Dr. Brown-Sequard, the great great authority on epilepsy with the human race, practices a great deal on the lower animals. His statement was published in 1870 and has been repeated time and again, and it well answers my purpose in illustration. He produced artificial epilepsy in guinea pigs, and then breeding from them he produced epilepsy in the descendants, which was transmitted by heredity. Some of these epileptic guinea pigs in their fits would eat off the outer toes of the left foot, which had been deprived of sensation. The epileptic descendants of these guinea pigs were without these two outer toes. In these experiments which have been carried on since, and which have been the subject of a number of papers before various scientific societies, he not only produced the disease artificially, but then he bred from his epileptic guinea pigs, produced thus hereditarily, and he found that in the descendants there would be a node on the sciatic nerve at the place where the old nerve had been cut, in producing epilepsy in the parent, and afterwards grown together again. I have known one particular case personally, where there was a great scandal and murder trial, in which there were eight children belonging to a family. The first four were normal; the father received a blow on the head which made him crazy for the time; he was supposed to have recovered, and had four children afterwards. Three of them died before maturity, but all of them were queer. The third one was very queer; grew up and married and attempted to poison her husband without cause, and did poison her offspring as they grew up successively, and finally ended her days in state's prison. Examination of that woman's brain after her death in state's prison showed where the defect was.

It would seem then that under ordinary circumstances mutilations are not transmissible. After delivering this lecture once, I received a letter a few days afterwards from a lawyer in Central New York, attended by other evidences, of a very curious case where a dog had been wounded on the tail and had transmitted this peculiarity to its offspring. I knew of another case like this: You may remember that something like twenty-one years ago the Prince of Wales was in this country with a party. Along with them were some valuable setter dogs, and one of them, a bitch, while in the State of New Jersey, had her leg broken by accident. The leg was put up in plaster of paris and mended very perfectly. She got along very well, but she often folded that leg under her afterwards, in a different way from what she did before. The last that I knew of the descendants of that dog, down to the third or fourth generation, a certain portion of every litter had the peculiarity of lying down and folding a foot under them in the same way in which the mother did; but the descendants did not show any special weakness of that leg, as the mother did. The mother showed a weakness to the day of her death.

Now, there are mutilations which have been transmitted, and the number of cases that could be cited is quite large, but we may say that they generally do not take place. We can count on it that they will not take place, but that they sometimes do take place. And they belong to the class that come up next— the heredity of acquired characters.

I said on the start that any character possessed by an individual, no matter how acquired, might be transmitted. I did not say that it *is* transmitted always, but that it *might* be transmitted. It may be acquired by disease, it may be acquired by accident, it may be acquired by training, by education — I care not how it comes, it may be transmitted, and sometimes is. What is transmitted depends upon a variety of circumstances. The things most apt to be transmitted are those longest held, but those that are just acquired may be transmitted — may be, and sometimes are. The way in which that works is very curious, very curious indeed. For the forms that it assumes we need not go to the domestic animals — we may take it in common life. Why does every third, fourth, and fifth rate scribbler praise small hands and small feet on the part of women and men? What is the point of it? Is it because it shows especial beauty? Is there a painter or sculptor in the world who does not make his hands and feet according to a certain rule? But no scribbler, particularly if he has had a pretty hard time and risen from pretty low origin, but makes his heroines with very small hands — a little too small for the Greek standard — and little, small feet; and why? Why, if the hands are too small it is rather an indication that they did not work, or that their parents did not work, and that they belong to the class technically called, in the literature of a previous age (thank Heaven, not in this!), gentlemen and ladies, which meant people that don't work, but get their living off of somebody else. [Laughter.] That is what it means. It is supposed to be the persons that are on their feet at work that have big feet. It is your Chinese woman who does not work who has small feet and hands. If we want to put it on pretty thick, and show how exceedingly fine and delicate and all that the heroine is, we must put it that not only she but her great grandmother didn't work, and their feet have become useless, and their hands, too, for that matter; and we might have added their brains, too, for want of action.

Now, habits indicate education. We educate our horses to that, and we breed a race of trotters; that was not natural originally. A course of lectures might be delivered on dogs—how we have bred new instincts, new habits, new thoughts, new ways of doing things and new shapes, through the education of successive generations and the selecting and choosing those that received that education best. Pointers have been taught to point in that way until they point naturally; there is nothing like that in nature; setters, until they set naturally, better with training; there is nothing like that in nature; part education and part training. In that way we have produced our breeds of dogs with such a variety of instincts that it is positively marvelous what has been done; it is the transmission of acquired characters.

There have been within the last few years, within the last ten years, I may say, a very large number of most interesting scientific experiments bearing directly upon this point. When I began to lecture on this subject twenty years ago the heredity of acquired characters was almost entirely denied. Agassiz, to the end of his days, denied it with all his force; he repeated it in one form and another over and over and over again: that no creature had any character not derived from its ancestors. I believe that we are going to prove—that we have prove—to the contrary. Theologians held that to hold anything else, any other view, was to pave the way for the most deplorable unbelief. I believe most emphatically—I know—that the hope of improving breeds lies entirely in getting something better than we have had before. There is a limit, of course, to all this, but I have no doubt of what is going to be the effect. If by sanitary science and other means we make the present generation of men healthier, if by education they are led up to higher ideals of life and action, I have great hope of the race, on natural and physical grounds as well as on spiritual grounds. I think the future is bright, and not dark; that as the laws of nature come to be better understood, education will have a value then that that we do not give it even now; and that prospect is indeed good.

There is another form in which the offspring does not resemble the parent as much as it does some ancestor more remote than the parent. The most obvious case of that is where (again using a human comparison) a man would resemble his mother's father more than his own father. Suppose his grandfather had a red beard, and his own father had a black beard; you say he got it from his grandfather. We speak of that as reversion; as *atavism*. Now, in reality, ancestors have as much to do with the characteristics of the creature as the immediate parents; and it very often happens that the animal or the man looks a good deal more like some one of the ancestors that is quite a way back than he does like his own immediate parents. Let me give you a case that is mentioned in one of our agricultural papers. An Ayrshire and Jersey were crossed, and the offspring looked like a Jersey; that is not a very unusual thing. This cross-breed, of course, was one-half Jersey; it is again bred to the Jersey, and the offspring is three-fourths Jersey; it looked like a Jersey, and so far as looks were concerned, it could be sold as such. It is crossed again with the Jersey; it is now seven-eighths Jersey; it has all the characters of a pure Jersey. It is crossed again with a Jersey; it is now one-sixteenth Ayrshire and fifteen-sixteenths Jersey; instead of having a Jersey you have got an animal that looks so much like an Ayrshire that it could be palmed off on pretty good judges as an Ayrshire rather than a Jersey. We call that atavism, and it is one of the most common things; an exceedingly common thing in the experience of breeders; and it is because of that that pedigrees are of such value, that we want to keep the blood pure, and that there shall not be any striking back, or "breeding" back, as the breeders term it. Sometimes this shows itself in alternate generations; sometimes it shows itself by some particular animal varying very widely and sometimes in some other ways. That is the reason why we have to run on to pure breeds as much as possible.

Now bear in mind, in closing, that to every rule that can be laid down exceptions may be given. In the generality of cases where you have bred your Ayrshire and Jersey together, and cross-bred to Jersey to three-fourths, seven-eighths, fifteen-sixteenths, 99 cases out of 100, 999 out of 1,000 will be as you expect they will be; but it is not always so. But in law and in science we have got to take advantage of this little doubt that comes up, and this occasional exception. But in practical breeding you have got to depend upon the law of general averages, the argument of averages; what is likely to take place is the thing to consider. In this particular case, interesting as it may be, it is not the one which the breeder must depend upon.

My last item is, What is constitution? We have been talking about heredity. I mean, we all mean, by constitution the sum total of all of the characters that we have received from our parents and ancestors, good and bad; the sum total. The constitution is that which we have derived by heredity. The constitution is bad if we have inherited a large amount of weakness or disease or evil tendencies from our ancestry; it is good if we have not; and what we mean in ordinary language by constitution is simply the aggregate, the sum total of all these taken together.

DISCUSSION.

Question—You spoke of a woman who was in state's prison having a defect in the brain; was the defect in the same position as the injury to her father's head?

PROF. BREWER—I did not learn that. I ought to state that I may have put that a little too strong in that I have taken all as true, what was believed to be true, and assumed. Regarding the queerness of the other children that died, some said they were not quite so queer, others said they were; that there was also a difference in the opinion of those who examined the brain as to whether this defect in the brain might not have been the result of disease that had nothing to do with the father. You can easily see that finding where defects had been and were in the brain did not prove that she had inherited those from her father. She had it, and I think it is exceedingly probable; that is the way I meant to put it.

Question—I would like to know what term you apply to two thoroughbred animals crossed together — whether it is merely a cross-breed, or a grade?

PROF. BREWER—A cross breed. The term "grade" is purely an American term; it is never used in the old countries. For that reason in reading our stock papers we are a little liable to be led astray. In the old countries, and emphatically England, every valley, every county, as things were before the present century, had its own breed of cattle that had grown up on the ground, and there was nothing there analogous to our natives here that are a mixture of almost everything. They only use the term cross breed when they breed between two entirely unlike breeds with the name, so to speak, of different valleys. We in this country, where we have a common stock that is a good deal more mixed than theirs, when we breed them on any improved breed we call the resulting cross a grade. It originally sprang from sheep. I have taken a good deal of pains to find out the origin of this word. It seems to have been first introduced in connection with sheep — Merino. They speak of a sheep as being half-blood, three-quarters blood. When the wool came to be in market about 1830 to 1832, that was the first I know of the word "grade," and it was applied to wool, and finally applied to the sheep which produced the wool; they were three-quarters Merino, and produced wool three-quarters grade. From that I think the term has been introduced and it is a very good term indeed.

Question —Why I raised the question. I read that Commissioner Loring would insist that two thoroughbred animals crossed together were grades. I have always understood it the same as you have given it.

PROF. BREWER — The definition which I have given and which you think is correct is the one which ought to be used, and it is the one which has crept into the supplements of both Webster's and Worcester's unabridged.

Question—I would like to ask another question: Whether, by the crossing of two pure-bred animals together — for instance, take the Holstein and the Jersey, one noted for large quantity of milk and the other for its quality—you would not be more likely to get a desirable animal from such a cross than you would to cross a pure-bred Jersey on to the native cow or a grade cow that was supposed to be a large milker?

PROF. BREWER— I can not answer that at all. As a matter of fact it is a very common thing that a cross between two breeds is better than either of the breeds as an animal for use — not for breeding, but as an animal for use — it is a very common experience. Which breeds to cross to the best advantage is a matter to be determined by experience, not by science.

Question — You don't quite get my question. Wouldn't it be more likely to produce a good animal from two breeds that had been bred for certain qualities for a long time, like the Holstein for the large quantity and Jersey for its quality — wouldn't it be more likely to get a good animal from the crossing of those two breeds than from a grade?

PROF. BREWER—Yes, a good deal more likely.

PROF. PORTER—I think your statement can be verified by the experience of every practical farmer in this room. I do not believe there is one case in one hundred where these exceptionally good milking cows have produced a calf equal to the mother when taken from the scrubs or common stock. The excellent milking qualities developed in the cow have been one of the exceptions, and the atavism that you have spoken of has accounted, of course, for the degeneration; they have gone back to the low condition of the ancestors rather than to the peculiarly valuable condition of that individual.

PROF. BREWER—My farming days are over, but I believe there is one of the best fields open for the young progressive farmer in producing a better breed of dairy cows. I do not see anything that opens so inviting a field to me, if I was a young man, to start my life over again, as that. The objection to the Jersey is that she is not fit for anything but a butter cow. The objection to some of the larger breeds is that they are not butter cows. I think it is possible to unite the two in one to a much greater extent of perfection than it is now. We have succeeded in breeding the horse of all work, and I believe we can breed a cow for all purposes. Sometimes butter is an object more than cheese. Sometimes in the same locality a man wants to turn his attention to cheese—the creamery system, of course, now prevents a man from putting his milk in common with those who have cows that give a much larger quantity of milk of a much poorer quality; he would be a loser. It seems that in crossing some of these pure-bred animals that there might be a breed brought out that would answer the general purposes for which we keep cows, with much profit to the breeder and very much profit to the farmer at large. The first lecture I ever delivered before any meeting of dairymen I made that my theme and took just that ground. So you can't think how much you have flattered me by saying that. I took that ground and was roundly abused for it as holding the purely theoretical views of a college professor, who is supposed to know nothing upon this subject. [Laughter.]

PROF. PORTER—I presume that you early found that the old problem, how to keep your cake and eat it too, was presented for solution. The trouble is in our general utility cow, if we may so call it, we expect to get large feeding qualities, we expect to get large quantities of milk, we expect to get early maturity and we expect to get great richness of milk. Those are conditions, of course, that we can't get in their maximum in the same animal. We have got to be satisfied with an average of all these; to get in our general utility cow one that will not be as fine a feeder as the Shorthorn, nor give as rich milk as the Alderney or the Jersey or the Guernsey, that won't give as much of it as the Ayrshire; but we will get one that will give more milk than the scrub, be a better feeder than the scrub and give richer milk than the scrub. We will get an average cow that of course will be better than the average of the stock around us, but of course we can not expect maximum results without breeding for these particular qualities.

A MEMBER—The question arises whether a high average is not better than an extreme in either?

PROF. PORTER—It is simply the old problem whether a man better be a man of all work, be able to turn his hand to almost anything, rather than to be a specialist and be highly successful in one and a perfect ignoramus in everything else.

PROF. BREWER—The whole tendency of the times in breeding is towards greater specialties instead of getting a more general animal. We have a horse of all work, so, too, we have a cow of all uses, and all these uses differ in different places. It is entirely according to where you are as to what your average cow is. Twenty-one years ago, about, talking with a large *ranchero* in Southern California, I was driving out with him to look at his tremendous herds, as the cattle business then existed in that part of the State, I ventured to suggest: "Now if you had some Shorthorn bulls for your herds, what improvement!" He looked at me with an eye of mingled contempt and pity. "Shorthorn bulls! No," said he, "no Shorthorn bulls for me; no Shorthorn bulls for me! Great lazy good-for-nothing things," he says. "I want an animal that can keep out of the way of the coyote when he's young, that is enough for a grizzly when he is old, that can live whether there is any feed or not, and will make a little sport on All Saints' Day," says he. "That is the animal for me." And he had them. [Laughter.]

SECOND LECTURE.

"VARIATION."

We considered this morning the "law of likeness," or the tendency of living things to be like their parents. Now, there is another law, or force, whatever we see fit to call it, opposed to this. If we should compare the law of heredity to that of gravitation, as I did this morning, as there is also a principle of repulsion in nature opposed to gravitation; so there is a tendency in creatures to vary; a biological force, or law, or whatever we see fit to call it, which is just the opposite. Heredity tends to keep living things alike, to keep nature in the fixed line marked out; but there is another force at work just exactly the reverse which tends to make nature vary and change. Now we suppose that there are no two living things in the world exactly alike. It is the second part—variation. First, we have heredity, keeping living things in the same line or rut; and, second, a force which tends to get them out. That assumes several phases. In the first place, as I have said, all of the creatures that we have to do with have two parents, a father and a mother. Of course it can not look like them both in all particulars, that would be an impossibility. We could imagine it to be exactly like either one of them, but we can not imagine it to be like both of them. If the parents differ from each other, the offspring must have some character not possessed by one or the other. In short, there is an individuality. I question if two peas ever grew exactly alike. No two men look exactly alike. It is not probable that any two sheep ever did.

Now, there is a sort of change that we see going on, in which we see very plainly the causes of it; and first is that which is produced by food. We may take two young animals very much alike, of the same breed, so that we can expect them to grow about alike, and bring one up well fed and the other half starved, and we all of us know that they would grow to be very different animals. There is a *plasticity* in nature, a plasticity in each living thing, which allows it to adapt itself to different conditions. If it is an animal in a region where there is an abundance of food, it eats more food, grows larger and needs more. If it is half starved it learns to do with less food; it never attains so large a size, it is a smaller animal in the end. It adapts itself to that condition. So far, that is very easy; we all see that; of that there is no question whatever. But the fact is equally true in a vastly wider range of things. There is a plasticity in the individual which tends to help it adapt itself to its surroundings. It can learn to sustain a colder or a warmer climate, to do with less or to live on more food; and so on, through a very great variety of external conditions; and in adapting itself to these conditions it is itself moulded as it were into shape, and into form. I do not suppose any of you would doubt for a moment that if we were to divide a herd into two parts, and remove the two parts into widely different regions, with a different soil, different amount of food, and breed from those two herds year after year, that in the course of time there would be a difference in the descendants, that each generation adapting itself to these new conditions, would be modified; these modifications would be in part transmitted to the next generation, and thus in the course of time we would have two breeds, neither like the original one, perhaps, the two differing from each other, having absolutely the same ancestry.

But during the formation of a breed in this way there is another process going on; it is that of selection. We have now a fearful storm that has been going over the Western plains. You can easily see that if we had all the cattle on the plains that could be stocked and fed there, that in such a storm as this a good many will be killed off. Now only the tougher ones would survive. If such a thing as that took place every ten years you would have in the course of time a class of animals that would be the survivors and the descendants of survivors of repeated hard years; you would have a very hardy race. And that is the reason why scrub cattle are very frequently more hardy than the more improved breeds. They are the survivors of those that have withstood hard years in previous times. My first acquaintance with California horses was as they were twenty or twenty-five years ago. I was especially struck with the marvelous hardiness of those animals. And how had they been bred to it? Not by artificial breeding, but by this form of natural selection; hard years, dry years, in which those horses that could not stand short food went under, and those that could were the ones that lived, and were the ancestors of those that we had to deal with.

But there is also another element in this process which goes on in nature; where horses are running in a wild or semi-barbarous condition, the stallions settle for themselves who shall have possession of the mares, and the more hardy and the stronger of the stallions become the sires of most of the foals. There is a variety of conditions, then, which would tend under such circumstances to make a tough and hardy race of horses. The influence of climate, soil, etc., in making local breeds has been noticed in all times. A course of lectures could be devoted to it. Small breeds live on islands. Where you have large islands, continental islands like Great Britain or like Japan, there you may have large breeds of horses and cattle, but they have been especially bred to it; but it is on islands where we find small breeds; the small ponies of Japan, the ponies of the island of Shetland, the cows of Kerry, the small cows of the Channel Islands, etc. And geologists tell us that if we go away back into the earlier geological times we find it was just so then. Only a short time ago I saw an account of a certain fossil elephant found on the Isle of Malta, little bits of ones, only three or four feet high; in other words, not so very much larger than a Newfoundland dog or a calf. They were a distinct species, and they originated in that way. Climates, regions, produce breeds of their own and all of our breeds that are more celebrated are local. If you will think it over you will find that most of the English breeds take their names from a locality; it is emphatically the case with cattle, not quite so much with sheep. Here we have the Devonshire cattle, we have the Ayrshire cattle, we have the Aberdeens, and so on through quite a number. The Shorthorns are known almost as widely by the name of Durham as of Shorthorn; they used to be known frequently as Teeswater cattle, from the valley of the Teeswater. They have been developed in particular localities, partly by breeding and partly under the influence of external conditions; both of them working together have produced the variations and these variations have become hereditary and constant in the breeds, until now we have this wide variety. There are fifty or sixty breeds of cattle that are recognized on the continent of Europe. I quote from memory; but if I recollect right, in Moll and Gayot's great work on the breeds of cattle in France they enumerate fifty-six breeds of cattle that are found in France, either native or introduced.

Animals may be modified by diseases. I wish to guard against one mistake that we are liable to make. We may find variation going on and attribute it to a cause when in reality the cause that we attribute it to is not the true one. There may be causes at work in a climate that causes selection, so that the race or the breed in the end is found changed without the climate doing it; or it may be changed by some other influence. I will try to explain in another way. It was announced, some years ago, that in certain parts of the south, Southern Georgia and Florida, there were regions in which all the hogs were black; and they were all black because there was a certain kind of root which hogs were inclined to eat that was poisonous to white hogs and not black ones, and as a consequence if the white hogs ate them they were killed off, and only the black ones survived; so that in the course of time there were only black hogs. Now, you see, if I ask the inhabitants of that region, "How does it come that all the hogs are black?" the answer would be, "Well, because of this root, for it kills off the white hogs and don't the hogs that are black." Now, it is not the root that makes the hogs black; it is the black hogs which survive from the root. We have therefore probably some other cause of variation. It was not the root, recollect, that made the hogs black; it was the root which exterminated the white ones. We are liable to get two facts mixed up, in speaking in the way in whieh I have been speaking, first, of that which produces change, and second, that which saves changes that are already produced. We generally see the thing working along together. It is a mooted question what causes change. We do not know what causes it. We do know what causes some, but we do not know what causes others. I will come back to the theories on that subject again, but I would carry on these two together. Recollect that there are two points here that we should keep distinct in our minds. Our domestic animals are closely related to climate in several direct ways. In the first place, directly related to it. It is not all cattle that can stand such storms as we have had. What would Alderney or Jersey or Guernsey cattle have done on the plains during the past week? Those breeds have been bred for generations on those islands in the sea that have a moist, mild climate; an atmosphere of zero is practically unknown there. Put them out, therefore, on the plains in a dry climate, with such storms as we have, and what chance would they have? Why, they would perish. They would have to be sheltered. Or take another case, look at the many kinds of cattle that can not be introduced into Texas without taking fevers just as people do who are introduced from a cooler to a hot climate. They have to become acclimated. Cattle, all kinds of animals, are directly related to the climate in that way.

In the second place, they are directly related to it in other ways through the production of food. A hot climate produces different kinds of food; it also harbors different kinds of enemies. You will not find the same kinds of insects and flies and enemies of one kind and another troubling the stock in a hot country that you do in a cold country. Each and every one of those things modifies the kind of stock that we can raisė, and if we continue raising stock in the same region a long time, modifies the stock themselves. Particular storms, it may be, of the character of last week's; storms, it may be, in the form of Texas northers which are either cool or damp; the California norther, which is the other extreme, for you have hot northers there altogether, like a blast from a furnace, peculiarly destructive to certain kinds of stock, particularly hogs. I think it is very possible that one reason why buffaloes have such shaggy hides is because of the hail storms of the plains. That is simply a belief—I can not prove it, but personally I do believe it. You know what tremendous hail storms they have there some times. Buffaloes can stand it a good deal better than ordinary stock.

Sometimes the climate of one region is especially valuable to the cure of the diseases of another region. I have spoken about climate producing diseases; for instance, certain stock getting fever when they go to Texas; there is another side to that. Just as men can change climate and have their health affected; they may have certain diseases, and go to more favorable climates and stop them. We have a very interesting case of that in Algeria, the French colony across the Mediterranean in Africa. After the French had had possession of it for a time Arabian horses got scarce and farmers got to sending their horses across from France. There are certain diseases of the eye which French horses were peculiarly liable to, and it was found that they were cured up in Algeria, and lots of them were sent over there. There is a disease known as periodic opthalmia which is incurable in France; they were sent to Algeria and entirely cured there and there was no return of it. From the fact that horses have their eyes so cured in Algeria, of late years that climate has been recommended to send human patients to for certain defects of the eyes.

I come now to touch on a phase of climate which is an exceedingly delicate one to touch on—its relations to wool. The number of places in the United States where they can grow wheat, where they can grow corn, where they can grow sheep—"That, sir, is just the best place the sun ever shone on to grow sheep"—is quite large. They will tell you that "right here is the place to grow sheep, that right here is the best place to grow wool in the world," etc., etc. There is a great deal of difference in the climate for producing wool, whatever is said to the contrary; that is demonstrated beyond the shadow of a doubt. In some of the mills of New England, that buy wool, they pay a slightly higher price for wools that come from the region that embraces Southern Ohio, Western Pennsylvania and a portion of Western Virginia, than any other part of the United States. There is a texture to it, a slightly different feel which manufac turers understand. And sheep transported from those regions to other portions of the United States which are a little drier, whether it be directly due to the influence of the climate or indirectly due to the breed, it is certain there is a change in the wool. I keep for demonstration with my classes—I did not bring the specimens along with me, because they do not belong to me—a bottle of wool; I keep it in a bottle so as to be clean. I obtained it from one of the manufacturers of New England. He said he had been in the habit of buying wool of a certain farmer in Southern Ohio. As the farmer's family grew up and swarmed one of the sons went into Kansas and carried with him a portion of the flock of the old farm; and the manufacturer that furnishes this wool to me, stated that he bought wool of both father and son; and the wool that I have purports to be not merely from the same flock but from the same individual sheep, taken two or three years apart, one when the sheep was an inhabitant of Ohio and one when it was an inhabitant of a pretty dry portion of Kansas. They were colored in the same dye, the same mordant was used, the same vat, and were I to hold them up here, you would have to be color-blind not to see the difference between them all the way across the room. A gentleman of large experience in Virginia told me almost precisely the same kind of history. He himself had attempted the growing of sheep with the purpose of getting wool just as good in one region as he had got in another, and failed. There is a considerable difference in the quality of wool as produced in different climates that is due to the climate itself, directly or indirectly, and the food that is produced in that climate. It may be brasher, there may be a certain harshness about it, and it may not manufacture quite so well. Now, while sheep are long continued to be bred in the poorer of these climates, they deteriorate, unless the blood is kept good by an infusion from the better regions. And that is what will give some regions perpetually an advantage in certain kinds of stock growing over others; it will always be to their profit to produce animals to go somewhere else and mingle with the blood of the stock grown somewhere else, just exactly the same as farmers living in one region may grow seed grain to be used in another region.

In the matter of the production of small animals on poor soils, take the ponies that I have spoken of and see what a large number of breeds of ponies have been produced in one country and another where forage is poor, soil rough and the conditions hard. The ponies of Corsica are very small; of Brittany, of Sweden, emphatically of Iceland. There is a regular trade going on for ponies from Iceland, little ones, only 11 or 12 hands high, into England for use in the coal mines. On those high plateaux between Hindostan and China, up in Thibet, there come those small horses, precisely how small I do not know—I have heard some wonderful stories. I have never been able to get any authentication of the accounts of smaller ones than I have seen.

On the other hand, we may have, in a rich region pasture with certain chemical constituents of soil, a tendency frequently to a larger growth. I suppose there is no question whatever but what there is a tendency for cattle, for horses, for men to grow larger here in the West than East. I do not suppose that anybody would deny that proposition. If we take it in the case of cattle, in the case of horses, we find that the rule is that they generally grow a little larger on limestone soils; we know that it is so with men. If we take in those countries in Europe where they have conscription for the army, and where men must come up to a certain height, the number of persons that escape conscription because of lack of height is greater in the regions where limestone does not prevail than where the water is most hard. And, if you recollect, during our own war of the Rebellion Mr. Gould, connected with the sanitary commission, had measurements made; if I recollect right, they were made of about a million men; a large volume was published. I am giving now these figures from memory, but the main facts are true, even if I do not give the precise figures straight. Suppose, for instance, you measured 1,000 men at 17 years of age, 1,000 at 18, 1,000 at 19, 1,000 at 20, etc., you could find out from the way the average ran about what time the average man gets his growth. He found that they do not generally grow any after 27 years of age; here and there a man did, but upon the whole mankind, in the United States at least, got his full stature at 27. If you come to compare, however, 1,000 men from Vermont and 1,000 men from Illinois, the 1,000 from Illinois were considerably the tallest. If you took 1,000 men born in Vermont and raised in Vermont, and another 1,000 men born in Vermont and raised in Illinois, the last set would be three-quarters of an inch taller than the first.

I shall not go into the causes of all this; food has something to do with it, undoubtedly, and water has something to do with it. As I have said, so far as we have observations in cold countries, there we find that the regions of hard water produce upon the whole a little taller men; at least there are fewer exempt from conscription because of lack of height. Now, throughout the whole of this Western country, we have hard waters as well as luxuriant feed, and I think the tendencies are both with cattle and with horses, probably with all of our domestic animals, that they grow heavier boned and larger; I will not say firmer boned, because that depends largely upon exercise, but, as a whole, I don't see why you should not, and I think, as a matter of fact, you do, raise with the same care, larger cattle than we should East. The conditions are such as to induce that kind of variation of the cattle that we have here.

But in any such case as that there are a number of influences at work that have sometimes been called regional influences, not due to one cause; water has something to do with it, atmosphere has something to do with it, food has something to do with it, the nature and texture of the soil, etc., etc., etc. Whether the feet of horses grown on prairies are as good for Eastern city use as that of horses grown on the stony hills of Pennsylvania or the stony soil of New York or New England is a question that is discussed almost every day in Eastern cities. A great many believe that they are not; others claim that they are—particularly those who have horses for sale. I have made inquiries of horse-railway companies; one person who bought a large number of horses says this: "Sir," says he. "that is not a practical question with us. We have got to get Western horses, but I would rather have a horse with Eastern feet. I would rather have a horse," he says, "that as a colt had to hammer his feet on the

New York or the Pennsylvania or the Vermont soil than one from the soft prairies of the West." A variety, then, of conditions are at work, so that each region has a sort of personality of its own, advantages of its own, and disadvantages of its own.

Again, variation may take place because of changed condition in life. We see that very marked in the domestication of animals. The conditions are new, and along with these succeeding generations put on new characters. Whether all of the changes which take place are due to external circumstances is a question. I may say, that variation does occur nobody doubts. When it comes to the causes — I said I would return to that again — there are a variety of reasons. I will speak of that now and then go on. Persons who hold as Agassiz did, and as most of the naturalists did up to his time, that all of the species of animals were created as we now find them, each complete, distinct, unchanging and unchangeable, that we have it just as the first of its kind was created, and when the conditions of life are no longer suited to it the species will die out — the theory of specific creation, I may say — hold that in all such cases the Creator probably created a number of these creatures at once; that mankind was not derived from one pair, one Adam and one Eve, and that the Adam and the Eve of the Bible — that was Agassiz's theory — was taken as a typical case, that all the varieties of individual expression and everything else that we find now in the whole of the human race may have arisen, must have arisen from the different combinations that can take place between these few conditions that exist in the originally created individuls; I may say, just the same as we have the ten Arabic characters; and with these ten figures we can express inconceivable millions of conditions; so by different combinations of these conditions that originally existed in the created men, and the same with each kind of animals, are all the changes that are to be had. In short, that whenever and wherever any creature did not exactly resemble its parent, it was some form of atavism, in which it reverted back to some other ancestor that it had somewhere between us and Adam. That is one theory; I give it to you, although I do not believe it.

The second one is that species are not unchangeable; and that is the one that is held almost universally by naturalists to-day. That they are not unchangable; that they do vary, one passing into another in the course of time and ages. But when it comes to the causes of this change there is a variety of opinion. Some believe that all of the change is produced by external conditions such as I have been describing; by climate, by soil, by exposure, by food, by drink, by a thousand and one influences that operate on the animal economy, and combined with all these, education or training or whatever you see fit to call it, by which animals acquire experience, acquire knowledge, anything of that kind, of course, which affects their frame, would be transmitted hereditarily.

The third theory allows all of these, but puts in addition to them an inherent tendency to change; that there is a natural tendency to change just as much as there is a natural tendency not to change; the same as there is a biological force which we call heredity which tends to keep nature in the same line; so there is another one working with it and always working with it, never quite so strong as heredity, but always there, which tends to make the creature unlike its parents. That this force operates in some directions stronger than in others; that various causes influence it and modify it; but that it is a separate, distinct biological force as strictly applied as that of heredity. I believe that myself. It is but a theory, I will admit, but it is the one which I think is most probably true. I say I think it is true, because it explains the facts more and better than in any other way.

Now, such being the case, that there is this innate tendency to vary, which is heightened by a variety of other causes, by food, by drink, by other causes which I shall bring up, like crossing, etc., then the other element that comes in is selection in nature—natural selection; in artificial breeding, by artificial selection. Nature inexorably weeds out those that can not stand it. To use a slang phrase, the great motto of nature is: "Root, hog, or die." Those that do not root die, and those that can't root hard enough die. In the case of art we breed the hog without much snout to root with in feeding; select such as we want; artificial selection in art does what natural selection does in nature. Now, it is this natural selection in nature, combined with artificial selection, which is brought about by profit, greater or less profit, that tends to make these changes in the end that I have attributed to regional influences. What nature does in weeding out the weaklings, art does in weeding out the unprofitable ones. We are breeding for profit, and those that do not bring the money are unprofitable ones; and if there is any particular character that has got money in it, that is the character we save; large horses in one place, small ones in another.

There is another element that comes in there that I ought not, however, to entirely pass by, especially if I have got a lot of breeders around me, and that is the "fancy" element. We breed "fancy," and however much we can say to the contrary, we continue to do it. You will hear one man say: "I am breeding to milk; I want a good milker; I don't care what kind of a cow she is." Five minutes after that fellow will be saying: "I prefer a cow with solid colors." It has about as much to do with the value of the milk as the fringe on a lady's bonnet has with keeping her warm; but nevertheless the trimmings on the lady's hat is an important element in the social economy, and the fancies that we go for in stock breeding are an important element in that matter. Frequently it works against profit. Fancy breeders are breeding for fancy points. Now, very frequently in some regions there is some reason why some particular character has a value which it has not in another. There is some thing which makes one form a little more profitable than any other.

I now come to another and most important cause of variation; I say *cause*—yes, I will leave it as cause — one of the things that induces variation; and that is violent crossing. Let me give you an illustration from the vegetable world, because it is one with which you are familiar. Take the dahlia, an exceedingly common flower of widespread popularity, and which has a vast number of varieties. The dahlia is a native Mexican plant, no very great beauty in its wild state. It was carried from Mexico to France a long time ago, along with a great many other American plants, and cultivated as a curiosity in the botanic gardens. In their efforts to produce different varieties they failed. It was cultivated for a good many years without much change; it was very fixed in its characters. Finally some other botanist carried into France another variety of dahlia from another part of Mexico. They were both of them dahlias, they both belonged to the same species, they were local varieties; they differed from each other in their nature as two breeds of cattle would differ. The two were crossed, and then began the variation, and having once got variation started, having broken up this tendency to grow true to the seed, then, along with the money that was in the varieties that were produced, came that marvelous variety of forms for which the dahlia is so celebrated.

Now, we may take animals and cross them; as I told you this morning, if we keep the blood pure and breed from animals having the same general characters, so we keep up uniformity. On the other hand, where we mix various breeds and keep on mixing them, then we introduce variation. And not only by atavism,—getting variety from the resemblance to various of the individual ancestors that were unlike,—but we introduce fresh variations. The dahlia that I spoke of not only got the two single forms from which we started, but we got a thousand, two thousand, I don't know how many forms of single and double flowers both, from which we never started and the like of which did not exist in nature.

In just the proportion in which we have a varied and varying ancestry, in the same proportion we introduce or create, as it were, a tendency towards variation. But we can not tell what is going to be produced. I say we can not tell what is going to be produced in that case. Nature is exceedingly capricious, and we do not know what determines what shall be produced in that case; we simply know that we are going to vary. Let me again make a comparison with the plant world. In the case of our grains and all short-lived plants like the grains, that are propagated from the seed, there it is very important that they grow true to the seed, and we have got to take some other way of producing variety, generally through selection of those having some particular character. But with our long-lived cultivated useful plants, particularly with apples, etc., there we take another way. Suppose that all of the cultivated apple trees should be suddenly struck out of existence, and that we have left us a single group of the original sour crab from which all our good apples were derived, one little spot of earth and nothing else, and we had all of our present knowledge. How would we go to work to manufacture out of that miserable, sour, puckery crab the various kinds of cultivated fruits that we have? I may say that we would go to work perfectly intelligently, and with perfect certainty of doing in one hundred or one hundred and fifty years almost as much as the race has done in all these thousands. The first thing to do would be to take and choose your climate just as widely different as possible, and plant seeds, and keep on planting, and then from the fruit of these choose those that differ as widely as possible from the original, no matter whether they are better or worse; all you want to do is get something different from their parents, and then plant those, and by the time you have been going three or four generations, crossing these also as much as you can, you have broken up this tendency to grow true to seed, and then the apples begin to sport.

How do we get varieties of apples? We start these thousands and thousands and thousands of seedlings, and one out of 10,000 is worth preserving; it happens to be a variation in the right direction. The other 9,999 we throw away, cut down the trees and use them up as firewood, and propagate this one by grafts. Now, precisely the same law holds all through nature. If we break up the tendency to breed true and breed from a varied ancestry, I don't care whether it is the highest organism with which we are acquainted, man, or the lowest with which we know anything about, the same thing holds true. Take for instance the highest organism, take man; 10,000 persons whose parents were of two different races, take the white and the negro, which is the most common cross that is at all a violent cross —I suppose that if you should take 1,000 mulattoes whose origin was a white father and a black mother, and they would be marvelously uniform, I mean as to color, and as to race characteristics, but let these thousand mulattoes marry, and then marry again. Now, theoretically, every child in the whole lot should have an equal amount of white and black blood; but those of you who have been and seen where that thing goes on, know that in the next crop of children or along about that time, there is no uniformity. There is every possible variation. I will venture to say that more than one of my hearers can tell of individual families under their own observation, famlies virtuous and honorable, too, where in the same crop of children some will be as white as a white man and some as black as a black man; one will have the white skin but with the flattened nose and thicker lips of the other race; another will have a black skin and a thin nose, and so on in interminable variety.

You can not make a uniform breed without a marvelous amount of selection, which we can not carry on in the human race, killing off those that do not grow according to our ideas; and I do not believe you can make a uniform breed having the better characteristics of two races by mixing two races or two breeds. Let me give a case: The English improved mutton sheep are comparatively new breeds. Mr. Bakewell began his breeding observations a little over 100 years ago. He began as a breeder about 1770 to 1773, variously stated by different ones. The celebrated Bakewell sheep and the better varieties of coarse-wooled English mutton sheep have received their better qualities from his experience and from breeders since his day. He may be said to have been the first scientific breeder. He did not leave any record of his work; we know what he did, however. He went to work in the right way. A keen observer, he slew his lambs, many of them, and that was one of the tests that he used, but if you will read up the history of his work you will find how enormously the price of rams increased under him. The letting of rams was an important item then, as now, and the price increased several fold. Now, after such marvels had been done there, twenty or thirty years ago some intelligent Frenchman attempted to improve the native French sheep by the importation of English mutton sheep. Southdowns and Dishleys and Cotswolds and several of the better Shropshires were also used. In the various valleys of France there was a large number of local breeds of sheep, coarse-wooled, hardy, tough—excellent sheep, except that they were good for nothing. [Laughter.] They would live and hold their own on a poor soil. As animals, they were an eminent success; as sheep, they were failures. In every attempt, without a single exception, to improve these native sheep by these English improved breeds was a failure. The same thing took place with the German breeds that I was telling you of. Why? Why, these old French breeds were old; they were thoroughbreds, running back, I don't know how long. They were old breeds. They were the real old inhabitants—the real aristocracy of the country. And when these newly acquired characters of the new and improved breeds came in, why, their blood was not worth anything against this old-established routine that had gone on so long, and every attempt was a failure.

Now, how did they get around that? They wanted to breed sheep that would have the good qualities of the English sheep and that would stand the climate. A noted French breeder goes to work; you will find the whole thing described in detail in several French works; there is a large work on sheep, published by (the equivalent of) the minister of agriculture of France; Moll and Gayot are two of the authorities on that subject. He takes two breeds from two valleys and gets a cross between those, and takes a third one and a fourth one; these are crossed. Then he crosses the whole of these. Now he has got a lot of sheep with the blood of four of these old French breeds in them. On these mongrels he crossed the English, and hit it every time, made an excellent mutton sheep. They sent to England to get their rams and served this mongrel stock made up of these four breeds with the English rams, and the English rams had prepotency enough to improve this material very much indeed. They had made a sheep that was half Bakewell, if you choose, and one-eighth of each of the various varieties, and they had a capital animal. They varied amongst themselves considerably, but the mutton was good, and they were hardy. Sometimes the same cross would be crossed again on the Bakewell; if crossed on each other sometimes they were pretty good, sometimes not. I might take up the remainder of this lecture in giving illustrations of this.

Stonehenge says, regarding dogs: "There is a tendency in the produce of a litter to a separation between the different strains of which it is composed; so that a puppy composed of four equal proportions of breeds represented by a, b, c, d, will not represent all in equal proportions but will represent one much more than the others; and this is still more clear in relation to the next step backwards, when there are eight progenitors, and the litter, which for argument's sake we will suppose to be eight in number, will consist of animals composed each of the above eight."

Then if you read any authority on sheep he will tell you it is so with sheep; another one on rabbits, and he will tell you that it is so with rabbits. The most famous breeder of setters in the world has published a book on the Laverick setter; a beautiful work it is. He says it is useless to breed dogs without a pedigree. Then he goes on and describes two dogs, two own brothers, "one as magnificient a specimen of a pointer as you could wish to look on," and he says he bought those for a friend to breed from, a capital person in his profession as a dog breeder. "His own brother of the same litter was as good a setter as his brother was a pointer, and both were such good workers that many people bred from them; but now mark the result, their stock was the most mongrel of wretches, not only in promise but in performance. So I might quote Youatt or any other of the old or the new special breeders that are breeding for this, that or the other special point, and they all come back to that one thing, that there is this tendency to vary enormously enhanced by this mixed ancestry. Just in the proportion in which we have a more varied ancestry, in the same proportion is this tendency to spontaneous variation.

It is easy enough to see that along with this there may be an appearance of new character. I don't think it is true that no animal has a character not derived from its ancestry. The most common variation we see is that which relates to color. The Hereford cattle are now occupying a good deal of interest and attention here in the Western country; and in Rollin's account of the origin of this breed I notice this—it has got nothing to do with the Hereford cattle—"About 1750 * * * a favorite cow had a white-faced bull calf. This had never been known to occur before, and, as a curiosity, it was agreed that the animal should be kept and reared as a sire, and the progeny of this bull became celebrated for white faces." Now there is a suddenly appearing character. That is one point. Another point of more interest to us just now is that that character was transmitted with marvelous force. It was kept as a curiosity for a sire, "and the progeny of this bull became celebrated for white faces." When I was a boy my father bought a little white-faced calf, a grade Shorthorn, and it was the only Shorthorn in the neighborhood, a rather likely animal. It did seem to me that the one character that fellow always transmitted was his white face, and I never go home now, more than thirty-five years have passed, without noticing the large number of white faces in that neighborhood which have been left there from that calf.

Now some new character appears; now it is drooping ears, now it is a spot. There is a very great tendency for animals, as I have said, to show spots and colors, to become albinos and white. There are very few white wild animals, very few indeed. There are no white wild animals in countries where there is no snow—they are too conspicuous for their enemies, and for the same reason there are comparatively few spotted wild animals where the spots are not an absolute protection. But where they are they vary as our domestic animals do. I have carried on an investigation—more curious than useful, I will admit—and I have spent a good deal of time on it, on the markings of domestic animals and the laws by which they are governed. There is a popular belief that the markings of domestic animals follow a very different law from that of wild animals. I do not believe any such thing. There is a continued tendency for wild animals to vary; they become spotted, but the instant a wild animal becomes spotted, if he has a big white spot on him, that marks him for his enemy. Show a buffalo on the plains that has got a white spot on it, and the hunters for miles around will go for him, and emphatically so if he be an albino buffalo. They only have white on them where it is some means of protection in some way or other. But when it comes to domestic animals, then, as I have said, in an early state of society particularly, it is a means of identification; it is a sign of ownership from the very early days when the "ringstreaked, speckled and spotted" cattle were Jacob's down to the present day, when the ownership of cattle is liable to be uncertain; it is a good thing to have them marked, and we breed them. Nevertheless, there are some curious laws involved in it; there is more white on the left side than on the right. If you have spotted horses, a much larger proportion have the white on the left than on the right side. A given number of horses spotted on both sides, there is most white on the left side. So, too, in foot-marked horses, there are most white feet on the left side; the right hind foot being most often marked, and the left fore foot least often marked, the order of succession being: right hind foot, left hind foot, right fore foot, left fore foot. These are mere facts; I don't know why it is so—it may be the left side is weaker; I don't know—I merely give this as a fact. But the first beginning of variation, the appearance of new characters, is this matter of color. Now, as an answer to all of those who think that there is no change, one of the most eminent writers on breeding in the United States has stated over and over again that the only chance of improvement that we have is in feeding up an animal so that he grows larger than his ancestors did, or educating or training him in some way so that he has some character that his ancestors did not have. Now, I believe in that, and I believe more than that; that there is an innate tendency to vary, that there is an acquisition of new characters, and that we want to seize on those, and that the keen breeder, the sharp man that has the kind of faculty to know how to take and how to pair, can make use of them. Why, 150 years ago all the authorities state that the Galloways were horned, a majority of them, anyhow. We know that 70, 80 or 100 years ago some of the Galloways had horns and some were hornless— "muleys," as we used to say in New York. Now they are all without horns; they have been "bred off," as the breeders say. You say bred off—what do you mean by bred off? Why, simply that we have selected the variations; that we have gone on in that direction until it is the rarest thing that we have a Galloway with horns. That brings us to the next point, an important one, and coming back along with the thing I have just been speaking of.

Spontaneous variation: variation by crossing. Now what kind of variation is apt to take place by wide crossing? One kind that is very apt to take place is degeneracy, very often; and we have got to learn by experience what two breeds to cross to make them better. But very often there is a degeneracy in some particular, and the more violent the cross the more apt that is to be. It may be something that does not injure the animal; but where we cross violently we have some variation which is very apt to be a defect. We cross the horse and the ass; the mule is more intelligent than either, he is tougher, he is an excellent animal. But he won't breed; he shows his inferiority in that way. Very, very apt to show it in temper. By wide crossing we are very apt to go back to some earlier form. We cross the water cow on the common cow, the zebu on the common cow; a great variety of crossings. I have collected a large amount of data on that point, and in almost every case the temper is injured by it. Why, the horse is perhaps more celebrated than any other animal except the dog for its docility and intelligence. The ass is one of the most docile of animals. The mule has an evil reputation — a very evil reputation as to his temper and propensities. That is a common experience. The crossing of the Cape buffalo on the common cow gives an animal most excellent for beef, strong on the draught, but of such irascible temper that he is good for nothing as a general thing. And so on to the end of the catalogue.

Now there is no breed that has been bred so pure or so carefully or so long but what variations take place; and therefore if we would keep the best quality of animals we must not only breed throughbred but we must select. Probably one of the oldest breeds of cattle in Europe is the celebrated Chillingham white cattle. They were known as early as the tenth century, nine hundred years ago, and for one hundred and fifty years we know that one herd has been kept strictly and absolutely pure; and yet the keepers of that herd say that every little while a spotted calf is dropped; whenever one is dropped it is shot.

The domestication of animals induces changes. Judge Caton has given a very interesting account of the changes that occur in the domestication of the common turkey. He has marked the changes in form and instincts that have gone on. There is no organ of the body of the animal which may not and does not occasionally vary more or less from the normal type, and there is no variation which may not be transmitted — I do not say it always is, but which may not be transmitted — by selection, from generation to generation, and may be the foundation of a breed or a race. Now, recollect that *numbers* are an element in the production of a breed. In the production of new breeds of sheep think how many millions of sheep there are in the world. If you have a wide variation here or there, may be one sheep out of ten million that may lay the foundations of a new breed.

But aside from those variations, which are comparatively slight, that I have been speaking of, there is another form of variation which we call *sporting*, which is a sudden and wide variation. That is a little more curious, too, and of which we are entirely in the dark as to its cause. The most obvious phase of that which we see is in the production of Albinos, and very frequently it takes place in form. A good many examples might be cited of that. A breeder of sheep of the name of Graux, in France, in the department of Ain, in the northeastern part of France, in the year 1828, found among his lambs a ram which had a fleece apparently entirely unlike the rest. We will divide wools into two great classes — combing wools and felting wools — of which the Merino is the type of the felting wools. The combing wools are the basis of the worsteds; all the English coarse-wooled sheep produce combing wools. Now, the Spanish Merino and those sheep that are descended from it, are not only felting, but they are finer. Now, in the case of this particular lamb, it had the fine character of fibre of the Merino, and it had the silkiness and lustre of the combing wool. That is the best way I can describe it. And he saw that if he could produce a breed of sheep like that he had a good thing. And so, two years later, in 1830, when the ram was two years old, he allowed it to serve certain ewes, and he had two lambs — one of either sex. In 1831 he had five — four rams and one ewe. In 1832 I have not seen it stated. In 1833 he had rams enough to serve his whole flock. In 1834 he had 142 animals from one month to six years old. The first article that I saw on the subject was published in 1851, and there have been a good many published since. In each subsequent year the lambs were of two kinds — one possessing the curly wool of the Merino, the other like the new breed. That is, for ten generations there was a tendency to revert to the old Merino form; but he kept on selecting, and established a breed. In an account that was published later by Lefebvre in a work on sheep in French, he says that other proprietors have had similar lambs dropped, but had not used them; that it was a native of Australia. Without going into that at all, we will stop a moment on Graux's work. He did a very bold thing in keeping a lamb that was liable to ruin his whole flock; but he weeded out those that did not breed true to this form, and the old type slowly disappeared. But in one of the statements it is said that there was no case where both ram and ewe were of the new type but what the lamb dropped was of the new type. That is the statement of one of the persons. In 1836 he took a prize for what he had done; a little later a gold medal was taken. He established a breed of French sheep founded on the production of this wool, and it has grown a new class of woolen fabrics that is mentioned in all French works on the manufacture of French woolen goods. Graux received first a prize of 1,500 francs, another of 3,000, another of 4,000, another of 6,000 francs, and a French authority states that in twenty-five years he had received at least 120,000 francs; so that he made a pretty good thing of it.

There is one interesting case of where a breed originated in a "sport;" we have but few such cases. That was a valuable breed. In early days in this country sheep used to jump stone walls in New England; and a man named Seth Wright, down in Massachusetts, had a lamb produced like the others, but with very short legs, and which could not jump stone walls, from which arose a variety known as the Otter sheep. At one time they were common animals all through New England; my impression is that they are extinct. I saw a statement that somebody had found two of them preserved up in some farm in Maine. Someone said there was the skin of one stuffed at the Centennial; if so, I did not see it. The whole history of them is known. This man had a few—fifteen ewes and one ram—of the common kind. He says that in 1791 one lamb, differing for no assignable reason from its parents, was dropped, having no valuable quality that I know of except its short legs, and a good many qualities that were not valuable. In these days the thing has passed away, and I imagine it has become extinct.

We have every little while a breed of hogs spring up with solid hoofs. I know there is one sprung up in England; there is an account of them in one of my hog books. There is one sprung up in Texas; instead of the hoof being split, it is solid like a horse's hoof, and every little while there is a breed that will spring up in that way in which it has no other character to distinguish it; and it may run out for lack of careful breeding, or being of no value it may be bred out because of throwing suspicion on animals that are bred for other purposes. This matter of "sports" is only introduced to show a kind of variation which takes place, and of which we are totally and entirely in the dark as to the cause. Some assume that it is due to atavism. There have been several long articles published on this matter of the French Merino that have assumed like this, that the old original Merino before it went to Spain came from Persia and had silky hair, and that this was a reversion to some ancestor away back before the days of Jacob or Noah, or I don't know who, I don't know when. I do not know of a particle of proof of it. It is a mere theory and you are any of you at liberty to make another theory just as good as that. At the present time I must confess I see no good explanation of it.

It is very rare that breeds of domestic animals are produced from "sports." It is very well, however, to know that just as males are more apt to be very prepotent — or, at least, for us to notice this prepotency — more than females, just so they are more apt to vary. So far as I know everyone of these marked sports has been a male. The first of the Otter breed of New England was a ram lamb. The first French Merino was a ram lamb, etc. Now, physiologists tell us that any monstrosities, any abnormal variations from the ordinary type of man, are a good deal more apt to take place with the male sex than with the female. There are more men who are idiots — I mean, more out-and-out idiots — than women. There is a great variety of variations which are unfortunate as well as those that are fortunate. Now, comparing these two together, we see that in the first place, this matter of tendency to vary, some of the causes that make animals vary; we find that any character may be transmitted wholly or in part. Here we have the foundation for the improvement of breeds. Another reason is, because every creature has two parents and it never takes all the characters from one. We will pass on to-morrow to the next.

I ought to add one word—I have run over the hour a little — that these sports, where they transmit their characters, transmit them generally entire. In the case of that French Merino it was not like ordinary crossing; where they crossed this ram with the ordinary Merino it transmitted its characters entire or not at all, and that was the case until the breed was pretty well formed. Now that has been formed a good many years; if that is crossed with the ordinary Merino we get a cross with the same characters. I am merely giving it as stated. There are two sources for the origin of breeds, which you have all seen: one is in sporting; the other and more common is the slow adding up of characters that we have been breeding for. We add up from generation to generation some particular character in one particular direction, until at last we have a well-marked breed.

Now, in this matter of uniformity in the breed it is desirable in breeding to certain qualities, and we want to get them every time. But we want flexibility in a breed, that we may adapt it to new conditions and improve it for new purposes.

I will say a last word on pedigree, its uses and abuses: That the use of pedigree is to know what the blood is. "Blood will tell," but to tell a good story it has got to be good blood. Pedigree does not take the place of selection. We find lots of cases of persons trying to sell animals on a pedigree when the parent was not good for much; running on their great-grandparents. That is one of the worst abuses that grows out of the whole pedigree system. As long as we keep that in our minds there is no danger of our being led astray too far by trusting too much to pedigree.

THIRD LECTURE.

"CLOSE BREEDING."

In the two lectures yesterday I considered: (1) The matter of heredity; how that animals tend to be like their ancestors. (2) In the second lecture I took up variation, the causes of variation; or, if not the causes—perhaps that is too strong a word—the conditions which induce and favor variation. I told you that the wider the ancestry and the more varied the ancestry, the more apt animals were to vary; because of two different reasons: They varied, in the first place, by reverting to some one of their many ancestors. They had many ancestors; every creature has 2 parents, 4 grandparents, 8 great-grand parents, 16, 32, 64, 128, 256, etc. Supposing there was no pairing between blood kin at all; if we go to the twentieth generation, the twentieth line would be represented by about 1,000,000, and we have seen, we know, that reversion may take place after more than twenty generations. Much more than that. And if there was no blood kinship between these 1,000,000 on the twentieth line or the 500,000 on the nineteenth line, etc., giving it in round numbers, there would be in round numbers 2,000,000 of ancestors in line in twenty generations, and the creature might resemble any one of those.

If now in any way we can reduce that number of ancestors we can reduce the chances of variation by atavism; but with a varied ancestry it seems, furthermore, as if the inherent tendency to change is increased. Of course, you easily see that we can diminish the number of ancestors by breeding between animals of blood relationship. I hinted without dwelling upon it in the last lecture that very often two animals that are very unlike in their characters have excellencies for us greater than either of their parents. If these ancestors are very unlike, if it is a "violent" crossing, they may combine excellencies in some directions with defects in others; for there are always defects and not always excellencies. If we take for instance in the most violent of all crossings, between different species, the resulting hybrid generally shows its imperfections by being sterile, and also in some other form of weakness. If we take a cross between very unlike breeds, there is some form of weakness shown; but if we cross between animals that are not so widely separated in their characteristics it is an exceedingly common thing for the first or even for the second cross to get a product which is superior to either of the parents. Now that is a fact that has been observed — it must have been observed — from the days when breeding as an art began. I think if you look over the old works on breeding, those in our own language and in the languages to which ours is kin — they are fewer, curiously enough, in English than in some of the other languages — you will find that down to the last century, and indeed I ought to say, to past the middle of the last century, the great and almost universal way of improving live stock was not by keeping the blood pure and selecting the best animals, on certain limits that I will mention in a minute; but by crossing it with something else; crossing, crossing, crossing, going somewhere else and getting animals of another kind and crossing with them. And the only reason that breeds sprung up and grew up in those days was because of the isolation of the different communities, partly owing to political reasons, partly owing to the difficulties of travel, and the thousand and one causes which brought communities together in little groups, which in the old world gives each little valley its own language and its own customs and its own class of peasantry; the same causes produced local breeds of animals. But even then and there they were continually trying to improve by getting animals from somewhere else.

It was only after the middle of the last century that the attention of people of our race became extensively occupied in the matter of improving breeds within the breed itself. You can not call to mind the former of a single one of our great breeds of cattle who on the start did not try to improve them by introducing something else. Why, even with the Shorthorn, that breed which to-day is kept with such marvelous purity, if we go back to the great father of Shorthorn breeders—I do not mean the first, but the one to whom we all go back and cite, Charles Colling—what did he introduce? The Galloway cross. What did he introduce the Galloway into his herd for? Why, you would say any fool ought to know better to-day. He did it because it was the universal method in that day of improving herds. They didn't know any better. At least—I won't put it quite so strong as that — he was still tinctured with the old ideas. The father of breeding in our present shape, the founder of the science, if there is a science, undoubtedly was Bakewell. He stands out pre-eminent. This farmer, born at Dishley in 1725, became impressed with the idea that everything depended upon breed. "Blood will tell" is the way we put it in modern times. And as he was going to be a breeder of cattle he thought the matter over and started out with a breed. It was unfortunate, I think, for the world that he chose the breed that he did. He took the longhorns instead of the Shorthorns. How did he begin? From the cattle of all his neighbors he chose only three to begin with, one bull and two cows, and that was the foundation of his herd; getting three of the best animals that he could possibly get, and breeding only from them and their progeny, very closely. He died without telling what his secret was; but we probably know pretty well what it was. He slaughtered the animals, examined their flesh, examined the parts, weighed the relations between the good and the evil, and so on to the end of the category; he worked it out scientifically. He began his experiments, we will say, about 1770 or 1773, and lived to a good old age. With sheep he began on certain coarse-wooled animals and laid the foundation of that breed which we call the Bakewell breed. I need not dilate upon precisely what he did, but he increased the value of that breed so that they were held at — I don't know now much now, I have seen it mentioned a good many times. But his grand theory was that the purer the blood the better, if the blood was only good blood. So he commenced breeding "in-and-in." I can not find the use of that term "in-and-in" before Bakewell's time at all. It originated among the English farmers. It was used certainly as early as 1780, and probably earlier.

You know the way farmers learned the trade in those days, as they still largely do in England, was for persons who intended to be farmers to live with other farmers. "Farmer" there does not mean what it does here. Our "farmer" in America is represented by three distinct classes in England, three classes socially, three classes industrially; there are the owners of the land, the landlords; there are the farmers, who supply the capital and who rent the farms and manage the business; and the farm laborers. Now, among the young farmers that were coming on were two brothers named Colling. One of them, Charles Colling, who appears to have been the bolder and the more enterprising man of the two, went and lived with Bakewell and got his ideas of stock breeding from Bakewell, and early in the present century he started out, but he began with the Shorthorns, as found in the valley of the Teeswater.

There has been so much written upon the Shorthorn, there are so many men ready to trumpet their excellence, that I don't know as it is necessary for me to dilate at all upon that. I could not say a word about their history but more or less people would pitch into me and say I was wrong. "They came from somewhere else — they had a good deal earlier origin than that" — etc., etc. They will say that a breed existed as early as the twelfth century, etc. All of which indicates that we do not precisely know where the Shorthorns come from, any more than this: That they have certain resemblance to the Dutch cattle, and certain Danish cattle; that in the universal effort to improve cattle by mixing there is no telling what kinds of blood or how many kinds of blood there were in the original breed; that they were raised on the fertile soils and in the rich pastures of the county of Durham, that they were excellent cattle, and they were cattle which the Colling brothers and others began to breed from. They had begun to preserve written pedigrees. The stud book began before the beginning of the present century with horses. There was a breed they were breeding pure. In Spain they were breeding Merinos pure; in Arabia they were breeding certain strains of horses pure; but I am talking now of English speaking people and people of the north of Europe. The Collings by picking out the Shorthorns, acting on the experience they had learned of Bakewell. Those were excellent cattle; they got the best they could get, and they bred closely "in-and-in."

Charles Colling — if he tells the truth, and it is too late in the day to say that he lied — if he tells the truth, bred closer than any man has ever been able to do since. I do not known of a single case in the whole literature of breeding that shows such marvelously close breeding as Charles Colling performed, I mean, and did it successfully. Charles Colling is the one that we generally speak of, although Robert was a good breeder of animals. Early in the present century — I have forgotten the precise year; I could not find the pamphlet when I came here, and I am very sorry — he took one of his best steers and fatted him up until he had him weigh a tremendous amount — I have forgotten the amount. I have mislaid the pamphlet or loaned it — I hope not loaned it — suffice it to sav that he started the steer on a tour of exhibition, and it was known as the Durham ox, and had more to do with giving the name Durham to the Shorthorn cattle than anything else. That ox traveled for two years about England, and there was published at the time a pamphlet with a portrait and where he had exhibited each day, and a comparative view of the receipts, and when at last the poor fellow broke his leg in transit he was slaughtered. All of it was a glorious advertisement for Colling's cattle, and when everything was just right and the tide was high, Charles Colling sold out and scattered his herd. It is not the only time in history where a man has done a good thing in that way. Some of his animals sold for 1,000 guineas, a thing absolutely unheard of.

Breeding "in-and-in," as I have said, means breeding between near blood kin. Breeders are by no means agreed as to how near the relationship must be to come under that head. The closest of all breeding as shown by practice is between the offspring and its dam; we will say, between the son and its mother, using the human terms of relationship. That is the closest of all breeding. The next is between the sire and his own daughter. The next is between full brother and sister. The next is between half brother and sister. That we would call all of these breeding "in-and-in" there is no question whatever among breeders. Then between niece and uncle or nephew and aunt — I am using the human terms here, for we have no others. We generally speak of that as breeding "in-and-in," and I think that as a whole breeders would put them in that class; but when it comes to breeding between what in human relationships we call cousins, full or half cousins, some breeders say, "I don't call that "in-and-in." The majority say they do. It is simply a quibble upon words, as to where we leave off saying that it is breeding "in-and-in." But we mean any way breeding between comparatively near kin. An animal must have two parents. I have drawn out a diagram on the board, the common way in which I have worked up pedigrees, using two colored pencils or chalks to represent the two parents.

In this case we will let the parents be represented by horizontal lines; the male parents or sires represented by the yellow lines on the board, and the female parents or the dams represented by the red lines. I am supposing that we are following the pedigree of a certain male, we will say for the time being, a bull, if you choose. Now that has two parents, of course. But these two parents instead of descending from four grandparents, may have descended, if you choose, from three grandparents. The two grandsires might have been the same animal, paired, if you choose, with different females. Now here instead of having four grandparents, we would only have three; or, suppose that these parents had been full brother and sister, then we would have only had two in this line. Supposing we pair full brother and sister; of their progeny again pair full brother and sister; of their progeny again pair full brother and sister; of theirs again. Of the four animals we would have but two; instead of the eight animals we would have but two; instead of the sixteen animals we would have but two.

Now if we come to consider this in the line of atavism, there would be very few animals. Here are thirty animals naturally in the line, and that is not as far back as we go even for entering in our herd books. Now of those thirty animals we could pair so closely that instead of being thirty, there would only be eight. That is an exceedingly simple way of stating the principle upon which we are at work. A writer in Ohio, Mr. Humerickhouse, has stated the argument of atavism so clearly that I will quote him. I will give in substance what he says; it is not necessary to follow his precise language, but nearly his precise language: "In thorough breeding we are enabled to place in the line of direct ancestry of our flocks near or remote, a greater number of superior approved individuals, both male and female; and in the ratio of the number of approved individuals in the ancestry will be the chances of obtaining approved offspring." This is obvious. Then he says: "If there are advantages arising from the having placed in the line of ancestry, near and remote of our flocks, a great number of excellent and improved individuals both male and female, it follows that there must be a far greater advantage arising from having some one individual of marked superiority placed in that line the greatest possible number of times. This is done by "in-and-in" breeding, and is the object of it. Now, it is easier to find this one unsurpassed individual than to find many; for in the many there will most certainly be one to be preferred to all the rest. Then, under the operation of the principle of atavism, the chances that the resemblance of such unequaled ancestor will be obtained must be in the ratio of the number of times that he occurs in the ascending lines; hence, greater uniformity and greater excellence in all the progeny."

I believe that entirely. I will go further than that and explain it right here. I told you that by using a varied or varying ancestry, we enhanced the tendencies to variation; that it made the progeny more liable to vary. Now, I believe that the reverse of that is true; that by using a large number of times some animal of superior excellence, we enhance the probabilities of getting that excellence, not only in the numerical ratio of the number of times that he is used, but more than that. There is a concentration of tendency towards uniform excellence. And there could be absolutely no argument against breeding "in-and-in" on the line of atavism, were it not for other conditions and facts that come in, which will be noticed a little further on.

Now I will illustrate still further in practical cases. I don't know of anything that is harder to illustrate to a class. I have been lecturing on breeding before a class for nearly twenty years, and I state that I have spent more time in studying up the matter which I am talking about this morning, and more time in trying to see how I can show that to a class, than in all the rest together. How to show it to a class practically, I can not yet do it. I have made I know not how many diagrams in one way and another. Other breeders have done it. There were diagrams of Allen, the editor of the Shorthorn Herd Book, and I thought they were capital, and studied them until I got hold of them. I did not find that one member out of five of the classes understood them after I got them out. Prof. Manly Miles, formerly of the university of Michigan, started out on a different line. If a man should sit down and study it he might understand it, otherwise it would be simply a confused mass of lines. Therefore I labor under a disadvantage, and a great disadvantage, in trying to show you the real force of the argument which I am trying to use. If you take and carry out this system (pointing to the diagram on the board), it soon becomes too enormously large I have sixteen lines here, and have only gone four generations. I will come back to that again in a minute. I will read—I don't expect you to remember it—but I will read one page from the herd book.

[The lecturer then read some extracts showing the frequency with which certain animals appear in the ascending lines of the same pedigree.]

It is simply impossible to follow it out, unless a man has nothing else to do with a lifetime, with some of the Shorthorns now. I will illustrate with another: A particular strain of setter dogs is very fashionable now, both in this country and in Great Britain and in Ireland—the Laverick setters, I mean. I spoke yesterday about them. The originator of those dogs — the author of them, the creator of them, whatever you see fit to call it — was Mr. Edward Laverick, of Shropshire, and he has published a beautiful little book, ten years ago now; he was then an old man. There were several strains of setter dogs long ago, but about 1825 he bought a certain dog and bitch, known in — I may say — the fashionable literature of setters as "Ponto" and "Old Moll." Those were bought of a certain Rev. Mr. Harrison, near Carlisle. The breed had been kept pure, as he stated, from 1790 at least, and perhaps were nearly pure much earlier than that; so that he had a pair of dogs of approved pedigree then. Now, all the present Laverick setters are derived from these two, "Old Moll" and "Ponto;" so that if we go back, instead of having the 5,000 or 10,000 ancestors that we ought to have, away back in 1825 there are two. They stand as the potential ancestors, the representatives of the Lord knows how many thousands, I don't know. Now, why shouldn't we have great uniformity there? On every principle we should have it. Our sporting papers had a good deal to say a few years ago in regard to a particular setter that was imported; he came West — I don't care where or when or whose he was — it was the breeding of the dog that interested me, the "Pride of Durham." I had the curiosity to run the pedigree back. I am not going to bore you with the whole of it. This "Ponto" and "Old Moll" had whelps; of them two, full brother and sister, were paired; of their whelps a full brother and sister were paired; of their whelps again full brother and sister were paired; of their whelps again full brother and sister were paired. This produced "Moll," who was the paternal grandam of this "Pride of Durham," under discussion. As soon as we get out of that it becomes a little more complicated, but it is "all in the family" — all in the family. And if we come to consider that in this line (referring to the diagram on the board) I would have to carry out another line; so that instead of having two parents, 4, 8, 16, 32, 64, there would be two parents, two grandparents, two great-grandparents, two great-great-grandparents, two great-great-great-grandparents, and that is all.

The tendency of all this is — I am now looking at only one side of the shield — to enormously diminish the chances of reversion to bad ancestors and to fix the characters which we wish to fix, "Old Moll" and "Ponto" might have had fifty whelps, but only two were saved, that had the characters that the parents had.

I don't know how many the second generation had, but they were all sacrificed but two. I don't know how many there were in the third. There is a tremendous sifting there to get the best. When somebody asked the most celebrated breeder of greyhounds in England "How do you breed such marvelous hounds?" he said, "It is easy, I breed a great many and hang a great many."

On account of this selection, on account of every principle of direct heredity and atavism, there should be this concentration of blood; there is every reason why such animals should be exceedingly prepotent, why they should carry their characters when crossed with mongrel progeny. It is but a natural consequence that such animals should be prepotent, and when we have such animals we know they are prepotent. There is not a single improved breed to-day of cattle or swine or sheep, in which this principle has not been employed. It has been employed to a different degree with different improved animals and in different ways, but the principle is involved, and it has been employed, along with that change in the dogma of breed that has come about within the last one hundred years, that the best way of improving a breed is to improve within the breed instead of going out: *thorough breeding*, instead of going out and crossing all the time.

Now why should there have been so much written about this? It is all one-sided apparently. Why should there have been such an enormous literature written about it?

There is no other one point in the whole learning of breeding upon which there is such a difference of opinion as upon the very one upon which I am speaking. I could not get together an audience of one-quarter this size of practical breeders that would agree on the very point I am talking about. They would all agree on one point: that breeds have been improved; but they would say, it is very dangerous. Why is it dangerous?

For the simple reason that there is a law of nature that appears to be as wide as that of living beings, which is, that if we continue breeding too closely there is a degeneracy of some kind. Just as I said, that in wide crossing we might have some form of excellence very much enhanced, there comes along with it some form of weakness and degeneracy; so here, just as we have improvement in certain directions, we introduce other evils. And in breeding as in human society, in breeding as in all good things, whenever and wherever we introduce any good thing some evil is introduced along with it and grows along with it and the great care is to see that the evil shall not overcome the good. As I said, it is so in human society. There is not an institution that is instituted, there is not an improvement that is improved, there is not an advance, in science or in society that does not bring along with it some evil; and that evil has got to be fought, it has got to be got around and obviated in some way, or the evil may grow to be greater than the good.

I could take up an hour — ten hours — showing you illustrations of this, and in explanation of the general rule. If it comes right down to the truth of the matter, all breeders will allow that we can breed "in-and-in" some; but as to how closely they will differ. And they will differ very much, because they are breeding different kinds of animals. Now, as a matter of fact, I will anticipate here by saying that you can breed some animals a good deal closer than you can others. It has been practiced closer in Shorthorn cattle, in certain of the fine-wooled sheep and in swine than in anything else. I will come back to that. But there is always a deterioration of some kind if continued. It is with that as with everything else. There are certain recuperative powers in the organic world; we can abuse a friend, we can abuse an animal, to a certain amount and they will recover from it; we can carry it to far and they will not recover. We can in this case practice it to a certain extent and derive benefit; we push it a little further and we got too much of a good thing; we increase the evil faster than we increase the good.

I could take up two hours quoting the sayings of the strongest advocates of in-breeding. If we go away back to the last part of the last century, and the first part of this, Sir John Sebright, one of the noblemen breeders of England — the great monument erected to his memory is the Sebright bantam — he bred "in-and-in" very closely. Every poultry grower knows the little Sebright bantam; that is the monument of the great Sir John — because he was a great man. He thought that the pairing of brother and sister was closer than that of parent and child. In that he differed from some of his contemporaries. The oldest sheep breeder that I have ever known, old Mr. Blakeslee, who stood upon the wharf in New Haven in 1814 and took away some of the Merino sheep as they were left upon the wharf there, brought from Spain, which formed the basis of the celebrated American Merino flocks of Vermont, Ohio and elsewhere, and who continued a sheep breeder until past eighty years of age; he told me that he never in all of his experience had succeeded in raising a healthy lamb that was the product of a sire and its own dam. Now, in that experience others succeeded better. There are numbers of breeders of sheep and of Shorthorns — I have already cited Colling — that have served a dam with its own offspring and produced healthy offspring. But to show how difficult it is, here is an old breeder, as I have said — he certainly was a breeder of sheep for more than sixty years, and of Devon cattle nearly as long as that — and that was his experience. It has been claimed by a good many writers on Shorthorns that with animals that have been kept too close a lack of fertility will come in, and that other blood would have at last to be introduced. It is said that Bakewell did that for his longhorns; that he did not, after all, strictly keep to the progeny of those two cows and one bull. But there is no proof that I know of of that. It is assertion. As he left no written records whatever, it may be true, it may not. And so there have been endless disputes that have gone on regarding certain strains of Shorthorns, as to what foreign blood had been introduced, and when introduced, which I do not propose to go into here.

There has been a great deal of discussion of that kind over the Bates herd. I will refer you to the stock journals and the enormous literature that has grown up on that matter. I do not care to follow it up. In every case of close breeding they all wind up by allowing that it must be done with discretion. It is well to breed close, but you must not breed too close, and the only difference of opinion after all is as to what is too close. There is no agreement there, and science can not indicate what is too close. All that we can say is that after pushing it a certain length of time, that then some defect comes in. There is a weakness of constitution, there is a loss of fertility, or there is something else which checks us. With regard to their loss of fertility, increasing barrenness, it sometimes is explained by the fact that in-bred animals, that is, closely in-bred animals, are inclined to lay on fat more than others. The tendency to lay on fat is generally accompanied with loss of fertility. And the positive facts that are universally admitted in addition to those that I have been speaking of, are its tendency to refine the bone, to refine the skin and make it thinner, to refine the hair or wool and make it finer.

I was personally acquainted with a man who claimed to have bred the finest wool in the world at the time of the first London exposition. He began with the Saxon Merino, he bred "in" just as close as he could, and bred to fineness of fibre. I shall allude to this case again. He beat the world on fineness of fibre, but what kind of sheep did he have? He told me himself that they averaged less than three-quarters of a pound per head, and they were so tender that he had to house them every night and never allow the dews of heaven to fall upon them. He sold his flock; he said they were not profitable. [Laughter.] He carried the thing beyond the line of profit. Up in Vermont, where they have raised such marvelous sheep and sometimes get such marvelous prices, the different breeders there have had very different success in how closely they bred. Some have been able to breed a good deal closer than others. Why? Because of the marvelous sagacity that some men have.

It is not every man that can make a good breeder. A celebrated breeder of live stock, you know, in London says: "Why, one man out of a thousand will make a pretty good member of parliament; one man out of ten thousand would make a very good general; but," says he, "it is not one man out of a hundred thousand that can lay his hand on a bullock and tell how much he is worth by feeling of him." It requires a peculiar kind of sagacity, and if a man has that sagacity, and if it is the thing that is nearest his heart, and he is breeding one kind of stock and only one, he studies that up and he gets it so that he can do what others can't do. Riding in a car one day in a snow storm, in which we were detained not quite so long as we were the other day, with a Vermont sheep breeder coming from a winter sheep meeting up in Northern Vermont, I pumped him on the question of those sheep. One of his neighbors had taken me in to see his flock. Why, my stars! his flock wouldn't have filled this room, but there was a fortune in them. They were nicely housed. I was asking my companion about them. "Well," he says, "I can't breed as close as my neighbors; I can't. My sheep get paper-skinned, and they get weak; I can't do it. There's Mr. So-and-So" (speaking of his successful neighbor); says he, "he is the man to do it; he has only got a few sheep, but they are all his thought, Sundays and week days. "For the sheep he lives and for the sheep he will die," he says, "when he comes to die. He thinks of them morning, noon and night, and if he is cold at night he gets up and takes his lantern and goes out and looks at them. Waking or sleeping," says he, "it is the sheep, and *those* sheep, and he thinks over which are the best ones to pair. It is a matter not of days, but of weeks and months and years," says he. "The trouble in France (it was at the time of the troubles in France) is as nothing to him, as to which one of two rams ought to serve that ewe; it is as nothing compared with that. Why shouldn't that man succeed? Of course he succeeds. He can get a thousand dollars for his rams and I can't get more than two or three hundred for mine."

I may say, that as a matter of fact, it seems to me that in all of those animals in which we breed for food and for wool we can breed closer than any others. Nobody for a moment claims that you can breed horses anything like as closely as I have been talking about; anything like as close. I have just touched upon the point, in the first lecture, of the heredity of diseases. It is found that of all diseases those related to the nervous system are most likely to be transmitted in the human family. It is probable that that is true in the lower orders. Now, with the human race we have settled that point long ago. There is not a race nor a people, I care not how savage, that has not laws against incest. When it comes to anything like this close breeding that I have spoken of in our domestic animals the discussion is wideened enormously. They have thrown out entirely all these close relationships that I have been speaking of — all of these. It is only between cousins, or nieces and uncles; we do not discuss the matter any closer than that; but on that there is an enormous discussion going on. But it is the nervous system of the human race that comes in here; the nervous system is affected: Now if we take those animals in which this quality depends upon instinct or endurance, we can not breed so close. The only exception that I can cite is the matter of setter dogs, and, as you know, there is a good deal of difference of opinion in regard to that. If you breed too close the skin becomes too thin, they are too easily scratched with briars, they haven't got endurance — they do not have to have the endurance that some other hunting dogs have — and they haven't got pluck and courage.

Now, if you are breeding animals for flesh, or breeding them for wool, you refine the bone and increase the tendency to fat; you do not care if the animal is half idiotic. If you want sheep for wool, if you are getting fineness of fibre or something of that kind, you can carry that further. You do not ask a sheep to know much, nor to have any great powers of endurance; but if you are breeding a racer or a trotter, where it is not in form entirely, it is not in muscle entirely, but it is in the will to do and to keep ahead, as much as it is in the man, to win. When you are breeding fighting cocks, if you want endurance and pluck, why, there is not a breeder in the world that advocates breeding close; and there is scarcely a breeder — I don't know of one breeder — of fighting cocks but would say if you breed too closely with fighting cocks you injure their courage and pluck; they will not hold out so long. If you come down to bull dogs, in the good old days of bull baiting, and those other so-called humane sports, people did not breed their bull dogs closely in those days. They were perfectly willing to cross between different strains of bull dogs to get the requisite pluck and courage and savagery. So that, where we are breeding for endurance, for courage, for what you would call pluck, etc., we can not breed as closely as we would if we did not care so much about the disposition.

I have not time to discuss that interesting matter regarding the marriage of relatives in the human race. There is an enormous literature relating to that. It seems to me that the indications of science are that where both parties are healthy and where both parties are of healthy families, that marriage as close as cousins is by no means necessarily bad. That as a matter of fact very often such cases are bad, is because of the very common prevalence of nervous diseases, etc. There is a great amount of testimony. Some twenty odd years ago a certain doctor published and tabulated 833 cases of marriages of consanguinity, classified so as to show results, and these were classified along with non-consanguinity. In fifty-five reported cases of marriage or incestuous intercourse between father and child or brother and sister, there were thirty-one children. Of these thirty-one, twenty nine were defective. In class B of that list, beetwen uncle and niece or aunt and nephew, there were seventy-eight cases that show fifty-one children. Of the fifty-one, forty were defective in some things. Where the relationship was less close, in a table of 200 families that had 1,375 children, there were 536 defective in some form, of which a few were deaf, a few blind, a few idiot, a few became insane, but the majority of them were defective in some other character. That matter has occupied a good deal of attention in medical and legal literature, and it seems to me that the outcome of it all is that where the parties are healthy and represent healthy families, we very often, very often indeed, find that there are no evil effects that can be traced to the marriage of cousins. But, as a matter of fact, very often the parties are not entirely healthy, and, owing to this transmission of nervous peculiarities and nervous diseases, there is a liability on that account of a greater proportion of the children of such marriages being defective in mental acquirements or in their mental constitution, than of other children.

The sum of all I need to say as to the effects of close breeding on constitutional character, is that if continued it is weakened. We have a good many suggestions from nature on this matter; fewer from animals than from plants; but there are a great many in animals. The instincts of wild animals are such that while close in-breeding must very frequently result, there are various ways which nature takes to guard against it; and as a whole, I think, among wild animals, it is propably quite rare that there is any very close in-breeding, and as a matter of fact, never anything like as close as that which is practiced by art.

Closely allied to this is the method of beginning with a comparatively few animals and founding a family, and then afterwards breeding within this family entirely and without any such close relatives. Suppose for instance we take this case of the longhorns of Bakewell. The first pairing — I mean, of course, the second generation — he would have to pair half brother and half sister; but after that time he would have animals that he would not have to pair quite so closely. In a very few generations, supposing the animals remained fertile, we can imagine a man with a large herd, who would not be breeding between immediate near relatives, and yet still they might all be descendants of the same limited stock on the start. This is breeding in line indefinitely, breeding in families, breeding in tribes — there are half a dozen terms applied to it. As regards the suggestions from nature, there are some very curious ones shown in the plant world. Now, an ordinary flower, the most common flowers that we see have the male and the female organs in the same flower. Within the last twenty-five years, since Darwin has pointed out the matter of cross-fertilization between flowers, there is no chapter of botany that is more pleasant and that has excited more attention and more curiosity on the part of botanists than that. While the male and the female elements are placed so near together, what curious, what marvelously curious ways nature takes that they shall not be fertilized. It would seem as if, after doing everything that could be done to secure fertilization of the seed right at the right point, that then nature had absolutely gone beyond itself in devising methods of "how not to do it." Sometimes the pollen is not produced at the right time for the stigma to receive it. At other times it is so placed that it can not get on to the stigma and has to be carried by insects or the wind, or this or that or the other way to secure cross-fertilization.

In all of these experiments which have been carried out by art, some of them continued for years with almost infinite labor and care, there is not a single one that I know anything about but what has shown in the end that if close fertilization with plants is continued, there is either loss of fruitfulness or loss of weight or some other loss. It would appear, then, that it was a law of nature that living beings if bred too closely degenerate constitutionally. How closely they may be bred depends upon the species, upon the variety, upon the soundness of the particular parents, upon a great many other collateral conditions.

Closely allied to this and right along with it, just one word upon a phase of crossing. When two animals appear to fit exactly well, they "nick" well, as we say in this country, they "hit" well, as they say in England. The successful breeder learns from experience and partly from observation to guess very closely what animals will "nick" well. It is not an uncommon thing that we find two animals that by every theory, by all the principles of science and common observation, their progeny ought to be excellent, but it is not. We say they do not "nick" well, or it is not a good "hit." Precisely why, we do not know; but that is one of the personal characters of individual animals, the same as prepotency may be. It so happens that among the various animals two are so constituted for some reason, we know not why, as to produce offspring having desirable qualities; much more likely to than others. This matter of "nicking" well and "hitting" well, applies to individuals, it applies to tribes, it applies to whole breeds, and the only way to learn that is simply to take counsel of experience. The art of breeding depends upon our sagacity in determining that. But in a little while certain empirical rules may be applied. We know that in mutton sheep there are certain cross breeds that do better than other cross breeds. That is simply the result of observation and experience; it is hardly science, but it applies to the art of breeding, and the foundation of it lies among the unexplained things of nature.

DISCUSSION.

Question—I would like to ask if it is a common thing with animals, for the mother not to recognize or care for her young? I have had a mare that I bred twice and both times she refused to recognize the colt and would kick and bite it.

PROF. BREWER—That is personal, individual peculiarity. It is more common in our domestic animals and in well-bred animals too. In the Western country where they raise large numbers of sheep, most of the flocks of the plains of Texas, and all through the West, are not thoroughbred sheep; they are Merinos—the most popular for wool, of course, are Merinos—bred on some coarse stock and generally on the coarse stock of the country. Through Arizona, New Mexico and California, the basis upon which they have bred these Merinos is the Mexican coarse wooled. In almost all of those states and territories the testimony is exceedingly wide that as they get on towards the thoroughbred Merino the ewes lose a good deal of their motherly instinct, that a much larger proportion of them refuse to recognize their lambs until they are shut up with them. Where flocks are not so large we can shut up the ewe with her lamb in a pen and make her recognize the lamb, but in these large flocks on the plains of Texas or the wandering flocks on the mountains of the far West it is a more difficult matter.

Question—My animal is not a thoroughbred. I don't know that she is anything that you would call fine blood. Her mother was an excellent nurse and took care of her colts. The grandmother was in some respects better than the mother in taking care of hers. But this one absolutely refused, would kick and bite; she couldn't be made to allow the colt to take nourishment; wouldn't acknowledge it in any way.

PROF. BREWER—I don't think that is as rare as you might think. I might say here that wild animals have a good many analogies with savage men, and domestica nimals have a good many analogies to civilized men. We find among domestic animals this great variety of whims that we find in civilized society; just as we find the lowest savages in civilization as well as the highest talent, all sorts of whims and cranks and crooks, we find the same among our domestic animals. They vary amongst themselves as civilized men in civilized society vary. There is scarcely any whim or peculiarity or instinct that somebody will not bring up examples of in their flocks or herds of domestic animals of some kind or other. Among wild animals you would scarcely see that; it would be exceedingly rare — the non-recognition of their offspring. We have a very curious example of that in fowls; when we push the laying qualities too far they won't sit. In the last lecture I said that crossing very frequently tends to reversion — going back to the original breeds; that if we cross two non-sitting breeds they generally produce a sitter.

Question — In your first lecture you spoke of the origin of the thoroughbred as coming from four horses — the Arabian, the —

PROF. BREWER — Three, or possibly four, if we call the Persian one.

Question — You spoke of the Barb. I always supposed that the Barb was an Arab.

PROF. BREWER — The Barb horses are horses from Arabia, particularly from Morocco. When the Moors invaded Spain, you know, they were in Spain four hundred years, the horses they had were specially called Barbs. They all of them had the characteristics of these oriental breeds; they all of them were small horses, light-limbed, fleet; all had dish-faces, broad foreheads, etc. The Arabs and Turks, you know, were a good deal alike; at the present time we do not make much distinction, but in olden times they did make a distinction. The Spanish horse that was so celebrated in the middle ages had a large amount of Barb blood in him. The Spanish horses that were brought to this country and became the progenitors of the wild horses of South America, of Mexico and of California, were Barbs rather than Arabs. Those California half-wild horses to this day show in their build and in lots of characteristics evidences of their old Barb origin. We do not know what was the origin of the domestic horse. We only know this, that of our common domestic animals he was the last that appeared on the scene. In Egypt, on the monuments, they had the horse long after they had the others. The ass, the camel, the cow, the sheep, swine, dogs, all appear on their monuments a long while before we have any evidence of horses. And they appear on the monuments through what is called the reign of the Shepherd Kings. If you look over your Old Testament you will find that it was not till long, long after — it is probable Abraham saw horses when he went down to Egypt — but it is a great way on in the Bible before horses are mentioned, and then only incidentally. Sheep and camels and cattle were mentioned long before horses were.

Question—The Moors brought their religion from Arabia. I supposed they brought their horses with them. They were the originators of the fine horses of Spain, as I have understood it.

PROF. BREWER—We have no evidence that the people of Northern Africa were without horses before the Mohammedan religion went in there. The Barb is the same as the Arab in general character and feature; they were all called oriental horses, and they were bred together, and that marvelous production, the English race horse, was produced by using the best of those and then breeding from the winners. The nature of the competition in racing is entirely different from anything else. If you have two farm horses one will do a little more work than the other and he will bring a little higher price; but if you have two race horses and one comes out only two inches ahead he rakes the whole pile. They breed closely to get that small gain, no matter how slight, in breeding from the winners, and they have bred the race horse up to what it is. For the purpose of my illustration I can speak of the English race horse as originating in four breeds. If they were not distinct breeds they were different strains of the same breed which had been bred so long on different soil and under different conditions and with different peoples, and for our purposes they were wide enough apart to be closely allied and still different breeds. They differ from each other, we may say, a good deal as the French Merino, the Saxon Merino and the Vermont Merino differ from each other. They all come from the Spanish Merino.

Question—Isn't it probable that Noah had horses in the ark with him during the flood?

PROF. BREWER—I know nothing to the contrary; there is no mention of it in the Scriptures; but far be it from me to assume as Bible truth what we don't find there.

Question—Is there any mention in Scripture of horses before the flood?

PROF. BREWER—The first mention of horses, if I recollect right—I don't know as I am as well "up" in Scripture as I ought to be—was where Dan was compared to the serpent that bit the horses' heels, or something like that. I am not quite sure that I am right about this. It is a thousand years, however, after it appears on the monuments of Egypt.

Question—It is found on the monuments of Nineveh, is it not?

PROF. BREWER — Yes, but there are more on the monuments of Nineveh that date back to the time of Moses. Moses was familiar with horses, When the people went out — we have heard the story of Pharaoh's chariots; his chariots were not drawn by oxen that were overwhelmed in the Red Sea; but the use of horses in Europe was considerably later. I will speak of that in my last lecture, on the trotting horse.

FOURTH LECTURE.

CROSSING — BREEDING TO POINTS.

Following on in the direction indicated by our published scheme of topics, we come now to the matter of crossing. We have had considerable to say about that; I simply use the word here to speak of the many meanings attached to the word, the many senses in which the word is used. It is sometimes used to mean a mere selecting and pairing of animals. We frequently speak of the "first cross," the "second cross," the "third cross." Again, it is used by others in the sense only of pairing of animals that are not blood kin, in the same sense in which others use the term "out-crossing." Again, it is applied to the breeding between animals of different breeds, in the sense of cross-breeding, a good deal as we use the word cross-fertilization in plants. I don't know as it is necessary for us to have any difficulty now, but whenever I may have occasion to use the word we will know in which sense it is used.

The opposite of in-breeding is out-crossing; and we mean by out-crossing, breeding between animals that are not related by blood — at least, not nearly related; there may be relationship through some remote ancestor. Now, from what I said at the last of the last lecture, it might be inferred, if nothing more was said, that the antidote for the evils which come from too close breeding, the evils which inevitably come in if we do breed too close — the only question being as to what is too close — the ordinary, the usual, I may say the universal, antidote to that is what is technically called out-crossing; breeding between animals that are not near kin. They may be of the same breed, but they must not be near blood relatives. Now, the first effect of that is to increase the constitutional vigor, and the individual vigor, I may say, of the progeny. Cross-bred animals have in all times been noted for their excellence; at least, a great many excellent animals in all times have been cross-bred. A great many cross-bred animals are poor, but a great many excellent animals are cross-bred. It has been because of the wide experience, the common experience, that the first or the second crosses were frequently so much improved that it led to this promiscuous wide crossing as a means of improving animals, that was so much in vogue before the present century, as I spoke of in the last lecture.

If we are improving a breed by out-crossing, it is unnecessary to to say that the best crossing is that between different animals of the same breed, in which we carefully study up and pair those animals which we think will produce the best result; to mate between especial excellences in one and especial deficiencies in the other. Now, there are two theories regarding breeding, and what kind of parents should be bred from; that vigor is increased, that fertility is increased by a judicious amount of out-crossing I think there is no question whatever. I do not know as anyone disputes that. But when it comes to the selection of parents, there are a good many individual opinions and individual theories. Some men claim that the two parents should be as nearly alike as possible, although not of the same kin. Others claim that they should be unlike; have the same general characteristics that we are seeking for; that the points of the breed should be alike in the two, but in their characteristics they should be unlike. And these two opinions that are diametrically opposed to each other are each held by practical breeders of good sense and of undoubted success in their work. And it makes me believe that after all the picking out of the proper animals to cross depends largely upon a certain sagacity of the breeders themselves, in which they may not be able to tell themselves why they choose.

There are certain rules that anybody can understand. If we have an animal that has a larger head than we wish we would be inclined to pair him with one in which the head is even smaller than we wish. That kind of crossing anyone can see the reason for. But when it comes to this other phase that I have been speaking of; Stowell speaks of a natural law of production, as he calls it, that "likes intensify characteristics." Therefore, if we want to intensify any characteristics we should breed between those. Others simply state that we get certain characteristics by crossing. We intensify them if the parents do not have those characteristics in an eminent degree. The sagacity of the breeder, partly gained by experience and partly a natural faculty, however, determines nearly always his judgment as to what animals to pair. I have already explained what we mean by "nicking." I took it up at the last lecture. We mean, as I have said, that when animals for no obvious reason produce better results when paired than other animals do that are equally well matched so far as we can see—animals whose progeny are equal or superior to themselves, we say "nick" well.

Now, suppose for a moment that we pass to the extreme of crossing; I have already alluded to this. The most violent crossing that we can have is that between different species, in which we call the product a hybrid. Nature has generally interposed barriers to this. Some of the old naturalists in defining species made that the rule of a species. It is sometimes very difficult to tell what is a breed and what is a distinct species in nature. Note the differences of belief existing among naturalists: Before the days of Darwin species were considered a good deal more distinct and separate than they are now; and there was believed to be a radical difference between breeds and species. Breeds would inter-cross with each other; species would not. Some of the old writers made that distinction, that breeds would intercross and species would not. We now generally believe that the difference between a breed and a species is one of degree and not of kind, and, without being able to define a species accurately, without being able to give a definition which all naturalists would agree upon, all naturalists in their classifications take the species as the unit of classification; they begin with the species in classifying under any system. All naturalists do that. Now, as a general thing, very general, indeed, species will not cross. There are numbers of cases in which they do; but for one case where two species will cross there are a hundred where they will not. In the first place, generally, there is a natural repulsion between the species; one species will not receive the attentions of another. Where this is overcome by art, it is rare that one species will conceive with another. If there is fertilization, in a vast majority of cases the embryo perishes before birth. If it is born, or hatched if it is an egg-producing creature, they generally are weak and die young. So that the number of species that we can produce a full-grown hybrid from is comparatively small, and of those hybrids there are only very, very few cases indeed that are fertile.

Those hybrids very frequently, after we have produced them, have some special excellence, but they always have some defect; the most common defect I have spoken of being that of unfertility. And if we take those that are fertile between themselves or fertile with either of their parental species, as is sometimes the case, then they lack constitution and vigor. In other words, Nature abhors extremes. Just as she abhors too close breeding on the one side, she still more abhors too wide, promiscuous breeding on the other. Nevertheless, it is sometimes desirable to produce these hybrids. The one we see most commonly in this country is the mule. I need not descant upon the mule; I have already alluded to some of his characteristics. He differs in temper and in many things from either of the parental breeds or parental species which produced him; that he is unfertile, a male mule always unfertile. I do not know of a case on record of a male mule producing progeny. There are very few on record where the female has produced, and most of these cases are ficticious. I have investigated a number myself where the accounts have got into the newspapers that some female mule had produced a foal, and in every case that I have investigated personally I have found there was no proof of it. Mules are very capricious in their affections, and they will pick up almost anything. It is not an uncommon thing that a foal gets to following a mule, and mules running off on the prairies or ranches of the West sometimes are found with a foal following them, and it is assumed that the foal belonged to the mule. In every case I have investigated there has been no other evidence whatever; but there have been cases undoubtedly There is a noted case in France of where a mule with an ass produced a progeny. A case was reported a few years ago of that kind, and the animal was bought by the society in Paris which has for its object the acclimatization of animals, and carries on a garden of acclimatization. The mule was brought up there and produced a foal under the keeping of the keeper. But it is so very rare that for all practical purposes the thing may be entirely thrown aside here. That is not the only case of hybrid breeding. In France there is a hybrid bred between the rabbit and the hare, known as the leporine, that is said to be fertile; I do not know much about it. I tried to get some definite information on the matter and failed. I simply know that I have seen numbers of statements going the rounds of the press that the leporine is a valuable poultry animal raised for food, and is a cross between the hare and the rabbit, and that it is fertile. If so, it is the only case I know of where the continued fertility is kept up.

There are quite a good many hybird canaries that are bred; hybirds between the domestic canary bird and various species of finches; they are all of them unfertile, or if any of them under certain conditions may be made to appear fertile with one of the parent breeds the young of these die. But they are nearly always unfertile, though some of them are excellent singers, and at the various canary shows that one sees in the old world you may find these canaries. Sometimes breeds are sold in this country as "mules," and they are either frauds, or very frequently it is the name of a breed. Some have a breed that they call "mule" canaries; but the breeding of hybird canaries is a legitimate business in some of the countries of the world, and their songs are valued and some of these song birds bring very high prices. Between the various species of geese there are various hybirds, particularly with the china goose and others, some of which are said to be fertile. There are numbers of cases where we have a hybird that is fertile with one or the other of the parent species. We have a good many interesting cases in the plant world which we may allude to, because Nature is one in many of her laws.

Gærtner, a German experimenter, has perhaps carried this as far as any man. He found that he was enabled to rear some hybrid plants, cross-breeding them, and again crossing with either parent, for six, seven and in one case ten generations; yet their fertility decreased and generally ceased suddenly. Now, this was performed a number of years ago. Within the last few years this has been repeated in a great variety of forms in the various botanic gardens of the old world, and as far as I know the general law has been confirmed in all of the cases. In the case of the canary birds I spoke of, I find that they have been crossed with nine at least of the finches, and all of these are sterile.

Darwin mentions the case of a Mr. Salter, and the results of various crosses between three species of the *genus Gallus*, the one to which our ordinary fowl belongs, and their hybrids; of about five hundred eggs he says that the majority of those eggs had been fertilized. In the majority of the fertilized eggs the embryos had either been only partly developed and had then aborted, or had become mature and the young chickens had been unable to break through the shell. Of the chickens which were hatched more than four-fifths died within the first few days or weeks at most, without any obvious cause, from mere inability to live. So from the five hundred eggs only twelve chickens were reared. I need not multiply cases; I have simply brought this up to illustrate a phase of the most violent form of cross-breeding.

Now let us take the next most violent form, which is breeding between very unlike breeds. With some of our domestic animals you can see that is simply impossible from the relative difference in the size. We could not breed between the extreme breeds of dogs; there nature has placed entirely too strong a barrier; the cross is too wide; it is just as wide as it would be between different species. We can see that the toy terrier would not do very well with the large-sized mastiff or the Newfoundland. The difference in the size of the animals is entirely too great. And the same thing is true of horses. There is a greater difference in the size of horses than any other of our farm domestic animals, if we do not include the dog. The smallest Shetland ponies, compared with the largest draft horses of Europe are only about one-sixteenth to one-twentieth as heavy, and if it be true that some of these horses of India are as small as they are reputed to be, we can carry that down still more. But we have abundant evidence of Shetland ponies only eight or nine hands high — not higher than many dogs. You can easily see that it would be impossible for such animals to cross. But if we take cross-bred animals where the breeds are very unlike, we find some form of defect similar to that found in the case of hybrids, only less in degree. Either the constitution is weaker or else there is some other defect. In some cases there is a lack of fertility.

The *London Live Stock Journal* a short time ago contained an account of somebody experimenting on two very unlike breeds of hens; he produced several hens that were very beautiful, but he found they laid eggs no larger than pigeons' eggs. And so, if you will follow up in the various stock journals and in the journals of the fancy breeders the history of the production of domestic animals, you will find cropping out here one form, there another — illustrations of this very violent breeding. The cross between the English thoroughbred horse and the half-wild Mustang (so called) of California is not a very good one. There are numerous cases where violent crossings of horses have not been good; where the result has not been an improvement on either parent, nor has it been half way between the two. Sometimes where we get a good result in violent crossing the first cross, and where they are fertile, it is not repeated. Now, in the case of mules, we get a good cross, but they are not fertile. In cross-bred animals frequently we get a good cross and they are fertile, but the succeeding generations are not good. They fail in this, that or the other. They are unstable in character — as I have already said, the instability of grades is very well understood — or they show some other character. When we go away back to the beginning of the present century, in the early attempted improvements of French sheep by crossing on the Spanish Merino, Tessier, one of the early writers on that subject, says that the first impressions on seeing the good effects of their crossing, which produced finer rams than those of the native breeds, they were inclined to employ those for covering, but he says that the quality of the wool of the grades has in all cases diminished where that was done. Uncertainty! uncertainty! Breeders are all of them familiar with cases of sterility arising from too violent crossing; or if not natural sterility, impaired vigor or impaired health. This is a rule that applies just as strongly to the human race; just as strongly. If we take the more violent forms of crossing between the different human races, we have a very abundant literature on that subject. I have never seen a writer, I know of no single writer, I care not what his opinions are on other points, who has treated upon the subject as a medical man, as a scientific observer, who states that the progeny of mulattoes in the Southern states are as healthy as the mulattoes themselves or as healthy as the parent stocks from which they originated. I think that that is the universal experience. I have had considerable to do with sanitary matters — it has nothing to do with breeding, but I simply state it as a fact: I am connected with the state board of health, also with our local board of health, and president of our city board of health. I have taken a good deal of interest in sanitary matters for a great many years. In certain sanitary conventions that have been held I have taken pains to inquire of health officers and others whom I thought unprejudiced, from Southern states, where they had wider means of observation than I had, and I have not found a single dissenting voice among the medical men but that the tendency to disease is greater among the children of mixed bloods than among the children of the pure races; that the first cross may be vigorous; mulattoes are frequently as vigorous as either race — not unfrequently the result is later. They have very brilliant mental characteristics, they may have all the virtues of manhood well developed except the physical ones. I used to teach in a colored Sunday-school in which about five-sixths of all the pupils were the children of mixed bloods; and it was curious to see. I have never been in any other audience of any kind or of any race in which you saw so many characteristics of physical weakness; small necks, the hue of the skin — all of those phases which indicate a weakened constitution. All through the South Seas, where the various European races have mingled their blood with the native races of the South Seas, I can not find a single case or a single island where these mixed bloods of more than one generation are not perishing with various forms of constitutional diseases. Consumption is very common.

It seems, in short, that just as Nature repels too close breeding, so, too, she has set her laws against too wide breeding. And while in art, for the purposes of the stock breeder, it is often, it is very often, desirable to cross breeds for the use of the first or the second cross as animals of utility, that nevertheless they have defects which unfit them for the best service afterwards. It is because of this that thoroughbreds bring their high prices. A full-blooded Shorthorn, a full-blooded Devon, a full-blooded Ayrshire or a Galloway make no better beef than cross-bred, generally not so good. They do not fatten any easier, they grow no heavier — and so on to the end of the category. There are other phases which suggest themselves in these relations to human society, which I will pass by here. In poultry, in canaries, in rabbits, in pigeons, in all forms of fancy breeding, this comes out very often — that we can get excellent animals, marvelous animals in the first cross, but when we carry it on a little further we do not. Think of the number of attempts that have been made, as I have said before, to combine two breeds and get the excellences of the two in one breed; we often get them in one animal in the first or second cross, but to have a breed that perpetuates them, so far as I know there is not a case. Sir John Sebright experimented on that a good many years, and he failed, and so far as I know everyone has failed, with perhaps the exception of the Plymouth Rock chickens, if that be an exception; I have understood it was disputed.

Now bear in mind that the excellence of this first cross may extend — instincts, with animals, and mental characters, with men — and in a mongrel progeny afterwards some of them will be exceptionally excellent; whether animals or men. And while there may be a lack of uniformity, it is a condition of human society in which you will find exceptionally brilliant men. I think that if you will look through history and see the number of men who have come to the front, who have been of mixed blood of one kind and another, either of two nationalities, two breeds that were closely allied like the French and the German, or the English and the French, or still wider ones—if any of you see fit to collect a list of such you will get a wonderfully curious and most instructive list. You will find that it is curiously coincident with the experience that we have in the animal world; that we have by judicious crossing a vigor and stamina which is not found where the animals are kept too close and too much interbred; and with a judicious mixture we have a good deal of variation and a good many very excellent characters. So, with this first cross, there are a great many smart men found amongst them as well as later crosses, but if this is continued we have perhaps an undue proportion of defects, of scalawags one way or another. They would be "culls" in any herd. There is an important social side to that, particularly in our American society. We hope by our education, by our superior methods of living, etc., to control the reversions and make a good use of the variations which are in the right direction.

I have already alluded to the effects on disposition and temper of violent crosses. I will allude to that again here. There is very liable indeed to be a reversion in physical characters to some earlier type; so, too, there is in mental characters. A great many cases might be cited here. I cited a few the other day. The cross of the zebu on the common cow; I understand that the crossing of the buffalo on the plains with our cattle has been tried time and time again; the beef is excellent, but in other respects the animals are not to be depended upon. I lack definite information upon this subject. Mr. Allen has given another account of it in which it looks a little more promising, but I have not much hopes of it. The Earl of Paris experimented upon the cattle of India bred on our common cattle; the hybrids, he says, were very wild. Sir Francis Dawson crossed the European wild boar with the Chinese pig; he says the offspring were extremely wild in confinement, and would not eat swill like common English pigs. Mr. Jewell tried English pheasants with five breeds of fowl, and the offspring were of extroardinary wildness. The Cape buffalo crossed on the common cow, in the same way runs back to some previous more savage type. The crossing of two non-sitting breeds of hens runs back to the origal normal type of sitting hens. Some of you may have seen quite a humorous article that went the rounds of the papers not more than three or four years ago, a speech of the Rev. Professor Houghton of Dublin. He is connected with the Irish Zoological

Society, and they got into the garden there this Australian wild dog or dingo, and it was bred on a lot of common dogs; some persons thought it was some improved breed of dogs. The Rev. Professor gave a most amusing account of the experiences which that neighborhood had regarding the progeny of these wild dogs and the sheep of the neighborhood. The cross produeed was not good for shepherd's purposes. It belonged to that class that Oliver Wendell Holmes so graphically described — "dogs that allowed their love of mutton to get the better of their love of sheep." We have too many such. I live in a state where sheep will be exterminated by dogs; you know there are a good many such states. I live in a state where the same rule pertains that is said to pertain in Ireland — attributed to good Dean Swift, I can't say that it was he — "the country where every poor man kept a dog, and where every d——d poor man kept two." It is a good deal the case with ours, but these dogs are mongrel curs, most of them, and it is from these mongrel curs of no particular breed that a great majority of the sheep-bitings and the sheep-worryings come. We have particular breeds, I know, that sometimes takes to mutton very kindly, but, nevertheless, most of the trouble comes from mongrel dogs — I won't say of no particular blood, but of very uncertain blood — and with decidedly wolfish habits in that respect.

Regarding the unstable character of grades to breed from, I need not follow it further. That there is an abundance of experience, and that the better stock breeders all maintain the principle, I think there is no question. But it is among persons who are not the best stock breeders that we have to apply the most argument. They so often find that the first cross is so excellent that they think they will continue it, and when they continue it then they have uncertainty. They may have good luck, then again they may not. This case of the French experiments that I mentioned yesterday — those were preformed about fifty years ago, they began about 1830; I will give you the name of the experimenter — if any of you may see fit to look it up — Malinge-Nouvel — and you may find descriptions of that in English; you will find it in the journal of the Royal Agricultural Society, volume 14, of the present series, page 216. It is a rather interesting case of that kind of experiments.

When we cross, then, for new breeds, we want to take several rather than two, and then it takes a long time. As matters now stand we have breeds that are so nearly adapted to our various uses that nine breeders out of ten can do better by taking something that we already have than by trying to make something new. Take for instance the Poland China hog, which is a good illustration of a good hog that is produced from a composite source. Now since we have got such hogs we can breed better hogs, and then cross-breed for special purposes that we want, and get our results a good deal easier than we could to go and form a new breed.

Domestic animals were made in the old world; not here; they were made out of the material they then had. There is a good deal of talk now about domesticating the buffalo. I have no doubt that the buffalo can be domesticated; I have no doubt but what he can be applied to a variety of uses; I have no doubt but what many breeds can be made; and if the Indians had taken hold of the buffalo two or three thousand years ago and been domesticating him all of that time and distinguishing him into breeds, what we might have had now there is no telling. I believe the thing could be done in less than two or three thousand years — less than a thousand years — I believe a good deal could be done in five hundred years; but five hundreed years is a good while to wait in these days, and I think we better stick to our cattle. Put our cattle on our plains. I have no hopes whatever of our ever breeding much beef from buffalo on the plains. It might have been done if somebody had begun 400 or 500 or 600 years ago, and we had the benefit of their experience and labor; but it is too far for us to go back now and begin.

Now how do we improve breeds? We "breed to points," we say; I mean by points, any especial excellence that we want. We breed with some object: selection.

You all know what the Darwinian hypothesis is. It is founded on a very few simple propositions; four, I may say: (1) That no two beings are alike; they differ in their ability to win a living from nature, and in their vigor. (2) In the second place, owing to the geometrical law of increase, only a few of the whole number can survive. (3) In nature the fittest, and the toughest for the particular place, will grow up and survive and leave descendants; and (4) by this continued change and adding up of characters new species are formed. There is the whole of Darwinism. Now, we may say that no two animals are exactly alike, and they differ in their usefulness to man. Owing to the geometrical law of increase we can reject all of those which have not the best qualities and breed from comparatively few;

and that gives us the means of breeding, as I say, for the especial characters that we want or breeding "to points." The rates of increase are enormous. It is geometrical. In the case of weeds, in the case of wild animals, that overrun, nine times out of ten they owe a large part of their power for evil to their extreme fertility; they are very prolific. Some of our weeds produce a million of seeds. Some of our pest animals will produce a dozen at a litter and two or three litters a year. Look how quick it will pile up! I once made a calculation on potato bugs. Suppose a single pair of potato bugs should come from the West into the United States, and should multiply according to the laws and rules that naturalists say they can multiply, and that none be destroyed. Why, it would only be a very few years before they would cover the whole ground several feet deep, like a stratum of rock! Now a large amount of them must perish, and only the merest, smallest fraction survive.

If we come to apply that to domestic animals, if any of you sit down and calculate it according to the ordinary law of increase, starting with twenty cattle on the farm and do not sell any, keep all the calves and let them breed as they should, why, how many will you have at the end of ten or twenty years? You won't have standing room in a very few years on your farm for them. The chance of selection is enormous. Under the natural conditions of things animals degrade, or if they do not degrade, assume a very low type indeed, if we do not weed out the poorest to a tremendous extent. Take it in India, for instance, where the disinclination of the natives to geld any male animal, founded on some religious prejudice or other, causes the country, all accounts state, to be completely overrun with inferior animals. That applies only to a lack of one kind of selection. Now, in practical breeding, we have got not only to breed to points, but, setting up, as it were, a scale of special characters, to select the best animals, those that have the highest average of points. Go to our dog shows, to our poultry shows, to our cattle shows, and you will find the animals judged by a scale of points, those different points varying in their relative qualities according to the kind of animal that you are breeding. If you are breeding hogs you will not attach much value to ears; if you were breeding fancy rabbits you would. If you were breeding Galloways you would attach no value to horns, but it would be a positive defect. If you were breeding some of our horned cattle you would give some value to horns as a fancy point. Breeders in the various breeds have agreed what they shall consider a scale of points; it may be so many parts in 100, it may be so many parts in 1,000. Here is a scale of points for pigs, taken from *Coburn's Swine Husbandry:* Say, for instance, ham 12, back 10, shoulder 8, long ribs 8, short ribs 7, etc., etc., length of body 6, snout 4, jowl 3, skin 5, hair 3. The ear and tail are taken as fancy points, but they are pretty low. Now, on any such scale (pointing to a series of a dozen or more paintings on the wall of swine in various stages of domestication) where would any of these animals be? (Pointing out one) where would his ham be on a scale of 12? That animal would foot up pretty low. We have some scale and we breed to it. In this way we come very frequently to have fancy points. What the scale is depends upon what we are breeding for. I believe that most of the good breeders have in their minds an ideal type. I think that if we examine cattle bred for the same purposes, although they may be of very different breeds, we will find them curiously alike in certain points. While the Ayrshire and the Shorthorns or Durhams and the Aberdeens vary enormously in some characters, how much they are alike in others! And you may take photographs or have pictures drawn to the same scale of half a dozen milking breeds, and see how they will run alike. Take an animal like that one that I see up over the door; here is a good beef breed. Now you take a dozen milking breeds, good, typical prize animals, and they would have quite a different shape. They are a little more raw-boned, they "spread out" more, there is a different shape of the ham, there is a different form of lung, etc. There is a sort of general similarity in the whole of them; a correlation in the general shape to the use to which the animal should be applied.

I think it very probable that a great many breeders have a good deal more definite mental picture in their own mind than they themselves are aware of. An old sheep breeder once that I was pumping on the question of sheep breeding, complained that he never could get exactly what he wanted. I noted very carefully what he said, and as soon as his back was turned I jotted it down, because it expressed a good deal. He says to me very seriously: "I can shut my eyes and see before me the animal I want and the animal I am breeding for. It has a beauty which I have never been able to reach. I can see it plainly in imagination! All that I have been able to produce have some defect, either in shape or in fleece or in constitution." Wasn't that ideal? "But I know what I want; I can see it in my mind." Now there was a mental picture; there was an ideal, just as truly formed a creation as ever appeared to the mental vision of old Phidias, or of Michael Angelo, or of any sculptor or painter that ever lived. A domestic animal of improved breed is just as much a work of art as a picture. Nature furnishes material, but man gives it shape. In the case of the picture, Nature may give us the means to make the paint and the canvas, and so on, but the creation, what stands on the canvas or is cut in the marble, has been formed in the mind of the artist who makes it. An improved animal is just as truly made, just as truly created by the skillful breeder who has produced it as the painting which comes from the hand of Michael Angelo or the statue which comes from the chisel of Phidias. The domestic animal is an artificial production; there is nothing like it in Nature. There is not a country in the world where sheep could live or where our improved breeds of swine could live or where our best breeds of horses even could live and not perish without man's care and support and help. He is dependent upon man, man is in one sense his creator—I do not say it in any disrespect to the Author of our being. The materials have been furnished us by Nature, by the Creator; but in man's hands they have been moulded into the shape that we have.

There are certain limitations in this art, as there are in all others, but it is a perfectly artificial production. It is bred up to certain excellence by man's skill, by man's genius; it requires genius just as much to produce a high ideal of cattle as it does a high ideal of a statue in marble or a high ideal of painting on canvas. And this sheep man talked to me in that way; he says: "I can shut my eyes and see exactly what I want; I can see the animal I am breeding for and which I have never yet been able quite to reach." Anything that he could reach would have some imperfection. That is exactly what many an artist is struggling for, and he can not quite produce what he thinks he can see in his mind.

Now, we breed from winners; breed from the best, in other words; we take the best material that we have. Our material is imperfect, but the best material that we can get, that we can use, we select from the best. Take Hammond at the very height of his fame in breeding Merino sheep, when rams brought such tremendous prices; someone asked him, "The rams that you produce, what proportion of them would you use yourself, now, to put the matter home? Would you use one out of twenty of your own rams?" "No," says he, "not one out of two hundred." He wanted only the very best; that wide selection.

In the few minutes that I have left I propose to illustrate a particular point — the change which goes on in domestication. I have hung up a lot of pictures of swine; I have taken these simply because we have their whole history. We do not know for certain what was the origin of the horse or where he came from or what his native country is; we do not know what was the origin of our domestic cattle — whether one species developed into various breeds or several species mingled and again differentiated. We do not know what the origin of our sheep was. So that of all the various animals there is but one animal of which we perhaps know the origin. The boar is still wild on the continent of Europe; wild boars are still hunted; they are hunted in the forests of Lithuania, there are said to be some in England, but I am not certain about that. We have abundant evidence of what he was in the last and previous centuries. The boar has been from time to time domesticated. We find evidences of semi-domesticated hogs in the remains of the lake habitations in Switzerland; but we have no doubt whatever that the domestic hog is a descendant of the wild boar. Now the pictures which I have had drawn here, I would say on the start that they have all been drawn to show only one thing; they do not show everything, but simply form. I have had them purposely colored the same color. I have made no attempt to show difference in size, in the texture of their hair with the exception of three, and that was so because it was so in the original pictures which the artist I employed to get up these diagrams used. Now taking the wild boar as he exists, he is a dusky brown or iron-gray in color, often with black spots; the pigs are striped, the stripes running lengthwise of the body. The body of the boar is covered in part with coarse hair, becoming bristles along on the back and a fine down on the skin. The nose is pretty nearly straight. I have two pictures of the wild boar here. One is a picture copied from Cassell's Natural History. The legs are a little too small (that is the artist's privilege), and his back is a little straighter than he is in reality. He has given his shoulders pretty high, that being the typical form of the more savage fellows. The next is a magnificent reproduction, done to a scale, of a photograph of a wild boar in the Zoological

Gardens of London, and it more nearly represents the tamed wild boar than the other.

Now, what are their natural characteristics? They have this heavy straight snout, straighter than is generally given here — this a little too crooked; the first one is better as a general rule. They have large tusks, they are very savage animals; they are only partly gregarious, they do not take to flocks very kindly; the old boars generally roam alone, but they protect the sows and their litters; they have great strength; they fear nothing and shun nothing. I will not run off here into the stories of hunting the boar in the olden time. The sows breed only once a year; they usually have four, sometimes five, at a litter, and they all follow the sow for two or three years. Then the little herd unites for common defense and makes a rather formidable array. Now we will suppose that we have a forest fenced in, and it is stocked with wild hogs — wild boars. There are as many there as can get food. What takes place? It is simply a question of which shall live and which shall die; the weaker pigs die, in a time of scanty food the weaker animals die. When it comes to rooting, the ones with the strongest snouts do best. They must be stout fellows to stand the condition of things — as they say out West, to "rassle" well with nature. Now, they have tusks for defense. The boars fight for the possession of the sows, and the weaker boars go under in the conflicts, and as a consequence the stronger boars are sires of the new litters and the fresh herds. Let us suppose we domesticate all those; see how all the conditions are changed. I am supposing that if we domesticate them we domesticate them for use. In this country so far as we know of the hog he has but one use, and that use is for his meat after he is dead. Now, if we want his meat, we feed him; if we feed him he has not quite so much exercise for snout. It is not to be wondered that it does not develop quite so well. It is not so important that he should be a fighting animal; we do not want boars to be killing each other; if there is any killing to be done, we want to do it and save the pork; we breed from those that have the smallest tusks. As a consequence, in the course of a few generations the tusks grow weaker and feebler. There is a correlation between teeth and hair — you can not disturb one without disturbing the other; as the tusks become smaller the hair becomes smaller, the bristles become finer over the body. This is the case with all animals; a defect in the hair is accompanied by an abnormal condition of the teeth. You show me a bearded woman, or a man with hair all over his face like the celebrated "Spaniel man" of France, and I will show you some abnormal defect in the teeth. So here we affect the teeth, we affect the hair; it is also further affected by a certain amount of breeding in-and-in.

In the last part of the last century one of the most noted publishers and engravers was a man named Bewick, risen from among the people to become the most noted wood engraver of the day, perfectly familiar with rural scenes. Bewick's publications now bring fancy prices among book fanciers. But it is among his portraits of domestic scenes and domestic animals and of ordinary life as it existed in England in the last years of the last century that he has his greatest fame. Here is a picture (pointing to one of the series) which I have copied from Bewick's Natural History, an old volume which used to belong to my grandfather, and I recollect how I used to look at that very picture from which this was taken; under it the legend, "The Common Boar." That was the common boar, then, in Bewick's time. Look at his head, look at his legs, look at the whole animal; and compare it with the wild animal. Where is the difference? It is a slight improvement. He has not got quite such big tusks; he has not had to be on the alert all the time and listening for this danger and that, his ears are fallen into disuse and begin to lop. There is no need for quite so much vigor—his back begins to sink down. Englishmen already begin to appreciate ham, and they breed a little more ham on him, but still he is very much like the old animal. That was the common English boar, as I have said, in the last part of the last century. When you read in your various literary works of the ceremony, in some of the old English universities, of serving up the boar's head, that was the kind of a hog that furnished the boar's head.

An anonymous writer published a book on life in Scotland in 1814; I have the second edition—the previous one was in 1811—and the frontispiece of that was this hog (pointing to another). That he gives as his beau-ideal of a profitable hog for the English market. There is a marvelous improvement there; rounded back, snout is shorter; there is considerable ear, but they did not look with great disfavor on ears in those days; souse was a popular dish in England then, and all offal was not discarded. The next is a copy of the frontispiece of Henderson's treatise on the breeding of swine; it shows an improvement a little later among the improved breeds.

At an exhibition in Paris in 1854 the prize animal for native breeds belonged to the Craonnais breed; and published in the *Journal of Practical Agriculture* of France, in 1854, is this animal (pointing to the next portrait in the series). Now, recollect that this is a prize animal at a fair in Paris, less than thirty years ago, of a native breed. The tusks are gone, the nose is shortened, the forehead is very rounding, there is a long neck but still there is considerable body, and it is said that these animals made most excellent ham and bacon — what there was of it. About the same time there was another breed popular in France, among the large breeds, known as the Tonquine breed. The next is a portrait of a prize animal that was shown at an exhibition in 1853, an exhibition of animals for slaughtering — not precisely the sense in which we would use the word; not a show of fat animals, but of animals that were not necessarily fat, but of a kind that are used in butchering, that is, oxen, horses, etc. They consisted, in other words, of cattle of breeds for slaughtering rather than for milk, of sheep for slaughtering rather than for wool, and of hogs; and this was the prize Tonquine of France. The next is a French animal; seems quite a large hog; I said I have only been drawing the form here, not weight. This is also a prize animal at a similar exhibition to the one I have spoken of, still a little earlier; that was in 1851. Now, those show improved animals; care has been taken in their breeding. But, suppose no care has been taken in their breeding, they will not improve. I have been on the look-out for years to get hold of a good example of our alligator-pigs of the South; I would give ten dollars for a good typical photograph of the alligator-pig of Alabama or even Georgia. All the pictures that I know of are caricatures; but I came across one that would answer my purpose in a German work on swine, Schenck's. I got a German to make these copies, and that was the picture that suited him more than anything else. "How natural that is! That is a capital picture," he says. It exactly took his fancy; it struck him almost as one of the companions of his youth. [Laughter.] Now, what is the matter with that? He hasn't any of the vigor of the original stock; we bred off of him all his vigor, and when he ran away he degenerated to this. And the varieties of this degeneration are very numerous, but unfortunately authentic portraits are rare. We have any amount of caricatures in the various papers and books. As I have said before, I told the German who reproduced these very pictures to make the pictures all the same size, regardless of the size of the animals, and that took his fancy as a most excellent representation of a very common breed of swine in his youth.

Here is a Poland China; this is a copy of a picture that was published in the *National Times*, a Chicago live stock journal, in April, 1881, less than two years ago; a Poland China hog — the specific name given there is "Oxford Pride," quite a big name; and the last is a small, white Yorkshire, "King John No. 10." Those are quite popular East; that was one that was owned at Morrisiana, New York. That was from a photograph. Now, what has been done in this breed? The pictures I hung up merely to show difference in form. We have taken off from one place and put it on another. Whatever value there may have been attached to boar's head as a dish, snouts do not sell well now. Packers do not pay high prices for the snouts of hogs, and so we have kept on breeding off those parts which produce the most offal and breeding on those which produce the least. What we have taken off from the snout, and taken off from the legs, and taken off from the hair, we have added to the back, sides, ham and shoulder — to those places that bring the best prices. But are those the only changes that have come in? Not by any means. I spoke of the boar, of the old savage fellow roaming around wild and vicious. We have tried to get as peaceable a hog as possible. With hogs, as with men, it is your quiet ones that get fat, not those that are blustering around and wanting to fight everybody. So we get those of the quietest disposition; we do not care if they don't know much; we do not breed the hog for intelligence; we breed him for one thing, and as long as he eats well, sleeps well, and has a good digestion, assimilates the largest possible amount of his food, and when he dies yields the largest possible amount of good, paying, high-priced pork, he is the one we want — so that his instincts as well as his form have been interfered with. And that is not all; he has been changed in his structure. I have got somewhere a table of some of the points of structure. If there is any one thing that is supposed to be fixed in the structure of animals, it is the back bone. Now, we take the various breeds of pigs and we find the neck bones are always the same in number — seven; we have made no change there. Then if we take the number of vertebræ along the back, the dorsal vertebræ, they vary from thirteen to fifteen in the various breeds. If we take the vertebræ along the small of the back, the lumbar vertebræ, they vary from four to six. If we take sacral, they vary from four to five; and those in the tail from thirteen to twenty-three. So you might take up character after character, relative length of bones as well as number, as shown in the back bone; we have changed their form, we have changed the bony structure on which the form is built, we have changed the disposition of the muscles and the relative size of them, the relative portion of the parts; and we have changed their instincts. But I have not got to the bottom of it yet. I said that the wild sow, or I ought to have said, produced four to six to a litter; they begin to breed when they are two years old, and produce but one litter a year; and the pigs follow the sows two or three years. Why, how long could a man profitably breed hogs at such a rate as that? Four to six at a litter! English works generally lay down that you must kill sows that do not readily produce ten at a litter, because they are unprofitable. We, in the first place, have bred them so that they breed earlier; they begin to breed before they are a year old. The wild hog breeds in its third year — when it is two years old past it has its first litter. They produce several litters a year; they produce a larger number at a litter — that most profound item in the constitution of the animal economy, that which relates to the perpetuation of his species, is profoundly changed. Not only is fertility maintained in captivity — almost all animals do not breed in captivity — but their fertility is enormously increased. I have copied from time to time statements given of the number of pigs produced in a given length of time. One person brings up a sow of the Suffolk breed, from New Hampshire, that produced 256 pigs in eight years. Another fellow tells of his sow which littered three times within twelve months, producing in the three litters forty-nine pigs; that was a Berkshire. Another one mentions a sow that had 212 pigs in sixteen litters. I have not got the time in which that was done. Another mentions three litters in eleven months — May 10, 1870, fifteen pigs; Nov. 3, nineteen pigs; April 6, 1871, sixteen pigs; total, fifty pigs in eleven months, and so on. This man pathetically remarked that as there were only twelve rations for the nineteen pigs, he didn't know exactly what to do.

But fancies differ; as a consequence, we have different breeds; one man wants a big hog; to him a hog is not worth much that will not weigh 500 or 600 or 700 pounds. They have whole herds in New Jersey that when they are slaughtered average eight hundred pounds. Then we have these little Yorkshires; you can't quite eat them with a spoon, but you can pretty nearly; all sorts of tastes and fancies. This man wants big hogs, another wants little ones. This one raises hogs by the hundred on clover and feeds them on corn; there is the poor Irish woman that keeps her pig in the pen, feeds him the slops, and speaks of him as the "gintleman as pays the rint." All these tastes have to be met, and they are all forces at work in the production of the various breeds. Hence we have changed this wild animal into this variety of artificial productions. He comes to earlier maturity, he fats easier. I do not purpose to take up the subject of the limitations to this; I shall speak of that in the next lecture.

We have an equally interesting story of any one of the domestic animals—I wish I could take it up—and generally more so, because most of our animals are more interesting to discuss than pigs; only we have not quite so complete a history. But I have not got to the end of the category yet. I said in our country we only grow pigs for the purpose of eating them; we grow them for their pork; but pigs are bred for other uses. There is a breed of pigs in France known in common language as greyhound pigs, trained to hunt truffles—that is a kind of fungus that grows on the roots of oaks underground; it is a difficult matter to find them. They are highly prized by epicures and bring high prices. The pigs are trained to hunt them; and they have a breed of pigs that will point out where they are, and will root for them and at the same time help the peasantry in finding them. I have tried to get a portrait of those pigs. Numbers of cases might be brought up of where pigs under especial conditions or among special people, even if they are grown for pork, have grown into breeds quite abnormal. We might enumerate various kinds of pigs that have become wild from domesticated hogs. Pigs run wild very easily. They have been taken to the South Seas and turned loose on various islands, so that they should become wild, so that shipwrecked men and others might find the means of subsistence there; and these various pigs are different in different places. If the story of the whole pig race were collected and pictures taken of them, it would after all make a rather interesting story, uninteresting as is the pig.

I have a little item here among my scraps illustrating the breeding of thoroughbred pigs; one man gives his experience: Mr. T. S. Cooper, of London Grove, Coopersburg, Penn., sold in one year 203 head of thoroughbred Berkshires for $40,702, which is an average of $200.50 per head. This we quote from the *Country Gentleman* of Jan. 4, 1877." Where there is money like that in an improved breed, it is easy enough to see that are intelligent men to go for it.

DISCUSSION.

Question—Where the hog has been allowed to run back into the wild state again is the reversion as rapid as the progression?

PROF. BREWER—I do not know; some claim it is more rapid, but I have heard numbers of persons say that it goes back to its wild state and to its wild original characteristics. I have asked various such persons that I have met if their tusks were as big as the old original wild boar, and they either did not know or else they had never seen the original wild boar. I have tusks of hogs that are not wild, of a common breed in the East—I don't wonder that Moses wrote against them—with tusks a foot long, and those are the common hogs of the present day in portions of Syria.

Question—I would like to ask whether trichina is found in degenerated hogs or not?

PROF. BREWER—Not necessarily; that is a parasite that hogs get from their food. The trichina is an animal which lives in different hosts and the hog is one of his hosts, and it makes no difference whatever whether the hog is well fed or poorly fed, he may become infected. It makes a little difference with the hog's dying as to how vigorous he is, but I mean as to the infection of the flesh. I have known of cases of where well-bred hogs kept in pens have been trichinous.

Question—Fed on grain or grass?

PROF. BREWER—Fed on a mixture of grain and swill. It is not clear where hogs get their trichinæ. The belief is that they get it from occasional mice or rats. Where man gets his—it is plain that he gets it from pork—uncooked.

Question—Does John Chinaman ever get trichinæ from rats?

PROF. BREWER—I am not aware that John Chinaman eats his rats raw, or his pork either. Raw meat, raw pork, has no charms for John Chinaman. I examined portions of the muscle of a man who had succumbed to trichinæ at one time, in which the story told was this: He was a German, on a German vessel in New York. They invited some friends aboard to take lunch with them. He had nice American ham served up boiled. Now, it had not been boiled enough, but it was not raw. He was anxious to do the thing up well, so he cut off the best done portions on the outside and served it up to the guests, while he and some of the others took the rawer portions of the interior. The guests escaped; he did not. I have got a specimen of him now at home. Now, all the other cases of trichinæ that have come under my observation personally, without exception the pork was uncooked, either in the form of raw ham or else raw sausage. I have had quite a number of cases.

Question — Does curing it with salt have any effect upon it?

PROF. BREWER — It does not kill all of the trichinæ; it kills some of them. No; get in the habit of eating cooked pork; well cooked, and you can defy the trichinæ.

Question —About what year was the first appearance of trichinæ?

PROF. BREWER — I do not know; trichinæ appeared for a long time but it was not known what the cause was. I studied chemistry under Liebig in Germany: I heard his course of lectures in the winter of 1855-56, and I still have a very vivid recollection of his explanation of the so-called "pork sickness." We now know what that is. We know too well what it is: it is trichinæ. But he held that it was a poison that was generated in sausage or in ham as the case might be by the curing. He had examined such sausage and ham that had killed individuals and the nature of the poison had escaped him; but he had a well defined chemical theory that through some ill way in which the ham or the pork was cured or in the curing some organic poison was formed which was deadly to man. It was perhaps, he thought, some alkali; if it was not formed there and then, there was something formed in the ham which taken into the human stomach combined with something in the human stomach and produced a deadly poison there. A little later — only a few years later than that I believe — the source of this sickness was first described by a German named Kuchenmeister; it is my impression about 1859 or 1860. Within two or three years the origin of several important animal parasites was discovered, trichinæ and tapeworm, which comes from measles in swine — the ordinary tapeworm. We have a kind of tapeworm that comes from measles in calves.

Most of them come from measly swine and under-done pork; if it is cooked of course they are destroyed. There are very probably a good many cases in which persons die of these diseases or are injured by them in which the disease is diagnosed as something else. After one of our students had finished his course of studies he went into a medical college in New York and a body which they were dissecting he found was full of trichinæ. He sent me a portion of the muscle. They had the curiosity to know—what medical students seldom do—who the subject was. They found that the subject had died ostensibly of rheumatism complicated, as the person said, with rheumatic fever. Now you know trichinæ produces a good deal of inflammation, and the probabilities are that this individual doctor mistook the pains attending all the motions of the body for rheumatism; it was diagnosed as such, the person died and the certificate of death was made out in that way, and the friends think I suppose that that was the manner of death still. I do not anticipate any danger from trichinæ as long as people cook their pork. I would little rather have pork that has no trichinæ in it [laughter] but I have no more serious prejudices against trichinæ pork than I have against maggots in cheese—I shouldn't certainly discard cheese because it has a few skippers in it. [Laughter.]

Question—I understood you to say that tapeworm is produced from measles?

PROF. BREWER—You have seen measly swine? It is a disease in the lean part of swine—very little in the fat. There are little bladders as large as a very small pea filled with a yellowish liquid. You hold the hog's mouth open so he can't bite your fingers and you can generally feel them under his tongue in the form of little bumps. If you cut one of these measles in two the yellow liquid runs out of it. Now that is the incipient stage of the tapeworm. If you take one of these measles into your stomach it will develop into a tapeworm. That has got nothing to do with breeding, but I should be happy to describe the whole process to you. I have looked into it quite carefully.

In certain countries of the world most of the tapeworms are derived from beef. There are two kinds of tapeworms that come here. An old fellow came into our school to sell a tapeworm. Our professor in that department bought thirty-three feet of it of him, and it was the beef tapeworm. The old fellow pretended the whole of it was there. The head was not there and the tail was, and he came back after a while to sell more and he glutted

30

the market after a time. If we take an insect you know it has four separate stages of existence that are very unlike each other. You take the egg which hatches out the caterpillar. That is the second stage, we will call it. After a certain length of time this passes into the third or pupa stage, and it lies torpid for a certain length of time. It undergoes a certain metamorphosis in third stage as a full grown butterfly. The butterflies in turn may eat or they may not eat; if they do eat they very frequently eat something entirely different from what the caterpillar did. And the butterflies pair and then lay eggs on the ground. If our experience extended to only one of these four stages, if nobody ever watched a caterpillar hatch into a butterfly, we should never for a moment suspect that the caterpillar and the butterfly was the same thing. Now, the tapeworm goes through several stages in the same manner, very unlike each other, and so long as our knowledge of the tapeworm was confined to the tapeworm in swine we did not know what he was derived from. He seemed like a creature all alone by himself. A tapeworm does not have to eat; he lives in the intestines of men; he lives in digested food; he is bathed in digested food; and the outside of the tapeworm is like the inside of the stomach of other things, absorbs the food that is all around him. He has no need therefore of a head or a mouth to eat with. He has a head but he has no mouth. He has a head which is simply an anchor to hang on by, as it were. If I were to draw a picture of an adult tapeworm's head enormously magnified it would be like this (illustrating on the blackboard), with four discs on the side of the head over the top of a place called the mouth; around that are a lot of queer litttle hooks, a lot of them, microscopic in size. Below the head is a series of little fine rings, two or three hundred of them, and these grow finally a little larger and at last they spread out into great flat joints which constitute the tapeworm proper. In the ordinary human tapeworm derived from pork they are not quite so broad as my little finger and look very much like white tape, these joints being from half to three-quarters of an inch long. If we magnify such a joint, take it off, we find scores of ramifications all through it filling the whole concern, and it is filled with eggs. When it is ripe each joint is sexually complete; it has both organs of generation there: not only an enormous ovary filled with eggs, but also a penis to fertilize them. This animal in its nature is hermaphrodite—it has male and female organs just the same as any plant that may have the male and female organs in the same flower. These joints, then, are the sexually mature part of the tapeworm. When he is in the human stomach he fastens himself by the hooks or suckers at the side of the intestine, and this long, loose portion floats about; it derives nourishment; these successive joints grow, and when sexually ripe and the eggs are produced they let loose, one, two, three or four at a time, and pass off from the bowels. If you watch them at that time they are alive, each individual joint will wriggle for itself. An eminent man of science whose name is familiar to you all here, I guess—I shall not mention his name—was giving me his experience in Cincinnati; he was afflicted with tapeworm for several years, and he said that he had watched their heads a good deal; that he used to go out behind his barn and attend to the wants of nature and with a spade bury his fœces so that they should do as little damage as possible, and he said those joints had a great tendency to crawl up on the grass and hang there. They were exceedingly tough and exhibited remarkable tenacity of life. We will suppose that they are eaten by a hog; the outer material is passed away and the eggs are left in his stomach. The envelope is digested in the gastric juice and the eggs hatch there; they are microscopic in size, and the young creatures burrow their way immediately through the walls of the intestines and get into the blood vessels and are carried to all parts of the system. It developes mostly in the muscles—it may develop in other parts; as it developes it produces the disease which are called measles. Now, a measle, if we dissect it carefully, we find that it is a little bag, as I have said, filled with a yellowish liquid. On one side there is a slight depression; if we take this and put it on a plate and tickle it carefully with a camel's hair brush we find that there is a portion turned inward, forming this depression, like a glove finger inverted. If we press upon the side of that with very great care—I never did it myself. I have examined measles, but this depends upon the authority of Thudicum, an Englishman who has worked this up with a good deal of care. He says that you may, by careful management, squeezing this with a camel's hair brush, slightly squeeze it until it comes out. There you have an incipient tapeworm. When this is swallowed, suppose you eat measly pork, this is digested and all that is left is the head; it develops in the stomach and produces tapeworm, and the reason why it is difficult to get rid of them sometimes is simply because we do not get rid of the head. You may kill all the rest — get rid of that — and the head remains and grows and developes again. A single joint produces eggs, and the head is what works in the man.

Now, the tapeworm had been known for ages, but precisely what it was nobody knew. Kuchenmeister, a German, now more than twenty years ago, who had made special study of the internal parasites of man and animals, was thoroughly familiar with the tapeworm, and after examining measles of pigs, which were supposed to be an animal parasite — he believed it to be — he noticed the similarity between these little hooks, only seen by a good powerful microscope, and the hooks in the head of the tapeworm, and it occurred to him whether or not the measles in pork was not the larval form of the tapeworm — whether the measles in pork did not bear the same relation to the tapeworm as the caterpillar does to the butterfly. Capital punishment was in vogue in Germany then, and they applied the criminals sometimes to the purposes of science — you can make some use of them after they die and cease to be of any other use to society. He took a criminal who was to be beheaded at a certain time, and put some raw meat on the bread and fed him, without the criminal's knowledge, a certain number of the measles from pork; waited a while longer and fed him a few more. In due time said criminal was gathered to his fathers [laughter] and Kuchenmeister examined his remains and found tapeworms of two different degrees of development, as he ought to have found them. It then seemed pretty certain.

One of his students then, with a zeal for science that must be commended, concluded that he would try it; he never had been affected with tapeworms; he swallowed a couple of measles. In due time he found himself afflicted with tapeworm, and by a due course of medicine relieved himself of two very healthy tapeworms. So the thing was considered complete. We now know that there are a good many species; another one derived, as I have said, from beef — but that is the history of the generation of tapeworms.

Question — Does cooking pork render these measles harmless?

PROF. BREWER — Entirely. Measles are a good deal easier killed than trichinæ. An eminent scientific friend of mine went to a butcher and told him privately, "Now, I don't suppose you ever sell measly pork, but you sometimes see it, now," he said, "for scientific purposes I want a piece that is real measly; I want to see about transmitting them to other things." Well in due time the butcher meeting him said to the professor, "Well, was that measly enough? I sent you twenty pounds." The professor's family had eaten it all up and nobody had any tapeworm in that family. I may say that they were watched for with a little anxiety. It is not a very rare disease. It is sometimes rather troublesome to get rid of but not always. Our younger school of doctors can generally get rid of it. I can't recommend them, but they are not so bad as they might be. If we go without pork because of tapeworms we might just as well go without veal. If we don't eat anything because some evil may result from it we will starve.

Question—Is there not some parasite known in beef?

PROF. BREWER—Yes, as I say, that man who sold two successive portions of tapeworm to us—those were beef tapeworms.

Question—Can you tell the difference in the form?

PROF. BREWER—Yes in the form. The *tænia solium* is the pork tapeworm; the beef one is the *tænia meliocamellata.* There are a good many other forms; those are the two most common form.

Question—Is that likewise killed by cooking?

PROF. BREWER—Yes; it is more apt to grow in veal than in beef. It is the tapeworm of the Tartars; you have heard how among the Tartars nearly every man and woman has a tapeworm, sometimes several of them. Now they are in the habit of eating raw veal, and it is believed to come oftener from veal than from beef. It occasionally occurs in this country, but the pork is vastly more common in this country. The measle which afflicts pork may get into man and this measle may produce various results, and there is not a great hospital in the world probably that can not give cases of that. There is a form of tapeworm whose round of existence is between the sheep and the dog; it is the smallest of all known tapeworms, it ripens only one joint at a time, and the entire adult tapeworm is less than an inch long; it is the *tae nia echinococcus.* The measle in that case lives in sheep and the offal of the sheep given to dogs; it is harbored by the dogs. Now man occasionally gets the larval form, I mean by that the measle form, when the measle may grow to immense size, and it may multiply. It is more common in Iceland than anywhere else, and it is reputed in certain districts of Iceland to produce one-fifth of the deaths that occur in the human population. At the present time all the dogs of Iceland—for the mark to treat the dogs of Iceland. For two or three years every dog in the island has been treated for tapeworm, hoping to diminish them. In that particular case these parasites may go into man. How they get there we do not know, whether the eggs are taken in eating lettuce, or in drinking water or in what form we do not know, but they sometimes do get in and one of the nearest and dearest friends I ever had died with that. In delivering a lecture on dogs at Harvard University a couple of years ago, I mentioned this manner in which dogs affect the diseases of humanity. After my lecture Prof. White of the medical college attached to Harvard University came to me and told me that he had known of six cases in Eastern Massachusetts; I think it is very possible; I understand they are not rare. It is not an uncommon cause of death in England. I think it is a more common cause of death than is popularly believed. It sometimes causes one of the forms of ovarian tumor; this form of watery tumor which may grow as large as your fist or larger is really a parasitic disease of the nature of the tapeworm.

FIFTH LECTURE.

"SUNDRY TOPICS."

I wish you to continually bear in mind that I am trying in this course of lectures to bring before you the biological laws which underlie the art of breeding. I will admit that I look at it from the theoretical side, in the sense that I have not been a practical breeder of late years. It is the bringing together of the experience of a good many that are breeding and a consideration of the laws of nature which lie at the foundation of the whole matter. These biological laws which underlie and control all the phases of breeding are general, but in special details they vary widely. A poultry breeder would differ quite widely from a Shorthorn breeder, and he in turn from the breeder of racers, in many of the details; particularly that which relates to "in-and-in" breeding, and in many matters which relate to it, such as the relative age of the parents, etc. The art is founded upon the two primary facts underlying all, which I wish to keep before you; that is, heredity, or the force which tends to keep creatures like their ancestors, and the force of variation, which tends to make them unlike. Breeders, as well as scientific men, are still saturated almost with the old ideas, the old dogmas of science, that species is fixed, unvarying, that it remains from age to age the same; in other words, they are prejudiced against allowing too wide variation because it tinctures, as they say, of Darwinism. Now, Darwin has been the greatest friend of the breeder, and he drew his strongest arguments from breeders' experience.

We must remember that these two forces go together, work together; as I compared it in the first lecture to the dead forces of Nature; we may compare, if you choose, heredity to what we call momentum — if a body is in motion it tends to always move forward in the same straight line; and variation we may compare to the force of gravity which tends, if a body is not falling directly, to draw it out of a straight line. Now, if you will al-past two years that has been the case — all the dogs of Iceland are undergoing treatment at the hands of dog doctors — "canine pathologists," I believe they style themselves — sent out by Denlow the comparison, I might compare this to astronomy; astronomers tell us how inconceivably fast the earth moves in its orbit round the sun; it goes around once a year, and that orbit is so great that the earth moves, so they tell us, nineteen miles in a second; while the pendulum is swinging but once it has moved onward in its course nineteen miles, in an almost straight line. The end of that line swerves less than the eighth of an inch from a straight line, so they tell us. Now, that eighth of an inch is an important matter; it is enough in the course of a year to bring it all the way round, and it keeps the earth in its path. Now, in heredity and variation, looking at heredity alone, the line seems so strong, the law that like begets like seems so strong species continue from generation to generation, varying but little, that we forget that after all this slight variation, in which each generation is unlike its ancestors, is important; but it is the eighth of an inch in the earth's course that brings it round, the eighth of an inch each second; so it is the slight variation from generation to generation which, added up, makes such enormous differences in the improvement of our breeds. The last lecture of this course was directed to this point; how we could improve in one direction, how we could improve in another, and keep on bending this variation in some given direction more and more until it varies wider and wider from the original path in which it was running. Just as Newton called attention to the law of gravitation and showed what its relation was to pulling the earth or the moon in its orbit a little out of the straight line and bringing it around into its place afterwards; so Darwin by his genius showed how that organized beings or living beings following certain laws have come to their present shape and form on some path, as it were, along which they had traveled, how by slight variations in any one generation they in time widened enough to become new species.

Now, coming back again to the practical side of this; from what I have been saying it would seem as if this variation was always in the line of progress. It is in the line of progress when we are selecting in that way. We find a variation or an improvement which we want, and we keep on selecting it, and by selecting in that direction we keep adding up and adding up. It is like a gardener planting a new kind of beans; if he wants pods the longest possible he would keep planting the seeds of those which have the longest pods, until he gets them of almost inordinate length. But the variation goes on in every direction — more liable to in some directions than in others, but nevertheless it goes on in every direction; and this variation is not necessarily improvement. There may be deterioration just exactly as their may be improvement. And the qualifications that are necessary for a good breeder are that he has the tact and he has the observation and he gives study to it, to see how to pair, to know what he wants and to work towards that end. Bad points and characters may be just as sure to breed as good ones, and there may be a degeneracy of breeds. If we take our improved breeds, we take our Berkshire swine, our Alderney or Jersey cattle, and put them under most unfavorable conditions, and they don't do half so well as the natives and they make the meanest lot of stock in a few generations. I have been told that there are places in the United States where the most miserable, contemptible, of all the swine are the degenerate descendants of Berkshires. Where some men went in twenty or thirty years ago and carried Berkshire hogs and let them run half wild, living upon mast, without having half the chance of depredating upon their neighbors that the old original had, without that length of snout; their snouts still kept short, but they degenerated in the very places where they had formerly been built up. As one disgusted Southerner told me of such hogs down where he lives, says he: "Their noses kept short, but their hams dwindled until they have hardly got weight enough behind to hold them down when they root." [Laughter.]

Remember that our improved breeds are very artificial productions. They have been bred up by long care and long selection, and when we cease to continue those conditions, when we cease to breed carefully and care for them kindly, then they go back; and with breeding, as with everything else, the down-hill road is the easiest to travel, and they go back a good deal easier than they come up — not necessarily back to the point where they started; they generally sink into some worse point than that. We may have a high-bred animal sinking to a low condition, and revolting against it to the end. We sometimes see that in horses. Rysdick, the owner of "Hambletonian," heard that old "Abdallah," the sire of "Hambletonian," was being abused, and he went and looked him up, and found that as he had got old he had descended, so the story goes, until he was found down somewhere on Long Island, where he had been sold from one to another fisherman to go before a fish wagon, but the proud old stallion wouldn't brook that; he had kicked divers and sundry fish wagons to pieces, and was turned out to die. I am not sure but what he did die in that way; it so affected Rysdick in the matter that he was determined that his grand stallion should never have so ignoble an end, and he took such special pains that his old age should be cared for and his bones honorably buried, that it is now impossible to get the skeleton for the National Museum, as I have tried to do. I have tried very hard to have the bones of Rysdick's "Hambletonian" preserved in the National Museum at Washington, as probably the most important and interesting of all the horse skeletons of the United States, but it was so bound up by the will of the old man that it was impossible.

But to go on with the direct matter of to-day's lecture. I have put in the published outline a point which I purpose saying a word only on — the useful character of breeds may be impaired by too much attention being paid to "fancy" points, or as to local fashions, or to "style." I think that all of you will allow that in theory; nobody will dispute it. I will only use a single illustration; I might use a dozen of the same kind. Now, we take the Channel Islands cattle a generation ago and they were spotted. I do not believe that you can find an engraving or painting in existence that represents a herd of Channel Islands cattle, Alderneys, Guernseys or Jerseys that does not represent them spotted. While there were some of solid colors, the most of them were spotted. Now the fashion has grown up from solid colors. You know how very fashionable the fawn-colored Jerseys are. It does not seem to me that it requires any argument to prove that it is better to have excellency in two points than in one. They were formerly bred for milk, for a particular kind of milk — milk which was valuable for butter, rather than for cheese. If they got a cow that milked well they didn't care whether she was solid color or not. But if we must have a cow that milks well, and also a solid color, or any other one point in addition to the one that we are after, just so soon as we add a fancy point to them, I don't care how little that fancy point is, we handicap our work by just so much. In breeding Poland China swine we must have them lop-eared to distinguish them from the Berkshire, and you will see lots of herds in which they have paid a good deal more attention to the ears of swine than the subject calls for. It has become a "fancy" point. The white feet of Berkshires have become such a fancy point that an animal many be all good in other ways, but as long as he is preferred if he has just the right white feet, so long you handicap the breed. And we see that going on all the time. There is only one kind of animal at the present time in which we are not more or less handicapping the breed by attention to fashionable points, and that is the race horse or the trotter. Nobody cares exactly what color he is, or how long or how short his head is, whether he is solid color or not, whether he has one white foot, two or four, providing he comes in ahead. That is what "rakes in the pile." And they don't take any excuse if he doesn't do it. That is the one thing in a race horse; we want constitution, we want the right shape, we want the thing that will make the horse win, and we have gone for that one point. But there are limitations to that, and these limitations we will next consider. I want to put in quite a number of items in this lecture that have been lying over — lying around loose.

We can not go on improving a breed, I don't care what it is, forever; and the limitations to this improvement are of two kinds, The first are those which grow naturally and obviously out of the kind of work that we are doing. You can get a breed of slow horses and breed them a little faster and a little faster; but there is no amount of breeding that will make a horse run a mile in no time. It has got to stop somewhere; there is a natural limitation to it. And it does not require any argument at all to show that there must be a stop. Sometimes, however, it is not quite so obvious, but there is a limitation because of some equally obvious difficulty. Mashall, in one of his early accounts of the breeding and the agriculture of Yorkshire, England, tells us that there was a tendency among farmers for a time to select cattle with large hindquarters, both for beef and for veal, and they made a strain which was called, and still you frequently hear it spoken of in literature as Dutch butter cattle; very large round hindquarters. He says that this was continued until the monstrous size of the buttocks of the calf was frequently fatal to the cow, and numbers of cows were annually lost in calving. Now, you can easily see the limitation of breeding to that point. And so numbers of them are obvious.

But by far the larger proportion of limitations to breeding to points comes from another law, that which we call correlations of growth,, that is, the different parts of the animal are so related to each other that we can not change one without changing something else. We can not breed for something that we do want without having developed along with it some other characters that we do not want. Moreover, it is a law of nature that excessive development of one part involves loss somewhere else. I can illustrate that; I will say it is like conservation of energy in physics; you have a given amount of cold, it will produce a given amount of heat; now, if we have a certain amount of heat we can turn it into power, use it in some engine for mechanical purposes, or we can turn it into electricity and use it for lighting, as we see with the electric light, or we can turn it into chemical action, as we see in electro-plating; but we can not have our heat, our light and chemical action all at once; we can not "eat our cake and have it too." Now, just so in breeding, just so in physiology, there is something which is analogous to that which we call conservation of energy in physics. We can not have the best kind of trotter, the bese kind of runner, and the strongest draught horse all in the same animal. We may have an animal that will trot pretty well, that will run pretty well and is a reasonably good animal for ordinary purposes for draught, but he will never win a race in trotting, he will never win a race in running, and he will not be the best draught horse you can get; he may be a compromise between them all and we will use him; but we can no more have a horse for all work than we can have an engine for all work. One man wants an engine to pump water out of mines, another wants to drive a locomotive and pull a train of cars. Now, we are never going to combine all of these steam engines. We are never going to have a kind of engine which will answer the best purpose for all of these. There might be an engine got up which will answer several purposes, which will drive a printing press or run a wood saw or drive a threshing machine; but it will not be the best for the printing press or the best for the wood saw or the best for the threshing machine. If you have special work to do you want a special engine to do the work. So with our animals; you will never get an animal that will produce the best beef and the largest quantity with the smallest amount of feed, that will give the largest amount of milk for sale in the city, that will produce the largest amount of good butter for sale as butter, and the largest amount of cheese to sell as good cheese—all in the same animal, I need not appeal to

Prof. Arnold, but I will risk his opinion on that. You can get a cow that will give milk, and when she gets too old for milk you can fatten her and — I was going to say eat her, but I will modify that and say, fatten her and sell her; but you will not get the best of those qualities.

Now, when we develop in any one direction, along with the quality that we wish, another develops and comes along with it; and that leads to limitation. That is a fact that is true not merely in breeding; it is almost as wide as the universe. It is so everywhere, in everything; it is so in human society. In human society you can not develop any good thing unless an evil grows along with it; and how to suppress or restrain or control the evil that grows along with good institutions in human society, constitutes nearly all of the effort of our laws and of our police courts; this matter of correlation of growth. A portion of those are obvious. The bones of the race horse are finer, stronger, firmer, smaller than the bones of the large draught horse. It is in part due to exercise, in part due to this matter of correlation of growth. Just as I have said, swift horses have finer bones, they have firmer bones, they have as a whole smoother coats, and a variety of those things. Who ever saw the finest wool on the coarsest-skinned sheep? Anything that refines the wool refines the skin. I will quote again the experience of a gentleman of my acquaintance who claimed to have bred the finest Saxon wool in the world; he bred "in-and-in," sheltered his sheep; he said "the dews of heaven were never allowed to fall on them," and he got a little small sheep, thin-skinned, that averaged less than three quarters of a pound apiece, but he bred the finest wool in the world. And you can carry that all the way through. There are certain processes which tend to refine the bones, thin the skin, diminish the coat, etc. If we continue it too far we get an animal too thin-skinned, and they shiver in the wind. Take the matter of breeding dogs "in-and-in." I spoke of the setter dogs; I did not speak of the objections to breeding "in and-in." You go among sportsmen and ask them about the objections to too closely breeding "in-and-in." The skin becomes so thin the dogs become cowardly; they don't want to be scratched by the briars; that is one of the difficulties in the way.

We breed in any one direction and recollect there is some correlated point of growth. The whole of comparative anatomy, one of the most marvelous sciences of the day, is founded on correlations of growth. Naturalists, if they find one thing, know something else has taken place; they find a single tooth, and they know what sort of an animal that has belonged to. Working beasts want large lungs; it does not require any argument for that. You would not expect a greyhound with small lungs to hold out in the chase, nor a race horse with small lungs. No, they want large lungs and wide nostrils. But anything that uses a good deal of air burns up a good deal of fat. It has long been known that too large lungs are not favorable to ease of fattening. Therefore you can not have an animal which at the same time is the best animal for draught and for speed, and the best animal for fat. The two are incompatible. You don't want to breed a pig with large lungs. You would if you put pigs on the course and had them run. But it has been demonstrated over and over, as I have said, that the tendency to fatten is inversely as the size of the lungs. Our race horses are not celebrated for their roundness of form or their fullness of body. by any means. We will take that up at another time. But this shows itself in a variety of ways. In raising animals for meat, our pigs, our cattle, our sheep—the mutton breeds—we want to bring them to early maturity; but all of the highly improved English sheep that come to early maturity are also short-lived. "Early ripe—early rotten," is the way one person expressed it. Milk-producing and flesh-producing animals are quite different; the very best milk producer is not necessarily the very best flesh producer. The very best flesh producer does not require nearly so much vigor as the one that produces milk. A large continual production of milk is a tremendous strain upon the system, and it requires a large amount of vigor that may be called mechanical force, mechanical vigor. We have certain strains of shorthorn crosses in which we get large quantities of milk, pretty good milk, too, and animals that fatten reasonably well. Incidental to this is a statement that is found by various authors that vicious animals do not fatten well. I have been exceedingly amused at a series of articles that have recently appeared in our Eastern newspapers apropos of crime and fat. Some newspaper met a jolly saloon keeper, inclined to tip the scale at a high figure, who solaced himself by saying, "Oh, well, you never saw a fat criminal." The worthy reporter thinks there is a point for a newspaper item; so he goes over to Blackwell's Island and interviews the warden to know whether they have got any fat criminals. "Oh, no," the warden says, "they have been exceedingly rare." He instanced one case of a fat criminal, that eminent statesman, Mr. Tweed, but he was a rare exception in a variety of ways; but as a whole, criminals are lean men to-day, as they were in the days of Shakespeare. So he goes to Sing Sing and investigates, and he finally produces an article which is semi-humorous and semi-philosophical. The matter was taken up in the newspapers, and I dare say you have seen in the last three months some of the articles about the relation of leanness and vice.

But they need not have gone to all that trouble. It has been known for a generation that among animals that applies. Show me a specially vicious animal of any kind, and I will show you one every time that does not take kindly to fat. It is your good-natured pig that isn't all the time trying to get into mischief. The miserable vicious fellow that is looking around to find some fresh rails out of the fence or pickets loose enough to get through, turning on edge so as to shoot through the fence, that hog is not going to make his fourteen pounds of pork for a bushel of corn, nor twelve nor ten; you will do well if you get five. He isn't the kind of hog to fatten. You may lay it down as a rule that vicious animals do not fatten well. They have qualifications for other work, but that is not their line.

Then again we may breed so fine as to diminish the vitality. In England a lady breeder of Jerseys and Alderneys has written a series of articles of late for one of the leading English stock journals which were rather a revelation to me. She said that she could not breed such fine-boned nice Jerseys as some of her neighbors, she could not take prizes, but she came to find out that they were in the habit of starving the calves; that they never allowed the animals to develop as they would under good conditions, and this was done to give them slenderness of frame and fine bones—in short, they were breeding fancy cattle. Now, if we want to breed anything very fancy and very fine we invariably diminish their vitality. We see the best illustration of that in the toy-terriers. I have tried to find out how small a dog can be bred and live. They breed them down, down, these little smallest toy-terriers, and as they get down at last the little fellows haven't got quite life enough to hold on and live. They are in a sort of condition not quite dead enough to bury, without having quite life enough to live. It is a difficult matter to get a dog—a good healthy dog—down to two pounds; they do do it considerably below that, but they run out; you have got to breed a good many to have them hold on. They degenerate in their legs. One eminent breeder of toy-terriers in New York said to me as he looked with disgust at some dog which had beaten him two or three ounces, "Yes," said he, "but he's no dog; look at the 'ams of him," he says. The English gentleman thought that his hams had been bred off: "Look at the 'ams of him." The probabilities are that you could not continue that another generation. I don't know how light they have got them. I saw a dog exhibited in a window in New York a month or two ago which claimed to be the smallest toy-terrier; I have forgotten what his weight was—less than two pounds, however.

Then, again, there is another phase of correlation of growth. Whenever we affect the teeth we affect the hair, and *vice versa.* I showed you on these pictures of hogs at the last lecture how we bred off the tusks. Now, when we bred down the tusks we also affected the bristles. You are not going to have heavy bristles along the back of a hog that has no tusks. What the relation is between hair and tusks or hair and teeth, why there should be a relation, I do not know, but there is, and naturalists have called attention to a variety of them. Some of you may have had occasion to see a hairless horse. There are no breeds of hairless horses that I know of, but the few cases that I have seen had defective teeth. These Mexican hairless dogs are apt to be defective in their teeth. An abnormal development of our bearded lady was shown in her teeth. The "spaniel man" of the French, and his children who figured in divers and sundry works on anthropology, with their portraits. There is also a relation between the color of the skin and the eyes. Albinos are very apt to have pink eyes. So other correlations of growth have been mentioned; the fact that green-eyed cats and blue-eyed cats are apt to be deaf. Attention was called to that by Darwin. Lop-eared rabbits have oblique skulls; why that should be I haven't the remotest idea. The black hogs of Florida that were not killed by that "paint root," as it was called, I have already spoken of; and a large number of these. I don't know as it is necessary to follow it up any further. These are noticed by breeders; they have learned them by experience. Some times the connection is very intimate, other times not. I have paid less attention to poultry breeding and pigeon breeding, poultry especially, than any other department. I mean theoretically. They tell us of certain breeds that produce one hundred and fifty or two hundred eggs per hen per year; all those are non-sitters. We develop in one direction and we diminish in some other. I happen to have some friends who are breeders of Leghorns, and they bred to those enormous top-knots. The top-knot keeps growing and the skull keeps growing thinner, and at last they get so thin skulls are perforated and portions of the brain are seen covered by membranes, and whole lots of the chicks become idiotic. It appears as if their strength runs to feathers rather than to brains in that way. It is for the interest of the breeder, therefore, to watch and see how far any such defect can be pushed, and the whole art of breeding is a compromise between qualities that we do want and those we do not want, and the judgment of the breeder must decide where he leaves off in any given direction.

Now, intimately connected with this are many of the signs that are used in the judging of animals. We pay a good deal less attention to color now as a useful factor than we used to; it has become a fancy point of very great importance, but as a useful one vastly less than it used to be. I do not believe that you can take up a book published on the horse before the year 1600, or many that were published long after that, that did not devote a large portion of the book to the signs of qualities. We have almost — not entirely — ceased that. You occasionally hear a man say, "Well, a roan horse is a good horse." We all know that white horses are a little thinner-skinned than some others; but we do not carry it out to such an extent as we used to. We have a prejudice against white feet. "One white foot, buy him; two white feet, try him; three white feet, deny him; four white feet, ... If he has a stripe on his nose, knock him on the head and feed him to the crows," etc. I do not know how old that prejudice is; it runs back to ancient times, certainly. Lucky and unlucky animals; in the old classics you will find numbers of allusions to unlucky animals, where there was an unfortunate marking of the feet which boded disaster to the master. There are a good many signs of qualities which we have placed considerable reliance in. Some of them, although we could not tell why they exist, nevertheless we are governed by them.

Now, upon certain ante-natal influences — influences that take effect before birth. This is not the time to go into the generation of animals, any further than just a word of explanation. You know that all the animals with which we have to deal are developed from an egg — *ovum*, if you prefer the Latin term.

This is impregnated; if it is a fowl it is laid and hatched by heating afterwards, but in the case of all of the mammalia it is impregnated in the female — in our ordinary domestic animals these ova are developed in certain organs that we call the ovaries; they become detached when ripe and ready for fertilization, then they pass down through the Fallopian tubes, are fertilized, and pass on to the next organ, which we call the womb, which is ready to receive it at times of heat; it is covered with a membrane, and takes up an independent life there; first absorbing nutriment from this mucous membrane spreading around it, enveloping at last the whole interior of the womb, and the animal is suspended in a liquid, attached to this investing lining or membrane which has grown in the interior of the womb, and draws its nourishment in that way. One reason why I speak of this is, there is neither blood vessel passing from the mother to the growing fœtus, nor nerve. Now, inasmuch as there is neither blood vessel nor nerve passing from the parent to the growing young, it is developed by hatching, so to speak, within the belly of the dam, instead of without, as in the case of the chicken; the question then comes: Can any impression or influence on the dam affect the offspring before its birth? There has been an immense amount of discussion on that. We can easily see that anything that affects the nutriment of the dam should affect the development of the young, because the young has to be nourished by the dam. There has been a great deal of argument and talk and writing regarding whether impressions, that I may call mental impressions, on the mother affect, and how much they may affect, the offspring.

That some of those affect it nobody doubts. That intense fear or fright may so operate on the nervous system of the mother as to cause premature birth of the young, nobody disputes. Dogs worrying sheep often cause the ewes to prematurely drop their young. It has been noticed certainly as far back as the days of Pliny that wolves getting after sheep caused premature birth. I will venture to say all of us who have had any experience with animals know that severe fright or worry or some important nervous impression upon the dam has produced an unfavorable influence on the offspring. Then comes the more disputed question of color, whether a mental impression on the dam at the time of conception or during the early period of gestation will affect the color of the offspring. In the human race such things are said to produce what are called "mother marks" or "birth marks." I think at the present time veterinarians as a whole are agreed that whatever may be true of the human race with animals there is something in this matter of maternal impressions. I have been very much interested in these things. I started out with the idea — and persons are very apt to from reading medical literature — that there was nothing in it. Doctors — I suggest nine out of ten — do not believe in that influence as regards the human race. They say it is an old woman's whim, and they bring forward lots of facts to show it. In certain lying-in hospitals in Edinburgh for a number of years every woman was asked if she had any special impressions, and out of, I don't know how many hundreds of births, they never found a single case which was deformed or marked as the mother prophesied it would be, though very frequently after the child was born the mother would explain its peculiar markings.

Now whatever may be true as regards the human race, I think that the opinion held by veterinarians and breeders and the preponderance of testimony is very much that with cattle, it may take place; it sometimes does take place. I do not say that it always does but that it sometimes does. I will not go back to that well-known and often told Bible story of Jacob's cattle, because we may assume that it was miraculous; we will leave that all out; but if you will look over horse literature and see the number of cases of foals that have been marked the color of the "teaser," they are too many to be entirely a matter of coincidence. There are many curious cases of that kind on record, of where they have used a teaser of one color and a stallion of another and particularly where the teaser has been of an unusual color, where they have left their mark very often. There is one case that is mentioned, thirty or forty years ago, of where a cream-colored horse was used to "tease" a number of mares, and then the mares were blinded and covered by a fay horse, cream-colored colts in several cases were begotten; not always — not always. The number of cases that are mentioned, several of which have been published, several have been related to me as happening in the experience of men, of where cows in heat have been ridden by oxen. Now we know what the nervous condition of a cow is when in heat. I have in mind now one Devon breeder, who had been a Devon breeder for many years; he said he had a cow ridden by a spotted ox; you know thoroughbred Devons breed remarkably true to color; and that when she was afterwards served by a Devon bull she had had spotted calves and that he sold these spotted calves because they brought suspicion on his herd as not being quite thoroughbred and that he had watched them in the hands of his neighbors bred to Devon bulls producing spots three or four generations. A sharp, critical, intelligent breeder told me that story.

Now there are two things involved here; I may admit that it does not prove anything. You can not prove anything by a single case. That may be an exception, but there are so many of those that it is significant. In this case, if you allow it to signify anything, it is, first, that the "mental impression" produced those spots on the calf; second, that the spots were hereditarily transmitted. Now it has been claimed quite frequently that some of the sudden varietious that I spoke of in the second lecture have been produced by "maternal impressions." I think that one of the most remarkable set of facts pertaining to this is that which occurred in Great Britain after the famous cattle plague a few years ago. You know how that cattle plague ravaged the island, how many cattle were destroyed. Damage done, estimated, if I recollect right, at seventy or eighty millions of pounds sterling. Many of the establishments were disinfected, barns and everything about them were painted with coal tar black for purposes of disinfection; fences, stalls, stanchions—everything about them painted. The veterinary journalist, Prof. Law, has cited several cases of where Shorthorns—and black is the rarest of colors among Shorthorns—thoroughbred Shorthorns of unquestioned blooded pedigree—produced black calves under such circumstances. Regarding sheep, I have thrown out all the testimony there, because there is another element coming in which vitiates it. In short, there is a large class, a large number indeed, of facts; it seems to me too many to be thrown aside, to show that this may take place. Bear in mind not that it always takes place. I do not claim that it takes place half the time, nor a quarter of the time, nor one case in ten; I do not know; but that it may take place, and sometimes does take place. That is all I am arguing. That much I believe. Personally, I believe it is true of the human race.

To tell the truth of the matter, this has played a most important part in more than one human scandal. I will only allude to one, and I do not wish to be misunderstood in respect to that either. I will only allude to one, because of its exceeding prominence before the world; that is to the case of the unfortunate Napoleon III. It is a very sore question in France. As you know, he was the reputed son of the king of Holland; his mother was Queen Hortense Eugenie Beauharnais. Of the known facts regarding it: the mariage was not a happy one; numerous writers have stated that the king of Holland refused at first to acknowledge the son, some of the writers claiming that it was only done by very stong pressure by Napoleon I. Without discussing that at all, he was the acknowledged son, at least afterwards, of the king of Holland. Now, that Eugenie Beauharnais afterwards, and after the separation from her husband, led a dissolute life in Paris, there is no question; that she was not a virtuous woman in the American sense, I mean, of that word, there is no question whatever. Nobody disputes that. That she had several illegitimate, or, as they call them there, natural, children, the Duke de Morny was one prominent one. Now among her many lovers there were two that were specially prominent, one a Dutch admiral, whom scandal claimed was the actual father of Napoleon III; that she had a fondness for the man there is no question; that they were on terms of intimacy that in any other society would have occasioned scandal, there is no question; that Napoleon looked marvelously like him there is no question. So far the facts are certain. Now how shall we account for it? And here these two theories come in. If we allow that the king of Holland was not the father of Napoleon, in short, there is no Napoleon blood in him, then it is very easily accounted for on the principle of heredity. But all the Napoleons without exception had remarkably formed noses, and one way to explain this is on the principle of maternal impression; that he is the actual son of the king of Holland, who was the third brother, if I recollect right, of Napoleon Bonaparte, but, owing to maternal impressions he resembled in his physiognomy the man whom the woman loved rather than the man who was the father of the child. And this nose, which figured in all the caricatures of him and which occurs alike on the nose of Napoleon, was what gave the special sting to the caricature, and was one of the reasons why it was suppressed, and a reason why Victor Hugo was exiled. I allude to this because of the prominence which that scandal has had in human society and human history, and because it illustrates the point that I am after, that if it be true —and I do not say that it is not, by any means — if it be true that he was the legitimate actual son of the king of Holland, then we have a remarkable example of what is technically called "maternal impression."

Closely allied to this and frequently confounded with it, is the influence which a previous sire frequently has on offspring. With certain of our domestic animals, emphatically with the horse — the same is true with the human race to a certain extent — a mare that produces a foal by one sire is apt to have some of the succeeding foals marked after the first sire. There are two ways of explaining this. The first is on this principle of "maternal impressions," that I have now been speaking of; the second I will speak of now. Take a case which in this connection is always mentioned and has become classic. An Arabian mare, seven-eighths blooded, chestnut color, belonging to the Earl of Morton, was covered by a quagga in 1815. The quagga is what we call the zebra. The genus horse has four or five species; the horse, the true zebra, the hemionus and the quagga. All the zebras that we have ever seen in this country are quaggas. They differ a good deal in the number and in the intensity of their stripes. I heard the keeper of a menagerie, years ago, who had a very fine team of quaggas, offer to bet a thousand dollars that there had never been a zebra in this country. The zebra and the quagga differ from each other somewhat as the horse and the ass do; the quagga has the hair more tufted on the end of his tail, like the ass, while the zebra's tail is more like the horse's tail, and the colors are different — they are more intense in the true zebra. This mare was covered by a quagga in 1815. She was covered but once; in eleven months and four days she gave birth to a hybrid foal which had a head like the quagga and striped legs and shoulders. In 1817, 1818 and 1821 the same mare was covered by a big Arabian horse and produced successively three foals, and although she had not seen the quagga since 1815 and never saw it but once, the foals all bore his curious unequivocal marks. She was barren, according to the story, until some London veterinarians advised that she be served by some animal other than a horse; she had been put to a horse frequently and had failed — if she could be made to breed with something or other once she would afterwards breed with a horse. So she was served by this quagga.

I have seen a number of cases where mares whose first foals had been mules, and the succeeding foals of the same mares had an increased size of head, narrower hoofs and longer ears. But it does not always take place; I can not even say that it generally takes place; whether it generally takes place or not I do not know, but that it does not always take place, at least obviously. It has been very strongly denied, and within the last few years has been the subject of considerable controversy in some of our stock journals. Ribot, in his work on heredity, allows this, and gives it as his fourth law of heredity; he calls it the "heredity of influence," and says: "It consists in the reproduction in children by a second marriage of some peculiarity belonging to the former spouse." In the literature of heredity as applied to the human race, there are a good many curious cases, where in the marriage of widows, children by a second husband have resembled the children by the first husband. I have seen it somewhere stated that some old classical author has given it a form — I don't know who nor where — I can not cite the precise place — putting it in this form: "The adulterous child pleads for its mother." In other words, that an adulterous child is liable to resemble the husband rather than the father.

There is no need of my stating that this whole thing is denied by many breeders; but I have asked the opinion of a great many breeders and I think that the testimony is very strong that there is something in it, and that it may take place. I have the testimony of one Devon breeder in Connecticut — again I will admit that this is but a single case, but it is one of many, all pointing in the same direction — that one of his thoroughbred cows was served by a scrub bull; she escaped into the road, where there was a spotted scrub, and she had her first calf by it; that the succeeding calves were marked in that way, and he sold the cow for the same reason that the other man did — that it cast suspicion on his herd. Some will say that it is produced in the succeeding calves by this law that I have spoken of; others would say that it was "maternal impression," and particularly as cattle are less apt to carry those than horses. Horses, perhaps stronger than any other of our domestic animals, are apt to be influenced in this way.

Closely related to this is the matter of the hereditary transmission of defects and mutilations. In a previous lecture I said that they were very rarely transmitted. The number of cases where some special transmission has been, while it is rare, still in the aggregate a good many cases can be given where some especial mutilation has been transmitted. Now, that is frequently believed to be due to maternal impression. I do not pretend to decide on the matter. I am simply giving facts and stating that in certain rare cases there is a transmission by apparent heredity of mutilations; there are cases; but whether it is due to direct hereditary influence or to a psychological cause I do not know of any means of determining.

This brings us very naturally to the attempts to control the sex of offspring and the theories pertaining to it. Pliny in an old work speaks of it. You know that this is a very important matter with stock breeders, and there has been a good deal of thought devoted to that—How can we control the sex of our animals so as to breed which sex we want? Pliny, in his essay on sheep, speaking about breeding sheep, says of the rams: "If his right cullion or stone be tied, he getteth ewe lambs, but if the left be taken up he getteth ram lambs only." In 1810 Chambon, in a French work on the raising of sheep, *L'Education de Mouton*, says that Hippocrates is the reputed author of the statement that if the left testicle of the animal be tied then only males are begotten, and Pliny gets his authority from him. If we go back, there are a good many theories floating around now, but they are as nothing compared to what they were in the previous generation. Take only in the last century, in a work on *Breeding Horses and Sportsmen's Dictionary*, 1775, we find this statement: "If you desire to have a horse colt the usual advice is to have her (that is, the mare) covered in one of the masculine signs, which are either Aries, Taurus, Gemini, Cancer, Leo; under the other signs you will have a mare foal. This is a custom so certain that it seldom or never fails, especially if the wind be either west or north, though the west is the best." I think I could cite thirty or forty authors that give considerable importance to the direction of the wind, and quite in detail, as to how the mare shall stand as respects the wind when served by the horse to insure a horse or filly, as may be wished.

I need not attempt to refute any of these olden theories. We know incontestably that neither spaying, taking out the right ovary or the left ovary of the female, or removing the right or the left testicle of the male, makes any difference. There are numerous cases on record of animals with one testicle that have begotten offspring of both sexes. It is equally true of men, it is true of horses; we have less information regarding those below that. The sexes are about equally produced even in polygamous animals. The same male may serve many females, and this excess of males gives Nature a chance of using only the best for the sires. I need not take that matter up any further. I will say that we do not know what determines the sex, up to the present time; we can not determine it. I will start out with that. We can not breed males and females at will. Nature has put that down beyond our ken. Whether we will ever be able to do it or not I will not pretend to predict. I should not be surprised if we do; but we haven't got it yet. I am now going to speak of some of the opinions that are held, and they are held with exceeding tenacity.

One of them is that it relates to the different nervous influences of the two. I know a farmer who is exceedingly certain that his theory is right, and he depends upon the relative heat of the two parties. When he wants to breed heifers, when a cow comes in heat the boys are sent for nettles and the cows are switched well about the organs of generation with nettles until they are brought up to condition almost equal to frenzy, and that man is sure that that is the way to breed heifer calves; there is no doubt about it. He says he knows it. "I have been a breeder of cows for forty years, and I *know* it. You let a cow go to a bull," says he, "without any such care, and she has a bull calf as like as not. Just treat her with nettles and you get a heifer calf every time." If he fails to get a heifer in that way he has some other way of explaining it; it doesn't affect his theory nor his belief in the least. There is another belief which is held more largely in regard to sheep, that a young male begets more females and an old male begets more males. There are many cases on record of young rams where this has been true, but I can not find any case of where this has been carried out in observations on a large number of rams that has warranted any such conclusion. Another is that what is called constitutional vigor of the female may influence it. Perhaps the most important of all the theories is one that given a few years ago by M. Thury; it seems so plausible that I was inclined to accept it when it came out. I am by no means sure that it may not be true as regards some of our domestic animals. It is in effect that when the egg or the ovum is ready to be fertilized, if it is fertilized early in its ripeness a female is more liable to be produced than if it remains a little longer and gets what for want of a better term I may call overripe; that then a male is more apt to be produced. Physiologically speaking, the male is the higher development of the two sexes. The male is a higher scale of development than the female in almost all nature. Now the argument was that the egg became a little further developed, that if we wanted to produce females we should have the dam served as soon as she was discovered to be in heat; whereas if we want males to be begotten we should not have the animal served until late in heat. There are a good many facts relating to cows — those are what he practiced on; a good many have tried that where it seems as if the law held, but in some herds where it has been tried very extensively it does not hold, and I think that as a whole stock breeders are not inclined to believe it, but it is very certain that in some particular cases tested, and tested on a considerably large number, it looks as if there was a good deal in it. I am by no means sure that it may not be true of some of the domestic animals; I am perfectly sure that it is not true of them all. We may take it for instance with swine; you may find that the males and females in the litter; or take it while still undeveloped and while the sex can be determined in the womb of the mother, that you do not find the female at one end and the males at the other end of the succession of fertilized ovules. Then there is another, that each alternate ovum is a male and a female. Then there is another one on the effect of food—that pampered animals are more apt to produce males—or females, I have forgotten which. Certain laws deduced from insect-life give certain views.

Question by one present—"What do you say to that last theory of alternate male and female?"

I simply say that it is not proved; it may be true for aught I know, but it is not proved. It is undergoing investigation now. I mean by proved—I want to see it tried, not on one, nor on two, nor on a single herd, but on a hundred herds.

The best breeding age of animals—on this I need say but a word—that period in which they are in the most vigorous health. If we continue to breed from too young animals we degenerate them. If we continue to breed from too old animals we degenerate the race. Nature, left to herself, breeds from the most vigorous. It has been found that by continuing too long with immature animals we weaken the constitution in some way. It certainly is true that breeding from young sires stunts the sire. Whether a very old and a very young animal should be paired together there is a wide difference of opinion, but I have no means of settling that. I do not wish to express any opinion. I have heard practical breeders express themselves with great insistence both ways. With some, if they had a stallion which was older than they wished to breed from, they would counter-balance that by breeding to a very young mare, rather younger than they would expect to produce the best results from. That is the view of some; others take exactly opposite views. I do not pretend to decide. I don't know as I have facts enough for any generalization.

If animals are too fat, or if they are gaining in flesh fast, or if they are being pampered, or if they have been closely bred "in-and-in," all of these tend towards barrenness. Animals that are losing flesh conceive easier than if they are gaining in flesh. One of the reasons why a great many people are prejudiced against red clover is that they think it leads to barrenness. I am inclined to believe it is largely due to the fact that frequently animals turned out on red clover are gaining in flesh at the time they are served. There are some very curious facts that come under our notice in our Western mountainous country, such as the effects of climate on fecundity, but the data that I have are in such a confused shape, and the facts are so conflicting that I do not care to make any generalization from them, but this I may say, that in the rougher climates of the mountains of the far West the generative organs are in some way affected.

When it comes to the relative influence of sire and dam, there are two entirely distinct questions. If we mean the relative influence of the sire or dam on the improvement of the stock of a region, why then the sire is the more potent. The sire may sire a thousand animals. If on the individual offspring, that is a very different question. Away back in the olden time it was assumed that the mother had the greater influence on the nervous system and on the secretory organs, and the father the more influence on the muscular system and on the covering. This was again propounded by Linnæus in a work on the sexual characteristics of plants, about the middle of the last century. That was revived again by Orton in a prize essay on breeding a few years ago, which prize essay was published by the Highland Agricultural Society, and has been the subject of considerable discussion since. Linnæus' work was published in Latin in 1760, and was then a little later published in English in 1786. So far as I know, that was the first formulation of that doctrine in English. It has figured quite largely since, and I am inclined to accept it as a whole, though I would not carry it as far as a good many would. That the male parent determines the external characters generally, the outward structure, the locomotive organs, the frame work, bones and muscles, organs of sense and the skin, while the female parent chiefly determines the internal structure, the vital organs, the heart, lungs, glands, digestive apparatus, giving tone and character to the vital parts of secretion and growth, and also has the most to do with the nervous system. I mean that this is the general rule; not that it is always so. We may have a creature resembling the sire more than the dam in all parts, or the dam more than the sire, but this may be taken as a general rule. And Mr. Orton takes this theory and runs back still further and makes a study of hybrids, and finds it generally true with them. If this is true, then, if we are breeding for speed in horses, why, the stallion is the more important. If we are breeding for beef, for mutton, for wool, then the sire is the more potent animal and we get improvement more rapidly through him. If we are breeding for milk, if we are breeding for any of the secretions, if we are breeding for instincts, for temper, etc., then the female. I am inclined to believe that this, as I have said before, is as a whole true; that it is true as a general rule. I believe it to be true of the human race.

Sir Humphrey Davy said a great many years ago that he had never known an exceptionally smart man who had an exceptionally dull mother. He had known smart men who had dull fathers; and long experience as a teacher, having first and last a large number of students of one class and another under me, I may say I have never known an exceptionally brillant student who had a dull mother. I have known more than one that has had a dull father, and my own belief is that the mental faculties are more apt — I don't say always, bear that in mind — are more liable to be transmitted through the female than through the male parent. Colors are believed to more commonly follow the sire. I might multiply examples of where this is apparently true.

This finishes the subject that I had on paper, but I wish to speak of one point which properly belongs here before I leave it. I will not keep you so very long. What constitutes the difference between a domestic animal and a tamed animal. We may tame almost any animal, but there is a wide difference between a tamed animal and a domestic animal. With tamed animals the first effect is generally to diminish their fertility. Most animals that we tame in captivity do not breed freely, some of them do not breed at all. You know that the elephant is an illustrious example, and it is only within the last few years there are less than half a dozen cases on record of tame elephants breeding. Two have bred in this country. In India they merely tie up a female elephant in the jungles, where she is visited by wild males, and in that way she conceives. In the taming of animals, and it applies also to animals of prey, birds of prey particularly, they are specially liable to barrenness. The male is more liable to be barren than the female. But there are some animals that are very easily tamed and you would suspect that they would be fertile. The antelope is an example; there is no case on record of a tamed antelope breeding. In captivity they are very salacious and they receive each other's attentions with a good deal of zeal, but nothing can come of it.

Now, the first change then in taming is that the sexual apparatus seems to be impaired, and we have got to have our females bred in captivity before they can be domesticated. That is the first characteristic; and in the course of time, as I showed in the case of swine, they not only breed in captivity, we make them more fruitful than they are in the state of nature. A second, and one of the most prominent points, is in regard to the influence on their instincts. A great difference between a tamed and domestic animal is, that the offspring of the tamed animal are wild — born wild; the offspring of the domestic animal are born tame. You may take the eggs of the partridge or pheasant and hatch them under a hen and bring them up, they will be as tame as can be, as tame as hens, but when we come to hatch out their offfspring the young ones begin just as wild as their parents were. Now, a chicken begins life tame, it is born tame. A calf is born tame. A deer is wild. In other words, our domestic animals have been so long bred by man that their instincts are the inherited experience of successive generations. When we tame a creature we modify its brain. The brain is a part of the nervous system; the brain is the organ of instincts and the organ of the mind in man. Now we modify this by education and by training, and this modification is in part transmitted, and those animals that we have had as our companions for many ages are born tame. They have ceased to have a fear of man; man has not been a natural enemy. They are left still with their instincts as regards their natural enemies, and the little chick, which has no special fear of man, recognizes a hawk's scream the first time he ever hears it. Now, the two great destinctions between domestic animals and wilder animals, or merely tamed ones from the wild state are, that in the case of domestic animals they breed freely in captivity; in the second place, they are born tame, they don't have to be tamed. There have been two elements at work; not only in the way of educating that I have been speaking of, but we have been eliminating through endless generations the wilder ones. They are less useful to us, they do not fatten so well, if we are after their fat, we can not get them to milk so well, they are not so handy to ride, for beasts of burden, and so on, and in short we have been eliminating and selecting out the tamer ones from generation to generation, so that our present domestic animals are born tame for two reasons: partly as a result of education, and partly because they are the survivors of the tamest strains of the tamed strains from the early times. If we take those two creatures of the animal world that have been the last to be strictly domesticated — we can hardly call the ostrich domesticated yet although it is now in rapid process of domestication — I mean turkeys and canary birds; they are still the wildest of all of our truly domestic animals; the turkey is naturally the wildest of all our poultry, and the canary bird still is quite wild. If you wish to carry out the analogy that I have hinted at, between the human race and wild animals — that the civilized man is more like the domestic animal, and the savage man more like the wild animal — you have in the facts I have given one of the reasons why races disappear before civilization. The Christianization and the civilization of the Sandwich Islands has been like taming a lot of wild animals, for they not only have died from the vices of the whites, but I have no doubts whatever that they have perished in part from diminished fertility; it seems to be a great law of taming. And whenever and wherever a civilized race comes in contact with a savage one, the savage race becomes civilized and loses a portion of its fertility, and that is one of the reasons why savage races, on the whole, go down before civilization. Begging your pardon for keeping you so long and so much running over time, I will close.

SIXTH LECTURE.

THE AMERICAN TROTTING HORSE.

The trotting horse, as we now know him, is a very modern creation. Our grandfathers did not have him, they did not know him, they did not even want him. What he is, where he came from, how we got him, why we have him and why our ancestors did not have him and did not even want him, will be the principal theme that I shall take up to-day. I shall consider first the horses of previous ages; what they were, why they did not trot and why people did not want them to trot; and then how it came that we want trotters, how we got them, and the historical line along which we have traveled. I shall not consider the special pedigree of special horses, or how this or that or the other noted trotter has been produced; that is the subject of such an abundant literature and can so easily be studied up by anybody who sees fit to take it up, that I shall leave out that part entirely.

The horse is an essential element of our present civilization. What kind of a civilization we might have attained to if there were no horses we can not say; but this much is certain, it could not and would not be our existing civilization or anything like it, and the higher the civilization of the people the greater the variety of uses to which the horse is applied. I say the greater the variety of uses to which the horse is applied, not necessarily the greater the use of the horse. The horse was not domesticated so early as most of the other farm animals. Among all the older nations whose history we have, the Hebrews, the Assyrians and the Egyptians, the sheep, the ox, the ass, the camel appeared long before the horse did. He first appears in history on the Egyptian monuments — those are our oldest written history — about 2,200 years B. C., or say about 4,100 years ago. The ass, the camel, the sheep, the ox, all appeared before that. This was more than five hundred years before the first allusion occurs to him in the Old Testament scriptures, and horses were not common among the Hebrews until Solomon's time, and it was still three hundred years before the Greeks had any cavalry.

From that time down the history is pretty well defined, better, perhaps, than that of any other domestic animal. We have many representations of the horses of old from monuments, statues, bas-reliefs, gems, etc., and we may believe that we know pretty well what the horse of antiquity was; that he was a small, strong, wiry, tough beast, but he was not a swift one in the modern sense of the word. In a general way we can judge of the comparative strength and fleetness of the horse by his form, particularly by the angles which the bones of the legs form with the bones of the trunk. In those breeds noted for their strength rather than their speed, the humerus forms a more obtuse angle with the shoulder-blade, and the femur with the pelvis, than with the swift breeds; and this gives them a heavier neck and shoulder and more rounded buttocks. If you want speed you use a high angle; if you want strength, a lower one. You can not judge entirely by the legs of a horse. Many a man has bet on a horse by his legs, and has not won; but, upon the whole, there are certain general rules that are true. The horse of the ancients was the horse of art; he has been the horse of art in all ages. It is the horse of strength that gives us the form — the especially broad chest, the broad form of shoulder, the very thick, heavy arched neck and rounded buttocks that artists so love to put in their horses, and which we still see before our drays but not before our sulkies. It is curious how artists have clung to that; that great round fat draught horse is the horse of art everywhere. A few years ago you may have seen in every other house almost in the land a picture which had a wonderful run, illustrating Sheridan's celebrated ride. He is put upon a horse that if he had attempted to make that famous ride on he would have been winded and he never would have made his "twenty miles" in the world.

To go back to the horse of the ancients. We have in the art school of Yale College bas-reliefs from the Parthenon; there are representations of twenty-eight horses of a date earlier than 300, B. C., the best of them by Phidias himself, and all of them representing the best taste of Grecian art. They each and all represent small, tough, wiry breeds; they are all what we call oriental breeds, they are dish-faced, they are all roached — it was the fashion in ancient times to roach horses —

and there is not one of them on the trot. Twenty are on the gallop, eight are standing still, but none are on the trot. A very large proportion of this celebrated frieze of the Parthenon is in England known as the Elgin Marbles. Out of over two hundred representations of horses there, Youatt says that only four are described as trotting; all the others are on the canter or gallop or standing. He says there are only four described as trotting, and these are all drawn wrong, in that both legs on the same side of the horse are raised at once. I may say right here that it seems to me more probable that those old sculptors were correct. They generally studied Nature faithfully, and if they made any such mistake as that, so far as I know it is the only mistake of the kind they have made. I haven't a shadow of a doubt in my mind but that they intended to represent ambling horses, or what we call pacing horses; they were valuable horses in all times down to the present. Artists say that this is a "mannerism" of ancient art; they say it was one of the fashions of art. Supposing it was a fashion of art; it has been a fashion of art in all times to show things that were considered best and most beautiful. It was not the old and the raw-boned and the broken-down horses that were represented in sculpture, they were the horses of the kings and the warriors and the prize horses, and if it was a mannerism of art it was because the thing actually lived. Pacing horses were preferred rather than trotting horses. Now we have found them, as I said, on Greek, on Assyrian, on Phœnician sculptures; suffice it to say that I have examined for a great many years and kept records of the most of them, all of the representations of horses that I have found on bas-reliefs, on coins, on medals, on gems and in every other way; they may be in the aggregate given by the thousand. There are horses on Egyptian monuments, in Egyptian pictures reproduced—I have never been in Egypt and I have to take those second-hand—and in some cases genuine Assyrian sculptures. I have seen, of course, some Egyptian that we have in this country. In the collections of the old world I have examined them earlier and later, wherever they have art collections. In the famous Cesnola collection in the Metropolitan Museum of Art there are equestrian statues and representations on old sarcophagi. In the Museum of Art in Boston there are large numbers of bas-reliefs, Assyrian, Egyptian, Etruscan, Greek, Roman and Phœnician, wherever we go back to art, we find that horses are either standing, or if in motion, if not on the gallop or on the run they are nearly always ambling, pacing, or at least in an attitude of ambling or pacing. You watch the horses in the street, good, poor and indifferent, car horse, carriage horse and draught horse, and when they stop nineteen out of twenty will stop in what we may call a trotting attitude. The two feet on the same side will not both be placed apart. On one side the hind foot will be furthest forward and the fore foot furthest back; on the other side the reverse. But in all of this ancient art the other is the way of representing horses Now, my own belief is very strong that it was because pacing horses in those days were desired. I shall come back again to that more than once before I get through.

Of all of our domestic species and farm animals the horse is the most susceptible to the influences of surrounding conditions, and is more changed even in a few generations by climate, soil, food, drink, care, and other outside conditions. Owing to this plasticity of Nature breeds are moulded into shape by surrounding conditions, whether the breeds are wild or tame, easier and more markedly than any other of our domestic animals. The wild breeds of California, Mexico, South America, the Falkland Islands, etc., differ greatly from each other and differ greatly also from the original domestic breeds from which they sprang, owing to the plasticity of which I have spoken. And in domestication there are vast numbers of different breeds in the world, hundreds of them, differing from each other more widely than those of any other of our domestic species, always excepting dogs; any other species of mammalia. There is no such great difference in either cows or sheep or swine as we have between such breeds of horses as the Shetland or the Iceland or the Thibet ponies on the one side and the Norman or Clydesdale or other heavy draught horses on the other. It is not difficult to pick out horses that would be sixteen, seventeen times as heavy as other horses, and one authority puts it twenty times as heavy as other horses. There are no such differences as that existing among sheep, among swine or among cattle. I mean as to breeds. When horses of old breeds, the oldest breeds, are carried into new regions they change their features slowly, new breeds spring from them under the moulding influences of new conditions.

Now, man's wants change with time, and, what is a good deal more important in this connection, fashions change and new breeds in domestication come up to meet these new wants and to suit new fashions. Now, the trotting horse is by far the most interesting example of this kind of evolution which at the present time is going on. The American trotting horse can not as yet strictly be called a breed, it is not a definite breed, it is rather a most instructive example of a breed just in process of formation. It is a breed that is just being moulded into shape by a very curious combination of influences. To trot fast has not been natural to horses heretofore, nor to any breed of horses. We are just now in the act of making it natural. We are just in the act of making a trotting breed, and I have no more doubts but what the next century will show us a breed of trotting horses with two-minute trotters not rare,— I haven't a shadow of doubt.

Now, to return again to the horse of antiquity. We have some history of the domestic horse for over 4,000 years, and since that, say at least 1,500 years before Christ, he has been applied to all the principal purposes we now use it for, except one, and to meet that one use the modern trotter is in process of evolution. Now a word — more than a word: I shall devote some time to showing how it came, and why it was that he not only was not formed but his whole formation we might say was resisted.

Although applied to such a vast number of uses the greatest use of the horse down to within one hundred years has been as an implement of war and of ceremony; all other uses have been subordinate to these. For this he was brought into Egypt, for this Solomon imported horses; for this nearly every country of continental Europe to-day maintains breeding establishments for the improvement of horses, not so much of other cattle but for horses. The horse for war was the most important use, and until the days of artillery and baggage wagons the war horse was a horse for riding. Napoleon introduced very great changes in military operations. We may say that the two great changes were, in the direction of how an army should be placed in the line of battle, instead of in a long line as before, in lines several deep; that is the one that wariors speak about; but an equally important one was in the management of armies, in the feeding of armies and in the management of baggage trains. Chariots were sometimes used, but this was but a trifle compared with the great use, in all ancient times I mean, in war, which was to carry a rider. Next to this, to carry a burden, a pack-horse we say, and for this purpose the best animal is not too large; it must have strength, endurance, intelligence, courage and a variety of gaits. Now this last item is one that is of no importance to us;

it is a disadvantage. It was everything in all previous ages; a variety of gaits, a most desirable quality, for a change in gait may be a relief to both horse and rider on long marches. Any man who has had to ride a few thousand miles knows what that is. If he has only been in the habit of riding in a buggy he knows nothing of it.

Now, for these qualities certain oriental breeds have been noted from the very earliest history. The Persian, Arabian, Turkish and the Barb, and their blood, mingled with modern breeds, make the best riding horses in the world. Besides their physical characters, their disposition and instincts especially fit them for the companionship of men, and it is only the rider who knows and has true companionship with his horse. Between the driver sitting in the wagon and the beast of burden which pulls him along the road there can be no such mutual sympathy as between the rider and his horse, where the two seem as one creature, moved by a single set of nerves, each one feeling every motion and knowing every thought and purpose of the other. The Centaur of the old poets, a creature of the imagination, was not greatly out of the way after all. The horse of antiquity, the horse of all previous ages, was a riding horse. What part the riding horse has played in the history of mankind can only be appreciated by a study of the horse, rather than a study of nations, and only partially, I may say, even then. Take for example the history of Mohammedanism; Mohammed and his followers swept wherever the Arabian horse and his armed rider could tread and no further. Other nations and other peoples and other races have pushed their conquests by sea as well as by land, but on the horse and with the horse all of the Mohammedan conquests were made. Where the Barb horse was stayed there Mohammedanism was stayed. The Arabian and the Barb horses were the true standard-bearers of the Crescent, and where the horse was stopped there the spread of Mohammedanism was stayed. When the Moors went into Spain they went on their Barb horses, and when they were driven out, after being there four hundred years, that blood made the Spanish horse what it became; and what part it played in the wars of Europe is told in many an old Spanish ballad. When the Spanish nation was at its height the Spanish horse was at its height; or, I am willing to put it the other way — when the Spanish horse was at his best then the Spanish nation was at its height, and with the decline of the Spanish horse came the decline of the Spanish nation.

Those breeds were carried into England and into Holland and made the war horse and the riding horse of those regions, and were important elements in raising the power of those countries. This was the same breed which the Spaniards brought to America, and what part those horses took in the conquests of Peru in the South and Mexico in the North forms one of the most romantic and picturesque features of those cruel ages. Those were the progenitors of the half wild horses a little later which spread from the La Plata and Patagonia on the South and the West Indies on the East to the valleys of California on the North, and the California breeds show to this day their Barb blood in their shape and in their instincts. These horses were adopted afterwards by the Indians of the plains; before that the Indians of the plains traveled with dogs. They were feeble tribes and followed the migrations of the buffalo. The old Catholic fathers have given us a good many accounts of the miserable life and feeble nature of those old Indians of that date. Volney, an educated Frenchman who traveled in the United States from 1795 to 1798, traveled extensively in the West, far west of the Mississippi, went back and published a volume which was translated into English and published under the name of "A View of the Soil, Climate, etc., of the United States" in 1804. In that he compares the Western plains to the plains of Western Tartary. He says, "The likeness would be complete and entire could we see these nations metamorphosed into horsemen." He says this transformation has actually begun, for within these last twenty-five or thirty years horsemen are beginning to appear, for the Sioux are now mounted on Spanish horses stolen from the plains north of Mexico. And he says, "In half a century these new Tartars will probably become formidable neighbors to the people of the United States, and the settlers beyond the Mississippi will encounter difficulties totally unknown to their ancestors." How true this has been! These feeble tribes of the plains with the horse have become strong; they have become the Arabs of America, rather than Tartars, the most formidable foe which European civilization has met with in its Western march.

This could be followed up; we could carry the same story into England, into France, into Germany, anywhere into Continental Europe; it is the same story. And, remember, all of this is about the riding horse; the horse that would walk when in no hurry, or trot or amble or rack or canter to relieve his own or his rider's tired muscles, or on the run might sweep down on the enemy like a whirlwind, and then if necessary retreat as quickly. Now, only a running horse was fit for such work. Try to imagine if you choose an Indian raid or an Arab foray on a trotting horse! The very idea strikes one as ridiculous. Now, then, in Europe the want remained essentially the same. With the use of heavy armor a heavier animal was needed, but yet he was a charger, a prancing, galloping steed. Imagine a crusader of old or a knight clad in steel rattling to the charge on a trotter! It is ridiculous. Even in later times, when artillery and baggage trains became a part of armies, the want was essentially the same. The horse of the dragoon was fit also for the gun carriage, and great as were the changes which Napoleon introduced into the art of war he still left the want the same. In ancient times, you know, an army lived on the country, as they do not now. Many of the horrors of war have been reduced enormously by this change. We can not conceive to-day of what the horrors and attrocities of war were before baggage trains, before armies carried with them their provisions. The war horse was a strong, stout, but not a swift beast. If by any means a swift beast was used he was carried along as an ornament. When the crusaders went to the East each warrior had his two horses—his horse to ride on the way and his horse for battle. His horse for battle was the swifter and nimbler one, and often was heavy compared with our modern racer. It was the war horse that stood as the representative of his species from the days when Job's horse sniffed the battle from afar, down through the centuries, down through the days of Greece and Rome, down through the Dark Ages, down even past the wars of Napoleon, down to the time when the locomotive began to draw armies to the battle field.

In times of peace then he figured in the ceremonies as an index of rank, as an implement of sport or as an element of luxury. As a common beast of burden and in agriculture he played a very minor part; until within one hundred years that part was a sorry one. The ox was the farm animal, was the beast of burden. A papyrus in the British Museum tells what the miserable lot of the horse on the farm was in Egypt a generation before the days of Moses, and it did not change for the better for nearly thirty-three centuries.

The social relation of the horse has been an important factor in the formation of breeds. From the time when an ordinary

Roman citizen was forbidden to use white horses there has been a social factor entering into every problem of horse breeding. What color of a horse might be used by a person of this rank and that rank, who might go on a horse and who must do it on foot, who might ride at all and who not, have been the subject of numerous laws during all the previous centuries. They exist to-day in more than one semi-barbarous country. The laws are not enforced, but I believe it is on the books to-day that no Jew shall ride on a horse in the city of Cairo. In all ages the use of the horse has been in one way or another an emblem of social position with the Pagan, Mohammedan and Christian world alike. Even in our day, in this very country it is an important item. In all of the larger cities they speak of people as being "carriage people," or they are not, and to be "carriage people" means a good deal. A horse means a good deal more to a great many than the convenience of the thing in getting about. I know very good Christian people, more than one, in our city that will go on the street, to the shop, to their business on week days with one horse, but they would rather stay at home than go to church on Sunday with but one. Their social position demands that they shall worship God with two horses and a driver, if they worship Him at all [laughter]. The very use of the term "one-horse affair" as a term of contempt is part of this social point. Nobody but one of the strongest of the English nobleman could face it enough to drive his own single horse even to the railroad station, and the carriage was named after him "Brougham;" what we call a "coupe" in this country all over England is a "Brougham," and oh, what a lot of caricatures were poured out on Brougham because he even dared to drive one horse when he went to the cars!

After Garfield was elected, they tell the story of an enthusiast who went to Mentor to reason with him and advise him that he should not ride to church; that his example was such that he should not drive to church; and the newspapers spoke of that man as a "bore." He was probably a philosopher. Now this social factor has entered into all problems of horse breeding at all times, and it has been a most important one. It is fashionable to drive a trotting horse; and how much that has to do with the race of trotters! I could not attempt to measure it, but if for any reason you make it unfashionable to-morrow to drive fast trotters I will show you in the neighboring stables down between here and St. Paul before the week is out horses diminishing enormously in value. It is fashionable to drive fast horses, fast trotters. In some cases even yet political as well as social rank is related to the possession of horses. Now, such matters of fashion and social rank, as I have said before, form an important factor in every problem of horse breeding. I have a great fancy for old horse literature; for years and years I have been buying old horse books. They are not good for much, but they are very curious. Many of those old fellows feeling their importance in society wrote great ponderous books, great big folios as thick as Webster's Dictionary and twice as long and twice as wide; there were big books and little books, they came by the hundred, and they were written by the most important individuals in the community. I have bought a good many such; I can't say I have read them all, but I have read a good deal in them, and from one end to the other I don't find anywhere a good word spoken for the trotter. He is always spoken of in contempt, unless we get it, for instance, in such remarks as these, which I have found in the book of the Duke of Newcastle, one of of the earliest works on horsemanship in English, a great folio written by the Duke of Newcastle about two centuries ago, I believe about 1665. I quote from memory, and he says that he does not like an ambling horse, but he does a trotting horse, because the trot is the basis of the gallop, and when the horse breaks into a gallop he does not break into a gallop from an amble as nicely nor so well as he does from a trot, and therefore he goes for the trotting horse, not at all in the sense in which we use the word.

In an old French ballad called "De Lai du Trot," or the Song of the Trot, it is said that those women who are kind to their husbands in this world, in the next may ride on beautiful ambling palfreys; but those who are wicked in this world will have in the next world to ride on trotting nags. Now that represents the feeling that was held towards trotters. I shall not attempt here to describe the trotting gait. Most of you have seen trotters, and know upon the whole what it is. None of you probably, unless you have made a very long study of it, have any conception of the number of gaits that a horse is susceptible of. We see him in ordinary life as we use him now, using not more than four or five or six gaits. We see him walk; we know what that is. If he is pushed a little faster we have a little sort of a slow trot, which is sometime called a dog-trot, in England it is called a fox-trot, a very easy gait when the horse does it well. Then there is the ordinary trot, in which the horse scarcely leaves the ground; if he leaves the ground at all it is but for a second, for an instant, but there is generally one foot at least upon the ground, and frequently only one. Then comes the fast trot that we have with our fast trotters; the stride is greater than the horse could possibly reach, and there is a portion of the time when no foot touches the ground. Then there is the pace or amble—called in the old world the amble, in this country the pace—in which the two feet on the same side move together. Then we have the rack, which is a little different from the trot; then we have the canter or gallop; many make a distinction between the canter and the gallop, the canter being slow and the gallop being a little more brisk; and then the run. In the ordinary canter the feet are never entirely from the ground; the horse is poised upon the two hind feet or the two fore feet, or else upon the two diagonal feet, according to the rate with which it is done. Then we have the run, in which the horse by a series of leaps makes a succession of flights through the air. Those flights are not such as are estimated in the papers. Those wonderful photographs made within the last ten years by Mybridge, of California, of running horses, show what it is. The horse by a violent effort leaps into the air, draws his legs under him, they are drawn up in a knot under his belly, and bringing his legs well forward he alights on his hind feet. If he runs so as to go a little slower and jump higher, then he alights on his fore feet, as we see in hurdle racing.

Now, these gaits are all taken naturally by horses; all horses have them. In addition to these there is a vast number of artificial gaits and positions, and in the riding schools of the previous century every king and duke and prince had a riding school. What the club lecture room is now in social life the riding school was then. A vast number of artificial gaits were taught, positions, each one having a name, and you may take some of these large folios in which every leaf has a different position for the horse and every one has a name nearly, and the young knight in the tournament or even riding along in front of the balcony, where the ladies were looking on admiringly, had a series of steps and positions and motions which he put his horse through, and the horse had been trained to perform these with very great care, and the horse that would make these in succession and make them just right was a valuable horse. Those monstrous positions which we see horses assume in statues, poised on two hind legs, etc., were all positions cultivated with a great deal of care in those old days of riding schools. From what I have said in previous lectures, where any thing is trained to do a thing in a particular way, you might infer that it would become instinct. I am positively amused to see the discussion that has been going on in some of the papers regarding "natural pacers." They are talking as if the pace was unnatural for a horse. Why, horses were taught to pace for three or four thousand years, and to talk about "natural pacers," why, it was a natural gait, it was the common gait of valued horses, and thousands if not tens of thousands of horses were born to pace. They paced as foals, naturally. If you will take any newspaper, I care not where it is, previous to the present century, and it is the same thing. I have only looked over the New England papers; I have taken our own *Connecticut Journal*, beginning about the time of the American Revolution, beginning with perhaps 1783, and looked down to about 1820, paper by paper, column by column, advertisements and all, to see about horses, horses to trade as well as for sale, wanted, stallions advertised, etc., and in more than half the cases the gait is mentioned. If the gait is mentioned it is an exceedingly common thing to say that they amble, and it is one of the points in describing a horse, does he amble or does he trot, or does he do both?

Now, trotting is intimately connected with wheeled vehicles. As the gallop is the gait for the saddle so the trot is the gait for the wagon. There were chariots in the olden times, and the various books tell us that wheeled vehicles came into vogue about 1381, and they were called whirlicotes or wheeled litters, etc., etc. But after all it was a long time after that before they were at all common; it was not until the reign of Queen Elizabeth. The roads were bad. Our early ancestors knew very little indeed about carriages. Even in old England they knew little about carriages in reality. When King George II died in 1760, the lord chamberlain, the Duke of Devonshire, arrived in town in three days, having traveled at the prodigious rate of fifty miles a day. That is the description that is given, even then, 1760, only one hundred and twenty-three years ago. What need was there of fast roadsters at such times? When the Declaration of Independence was signed, July 4, 1776, it was not received at Washington's headquarters in New York City until July 9th. It was approved, I may say, by the provincial assembly sitting at

White Plains the same day, and on July 10th Washington caused it to be read to his army. Just think of the length of time for that little thing! Who has not read the story of Paul Revere's Ride, the night before the battle of Lexington. The battle of Lexington was fought April 19, 1775; the celebrated Paul Revere's Ride was April 18th. Does it ever occur to you that it wasn't much of a ride compared with what might be done to-day? The news of the battle, and then only a most confused account of it, reached New York on the twenty-third of the month, and that was going through pretty quick. Wheeled vehicles one kind and another are now so common that it is simply impossible for us to appreciate how exceedingly modern they are, or at least how exceedingly modern their common use is. Why, the first stage route between New York and Boston was not established until considerably more than one hundred years had passed from the first settlement of those colonies. And in some countries to-day, in the countries of riding horses, there are no trotters. When I was in the old town of Acapulco, a city that had been known on the maps for more than three hundred years, there had never been a carriage in its streets yet. Do you suppose that is the place to look for trotters? Coaches were not introduced into New York City until 1745 by Lady Murray. Carriages were taxed as luxuries until long after the Revolutionary War in the United States. You look over the local papers of the Eastern towns and you will find when the United States commissioners were receiving taxes on carriages; they were luxuries.

Now the greatest use for the trotter is for light carriages; I have been talking thus far of heavy great lumbering coaches; light carriages are still more modern in their present form. When did buggies with steel springs first come into use? Well, I don't know, and I have spent a good deal of time on that subject. I live in a great manufacturing city of carriages, and perhaps I can give it near enough for our purpose here. Early in the present century farm wagons were exceedingly rare. I have interviewed a large number of old men in New York and in New England and I find that at the beginning of the present century farm wagons were more common in New York than New England because horses were used more; but they were still not common; between 1800 and 1805 it is not an uncommon thing to find towns that did not possess a single farm wagon. They had carts. When it came to vehicles to be used on roads there would be perhaps one or two chaises with or without tops; in some towns not a single one. Light one-horse wagons came into use in New York rather before they did in Connecticut, and it is in New York and Connecticut that the trotter may be said to have originated. But in the second decade of the present century light one-horse wagons were comparatively common, the box sitting right down on the axle. Less than two weeks ago a man who went into the carriage business sixty-one years ago was telling me what he knew of wagons made by his master and by him when he first set up in the business. He tells me that the first set of steel springs that he had was in 1828; that he bought them and put them in a wagon, but it was long after that before they came into use. I am not willing to allow that I am a very old man, but I recollect very well the first light one-horse wagon I ever saw that had a pair of steel springs under it. I was a boy large enough to remember it; they had not begun to be used before my time. This man said he bought his first in 1828, but it was later, between 1830 and 1840 before they became comparatively common. I mean by comparatively common, not that everybody had them, but that when one went along the street people would not stop to look at it as a curiosity. They ceased to be a curiosity before 1840, but buggies, as we now know them in the form of light wagon with steel springs under them were rare until after 1840. Well, now, what use was there for the fast trotter then? I was raised in a new country where the roads were bad. Half a mile north of my father's was a "corduroy" road; I recollect very well going over that road more than once with our one-horse wagon that was without steel springs, and what a promoter of digestion that was! [Laughter.]

Now these dates that I am giving are important ones in the history of the trotter. Between 1840 and 1845 there was a sudden spread of buggies. Two or three English travelers who traveled in this country between 1840 and 1845, whose writings I have seen, spoke of an "exceedingly ridiculous thing" that they saw about New York. "The bloods were out on the roads, driving what they call their fast trotters before wagons, and they had trotters that they claim can go a mile in two minutes and thirty seconds, but such trotters have not yet been shown." For some reason to me unknown the trotting gait became popular here in the last century. It sprang up in Russia in one place about the same time, and the Orloff trotter was the result. I have told you that I have looked through the Connecticut newspapers, some of them. Somebody else had looked over the old Hartford *Courant* in the same way.

I found in 1788 among the advertisements a horse called "Game Leg" advertised as standing at Guilford, in Connecticut, belonging to one William Fowler, and he is described as "the swiftest trotter in Guilford." So far as I know that is the first trotting stallion on record. "The swiftest trotter in Guilford." About that time New Haven was the most important port in the United States for the shipping of horses. The very house that I live in at the present time was built by a shipper of horses that were shipped to the West Indies. In looking over the advertisements in the New Haven papers in the last part of the last century and the first twenty years of this, I find this statement in some form or other frequently given, "trotters preferred," or "trotters and pacers wanted," and in one or two cases, "trotters suited for the French market." The French market—what is that? The French West Indies; and I strongly suspect that a fashion had sprung up in the French West India islands—many went to Martinique—by which somebody wanted trotting horses down there. And where anybody wants to buy a thing far be it from an American not to sell it, and if he hasn't got it, to produce it, and they were trying to produce trotting horses in Connecticut. As I have said, this trotting horse, "Game Leg," was advertised in 1788. I find in the New Haven *Journal* for June 19, 1806, this copied from the New York *Spectator*: "Fast Trotting.—Yesterday afternoon the Harlem race course of one mile distance was trotted around in two minutes and fifty-nine seconds by a horse called 'Yankee,' from New Haven, a rate of speed, it is believed, never before excelled in this country." So far as I know that is the first record of trotting "against time." This is twelve years earlier than the famous case mentioned by Frank Forester, which he says was the first trotting there.

That brings us to another phase of the subject which we will glance at now. I have rather been hinting about the horse in old times as a useful animal, but in all times he has been an instrument of gambling and of sport, and the trotter is the most scientific acquisition. The interests involved are so large, so many horses are devoted to it, so many millions of dollars are staked every year, the records of success and failure are kept with such curious labor and accuracy, and the pedigree of the winners is so carefully studied, that it makes one of the most interesting studies in biology. Look over the sporting papers and find the regular prizes offered in some of the trotting circuits in the United States. In 1875 it amounted to $1,418,971; in 1876 to $1,078,449; in 1877 to $951,137, in 1878 to $817,629. And that is only a very, very small part of the cost of those concerns. Then comes the money that is staked and the money that is bet; and they have an exceedingly important code of laws, a good deal more carefully considered than are the laws of the nation, and in which there is more care taken to get the men of the best ability in the ranks to form them.

The English thoroughbred is a race horse, that is, a running horse; he is very rarely indeed a fast trotter. There are no fast trotters in the modern sense of the word that are thoroughbreds. English thoroughbreds do not trot willingly; some more than others. They are a breed of runners. Our American trotter, however, has thoroughbred blood in him generally, nearly always; but there is no English thoroughbred, not one, that is a fast trotter in the sense in which that word is used to-day. He was imported quite early as a race horse and has been of incalculable value in improving the breed of horses. There was an early breed of pacers bred in New York, known as the Narragansett pacer. He is reputed to be of Spanish origin, to have been imported by one of the governors of Rhode Island from Andalusia, in Spain. That has recently been denied by one of our copious writers of horse literature. I say nothing against it. That we had the Narragansett pacer here, that we have an improved breed kept pure in New England, there is no question. That they had pacing horses in Spain nobody will deny; I see nothing improbable in it. The horses of the Eastern United States are of very mixed origin indeed. The common horses were brought from England, but the better class were brought from Holland, some came from Sweden, brought into the settlements near Philadelphia. There were some brought from Denmark. Frank Forester thinks from the form of them that they were Irish horses. French horses went into Canada, and there was an important importation of horses into the province of Quebec in 1665 which laid the foundation of the Canadian pony, and they spread along the St. Lawrence, and the French occupied originally the country about Lake Champlain until the French War, and their blood mingled quite largely with New York horses. The Dutch had in the last century a rather large breed of horses that were known as "hard trotters," and every little while we find some mention in the papers and other literature of those Dutch trotting horses.

Now, whatever may have been the origin of the American Eastern horse he undoubtedly had in him a good many different kinds of blood, and all of the writers that wrote before the American Revolutionary War, so far as I know, I do not know of a single exception, every traveler that traveled in this country and discussed the matter told of the deterioration of horses on American soil. I have no doubts of it. The deterioration was always spoken of; their deterioration in size. Now, horses brought from the old world were brought under new conditions; they were here under unfavorable conditions. The early cattle and the early horses here had to live on browse in the Eastern states. The prairies and their grasses of the West were unknown to all the early settlers. It is since the Revolutionary War, almost since the beginning of the present century, that all of this growth has taken place. It was a forest-clad region that they lived in and horses and cattle had to live more largely on browse than they do now, and they deteriorated in size. The French pony ran down in size, and all of these new breeds that I have been speaking of tended to develop a tough, wiry kind of horses. And this very writer that writes about American horses speaks of them as being smaller than their European ancestors, but tougher and better riders. The blood of all those are in some way or other mingled in the modern trotter. Now, a breed, as I have said before several times, is not formed by the union of two but by the union of several, and it is in the union of the English thoroughbred with the mongrel stock, having various strains of goodness from various sources, that the modern trotter has been derived; old Messenger, that many called the father of all trotters, being an important point. The English thoroughbred was imported just after the Revolution and in the early days of the present century extensively; he was a race horse, and horse racing became popular.

The moral side of this I do not propose to discuss, but there are certain phases that we are obliged to look at. Between the years 1810 and 1825, I might better say, perhaps, between 1815 and 1830, there was a tremendous reaction set in against horse-racing. Nearly every state passed stringent laws against horse-racing. One effect of this was to discourage the breeding of English thoroughbreds, and entirely stop their importation, and the very best horse writers of the times state that there were fewer thoroughbreds in America in 1850 than there were in 1820. There was a little racing in spite of divers laws, but the laws were exceedingly strict and severe. The newspapers state — I have no other evidence — that the laws still stand in the State of Pennsylvania, not only forbidding horse racing, but making it punishable if any man sticks up an advertisement telling where a horse race is to be, or allows it to be upon his building or upon his fence, or allows an advertisement to be upon his property. I know that laws as strict as that existed in Connecticut until within three years ago. There was racing, nevertheless, and we take it there was an immense amount of prosecution. There was a good deal said against it, and there was a set-back in public opinion against that portion of the community which especially prided itself on its moral ideas against horse racing. I have had considerable to say about instincts. Now, I think there is an instinct in the average American that loves to see a horse go fast; and in spite therefore of divers laws there were divers and sundry ways of "whipping the devil around the stump." If you look in your dictionaries and see what a race is — any dictionary of olden time — I think you will be a little surprised. We talk about racing as a striving between two or more things; two or more horses running to see which can get ahead; two or more men running to see which can run fastest; two or more boats rowing to see which can row the fastest. That was a race. But that was against the law. One man would bet another that he couldn't find a horse that would go a certain distance in a certain time. Why, that wasn't a race! Old Father Time was always represented in the pictures as an old man with a scythe; he kept on going, but he didn't run very fast; but in horse-racing he was personified, and racing began to be against time — time as an individual. And in that way we began to keep records.

Frank Forester says that the first race for money was in 1818, when a certain Maj. Jones, at a dinner of the Jockey Club on Long Island, bet $1,000 that no horse could be produced that could trot a mile in three minutes; he says there was much side-betting — we are told that the odds against this was many. But a mare was found, called "Boston Blue," which went handsomely, and Maj. Jones lost his $1,000. In 1823 — possibly a little later, possibly 1825 — I have not very good data of that — the New York Association for the Improvement of the Breed of

Horses was established. It was a moral thing, it was "for the improvement of the breed of horses." It was founded by an act, perhaps in 1821, perhaps in 1831. The act says that "From and after the passage of this act the training, pacing, trotting and running of horses upon regulated courses and upon private property in the county of Queens is hereby declared to be exempted and freed for five years from the passage of this act from the provisions and penalties of an act entitled 'An act to prevent horse racing, and other purposes.'" Trotting races were begun. There had been a little private racing like that in 1818 a little before that. Now they began to trot on private tracks owned by individuals; and the New York Trotting Club was organized in 1825 for improving the breed and the speed of road horses; just as the older jockey clubs had been formed for improving the breed of riding horses, this was formed for improving the breed and speed of road horses. Their course was the New York Trotting Club, near Jamaica, Long Island, about a mile out from the old Union course. This was really the first trotting course. We may say that trotting was a regular established sport by about 1830, and there were a number of horses at that time, not always of the most euphonious names. There were Rattler, Betsy Baker, Screw Driver, Burster, the Treadwell mare, Jersey Kate, Bowery Boy, Shakespeare, Defiance, Bull Calf, Rob Roy, etc., etc. Top Gallant, an old horse believed to have been foaled about 1806, of very humble origin, was a most popular horse. He lived to a good old age. He doesn't appear to have won much, but he was very popular, like some politicians we have known, and he continued in his popularity in spite of repeated reverses, and his time came to be the slang phrase for speed—"two-forty"—which continued down to very modern times. Two-forty was his best time, and "two-forty" was the slang phrase, as no other speed has ever been, for great speed in trotting. Then coming on a little further to the front, in 1832 Old Burster, or "Old Buster," as he was called, made a little better time; he got down to 2:32. That was pretty lively.

I do not know precisely when our present records began, no records were kept in the sense in which we keep them of races of any kind in England; that is, the time. It appears to have grown up in this country. I have no other explanation of it. I have no proof that what I say is true now, but I believe that it probably grew up owing to the adverse horse-racing laws that I have spoken of. Men could not race, but they could bet not on whose horse could trot fastest but whose horse could trot quickest. The devil was whipped round the stump, but according to the law and the dictionary there was no race. But they got almost as much fun out of it [laughter], and records at last came to be kept and were kept with the very greatest care. Any contest for a purse, premium, prize, stake or wager, on any course in the presence of a judge or judges constitutes a public race. There need be but one horse; it is a contest; and that contest may be with time; only the winner has a record. Those are the rules; there is no record, you know, of the other horse. And we have kept lists of records. Now if we go back and look at this evolution I think it is the most interesting case of evolution of which we have the whole process; if we go back here is this Yankee in 1806, say 2 minutes and 59 seconds. In 1818 was the one where Boston Blue made it inside of three minutes. Well, those do not do down in modern lists or records. Then came, as I have said old Top Gallant, we will say somewhere about 1830, when he made his 2:40. Then came Old Buster in 1832 with 2:32; then came Edwin Forrest in 1834 with 2:31½. That was tremendously strong; it causes a smile, but yet it is exceedingly important to know that it took nine years to better that record, and there was a good deal of trotting in those days. It took nine years to lower that record. In 1843 two horses got inside of 2:30, Lady Suffolk and Beppo, and they made it in 2:28. These cases do not appear to have aroused so much enthusiasm and the next year Lady Suffolk lowered that, and finally, about 1849, she made a good deal better time, she got down to 2:26½ which was her best.

[The lecturer then read a table showing the number of horses in each subsequent year falling into each class, which he did not desire to have published, as the list was not complete.]

I think the record will be reduced to two minutes. I have no doubt that in the course of time there will be a good many two-minute trotters. I do not believe that we will get it much lower. In the running horses the number of running horses that have made better than 1:44 is quite large, but we do not get them much faster than that. It would seem as if in running the limit is about reached. In the case of trotting it is not. We are gaining on running exceedingly, lately. Now it seems as if we have bred up the running horse until we have got about as fast as flesh and blood and bone can be made to go. It is possible we may gain a very few seconds on the run. I have no idea we are up to that point as yet in respect to trotters. We have this evolution shown in two ways. First, in the increasing speed of individual horses; second, in the increased numbers of each type. Think what a while it took to get two other horses, after the first had got below 2:30, to get some more. From 1843 to 1849 the number had risen from two to six. The number that drop into this class each year now number in the hundreds.

I have detained you entirely too long. Just one word to clinch the whole matter. We see that a variety of influences have been at work to produce the trotter. The railroads have come that have changed transportation. Roads have been made better, inventions in wagons and easier wagons, the necessity for getting round to our business in a short time, roadsters to get us to the railroads that are to whirl us over the country. The railroads have always increased the number of years. Then the social factor and the fashion to drive one horse. As late as 1856, in Frank Forester's work on the *Horse of America* he states that he never in his life had known an Englishman to drive out for pleasure with a single horse. He said that the nearest it came to that was sometimes Cambridge students out on a "lark" would drive two horses tandem. In America that fashion sprang up and we like to sit behind a single horse in a light wagon. Now, there is another element that probably none of you ever thought of, and that is American woods. Could the fast trotter have originated in a country that had no hickory? He did not; any way, I don't believe he would. As trotting is extending to other countries the wheels of trotting sulkies made in this country are sent there. They go from my own city, where there is an old wheel establishment, and they send the wheels to England. Why, there is a trotting register published in Norwegian, and American trotting sulkies go there. There is a trotting record now published in Australia, and American trotting sulkies go there. The hickory does not grow there. There was nothing in the old world to make a trotting sulky of, and not the taste to make the trotter. Fashions, use, laws affecting horse racing, the whims and so on of individuals, have all combined in his formation. The horse of the ancients and the horse of the middle ages, as I told you, was a runner, and he was the horse of war; the horse of to-day is the horse of peace, the horse of the road; the horse to drive, and he is a trotter. And just as the horse is the end of the long line and course of evolution — read Marsh's articles on the fossil horse, and you might consider that the horse was the crown, the very crowning piece of this long line towards which Nature has been aiming — and so if we carry that out a little further we will see that the American trotter is the cap-sheaf of all the breeds of horses, the last and most complete in many respects, the most perfect development in this long series of evolution.

What the influence is to be on our civilization, on our race, I will not attempt to prophesy. I have merely given you some items in the line along which this evolution has gone on; I have left out some most important elements that others speaking upon the same subject might bring most to the front. I have left them out where I have for a purpose. I could not give the whole history of the trotting horse in one lecture even if I should overrun my time twice as long as I have; and I have given those points that I have with a purpose and as illustrating certain phases of the subject. One element in connection with this is the numbers. One can not easily make a new breed. It wants fashion among large numbers, and these thousand or two trotters that can trot in 2:30 are only a small proportion after all that men have hoped to get. They are only the choice ones, and to breed these there have been a great many, tens of thousands, bred; so that there must be a widespread fashion and very great incentives to the work. These have all been at work here, and we see from these tables how marvelously rapid has been this evolution of which I have been speaking.

ADDRESS

OF

HON. C. P. BAKER, TOPEKA, KANSAS.

FORESTRY IN THE NORTHWEST.

I see that I am announced in your program to deliver a lecture on "Forestry in the Northwest; What Has Been Accomplished?" I did not know till I reached Chicago last Friday just what was expected of me. At that place I met letters, which had been "blockaded" in the late snow storms, one of which, from Prof. Porter, had inclosed the announcement of the Farmers' Lecture Course of the College of Agriculture.

On the eighteenth of January I received at my home, Topeka, Kansas, a letter from the commissioner of agriculture, stating that he wished me to visit this city at this time to represent the department, and that the subject of forestry would be discussed from the fifth to the ninth inst.

You will perceive that I have had but little time to prepare an address on the subject I am expected to talk about, and beg your pardon for using, in part, material originally prepared for another purpose.

I also notice in your announcement that I am called a "forestry expert." I beg to assure you that this is a mistake. I have no doubt that there are before me a large number of gentlemen who can teach me how to set out trees and what is the best variety to grow under given circumstances, etc. I do not appear here as a scientist, nor as a specialist, on the subject of forestry, but rather as a practical business man, to tell you somewhat about what has been accomplished in the Northwest, but mainly and more particularly to give my views as to what should be done in the future.

To those of you who have read an article in the October number of the *North American Review*, written by Prof. Sargeant of Harvard University, it is perhaps unnecessary to give any reason for the space I have devoted to the timber culture act. You will recollect that he recommends the repeal of that act, and gave as the reason that it misleads the people of the country in holding out inducements to them to grow trees on the prairies, where, in point of fact, he said trees would not grow. We in the West knew different, but the fact that such an article was written by a college professor and published in a leading magazine of the country showed me that some portions of our people, at least, needed information. To meet this demand and to get it into shape for pretty general circulation, I sent out to United States land officers and to individuals a series of questions to ascertain "what had been done" towards forest growing on the plains; and in connection therewith the propriety of repealing the timber culture act. I embody some of the information received in answer to these questions in that paper.

It is unnecessary before so intelligent an audience as I see before me to describe the condition of the Great Plains at the time settlement began upon them.

Its boundries were defined as follows by Mr. H. M. Thompson, of Lake Preston, Dak., in a paper read before the Forestry Congress, at Montreal at the meeting in August, 1882:

> The Great Plains extend from the southern limit of the Staked Plains in Texas northwardly about twenty degrees of latitude to the Sashkatchewan River and Hudson's Bay, and from an irregular east line, commencing in Texas, running through the eastern part of the Indian Territory, Eastern Kansas and Nebraska, Western Iowa, the big woods of Minnesota, and the Red River of the North; westerly of this irregular eastern limit an average distance of about ten degrees of longitude to the foot-hills of the Rocky Mountains, and containing an area of about 950,000 square miles. If all this region possessed a propitious climate, and all the soil were susceptible of cultivation, the area is sufficient to make 3,800,000 farms of 160 acres each, and which, by the aid of a proper forest economy, may be made capable of supporting an agricultural and pastoral population of 50,000,000.

WHAT HAS BEEN DONE.

The first great step toward the promotion of forestry in this country was what may be called a change of sentiment in regard to the value of forest trees, a change which has taken place within the last half century. The pioneers on the continent made their settlements along a heavily timbered coast, and for the better part of two centuries literally hewed their way toward the interior of the country until the great prairies were reached. Trees were not only cut down for use, but were slashed and burned and girdled. It seemed to be the purpose of the early American settler to destroy as far as possible the native forest. The woodman's ax was the symbol of civilization, and the state seal of Indiana bears the figure of a woodchopper.

The setting out of orchards was, of coarse, the work of the earliest pioneers, a passion for fruit trees having been brought from England; but the idea that a forest tree was of any value except to be used up for rails or posts or boards, or burned to ashes for pearlash, is of comparatively modern origin. Even when the settler reached the prairies of Illinois, where timber compared with the older states was very scarce, he does not appear to have exercised the least care or foresight. If he lived near the bodies of forest which skirted the streams, he cut them down for rails or cord wood, as if the supply was inexhaustible, and out in the prairie the settler contented himself with hauling green wood a long distance for firing, nor dreamed of setting out groves about his house which would supply his demand for fuel at less trouble and expense.

Kindly nature strove to repair damages, and in many instances successfully. And when, in time, men heeded the warning and became less lavish in the work of destruction, the woodland began to gain in area, until in many parts of Illinois it is now much greater than when the country was first settled. In time came the discovery of coal, which lessened the consumption of wood for fuel, and the question of material for fencing becoming serious, hedges and other substitutes for posts, plank, and rails were resorted to. Thus by degrees the subject of the value of forest, and so the possibilities of forest culture, became impressed upon the people; in short, forestry became a subject of popular interest.

An augmentation of this interest came with the settlement of the country west of the Mississippi, and more especially west of the Missouri. Here were immense treeless areas, and believed by the first explorers to be uninhabitable on account of the absence of forest for building, fencing or even fuel; it was known that travelers and hunters traversing these plains used buffalo chips for fuel. And yet here were millions of acres of suspassing fertility, open to settlement by the passage of the homestead act; and the progress of settlement stimulated by the extension of the railroads. It will be seen that under these conditions the forest question became one of the first importance. The rivers and the railroads solved the problem of building by bringing pine from the forests of the North, and the demand for fuel was met in part by the opening of mines of bituminous coal, which seem providentially to exist in most prairie countries. The fence question was met in Nebraska and Kansas by the general adoption, after much discussion, of the herd law, which does away with large farm inclosures. In the settlement of these trans-Missouri states every step tended to reveal the transcendent value of forests. The lack of them, though supplied as we have said, was felt, and as soon as horticultural and agricultural societies were formed, tree planting became a subject of eager, active, and constant discussion, and so has continued to be ever since. It is safe to say that there has scarcely been a number of an agricultural or horticultural paper issued in the States of Minnesota, Iowa, Nebraska or Kansas, in which the subject of tree planting has not been discussed.

The first efforts to repair the deficiencies of nature were those made by individuals. All through the country embraced in the limits of this paper is found a tree of quick and early growth, requiring little in the way of sustenance, living a long time on water alone, planting itself in the most unexpected places and sowed by the busy winds. This tree is the cottonwood, and being the first at hand it was everywhere seized upon by the settler and planted by thousands about the homestead shanty, along the boundaries of the prairie claim, and in the little public squares and along the streets of the villages which spring up in a week or a month. Although time and trial have proved that the cottonwood will not sustain itself on the high prairie unless carefully cared for, dying like the Indian with the growth of civilization, it will yet be held in remembrance in this Western country as the first of trees, and its planting as the beginning of forestry. Many a settler in years to come will recount how the armful of little cottonwoods, which he pulled with his hands on the sandy bank of the river and carried to his claim, furnished in time the first shelter from the fierce winds and the burning sun.

In time the pioneer tree was followed by others, the black walnut, the maples, the box elder, the catalpa, and with wonderful success. The denizen of the town in Minnesota, Iowa, Kansas, and Nebraska proved quite as enthusiastic a tree planter as the farmer in the country, and in Kansas the newer the town, as a rule, the more zeal has been displayed in the matter of tree planting. Lawrence, the university city of Kansas, after twenty-five years is a town full of verdure, but the same is true of Wichita, a town which seven years ago stood treeless on the bare, sandy banks of the Arkansas.

As to the results of individual effort, without encouragement from the State or from societies, a small portion of the immense amount of evidence which might be furnished is herewith submitted.

The latest standard authority on tree culture in Kansas is the "Second Report on Forestry, by the Kansas State Horticultural Society." In this pamphlet, in the shape of county reports, is briefly summarized the results of tree planting in Kansas, together with the teachings of experience in regard to proper varieties, etc.

The counties reporting, through careful observers and practical tree growers, are Allen, Atchison, Barbour, Barton, Butler, Chautauqua, Cherokee, Crawford, Cloud, Cowley, Davis, Dickinson, Edwards, Ellis, Elk, Harper, Harvey, Jackson, Jefferson, Jewell, Johnson, Kingman, Labette, Leavenworth, Lincoln, Lyon, Marshall, Miami, Mitchell, McPherson, Montgomery, Morris, Pratt, Ness, Nemaha, Neosho, Ottawa, Pawnee, Pottawatomie, Reno, Rice, Rush, Russell, Saline, Sedgwick, Sumner, Wallace, Washington, and Woodson. A glance at the map of Kansas will show that these counties represent every variety of soil and climate within the limits of the State, and from the earliest settled counties, on the banks of the Missouri, to the newest, far out on the high plains, and from the Nebraska line to the Indian Territory. The highest of high prairie and the low level bottoms of the Arkansas, but a few feet above the level of the river, alike send the same report, "Timber culture seems to be made profitable in this county."

Taking the older counties, Leavenworth reports:

Timber groves were planted in 1860, of cottonwood chiefly, and on upland, many of which are fifty feet high.

And taking the newer counties, Saline reports:

The age of the oldest successfully grown timber lot or grove in the county is not over ten years old; was planted on lowlands, and composed of cottonwood. The average diameter of these trees is twelve inches, and the height fifty feet.

The correspondent from Sumner County reports.

Timber growing can be made a profitable investment. My first planting, now eight years old, affords me posts and poles for their uses on the farm, and considerable fuel. I would not be without it for fifty dollars an acre.

These extracts are from the report two years old; as to later evidence, Hon. Martin Allen, of Ellis County, an old resident of extreme Western Kansas writes:

I have myself been cutting and using timber for a number of years that has grown on the prairie since I came here, and many others within my knowledge are doing the same. Even the slow growing black walnut has made annual additions of near an inch in the diameter of its trunk.

Hon. H. C. St. Clair writes from Belle Plain, Sumner County, Kansas:

In this county there are thousands of acres of cultivated timber. Every good farmer, one that has now come to stay, has from one to ten, and some twenty, acres in timber, consisting of cottonwood, walnut, ash, elm, box elder, maple, ailanthus and catalpa. It is true that some varieties are of slow growth, and a beetle destroys the cottonwood on the high lands; but where timber lots are cultivated like an orchard, as they should be, timber raising is a success, and money spent by the government to encourage timber culture on the plains, is well spent.

Theodore Boggs writes from McPherson County, in Western Kansas:

There have been a great number of timber filings made in this county, and while some of them have been changed to homestead or pre-emption entries, there are a great many timber claims under a good state of cultivation, and the trees in most instances are healthy and doing well. I have trees on my farm near McPherson, planted in the spring of 1873, that are as large at the butt as a man's thigh, and they are healthy and show no signs whatever of decay. The repeal of the timber culture act would be a very bad thing for the plain regions, and I should be sorry to have it done. There are timber claims in this county that could not be had for $5,000, and inside of five years they can not be had for $10,000. There is no question about the success of timber on these prairies, if it is only planted and cared for.

So much may be gathered of the results of tree planting in Kansas.

Nebraska, in the matter of systematic forestry, is far in advance of Kansas. Possessing a much smaller area of natural timber than Kansas, the efforts of the people to cultivate artificial forests have been more vigorous. The statement is made by J. T. Allen, forester of the Union Pacific Railroad, that Nebraska has now growing, and in the best possible condition, *forty-five million* of forest trees, and this planting extends three hundred miles west of the Missouri River.

SUCCESS OF THE MENNONITES.

Under our homestead system, in fact under the general system by which the West has been settled, there have been exhibited few of the benefits of co-operation. Each settler is independent. He is supreme on his own quarter section, giving and receiving little help from others. Were this different, did the settlers of a given district join with each other in developing the country, did they combine, for instance, in the great work of rendering the land beautiful and profitable with trees, much could be done. How much is shown by the example of the Mennonites in Kansas! These people, bound together by a community of race and religion, and the fact that they were all alike "pilgrims and strangers" in this country, emigrated from Russia in large bodies in 1876 and 1877, and settled for the most part in the counties of Harvey, McPherson, Marion, Butler, and Reno. They bought land in severalty, yet in contiguous tracts, and have, without being allied in any socialistic bond, aided each other in their labors. Settling in an open prairie country, they have transformed it. Being intelligent tree planters, they have surrounded their dwellings with fruit and forest trees, so that at a little distance a Mennonite settlement looks like a grove. They early introduced the culture of the Russian mulberry, which, under their system of careful cutting, furnishes in three years from the start abundant fuel, besides fruit, and the leaves for feeding the silk worms. The same care and skill everywhere displayed would transform the great plains and change the climate of the western half of the United States.

ARBOR DAY.

An instance of the value of united action, even though for a brief period, is seen in the institution of "Arbor Day." The credit of designating a certain day in the year, when men, women and children shall join in planting trees is due first to the State of Nebraska. It was later taken up by the State Forestry Association of Minnesota, and on the first Arbor Day in that State, in 1876, 1,500,000 trees were planted. Premiums were offered by the State Forestry Association and by individuals until every farmer in Minnesota seems to be a forester. In Iowa Arbor Day has become a fixed institution. In Kansas the day was first observed by the citizens of Topeka, who turned out under a proclamation from the mayor and filled the capitol grounds with trees, which remain to this day. The governors of Kansas have since issued their proclamations for the observance of Arbor Day, which has been observed, however, principally by the school children, who have by their efforts greatly beautified many school grounds in the State.

ACTION OF RAILROAD COMPANIES.

I have spoken heretofore of the work of individuals. The work of forestry has been carried on to some extent by railroad companies, but not to the extent desirable. The Atchison, Topeka & Santa Fe Railroad Company in Kansas some years ago employed a forester, but afterwards, probably believing that the experience of private parties had fully demonstrated the fact that trees *would* grow to the extreme western limits of Kansas, abandoned the experiment. The following statement is instructive in this connection: Under date of Oct. 18, 1882, Mr. C. H. Longstreth, late forester of the Atchison, Topeka & Santa Fe Railroad Company, speaking of the efforts of that corporation to grow trees on the great plains, after it had been a question of great doubt whether trees could be grown there at all, states that, in connection with S. T. Kelsey, in 1873, he commenced tree planting at Hutchinson, Kan., working from there westward. He says:

The object of our work was to settle this question and learn as far as possible what kinds of trees were best adapted to this part of the State for forest purposes. We did not do much until the spring of 1874, when we did considerable in the way of planting seeds and cuttings, most of which grew and promised well. In February, 1875, Mr. Kelsey left the work, after which I continued the planting and growing of trees until 1879, when, having the grounds all filled out and trees in such shape as to require but little care thereafter, the railroad company concluded best to discontinue the work and not plant any further.

Since 1879 the trees have had no work expended on them whatever. Below I give notes of growth and number of trees now growing, which I took a few days since:

First point, Hutchinson, is one hundred and eighty miles west of the east line of the State; elevation, 1,500 feet; soil, light, sandy loam. Here are now growing—

	No. of trees
Cottonwood, 30 to 50 feet high	1,000
Box elder (ash-leaved maple), 15 to 20 feet high	8,000
Black walnut, 12 to 18 feet high	2,500
Green ash, 15 to 20 feet high	3,600
Ailanthus, 18 to 24 feet high	1,200
Catalpa, 16 to 20 feet high	2,000
Elm, 15 to 18 feet high	200
Honey locust, 15 to 25 feet high	500
Gray willow, 30 to 40 feet high	500
Hackberry, 6 to 10 feet high	500
Soft maple, 12 to 20 feet high	1,000
Coffee bean, 4 to 6 feet high	3,000

Ellinwood, the next point, is forty miles further west; elevation, 1,750 feet; soil, a black, sandy loam, with a tenacious subsoil. Here are now growing—

	No. of trees.
Soft maple, 16 to 20 feet high	600
Honey locust, 15 to 20 feet high	400
Catalpa, 15 to 20 feet high	1,800
Box elder (ash-leaved maple), 15 to 18 feet high	500
Ailanthus, 18 to 20 feet high	300
Osage orange, 12 to 15 feet high	2,000
Cottonwood, 30 to 40 feet high	2,000
Green ash, 12 to 15 feet high	1,500
Black walnut, 12 to 18 feet high	4,000
Gray willow, 25 to 30 feet high	600
Hackberry, 8 to 12 feet high	400
Elm, 15 to 18 feet high	500

Garfield, the next point, is forty-three miles west of Ellinwood; elevation, 2,100 feet; soil, light loam. The following trees are growing here:

	No. of trees.
Cottonwood, 20 to 30 feet high	4,000
Box elder, 12 to 15 feet high	2,700
Ailanthus, 15 to 18 feet high	5,000
Black walnut, 12 to 15 feet high	4,000
Soft maple, 12 to 15 feet high	800
Catalpa, 10 to 14 feet high	500
Honey locust, 15 to 20 feet high	400
Green ash, 8 to 12 feet high	2,000
Gray willow, 20 to 25 feet high	200

The above is a brief description of the results of our work down to the present time. All of these trees have been grown from seeds and cuttings. The conditions have been such as to put the trees to severe tests. There has been no extra work done with them. They have been simply planted and cultivated well. It has been stated that we irrigated a part of our own ground. This is not the case. Our trees never received any water except what fell from the clouds. All of these trees at the present time show a promising and healthy appearance, with all prospects of making a rapid and mature growth in the future. This work has demonstrated beyond any question of doubt that trees will grow here with all success whenever planted intelligently and cultivated and taken care of as they should be.

It will be seen that the Atchison, Topeka & Santa Fe Company went no further than experiment to demonstrate that the growth of trees was possible in the region traversed by its line. The same was true of the Kansas Pacific, now the Kansas division of the Union Pacific. Several experimental gardens or nurseries were started under the direction of the company, but abandoned years ago. Settlers in the same counties where these experimental groves were planted, have, on hundreds of timber claims, settled the point at issue.

The Burlington & Missouri River Railroad, in Nebraska, carried on some experiments for a short time, in the way of planting trees along cuts for snow fences.

The Missouri River, Fort Scott & Gulf Railroad Company has entered upon the work of forestry proper; that is, the raising of trees for actual use.

R. Douglas & Son, of Waukegan, Ill., have a contract with this railroad, which runs from Kansas City south, in Kansas, near the line of Missouri, to and beyond Fort Scott, Kansas, to plant two sections of land in trees. One of these is located at Farlington, and the other at Hunnewell, near by. These places are about one hundred and twenty-five miles south of Kansas City, Mo. Of the Farlington plantation Mr. Douglas, under date of Oct. 24, 1882, writes:

Three hundred and twenty acres are planted, and we are now planting 180 acres more. That will be finished before winter sets in, or before April 1, 1883. The plantation consists of catalpa (*speciosa*), with the exception of a few acres. They are all planted 4 by 4 feet apart, containing 2,720 trees to the acre. The land is prepared same as for corn, and the trees are planted with spades. The catalpa trees planted in 1878, after four summers' growth, are 10 to 15 feet high and 2½ to 3½ inches in diameter. Three years planted, 5 to 9 feet; two years planted, 3½ to 6 feet (a drought last year; one year planted, 3 to 4 feet. On rich land these trees shade the ground after two years' cultivation. On poorer land they require three years' cultivation.

On the Hunnewell plantation, three miles from Farlington, we have already planted one hundred and seventy-five acres catalpa (*speciosa*) and ailanthus, and sixty acres of the white ash. The catalpa are one and two years planted; we will have two hundred and eighty-five acres on the above plantation between now and April next, all catalpa and ailanthus, making five hundred and sixty acres on the Hunnewell plantation. Our contract requires 2,000 trees to the acre when they are four to six feet high. Nearly every acre on both plantations will contain 2,500 trees; every acre will contain over 2,000 trees.

Besides the Missouri River, Fort Scott and Gulf, the only other railroad company reported as engaged in forestry is the St. Louis, Iron Mountain & Southern. Mr. Kerrigan, superintendent, writes:

We have no trees planted on our road excepting 50,000 catalpa trees on right of way near Charleston, Mo. We have a plantation or farm of catalpa trees (100,000 trees) on Belmont branch, eighteen miles from Belmont, Mo. The above were all raised from seed. We also have a catalpa farm of 250,000 trees at Bertrand, Mo., about twenty miles from Bird's Point, on the Cairo branch of this road. These were planted in June, 1880, from slips. Have been cultivated twice, and are now in fine, thrifty condition. Will average about eight feet high, and will not require any cultivation after next year.

THE TIMBER CULTURE ACT.

The general government, acting through Congress, has confined its encouragement of forestry mainly to the passage of the timber-culture act, which grew out of the homestead law, and is designed to be supplementary to it. The original congressional timber-culture act became a law March 3, 1873. It was amended March 13, 1874, and was on the fourteenth of June, 1878, changed to the shape it now bears, and since the date of its last amendment most of the filings under the law have been made. That is, the law has been in practical, extensive, working operation but four years.

As showing the extent of operations under the act, the following table, furnished by Hon. N. C. McFarland, commissioner of the general land office, is given:

Statement of the number and area of entries under the timber-culture laws in the different states and territories, by fiscal years, from the beginning of operdtions to June 30, 1882.

States and Territories.	1873.		1874.	
	No. os entries.	Acres.	No. of entries.	Acres.
Arizona			2	196.51
California	2	329.75	59	8,878.06
Colorado			17	2,272.24
Dakota	24	3,560.00	865	124,997.29
Iowa	1	145.90	33	3,816.05
Kansas	60	9,642.17	1,954	282,479.07
Minnesota	95	14,710.15	804	113,131.63
Nebraska	137	21,858.07	2,164	312,712.09
Washington			22	2,482.22
Wyoming			1	80.00
Idaho			2	180.83
Totals	319	50,246.04	5,923	851,225.99

States and Territories.	1875.		1876.	
	No. of entries.	Acres.	No. of entries.	Acres.
Arizona	2	320.00	10	1,197.15
Arkansas			3	231.92
Colifornia	195	29,065.53	136	20,524.33
Colorado	27	3,453.82	45	6,514.22
Dakota	451	61,969.75	842	119,835.23
Iowa	92	9,127.52	99	8,563.42
Kansas	1,265	168,269.06	1,354	185,596.43
Minnesota	499	63,673.73	1,070	140,126.30
Nebraska	1,061	130,894.26	834	106,499.74
New Mexico			7	1,128.00
Oregon	7	882.68	13	1,793.18
Utah			3	399.88
Washington	31	3,324.14	54	5,374.28
Wyoming	1	130.47	1	160.00
Idado	21	2,583.25	17	1,973.89
Totals	3,652	473,694.21	4,488	559,917.97

States and Territories.	1877.		1878.	
	No. of entries.	Acres.	No. of entries.	Acres.
Arizona	21	2, 440.00	11	1, 600.00
California	75	10, 586.05	60	8, 029.42
Colorado	28	3, 343.33	125	17, 486.73
Dakota	476	68, 266.92	3, 769	579.804.04
Iowa	59	4, 791.56	89	7, 535.47
Kansas	1, 666	238, 020.44	4, 031	593, 295.17
Minnesota	561	76, 021.53	2, 693	377, 017.78
Montana	3	398.59	9	960.00
Nebraska	706	90, 812.90	1, 408	195, 306, 68
Nevada	2	240.00	5	600.00
New Mexico	....	....	2	320.00
Oregon	19	2, 509.37	130	18, 446.31
Utah	3	338.50	9	1, 280.00
Washington	148	19, 746.75	562	78, 237.00
Idaho	52	7, 035.91	158	22, 169.53
Totals	3, 819	524, 551.85	13, 061	1, 902, 038.03

States and Territories.	1879.		1880.	
	No. of entries.	Acres.	No. of entries.	Acres.
Arizona	21	3,280.00	6	719.65
California	112	14,458.81	99	12,1 0.31
Colorado	121	16,142.03	214	30,302.14
Dakota	4,675	728,687.83	5,575	868,748.39
Iowa	73	6,577.67	57	4,714.05
Kansas	7,776	1,167,582.77	2,891	408,261.74
Louisiana	1	80.43	1	40.00
Minnesota	1,847	257,642.50	909	123,735.36
Montana	27	3,134.20	61	6,835.32
Nebraska	3,183	465,968.94	3,202	475,275.87
Nevada	1	160.00	5	560.00
New Mexico	14	1,891.93	24	2,887.95
Oregon	130	18,446.21	482	73,061.66
Utah	9	1,280.00	35	4,044.05
Washington	562	78,237.00	893	134,637.65
Wyoming	....	....	9	240.00
Idaho	162	22,013.93	181	23,300.04
Totals	18,629	2,775,502.66	14,644	2,169,484.18

States and Territories.	1881.		1882.	
	No. of entries.	Acres.	No. of entries.	Acres.
Arizona	6	760.00	9	1,352.77
California	201	24,538.28	306	39,882.99
Colorado	195	26,473.31	329	47,436.05
Dakota	5,133	868,400.36	9,368	1,466,532.34
Iowa	55	3,644.25	82	6,235.62
Kansas	1,924	268,575.09	1,933	273,053.55
Louisiana	19	2,293.40	7	1,004.02
Minnesota	1,168	167,582.16	1,220	176,741.42
Montana	131	16,535.20	266	35,409.94
Nebraska	1,682	240,306.94	2,086	298,520.11
Nevada	7	1,040.00	10	1,520.00
New Mexico	16	2,039.26	24	3,351.99
Oregon	212	31,176.40	590	88,038.77
Utah	35	3,921.52	32	3,831.71
Washington	540	77,008.62	603	87,524.76
Wisconsin	1	40.00	....	....
Wyoming	5	784.30	20	2,284.44
Idaho	224	28,680.26	272	33,965.61
Totals	11,554	1,763,799.35	17,157	2,566,686.09

By this table it will be seen that, since the passage of the original act in 1873, 93,246 filings, covering 13,637,146 acres, have been made. Of that amount there have been filed upon since the passage of the amended law in 1878, 11,177,510 acres.

Of this amount of 13,637,146 acres on which timber filings were originally made, it is safe to say, from information received from various government land offices in the prairie states and territories, that at least one-third has, for various causes, been canceled or entered under other acts, leaving, say, 9,000,000 acres held for the present under the provisions of the timber-culture act.

Before giving an opinion as to the practical operations of the law, attention is called to the statements of those who, from official position or other circumstances, may be supposed to have the best opportunites for practical observation of the workings of the act and the amendments it needs to make it more efficient. Hon. Charles A. Morris, register of the United States land office at Larned, Kans., writes:

I have to state, in reply to your letter, that there have been made at this office, since it opened for public business, Feb. 15, 1875, 4,611 timber-culture entries, embracing about 700,000 acres, and of these entries there have been canceled by contest and voluntary relinquishment about one-third, embracing about 233,000 acres.

The object of the timber-culture law is to encourage and foster the growth of timber on the Western prairies, and the fact that it is not more generally successful is owing to the traffic in "claims," entered under its provisions by claimants who appropriate public lands under this law for speculative purposes, and when opportunity offers, sell to homestead and pre-emption settlers; thereby not only defeating the object of the law, but forcing the new comer to pay a bonus to secure a desirable location for a home which he otherwise might have obtained at a minimum cost, to-wit, the government fees. This evil can be remedied and the law made effective, and the growth of forest trees on the Western prairies assured, by so amending the timber-culture act of June 14, 1878, as to provide that land once entered under its provisions be ever afterwards appropriated thereunder, and not subject to entry under any other law. I would suggest that section 3 of the timber-culture act, approved June 14, 1878, be amended as follows, viz.:

"*And be it further provided*, That lands once appropriated under this act shall not, in case of the cancellation of a timber culture entry, or from any cause, be subject to entry under any other law, but shall be only subject to entry under this act."

An amendment of this kind would stop speculation of the nature I have stated, and, in my judgment, insure beyond question, the successful growing of timber in Kansas, for land once entered under this law would be thereafter forever dedicated to the successful growing of timber, and title could only be obtained, by the original claimant or otherwise, by making the growing of timber a success, and it has already been demonstrated that timber can be successfully grown even in Western Kansas, by honest and intelligent effort.

E. A. Knidler, register, and C. H. Gould, receiver of the United States land office at Miles City Mont., present some valuable ideas about the operations of the timber-culture act in the following letter:

We would state that the intention of the act is excellent. Theoretically the law is good, but in the practical application of the same it has proved very faulty.

It is an excellent law for speculators in prospective town sites, as one person, at least, in Eastern Montana has discovered, said person taking up a "tree claim" at the cost of fourteen dollars, and, before expending one penny for breaking, even, received $5,000 for his relinquishment.

We are of the opinion that out here nine persons out of ten, who make timber-culture entries, do not expect to ever plant a cutting, slip, or to sow a seed of a tree.

The lands most sought after in this land district are the bottom lands along the Yelolwstone, the Tongue, Powder, and Rosebud rivers, and nearly every section along and skirting those streams contains more or less timber. The average speculator endeavors to take the best bottom lands, and with just as many trees upon the section, and frequently upon the tract actually entered under the timber-culture laws, as they dare or can; they hold the land a year or two, and then, if it is not contested as fraudulent, they relinquish their entry, asking that their right and fee and commissions be returned to them, upon the ground that the entry can not be confirmed, the land not being subject to timber-culture entry. There has not been, to our knowledge, a cutting, seed, or a tree planted upon a timber-culture claim in this land district, but cottonwood trees have been planted in the yards and streets in town, and nearly all have grown, although the ground has never been prepared or cultivated. In our opinion, trees can be successfully raised upon prairie land, by careful and intelligent care and culture.

We think the present timber-culture laws should be repealed or amended as follows, viz.:

1. The applicant should be required to swear that he personally examined the whole section of six hundred and forty acres, finding the corners of the same, and that there is not, at the date of the affidavit, and apparently never has been, upon the said six hundred and forty acres, any trees, shrubs or brush growing thereon, excepting —— (describing the growth). This would enable the local officers to judge by the affidavit as to the character of the land. Under no circumstances should the applicant be allowed his right and fee and commissions restored to him.

2. When a tract of land has once been withdrawn by a timber-culture entry, it should not thereafter be subject to homestead, pre-emption, scrip location or cash entry, provided the land should be properly subject to timber-culture entry. Nor should more than three timber-culture entries be allowed for the same tract, the former entry having been canceled for relinquishment, or upon proof of non-compliance with law after contest. The tract thereafter (the three timber entries have been made) to become the property of the State, upon proof of compliance with the requirements of the timber-culture laws, on the part of the duly authorized agent for the State.

This, we think, would stop speculators from taking timber-culture claims, and would have the effect of eventually establishing ten acres of good timber upon every even numbered section of United States lands, the same being prairie land.

3. The amendment of the act, whereby the same commissions and fees are to be paid by the applicant as would be required under the homestead laws for the same tract.

Under the homestead laws the applicant for 160 acres of double minimum land in Montana, and ten other states or territories, is required to pay at date of entry $10, fee to the United States and commissions to the local officers of $12, and the same commissions for the local officers at the time of proving up under the homestead law, viz., $12. Under the timber-culture laws the fee to the government is the same, but the commissions to the local officers are only $4 to be paid when entry is made, and $4 to be paid when proof is made; making a loss to the local officers of $18 for each 160 acres taken under the timber-culture laws.

Thus the law as it now exists virtually offers a premium, and makes it a great object to local officers where the maximum is not attained (and those are in the majority) to discourage timber-culture entries. We do not think the timber-culture law strong enough to carry so heavy a weight; they are too heavily handicapped.

We may be too strong in our suggestions to suit you, but the above are our honest opinions.

Soren Listoe, register of the United States land office at Fergus Mills, Minn., says:

The timber-culture act by no means has proved to be of so great a benefit to the public as has been expected, still I would consider it a great calamity and a serious mistake if said act should be repealed. It is true that a great number of acres have beed entered by speculators under said act, who, for instance, hold it two or three yerrs and then sell their rights to other parties. But on the bleak prairies of this State and Dakota I know of a great many claims which have been entered by parties, actual settlers, who honestly try to carry out the provisions of the act.

Hon. J. V. Bogert, receiver of the United States land office at Bozeman, Mont., speaking of relinquishments under the timber-culture act, says:

It is my opinion that speculation, expense and labor mainly caused the relinquishments. I do not conclude that the relinquishments, to any extent at least, are caused by the failure of trees to grow, if properly cared for.

It is my opinion that the time given in which to perfect an entry is too long; it encourages speculation in public lands, enabling parties to hold them eight years, in very many cases without planting a tree. Contests are not so often brought; parties do not like to antagonize neighbors; while the fact that inclosed or cultivated land has been taken under the timber-culture law may be, can be, and no doubt often is concealed.

I see no reason why parties should not be obliged to plant a certain area in trees, and during the first continuous summer succeeding their filing, if made *during* a summer, and during the summer succeeding filing if made *prior* to a summer. I do not notice any necessity for the first year's plowing and the second year's cultivation, if I am to judge from local success with trees without said work and use of time. Of course, I know that trees require care and ground preparation, but, were said two years not given, more compliance with the law would follow and less speculation in entries result. Again, at stated times during pendency of each case, parties should be obliged to appear at the local land office and prove compliance with the law. This would force compliance or relinquishment, and do away with eight years' withdrawal of much land.

W. E. Powell, the general agent of the Chicago, Miwaukee & St. Paul Railroad, writing of the workings of the timber-culture act, and referring particularly to the Territory of Dakota, says:

The tree-claim law is shamefully abused in that Territory. While it was made for the benefit of the actual settler, there is no chance for him to get a tree claim at all. They are all taken up in each township by speculators in less than twenty-four hours after the township is in market. They file them under fictitious names and hold them until a settler comes and buys them for $300 or $400 each, but, if they can not sell them before improvements must be made on them, they relinquish them to each other or to some unknown parties, and get new filings on them, and they can keep them so many years withou any planting whatsoever, thus circulating reports among the ignorant that trees will never grow on prairie land. We will prove to the contrary.

D. S. Hall, register of the land office at Benson, Minn., says:

I have no doubt that the timber-culture law is, and has been, a cloak for covering large tracts of good land by parties who have no idea of ever complying with the law, as far as planting trees is concerned; but a slight amendment to the law, requiring the parties to promptly and strictly comply with the requirements thereof, would remedy the evil and stop the fraud.

D. S. Grimes, a gentleman of great experience in tree growing, and for many years a resident of Denver, Col., writes:

With the timber-culture act as it now stands, the incentive to planting is to secure title. The claimant does as little as possible to comply with the requirements of the law; he has no pride or sympathy with his work only as refers to obtaining title. The planting, protection and healthy growing of his trees for eight years is sworn to by interested and accommodating neighbors, hence this act is often taken advantage of. To repeal this act would do the West great injustice. It should be amended so as to compel a faithful performance of the contract on the part of the claimant. Instead of one entry of 160 acres to each section, there should be two entries allowed, not to exceed 80 acres each, upon a section of 640 acres to be planted to timber in the same proportion as provided for in 160-acre tracts. The advantage of dividing 160 acres into individual timber entries can plainly be seen:

1. The timber is in two plantations instead of one, and perhaps located in opposite parts of the section, and will be benefiting twice the number of settlers.
2. One hundred and sixty acres are too much for a man of limited means to cultivate successfully; the area of land being so much greater than his ability to control, neglect and failure will result.

A state or district forester of practical experience should be appointed by government, whose duty should be to give information free to all applicants upon the subject of forest culture. In making final proof on a timber-entry the forestor should first make a personal inspection of the lands claimed under the act, and if the law has been fully and faithfully carried out, then his certificate should be sufficient evidence that the law has been complied with. This will not only compel the party claiming land under the timber-culture act to be thorough in planting and cultivating, but will save to the government thousands of acres annually that would otherwise pass into the hands of dishonest claimants.

Mr. D. Pratt, an old resident of the plains country, sends the following suggestions:

I would first repeal the acts granting lands for timber culture and for pre-emption claims, and permit claims to be taken only under a modified homestead act. The changes I would suggest in the homestead act are as follows: I would allow a settler to take any number of claims he chooses, up to one section, 640 acres, with this proviso, that on each and every quarter section granted him he should plant, cultivate, protect and maintain 16 acres of timber across either the entire north or south side of said quarter section. The planting I would require to be done in the following manner, viz: Previous to the first day of June next succeeding said homestead entry he should break across the entire north or south side of each quarter section not less than 4 acres. And previous to the first day of each succeeding June, for three consecutive years thereafter, 4 acres more, or until 16 acres are broken. The first 4 acres should be planted within two years, or the second spring after the land is broken, and 4 acres more annually planted thereafter until the 16 acres are all planted. The land should be thoroughly cultivated the year previous to planting, and each succeeding year till the trees are at least six years old. I would make the cultivation of the land thus granted, other than the sixteen acres above specified, entirely optional with the grantee, but would require an actual residence on the land, which the timber-culture act does not.

S. M. Emery, of Lake City, Minn., says:

My personal observation in tree planting has, in the main, been confined to the portion of the West contained in Western Minnesota, Northern Iowa, and Eastern Dakota, where many farms have been taken under the timber-culture act. These apparently have not always been successful in the production of timber, not from any constitutional difficulty in the soil but from force of circumstances, and these mostly arise from the inability of the pioneer settler to obtain suitable stock for planting, the lack of knowledge as to culture, and lack of means to give the land suitable cultivation. I have seen some very fine groves of artificial timber, mainly white willow and cottonwood. There is nothing in the working of the law that prevents the growth of timber. Land well broken and backset the first season, cropped to flax the second season, this cut, and the land plowed and harrowed thoroughly in the fall, immediately after harvest and then planted to either box elder seed or hardy seedlings; and then the same care given the crop that a good crop of corn should receive, will surely produce a magnificent growth of trees. This I know for a personal fact, having had the management of five timber claims aside from my own. The number of claimants who have proved up is small beyond doubt, as it is not a law of long standing. That there are frauds under the law we do not donbt, but it is fashionable nowadays to do this. If millions of acres of valuable pine timber can be stolen under the pre-emption act, it would not be strange if fraudulent proofs may be made on timber claims. I have thought much over the best way for government to manage the timber-claim filings. It does not seem right for a man to cover one hundred and sixty acres for three years, then relinquish to some other party who can do the same thing, and thus indefinitely cover and hold a piece of land. Again, the law is much abused in the planting of seed. It would seem advisable to me that a claimant in case of contest for non-compliance with the law, who should base his defense on having planted seed which did not germinate, should be made to show by at least four witnesses of unimpeachable veracity, that the seeds were actually planted and that a series of as formidable questions and answers as are needed for proof paper should be used to prove his defense. This would work no injury to innocent parties, and would certainly have the effect of making men careful. I think the law should plainly state that 27,000 trees should be planted on ten acres in rows eight feet apart, trees two feet apart in the rows. This will admit of crop cultivation in half the soil and will leave trees in better shape for trimming. I think an annual cultivation should be required, for at least six years of the eight. It might be worthy of consideration, the idea of allowing a man to commute at the end of the fourth year from filing, provided he can prove the existence of six hundred and twenty-five good trees on each of ten acres by payment of one dollar and twenty-five cents per acre. The effect of all this would be to open up that much more land. Of course no purchaser would destroy so valuable a property as ten acres of growing timber. * * * I am sanguine that we will yet see our bleak prairies dotted with noble clumps of timber, the result of the act.

It will be seen that the testimony of these witnesses, government officials and others is uniform. They all state that in many instances the law fails of its main object, the extension of the forest area of the country. The great evil pointed out by all of them is everywhere the same, viz., the sale or transfer of timber claims by the original claimants to speculators and other parties.

I have already called attention to the fact that of the 13,000,000 acres filed under the timber-culture law, at least one-third has been canceled or entered under other acts. It is safe to say, with the statements herein given before us, that within a brief period, unless the law is amended, a large portion of the 9,000,000 acres remaining will be diverted in a similar manner. Admitting that the law is defective and that men are dishonest, and that they perjure themselves in regard to timber-culture claims just as they frequently do in regard to the homestead filings, is it proven that the law utterly fails of its intention; that it has accomplished no good purpose, or that it can not be made to do so? The testimony does not show this. None of the land officers or others whose observations we have given recommend the absolute repeal of the act; they simply recommend its amendment and its enforcement. The objection made that natural causes make compliance with the law impossible, in other words, that trees can not be made to grow with proper care, is nowhere sustained. On the other hand, the evidence is overwhelming that in all the country between the Mississippi and the Rocky Mountains trees will grow under cultivation, and that no man can yet say where the line is located, beyond which forestry is unprofitable.

From a mass of letters and reports from all parts of this vast region we give the following:

B. P. Hanon, of Reno County, Kansas, writes:

In every instance in our knowledge where suitable varieties have been planted and properly cared for afterwards, they have grown well and proved satisfactory.

Mr. E. E. Ballou, of the United States land office at Helena, Mont., says:

I am fully satisfied that cottonwood, balm of Gilead and box elder, all of which are native, can and will be cultivated successfully here. The silver-leaf poplar also grows quite as thrifty as any of them. I should much regret the repeal of the timber-culture act, for I think it will prove a great blessing to this as well as other territories if continued.

Mr. D. S. Hall, register of the United States land office at Benson, Minn., says:

No person who knows anything of Western prairies will deny that planting trees thereon is the very thing of all others to make it a place to be inhabited by man. I speak from years of personal experience when I say that it is perfectly natural and easy for trees to grow on these Western prairies. Where prairie fires are kept from running, groves of trees spring up at once. I know of a grove of heavy timber, containing sixty acres, which stood in the centre of the prairie, miles from any other timber, in Renville County, this State. This grove was almost surrounded by water, which protected the land from the ravages of fire. It was called Bird Island. I could refer you to any number of illustrations to show you that trees will grow on these prairies if you will only let them, and also that by the slightest effort nearly all of the valuable timber-producing trees may be successfully grown out on the prairies.

The evidence of E. T. Byram, county surveyor of Jewell County, Kansas, is to this effect:

If anyone has any doubt about this matter he has only to pass through this and adjoining counties and see the beautiful small groves and windbreaks of different varieties of forest trees to be fully convinced that trees will grow on the prairies two hundred miles west of the Missouri River. There has no doubt been a great deal of deception and fraud practiced in regard to timber entries; but the same may be said in regard to homesteading. I do not know how these evils can be remedied, but I do know that, although I have less than three years remaining of my threescore and ten, yet if I needed to do so I would plant forest trees with an abiding trust that I would live to reap the benefit of my labor, and that in less than ten years I would have all the fuel I would need year in and year out.

Soren Listoe, of the United States land office at Fergus Mills, Minn., gives his opinion as follows:

In this land district but three timber claims have so far been proved up; upon all of these the trees were in good condition, and one of them which I have myself inspected presents to-day as fine an appearance as if it was a regular nursery, composed of cottonwood, ash and white willow; the trees are from twelve to twenty feet high, and some of them fit to be used for fence-poles to-day. I think it can be safely said that any man who will prepare his ground properly, and cultivate the trees after they are planted, can raise timber successfully in this State, and in Dakota, where I am acquainted.

T. G. Clark writes from Osage County, Kansas, a hundred miles west of the Missouri River:

Tree planting on the prairies is no longer an experiment, but a successful business. The time has come in the history of this nation to encourage the planting of forest trees, and I think it unwise to repeal the timber act. I think the law should not restrict the planting of every valuable variety of trees, but let the settler plant such kinds as will succeed best.

FORESTRY AND IRRIGATION.

It is asserted that a vast portion of the interior country of the continent, including portions of the States of Texas, Kansas, Colorado, and the Territories of Dakota, Wyoming and New Mexico can not be cultivated without irrigation, and this brings up the very natural question, why should they not be cultivated with it? It is admitted that forests affect the rainfall, or at any rate the general humidity of the atmosphere; why should not the rule be made to work both ways, and forests be sustained by the water now available, even in the most arid portions of the country, and the forests, on the other hand, be made to preserve and increase the supply of moisture?

The great open, high and dry country of which I am speaking, estimated in extent at three hundred miles wide and eight hundred miles long, is not naturally unfertile. It is not a sandy desert, or a rocky waste, of no intrinsic value for agricultural purposes, but the soil for the most part is a rich loam, possessing the constituent parts of rich, tillable soil.

The country is not entirely destitute of water, by any means; it is traversed by the Canadian, the Arkansas, the upper waters of the Kansas, the North and South Platte, the Rio Grande, the Nebraska, the Cheyenne, and many such streams as the Cache la Poudre. These streams are alike in their character; each has a wide shallow bed, shifting channels, swift currents, and a fall of from seven to ten feet to the mile. The banks are very low and the valleys wide, and with a descent to the eastward corresponding to the fall of the streams.

With water, and a fertile soil which only needs water, why should not the two be brought together? This is, briefly, what may be termed the "irrigation question."

To consider the difficulties, first, it is said that the streams mentioned can not be depended on to furnish the requisite amount of water at the season when is is needed. To this objection it is answered that there is every natural facility for the construction of immense reservoirs for the storage of water during the winter and the portion of the year when there is a surplus; and, further, that the great plateau is traversed by subterranean streams which may be reached by digging. The surface streams, which seem to dry up at some seasons, merely sink into the sand, and the fact is called to mind that in 1859-60, the driest season ever known within the memory of man, when in the country west of the Missouri no rain fell during a period of nearly twelve months, water was found by digging in the beds of these streams.

The best and safest rule in endeavoring to ascertain whether a thing can be done is to secure an answer to the question, "Has it be done?" Applying this rule to the irrigation question it will be found that irrigation has been successfuly carried on along the banks of the Rio Grande for the three hundred years that the country has been known to white men, and for indefinite centuries before the Spaniards landed in North America. The irrigating ditches in the valley of the Pecos may have been dug when the pyramids were young.

The results of irrigation carried on by an imperfectly civilized and unprogressive people, with the rudest implements, may be seen from the point where the Rio Grande leaves the mountains, for hundreds of miles; and amid a land which elsewhere seems cursed with eternal sterility, winds the green belt of trees and orchards, of fields and vineyards watered by the Rio Grande or its tributaries, from the garden of the archbishop of Santa Fe to the mass of verdure which enfolds the old New Mexican town of Las Cruces.

This is the work of a people with no scientific knowledge of hydraulic engineering, carried on with hoes and plows such as were in use in the days of Abraham. Can no more be done by Americans than by New Mexicans and Indians? Are the resources of modern agriculture inferior to the unchanged inventions of a Pueblo Indian? Must we abandon a country to desolation which Mexican peons have found capable of cultivation?

Answers in the negative are not wanting. Not to speak of the wonderful success achieved by the Mormons at Salt Lake, there may be cited what was once known as the "Greeley experiment," which is an experiment no longer. Saying nothing of the success in the direction of farming and gardening which has made the Greeley community one of the most prosperous in the United States, the growth of trees has been enormous. The cottonwoods planted in the early days of the colony are giants in size now, and other trees are growing finely and will eventually take the place of the "pioneer tree." Not far from Greeley is Fort Collins, the seat of the agricultural college of Colorado, and of the success of tree culture there, P. M. Hinman, the secretary of the college, writes:

> In regard to the growing of trees in this region, I will say that there has been a large growing interest taken in the past few years, and trees are being put out very extensively; I know of some walnuts in bearing and others being planted. Should think that the next ten years will find a very rapid increase both in the amount of land devoted to the growth and the kinds planted.

This is but one case. At various points in Colorado and in Wyoming irrigating ditches, to be in some cases sixty miles in length, are in course of construction. Wherever these ditches run, trees will grow, transforming the face of the country. It has been noticed, too, that in abandoned ditches young cottonwoods spring up by thousands, the presence of water the year before seeming in some manner to promote their growth.

At Garden City, Kansas, near the borders of Colorado, on the line of the Atchison, Topeka & Santa Fe Railroad, irrigation has been begun on a scale which bids fair within a few years to be the most extensive within the limits of the United States. The source of supply here is the Arkansas River, and the fall is so great that the water taken from the river twenty miles above Garden City, when it reaches that point, can be carried over the high plateau known as the "Second Bottom," and so an immense area is embraced within the possible limits of irrigation.

With the first beginnings of cultivation trees were planted, and this growth has been surprising. This much has been demonstrated, that there is nothing in the character of the soil to prevent a tree growth as luxuriant as can be found anywhere within the limits of the United States.

The theory that the high plains were once covered with forest, and that at a not remote period, is sustained by some remarkable facts. It is certain that the trunks of large trees are found in the bluffs or hills, miles from the water courses, and that not many years ago these giants of a century's growth were quite numerous.

Long before the settlements had encroached upon these plains, the Arkansas, the Platte, and other streams were skirted with timber which gradually disappeared as you traveled westward. These same streams were supplied with considerable bodies of timber from the mountains eastward. The intervening distance from where the timber disappeared on the east to where it again begun on the west was perhaps two hundred miles, although in the adjoining bluffs, at points where no trees or even brush was found along the streams, bodies of old trees were found and used extensively for firewood.

The digging of irrigating canals is the signal for a heavy volunteer growth or timber along their borders, the cottonwood, the willow and the elm predominating. Forest trees planted by the settlers or ranchmen upon the bottom lands, at any point between the Missouri River and the mountains, seem to live and flourish without further attention. All plainsmen remember the immense "lone cottonwood" tree that stood for a century, far removed from the Arkansas River, in the vicinty of Fort Dodge, Kansas. For years large supplies of cedar were found in the hills near Julesburg, Neb., not far from the confluence of the North and South Platte rivers; this timber was used extensively by Ben Holliday's overland stage line, even as late as 1865.

The average annual rainfall of this great plain, which extends from the Territory of Dakota to the Rio Grande, does not exceed twelve inches. Although it is claimed that timber will not grow in a region where the annual rainfall is less than twenty inches, and although it may be argued that the great plains are treeless because they are rainless, and not rainless because they are treeless, people who have lived on the eastern border of the great desert for the last quarter of a century, and noted the climatic changes wrought in that time, and who have seen this border pushed westward several hundred miles, have faith to believe that not only will the civilization of the Missouri Valley, fostered and sustained by modern forms of agriculture, be met from the West by that sustained by artificial water supply, but that the nineteenth century will witness the highest forms of horticulture and agriculture successfully practiced, upon an unlimited scale, in the very heart of this now treeless and rainless desert.

KNOWLEDGE IS POWER.

The great gain so far made, is that of knowledge, and to this great gain every discussion, every report, every experiment, every success, every failure even, has contributed. The too enthusiastic have learned moderation, and the despondent have been encouraged. No man who has looked over the ground will maintain that all kinds of trees will grow in the high prairies and plains that grow in lands of mists, rain and mountain, and, on the other side, no thoroughly posted and practical prairie farmer or plainsman will say that trees will *not* grow, even in the constantly diminishing precincts of the "American desert."

SUITABLE VARIETIES.

It has been decided what trees grow best in the prairie states, and a hundred tree planters selected from different localities in the states and territories embraced in this report would, if called upon, report the same varieties. They are the ash, black walnut, box elder, cottonwood, honey locust, Osage orange, silver maple, catalpa, Russian mulberry, white elm, and gray willow. It is not to be understood that no other forest trees will grow; many other trees are indigenous; but it is to be understood that where a selection is to be made these trees are most available. In selecting others the chances of losing time and money are increased.

PROPER METHODS OF CULTIVATION.

In addition to this useful knowledge certain points have been reasonably well settled in regard to the cultivation of these trees, and we give these directions in the language of one of the most successful foresters in the country, Mr. C. H. Longstreth:

> Trees should be planted closely, for immediate and mutual protection; second for economy in culture; third, for the purpose of securing valuable timber and early returns from the planting. There evidently was a want of practical

knowledge with our law makers on this question when they framed and passed the timber act allowing trees to be planted twelve feet apart each way. Trees planted such wide distances can never serve the purpose of a forest, but will virtually become an open orchard.

Propagation. — As a general rule the best and cheapest mode of growing trees for timber is by means of the seed; some kinds, such as the cottonwood, the willows, and most of the poplars, may be readily propagated from cuttings.

Preparing the ground. — In preparing the soil for planting of seeds and young trees it is essentially necessary that the ground should be deeply plowed and well pulverized.

Distance apart. — We have practiced planting in rows 4, 6, 8, and 12 feet apart, with trees 2 to 3 feet apart in the row, the results so far being in favor of rows 4 feet apart. Trees that naturally grow upright may be further apart than those of a spreading habit. In no case would we recommend putting the rows over 6 feet apart.

Planting. — Seeds that start with a delicate growth should be planted in nursery rows, or in a seed bed, to be transplanted to the forest at one or two years old; seeds and cuttings of a vigorous growth may be planted right out in the forest rows. The nut-bearing trees do not transplant well, and the seed should be planted where the trees are to remain. We would advise, most decidedly, not to allow your trees in nursery rows to get more than two years old before transplanting; and they are better transplanted at one year old. One-year-old trees are sure to grow, having in proportion to the top, more and better small fibrous roots. Young trees cost less throughout in handling and planting, and in the end make a larger, thriftier, healthier, and better tree every way. Be careful not to expose the roots of trees in handling; set them one or two inches deeper than they stood before, and press the earth firmly about the roots.

Cultivation. — To be successful in the growing of trees it is essentially necessary that they should receive good, thorough cultivation. You might just as well expect to grow a crop of corn without cultivation as a crop of trees. Too many people allow their trees to die or be ruined for want of a little care and cultivation, and then complain that tree growing is a failure. Neglect is a failure everywhere. Cultivate well in the early part of the season; allow no weeds or grass to grow; stop all cultivation with the plow after the middle or last of July, this being done in order to let the trees have time to ripen their wood and be in good condition for the winter; pull or hoe out all the weeds that may come in late in the season. In plowing among trees a short whiffletree should be used to avoid injuring the trees. All trees planted in the spring should be ridged the following November by turning a furrow against them on each side with a light plow; the ridges may easily be leveled in the spring with the cultivator. After three or four years, or as soon as the trees shade the ground, they will need no more cultivation, and they will thereafter need but little care. Be careful to keep stock from running among the trees, as they are very injurious, even after the trees attain a large size.

Pruning.—This is a subject that has been much discussed, and in regard to which there are various opinions, some even contending that trees should not be pruned at all. I shall consider it here only in relation to forest culture.

When there are more than two leading shoots they should be cut out to one, leaving the largest. Any side branches which detract in size and vigor from the leading shoot should be shortened or cut off entirely. This is all the pruning we find necessary in a closely planted forest; nature will do all other pruning.

Thinning.— Here is where we get our early returns. Several of our rapidly growing trees, if they have been properly planted and taken care of, may, in four or five years, be thinned out to advantage, care being taken to leave the straightest and most vigorous trees; then thinning gradually as the trees grow larger.

In a convention of nurserymen and tree growers it is quite probable that there would be found gentlemen to take exception to these rules. It is also true that these directions were given originally for the benefit of Kansas tree growers; yet Mr. Longstreth's views as to varieties, close planting, and cultivation have been indorsed by tree growers and men of experience all over the country, west of the Missouri, writing without consultation with each other.

THE BEST TREE.

Something has been learned, too, of the relative value of trees. Limited as the list seems, few persons will care to plant them all, and a choice must be made. In making the selection we should advise as the first choice the black walnut. It seems for the first three or four years a slow grower, but after that period it grows rapidly; and admitting that the soft-bodied trees grow faster at the start, they are of little value when grown, while the black walnut has an actual money value greater than that of any other American forest tree. It should be the Western forester's main reliance; but between the walnuts experience has shown that other trees should be planted which put forth their leaves earlier, though they may not be worth so much for their wood, such as soft maples, box elders, or cottonwood. The latter have the further advantage of compelling the black walnut tree to run up straight and high, and they serve to shelter and protect it from the hot sun and drying winds.

INFLUENCE OF DISCUSSION.

The varieties best for planting and their mode of cultivation having been definitely settled, the next great step is to ascertain and employ the best means to foster and encourage the work of tree planting. In this direction much has been done. Societies, notably the Forestry Association of Minnesota, have done much, and meetings like those of the American Forestry Congress at Cincinnati and Montreal have excited general interest. It is certain that never before in the history of this country has forestry been so generally a subject of interest among all classes of people.

THE FUTURE OUTLOOK.

It is but nine years since the timber-culture act, the first law of Congress designed to encourage tree growing, was passed. It is only four years since the law was so amended as to encourage action under it. The first timber claims are now being proved up, and the advantages and demerits of the law are now fully known. The subject has already been discussed in this paper. There can be no doubt that Congress will take action and so amend the law as to prevent fraud, and embody in the law the condition, "once a timber claim, always a timber claim," and so give an immense impetus to tree growing on the prairies. Thus, with increased and increasing knowledge; with enlightened self-interest, and the government of a nation pledged to the protection of the forest lands, still the common property of the people, from spoliation, the encourager of the honest settler under the timber-culture act, and in time, the active promoter of schools of forestry, we have much to hope for.

WHAT SHOULD BE DONE.

Before giving my own views on this phase of the subject, I will read a letter written by a Canadian gentleman to the commisioner of agriculture, and by him refered to me for my consideration.

SALIENT FEATURES OF THE AMERICAN FOREST QUESTION.

1. A little more than a hundred and fifty years ago, Europe was awakened to the fact that her timber supply was being gradually exhausted. The forests were either in private, municipal or ecclesiastical hands, or so saddled with private rights that the states had no adequate control of them.

2. The consequences apparent were: Expoliation of immature timber to the serious depreciation of the annual yield; the consequent want of first-class timber for ship building and other important works; the destruction of seedling trees by cattle,

resulting in a scanty crop of low, bushy trees — in a word, the area was being gradually contracted, and the annual yield reduced so much by mismanagement and neglect that it fell below the annual consumption; capital stock was being trenched on, a condition under which utter exhaustion becomes a mere question of time.

3. Austria, Germany and France rose to the emergency; they extinguished private rights, introduced state control, and demarcated the areas to be maintained as permanent forest. Germany reserved a third of her total area as forest, Austria a trifle less, and France nearly a fourth. Their aim was to increase the timber production to the highest capability of the reserved area, and to limit annual expoliation to annual increment.

4. Forest management in all these countries is now a great state industry, scientifically conducted. It is under the control of a specially trained department. The remedial measures have exercised an important bearing on the well-being of the countries named, and, what is more to the purpose, the undertaking has proved remunerative. The timber and other forest products yield a revenue leaving a margin of profit on all costs, including rent of the land.

5. In America both the states of the Union and provinces of the Dominion have already passed the stage at which remedial measures were introduced in Europe, and the outlook is a far more serious one for us; firstly, because our population is growing at a rate unparalleled in the past, and secondly, because the whole interior of the North American continent depends now, and must continue to depend, upon the Atlantic and Pacific states for the great bulk of its timber.

6. The saddest feature in the American timber problem is that the people have not yet shaken off the old tradition that "timber land is worth the value of the land less the cost of clearing." The stock of American timber is now so reduced that if artificial causes were not at work to keep down prices, there is not an acre of timber land on the North American continent that could not be sold for the amount which it would cost to reproduce it.

7. These artificial causes referred to are on the surface. England, with her wealth of iron and coal, favored by her insular position and large foreign trade, did not trouble herself about growing timber as long as she could supply herself from the supposed inexhaustible supplies of Northern Europe, cheaper

than she could grow it. She consequently supplied herself from Sweden and Norway, which possessed large natural forests, costing nothing. England was a first-rate customer to these countries, and in due course North America began to compete for a share of the trade; the market was overstocked, and prices naturally fell to the narrowest possible margin on the cost of bringing the timber to market.

8. In the struggle Sweden and Norway have denuded their natural forests, and are now organizing measures for restocking them at about three times the price at which they sold their natural crop.

9. As a consequence, America has the monopoly of the English trade; an enormous home demand undergoing rapid development; her stocks are undergoing such rapid exhaustion that by withholding supplies she could command prices undreamt of by the most visionary; but, in the face of these facts, the governments of the United States and the Dominion leave the control to private parties, who, in a spirit of competition, go on flooding the markets to their own and the national detriment.

10. Good pine timber requires a century for its development. There is as much timber now growing on the American continent as, with proper management and restriction of expoliation to ascertained annual increment, would avert a severe timber famine; but if the problem is not soon grappled with, America will ere long be dependent on Europe for her timber supplies.

11. The position is too critical for temporizing or half measures. The difficulty can only be met by the resumption by the State of untrammeled control of its remaining forests. This is an heroic measure, but nothing less would save the country. It would be costly, but the most pecuniarily profitable investment the State ever entered on. The problem is so grave as to demand the most careful consideration of the ablest advisers of the Union and Dominion governments. And much would be gained if the two would operate harmoniously on a prearranged basis.

12. If the program I have suggested were adopted conjointly by the Union and Dominion governments, existing stocks held back and felling stopped for three years to work off private stocks, and let the demand make itself felt, prices would go up with a bound, and I do not think they would stop far short of $200 per 1,000, American quotations.

13. At such rates the remaining forests, instead of hastening to extinction, would be permanently revenue-producing, besides

yielding a fund to meet the costs of a measure of forest administration commensurate with the future requirements of the continent.

In a country like this, where the power of the general government is scarcely known or felt, reliance must be placed upon the voluntary action of the individual. In European countries, where the government regulates everything, even to the amusements of the people, a system of forest laws can be adopted making the planting and preservation of forests obligatory, but such a system can not be inaugurated here. The government can not here compel all men to set out trees or care for them; and it is questionable if it can give much successful encouragement in the way of bounties. On the other hand, the government of the United States has a right to take care of its own. A quarter section of land in the prairie or on the mountain side is, until it is conveyed by the government to a corporation or individual, as much the property of the United States as is the capitol at Washington, or a fort or vessel flying the flag of the United States. It is as much the duty of the general government to protect that quarter section from invasion or spoliation as it is its duty to save the patent office or treasury buildings at Washington from robbers or incendiaries. Of course, the letter of the law recognizes this principle, but no laws have been more systematically violated than those designed for the protection of government lands. The theory has obtained that these lands belong to the first settlers, and that their product is to be used by them for their own individual benefit, under the plea of "Developing the resources of the country." Every man who has cut cordwood on the government land, and sold it and put the money in his pocket, has justified his course by saying that the operation "developed" the country, and thus increased the value of the government land itself. Nothing can be more pernicious in theory or practice than this. These lands do not belong to the first settler, or the first thousand settlers, which may come into their vicinity; nor the first corporation which may gain a foothold. They belong to the nation, which is the trustee for fifty millions of people. A citizen in Maine has as much interest in them as a citizen in Kansas or Colorado.

SPOLIATION OF GOVERNMENT TIMBER.

In regard to the forest lands still the property of the United States, the question has arisen, shall they be protected for the benefit of the country and of generations yet to come, or shall they be reduced to desert wastes for the private benefit of speculators and corporations? Take the case of the government forest lands in Colorado. Twenty-four years ago the slopes of the Rocky Mountains were covered with the untouched forests sufficient, if properly cared for, to supply the *reasonable needs* of the settler and miner, as contemplated by the law, till the end of time. In the shadow of these forests rose the headwaters of the Rio Grande, Platte, and the Arkansas, and the snow in the deep woods melting slowly, the rise of the stream was gradual and uniform for a long period. To-day these mountains are being left peeled and bare. The mountain side is being converted into a bald, bleak desert, the springs are drying up and the Rio Grande, Platte, and Arkansas now rise with sudden violence and then sink as suddenly in their dry and diminished beds. In other words, the people of Colorado, Kansas, and New Mexico are having inflicted upon them incalculable injury, and a wrong is being done which, if not arrested, will affect disastrously generations yet unborn.

In return for this devastation of its property, the government receives nothing; its magnificent estate is laid waste, and it gains nothing in the way of recompense. The land is nominally in market at $2.50 an acre in bodies of 160 acres to one individual, but it is not being purchased to any extent. With a view of aiding the poor settler or needy miner, a law was passed some years ago allowing him to take timber for domestic use, meaning thereby, evidently, his personal use, for fencing, firewood, or lumber necessary in the actual construction of his mining shaft. The law was certainly liberal enough, and was so liberally interpreted by the settlers that it was found necessary to send government agents to the spot to protect the rights of the government; but since that period the words "domestic use" have been interpreted to mean the right of the "party of the first part" to cut timber and sell to other parties for their use. Under this ruling there were lying in one mountain stream in September, 1882, half a million railroad ties, indicating by their length that they were intended for the "domestic use" of a broad-gauge railroad outside of the limits of Colorado, where the narrow-gauge is the usual standard. This is but one instance. Movable saw mills traverse the country, using up every tree valuable for sawed lumber; these are followed by the railroad tie cutters, who take every tree large enough for one tie; to complete the work, charcoal-burners follow, using every stick that is left. I had before me when preparing this paper a pamphlet setting forth the advantages of a Colorado town, and therein is the statement that within a radius of ten miles sixty charcoal-kilns are running, with a capacity of 4,000 bushel each per month, and representing a monthly distribution of $30,000. This charcoal is being made from wood belonging to the United States, which receives therefor no compensation of any sort; and, moreover, the actual settler in the vicinity is being deprived of the wood granted him for his own use, and is being forced to go miles for wood enough to cook his food; and last, and worst of all, drought and desolation are being invited in order that a few individuals may reap a temporary profit out of the government.

HOW THE FOREST MAY BE PROTECTED.

The few illustrations offered may serve to give an idea of the situation along the whole eastern slope of the Rocky Mountains, so far as occupied by miners or penetrated by railroads and railroad tie cutters. It is safe to say that no other government on earth, liberal or despotic, would suffer itself to be thus despoiled ; and in this country the offense is the greater because it is not the robbery of some prince, potentate, or individual, or class of individuals, but of the whole people. The evil is glaring and evident, and the remedy should be prompt and certain. It is suggested that the most effectual is the *withdrawal of all government timbered land from market*, and the sale of the timber under government regulation in such a manner as to protect the forest from extinction. To illustrate, the forest lands might be divided into districts of reasonable extent, each under care of a government inspector, whose duty it shall be to supervise the forest growth, to bring trespassers to justice, and to see that that only such trees are sold as can be spared without detriment, or whose removal would be advantageous, or that no trees below a certain size shall be cut on tracts designated. It should also be made his duty to exercise oversight of tracts from which the merchantable timber has already been removed, to see that the young growth is not injured, and especially that it be protected from fire. In the beginning, for what is done should be done at once, this duty should be performed by capable and discreet men, without any personal or property interest in the districts committed to their charge; men acquainted with the value of timber and its habits of growth, and, above all, men of incorruptible character.

GOVERNMENT FORESTERS.

To the end that thisduty, which is to be perpetual—for it should be understood the government forests are never to be destroyed—there should be a body of young, energetic, and practical men educated by the government, and standing in the same relation to it that the graduates of West Point and Annapolis do, competent, faithful, and fond of their work of preserving to the government and the people of the United States a domain greater in value than all its mines of silver and gold. To raise up this class, there should be established such a number of national schools of forestry as may be found necessary, care being taken that the schools are distributed in the different sections of the Union according to climatic division and the character of their natural forests, as, for instance, the white pine regions, the southern pine and cypress country, the regions where the walnut, maple, elm, and desiduous trees are the prevalent growth, and the high prairies and treeless plains and mountain slopes where, most of all, the forester is to find work.

SCHOOLS OF FORESTRY AND EXPERIMENTAL FARMS.

Attached to each of these schools there should be an experimental farm, where every tree known to the United States should be planted, and in certain localities, as determined by their natural dryness and altitude, the methods of irrigation as applied to forest culture should be thoroughly tested.

With these two questions of reforesting the plains—I use the word reforesting because it seems evident that forests once grew on the plains—and also of the possibilities and value of irrigation to be determined, the suggestion has been made to me that the general government should in some manner establish a series of experiments, or rather a continuous test, to scientifically settle the matter. Given a treeless region, eight hundred miles long and three hundred wide, to be reforested, largely by means of irrigation, there should be, in the opinion of thousands of intelligent people, some point selected where on an extensive scale trees may be planted, the different systems of irrigation applied, and results noted, and this through a series of years. This would settle, perhaps, that in some districts, generally embraced in the arid region, trees may be grown *without* irrigation. This is the opinion of Mr. D. S. Grimes, of Denver, a gentleman of vast experience. Mr. Grimes believes that trees planted in "dead furrows" and mulched will in four years shade the ground sufficiently for their own protection. This theory might with others be tested to the great benefit of all concerned. In the Western country individual scientific interest combined with munificence can not be relied upon to establish and maintain such an institution as a school of forestry and experimental farms. The land-grant railroad companies may in time plant forests to test the capability of their lands or to raise trees for their own use, but they have no interest in educating foresters. The states, with their agricultural colleges, have no sufficient facilities. It seems, then, that the general government should enter upon the work. The government of the United States, acting for the people, has the greatest interest. In years past it has expended millions in the exploration of this vast domain. It has expended millions in warring with the hostile savages who have roamed over it. It has a second mortgage on the great railroads that traverse it. The government of the United States, being the greatest land holder, also has a paramount interest in reclaiming this empire and converting it from a wilderness to fields, gardens, orchards, forests, and pastures. That the government should actually do the work is not to be expected, but it seems to be reasonable to expect that it should aid in doing it. Knowledge is power; and let the government furnish the knowledge. The government owns the land; it can set apart any amount of it which may be required; it can place the work in the hands of the best practical talent of the country; it can do on a large scale what individuals are doing on a small scale. As the government is impersonal and can be accused of no sinister or selfish interest, the statements put forth under the sanction of the government officers and agents will be received as the truth. It will be shown what trees can and what can not be grown on the plains; what are the effects of copious and limited irrigation; what is the actual amount of water required for given area; what is the result of irrigation on the same land for a series of years; and, most important of all, what is the effect of planting large bodies of trees —actual forests.

AMENDMENT OF THE TIMBER-CULTURE ACT.

So far the only legislation by Congress intended directly for the encouragement of practical forestry is what is known as the timber-culture act. It has been several times amended, and needs further amendment. It has been so long in existence that its faults are well known, and there should be no hesitation in remedying the law, that its original purpose should be carried out as far as the intention of any law is attainable.

The law contemplated that when a quarter section was taken as a timber claim it should be held as such until the terms of the law had been fully complied with, and a certain number of trees had been added to the forest area of the country. The intention of the act, according to the testimony of government officers and other comptent witnesses, has been avoided; non-residents and speculators have taken claims under the timber-culture act merely for the purpose of selling them to persons who wish to take them as homesteads or pre-emptions. It will be readily seen that this is an absolute avoidance. It works a failure of the object of the act. The remedy for this seems to be the adoption of the principle, "*Once a timber claim, always a timber claim.*" By this is meant that when a filing has been made under the timber-culture act, the land should be withdrawn from entry under either the homestead or pre-emption acts, so that the title shall never be perfected except in compliance with the letter and spirit of the timber-culture act.

The law is defective in allowing trees to be planted as far apart as twelve feet. Young trees need each other's support. Close planting is the law of nature, and nurserymen are more and more coming to recognize it, west of the Missouri at least. Taking the ground that the object of the law is to have the ground covered with live trees and not dead ones, the greatest distance allowed between trees at planting should be four feet. If the trees when growing become too thick they will be trimmed out by Nature herself.

TIMBER ON HOMESTEADS.

The power of the government over public lands is absolute. It can, in conveying them, impose any regulation not in hostility to the "general plan of granting the public domain to actual settlers under reasonable conditions." In addition to the actual occupancy for five years now required, the homesteader might with profit to himself and advantage to the country be required to plant and maintain during the five years one acre of forest trees, or set a row of trees along the highway, or both.

WHAT STATES MAY DO.

Except in Texas, where the state owns all the public land, the states own nothing but the school lands and lands granted for educational purposes. The power of the states over them is absolute, and in their sale the condition might be imposed on the purchaser that a certain portion of the land shall be kept in forest. The legislatures of the several states may take action making it obligatory on school directors to maintain trees on school-house grounds, and also making it compulsory on land owners to keep trees growing along the country roads.

DUTY OF RAILROAD COMPANIES.

The duty and the interest of the great land-grant railroad corporations lie in the direction of the encouragement of forestry. Next to the general gevernment, these companies are the greatest land owners on this continent. They have received from the government and municipalities, from the people, in short, an imperial gift, the source of immeasurable wealth, and this has been given them almost without conditions. It is but just that they should in return do everything possible toward the improvement of the country their lines traverse; and it is also their interest to do so, since whatever increases the productiveness of the country increases their own business. These corporations, with their great and hourly increasing wealth, can do what individuals can not do, and on them devolves the inauguration of the plan of planting great forests—not little experimental gardens, not a few trees in the depot grounds, but tracts such as are found in Europe of tens of thousands of acres. It is estimated that every year 275,000 acres are stripped in this country to furnish railroad ties, and the process of restoration must keep pace with that of destruction, else the time will come when railroad ties can not be secured at any figure. Why should not a great railroad company, with millions of acres at its disposal, raise its own railroad ties? We have spoken elsewhere of the very praiseworthy experiments of the railroad companies in the direction of tree planting. But the experience of tens of thousands of practical men, farmers and others, has shown that as far as Minnesota, Iowa, Kansas, and Nebraska are concerned, the era of experiment has passed. It is, for instance, as well known now as it ever will be, that the catalpa, the black walnut, the Osage orange will thrive, and that they may be profitably cultivated. Instead, therefore, of continuing the discussion of a settled question, the railroad corporations should set out trees; not by the hundreds of acres, but by the thousands. This is a case where timidity, conservatism, and niggardliness mean loss. There are many ways, too, in which railroad corporations may foster the forest interests, as the distribution of forest-tree seedlings, nuts, and seeds. A private firm, R. Douglas & Son, of Waukegan, have sent out millions of trees in packages by mail. A great railroad company could do this on an even greater scale with the prospect of a sure return. In a few years they would not be obliged to seek remote and almost inaccessible mountains for ties, but would have them growing within sight of their own tracks for hundreds of miles. We do not doubt that the facts here set down will be recognized as the truth some time, but every day of delay is a day of loss. But after the national government has done what it may, after state governments have done what lies in their power, the question of reforesting and of supplying with forest the region now destitute depends upon the people, and their action depends on an affirmative answer to the question, "Does it pay?"

LET US PLANT FOR OURSELVES.

I have, in a previous portion of this paper, demonstrated that the planting of forest trees *does* pay; but the evidence which can be given within the limits of a paper like this is but a drop in the ocean of procurable testimony. From the sandy plains of Cape Cod, swept by the bitter winds of ocean, where pine plantations have successfully been cultivated, to the sage-brush plains of Colorado, the answer is the same, that trees as a crop are profitable, paying as surely as corn or the other cereals. Those who have not made the subject a study, have no conception of the amount of printed matter that has been, and still is, constantly accumulating on this subject; the observations of individuals, the reports of committees, the transactions of societies, cover hundreds of thousands of pages, and in them all there is not the evidence of a single human being to the effect that he had lost time or money in planting trees. Much sentimental talk has been indulged in concerning our duty to the next generation. We should plant trees, it is said, under which our grandchildren may repose. This is doubtless a fine and ennobling sentiment, but the average American citizen cares little for the generation preceding him, and nothing for the generation to come; he expects the next generation to provide its own shade. The question he wishes to determine is whether the trees he plants will benefit men in this generation. Curiously, people almost always overestimate the age of trees. Who has not heard a great elm or oak spoken of as centuries old, when it really has grown within the lifetime of living men? Trees are a sure crop, and, after all, a quick crop. The homesteader who goes out on the raw prairie, knows that it is five years before his farm can be producing crops with anything like regularity. His trees are making a return as soon as his fields are. The Mennonite settlers in Kansas, of whose success I have spoken, in seven years, at the furthest, from the time they turned the first sod, are literally sitting in the shade of the trees they planted; are raising their own firewood and eating the fruit of their own mulberry trees. What these settlers from Russia, strangers to our climate and soil can do, others can do. It must be remembered, too, that the objectors have had their day; every argument which can be used against the cultivation of forest trees has been used in the prairie states west of the Mississippi against the cultivation of fruit trees. For example, men accustomed to hillside orchards in the old states have demonstrated to their own satisfaction that apples would not grow in Kansas; but wagons full of round and rosy evidences to the contrary may be seen standing in the streets of every Kansas market town. The number of those who till the soil, be it a bit of garden ground or acres by the hundred, who believe in the profitableness of trees, is constantly increasing. In front of the humblest cottage in town you see the three or four maples or elms covering the front of the lot; and out on the wide prairies, as far as settlement has extended, the group of planted trees marks the outpost of the picket guard of civilization. It is with the hope of contributing in some way to this useful and beautiful pursuit, which is to shelter the bare and blistered earth; which is to catch and hold the rain and the dew; which is to shelter the home and its occupants from summer's heat and winter's cold; which is to bring fuel and comfort to the housewife; and which is to increase by millions the well-earned wealth of a nation, that this brief paper is submitted.

STRAWBERRY CULTURE

BY

HON. J. M. SMITH,

PRESIDENT WISCONSIN HORTICULTURAL SOCIETY.

Strawberries grow perhaps over a larger extent of territory than any other fruit. Doubtless, in the words of another: "God could have made a better fruit than the strawberry, but he has not." It grows from the tropical to the Artic regions, on the rocky crags on the north of Lapland, and, indeed, on every kind of soil. With such a fruit as this the question arises "who should have strawberries." I answer everybody, as often as they need them—three times a day if necessary, and seven days a week. It is not an expensive dish. They cost no more than pork or beans, and in fact not as much.

In the cultivation of the strawberry there are two methods. In the city it is better to set close, but in the country the grower should set further apart, and if the farmer can cultivate with a horse he can grow his berries cheaper and to better advantage.

Soils.—Strawberries will grow upon almost all varieties of soil, except a very wet or a very sandy one. I prefer a sandy loam rather wet than dry, though no water must be allowed to stand either upon the top of the land or about the roots of the plants, if a large crop is expected. I select a soil that is naturally good, and then manure heavily with common stable manure and plow it under. In addition to this, I generally put on another dressing of fine manure after plowing and harrow it in. If you have hardwood ashes it is equally as good or better to put on after plowing, as it has no foul seeds in it. If ashes are used, put on seventy-five bushels per acre if unleached, and double the amount if leached.

VARIETIES TO SET.

All strawberry plants are divided into three classes. The staminate or male flower, the pistilate or female, and the hermaphrodite or perfect flowered. The staminate ought never to be used. They are great runners and will destroy your bed. Years ago many of them were set out. It is easy to tell the plants when one knows them. The Wilson is a perfect flowered berry. It is the most so of any I have ever seen with a perfect pistil and stamens. In the Crescent the stamens are very small.

If you rely on circulars you will imagine that you have only to choose from one of the hundreds of varieties advertised, to make your fortune. Some of these varieties succeed well on their native place, but are not adapted for general cultivation. Hence, there are many disappointments. Yet the propagator may be honest. Since the Wilson was introduced there have been many rivals, but nineteen-twentieths of the berries sold in the markets are the Wilsons; there has been nothing to equal it for a market berry. If you wish a berry for your own use, try a part Wilson, and then set whatever kinds may suit you. If very choice, try Burr's new Pine. It is an old variety, of moderate size, and very delicious in quality. The Seth Boyden, No. 30, is a large, fine berry, though a shy bearer. If something to lengthen the season take the Kentucky or Glendale. The Kentucky will ordinarily lengthen the season from a week to ten days. If you have a heavy clay soil the Jucunda. On other soils it is worthless. It is a fine looking berry, but not prolific enough for market nor adapted for ordinary soils. When you want to make money on strawberries, take the Wilson; when you want to fool it away, take almost any other variety.

SETTING.

Set the rows about two feet apart and plants fifteen inches between the row, though the Crescent should be set wider. Be careful to press the earth firmly about the roots. This applies to all kinds of plants and fruits. It is better to water once and water well. Set a little deeper than the original bed, but don't cover the crowns. Then cultivate, keep the weeds down until July or August when they begin to throw out runners. It is a good plan to spread them out in every direction from the parent plant, which will give you more and stronger plants. The Wilson does not throw out as many runners as some other kinds.

MULCHING.

When fall comes cover your plants. If you can get prairie hay it is better than anything else as it is generally cleaner than straw. Sometimes there are foul seeds which are liable to seed your bed. I wait till the ground is frozen. Don't put on too thick as you are liable to smother the plants. When the spring comes you musn't be in too much hurry to uncover. The ground freezes and thaws and often throws out the plants or breaks the roots. In either case the plants are ruined for that season. Leave covering until all danger is passed. Then remove it, except where there are bare spots. If I find any weeds I pull them out, and then put on a coat of fine manure or ashes at the rate of seventy-five to one hundred bushels per acre. When they are about ready to bear, men have come to me saying that their plants were not going to have any fruit. The Wilson will always bear—indeed, if you have followed my directions and have the true Wilson, it is bound to produce fruit as surely as the Canada thistles will propagate themselves.

During the more than twenty years that I have been cultivating them, I have never seen, either upon my own grounds or elsewhere, a good, strong, healthy Wilson plant that was not loaded with fruit. I have known some other varieties to partially fail; other kinds where the failure would be complete.

SPRING CULTIVATING.

Some say don't use the hoe in the spring. I say use. Cut out the weeds, at any rate. I clean out the weeds every spring thoroughly, and when they are in blossom we go over them again; and just before picking we go over again. When the fruit is set, if I find we are to have a big crop, I apply another coat of manure. If the fruit stalks are full, this dressing is necessary to mature all the berries. I prefer to have ashes either the first or second time. As to commercial fertilizers my experience has not been very flattering. Perhaps my land is not a good place to test them. For the past fifteen or twenty years it has been filled with manure so that fertilizers do not have so good a chance. Just before the berries have matured is a critical time. If the ground is very dry, you must water your vines or lose your crop. Give them a good watering—for one good watering is better than a number of slight ones. I have carried a number of large crops through in this way. I have taken water in pails and done this. Now I have a windmill and large cistern and irrigate with hose. Well water direct from the well is too cold. In this way one can obtain fruit in the dryest season. We have nothing earlier than Wilson unless it is the Crescent. If I was going to prescribe a lazy man's berry, I would name the Crescent. After the bearing season is over, if your vines look exhausted and do not show signs of recuperation by throwing out new runners and leaves, it is better to turn under the bed and not try to keep it longer.

This will likely be the case with Wilson's, if you get as large a crop as I have often had. Hence the necessity of setting a bed every spring. I hardly think the above will hold true of any of the other varieties now under cultivation, for the reason that they will not bear a sufficient quantity of fruit in any one year to exhaust their vitality. The Charles Downing is a fair bearer and will continue in bearing for three or four years and yield fair crops. Many other varieties will yield moderately well, and continue in bearing two or three years.

MARKETING.

When we commence picking the boys and girls are engaged ahead. Each picker has two boxes — one to put perfect berries in and the other small ones. Then a boy whose business is to carry boxes takes the filled boxes and leaves empty ones. He puts the filled boxes in a crate, and when this is full, it is carried by another boy to the cellar on a wheelbarrow with springs on it. They stay here until thoroughly cooled. We sometimes use ice to do this. They are not handled any more than possible. We make our own crates of lath, nailed onto end boards of lumber of right width. Drive to market on a walk. Each crate holds sixteen boxes. It is carefully taken to the depot, but after leaving our hands it sometimes takes the Christianity out of one to see how the express agents handle them. It takes seven lath to make a sixteen-quart crate. It takes a boy ten minutes to put them up. A twenty-four-quart crate can be made at a cost of not over five cents. We place three lath on the sides, and sometimes bribe the express boys not to steal the berries by offering them all they can eat. I got my Wilson in 1860. I got excellent plants on the start; have bought from other localities, but never have got as good as those I originally bought. These are as good to-day as when first purchased. I believe in high cultivation. The average crop in the United States doesn't exceed forty or fifty bushels to the acre. Under high culture they ought to go two hundred bushels to the acre. In 1875 I measured off a quarter of an acre as an experiment, and then picked the berries by themselves. The yield of merchantable berries — no poor ones — was 3,571 boxes, or at the rate of 446 bushels to the acre. I had one yield which I think was larger than this, but I have repeatedly grown over 300 bushels. If you have the Wilson, you ought to get fifty boxes to the square rod. In my family strawberries are as free as potatoes are. Don't pick this berry as soon as red. Wait until they are thoroughly ripe. A few years ago a gentleman who disliked the "sour Wilson," was in my yard; I picked a few of the perfectly ripe ones. He tasted and declared that they were not Wilsons; that I was trying to play a trick on him. We hardly ever get a ripe Wilson in the market. Three years ago, when we had a great many varieties, a lady visiting us declared that she would take Boyden's No. 30. The rest of the family took this and that kind, but after two or three days all except the lady came back to the Wilson and ate it through the season. The Crescent Seedling may be an exception to high cultivation. It is such a rampant grower that it will do better on a poorer soil. The Downer's Prolific is a good variety. It is not profitable as a market berry. It is a conical berry, round, moderate in size—perhaps a large one might measure three inches in circumference; commences ripening about the same time as the Wilson, and is really a choice fruit. The lazy man's berry is the Crescent. When it first was introduced to Wisconsin it was highly recommended and gained many friends. As a bearer it comes nearer to the Wilson than any plant I have ever tried. With me it has been unsatisfactory as a market berry, being too soft to bear shipping, and in my estimation of no better, if of as good, a quality as the Wilson. In all that I have said of the different varieties of berries as regards their bearing or other qualities, I wish to be understood as comparing them with the Wilson, and not with each other. In my own experiments with other kinds, and they have been many, I have doubtless often had a yield at the rate of from fifty to one hundred bushels per acre, but this, as compared with the Wilson, I regard a failure, and have so spoken of it. This most delicious of of all our small fruits is an almost universal favorite. It ought to be upon the tables of everyone, both rich and poor, and not as a luxury to be enjoyed by the few every day and the many only upon rare occasions, but as a common article of diet, where rich and poor alike might have a full supply at every meal if they so desired for at least one month in each year. If this paper shall do even a very little toward hastening so desirable an end, I shall feel many times compensated for the time spent in its preparation.

DISCUSSION.

Mr. J. S. Harris preferred a good loam for the strawberry, also a soil rather moist than dry. The latter gets loose and dries out too quick. For planting, the land should be thoroughly cultivated. He had had the best success by summer fallowing the ground for a season. Spread barn yard manare and ashes on it and plow it thoroughly. Plow again in the spring; set the plants so that the the crown will be on a level with the soil. Too much hoeing of the plants in the spring injured the surface roots and hurts the crop. Prof. Porter agreed with Mr. Harris that the ground ought not to be cultivated in the spring with a hoe, as it disturbed the roots. It is a fibrous plant, and has no tap roots. The practice among many Eastern growers is to press the bare foot down firmly on the crown of the plant when planting. The distance the rows are set apart is generally three and a half feet, and in the row one foot. Plants are set each year, and after the bed has fruited it is turned under, and either celery or turnips planted. One of the best fertilizers is salt. Apply in the spring.

The question of mulching was fully discussed. Mr. Wolsey did not favor any being left on the plants in the spring. Mr. Freeman Smith thought a little mulch left on was better. Mr. Wyman Elliot favored leaving the straw but poking it away from the crown of the plants.

Mr. Fawcett was considerably astonished at the difference of opinion here on mulching. He cultivated small fruits in Indiana on limestone soil. Mulched all the way from a half inch to six inches in depth. Lightened up the mulch a little in the spring. The foliage of the plant being wide, it has difficulty in pushing through unless this is done. He thought enough mulching should be put on to cover the soil, to prevent freezing and thawing.

Mr. Pearce said that the strawberry crop was one of great importance. Last year he has grown two hundred dollars worth on a quarter of an acre. He has tried many varieties, and the Crescent Seedling had scored more good points than any he had ever tried. He used a cultivator and a very sharp hoe. Did no weeding, but killed the weeds with a hoe. In regard to mulching, he didn't know what to say. He had a plan as follows: After July or August sow clean oats. They will grow two or three feet high, and drop evenly on the plants. One or two things in strawberry culture ought to be observed. Raise the best varieties, and study how you can make the most money from your crop. He exhibited a picture of many varieties which he grew. Mr. Fawcett illustrated his harrow on the blackboard. The plants were put in with a broad dibble, by which the roots had a chance to spread. After the plants were set the harrow was used with great effectiveness in keeping down weeds and loosening the earth.

Prof. Porter said that strawberry growers out here had much yet to learn, and instanced several points where there was a chance for improvement. In the first place the growers did not assort their fruit. Big and little berries were mixed together. A strawberry should never be touched from the time it is picked until it goes into the consumer's mouth. He saw hundreds of quarts here last year which were handled several times. Use quart packages for the solid varieties, such as Wilson and Glendale. Use pint boxes for softer varieties, and half pint boxes for still softer ones. Always use new boxes; never let a box be used twice. In the field he used little carrying crates in which the picker placed his boxes. It had legs on it and a handle and held ten quarts, and the picker carried it through the field with him and placed his boxes in it instead of on the ground.

FARMERS' GARDENS

BY

U. S. HOLLISTER, ESQ.,

SECRETARY OF MINNESOTA HORTICULTURAL SOCIETY.

The farmer of the present day, compared to him who tilled the soil a half century ago; surely occupies an enviable position.

Education has done its work—prejudice has been swept aside by its all powerful influence—and to-day the American farmer stands well toward the centre of the arena of active life a representative citizen.

The students of several mechanical associations, recognizing the fact that agriculture held the foremost place of all the in dustries of the world, have bent their best energies to further your interests.

Science does not trim her lamp in vain. And as a result of her labors, we find theory and practice reconciled; we find "book farming" the most successful one; we find refinement seeking a congenial home in rural places; we find farmers' sons and daughters no longer ashamed of their vocation; we find the farmer himself demanding the constitutional, political privileges of citizenship, and asserting his commercial and social position. He has ceased to believe that because his avocation gives him health, renders his arm strong and his nerve steady, that his brain is therefore the less active, and is prone to do much of his own thinking, and much of his agricultural talking, that used to be delegated to lawyers and doctors and politicians. And as advancement must be the rule in the future, as in the past, we need not be much surprised to hear that a farmer had delivered an agricultural address, at an agricultural fair.

If I had been led to believe that the subject assigned me was one of the most important of this course, I would be very properly charged with an attempt to make an acre look as large as a quarter section—because I treat of the circumscribed area of the former, as compared with the broad domain you call a Western farm.

The seeming unimportance of my subject gains strength when we stop to consider that of all the important interests that go to make a system of mixed farming successful, not one of them can stand alone, but each one must have the help of others, and I must claim for the farm garden that it has a very important place among the helpful factors.

I shall not, in demanding rights for the garden, combat any farm product any more than to wrest from the grasp of the Minnesota monarch—No. 1 hard—a single acre and help to properly cultivate it.

Men work that they may live. It is a principle of human nature, as strong as the love of life, to rebel against unrequited toil, and farmers as a general rule hate the garden, because they think it does not pay.

Dollars and cents enter largely into all plans for farm operations, as well as commercial; and the farmer is as apt as anyone to drop a venture in which there is apparently no profit.

In planning for the year's work, he lays out his fields in tracts to be devoted to special crops.

In estimating the cost of production of these crops, the average farmer is very apt to count strictly every item of his help, machinery, etc., but he entirely ignores the cost of living.

If he kept this last account as carefully as he did the first, he would find that it bore a very discouraging relation to his profit account, and very nearly equaled all the others.

This is fast becoming a world of luxury in food as in all things else, and the habit is fast getting foothold among the tillers or the soil.

If you do not grow and preserve for use the finer vegetables and fruits you are compelled to purchase them. Maine, Massachusetts, California, and other equally distant and foreign sources of supply, annually send hundreds on thousands of tons of canned fruits and vegetables to our state, and it is reasonable to suppose that farmers purchase at least one-half the importation. Such being the fact, and with the guarantee that if you faithfully persist in a system of intelligent farm gardening, you can save all this expenditure and consume a better class of goods, you need not be surprised at the temerity of your horticultural friends who came here to do battle for the garden.

To begin with the vegetable department, your garden must be rich in the elements of plant growth. If not naturally so, you must spread on fertilizers with a liberal hand. Do not be afraid of getting it too rich. All the garden crops do better, in proportion, as the soil is made rich. Even beans, reputed to grow on land too thin for any other crop, will do better on land capable of producing one hundred bushels of corn per acre.

Barnyard manure is not only the cheapest, but the best for all purposes.

Having once established the fertility of your garden, it must be maintained by liberal annual dressing.

Select the location convenient to the house, with southern or eastern exposure if possible. The best form is a paralellegram ten by sixteen rods, or larger, as you may desire. So arrange that nearly all the cultivation can be done by horse power—by which I mean put everything in rows, which should run north and south for proper distribution between the open rows of light and heat.

Cabbages will grow just as well in a row a hundred feet long as in a space ten feet square, and the same is true of everything else.

Get out of the old rut that impels you to plant beets, onions, and like growing sorts in little raised beds. Put them in rows the whole length or width of your garden, and give them the same liberal flat culture that you find best for corn and cabbages.

ASPARAGUS.

Procure an ounce of seed and sow it in a carefully prepared space, a little out of the way, so it will not be plowed up the next spring. Hoe and keep clear from weeds for two years. Then prepare the ground for the permanent plantation by thoroughly enriching and deep plowing or spading. Set the two-year old plants eighteen to twenty-four inches apart each way. Place the crown of the plant four inches below the surface. Cultivate, and each fall fork in an inch or two of well-rotted manure—and the mystery of asparagus-growing becomes a simple mystery.

Once established, as it will be in four years from the seed, and it will annually throw up its abundance of rich, healthful food product through all your time, and your children's children can gather and cut from the original plantation.

BEANS.

There is not much mystery about growing this plebeian.

Plant as soon as all danger from frost is past, in rows thirty inches apart and a foot apart in the row. Cultivate thoroughly if you want a good crop. It is a popular notion that they must not be cultivated after the vines are out — this is based on the fact that disturbance at that time produces a rust on the leaves which materially shortens the yield.

For garden use it is a matter of taste whether you choose the green or wax pod sorts. Of the former the Early Mohawk is the best for use as snaps, as it is the most productive of them all and remains longest in the green state. For green shelled the Early China Red Eye is one of the best, being nearly white at this stage of its growth, large and plump. Of the wax beans you will not be disappointed if you plant either the Black or Golden Wax, the latter perhaps being the least objectionable on account of color. Both are stringless and of fine mild flavor. The above are of the popular dwarf or bush varieties, best suited to farm gardening.

Of the pole sorts the Horticultural Pole and Large Lima are very popular on account of their excellent quality green shelled. In this latitude they should be planted in rich, quick soil, in a warm sunny place, and when the vines reach the top of a six-foot pole should be pinched back to hasten the development of the pods that are just setting low down on the vine. By this means you can produce an abundant supply of this semi-tropical luxury in Minnesota.

The green pods of the first named sorts are successfully canned and dried for winter use.

BEETS.

In this vegetable we have one that may be had as required for use, twelve months in the year, in a perfectly fresh state, which makes it a very important adjunct to our garden.

Seed may be sown just as early in spring as the ground will work well.

If sown a little too thickly, the young plants may be pulled or thinned out as required for greens, or as a substitute for spinach—though many would put it the other way, and grow spinach as a substitute for young beets.

They are usually boiled, tops and all, and are fit to use in this State until the beets get to be an inch in diameter, when the final thinning must be done, leaving the plants from 8 to 12 inches apart in the rows, which should be 24 inches apart for best results in both quantity and quality of crop cultivated well. When gathered in the fall those designed for winter use may be stored in the cellar, packed in dry sand or sawdust, where they will keep in a perfectly fresh and crisp state until spring.

If you wish a few for spring or early summer use, bury them in the fall in a trench below the frost line, and when the pit is opened the first of May they will be found as good, if not better, than when buried the fall before.

For first use of the young growing crop, plant the Egyptian. It is the earliest of them all and of very fine, delicate flavor when young, but grows woody as it matures, and is inferior for winter use.

For general crop, plant equal quantities of Long Dark Blood and Dewing's Turnip. The advantage of this vegetable over many others is, that if you have a surplus at any time of the year, it can be profitably fed to cows; and, as a general rule, there is never too many bushels of beets on any farm, as they are very valuable stock food.

CABBAGE.

Probably the most extensively and universally grown of anything on our list. It requires the best of land and the most persistent cultivation. It will make a fair crop with the ordinary weekly hoeing of the garden, but if you are after big specimens for exhibition at the fair, see that the earth is stirred about it every day during its growing season.

As it is so universally grown, so is its culture generally understood.

For first early sorts some plan should be adopted to have the plants ready to set out in the ground as soon as it is fairly in working condition, either by growing them in boxes in the house, or in a hotbed. If grown in either place, too great importance can not be attached to gradually hardening them by outdoor exposure, to enable them to stand the freezing they are sure to get, if planted early, without injury. A plant directly from the hotbed or house, always having been kept warm, will be ruined by fifteen degrees of freezing, when, if hardened by gradual exposure, it would endure nearly twice that without injury.

The finest crop of early cabbage I ever grew was planted out in Southern Wisconsin, the second week in March. After planting, a snow storm covered the plants, and the thermometer marked zero the next morning; it gradually became warmer, the snow melted away from the plants, and all but about ten per cent came out all right.

In hotbed planting, it is a safe rule to plant the seed six weeks before you expect the ground will be ready to receive the plants; and this applies to hardy and tender plants, alike — tomatoes being, perhaps, an exception, and may remain in hotbeds ten or twelve weeks.

For plants of winter, or late cabbage, plant the seed in the open ground, in time to produce strong plants for planting out by the middle of June, in this latitude.

To prevent the bursting open of heads in the fall, pull as soon as grown and invert in a dry place; or, if the weather is moderately dry, they may be pulled and placed roots up where they grew, until time to store for winter.

As a general rule, you can keep all you want for winter use by hanging up by the roots in the cellar, or setting them on a shelf.

To keep through the winter, for spring use, is quite another thing. The safest plan is to place them where they will freeze and remain frozen until the final thawing out in the spring. It matters little how you do this, if you bear in mind that the head must be kept inverted to guard against the possibility of any water being retained in the leaves; and that it must freeze and thaw but once, and that when the frost is drawn it must be while protected from exposure to the air.

I have kept them in perfect condition by setting them in a row, heads down, and covering with earth to the depth of eight inches.

For first early, plant Early Jersey, Wakefield, or Early York; for late, Flat Dutch and Fottler's Brunswick. The latter is a second early or medium late, and may be planted as late as the second week in July and make a good late crop.

CAULIFLOWER.

When well grown, one of the finest vegetables that can grace a farmer's table, and is used very extensively, both cooked and pickled.

Same soil and treatment you give the cabbage will answer for cauliflower, the only difficulty being in procuring seed of a strain that will produce good heading plants.

It is impatient of heat and dryness, and for this reason it is better for the farmer to grow the autumn heading or late sorts, planting them out at the time of planting winter cabbage.

To be successful, the plants must be got out so early as to mature before the summer drouth, or so late as to begin heading in the cool of September or October.

Of the early sorts, the Snowball and Extra Early Erfurt are the best, and Lenormand's Short Stem the safest late to plant.

CARROT.

Questionable whether this vegetable has a place here, but as it is often cooked or used in soups, it must have a little attention, especially as your horses will thank you for any surplus you may have on hand.

Plant very early in spring, thin to eight inches, in rows 24 inches apart, and keep from weeds.

Easily kept fresh through the winter by packing or burying, same as described for beets.

For table use, the Early Scarlet Horn is the best, while for stock purposes, the honors are pretty evenly divided between Danver's Half Long and Long Orange.

CELERY.

Here we have a plant, a royal good one, too, healthful, easily grown, but farmers are so mystified by the pretended great skill required to grow it, that it is seldom attempted and almost unknown on the farm table.

Sow the seed outdoors in a carefully prepared seed bed, cover very lightly or not at all; a packing down of the bed with the back of the spade after the seed is sown, being sufficient. Water liberally, and keep free from weeds. As soon as the plants are an inch or two high, I take them out of the seed bed, pinch off all of the tops, and transplant right back into the same bed, as thickly as can be done. This transplanting causes a mass of fibrous roots to grow, so that when finally planted out where they are to grow they are better able to stand the dry weather that usually occurs in Minnesota at the proper time for doing this work, which is from the midde to the last of July.

Select the nicest part of your garden, lay out rows four feet apart, and set the plants as you would any other; about six inches apart in the row. Cultivate thoroughly, but do not disturb while the plants are wet with dew or rain. When the plants are six or eight inches high, say latter part of August, begin earthing up, by first holding the stems together with the hand, while earth is drawn around them sufficient to keep them in an upright position. About once a week after this throw more earth about the plant, gradually approaching the top, which you must reach by the time freezing weather sets in. This earthing is done to blanch or whiten the stocks and render them tender and fit for table use. If you prefer, you need only to earth up a few stalks for early fall and winter use. The majority of the crop may grow on without any earthing but the first handling, and be bleached in boxes in the cellar during the winter as wanted.

Any box a foot wide and of a depth equal to the highth of the plants answers for the cellar work. Take up the plants with earth still adhering to the roots and pack upright in the box as closely as you can. Keep them at a temperature a little above freezing and you can have celery fit for the table until spring.

The drawf growing sorts, Sandringham, or American White Solid are always good and reliable.

CUCUMBERS

So easily grow that no direction need be given. The striped bug seems about the only difficulty any one ever encountered in growing them. By watching the young plants and daily dusting them with anything that will frighten the bugs away, until the plants have made their rough leaves, and the danger is over. For years, I was in the habit of dusting the plants with gypsum, ashes, soot, or anything I could find recommended. I finally began gathering up handfuls of dry earth from about the plants, and throwing it gently over them. The bugs would begin to run about, take wing and were gone for the day.

For the last six years I have used no other application to rid cucumber and squash vines of the striped bug, but dry earth. As with all other remedies it must be persistently used, and no matter how expensive, or hugely advertised any remedy may be, you will always find that eternal vigilance is the price of cucumbers.

SWEET CORN.

King Corn presents in the table varieties a very desirable garden crop. I shall only tell you the sorts to plant. It is highly important that a succession be kept up from the time of the first roasting ears until frost.

By planting the following varieties on the same day you will not be without good table corn a single day from first until frost. They are named in order of earliness: Early Minnesota, Crosby's Early, Moore's Concord, and Stowell's or Burr's Evergreen.

The Black Mexican excels them all for quality, but its tendency to mix with all other sorts on the farm will keep it from growing popular.

LETTUCE.

Always esteemed as an early spring salad and easily grown, but there is a great difference in the quality of that properly and improperly grown. Give it the best of soil, sow the seeds thinly, so that you will not have the plants closer than six inches, hoe carefully to stimulate rapid growth, and you will be surprised at the results as compared with the self-sown, crowded, uncultivated product. Of all the sorts I consider the Curled Simpson's White-Seeded the best for ordinary garden culture.

ONIONS.

The only secret about growing them successfully from seed is to have a very rich and rather light soil, and plant just as early as you can possibly work it.

Weeds must be kept down and the culture must be done shallow, that is, the soil must not be stirred deeper than half an inch, if possible. All the fining, pulverizing or mellowing the soil must be done before planting.

For first early it is best to procure a few quarts of top or bottom sets, planting them out as early as possible. It is a difficult crop to preserve in any great quantity in the cellar. A bushel or two laid thinly on a shelf or scattered over a pile of potatoes will keep fairly well, but as soon as you attempt to bin or have them in a warm cellar they soon assert their strength, perfume the whole house and rot before spring.

A number of years ago, having a large lot on hand — selected for seed stock — and having no proper storage room for them, I took the advice of the books, and let them freeze up solid and remain so until spring. They came out all right and I have pursued this plan ever since. A year ago last fall the manager of the State reform school farm had about three hundred bushels of onions on hand that he wished to keep for seed stock. I advised him to pile them in long windrows and cover with about four inches of earth, and he finally, with much misgiving, placed two hundred bushels in this manner, and, remarking that he would save a hundred bushels anyway, he put them in his well constructed root cellar. You all know what the winter of '80 and '81 was — long, steady, cold, with the thermometer down among the thirties for days. The result was that the two hundred bushels — frozen — came out all sound in the spring, while of the hundred bushels kept in the root house not twenty bushels were fit to plant out in the spring.

Some of the best authorities in our country in their published writings tell us that the onion will not stand thirty degrees of freezing without positive injury. The case just quoted as positively refutes it. The only care to be taken in subjecting onions to very severe freezing is that they be not allowed to thaw but once, and that without removal and still covered with earth and at the final thawing out in the spring. Onion sets, so difficult to keep in good condition in any quantity during the winter, may be safely stored in the same manner.

PARSNIPS.

Better plant a few rows of Hollow Crowned parsnips. They are fit for use as soon as grown in the fall.

A few may be dug and packed in sand in the cellar for winter use, and the remainder left out of doors, where they grew, to be eagerly sought for and dug as soon as the frost is out in the spring.

SALSIFY

is of similar habit and power of enduring cold, and may be used, stored, and dug in the spring for spring use, same as the parsnip.

It is a delicious, very wholesome root, and very popular with many.

In preparing it for the table, cut in short pieces, and treat same as green peas.

When once you begin growing it, you will probably continue.

The only danger in leaving these sorts out during winter arises from their being planted where water will stand, or being so located as to freeze and thaw several times during the winter.

In either condition, the roots rot in the ground.

PEAS.

Not one-half are usually grown on the farm, as they should be, of the simplest culture and easiest growth.

Of these you want a succession grown if you do not wish to be bothered with planting the same sort at different times, you may keep up the desired succession by proper selection of early and late sorts.

For this I would recommend four sorts, as follows: Philadelphia Extra Early, Little Gem, Yorkshire Hero, and Champion of England.

With this selection, planted at the same time, there will hardly be a break in the supply from the time the first Philadelphias are ready until the last of the Champions, which will take you through about all the length of season you can expect green peas in this latitude.

RADISHES.

Always popular in their season, if well grown, but often unfit for the table, because of the soil in which planted. It is a common mistake to lay all failures to produce crisp, tender roots to the seed planted. But little radish seed that will grow at all is sold, but will produce the finest results under proper culture.

SPINACH.

As easily grown as beets, and a very fine greens; healthful, and relished by nearly everyone. A half-pound of seed, costing twenty cents, sown at intervals from early spring until you tire of it, will supply a large family.

SQUASH.

Productive in a large degree of excellent, nutritious food for man and beast. You need not fear on overstock of this vegetable. As it is tropical in its nature, nothing is gained by very early planting, as they will absolutely refuse to make any headway until the ground is warmed by the sun of summer.

I have grown as good crops of Hubbards, planted the first week in June, as I ever did by early planting. They are strong feeders, requiring the best of soil and liberal culture, until the vines begin to run, when they should be let alone until harvesting time.

In gathering for winter storing, handle carefully, so as not to bruise them. Let them lie in piles in an open shed, to cure, until danger of freezing, when they should be placed on shelves, in a cool corner of the cellar.

The Hubbard still holds the first place as a winter keeper, and its quality is unexcelled.

For earlier fall use, or early winter, many prefer the Boston Marrow, a soft shelled variety, of good quality, very productive, and excellent for stock.

TOMATO.

With this, perhaps the most valuable of all our list, I will close this dry detail. The plants should be started early, so as to be big and strong by planting out time, about the middle of May.

The amateur may, by pruning and training, accomplish wonderful results with this vegetable. A friend of mine in St. Paul, from half a dozen plants, trained against the north side of a six-foot board fence, managed to cover the entire fence with fruit-bearing vines, that supplied an abundance through the season.

One of the most interesting experiments I ever made in tomato culture was to train a hundred plants to four-foot stakes. The plants were pruned to a single stem, which was tied to the stake as it advanced in growth, and pinched back as often as it got beyond the top of the stake.

The fruit grew in great clusters, every one perfect in form and color. It was a beautiful sight, and I think the crop fully equaled in quantity that where a dozen vines were allowed to sprawl over the ground from one plant, and the fruit was certainly finer.

In all management of this plant it pays to devise some means to keep the vines up a little from the ground.

PRESERVATION OF VEGETABLES.

Preservation of the different vegetables for use beyond their season, is an important item. Beets in the manner described may be kept in a fresh state as long as wanted.

Cabbages may be had fresh for eight months of the year. And we will try and get along with sauerkraut the balance of the time.

Celery must be kept in a natural state, as it is not possible to preserve it in any other way.

Carrots are used only in natural state.

Cauliflower can not be kept fresh for any length of time. It is usually picked for preservation.

Sweet corn may be both dried and canned, and in either condition preserves its natural flavor excellently.

Cucumbers only used green and pickled.

Onion may be had fresh the year around.

Peas fresh and canned, as the secret of canning these things successfully is fast finding its way into farmer's kitchen.

Squashes may be dried, either after cooking, or sliced in the good old New England way of treating pumpkins, and are excelent material for pies.

Tomatoes, both canned and dried, already enter largely into the winter store of farm housewives.

Currants, raspberries and strawberries, all—canned and dried—may readily take the place of all other dried fruits on a farm table.

Having discussed soil and varieties, it will not be out of place to talk about the seeds you plant. It is a lamentable fact, though much to the profit of the seedsman, that farmers are too careless of selecting and raising seeds. Once engaged in this work, it not only becomes profitable, but of the deepest interest.

The mysteries of fertilization and hybridization of plants, by which different sorts of the same species are mixed and new and better or worse sorts the result, forms one of the most interesting studies of vegetable life.

From this fact we derive discouragement to the farmer who attempts to grow seed for his own planting, became of the small area of his garden and the difficulty in maintaining the requisite isolation of different sorts and insure purity of seed.

He must plant more than one sort of sweet corn in order to keep up a succession of product fit for table use.

The Early Minnesota, growing upon one side of his garden, the Black Mexican upon the other. During the season he selects a few of the best hills of Early Minnesota, to reserve for seed, and selects carefully, as he ought, the most perfect ears for next season's planting.

The following summer our gardener is disgusted to find he is growing a mongrel corn, the white ears of the Early Minnesota, being spotted with the Black Mexican.

He did not think that the almost impalpable dust that the wind took from the top or tassel of the black corn and wafted across the garden and fell upon the silk of his pet Early Minnesota would work this change, but he learns it by experience.

Every grain upon an ear of maize is supposed to be in communication with one of the thread-like silks that force their way in a bundle through the husk at the end of the ear.

Destroy that silk, or cover it with oiled paper, before it has any possible chance to be fertilized by the pollen from the top of the stalk, and the cob will be barren of grains.

The same principle, then, that fertilizes the ear, and enables nature to produce the grain, will be found at work "mixing the children up."

You may be particularly impressed with the value of the Hubbard squash and allow none other on your ground. A neighbor half a mile away will grow nothing but the Boston Marrow.

You do not let this little whim of his worry you, but proceed to select your perfect type of Hubbard squash, to furnish seed for the next year.

When the product is grown, you cannot account for the yellow streaks on your green Hubbard, or for their inferior quality.

It happened in this way: Some enterprising bumblebee was out foraging one day when your vines were in bloom.

He stopped at your neighbor's; dipped down into the Boston Marrow blossoms and covered himself with their pollen. On his way home he passes over your grounds; thinks he has hardly load enough, and tumbles down into the very bloom that produces your pet seed Hubbard squash.

The mischief is done; the bee not only takes from this bloom, but leaves a little of the yellow powder on the pistils of the flower; fertilization is complete, and a hybrid the result.

Such results as these, while provoking in such cases, are often of great value in producing new and superior sorts. All our new varieties of corn, peas, melons, squashes, tomatoes, etc., are produced in this way, and many of them are better than the parent varieties.

I do not wish to discourage the careful selection and saving of seeds.

You may begin with the meanest specimen of field corn you ever grew and by fixing your mind on a type you wish to produce and selecting seed persistently that approaches that type, you can in a very few years produce a pedigree corn, so firmly established as a sort, that like will produce like, and you have a new sort entirely unlike the parent.

The same is true of all the vegetables from which you can save seed. Take the tomato as an example. By selecting the first ripening fruit and that of the most perfect form, you can have seed for your own planting better than you can purchase of any seedsman.

Get your boys interested in this work of improving old sorts and producing new ones, and you have done much towards making them satisfied that farm life is the best condition of man in the world.

As soon as a man or boy becomes interested in the mysteries of Nature, begins to study her wonderful plans and resources, he becomes morally better.

Learn your boys all you can of these things; call their attention to facts that set them to thinking; illustrate by familiar surroundings.

An oak tree spreading its top over a circumference of thirty feet, bears all the rain or dewfall far away from its trunk, and at first you think that tree would suffer greatly for water. When you stop to think, you are reminded that the great gnarled roots near the trunk have no capacity to drink in the water; but away around the line, just where the foliage sheds the water, are thousands of little rootlets, ready and capable of drawing life from the water, and sending it coursing up the trunk, through millions of cells, swelling the topmost leaf.

The tropical sunflower, thriving best with a limited supply of water, has its roots all in a close bunch, and the leaves are so arranged that the water from rain and dew is carried far from the reach of the rootlets.

The cabbage, with much the same habit of root but requiring much moisture, has its leaves so arranged that every drop of water that falls upon the leaves is carried toward the centre of the plant and deposited right at the roots.

To return to the farm garden proper, it is not complete with vegetables alone.

You must have grapes, raspberries, currants and strawberries in abundance. There is no place in the Northwest where wheat will grow, that you can not grow these small fruits easily and cheaply.

In the absence of apples, pears and peaches, there is the greater incentive to grow the small fruits. These have all been, or will be, discussed at the next meeting, under their proper heads, in our "Garden Talk." If we succeed in interesting the farmers in the work, enough has been accomplished. Their intelligence, seconded by numerous papers and books, will take care of all the detail.

We of the farm do not appreciate our condition.

To grow grains, vegetables, fruits and flowers is to occupy the only perfectly independent position in the world. Your time is your own and you call no man master.

You are envied for this by the dweller in the city, and your table is eagerly sought because the things thereon smack of mother earth, and your surroundings are those of nature.

No one but the grower or his guest knows of the dewy freshness of fruits and vegetables right from his garden.

That is a part of the reward for labor, and there is not only satisfaction in it, but health and life.

If any man should receive the fullest extent of reward for labor, it is the tiller of the soil; and if any man does receive such reward, it is the cultivator who makes the best use of soil and climatic conditions that go to make up its surroundings.

Nature, in the indulgent kindness of her great heart, showers her choicest gifts upon the man who appreciates her enough to intelligently and industriously second her magnificent efforts to make this, a world of plenty.

MARKET GARDENING,

—BY—

HON. JOHN S. HARRIS,

President of the Minnesota State Horticultural Society.

When Prof. Porter invited me to assist him in this course of lectures, I did not consent because I believed that I had any peculiar talent in that way, but because I have a great respect for farmers and farming, and because I desire to encourage everything that will add dignity to the calling and bring prosperity to those who follow it. Farming is the leading and essential business of about one-half of the laboring population of this State, and is the basis of the wealth, power and prosperity of the American people. Whatever lessens its dignity or lowers its appreciation tends to demoralize the nation, and just in the ratio in which this is done do we retrograde and go back toward barbarism; just in proportion as we lend dignity to it, so far do we advance national greatness. It was the original and divinely appointed calling of man. He read in Holy Writ that "God planted a garden in Eden," and made it man's duty to keep and dress it. When driven from Eden, it was still his duty to till the soil and eat his bread in the sweat of his brow. From that time down to the present, agriculture has been the basis of all progress, and on its prosperity hangs the hope of the race more than on any other calling or industry, and without it no other calling or industry could exist for any length of time. If it did did not provide the means of subsistence for the increasing population of the world, there could be no growth and progress, and now and ages since mankind would be a race of cannibals or imbecile barbarians, and few in numbers compared with the teeming millions who now constitute the present population.

Agriculture is the lever which moves the world, and forces the development of the arts and sciences. It is its strength that has tamed the elements and trained them to the use of man. She has made highways across the trackless seas, and linked ocean to ocean with chains of steel, and even the lightnings acknowledges her power and gracefully submit to do her bidding. Commerce and manufactures are her children, and without her motherly care could not exist. The farmer is a man of knowledge, and agriculture has been brought to its present honorable position by the intelligence and energy of those who pursue it as their chief occupation. We often hear it remarked that any man with sufficient muscle is good enough for a farmer, that such can dig and delve and enjoy it better than the refined and educated man; but it is the fact that to enjoy it and prosper in it a man must have brains and knowledge, and there is no calling so well fitted to give a man a more profound knowledge or comprehensive education. Therefore, the true farmer is a man of knowledge, whether he knows it or not, and the time is at hand when he will be the most thoroughly educated of all men.

But my topic is "Market Gardening," or what is frequently termed truck farming, and it ranks in importance not one whit behind those branches of farming which have been so ably presented and described in this course of lectures. It is a branch of agriculture that may be followed by the man of limited means who could not successfully engage in stock-breeding, dairying, wool growing, or the raising grain, while it also gives ample scope for the use of capital, and it is a system of husbandry that will cause the earth to afford more human food from a given quantity of soil than any other. I do not claim that it is more honorable, lucrative, or important than other vocations, but that it is equally so and merits a little of our attention. It is a branch of business that is more particularly adapted to the vicinity of cities and large towns, where the limited grounds attached to tenement houses will not permit private gardening, and because many of its most valuable products are of so perishable a nature or so bulky in proportion to their commercial value that they would not pay the expense of distant transportation. Whoever contemplates engaging in the business should bear in mind that it is a laborious one, and that it requires in the man who follows it skill and tact, and that education is no disadvantage, although not an absolute necessity. Although laborious, the business is not so heavy as in some branches of farming, but it is constant, pleasant and healthful, and usually profitable. As I have said before, a large capital is not an absolute necessity here in the West, where good arable land is comparatively cheap, but the man with a small money capital must start in a small way and enlarge and branch out as his means will permit, and a young man starting in the business in this way will be fully as likely to make a fortune as the one who starts in other business with the capital will be to save it, for the reason that he will at first be compelled to rely mainly upon his own labor, and practice rigid economy. The man who intends to engage in market gardening can not use too much caution in selecting a locality. It should be within a convenient distance and of easy access of some thriving village or city that will afford a ready market for all that is produced. Peter Henderson says in his admirable work, Gardening for Profit: "It is always better to pay a rent or interest of fifty dollars, or even one hundred dollars, per acre on land one or two miles from market than to take the same quality of land six or seven miles distant for nothing, for the extra expense of teaming, procuring manure, and often greater difficulty of obtaining labor far more than counterbalances the difference in the rental of the land." This, of course, has a more especial reference to the business in the vicinity of New York.

In this State, except in the vicinity of St. Paul and Minneapolis, the purchase money of land suited to the purpose would not greatly exceed that sum, and ordinarily less manure is required and teams are more cheaply fed; but the reasons will hold equally good here as there; aside from taking into account the extra time consumed in traveling too and from a greater distance. This, of course, applies only to those who raise bulky and perishable crops, and do their own marketing. A market gardener who gives his attention chiefly to growing vegetables of a less bulky or perishable nature, and that will bear shipment to long distances, may locate his garden anywhere at a point convenient to a railroad station and depend upon making his sales to dealers, and do well, especially if he can grow a better quality or get them into market a little ahead of those who are located nearer by. Where land is as cheap as it is in this State, and so good an opportunity is afforded for making a selection, it will not be an object to use any that is not cheaply put into condition, or that is not the best adapted to the kind of crops it is designed to grow. Somewhat of a variety of soil is desirable, but if confined to one kind of soil in a garden for all purposes, I should choose a deep, rich, sandy loam having a porous subsoil of sandy loam. A light sandy soil with a sand or gravel subsoil, is almost useless for the growing of late crops, and especially onions, cabbage, cauliflower and celery, while a stiff clay loam, with clay or hardpan subsoil could hardly be made to pay for growing early salads, melons, cucumbers, radishes, tomatoes, etc., but this kind of soil if deeply underdrained and well worked will be the very best for late cabbage, cauliflower and celery.

It is very bad policy to select land that has been worn out or run down by injudicious cropping and bad cultivation, or that is naturally of very poor quality, because the labor and expense of putting such land into good condition will be more than is required to take off two or three crops from the good soil. In selecting a garden site it is well to select one that is nearly level, with just slope enough toward south or east to give good surface drainage. The reasons are that upon nearly level ground the plowing and fitting can be done more cheaply and a large part of the cultivation may be done with a horse, and it will not gully in heavy rains, which would destroy and carry away much of the best soil. Southern slopes have advantages for growing early crops, but if anyways steep will require horizontal ditches to conduct the water away and prevent washing, the expense of which will be very little less than erecting walls or tight board fences upon the north side.

Under draining is but little practiced in this State, but it would pay well wherever the subsoil is retentative of water. In this country the preparation of the soil is always done with a team and plow. In Europe garden soil is fitted by trenching. The operation consists in opening a ditch upon one side of the plat, about three feet wide and one spit deep, throwing the soil removed to one side; manure and litter is spread in the ditch made, and dug in as deeply as well can be; then on the next course of three feet wide the soil is removed and placed in the first ditch, and the bottom of the ditch served the same as the last. This is continued until the whole plat is dug over, when the soil thrown out of the first ditch is carted over to fill the last. Unsightly rubbish, small brush and bones are frequently buried in the bottom, and land prepared in this manner is in good condition for all kinds of crops and will be loose and friable for many years; but the process is a slow and laborious one, and in this country, where labor is scarce and dear, is not practical. In that country the spade is used much more than in this in the place of the plow, but it is too slow a method for the American people, and unless very perfectly done is not, in my judgment, as good as plowing.

My method of preparing soil for a garden in this State is with a strong team and plow. If the ground is in native sod it must first be broken, an operation that is familiar to you all. This is best done in June, when all vegetation is in its most luxuriant growth, and the vegetation should all be turned under to facilitate the rotting and retain its fertility. The ground may lay without a crop the first summer, being harrowed once or twice to destroy weeds, or a crop of beans or sod corn may be taken off that will pay a part of the expense incurred; but the best plan would be to yard a flock of sheep upon it. If the breaking was well done and the season has been reasonably favorable, the sod will be pretty well rotted by fall, and it should be dragged and plowed before winter sets in, and somewhat deeper than it was broken. If manure is at hand, it will be beneficial if turned under at this plowing, and if the land is not fertile it is highly important that it should be done. The next spring it will be ready for use, but there are some crops that might not pay the first year. Probably the safest crops would be corn, potatoes, tomatoes, late cabbage, melons and cucumbers, giving another year's time before sowing fine seeds.

For most garden crops the ground will require liberal and frequent application of fertilizers, and you can hardly apply too much for asparagus, cabbage, cauliflower and celery. Stable or barnyard manure is considered the best and most natural fertilizer for all crops, as containing the constituents that go to make up the cellular structure of plants, and the gardener who has a liberal pile always at hand has deposits in a bank that never breaks or suspends payments. Where a sufficient quantity of barnyard manure can not be procured, Peruvian guano is considered the best for general crops. In applying it is sown over the surface at the rate of 800 or 1,000 pounds per acre, and then thoroughly harrowed in, and the crop is to be put in at once. For cabbage and cauliflower it is said to be an excellent fertilizer, either used in the hills or sown broadcast and harrowed in. Lime, ashes, salt, and almost every waste material of the house has great value when applied to the land.

As the earliest vegetables of their kind always meet with the most ready sale, and often at two or three times better prices, the thrifty gardener will resort to every means within his power to hasten forward his plants, that he may be the first in the market. The best devices for this purpose are manure, hot beds, cold frames, forcing pits, and green houses or other glass structures that enable the gardener to have under his control the heat and atmosphere necessary to growth, no matter what the state of the weather outside may be. The first cost of hot beds and cold frames being the least, they are much more generally used than the others. The best material for hot beds is manure and litter from the horse stables. It is all the better if it contains considerable of a proportion of straw or leaves from the forest, as these materials will generate heat much longer than fine manure or mixtures with hay, which is very commonly used for bedding in this country. About three weeks or so before the time for making hot beds, the manure designed for the purpose should be hauled out and placed in piles or ricks near where the beds are to be made; it will not do to leave it scattered about to become frozen, or it will be too late in generating heat. After a few days when the heat begins to come up, which may be known by the escape of steam from the pile, the whole mass should be forked over and mixed well together. As soon as fermentation again begins it is ready to lay up into beds. The beds may be built upon the surface of the ground, but in this climate it is economy to excavate pits a foot or more deep and one foot longer and wider than the frame which is to cover it after completed. In building the bed the manure should be laid in level courses, beating each course evenly down with the back of the fork until the whole is one and a half or two feet deep; finishing off the top with the finest manure or the earthy rakings from the bottom of the pile. When the manure bed is completed, we place upon it a frame made of inch boards, one foot deep in front and one and one half at the back; this should be put on with the lowest side facing the south, to admit the more direct rays of the sun, and the sash are put on immediately. As soon as the heat is up, which is usualy in two or three days, remove the sash and place within the frame about six inches deep of good but rather light garden mould, and replace the sash again, after leveling off the surface with a rake and removing sticks, stones and other rubbish. Now when this soil gets warmed through it is ready to receive the seeds. These we sow in rows across the bed about three inches apart. Cabbage, cauliflower and lettuce should not be mixed in promisciously with tomatoes, egg plants, peppers, etc., as the latter require a greater degree of heat to bring them up, and will endure a degree that would be disastrous to the first. After hot beds are sowed they will require constant attention, to give air when too warm and whenever the sun shines out brightly, and water when needed. I have often seen the entire contents of the bed burned up in a short time when the sun suddenly came out brightly on a stormy day with no one at hand to give ventilation. Hot bed sash can be made by any ordinary carpenter, or they can usually be purchased in our larger towns ready painted and glazed. The most convenient size is two and half to three feet wide by six long. Cold frames are much the same as hot beds, except the manure is left out, and we depend upon the rays of the sun to impart heat, and extra coverings and protection at night to retain it. Cold frames are very useful for growing cabbage plants and for transplanting into from the hot beds, for hardening off. Both cold frames and hot beds are much better for being sheltered on the north side by buildings, walls or close board fence.

IMPLEMENTS.

The gardener should use the best implements that can be procured. The first cost may be a little more, but they will prove more durable and will enable him to do his work better and more expeditiously. Within the last forty years inventors have brought out many improvements in these, and added to the list some that save considerable labor, so that the labor of planting a garden is more pleasant, and the cultivating more expeditious than formerly. The implements that are nearly indispensable are a two-horse steel plow, a harrow, Ames' bright spade and shovel, flat-tined spade fork, cast-steel rake, drawhoe shuffle or push hoe, pronged hoe or potato hook, cultivator and horse hoe, seed-drill, wheel-hoe, —or the two combined in one, —of which *Allen's Planet Jun* are full as good as any in use; wheelbarrow, manure fork, *line and reel* watering pot, and one each of plow, harrow, seed drill and cultivator, and more in numbers of the others, according to the size of the garden and number of men employed. The total cost of the above, I think, will not exceed one hundred dollars. A good substantial market wagon is another of the requisites.

SEEDS.

If there is any one thing that is of more importance than any other toward success, it seems to me that it is good, pure seeds. For this reason, were it practical, it would be better for every one to grow and save his own seed, or have it grown expressly for him; but no gardener who grows a general variety of vegetables can raise his own seed and keep it pure, on account of the liability of varieties to mix. Another difficulty in the way is that only the earliest and best specimens should be saved for producing seeds, and these are just what his customers want, and they will frequently bring him much more than the seed would be worth. Seeds had better, as a rule, be raised on larger farms, more distant from the city, and where there is room to keep the variety and species widely separate. Again, some varieties quickly deteriorate on our soil and climate, and are much better and more cheaply grown in Europe. Of many varieties, Minnesota-grown seeds will be found superior to any others. It is well known that grains and vegetables go through an acclimating process after being introduced here, and for several years increase in earliness, and often in beauty of appearance and fine flavor. Especially is this the case with corn, lima beans and tomatoes. I would not recommend any gardener to grow even a large proportion of his seeds, and in no case more than one variety of a family or species. This advice makes it necessary to purchase considerable of our seed, and the question that meets us is, Where is the best place to purchase?

There are a number of reliable seed firms in the United States that grow everything that is best grown here and import the balance from the growers of Europe. If you have been dealing with any such firm for a number of years and find them always reliable, remember that it is not generally good policy to swap off an old friend for a new one. If you have no such place to secure your seeds, I would advise you to purchase the bulk of them at home. We have two seed houses in this State, and perhaps more, that have already established a reputation for fair dealing and the superior quality of seeds they keep, and a considerable proportion of their seeds are not only produced in this State, but in the most careful and skillful manner, and unless you have good reasons to the contrary I shall recommend you to give them your support. True, they do not grow all the seeds they sell, and neither do the more Eastern firms. I think you will generally find it better not to divide your patronage, as the dealer you patronize will usually have better facilities than you for procuring the best. Never purchase any article for the reason that it can be had cheaper than at any other place; as a rule the price of good seed is nearly the same everywhere. Also, it is well to shun the commission seeds that are kept on sale at the grocery stores. Whoever attempts to raise their own seed should invariably select for the purpose the best grown specimens and purest type of the variety, to prevent deterioration. The mixing of varieties take place while the plant is in flower; the pollen from one is carried to another by the winds and insects. The comingling of the flowers and the crossing process seldom effects the fruit or vegetable the same season, except where it is the true seed that is valuable, as in the case of corn. It is well known that sweet corn fertilized by the field varieties becomes tough and looses much of its sweetness. In all cases the effect is seen in the next crop grown from the seed they fertilized and in no family of vegetables more than in the *Curcubacea*, which includes our cucumbers, melons, squashes, etc. There is scarcely a farmer present who has not planted melon seeds and grown mongrel pumpkins and squashes. Still, this crossing process is not without its advantages when skillfully managed, for by it some valuable hybrids have been and may be originated, which by judicious selection and cultivation retain their types.

The following is a list of the vegetables the market gardener is expected to be able to furnish to his customers. I will only mention such varieties of each as my experience has demonstrated to be the best for this climate:

Asparagus. Conover's Colossal.

Beans. Bush or dwarf for shell bean: Early China Red Eye, White Marrowfat, Early Valentine, German Black Seeded Wax, Golden Wax.

Beans. Pole or running: Lima or Small Lima, Large White Lima, Horticultural or Speckled Cranberry.

Beets. Egyptian Turnip, Dewing's Improved Blood Turnip.

Cabbage. Early Jersey Wakefield, Early Dwarf Flat Dutch, Premium Flat Dutch, Green Curled Savoy, Red Dutch for pickling.

Carrots. Early Scarlet Horn, Half Long Red, Improved Danver's.

Cauliflower. Henderson's Early Snowball, Early Dwarf Erfurt and Algiers.

Celery. Sandringham, Dwarf White, and Celaric or Turnip Rooted.

Corn. Marblehead Early, Early Minnesota, Harris' Evergreen, Stowell's Evergreen.

Cucumbers. Early Russian, Improved White Spine, and Green Prolific Pickling.

Egg Plant. Improved New York Purple.

Kohl Rabi. Early White Vienna.

Lettuce. Early Curled Simpson, Black Seeded Butter, and Hanson.

Muskmelon. Large Netted Nutmeg, Green Citron, Hackensack and Bay View.

Watermelon. Phinney's Early, Mountain Sweet. Light Icing.

Onion. Extra Early Red, Red Globe, White Globe, Yellow Globe.

Parsnips. Sugar or Hollow Crown.

Peas. Landreth's Extra Early, Little Gem, Laxton's Alpha, Champion of England.

Pepper. Sweet Mountain or Mammoth, Long Cayenne.

Pumpkin. Large Cheese.

Radish. Early Scarlet Turnip, French Breakfast, White Olive Shaped, Scarlet China, Winter.

Rhubarb. Linneaus or Wine Plant, and Victoria.

Salsify or Vegetable Oyster. One variety.

Spinach. Savoy Leafed, New Thick Leafed, Long Standing.

Squash. Early Bush Scalloped for summer, Hubbard, Butman, Boston Marrow.

Tomato. Canada Victor, Trophy, Acme, Paragon, and for trial Livingston's Perfection.

Turnips. Early Flat Dutch, Early Purple Top, Strap Leaf, Yellow Globe or Golden Ball.

Rutabaga. Improved Purple Top, Laing's Improved.

And a few herbs, such as sage, summer savory, majoram and thyme.

Time will not permit me to give a description of each of these varieties, nor a detailed description of the methods of cultivation and fitting for market. But they are all such as the gardener who is located so convenient to market that he can go in every day will find it profitable to grow, and that of the best quality, and to get them into the market as early in the season as they can possibly be matured.

The gardener distant from market may find it more profitable to omit lettuce, sweet corn, summer squash, and a few others. I have purposely omitted potatoes, as I grow only the early, and am not able to discuss the merits of the many fine varieties recently introduced. For early I have found the Beauty of Hebron to be about the best.

To grow vegetables to perfection requires constant attention in keeping the weeds out and the surface of the soil mellow and loose, and the appearance and condition in which they are placed on the market adds very much to their value and readiness of sale. All early vegetables that are usually bunched should be washed clean, surplus leaves removed, and be tied into uniform-sized bundles, and so much of the tops cut neatly off as will not mar the appearance of the bunch, as this delays wilting.

I will now give a more detailed account of my method of growing two or three of the more important varieties, by which time you will be weary enough to let me off with good grace.

I will first describe the making of an asparagus bed, as my friend Smith is present and can help me out or correct any errors I may make, and afterward follow with my method of growing tomatoes, if time will permit.

ASPARAGUS.

This is one of the most important crops that the market gardener has to do with. It is the earliest culinary vegetable that comes into the market, is wholesome and rapidly growing in favor, is very profitable, and ought to be produced in such quantities as will bring it within the reach of the laboring classes.

It takes two years of cultivation to bring new or old land into that state of cultivation that best fits it for this vegetable. As it is a plant that endures for many years, and grows better with age, it will well pay for the best of treatment. The cheapest method that I know of for forming an asparagus bed is, as early in the spring as the ground is dry enough to work, to select a plain of dry, sandy loam, and with a one-horse plow or corn marker draw furrows across it four feet apart, and follow with a common plow, returning in the same furrow repeatedly until a ditch a foot deep is opêned and the soil opened at least 16 inches wide. In the bottom of this ditch spread 3 or 4 inches of well rotted manure (that from stall-fed cattle is the best);

then place on this a little soil and drop the roots (which should be two years old) about 18 inches apart. This seems a waste of ground at first, but the beds will endure longer and produce a better quality of asparagus for it. The plants are to be covered by drawing 3 or 4 inches of soil over them with a hoe. This leaves the trench a little more than half filled, and the sprouts will soon come through, while if filled, some of the weakest plants will be smothered. Frequent hoeing must be given the first summer to encourage the strongest possible growth and to keep down all weeds.

In the fall when first frost occurs the tops are to be cut away and the ditch filled up level with the surface and the whole ground covered with a liberal dressing of manure. The next spring the beds may receive a shallow plowing, being careful not to go deep enough to disturb the roots, and after a few days level over with a harrow, and during this season the principal part of the cultivation can be done with a horse and cultivator. No cuttings ought to be made this year. In the fall remove the tops and cover again with manure. The next spring rake out the coarsest of the litter and plow between the rows, throwing the furrows over the row and rake it over to remove all lumps, sticks and stones. This leaves a shallow ditch between the rows. This season the bed will yield considerable of a crop of asparagus; and to keep it in good condition it should be cut every day, and after every rain the surface should be gone over carefully to keep it level and fine. The cutting should not be continued too late this season, lest the roots become weakened. When the cutting is stopped there should be a liberal dressing of manure applied between the rows, and the ridges over the rows plowed down and the whole bed be harrowed over fine and level, and all asparagus that comes up afterward is left to grow the balance of the season. It is beneficial to apply a liberal dressing of salt after the cutting is finished and the bed laid away for the summer, and it is imperative that no weeds are allowed to impede the growth of the asparagus or impoverish the soil. In the fall remove the tops as last year, cover with manure, and each year give the same treatment as we have described for the last, and the bed will continue to grow better for many years and be a paying investment for at least twenty years.

About where to cut asparagus to have it the best there is a diversity of opinion. It should always be cut two or three inches or more beneath the surface of the ground, using a long knife for the purpose. If a crisp, green article is demanded by your customers, let it get about six inches above the surface before cutting, as at that stage of growth all below the ground will be tough and stringy. If a pure white article is wanted, it must be cut as soon as it breaks the ground, and be sure to cut at least six inches below to give a suitable length for bunching, and great care must be exercised not to break or injure the buds that are not yet through. After it is cut it is to be washed clean and put into bundles, tops even and all one way, neatly tied with two strings; the buds cut off square, so that the bunches will be of uniform length, when it is ready for market. If it is not sold immediately, it must be kept in a cool place, and never be watered to freshen it up, or it will quickly decay. If the market could be educated up to it, it would be better without washing, as it would thus keep much longer, and in fair weather, cut at evening, will not have much soil adhering.

GROWING TOMATOES.

This is an important and valuable crop, if they can be well grown and got into the market early. For the earliest, sow the seeds in hotbeds about the fifteenth of March. They will come up in four to six days, and will need watching and watering and air on all pleasant days to prevent burning or damping. At the end of two weeks they will be in their second leaf, or rough leaf. My practice at this time is to have another hotbed ready and to take up the young plants carefully and to prick them out into it in rows three or four inches apart and an inch or so distant in the rows. This operation is best done at evening or on a cloudy day. Water immediately after setting, and shade for a day or two when the sun shines. They will quickly get accustomed to their new quarters, and will require plenty of air on all mild days. When they get about six inches high I take up and transplant again into cold frames, keeping them covered with sash nights and stormy days, where they are to remain until time for transferring to the open ground. In this frame they stand four to six inches distant each way, and will be strong and stocky, and can be taken up with spade or trowel, leaving most of the roots and a large bole of earth attached, and if carefully plante l will receive no check in their growth.

For early tomatoes I prefer a rather sandy loam, not made too rich with manure. This is best plowed two weeks before the plants are to be planted out. I never like to transplant them when the ground is wet or upon a rainy day, but do not object to a smart shower soon after the work is done. I have usually got the best results where the rows are four and one-half feet apart and the plants three feet in the row. If the ground is dry, make the hills with a spade or spade fork, shoving it down full length, lifting out the soil and inserting it back into the hole made. This leaves the surface moist and loose. The plants are now carefully dropped one at each hill, and a man or boy follows, takes the plant in his left hand, opens a hole in the fine soil with the right, sets the plant in considerabledeeper than it stood in the bed, and with a quick motion of the hands draws the earth about it, and in the same motion presses it firmly with the knuckles. If the soil is not rather moist, the planter goes back on the row, pressing it about the plants with his feet, afterward drawing a little loose earth over the surface to serve as a mulch and to prevent baking after showers.

I prefer the evening for transplanting tomatoes (and all other plants), and whenever possible use large, stocky transplanted plants, carefully taken from the beds with a trowel, and with such plants never water, no matter how dry the weather may be; but the plants should be thoroughly watered in the bed a few hours before taken out.

I am aware that this method is not as expeditious as using smaller plants and setting with a dibble, but I have always found it the cheapest in the end, unless the weather should prove favorable, as this vegetable is one of the gardener's most important crops, and pays much better if ripened early.

ADDRESS

OF

HON. J. H. SANDERS,

Editor of Stock Breeder's Gazette, Chicago.

IN-BREEDING AND OUT-CROSSING.

It is only by an aggregation of results, for a series of years, under a variety of circumstances, that we arrive at an understanding of the general laws which govern the operations of nature. Exceptions prove nothing. Individual experience count for naught if they are contrary to the results obtained by the great mass of men similarly situated. The *general result* establishes the *law* in such cases made and provided, and this law is the only safe rule upon which we can base a practice.

It is in this broad and general sense that I desire you to consider the question of which I shall speak to-day. No doubt nearly every observant person in my audience may be able to call to mind cases that have fallen under his own notice that tend to disprove the ideas that I shall advance. But I beg you to bear in mind that, while I speak of *general laws* that are susceptible of numberless modifications and exceptions, the truth of their existence *as laws* remain unquestioned; and the breeder who ignores their existence, and ventures upon a practice which these laws forbid, will find himself rowing against the tide. He may, indeed, strike an eddy, where the force of the current is not felt, and here he may make some progress; but in the end, unless his strength of arm and oar be greater than that of the current, he will inevitably find himself carried down stream. Circumstances may conspire to give a temporary success to a breeder whose practices are contrary to the known laws of heredity; but this example is always an unsafe one to follow, and he is himself upon dangerous ground.

The impression is well nigh universal among practical farmers and feeders of live stock that cross bred or grade animals are more profitable than thoroughbreds of any kind; and for an opinion which has become so deeply rooted and so generally entertained among practical men, there must be some substantial foundation. The beef that tops the English market is almost invariably from cross bred or grade cattle. The prize winners at the Birmingham and Smithfield shows are frequently cross bred beasts; and at our own fat stock shows, in Chicago, the steers that have been the recipients of the blue ribbon for best beast in the show, have, so far, *all* been grades or cross bred animals; although pure Shorthorns, Herefords and Devons have always been found among the competitors. And these are not exceptional cases by any means. In fact there are few, even of the most ardent admirers of thoroughbred stock, but will concede that for every purpose, except that of reproduction, the high-grade or cross bred animal is frequently quite the equal, at least, of its thoroughbred ancestry. The only exception, perhaps, that can be made to the general application of this rule, is in the case of the thoroughbred race horse, and of this exception I shall speak further on.

It has often been urged in explanation of this alleged superiority of grade or cross bred beasts, that but few thoroughbreds of any kind are ever fed for the market, on account of the demand for thoroughbred stock for breeding purposes; and that such as are fed are usually those that, on account of inferior quality, have been rejected as unfit for breeding purposes, or past the age to be profitably used as such. This explanation, while quite plausible, and doubtless correct in many instances, fails to account for the widespread and firmly grounded belief of which I have spoken, because the men who entertain it are not the men who breed thoroughbred stock, as a rule, and hence do not have these culls or superannuated breeding animals to experiment with. If you ask one of these practical farmers why he does not feed thoroughbred cattle, sheep or swine, he will usually say that it is because he does not consider them *hardy* — that they are not *good feeders*, or will not "do well" under such treatment as he usually gives his stock — that they are too tender, require too much "babying," "pampering," and "nursing'' to suit his methods. And yet in nine cases out of ten we find these same practical farmers using, and urging others to use, none but thoroughbred males, because, as they firmly believe, it *pays* to use them.

Now, there must be some substantial reason for a faith and practice that is so general among those who are admitted to be our most successful farmers. The very fact that they advocate the use of thoroughbred males shows that it is not the result of prejudice against improved blood; and so we must look beyond this for a solution of the problem.

To admit the truth of the charges of tenderness, lack of constitution, and bad feeding qualities, which these men make against thoroughbred animals, would be to admit that the labors of the great improvers of our live stock during the past and present century have been in vain; for it was to effect improvement in these very particulars that their efforts were directed; or else we must charge that there has been something radically wrong in the practices of the more modern breeders, which has lost something of what has been gained by their predecessors; for, theoretically, the thoroughbred *ought* to surpass all other animals in *all* the qualities that especially adapt him to the farmer's use.

I am satisfied that in many cases the charge is well founded — that there is a good and sufficient ground for the belief of which I have spoken. There is a constant tendency in nature that all animal life shall adapt itself to the conditions by which it is surrounded. With changed conditions of life must come a corresponding change of habit, form, or disposition, such as is essential to maintain existence under the new order of things. Such change may be either for the better or the worse — from a condition of abundant and highly-nutritious food and careful protection from storms, to one of scanty sustenance, and exposure to great extremes of temperature, or the reverse. In the former case, the change would be likely to affect the animal favorably; and a few generations of existence under the new order of things would of itself work a wonderful improvement in the quality of the animals, especially if raised merely as flesh producers. On the contrary, if the change has been in the other direction, we must expect the race to become extinct within a brief period, unless it possesses sufficient elasticity — vigor of constitution — to adapt itself to the new order of things, which requires it to forage for its own living, and to withstand great extremes of temperature without artificial protection.

Now, if we apply this law to thoroughbred cattle, sheep or swine that have for generations been kept in the highly artificial condition, fed to repletion with nutritious food and carefully housed from change of temperature with nothing to do but to eat what what is placed before them and then to lie down in a warm barn and digest what has been eaten, we shall at once see why such animals should not be considered hardy when subjected to great extremes of heat and cold and required to subsist on scanty fare. They are not adapted to such a state of existence, and of course cannot "do well" under it. Their habits of life, their form, and even their digestive apparatus, must undergo a material change before they are adapted to the new order of things; and by the time this change is effected, which can not be done in a single generation, it is likely that very much of the excellence which distinguished the thoroughbred under its former conditions of life will have disappeared.

But there is another cause which in my opinion lies deeper, and is more wide spreading in its influence than that of which I have just spoken; and that is the tendency of so many breeders of throughbred stock to continue the course of breeding in-and-in by which their favorite breeds were largely created, and which in the hands of originators or improvers of the various breeds, had proved so powerful an agent in fixing uniformity of type. Men who has given the subject of breeding *as a science* only a casual investigation — who have studied only the methods of a Bakewell, a Colling, a Booth, or a Bates, without taking into account the *circumstances under which these methods were practiced* — have hastily adopted the conclusion that what was successful in such hands as theirs must still be correct in practice; that because Bakewell and Colling bred in-and-in to fix a desired type, and by continuing that process for a time, succeeded in effecting substantial improvement in their cattle and sheep, it must necessarily follow that the surest method of preserving the excellence attained by them is to continue in precisely the same road. Or, to put it rather more mildly, because in the *formation of a breed* these men experienced little if any damage from the practice of breeding in-and-in to the extent to which they carried it, modern breeders of thoroughbreds can continue to breed in-and-in with impunity.

There is no one point upon which practical breeders as well as scientists are more perfectly agreed than that the ultimate tendency of breeding in-and-in is injurious—that when carried to *excess*, it will always result in a loss of constitutional vigor in the produce; that while its tendency may be in the direction of fineness of texture, lightness of bone, smoothness, evenness, and polish, it is invariably at the expense of robustness, strength, vigor and power. On the other hand, scientists, as well as practical breeders, will perhaps, with equal unanimity, concur in the belief that a cross in the blood usually gives increased size and vigor to the produce; and that cross-breeding, or the pairing of animals of distinct varieties, usually results in increased fertility. But it is rather singular that, while this result usually attends the pairing of varieties of the same species, if cross-breeding be carried so far as to unite distinct species, although increased size and vigor is still attained, fertility is almost entirely lost, as we see well illustrated in the breeding of mules. It is a singular fact, that a loss of fertility is also one among the very first bad results manifested from long-continued in-and-in breeding, which is the converse, or opposite, of violent out-crossing; and yet all experience proves this to be true.

We shall not enter upon an elaborate discussion of the principles of genesis by which this apparent contradiction is explained, and which forms the basis of correct understanding of the laws of heredity. But, in order that we may get a little farther below the surface in our discussion of this question than has usually been reached by those who have written or discoursed about it, I would invite attention to a statement of some of the principles which, in my opinion, underlie the whole subject of in-breeding and crossing. It is a well-established fact that, in order to produce a sexual union which shall be fruitful, and call into life a new organism, it is essential that the sperm-cell and the germ-cell, which, united, form the source of life to the new being, shall each proceed from different organisms. Now breeding in-and-in as usually practiced — being the selection of individuals of as nearly as may be a similar organization, with the avowed purpose of creating uniformity of character — will, in course of time, if not counteracted by opposing influences produce such a unity of organism in the members of a given family as will result in a loss of that differentiation which appears necessary in order to insure the fusion of the sperm-cell of the one with the germ-cell of the other, and call into life a new being. Or if, perchance, this power of fusion be not entirely lost, it may become so impaired that the result will be a feeble, sickly offspring—an imperfect creation—an illustration of that pre-natal condition which, for lack of a better term, we call a want of constitution.*

In the breeding of *thouroughbred* stock, we have the active principles of selection with a view to securing uniformity of type, which implies uniformity in the physiological units, and which steps in as an agent to hasten that homogeneousness which all scientists as well as practical breeders pronounce hurtful and dangerous; and many breeders have continued the practice of again and again breeding in-and-in, all intending, of course, to stop before they have gone too far, but forgetful of the fact that they are operating upon a stock with which in-breeding has been largely practiced from its earliest history; and which is already paying the penalty of this infraction of Nature's law in enfeebled constitutions and loss of vitality. It is only necessary to call any candid and intelligent breeder of Shorthorns, in England or America, upon the witness stand to prove the truth of this assertion. The most eminent authorities in both hemispheres admit and deplore the fact, and agree in specifying in-and-in breeding as the chief predisposing cause, although its operations are accelerated by confinement, want of pure air and exercise, and intemperance in feeding; and all these accessories to physical degeneration we find usually furnished with an unsparing hand by the same men that practice in-and-in breeding.

Go where you will among thoroughbred animals that have long been subjected to this course of breeding and these conditions of life, whether cattle, sheep or swine, and you will find evidences of the baneful result. Barenness is of common occurrence. A scrofulous taint is everywhere present; manifesting itself in swelling and ulceration of the intestinal glands, abscesses, enlarged joints, glandular tumors, tuberculosis, and, in short, a condition of the system unduly disposed to decay and death — an easy prey to any malady that may chance to seize hold of it.

It is this impaired vitality and predisposition to disease which unquestionably exists in much of our thoroughbred stock, and which has been brought about by the practices I have described, that has given rise to the belief that thoroughbreds are not hardy. And it is by virtue of the operation of the law

* Those who are curious enough to pursue this line of thought further, will find a very elaborate discussion thereof in Herbert Spencer's Principles of Biology, Vol. 1, page 278 to 284.

that a cross in the blood gives vigor to the stock, that general farmers find their greatest profit in rearing cross-bred or grade beasts.

The farmer who *permits* his stock to pair miscellaneously, without infusing fresh blood for many generations — as is the case with some — must necessarily practice breeding in-and-in; but, as in such cases the stock is almost invariably, at the beginning, of a heterogeneous character, it will require a much greater period of time before breeding in-and-in shall have produced a sufficient degreed of unity of organism to interfere with fertility, or to cause a loss of vitality, than in cases where the stock, to begin with, is of a uniform type, or "purely bred." In such cases, also, there is no effort on the part of the farmer to produce uniformity by selection of individuals for coupling. If there be any selection at all, the standard by which it is made is a capricious one, changing from year to year; and it is a well-known fact that in such hands uniformity of type is never reached, neither have any bad effects been observed from in-breeding in such cases. If the theory above advanced be correct, no bad effects will necessarily result from breeding in-and-in until uniformity of type, which implies unity of organism, is attained; and this, as we have seen, when breeding from a mixed stock, is a very slow process.

I stated in the outset that the thoroughbred horse was an exception to the general rule; and the reason is obvious. With the breeder of the race-horse, vitality has always been a paramount consideration, as upon this depends the ability of the horse to last in a long and closely-contested race; and a course of breeding that had a tendency to impair the vital force has never found favor with breeders of these horses. None of the practices that have combined to impair the strength and vigor of thoroughbred cattle, sheep and swine have been resorted to by them. In-breeding and pampering have been frowned upon. Selection of the stoutest and best specimens of the breed has been the touchstone of their success. Once in and twice out has has been as near an approach to in-breeding as has ever found favor among them; and, in consequence, we find the thoroughbred horse of to-day the superior of all the other representatives of the equine race in speed, stoutness, and endurance.

It appears evident that if the laws of heredity are as I have stated — that is, that the tendency of in-breeding is to weaken the vital forces, and that cross-breeding gives increased vigor and vitality — we have here a lucid explanation of why the general farmer finds it most profitable to raise grade or cross-bred stock for the dairy, or for feeding purposes. Thoroughbreds, as a rule, have been perfected to a wonderful degree in certain qualities; and when the general farmer, desiring to improve his flocks and his herds in any of these particulars, procures a thoroughbred male to use as a sire, even though such animal be suffering from some of the bad effects of in-breeding or over-feeding, the excellence that characterizes the *breed* to which he belongs, reinforced and reinvigorated by contact with the current of fresh blood he meets in the farmer's mixed stock, gives a produce of greatly increased value for everything except the purposes of reproduction.

I may sum up the conclusions to which I have been led by my own experience, observation, and study in this branch of stock breeding by simply stating that, when the breeding and management of thoroughbreds have been in accordance with Nature's laws, there is no foundation for the assertion that they are deficient in hardiness; and that the widespread belief to the contrary has resulted mainly from the bad effects which inevitably follow incestuous or in-and-in breeding. That with certain kinds of thoroughbred stock, this course of breeding has been so extensively practiced as to very greatly impair the vitality of the animals so bred; while in others, where selection has constantly been made with reference to hardiness, strength, and endurance, where close in-breeding has been avoided, and where there has been no unnatural forcing and pampering, thoroughbreds have no peers in these valuable qualities. That the lack of hardiness complained of in thoroughbred stock is an accident, due to a peculiar course of breeding or treatment, not justly chargeable to the simple fact that the animal is a thoroughbred, and not necessarily following the course of breeding essential to the creation of a thoroughbred. That in proportion as uniformity in all essential characteristics is approximated, the necessity for care in the selection of breeding stock with a view to constitutional vigor is increased, in order to maintain hardiness and vitality; and hence the much greater success which some breeders of thoroughbreds attain than others, with the same strains of blood. That thoroughbreds transmit their own qualities with much more certainty than mongrels, or animals of a mixed breed; and as they have generally been perfected to a remarkable degree in one or more valuable qualities, the use of a thoroughbred male

47

upon common or mixed stock almost always shows a marked improvement in the produce. That a cross in the blood usually gives increased vigor to the produce; but when both parents are already of mixed blood, nothing is gained by crossing. That to secure beneficial results from cross-breeding, at least one of the parents must be a thoroughbred, with race characteristics so firmly fixed that, while it may be invigorated and strengthened by being transplanted, so to speak, into a virgin soil, the produce will retain all the excellence of the thoroughbred parent. That, however excellent the results from cross-breeding may be, animals so produced cannot themselves be relied upon to transmit that excellence, except in a further union with thoroughbred stock. Hence, in all cases, to secure the highest benefits which result from a cross in the blood, as well as to perpetuate the excellence which has been attained in any given breed, at least one of the parents must be a thoroughbred; and hence the great importance of maintaining absolute thoroughbred races in their purity, as the only source to be relied upon in effecting further improvement.

The Culture and Management of our Native Forests, for Development as Timber or Ornamental Wood.

BY H. W. S. CLEVELAND.

Man's progress from barbarism to civilization is indicated by the degree of skill he has attained in the cultivation of those products of the earth which minister to his necessities and comfort. As long as the natural resources are sufficient to supply his primary wants of food and clothing, he will make no effort to increase them, and it is only as he is driven by the necessities of increasing demand and diminishing supply that he exerts himself to secure relief by artificial means.

The first efforts of the savage at cultivation are of the rudest description, and just in proportion as tribes and nations advance in numbers, power and intelligence, do they also gain in improved methods of tillage, in greater knowledge of the science of culture, and in better implements and machinery for its performance.

These are simple truths, which everyone will recognize. Their application to the subject of forest culture, lies in the obvious fact that it is not until a nation has reached mature age, and an advanced stage of civilization, that the native growth of wild forest proves insufficient for the increasing demand for timber, and the necessity of providing, by artificial culture, for an additional supply, begins to be felt.

We could hardly have a more striking illustration than is here afforded, of the adaptation of the provisions of nature, first, to the immediate necessities of existence, and subsequently to the development of the latent powers of the human race. The cerials and vegetables which are essential to man's daily support are of annual growth. Their culture is comparatively simple, and he soon learns that his very existence is dependent upon their renewed production with each recurring summer. The forests are equally essential to his further development, by furnishing material for the construction of houses and ships, and the countless implements by whose aid he attains to almost superhuman power. But the forest requires the lifetime of two or three generations for the full attainment of maturity. In the infancy of the race, the necessity of providing for such distant wants could not be foreseen.

Nature, therefore, as if she had been conscious that forest culture was too arduous an undertaking for primitive man, has furnished so abundant a supply, that no deficiency or necessity of economy is felt till the nation has acquired such a degree of intelligence as to be competent to the solution of the problem.

And this is the point at which we now stand, and which the older nations of Europe have long since passed, seeing plainly that our natural sources are well nigh exhausted, yet shrinking from the unfamiliar task of seeking to supply the deficiency by artificial means.

Many once powerful nations have dwindled into insignificance in consequence of their neglect of this lesson which nature imperatively demands that we should learn. Their fate should be to us a warning, as the efforts of the most intelligent nations of to day should be to us an example, to save us from a like fate. The necessity for action is imminent and can not be averted. The subject of the increasing demand and rapidly diminishing supply of timber throughout the country has been so thoroughly discussed by legislative committees, both state and national, by agricultural societies and by able individual writers, that it would seem but a waste of time to bring forward the oft-repeated statistics in evidence of the danger that threatens us, and the urgent need of adopting measures of protection and relief.

Assuming, therefore, that my readers are familiar with the data which prove the necessity, I pass at once to the consideration of the means of averting the danger.

The only measure of relief thus far suggested with any definite prospect of success, is the planting of new forests. Much has been said, it is true, about the preservation of those that remain; but the words seem meaningless, in view of the fact that private property is beyond the control of the government, and congress declines even to grant means to prevent the destruction of that which still pertains to the public domain.

The planting of new forests is indeed an all-important work, which can not be too strongly urged, but we have not yet reached the period when it is likely to be successfully inaugurated, except, perhaps, in occasional instances by railroad or manufacturing companies, with a view to their own future wants. Individuals will not engage, to any great extent, in a work which demands the investment, not only of a large amount of money, and the continuous expenditure of a great deal of labor, but also of a long period of time, which is the one form of capital of which we never have a surplus. It behooves us, therefore, to study rather more closely than we have heretofore done, the possibility of improving the condition of that which remains. The woods still standing contain a vast amount of available material which is susceptible of development in far less time than would be required for the planting and growth of new forests, our utter neglect of which furnishes one of the most striking proofs of our ignorance of forest culture.

No one can travel through any portion of the States east of the prairie regions without being impressed by the fact that he is never out of sight of woodland. In fact, the chief cause of the prevailing apathy on the subject of forest planting, arises from the fact of the great abundance of groves and extended forests, which convey the impression, in spite of the assertions of staticians, that there is still enough wood growing to supply the place of that which is removed.

The Duke of Argyle, in the interesting sketch of his trip through the States, published after his return to England, says emphatically that nothing in the aspect of the country surprised and impressed him so much as the great amount of wood still remaining, and everywhere giving beauty and variety to the landscape; but he added that it was everywhere the beauty of the wild wood, which never bore any evidence of culture or effort to increase its value by artificial development.

"I saw nothing (he says) that could be called fine timber, and no woods which showed any care in thinning, with a view to the production of such timber in the future."

Such a criticism is not surprising from one who, like most country gentlemen of England, is familar with the process of forest culture, but it certainly is surprising that, with all our boasted intelligence, we still remain practically insensible to the fact that, while almost every tract of woodland contains a large percentage of such trees as are most valuable for timber, already well advanced in growth, and susceptible, by judicious management, of being developed into proper form and size for use in far less time and at far less cost than would be required for the planting and growth of new forest; yet, if left to themselves, not one tree in a thousand will ever be fit for anything better than fencing stuff or fuel. Vast resources of wealth are lying latent and running to waste in our woodlands, and we stand stupidly unconscious of the fact that its developement requires simply the application of the intelligent culture we bestow on all other crops. In many instances, it is true, the native woods have been so long neglected, that they are past redemption, but there are, nevertheless, large areas of continuous forest, and smaller groves. and woodlots in every section of the country, now yielding no revenue, which might, by proper annual thinning, pruning and culture, be developed into timber forests of very great value, while yielding an annual crop of firewood in the process.

Where shall we find, or how shall we create, the men who are competent to the work? To judge from invariable practice, our people seem not only to be ignorant of the first principles of forest culture, but unconsious even of the possibility of its application to the developement of our native woods. The fact of such prevailing ignorance rests not alone upon negative evidence. We have positive proof in abundance in the attempts which we often see at the "improvement" of a piece of woodland when it is appropriated as the site of a residence. It is hard to conceive of anything more dismal and forlorn than the average result of the effort to impart a homelike aspect to such a place; the dwelling with its "span new" expression, standing in the midst of a multitude of tall poles, with tufts of leaves upon their tops, looking like fowls striped of their feathers, and the bare ground fretted everywhere with freshly upturned roots, the sole remnants of the wild shrubbery which has been ruthlessly exterminated.

In order to a comprehension of the principles of healthy forest growth, let us consider some of the processes of nature, and learn from them her requirements.

If we plant the seed of a maple, chestnut, linden, oak or ash tree by itself in the open ground in suitable soil, and suffer it to grow without molestation, simply guarding it from injury, we shall find that the the first act of the young plant is to send out broad leaves, which serve among other purposes to shade completely the stem, and the ground immediately around it in which the roots are growing. As the tree grows, it preserves a symmetrical shape, the limbs spreading and the trunk increasing in size, in proportion to its height, but always preserving the condition of keeping the trunk and the ground for a considerable distance around it, in the shadow of the foliage till mature age, when the roots have penetrated to such depth as to be safe from injury, and the trunk is protected by thick layers of cork-like bark, which safely guards alike from heat and cold the inner layers and young wood in which the sap is performing its functions.

Such are the conditions to which nature adheres, if not interfered with by accident or design, and such, therefore, we may be sure, are those best adapted to healthy and vigorous growth. The fact that they are continually violated with appearent impunity, serves only to show the wonderful power of nature to supply deficiencies, and adapt herself to circumstances, but in artificial culture, we should aim as nearly as possible to imitate the course she would pursue if unimpeded.

The requirements of nature are of course the same when trees are growing together in a forest, as when they stand singly, but the conditions of growth are so changed that the end is attained by entirely different means.

If we enter a tract of woodland, covered with a hardwood growth of an average height of thirty or forty feet we find it composed almost exclusively of trees which have run up to a great height in proportion to the spread of their limbs. The largest and oldest of them may have had some lateral branches which are now dead, but the younger growth will consist only of tall, slender stems, without a branch of leaf except near the top. It will be dificult, perhaps impossible, to find a single tree possessing sufficient symmetry of form to be worth transplanting for ornamental use. A little reflection will serve to convince us that this form of growth, so different from that of the single tree in the open ground, is the natural result of the action of the same rules under changed conditions.

When a young wood first springs up on open ground, each tree begins to grow as if it were alone, sending out lateral branches and preserving its just preportion. But whenever these laterals meet and mingle with each other, they shut out the sunlight from all below, and thence forward all lateral growth must cease and each individual is struggling upward to keep even with its neighbors and secure its share of the sumbeams which are essential to its existence, and which can only be had at the top. It thus becomes forced out of all just proportions in the effort to keep even with its fellows. The conditions of keeping the trunk and roots in the shade, however, are even more rigidily adhered to than in the case of the single tree, growing by itself, for the whole area of the wood is shaded, and, moreover, the trees on the edges of the wood, if not interfered with by men or cattle, will be clothed on the outer side with limbs and foliage, clear to the ground, so as to check the free passage of the winds whose drying influence upon the soil is even more active than that of the sun.

If we examine more closely, we shall find that nature adapts herself to these changed conditions, and avails herself of whatever advantanges they afford.

The single tree, when growing by itself, sends its roots deep into the ground in search of the moisture which can not be had near the surface, and thus, when it reaches mature age, it draws its supplies from sources beyond the reach of temporary changes and, moreover, secures so firm a hold upon the ground, that it suffers no injury from the storms that assail it, but fearlessly stretches forth its arms, as if to challenge the gale.

In the woods, on the contrary, the surface soil never becomes parched or heated, but maintains an even degree of temperature and moisture, in consequence, not only of the exclusion of the sun and winds, but of the deep mulching of leaves which annually cover the ground and keep it moist, while, by their decomposition, they form a rich mould comprising all the ingredients of vegetation.

If we dig only a few inches into this mould, we find it everywhere permeated by fibrous rootlets emanating from larger roots, which, under these circumstances have kept near the surface, where they draw nourishment from the rich material there provided. If the single tree in the open ground had tried to live by such means, it would speedily have perished for want of nourishment, or would have been uprooted by the winds, as forest trees are liable to be when left alone in a clearing.

In the woods the necessity no longer exists of sending the roots to a great depth, either in search of nourishment or for support against storms, and Nature always adapts herself to circumstances, and attains her ends by the simplest and most economical means.

If we now consider the facts I have stated, which anyone can easily verify for himself, we shall find that all the essential principles of tree culture are comprised within their limits, and by their rational observances we may secure healthy and vigorous trees, and develop at will either such forms as will fit them for timber or for ornamental use.

The five trees I have cited — maple, chestnut, linden, oak and ash — are among the most common, and yet the most valuable, of our forest trees, and may be taken as representatives and proper illustrations of the facts I am stating. Either of these trees, if growing by itself in proper soil, and undisturbed by other than natural influences, will attain, at maturity, a height of seventy or eighty feet, with a spread of limb equal in diameter to its height, and a trunk of such massive proportions as leaves no room for apprehension of inability to uphold the wilderness of foliage it has to support. But these same trees, if growing in a wood, will send up a slender stem, straight as an arrow, fifty, sixty or seventy feet, without a limb or a leaf, till it reaches the average height of its fellows, and sends out its tufts of foliage to secure the benefits of every sunbeam it can catch.

We see, therefore, that if we wish to form a beautiful and symmetrical tree, or a grove of such, composed of individual specimens of majestic and graceful proportions, we must allow it free access to sun and air, with full power of expansion on every side. While young, however, the growth will be more vigorous and healthy, and we can develop the desired forms more easily and successfully by leaving a much greater number of trees than are eventually to remain, and removing, from year to year, all which are near enough to the final occupants to check or impede their full development.

If, on the other hand, we wish to develop the trunk or bole for use as timber we must plant, or suffer the trees to grow more thickly together, and thus extend its trunk longitudinally by forcing it to ascend in search of the sunlight on which its very existence is dependent. The indigenous growth, however, is always a great deal too thick for successful development. The trees are so crowded that many of them perish in the struggle, and those which survive are drawn up into such spindling proportions that not one in a hundred ever attains the dignity of timber, whereas by proper and reasonable thinning, and judicious culture and pruning of the trees selected for final retention, every acre of woodland might be made to yield an annual crop of firewood, and all the while be growing timber which eventually in many instances might be worth more than the land itself; or by a different process of management may be converted into a grove of majestic and graceful, ornamental trees.

The proper preformance of this work constitutes the most important part of forest culture and for want of the knowledge of how it should be done, or from ignorance of the possibility of its application to our native forest, a vast area (in the aggregate) of woodland is running to waste; yielding no revenue and promising nothing better in the future than fire-wood, of which a very large proportion is yet susceptible of redemption and converson into timber of great value at far less cost of time and labor than would be required for the planting and rearing of new forests, while the very process of development would be yielding an annual income instead of demanding large outlays.

Travel where we may we are never out of sight of forest, and every wood lot is a mine of wealth waiting only the application of intelligent labor for its development. In almost every tract of woodland may be found more or less of the trees I have named and in many places also hickery, walnut, butternut. elm, cherry, beech and other valuable timber trees, mingled with a great variety of those which are worthless, or fit only for fuel. In some cases they are past redemption, having been so long neglected that they have run up into mere thickets of hoop-poles. Young growth may everwhere be found, however, which are in condition to be taken in hand, and in almost all cases the work of thinning and pruning may be entered upon with a certainty of profitable results if wisely and perseveringly conducted.

The work of thinning, as ordinarily conducted in the occasional instances in which on any account it has become desirable, is intrusted to mere laborers, who have no regard for the natural conditions which are essential to healthy growth, and which can not be suddenly changed, without serious injury to the trees that are left.

All the small growth of shrubs, such as hazel, cornel, dogwood, elder, shad bush, etc., is first grubbed out and destroyed under the general term of "underbrush," and this not only throughout the interior of the wood, but round its outer edges where such shrubbery is apt to spring up in thickets, which serve the very important purpose of preventing the free passage of the wind over the surface soil of the interior, besides adding incalculably to the beauty of the wood, as seen from without by connecting the line of foliage of the trees, with that of the sward below, and presenting a living mass of verdure. The trees which are considered most desirable to preserve are then selected, and all the rest at once removed. Finally the leaves are carefully raked from the surface and carried off or burnt.

Sun and wind now have free access to the soil, and it very soon becomes parched and dry. The fine rootlets near the surface, which have heretofore been preserved by the never-failing moisture of the the rich mould under its mulching of leaves, are converted into a mass of wiry fibres, no longer capable of conveying nourishment, even if it were within their reach. And while the means of supply are thus reduced, the tall, slender trunk, through which the sap must ascend to the leaves, is now exposed to the free action of the sun and winds. Now, I do not presume to say that evaporation can take place through the bark, but the provisions which nature makes to guard the inner vital tissues from the effect of the sun's rays indicate, beyond all question, that they are in some way injurious. I have elsewhere shown that in the case of the single tree growing by itself, the trunk is always shaded by the spreading foliage, when suffered to retain its natural form. In the forest, the trees shade each other, and thus effect the object by mutual action. But now let me call your attention to another provision of nature which few people observe, but the meaning of which is too obvious to be mistaken. If we examine the bark of an oak, elm, chestnut or maple, of mature age, which has always stood by itself, exposed to the full influence of atmospheric changes, we find it to be of great thickness, of very rugged character, and of a cork-like consistency, all of which characteristics make it the best possible non-conductor of heat or cold that can be imagined, under the protection of which the living tissues are safely kept from injury through the burning heat of summer and the intense cold of winter.

Now go into the forest, where the trees shade each other, and wind and sun are excluded, and you will find that the bark of the trees is smooth and thin in comparison with that of those in the open ground.

Nature never wastes her energies needlessly, and the trees in the woods do not require the thick coat of those that are exposed. But the effect of suddenly admitting the sun and wind upon them is precisely the same as that of exposing any portion of the human skin which had heretofore been clothed. It is to guard against injury from this source that experienced tree planters, when removing large trees from the woods, are accustomed to swathe the trunks with ropes of straw, which is a rational process, yet it is by no means uncommon to see the reverse of this action. I have seen, during the past winter, a great many very large, fine trees planted on the best avenues in Chicago, at a cost of certainly not less than fifty dollars each, from the trunks and large limbs of which all the rough bark had been carefully scraped, leaving only a thin, smooth covering over the inner tissues. This is as if a man should prepare for unusual exposure to heat or cold by laying aside all his clothing.

Few persons, even among those whose business is tree culture, as fruit growers and nursery men, have any just conception of the value of thorough mulching, as a means of promoting the health and vigor of growing trees. In fact, such a mulching of the whole ground as nature provides in the forest by the annual fall of the leaves, may be said to be unknown in artificial culture, so rarely is it practiced, yet its immediate effect in promoting new and vigorous growth is such as would seem almost incredible to one who had not witnessed it, and affords one of the most beautiful illustrations of nature's methods of securing the most important results by such simple and incidental means that they escape our notice, though going on right under our eyes from year to year.

Of course the richest food for plant consumption is in the soil near the surface, but if that soil is subjected to alternations of temperature and moisture, sometimes baked in clods, and at others reduced to the consistency of mire, no roots can survive the changes. In the forest, as I have elsewhere said, these changes are prevented by the shade of the foliage and the mulching of fallen leaves. The rich mould of the surface soil maintains an even temperature, is always moist, and is everywhere permeated with fibrous roots drawing nourishment from the rich sources which surround them, and this process may be artificially imitated; and the same results attained, by mulching, if properly done. It does not suffice to pile a few inches of straw or manure around each tree for a short distance from the trunk. If the tree stands singly, at a distance from others, the mulching should extend on every side beyond the spread of its branches; and in the case of an orchard, or young wood, the surface of the whole area it occupies should be covered with leaves, straw, shavings, chip-dirt, tan-bark, or whatever material is most available, to a depth of several inches. I first learned the value of the process when a young man, on a coffee plantation in Cuba, where a portion of the hands were constantly employed in collecting refuse vegetable matter of all kinds, and spreading over the whole ground between the rows of the coffee bushes, to such depth as served to keep the surface cool and of even temperature, and also to prevent the growth of grass and weeds and thus supersede the necessity of plowing between the rows.

Afterwards, when engaged in fruit culture in New Jersey, I practiced it in my vineyard and orchards with most satisfactory results, of which an account was published more than thirty years ago, in the *Horticulturist*, then edited by A. J. Downing.*

The trees and vines responded at once to my efforts in their behalf by such increased luxuriance of growth that it was easy to distinguish the portions that had been mulched as far as they could be seen, and, on digging into the surface soil under the mulching at any point, I found it filled with fibrous roots precisely as is the case in the leaf mould in the woods. No fruit grower who has once tried this experiment will ever after forego the advantages it offers, and I have spoken of it thus at length from the obviously vital importance of its bearing on forest culture. A moment's reflection will show that in the opening and thinning of native wood which had grown thickly together, a heavy mulching of such portions of the ground as may unavoidably become exposed may be of most essential service in preserving the health and vigor of the trees that are to be retained.

It is difficult to lay down specific rules by which a novice could be guided in the work of opening and thinning out the wood of a native forest, except by fully impressing him with the importance of preserving, so far as is possible, the conditions which nature shows to be the most favorable to vigorous growth, and proceeding very cautiously when it becomes necessary to change the relative proportions of the influences which affect the vitality of the trees. The age and condition of the wood at the time the work is begun, are, of course, important elements for consideration. If the growth is not more than ten or fifteen years and the trees have not sprung up so thickly as already to have become a mere thicket of hoop-poles, but have preserved a reasonable degree of symmetry, its management can be much more easily controlled than if it has attained a more mature age, and especially if the object is to create an ornamental grove composed of fine specimens of individual trees, a process by which

*Horticulturist, vol. 3, p. 113.

the value of desirable residence sites in the vicinity of cities or large towns might often be very greatly increased.

Whether this be the object, or the development of timber, the first thing to be done is to select and place a distinguishing mark upon every tree which is ultimately to be retained. Then remove at first from its immediate vicinity only those which are actually crowding it, or impeding its growth by shading or interfering with its foliage. Those which simply shade the trunk or the ground around it are serving a useful purpose, and should not be disturbed. Indeed, if it is found that the necessary removals involve much increased exposure of the surface soil around the tree, it should at once be covered with the mulching of sufficient depth to prevent the possibility of its becoming heated and dry. All other sources of danger to the health of the trees are insignificant in comparison with that of the rude check they are liable to receive from sudden exposure of the trunks and surface roots to the influence of the sun and wind, from which they have heretofore been protected, and to which they can only become accustomed by a gradual change.

The next year it will be found that the tree has gladly availed itself of the opportunity for expansion, and has spread its limbs to fill the vacant space around it, so that more trees must now be removed, while the increased mass of foliage it has developed renders it less liable to suffer injury from their loss.

The removal of the undergrowth of shrubbery should be very cautiously conducted, and in no case should it be removed from the outskirts of the wood, which should everywhere be left with as dense a growth as possible to prevent the entrance of the winds.

The sirocco-like wind from the southwest, which often blows with great violence for days together, especially in the spring and early summer when the trees are full of sap, and the young shoots and leaves are tender and sensitive, is the one from which most danger is to be apprehended. The merely mechanical injury it inflicts upon the spray and foliage is often serious, but its worst effects are due to its absorbtion of moisture and vitality.

All experienced nurserymen and fruit growers have learned to dread its exhausting influences, especially upon grape vines and other broad-leaved plants, and they, too, are aware of the fact, which comparatively few ordinary observers seem to have noticed, that its effects in giving a general trend of the spray and branches of trees in exposed situations towards the northeast is so marked that no one who has learned to observe it need ever be long at a loss to know the points of the compass in any parts of the country.

The fact, however, that we have it in our power to guard against the evil effects of this wind by artificial means, is not so generally known as it should be, and it was only after many years' observation and experience that I came to a full realization of certain facts in connection with its action, which have a most important bearing upon the question of forest culture.

I became aware, many years since, that many shrubs, trees and plants would grow and thrive at Newport, R. I., and at Yarmouth, Nova Scotia, which in the interior were only found much further south, and would certainly perish if removed to the latitude of those towns. The reason assigned in both cases was the warming influence of the neighboring gulf stream, which seemed a plausible explanation in which my faith remained unshaken for years, until I went to Chicago, where I found it was impossible to grow many of the finer fruits, and some of the forest trees which elsewhere are found in much higher latitudes. Neither peaches nor grapes can be grown at Chicago, or at any other point on the western side of the lake, without artificial protection, and the native growth of wood is very meagre, and many varieties which elsewhere are found much further north, as the beech and the hemlock, can not be grown; yet the eastern shore of the lake, only sixty miles distant, has no superior in the whole country as a fruit-growing region. Peaches, grapes, strawberries, etc., grow most luxuriantly anywhere on that shore up to the northern extremity of the lake, three hundred miles north of Chicago, and every variety of forest tree indigenous to the country is found in the best condition of vigorous health.

There is no gulf stream to account for this difference, but the relative position towards the lake of the whole extent of its fruitful shore is the same as that of Newport and Nova Scotia towards the ocean. In both cases the southwest wind reaches the shore after passing for a long distance over water, and instead of burning and exhausting vegetation with a breath of fire, it comes laden with the moisture it has gathered up in its passage, and brings health and strength upon its wings, instead of disease and death. Further reflection served to convince me that the rule was susceptible of much wider application, and serves to explain the different vegetation of the eastern and western shores of great continents in the same parallels of latitude. Central Spain and Southern Italy, the lands of the orange and grape, are in the same latitude as Boston, and going west on the same parallel to California, we again find ourselves surrounded with fruits and plants, which in Boston can only be grown under glass. Continuing our western flight across the Pacific, we find the flora of Eastern Asia to bear, in many respects, a striking resemblance to that of Eastern America.

These facts have certainly a very important bearing upon the question of forest culture. They prove that the southwest wind of spring and early summer is perhaps the worst enemy we have to guard against, and also that its deleterious influences are neutralized when it passes over a large body of water. It is comparatively rare, however, that a situation can be secured affording that advantage, and the question naturally arises, are there no other means of protection? I am happy to have it in my power again to summon nature as a witness that such means are within our reach.

I have said that the beech would not grow near Chicago, a fact which I was very reluctant to admit on first going there, and was only fully convinced of its truth by witnessing repeated failures, and the evidence of reliable nurserymen who had tried in vain to preserve it. Yet after I had long been satisfied that it was idle to attempt its culture, I was one day amazed, while surveying in the woods a few miles from the city, at coming upon a little group of beech trees comprising some twenty or thirty in all, of mature size and in full health and vigor. On examining the situation, to discover, if possible, an explanation of the phenomenon, I observed first that they stood in the bottom of a ravine so deep that their tops were scarcely even with its banks, while the wood which surrounded them extended more than a mile to the southwest, so that they were completely sheltered from the effects of the wind from that quarter. I have never been able to find or to hear of another beech tree anywhere in that region, and can only account for their presence by supposing the seed to have been brought from a distance by birds, probably crows, jays or wild pigeons, and dropped accidentally on a spot, which proved to be a "coigne of vantage," where they were safe from the enemy. The evidence thus afforded of the value of a screen on the southwest side, should not be lost upon those who are selecting sites for orchards, or vineyards, and shows the importance, when thinning a wood, of leaving whatever shubbery or foliage there may be on that side to arrest the progress of the wind.

The work of pruning the trees which are to be preserved for timber involves a careful consideration of the principles I have set forth, apart from the judgment required for the skillful performance of the mere manual labor. The object in view being the development of the bole, it is important to remove any limbs which threaten to become its rivals in size, if any such have become established before the work of improvement began. But after the trunk has attained the desired height, it is on all accounts desirable to develop the largest possible mass of foliage, because the making of wood can only be effected by the elaboration of the sap, which is the work of the leaves.

If one is rearing a new forest, in which the trees have been under his control from the time of planting, it must be the result of his own ignorance or negligence if he has failed to secure such forms as he desired, since it is easy to direct the growth of young trees, and prevent them from running into extravagances, which will unfit them for service as timber. And not unfrequently we may find a young wood of indigenous growth which may be taken in hand and wrought into such shape that its future progress can be easily directed. But, for the most part, in woods that have been suffered to run wild till they have approached maturity, a good deal of skillful pruning will be required to bring the individual trees that are to be preserved into such form as will give them most value. Nothing but practice and careful observation can confer this power. The little treatise of DesCars on the pruning of forest and ornamental trees, translated by Mr. C. S. Sargent, of the *Arnold Arboretum*, and published by A. Williams & Co., of Boston (price 75 cents), contains full and explicit illustrated directions for all the manual work of pruning, and is invaluable as a guide to the novice, and a work of reference to experienced foresters. But mere manual skill in the performance of the work will be of little avail without the application of a thorough knowledge of the principles of tree growth, and a strict compliance with the requirements of their nature.

If our agriculturists will but apply to the management of their forests the same intelligence with which they direct the culture of other farm crops, they will find an equally ready response to their efforts. The farmer who should leave his field of corn or potatoes to shift for itself, or suffer his cattle and hogs to ramble through it at will, would be just sneered at by his neighbors and punished by the loss of his crop — and trees have no more capacity for self-management than corn or other vegetables, and are quite as ready to profit by judicious culture, and to yield returns corresponding to the care bestowed upon them. They are not liable to be utterly destroyed, as corn is, by the incursions of live stock, but they do suffer serious injury from the trampling and rooting up of the ground. I have seen beautiful proves of oaks in Iowa full of dead and dying trees, and on asking the cause, have been told that the native woods "can't stand civilization," but always die out when cattle begin to run in them; and I am told that, in Kentucky and elsewhere in the South, the young growth is found to contain only the inferior varieties of oaks, as the swine running in the woods seek and greedily eat the acorns of the white oak on account of their superior sweetness. Has anyone ever estimated the cost of raising hogs on such food?

I have endeavored, in the preceding pages, to confine myself to the special features of forest growth which need to be regarded in the effort to develop and improve a native wood, wherever it may be. The planting and culture of an artificial forest is quite another affair, and I have made no allusion to it, because my special object has been, if possible, to urge the fact, and arouse attention to it, that we still have vast resources of latent wealth on every side, susceptible of development by proper management, which we are everywhere suffering to run to waste. The work of planting and rearing artificial forests can not indeed be urged too strongly, and there is no danger of its being overdone. But the conviction of its necessity can be more readily and forcibly impressed upon the popular mind by an illustration of the possibilities of forest culture when applied to our native woods, than by any other means. The need of further progress by artificial planting will speedily become obvious, and will follow in natural course.

It has been asserted, and with truth, that it is idle for us to establish schools of forestry, because there is no demand for foresters, and consequently no stimulus to the acquirement of a knowledge of the theory and practice of the art. It will be time enough to establish such schools, it is said, when we have evidence that there are people who desire to avail themselves of the advantages they offer, and that will not be till there is a demand for the services of those who have done so. This is true, so far as it goes, but the next consideration is how to create the demand. There was no demand a few years ago for telegraph operators, and when I was a boy there was no demand for railroad employes, for there were no railroads. How was the demand created? By showing the importance of the results. Think of the time and labor expended by Morse and his associates before they could get permission to demonstrate the value of the electric telegraph by a line from Washington to Baltimore? No general interest was felt in the scheme till its advantages were thus made manifest, because there was no *realizing conviction* of its truth. And to-day we are in a similar position in reference to the question of forestry. The impending danger of the diminishing supply of timber is acknowledged by all who are familiar with the subject, but there is no realizing sense of it in the popular mind, and there is a want of confidence in the practicability of any of the proposed measures of relief. The first and most important thing to do, therefore, is to stimulate popular interest by showing what *can* be done. To create a popnlar demand of any kind, it is essential first to demonstrate the value of its object. The men who are familiar with forest culture know, as well as Morse knew the capability of the telegraph, that the wealth of the nation may be enormously increased by the proper development of the native woods already standing, but they can point to no evidence of the truth of their assertion, and the fact that it has not been done is regarded as proof of its impossibility. There is no such thing in the country as an illustrative example of what may be accomplished by timber culture, and very few of our citizens who visit Europe can appreciate the works which have there been achieved. They go abroad to study works of art, with the idea that we have nothing to learn in regard to natural productions, and the comparatively small number who grasp the conception of the grand possibilities of development which our forests offer to the exercise of such artificial culture as may there be seen, can do no more on their return than express their convictions and urge the importance of acting upon them. This they have done for many years past, but they have not succeeded in arousing such a popular conviction of the necessity as should enforce the action of their representatives to the point of making needful provision. The enormous and costly scale on which the work of planting new forests must be undertaken, in order to be effective, seems to throw a damper upon every effort to bring it to pass.

If every owner of a wood lot could be convinced that its value might be enormously increased by a process which, so far from demanding an outlay, would add to his annual income, it would not be long before farmers would consider it as derogatory to their reputation to leave the forests in the wild condition they now are, as they would to have a field of corn presenting a similar appearance of slovenliness. To produce such conviction the truth must be demonstrated in actual practice, and the cost of such demonstration will be but a trifling price to pay for the returns it will bring. Let any state or city select a tract of woodland at some easily accessible point, and put it under a proper course of management, as an experimental forest, and it would very soon excite an interest which could not fail to increase. A portion of it should be suffered to remain in its original, unimproved condition. Another part should be improved as "open park," for the best development of individual trees in their fullest natural capacity of dignity and grace, and a third portion should be devoted to the production of timber by the process of thinning, pruning and proper culture. The progress of development could then be seen and watched from year to year in all its stages, and the demonstration thus afforded would touch the interest of every owner of a wood lot. The process would soon begin to be imitated, a conviction of the value and importance of a knowledge of forestry would become established in the popular mind, and the demand for the services of those who had acquired it would lead to a demand for the means of acquirement, and thus the schools of forestry would be called into existence by the natural course of events.

The inauguration of such an experimental or illustrative forest as a means of exciting public interest is surely an object that is well worthy the consideration of legislative and municipal bodies, or of corporations whose interests are connected with this form of national wealth. The cost would be insignificant in comparison with that of planting and maintaining new forests, and the spur of personal interest would incite such general action as would add incalculably to the wealth of every state without further outlay than the cost of demonstration.

It is of course desirable that the experimental forest should be as conspicuous and easily accessible to the public as possible, for which reason the vicinity of a city would seem the most appropriate point. And municipal bodies would be justified in making a liberal appropriation for the promotion of such an object, since it would certainly constitute, for great numbers of people, one of the principal attractions of the city. The beneficial results which would follow, however, would add so largely to the substantial wealth and power of the State that its main support should be derived from legislative rather than municipal action.

It is not, however, my province to discuss the means of effecting the work, beyond this general suggestion.

I have aimed only to convey a conception of the rich resources which Nature has placed at our disposal, if we choose to avail ourselves of her offer.

I have made no statement in regard to forest growth which will not be recognized as true by all who are familiar with the subject, and all such persons will indorse my statement that, *practically*, the rules which govern the process are universally ignored.

I have pointed out what I conceive to be the readiest means of awakening public attention and creating such general interest as will insure reform, and I leave to other hands the task of arranging the laws which must govern its execution.

FARMERS' ORCHARDS

BY

HON. JOHN S. HARRIS,

PRESIDENT OF MINNESOTA STATE HORTICULTURAL SOCIETY.

After devoting more than one-half of my lifetime to the solution of the question of growing the hardy fruits and especially the apple in Minnesota and the Northwest. I am compelled to say that the successful culture of the apple in our State has a greater number and more difficult obstacles to surmount than in any other state in the Union or than in any other department of labor that requires the cultivation of the soil in this State. Within the last twenty years, much time, labor and capital have been expended in trying experiments and testing varieties; and while failures many times outnumber success, some progress has been made and the time is at hand when fruit culture will become one of the most important industries within this State; not alone as a source of wealth, but of comfort, refinement and happiness, and when all the obstacles are removed or overcome, will reward the husbandman as well or better than the investment of the same amount of capital in any other enterprise. I long since arrived at the conclusion, and have frequently expressed the opinion, that it is possible for nearly every county in this State to produce the more hardy northern fruits in such quantity as to give an ample supply to meet every demand for home consumption.

I purpose at this time to speak only of the apple and give it as exhaustive a treatment as the time at my disposal and my ability will permit. First, our State being comparatively new, and our soil and climate somewhat different from that of other older states, it necessarily follows that we lack experience and that becomes an obstacle which only time and careful experiments can overcome. The old varieties of apples, our favorites in the Eastern and Middle states, have nearly all proved to be unsuited to the more unfavorable localities, and there is but a small list of them that are profitable to plant in the most favored places therefore we are compelled to plant largely of the Siberian and Astrakhan which have been advanced from the northern parts of Europe and Asia, and these, unfortunately, have some serious defects and cover but half of the season in which apples are the staple fruit. It has been said that the apple is the king of fruits. In its various species and variety it gives a wonderful range of qualities, size, form, color, texture, flavor and season of fruit which meets all purposes and satisfies every taste; no other fruit is like it and the demand for it exceeds that of every other and is on the increase yearly. American apples have a world-wide fame, either in their fresh or dried state, and the home demand is increasing beyond the supply even in the oldest apple-producing states, and to-day better prices are received for them then when not one-tenth of the quantity was produced.

Again it is a well-known fact that the use of fruit as a part of our every day diet increases as we advance in wealth and civilization. If the farmer out on the frontier provides for his family one peck of apples this year they will want a bushel next, and the next a barrel. They will never require less, but will always call for more, and this call must be answered just as far as means will permit, or the growing appetite will become vitiated and strive to satisfy itself with things that are hurtful or demoralizing. A farm without an apple orchard of the best varieties is a very poor place to raise children who will honor their parents and give them support and comfort in their declining years, and love the old farm more than any other spot on earth. There are a few farmers who do not view things in this light, but happily they are few. The end will justify the means, and just so far as we succeed do we promote our own happiness and prosperity and enrich our State. Some apples have been grown in Minnesota, enough to demonstrate the fact that they will grow here, and that if we have varieties adapted and give them the right locations and cultivation, our apples would rank with the best for beauty of appearance and superb quality.

SITE FOR AN ORCHARD.

I would select a high location, one that would give natural drainage and a free circulation of air. On such a location the vicissitudes of temperature are less than on low lands. The days are cooler and the nights warmer. Trees always injure most in low valleys, and a few feet in elevation may decide whether a man's orchard shall be a success or a failure. My experience is that elevation is of much more importance than aspect, and more especially with varieties that bloom early or continue their growth late into the fall.

A northern aspect is generally considered to be the best, but I should not object to a southern, if I could have it on a good elevation that commanded a free circulation of air, and on some accounts should prefer it to any other, if I could give it suitable protection and mulching, of which I will speak in another place. On such an aspect the fruit colors up better, and comes to more perfect maturity, and the trees come earlier into bearing. In low valleys we are more subject to late spring frosts and early ones in the fall. The first will frequently destroy a crop of fruit after the blossoms have appeared, and the latter sometimes causes serious damage to the trees, in causing bark-burst by arresting the return or downward flow of sap before the trees have fully ripened, and discontinued their season's growth. If it should become necessary to plant an orchard in a valley, I should, if possible, select a north or northeastern aspect, and as high and dry an elevation as possible. Soil is another factor that should be considered when planting an orchard. We find in this State a great variety of soils, such as sandy, clayey, loamy, alluvial, etc. A sandy soil is one in which sand, in some degree of fineness and sharpness, is a principal factor, and is usually quite defective in fertility; if very sandy it parts almost instantaneously with moisture, and trees planted in it are apt to suffer from drought. It lacks also many of the essential elements that go to make up the structure of the wood, and they can not be permanently supplied by manuring, as all the soluble parts of manure are quickly washed out of it and hence it would require constant application to keep up the growth. If no other soil can be secured, a sandy soil may be improved so as to make it more retentive by the addition of clay, ashes, muck, etc.

A clay soil is directly the opposite of sand, and is one where clay predominates. Its defects are that it retains moisture too long, is too adhesive, and in dry weather becomes hard like unburned bricks, and in the dry state is impervious to dews and light rains, and when wet requires a long time to become dry enough to cultivate. No fruit tree will do well in such soil, unless it is the plum and shellbark hickory. Such a soil may be ameliorated and fitted for orcharding by underdraining, deep trenching and the application of sand, ashes, muck, manure, etc.

A loamy soil is the one we hear the most about, and may be interpreted as being composed of a great variety of mixtures. The true loam is about an equal mixture of sand, clay and vegetable soil or humus, and is practically adapted for about all classes of vegetation, and is the very best for the orchard, and especially is this the case where lime is held among its ingredients.

Alluvial soils are composed of vegetable substances, the sediments of rivers and material washed down from neighboring hills. The valleys of our rivers and streams and the coulies among the Mississippi bluffs are largely alluvial, and it is the richest of all soils and well adapted for garden purposes and many of the farm crops. Fruit tres make a rank, vigorous growth in such a soil, but they are not so hardy or fruitful, and the fruit is not so high flavored and does not keep as well as that grown upon soil containing more sand and clay and less of vegetable mould.

PREPARATION OF SOIL.

It would be useless to plant fruit trees upon our Minnesota prairies with the expectation of growing any fruit upon them, until they are first broken up and subdued by taking off a few crops, and I doubt if, even in our naturally deep soils, that would be a sufficient preparation. Few of our farmers plow to a greater depth than six inches, and the roots of trees can not be confined to that depth from the surface, and when they commence to strike deeper will find an uncongenial soil that will have a tendency to give them a severe check. Some people recommend digging a large hole, eighteen or twenty inches deep, and filling it with good soil and compost. This practice might not do serious harm on naturally deep porous soils, but on clay and clay subsoils it would be disastrous and much like raising plants in pots without drainage holes in the bottom to permit the escape of surplus water. The safest practice is to have the soil prepared to a uniform depth throughout the whole orchard, and this is the best and most cheaply done with a plow and strong team plowing into narrow lands by back-furrowing, running the plow ten inches or a foot deep, leaving open dead furrows midway between the rows. If the soil is poor, the best fertilizer to use is well-rotted barnyard manure, applied at least six months before the trees are to be planted.

PLANTING.

Experience has demonstrated that fon Minnesota, if not for all the Northwest, spring is the best and safest season for transplanting. The reason is obvious; a tree or plant is a thing of life as much as an animal, and in order to be able to endure the rigors of winter, must have through its roots a vital hold upon the soil which it can not have if planted in the fall with mutilated roots and the rootlets left where the tree was taken from. There is doubtless a circulation of sap during the mild days of winter, and no matter how cold the weather, there is a constant evaporation going on from every bud and twig, and the roots having no hold upon the soil, and no mouths to drink up and take in supplies, this evaporation must greatly enfeeble the tree if it dose not kill it outright.

But while I advocate spring planting, I as rigidly hold to the theory that trees should be secured, dug, transported, root and top pruned, if necessary, and heeled in or buried with the roots entirely out of the reach of frost, the previous fall.

Trees should not be dug in the fall until the season's growth is entirely completed and the wood perfectly ripened up. Trees for shipping are sometimes dug too early, and the leaves stripped off before they have performed all of their functions. Such will start feebly and make a sickly growth. Digging trees in spring is a practice that ought to be condemned, and I am glad to know that some of our nurserymen are obviating the necessity of it by providing ample room for winter storage. The sap starts as soon as the frost is out of the ground, and bending the tree in the process of digging is apt to loosen the bark and produce sun scald on the south and west sides of the trees, and a slight bruise will make a dead spot in the bark; also trees dug in the spring are more liable to make a later fall growth the first year, and become black hearted after the next winter. If the ground is well prepared, it is not necessary to open holes larger than to receive the roots without cramping. After the hole is dug and the tree placed just where wanted, and little, if any, deeper than it grew in the nursery, it should be held in place with one hand, while with the other fine soil is worked about the roots; and care should be taken that there is no place where soil and roots do not come in contact. To expedite planting, first lay off the ground and set a stake at every point where a tree is to stand; next provide yourself with a machine which was described in some agricultural paper, some years since, viz., a board five feet long and six inches wide; bore an inch auger hole in the centre near each end, and cut a notch in one side midway between the ends and prepare two stakes that will slip easily through the holes. It is used by laying the board down with the notch fitting to the stake and inserting the two stakes in the auger holes, lifting off the board, removing centre stake, digging the hole and laying the board back over the end stakes and setting the tree to have the trunk fit into the notch. After the hole is filled, press the earth firmly about the roots with the feet, and finish off by drawing some fine loose soil about the tree, leaving the surface loose for two or three feet from the trunk.

MULCHING.

As a general rule, if a tree is properly taken up at the nursery, rightly handled afterward, and skillfully planted in suitably prepared soil it will live, but it is always safe to apply a mulch which will keep the ground moist and of an even temperature. Almost any waste material will answer for the purpose, but the best is leaves from the forest, half-decayed hay or straw, or swamp moss. Wood chips and crude swamp muck should never be used, nor fermenting manure. The mulching should reach beyond the extent of the roots.

CULTIVATION.

It is as essential to keep a young orchard clear from grass and weeds as it is any farm crop. In our virgin soil any crop that will not shade or interfere with the trees, and does not require cultivating after the first of July, may be grown until the trees come to bearing, after which time they had better occupy the whole ground. Beans, peas, potatoes and other garden vegetables pay the best; I have seen good results follow the growing of the smaller varieties of corn, leaving the stalks to stand over winter to help break the force of the winds and retain the snow. Where crops are taken off just enough manure should be applied to keep the ground in heart but not enough to make it fat. In plowing and cultivating great care should be taken not to break or mangle the roots.

PRUNING.

With some varieties pruning seems to be a necessity, but it should be done with great care. Everyone ought to know how and when to prune, but it is a knowledge that can only be acquired by careful study of the structure and habits of trees and peculiarities of climate, and I do not feel competent to lay down any arbitrary rules for it. The idea has been inculcated and advocated by some of the fruit growers of this State, that pruning is an unnecessary operation, and it has been acted upon in practice so much that many of our orchards are unsightly objects. I do not believe in the currant bush form for apple trees, but would start the head of the tree at from two and one-half to four and one-half feet from the ground, and keep the tops open and in a symmetrical shape, not allowing branches to cross each other. Sharp crotches or forks should not be allowed, as they are almost sure to split down and ruin the tree when it comes into bearing. Wherever such are inclined to form in trunk or top, one branch should be removed while yet small, and pains should be taken to have all such branches start out from the leader as near as possible at right angles. This system of starting the top also tends to earlier fruiting.

By commencing when the tree is small, about all that will be required is pinching off with thumb and finger, and removing small twigs, which can be done with safety at any time, except between the middle of March and the middle of June.

If it should become necessary to remove larger branches, it should be done about the first of July, or in November, and the wound made ought to be covered with grafting wax or paint.

GRAFTING AND BUDDING.

On account of mistakes of our judgment of varieties, blunders of nurserymen, the swindling of tree peddlers, and the Siberian hybrid man who sometimes induces us to make worthless purchases, it is highly important to be proficient in the art of "budding and grafting," that the worthless may be turned into something valuable. This art is easily mastered, and it is hardly necessary for me to spend time to describe the processes in detail. The operation of budding is usually performed on young trees or branches from one to three years old, and can only be done in the growing season. It consists in separating a bud with a portion of the bark attached, from a shoot of the current season's growth of one tree and inserting it beneath the bark of another, binding it in place with a string until it has grown fast. When this bud commences to grow, all of that part of the stalk above it is cut away, the bud grows on, and eventually the top or branch of the tree of the same variety as that from which it was taken. The ordinary season for budding in this climate is from the middle of July to the middle of August, but may sometimes be performed as late as the first of September. The buds must be perfectly developed in the axils of the leaves of the young shoots intended to bud from, and the bark must rise freely from the stocks to be budded, and this only happens when the stocks are in a thrifty, growing state. The only instrument necessary for the operation is a common two-bladed pocket knife, the large blade to be used for pruning away any branches that are in the way of inserting the bud, and the smaller for preparing the buds and making the incisions in the stocks. Strings of bass matting, woolen yarn, or cotton twine will answer for tying.

Grafting is the insertion of a scion of one variety or species upon the stem or branch of another. The best scions are the shoots of the previous year's growth. Stocks may be of any age from a yearling seedling to a fully matured tree, but of whatever age they should be sound and healthy. The best methods, and most commonly practiced, are whip grafting and cleft grafting. For whip grafting the stock is better not to be more than two years old, but may answer as large as one-half or three-fourths of an inch in diameter. Upon the stock the grafter makes a smooth, even, sloping cut, an inch or so long, and in the centre of this cut he makes a sloping cut downwards. The scion, which should contain two or three buds, is cut on the lower end with a sloping cut downwards, and similar in all respects to the one made on the stock, and a slit or tongue is made on it upwards, corresponding with that on the stock, and they are then neatly fitted together, the tongue of one within the other, and the inner bark of both placed in perfect contact, at least on one side. It is then firmly wrapped with a narrow strip of waxed cloth, to cover the parts united.

Cleft grafting is practiced on trees or branches too large for whip grafting, say an inch or more in diameter. In this method the scion is cut in the shape of a wedge. The part cut for insertion in the stock should be about an inch long, one edge a little thinner than the other, and with a bud at the shoulder where it is to rest on the stock. The stock is sawed off at the point for grafting, and a sloping cut is made on one side of the stock, about one inch and a half long, and coming about to the centre of the top. The stock is split a little one side of the pith, by laying the edge of a chisel or knife on the horizontal surface and striking it lightly with a mallet or hammer. The split is kept open by the insertion of a wedge, while the scion is inserted with the bud out and the thinnest side in. Grafts of this kind heal much more rapidly and are stronger than when the cut is made horizontally across. In grafting by this method it is more convenient to apply the cement with the hands, being careful that it fits closely and covers every part of the wound.

AGE AND SIZE FOR PLANTING.

In regard to the best age and size of trees for planting in the orchard, probably the best is short, unbranched trees of two years' growth from the root graft, and from three to four feet high. Such trees will need no pruning when planted, and, if skillfully managed, very little afterward. They can be purchased for much less at the nursery, cost much less for packing and transportation, and are more apt to have all the roots that belong to them. In no case would I recommend purchasing trees more than three years old, but if the planter grows his own trees, the age and size is not material, provided proper care is used in digging and setting them.

Trees should never be allowed to have their roots exposed while they are out of the ground; even a few minutes exposure to the sun and wind may prove fatal to them. It is best not to plant too early in the spring or before the soil is somewhat dry and warm, which is about corn-planting time.

DISTANCE APART FOR ORCHARD TREES AND PROTECTION.

On this point our fruit growers disagree; different individuals advocating all the way from twelve to thirty feet. The advocates of the closer distances claim quicker returns from the land and that the trees afford a protection for each other. I do not believe that a first-class and fruitful orchard can be grown with such close planting. It is true that they advocate the removal of a portion of the trees when they get large enough to crowd each other, but it would take about as much nerve to cause the removal of a sound, valuable apple tree as it would to undergo the operation of amputating an arm that may not be seriously diseased, or have a sound tooth drawn. The great danger is that the surplus trees will not be removed until they have injured those which are to remain. In my opinion the best distance for the prairies would be not less than twenty-five feet, and for timbered lands thirty feet. If planted at these distances other crops may be grown between them, that will serve for protection and pay all the cost of cultivation.

I should much prefer the greater distance apart, and use some variety of timber tree for a protection, which would cost less and be of more value for fuel when the time arrived for its removal. But doubtless the best trees to plant between would be evergreens, which can be purchased cheaply while small, and can at first be set so close as to throw their shade upon the trunks of the trees without the danger of their roots drying out the soil or exhausting it of the constituents essential for the apple tree. They can always be kept within bounds by seasonable pruning, or they will be valuable for taking up to plant in some other place. Upon our prairies protection from prevailing winds will probably be absolutely necessary, especially during fall and winter, and for this purpose live windbreaks of any quick-growing timber will answer the purpose and be worth much more than their cost.

Upon our prairies, protection from prevailing winds will be absolutely necessary, and for windbreaks any quick-growing windbreaks will answer. The belt should be planted before the orchard and be at least two rods wide and four rods from the outside trees of the orchard.

Within this belt and sharing its protection might be planted another belt of spruce, arbor vitæ, hemlock or other varieties of evergreen; but in no case let the orchard come within sixty feet of the windbreak, or it will be robbed by roots, and snows would be apt to lodge in deep drifts under their lea, nor should the belts be a complete shelter from the winds on all sides or the close atmosphere may develop blight. A belt on the north and west sides will be all sufficient. If the shelter belt is four rails wide it will take in nine rows of trees, with the rows four feet apart, and it can be planted to serve the double purpose of protection and the growing of valuable timbers for use on the farm. With this end in view I would plant the outside row with cottonwood; the next with ash, maple, oak, hickory or walnut; the two next with cottonwood, poplar, box elder or soft maple; next with hard wood; next with the rapid, soft-growing woods; the next with hard woods, and the last with soft. The trees should be planted from two to four feet distant in the rows, and will require an occasional thinning to give the hard woods a chance to develop. The hard woods will also require thinning in the course of time, but the thinnings will be found useful for fuel and other purposes.

WHAT VARIETIES TO PLANT.

First ascertain where you live and what you are planting for. If you live outside of favored locations, or in the newly settled part of the State, plant for large apples the Duchess of Oldenburg, Tetofsky and Wealthy, and of the Siberians the Whitney No. 20, Early Strawberry, Powers' Large Red and Pride of Minneapolis. Is that all? Yes, for the localities mentioned, if you are planting for fruit; but if you dare to risk the blight, the Transcendant may be added. In the older and more favored parts of the State, plant, in addition to these, the Utter or Cooper, Fameuse, St. Lawrence, Price and Tallman Sweet and Walbridge; also try the Wolf River and Scott's Winter in limited quantities. This is a small list, but at present it is hardly safe to add to it anything except of the Siberian species, but no doubt new, hardy varieties will soon be added.

WERE TO PROCURE TREES.

I do not believe that it makes any material difference where the trees are raised if they are well grown, carefully dug and properly handled afterward, and for that reason should advise procuring them as near home as possible. The worst policy a man can pursue is to order of some traveling vender of whom he knows nothing even if he is willing to give his personal "guaranty" that his wares are true to name and perfectly "iron clad," and is willing to pledge himself to replace all that fail to grow. Neither would it be policy to purchase a lot of poorly grown, scrubby trees, with sharp forks starting near the ground simply because they are cheap. They would in the end prove to be very dear. The best way is to go direct to the nursery and select just such as you want and see them dug, or send your order to some reliable man who has gained a reputation and is disposed to sustain it at all hazards. If you know of a nurseyman who grows his own stocks and uses for the purpose Minnesota-grown seeds as saved and selected from the hardest and best apples, by all means encourage him with your patronage. Even if the trees should cost you double on the start they would probably prove the cheapest in the end. It would be better if every man could raise his own trees — roots are of as much importance as the tops — and with a tender and diseased root we can hardly hope to rear a hardy, healthy and fruitful top. We are all watching the efforts of Mr. Peter N. Gideon with much interest at the state experimental fruit farm, and hoping that his efforts may be speedily crowned with success. The object he has in view is the originating of hardy new seedling varieties that will prove long keepers by crossing the hardest long-keeping apples with the Wealthy and Siberian species. We are also watching and waiting for the testing of hundreds of varieties imported from Russia and Northern Europe and Asia, and this test can hardly fail of giving us some hard and good winter apples. Again hundreds of the intelligent nurseymen and fruit growers of the Northwest are awake to the importance of the subject, and are engaged in investigating the causes of failure in the past and experimenting with new modes of propagating crossings and testing seedlings with as much intelligence as our best stock breeders are in raising thoroughbreds, and the knowledge of vegetable physiology that is now being obtained will enable them to accomplish more in a single decade than in a lifetime a century ago. We have also a State Horticultural Society that after a long struggle against difficulty is a live institution, ready, willing and able to help in the good work, and it ought to have one thousand members enlisted for life in the noble work. In view of these things, I believe that before this generation shall have passed away the problem will have been solved, and we shall be able to produce apple trees that are hardy and productive, and will produce fruit of as good quality and will keep as well as that grown in what is now known as the best fruit states. The greater the numbers who engage in the experiments the better is the chance for its speedy accomplishment, and the establishment of this fruit question by the introduction of six varieties of apples as good as the Seek No Farther, Genitons and Baldwins, covering the season from October to June, would be worth $100,000,000 to the State. With such an end in view and such a prospect before us, let us not pass the time in idle waiting, but arise and do with our might that which our hands find to do.

FRUIT CULTURE IN THE NORTHWEST

BY

HON. GEORGE P. PEFFER,

Vice President of Wisconsin State Horticultural Society.

FRIDAY'S MEETING.

Where the summer temperature is 90 or 96 degrees above, and that of winter 40 to 60 degrees below zero, fruit culture has to be learned or made a study of if it succeeds. Fruit can not be raised on a southern exposure, as it will be too hot, the foliage will burn and rust, mildew and blight will ensue. It can not be raised in low places or ravines, as the cold settles there, and the soil is too rich for trees. All fruits grow best on high clay or limestone soils, naturally underdrained and sloping to the east or northeast and north. The cultivation should not stimulate overgrowth. Fruits that can be protected in winter, such as berries, currants, grapes, etc., are safe to plant, as are also trees which have proved hardy in similar localities. Such are trees of the Siberian crab, and of the Astrachanica families, or hybrids from either; the last named are the ones that the Northwestern states will yet have to look to for their supply of apples. These hybrids are acclimated by reproducing from seed, and every generation can be grown a degree further north and get used to its climate. The seeds should be raised as far north as possible. Wherever there is a good and loose subsoil the main root is a very long one, and the fibrous roots near the surface but few; hence, where ground freezes from two to four feet deep,

A LOOSE, GOOD SUBSOIL,

is necessary to promote the deep growth of the top root below frost, where it can gather moisture through the winter. To raise a tree from the seed. prepare the ground thoroughly early in the spring, and cover the seed half or three-quarters of an inch deep. The root or sprout starts first and is supported by the starch in the dormant leaves that shield the bud until it sends out firm, fibrous rootlets and a supply of earth food is obtained to feed the plantlet until its leafage it sufficiently expanded to enable it to draw on the atmosphere for support. The plant is at this time but a single bud and all its energy is given to the formation of its first leaves. As soon as their leaves are opened a new bud appears in their axil and another extension is provided for, and so on to the end of the season. Some of these buds may be removed and if placed under favorable circumstances will grow and make a new tree the same as the seedling tree itself. The individual life principle resides in each bud. Here, then, in a tree, we have a community made up of as many individuals as there are buds, and supplied with an immense apparatus for absorption in common by which earth food is taken up, the whole to be digested in the innumerable cells of the inner bark and leaves.

THIS STRUCTURE IS IN OUR HANDS

to be treated intelligently. In order that it may withstand the hot sun in a southern exposure, it must be protected by the growth of the limbs, which should be near the ground. To accomplish this, pinch back the leader, thus throwing more sap into the side branches. Keep the head well balanced by pinching back the side limbs if necessary. If one branch gets much the start of an other it is very apt to absorb so much of the sap as to practically starve the shorter one. This must be guarded against. Trees from a nursery can hardly be as hardy as trees raised from seed, for they receive a check in the removal, and the body will suffer more or less, sometimes to the extent of entirely loosing vitality and dying. Let the young tree have as many branches and leaves as it will, for the tendency to fire blight will be thus partly avoided. Fire blight is caused by an oversupply of sap when the weather is very hot and unless there are plenty of leaves to aid in its digestion, fermentation sets in, and then decay follows.

The hybrids from the Siberian and Russian crabs have an unusually thick leaf and are not so liable to blight as some other varieties, and they will probably prove to be the

DESIRED HARDY APPLE OF THE NORTHWEST.

One great trouble encountered in raising seed, especially in mixed orchards, is the extreme liability of any variety to be fertilized by another, making it well-nigh impossible to tell what kind of fruit the seed saved will raise. It may even happen that no two seeds from the same fruit will bear fruit alike; apples and hybrid crabs have often come from the seeds of the same apple. To raise trees of a hardy and constant variety, foreign pollen must be guarded against. This is done by inclosing the flower in a paper bag or glass jar or anything else which will not interfere with its fertilizing itself with its own pollen. In this way the same variety may be propagated generation after generation. To cross-breed or hybridize remove the pollen by hand before the flowers open, and then inclose the flower in a sack or jar until the foreign pollen that is to be used for fertilizing is ripe. Then cut off a spur of the perfect flowers and place it in the jar with the flowers first operated upon, and shake the tree enough to cause the pollen to fall; leave the jar on the flowers until they wilt. Then there is nothing more to do except to label the new variety and save it.

THE FRUIT FROM CROSS-BRED SEEDS

will resemble the male parent most closely, but the growth and hardiness of the tree will be more like the female parent. The male gives quality, texture, and somewhat of size to the new seedling fruit, the female gives the form and very often the color. By bearing these facts in mind, almost anyone can raise fruit according to his taste, and with perfect success. If a peculiar quality of fruit is desired, use crabs for the female parent and pollen from almost any of the hardiest apple blossoms, such as the Wealthy or Walbridge. By following these directions, Northwestern farmers can soon have the finest varieties of hardy apples in quantities sufficient for home use and for shipment to foreign markets.

THE DAIRY COW AND BUTTER MAKING.

By Hon. WILLIS P. HAZZARD,

West Chester, Penn.,

Vice President of American Dairymens Association.

To properly answer the question, what are the best breeds of cows for butter and milk dairies, the three leading points of yield, profit and food must be considered, and it will be necessary, in this connection, to investigate somewhat the various breeds of cattle.

The best authorities upon the subject admit that the best strains of milking qualities are derived from the Holstein or Dutch breed, cattle imported into England by the Danes. These cattle have been cultivated by English breeders principally for their beef-producing qualities, on account of the late high price of meat, but the Dutch dairy farmers have improved the breed in the line of milch cows until they have attained to

A DEGREE OF EXCELLENCE UNSURPASSED

by any other breed. The Holsteins are now recognized as a very superior kind of shorthorn cattle, remarkably good for milk, both in quantity and quality, and, as working oxen, proving large, strong, high-spirited, having great endurance of heat, and great aptitude to fatten. They are extremely valuable to cross with other breeds. They are peculiarly adapted to this section of the country, and pre-eminently to the wants of the general farmer, though if proper attention is not paid to them they are apt to degenerate into large, coarse stock.

THE SHORTHORNS,

or, as they are sometimes called, the Durhams, from the county where they were first widely bred, were first imported in 1815, and have, since that time, become more widely and popularly known than any other breed. They have become acclimated, and flourish on common food as well as native cattle. They fat fast, make very powerful and docile oxen, and are naturally excellent in the dairy, giving large quantities of milk, butter, and rich cheese. The Durham and Jersey mixed is an excellent breed also. The Durham thrives well wherever there is plenty of winter fodder, but is not equal to the Devon or Kerry for stony ground or scant herbage. Next to the Shorthorns, the Devons have been most imported, and claim our attention. There are two kinds, the North and South Devons, varying in size and color, but similar in most qualities, and both very hardy and vigorous, and weighing from 1,000 to 1,200 pounds. The Devons give only a moderate quantity of milk, but that of very rich quality.

AS OXEN THEY HAVE NO SUPERIORS,

weighing from 1,500 to 2,000 pounds, docile and amiable, and affording the choicest meat for the butcher. The introduction of Devonshire clouted cream into this country is strongly recommended as a source of revenue to the farmer. Among the milk breeds prominent in the British Isles, a leading place is occupied by the Ayrshire, so called from the county of Ayr, in Scotland. They have always been prolific milkers, with rich but gracious quality, especially in proportion to their size, which is small. The usual yield is 600 gallons a year, or 175 pounds of butter, or 430 pounds of cheese. The oxen work kindly and the beef is excellent, though not so tallowy as in some other breeds. As a breed to cross with larger stock, they are highly recommended; the colors should be red and white, splashed and blotched.

THE JERSEYS,

or, as they were formerly called, the Alderneys, are noted for the extraordinary richness of their milk and their beautiful form. Though natives of a very mild climate, they stand the rigors of our winters nearly, if not quite, as well as our own natives, some claiming the American Jersey to be superior to that of the Channel Islands. The milk of the Jersey cow is particularly rich, of a deep yellow color, and yielding a rich, golden butter of firm grain and fine flavor. It is superior in butyraceous qualities to that of any other breed, the amount of cream being from nine to twenty-five per cent. The Jersey is not a large consumer, and makes excellent beef when dry, but will probably never become very popular as a dairy cow for the farmer, the first cost being too great for profit, compared with other stock. No better stock can be raised than by the use of a Jersey bull with prolific milkers of other stock, and every farmer ought to keep at least one Jersey to every ten cows of other breeds. Every farmer ought to breed for himself, rather than to trust to chance opportunities to buy probably poor stock.

VARIOUS BREEDS.

The Herefords resemble the Devons, and make excellent oxen and steers, but the cows are not prime milkers. The Galloways, black and hornless cattle from the Scotch lowlands, are well fitted for cold and rough sections, but their milk is deficient in quantity, though they yield a superior quality of beef. The Kerry cow, emphatically the poor man's cow, is small and very hardy, living well on the slimmest sort of pasture, yielding an abundance of milk of good quality, and fattening rapidly. The Swiss cattle are hardy and robust, somewhat like the Jerseys, but coarser, fatten well, and are excellent milkers, yielding from 10 to 20 quarts daily, and about 225 pounds of cheese in a season of four months. Having thus given a short sketch of the most prominent breeds, let us inquire

WHAT THE FARMER NEEDS.

(1) He wants a good sized-animal which will bring most of its cost for beef when failing as a milker. (2) A cow that will come into profit early. (3) A cow that will give plenty of milk and rich, whether for milk, butter or cheese. (4) A cow that will consume the least food for the product gained. (5) He wants oxen that will be tractable, active and docile, and that will feed up quickly for the butcher. If there is any one breed that will combine all these qualities, it is the Durham, or the Durham and

Jersey mixed; and farmers are in duty bound to raise their own stock more, by selecting the best cow they have or can get, whether native or imported, and breeding them with the best bull of pure stock, of known milking qualities, that they can get. Having decided what breed to raise, the first important step is to know

HOW TO CHOOSE A GOOD COW.

See that the cow is as much wedge-shaped as may be; that her escutcheon is good and free from depreciating marks; that the milk veins are large and prominent; that the udder is full in the forward part, and the teats of good size, well separated, and not too projecting toward the sides. The head should be small and slender; the horns thin and open; the eye full, but not too prominent; the muzzle not too broad; the neck long, flat and narrow; the hips wide, rugged and high; the thigh long and lean, with prominent veins; the legs slender, with flat bones and small, flat feet. A long and thin tail is a great point in breeding. The udder should be free from hair, flexible and soft, with no tendency to flesh; the teats well separated, and neither fat nor fleshy, nor too long, and with no tendency to strutting. No cow should be allowed to give milk beyond eight months before calving, the system requiring at least one month's rest. A young animal is indispensable for the dairy, either to breed from or to be profitable to the keeper. To determine the milking qualities of a cow, see that the skin is free and thin, the tail fine and long and well tufted, and the veins over the perinæum large, varicose, knotted and more or less oblique. This is a sure test. Guenon's method, based upon the forms of the escutcheons, is also an admirable test of milking qualities. The extent of the escutcheon denotes the milking capacity, its form and outline, the class, the fineness of the hair and color of the epidermis, the quantity and quality of the milk.

Having made a good selectian of an animal, the question arises how to maintain her in good condition for profit, and we will consider

THE MANAGEMENT OF THE COW.

She should have abundance of food, that she may consume it as soon as possible; in short, she must not have to work too hard for her living. The pasture should be often changed, and when not in pasture, sufficient food should be provided. Roots early in the season require an addition of solid food, such as clover, chaff or meal. The best roots are carrots, yellow turnips and mangel wurzel. Corn fodder, potatoes and sugar beets are excellent. In winter, oil cake and ground oats, steamed or boiled, are good food. No other animal than a horse should ever be allowed in the pasture with a cow, and the cow should not be allowed to sleep out after August. They should also be regularly curried, and a piece of rock salt should always be where they can find it. The milking cow should be kept free from rapid and considerable changes of temperature, and should not be turned out too early, as cold and chills will occasion her early falling off in her milk. Many breeders think it best to bring the cows in every night in the year. Perfect cleanliness and good ventilation are of the utmost importance in the cow house, and much care should be given to bedding the cattle. Milch cows should be milked at regular hours, twice a day, and should be fed with hay or meal while being milked, as the feeding engages her attention and helps sustain the stomach. The hands should be perfectly dry and clean, and the utmost gentleness should be used. Remember that all nature is alike, subject to the same natural laws, none of which can be safely violated.

The system of selecting dairy cows of Monsieur Guenon interferes with none of the other methods of judging of the merits of a cow, but it offers a nearly infallible adjunct to all the others, and should be learned by every dairyman. It enables him to tell almost exactly the quantity and quality of milk that any cow will give, how long she will probably remain dry, and many other important points. Guenon was a poor cowherd near Bordeaux, and first discovered the facts which underly his system, while driving his cows to and fro from their pastures. He noticed that the hair on the posterior of the cow grows in a different direction (i. e., upward) from the hair on the other parts of her body (which grows downward), producing figures which he called "escutcheons," and whose form and extent indicate the essential points in regard to milking qualities. The tufts of hair upon the escutcheon, and the color of the skin and its unctuous exudations, are also important elements. Also, there must be considered the breed, size, feed, period of gestation, age, climate, and many other things which will be explained.

BEWARE OF A COW

with white, dry skin and coarse hair on the escutcheon; they may give a large quantity of milk for a time, but will soon fail and the milk will be deficient in butyraceous elements. The system of Guenon contains ten classes of escutcheons, and six orders in each class. The classes are arranged according to the shape of the escutcheon; the orders according to extent. Out of the hundred various divisions, however, but thirty-two are really necessary to be learned. As a rule, never buy a cow in any class below the third order. The size of different cows, and their breed, even when the escutcheons are similar, will materially make a difference in the quantity of the yield, though not in the quality. The lower or thigh portions of the escutcheon is much the same in all classes; the vertical portion varies in all the classes, and thus demands the most attention. The thigh escutcheon indicates the quantity of milk that the cow will give; the vertical escutcheon, the time she will milk; and the "feel" of the hair and skin indicates the quality of the milk,

THE JERSEY BEING THE STANDARD

on this point. Breadth is the criterion of thigh escutcheon; length and breadth, of the vertical. The escutcheon also indicates the generative capacity of bulls, according to rules similar to those above. Guenon named his ten classes from the forms of the vertical escutcheon as follows, the first being the best: Flanders, Left Flanders. Selvage, Curved Line, Bicorn, Double Selvage, Demijohn, Square Cut, Limousine and Horizontal. The bastard marks on the escutcheons indicate short milking time; in the Flanders the mark is a small oval in the middle of the vertical escutcheon; in the other classes it is two ellipses on the prominences of the ischium. The udder ovals are unfailing signs of a good cow. Slices out of the thigh escutcheon are bad signs, as are all marks encroaching thereupon. Coarse hair on the udder is also an imperfection. The hair on the escutcheon of a first-class cow is generally darker and more furlike than that bordering it.

THE PROBABLE EXPLANATION

of the cause of the escutcheon is found in the supply of blood to the milk veins. The mammary artery sends blood to the udder, and also sends out branches which supply the skin where the escutcheon grows, and these branches ramify in the direction of the hair; hence it would seem that there is a ratio of cause and effect in this case. It is well known that the escutcheon increases in size until after the second or third milking. This Guenon system has been subjected to the most critical tests by scientific men, and has stood them all successfully. Every farmer and dairyman should understand it.

BUTTER AND BUTTER MAKING.

Butter is defined by Webster as an "oily substance procured from cream or milk by churning." If Webster is right, then we are wrong in denouncing any "oily" substance as being butter, though, perhaps, many persons have thought they were making and selling butter when they produce an oily or greasy substance and put it upon the market as such, believing it must be butter because Webster says so. Butter, properly speaking, is as far removed from an oily, fatty or tallowy substance as possible. The popular desire of purchasers of butter is to obtain a firm, fine-grained article, of rich golden color, sweet, nutty, aromatic smell and unctuous taste, and which invites both smell and taste. The object of this essay is to give plain, practical rules for making such butter as will sell itself. Most of them are derived from the practical experience of the farmers in Chester County, Pa., who supply Philadelphia with a "gilt-edged" butter at one dollar and twenty-five cents a pound. The best butter pays the best, and it is easy to make as an inferior article. It elevates the moral tone of the family; the character of the family can be told by the looks of the butter. There are many different ways of making fine butter, yet there are certain cardinal principles which rule in all, and which will produce the same relative results if carried out with due attention.

THE GREAT SECRETS OF MAKING GOOD BUTTER

are these: The utmost cleanliness of the cow house, in the treatment of the udder, in the spring house or vault, and in the use and care of the utensils used in the dairy; proper feeding of the cows; careful milking; care of milk and cream in the spring house or vault; churning at proper temperature, and evenly working and salting the butter, marketing and packing for market. Bear always in mind that from the time the milk leaves the cow till the butter graces the table, milk cream, and butter must be near the temperature of 60 degrees. Good butter should contain at least 82 per cent of fat or oil, composed of solid or margarine fat; and liquid or oleine. Winter butter contains 65 parts in 100 of solid fat, summer butter only 40 parts, which explains why cream should be churned at different temperatures at different seasons. The proper temperature for churning is 59 degrees for sweet cream, 62 degrees for sour, and 64 degrees for milk.

FRESH BUTTER

is a yellow, slightly acid substance, which liquefies at 79 degrees, and contains 7 fatty and volatile acids, together with an oil formed from oleine and butterine. Under the influence of oxygen this latter becomes butyric acid, which is the cause of the unpleasant taste and smell of rancid butter. Rancidity can be corrected by washing first in lime water and then in fresh. The quantity of milk required to yield a pound of butter varies form 8 to 14 quarts. The average is 9 to 11 quarts of milk for 2 of cream or 1 pound of butter. As a general rule small cows yield the more butter, large ones the more cheese; a warm and dry climate favors the butter, as does also the morning's milk, while a cool, moist region and the evening's milk best suit cheese production. Cows 8 to 10 years old will give milk producing 40 to 60 per cent more cream than the milk of their offspring 2 years old, though fed alike.

FEEDING FOR MILK AND BUTTER.

With a good lot of cows (for butter cows we recommend Jerseys and Guernseys) the farmer must pay attention to the feeding and watering if he would have good milk and good butter. In summer time the cows should have plenty of good, rich pasture, so that they can fill themselves quickly and lie down and chew the cud and make milk. The pasture should be clear of weeds, as they impart an unpleasant taste to the milk. Shade and pure water should be in plentiful supply, especially the latter, as milk may be poisoned in the udder by the cow drinking muddy or stagnant water. Towards the close of summer and in the fall, feed green corn fodder, sorghum, Hungarian grass, or an early crop of sugar beets. Bran and a little corn meal is good summer fodder. Winter fodder should be the best of hay, as clover and timothy; they should have about ten quarts of bran and corn meal mixed, and carrots, parsnips, mangolds and such roots; to keep their system open. Corn fodder, shorts, oil-cake, pumpkins, etc., are all good, though the former alone will not make good butter. It will pay well to steam or cook the food and to feed hay tea. Turnips and cabbages should never be fed for good butter makers, as they flavor the milk, and the butter is unfit for keeping. It is wrong to color butter artificially; the color should be derived from the food; early cured hay and corn meal will do this. The cow stables should be kept warm, but not with confined air, and should be always sweet; the daily use of plaster or diluted sulphuric acid is recommended.

MILK AND CREAM.

Milking should be done regularly, quietly, thoroughly, yet quickly, twice a day, and as near 6 in the morning and evening as possible. Great care should be taken to get the last drop; the strippings yield from 10 to 20 per cent more cream than the rest of the milk, and, besides, leaving the strippings will cause the cow to dry up sooner. Cows should never be driven to the milking shed hurriedly, as it agitates and heats the milk and the cow. The cow must be looked after as soon as she comes in, and if the calf does not take all the milk from her, she must be milked by hand enough to prevent the bag caking. One mess from a feverish cow will spoil a whole churning. If milk froths and foams, the butter made from it should be sold at once. In caring for the milk, a spring house is preferable to a cellar, as the temperature is more apt to be equable and the air is not so confined nor so apt to be contaminated by decaying vegetables etc., usually stored in a cellar. Wooden pails should never be used for milking or setting milk. The best pans are the tin, painted on the outside and with bails fitted to them. They should be kept perfectly clean and sweet by scalding, rinsing in pure cold water, and exposing the inside to the sun. They should be thoroughly cooled before using.

SETTING THE MILK AND SKIMMING.

Some dairymen prefer deep pans for setting the milk, others prefer shallow; we prefer the latter, say three or four inches deep, as there is more surface to receive the cream and the whole of it will rise. In large dairies, setting the milk in deep cans may be more economical as saving much labor in washing. The milk should not be set more than thirty-six hours, and it is better if skimmed in twenty-four hours, what is lost in quantity being gained in quality. It should be skimmed before it is at all acid or thickened. Above all, do not scald either the milk or cream, though in cool weather the cream should be set in a warm place, as it must be slightly acid before it will make butter. An ounce of fine salt to a three-gallon jar of cream makes it churn quicker. Cream should not stand longer than a week before churning. The milk should be closely skimmed and each time the cream is added to the cream jar the contents should be thoroughly stirred with a wooden spatula and the inside of the jar, above the cream, carefully wiped off.

SPRING HOUSES AND ICE HOUSES.

No farmer can hope to make first-class butter profitably without plenty of pure, soft water on his place. If there is a spring on the farm, he should build a spring house and utilize the running water. Those who do not own a spring should build an ice house, the larger and deeper the better, along the shady side of a hill. Then build a dairy house attached below the bottom of the latter. In the centre of the floor of the ice house construct a ditch, so that it will receive the drainage of the ice, and sloping to the dairy room, where it should be wide and deep enough to hold the necessary pans. Thus there will always be a supply of cool water to keep the milk at a uniform degree. The spring house should be of stone or brick, with a double roof for ventilation, and with the running spring water conducted in stone or cement troughs large enough to hold two rows of pans and deep enough to let the water be always a little higher than the milk in the pans. The walls should be plastered in all dairy houses, and kept scrupulously clean; everything should be removed that will impart impure odors or taint the air. The dairyman should remove his shoes when coming from the barnyard, and if kerosene lamps are used, they should be fitted with appropriate ventilators. The temperature should never be allowed to range more than from fifty-five to sixty-five degrees, and the dairy should front the north and be well shaded. In a prairie country, a good dairy house can be made near a well, by building a semi-subterranean structure, and then keeping a supply of water by means of a telegraph pump.

CHURNING AND WORKING THE BUTTER.

Churning in summer is best done in the early morning, while it is cool; in winter, in a warm place. An even, moderately slow and steady stroke is better than rapid time; fifty to sixty strokes a minute will bring the butter in half an hour. The churn should not be soaked over night, but should be washed just before using. If the butter will not gather, pour in ice cold water. The churn should be as straight up and down as possible, and the dash should stir all the milk at every stroke. Churn fully as often as once a week, and as much oftener as may be, and, upon churning, add all the cream upon the milk in the dairy. As soon as the butter has become hard, draw off the buttermilk, and remove the butter into a wooden tray with a wooden paddle, and in working it remember these rules: The butter is in good condition to work when it cuts clean and smooth, without crumbling, by a cold, wet ladle; it should not be mashed, but worked with a careful, gentle, yet telling pressure; it should not be finally worked until it is dry; it should not be allowed to stand long before working, as it is apt to become streaked and rancid. These rules apply to both hand and mechanical working. The butter should never come in contact with the hand, and should be somewhat sparingly salted and with only the best article. One pound of salt to twenty pounds of butter is a fair average. Butter should never be washed, as all the buttermilk that is necessary can be worked out without destroying the grain of the butter, it makes it insipid and liable to rancidity. If, however, you do wash your butter, use only soft water. The utmost moisture that should be found in thoroughly worked butter is a very slight dew, and it should be of such a firm consistency as to slice down, hardly dimming the surface of a knife blade.

COMPARATIVE PROFITS OF BUTTER MAKING.

Of the four ways of realizing from milk — butter, cheese, condensed milk and milk for family use — butter, if properly made, is the most profitable. Where the milk is sold and the butter is sold, both being near good markets and of good quality, butter at fifty cents pays a better profit, equal to at least ten per cent more than any of the others. It must, however, be marketed with taste to get the most income. It is practicable for producers of butter in the United States to increase its average price ten cents a pound, and this enhancement would put in their purses $100,000,000. This is too large a sum to pay for ignorance, carelessness and lack of cleanliness.

THE CHANNEL ISLANDS.

From their situation in the British Channel, these islands are called the Channel Islands, though more popularly known by the individual names of the larger three of the group, viz.: Jersey, Guernsey and Alderney. Those have attracted the attention of England and America, in recent years, through the merits and beauties of their two famous breeds of cattle, the Jersey and Guernsey breeds.

A stroll through the town of St. Peter's Port will reveal the handsome new market house and hall. Here we have a look at the rural population and products. In the middle of one part of the house are benches, upon which sit a number of women chatting with each other, each holding upon her lap her market basket, with its contents covered with linen or other covering. How gallant and kind it seems to have provided for the female purchasers a place for rest, and to have a social chat. But directly we are undeceived, for when we pass near several of the baskets are uncovered, and the contents are attractively displayed to tempt a purchase. How nicely the golden circles of butter look; how white and fresh the eggs! Ah, then, here the women sell the butter of their own make, and well they understand the art; that's why the circles are nearly double the size of our pound lumps, though they are only half as thick. Well stamped, and of the deep rich color which only Guernsey cows can yield, taste after taste will assure you there is none better. As the herds are not large in Guernsey, each maker can easily bring in her basket the few pounds she has to market.

THE MEATS OF THE GUERNSEY CATTLE.

We examined with care and tasted with relish the Guernsey beef, as we felt anxious to test its quality, to know whether the animal of that breed made good beef. We found it to be juicy, tender and delicious, with a fine, peculiar aromatic flavor. The color of the fat is a deep orange color, much darker than that of the Shorthorn of Devon, and to many would be somewhat objectionable, but only from prejudice. It is even of deeper yellow than the fat of the Jersey. The meat at the same time is of a deeper red than that of other animals. The animals are driven under an inspector's eye to the public yard, marked, and only allowed to come out to be killed at once by the butcher. The islanders guard their two noted breeds very carefully from any chance of being crossed, and do not allow the cattle even of one island to be imported into the other. This is one of the values of those animals imported into this country, the assurance of the purity of the breed.

THE JERSEY CATTLE.

The cattle of these islands are now famous for their beauty and their merit, and are of late being widely scattered over our whole country. In the native island, where the grass is strong and rich, much like our green grass or blue grass, and clover and lucerne are much used, the cows are led out in summer in the morning, and tethered with a rope or chain to an iron peg driven into the ground by a wooden mallet, and are allowed a space of about thirty feet in diameter. They are changed again at noon. In summer they are milked three times a day—such cows as are flush in milk—from April to August, and during the other months twice a day. When milked three times the butter is not greater in proportion. As this work is always done by women, who lead them to pasture and to water, the animals become very docile. It is thought an extraordinarily good cow that gives twenty quarts—the quantity being more usually from ten to fourteen quarts—the medium quantity is possibly ten quarts. In summer it requires nine quarts for one pound of butter, and in winter rather less, if they are fed upon parsnips. There are no large herds in Jersey or Guernsey. Ten or twelve is an unusual number; five or six are more frequent, and most every farmer tries to have one or two heifers to sell. Altogether there are nearly 12,000 head in Jersey, and between 5,000 and 6,000 in Guernsey. The sales from the two islands are less than 3,000 each year, the great bulk of them going to England. Canada is beginning to take a few, some go to France, and about 300 come to the United States. America is taking the best and paying the highest prices, and with the care taken in breeding in this country, we shall soon, and we might almost say now, have finer animals than the islands can show.

GUERNSEY CATTLE.

What we have said of Jersey may with equal justice be applied to Guernsey. About the same attention is paid to breeding their stock, but the farmers are more contracted in their views, and generally, if they can use a bull for a shilling they will not pay five shillings for a much better one. The result of this is seen in the escutcheons, and the hair of their animals. The one is not so well developed as might be, and the other is not as fine. But the Guernsey cow we think is rising rapidly in the estimation of our farmers. She is an animal of larger size, of greater yield, of greater docility, and yields the richest quality of milk. Her butter is self-colored, even in winter, is firm and of beautiful texture, and her golden milk will color that of from six to ten common cows.

ADDRESS

BY

HON. J. J. WOODMAN,

Master of National Grange, Patrons of Husbandry.

EUROPEAN AGRICULTURE, AND THE NECESSITIES OF AMERICAN AGRICULTURE.

It is conceded that agriculture is the primary source of all wealth; and that the earth is the great storehouse of Nature from which man draws, not only the supplies necessary to meet his physical wants, but the main inspirations to moral and intellectual development. The plow is the forerunner of all progressive development, and the thermometer of civilization rises and falls, as speeds this ancient implement.

This seems to be not only in accord with the teachings of history but with the decree of the Divine will. It was ordained in "the beginning" that man should have "dominion over the earth," but not without putting forth efforts and the employment of intelligent labor for its achievement and maintenance.

Asia is the parent land of the human race, the birthplace of literature and civilization, and the mother of nations; yet it is to-day as it has been for ages, shrouded in ignorance and pagan darkness.

That vast territory, containing more than one-half of earth's inhabitance, with a soil and climate and other natural advantages unsurpassed by any other quarter of the globe, has made no progress in agriculture, and consequently none in civilization. There the plow is the same rude implement that it was two thousand years ago, and the yoke used upon the oxen which draw the same is a straight stick lashed to the horns, inferior, perhaps, to those used upon the twelve yoke of oxen with which Elisha was plowing when Elijah cast his mantle upon him.

An eminent divine, who has spent many years in heathen lands, has said, "you must send the plow and the intelligent farmer with the missionary." The heathen lands must be plowed up, deeply subsoiled, pulverized, planted and sowed; and with each returning harvest, will also be gathered a crop of new ideas and intelligence, and the dull and beclouded intellect of this benighted people will begin to act, and they will then see and understand the plan of Divine wisdom for elevating, Christianizing and civilizing the human family. This, too, is in harmony with the experience of the ages, and the history of Christianity. Where agriculture has been neglected, and the cultivators of the soil degraded, degeneracy and barbarism have followed; while the highest type of civilization and enlightenment is to be found where this calling is most encouraged and honored.

As a preface to the theme which I have chosen for this address, I propose to present a few notes gathered from personal observation and study, during my visit to Europe, of the present agriculture of that quarter of the globe.

The lands of Great Britain and Ireland are divided into large estates and owned by, comparatively, a few individuals; consequently the cultivators are tenants. In England and Wales the average size of estates is 1,167 acres; and in Ireland, 2,139 acres. In a united population of 38,000,000 there is one land owner to nine hundred and eleven inhabitants. Some of the estates are very large. It is said that twenty-five persons own the greater portion of England. In traveling from Dublin to Limerick, in Ireland, a distance of over one hundred miles, we passed over the estates of only four men, and they live in London and take but little interest in the country further than to collect and carry away their rents. These land owners not only monopolize the land, but, having the power to do so, they control legislation and shape the laws so as to foster and protect their own interests, and make the soil return to them remunerative profits. Rents are graded according to the capabilities of the soil, and its productiveness must not be diminished by careless or improper cultivation. The laws ostensibly aim to encourage agriculture, and to regulate the relations between land owners and tenant farmers, so as to benefit both; but it is claimed that the benefits mainly accrue to the land owners. Whether this be strictly true or not, the requirement that the fertility of the soil must be maintained is commendable, and in this both parties are alike interested. The regulations also require that the hedgerows shall be properly trimmed and kept in repair, the drains and water courses kept open, so that no stagnant water can accumulate in the fields, that timber be not wastefully destroyed, and that all shade and ornamental trees and shrubbery be cared for and carefully protected. The terms of the rental contract are dictated by the land owner, and necessity compels the tenant farmer, who has nothing to hope for further than to provide the necessaries of life for his family, to submit to the circumscribed conditions and devote his whole energies to his life's work, the cultivation of the soil which he does not and can not own. He must be industrious, frugal and practical, and utilize every resource at his command, or he will fail; and failure means hopeless poverty. And yet, under these circumstances and influences, it is quite probable that agriculture in England has reached a higher state of perfection than in any other country in the world.

This is true, at least, so far as practical and scientific treatment of the soil is concerned. Waste land is reclaimed and utilized, and every variety of soil is made productive.

It is also most wonderful and interesting to notice the skill and science which is everywhere employed in breeding and raising domestic animals, and the care with which the purity of blood of different races has been preserved; also the adaptability of the different breeds of cattle, sheep and swine to the localities where raised and kept.

Notwithstanding all these achievements, the tenant farmers are not prosperous. High rents, exorbitant taxes and the low price of farm products combine to reduce their income to an amount below what is required to provide the necessaries of life and home comforts demanded by our modern civilization. It is generally conceded that English agriculture has reached the zenith of its prosperity, and is now in its decline.

In Ireland, with a soil and climate well adapted to a successful agriculture, and natural advantages unsurpassed by any other country in Europe, poverty and wretchedness among the farmers and laborers meet the eye at every turn. Without attempting to recount all the causes which contribute to this condition of the laboring people, it is quite enough to say that they are ground down under the iron heel of a moneyed power — the nobility of England. A few men, mostly living in London, own nearly the whole country, and those who cultivate the soil and tend the flocks and herds are compelled to live in hovels, unfit for human beings to inhabit, and toil for a scanty subsistence. All of the accumulated products and wealth of the country are removed, leaving nothing for permanent improvements, or to encourage other business enterprises and give employment to labor.

Were I to prescribe for Ireland, I would say, that land owners be required to provide more comfortable houses for their tenants, and suitable stables and conveniences for domestic animals, that rent be reduced, and the owners of estates be required to contribute to the support of schools. That the law of primogeniture be abolished, and provisions made for the sale and division of estates. This would give immediate relief to some extent, and eventually result in great good. These suggestions are equally applicable to all countries where estates are entailed.

In France the farmers generally own the soil they cultivate, and are undoubtedly the most independent, prosperous and contented cultivators of the soil to be found in all Europe. The lands of that country were once owned by the nobility and the church, and paid no taxes for the support of the government. But this order of things was changed by the revolution. The estates were confiscated to the government, and then sold out to individuals, in quantities suited to the means of the purchaser, and to be equally divided among all the heirs after the death of the owner. This subdivision has been going on until many of the farms have been divided into very small parcels. In order to leave each proprietor's land in connection with a road or drive way, many of the estates have been divided into long, narrow strips, some of them but a few feet wide. No fences are used, and the plowing is done with reversible plows, which turn all the furrows the same way, thus avoiding dead furrows. Some proprietors own several of these parcels, but as a rule the lines between farms are indicated by the growing crops. There are some larger farms, on which improved implements and machinery are used, but most of the work is done by hand labor.

In the mountainous and stock-raising portions of the country, the estates are generally large; but the average size of farms in the whole country is sixteen and one-quarter acres of arable land, and thirty-three and one-quarter acres including timber and rough pasture land. There are four plows to five farms, or one plow to twenty and one-quarter acres of arable land; one threshing machine to thirty-three farms; one mower to 1,258 farms, and one reaper to 1,408 farms. The threshing machines are generally driven by one or two horses. Much of the grain is threshed by hand, and hand-driven machines. There is in all France only about six working animals to five farms, including mules, oxen, asses, horses, and mares kept for breeding. When the large number of horses used in the cities and other industries are taken into account, it must be inferred that most of the farm work is done by human labor; and yet France produces annually over 700,000,000 bushels of cereals alone, being only the third cereal-producing country of Europe. While examining the agricultural products of France at the exposition, my attention was called to a very large collection of grain, grasses, and other products, all of superior quality, indicating not only choice varieties and good cultivation, but great care and skill in their selection and arrangement. The exhibitor was present, and I accepted an invitation to visit his farm. The superintendent informed me that he was one of the best and most extensive farmers in that portion of France, and had taken more first-class premiums on farm products, at the fairs, than any other person in France. His farm is located near the little village of Frankonville, about fifteen miles from Paris. On arriving at the depot at the time fixed, with my interpreter, we found him promptly on hand with his horse and cart. He conveyed us to his residence in the village, which was not so pleasantly located nor inviting as I had expected to find, but his hospitality seemed genuine, and I felt free to catechise him as far as I desired. He owned about fifteen acres of land, valued at $6,000. It consisted of thirty-five separate and detached parcels, all within one mile of his residence. He was raising wheat, rye, oats, barley, peas, beans, potatoes, and other vegetables; also grapes, plums, cherries, and small fruits. He raised no stock, not even a pig or chicken was to be seen about his premises. He had one large Percheron horse, two carts, a plow, harrow, and a few very ordinary hand tools. About one-third of his land was in wheat and oats. The team work of the farm, including hauling manure from the city, was done by this one horse, and the manual labor by two men and two women. He paid about ten dollars a month for men, and half that amount for women, and board. When asked if women labor in the field, his cheerful, robust wife answered by exhibiting her brown and calloused hands, to my entire satisfaction, and the relief of the interpreter. Twelve hours' labor is required for a day, and thirty days for a month. Business and labor in France is seldom interrupted by the Sabbath; and the requirements of the fourth commandment are unknown to the great mass of the people, or at least unheeded. Most of the manure used is hauled from the city, and costs about two dollars a load at the city. Quite an amount of valuable manure is made upon the farm. Litter and manure from the horse stable, weeds from the field, slops and refuse particles from the kitchen and house, are carefully preserved and carried to the compost heap, which was located in front of the stable door and about thirty feet from the sitting-room window; and from the odor which filled the room, it was evidently losing much of its value by the escape of gases.

The crops upon the farm were all in splendid condition, and the growth of the matured grain was enormous. The proprietor assured me that his average crop of wheat was sixty bushels per acre, oats from seventy-five to eighty, and barley thirty-five. The following system of fertilzation and rotation of crops is practiced upon this farm, commencing with a clover (lucern) sod.

First year, potatoes, or other roots with manure.

Second year, wheat or rye without manure.

Third year, oats or barley without manare.

Fourth year, beans, peas, and other vegetables with manure.

Fifth year, wheat followed by seeding to lucern without manure. Hay is then cut for two years and then another series of cropping and mowing begins. Three crops of lucern hay are cut in each year.

With this system of cultivation the soil is made to produce large crops every year, and rather increase than diminish in fertility.

In looking over the widely separated parcels of this man's farm, I was enabled to see hundreds of pieces of land with growing crops, belonging to his neighbors, none of which indicated better management or cultivation than his, and I was satisfied that none excelled him in thrift. He gave me the following as the result of his farm operations in 1877. His land was all in crops and meadow, and the amount received from the sale of produce was about $1,800. After paying all farm and family expenses, including taxes, he had $380 left, as the net income of his farm, including the labor of himself and wife for one year. This would seem to be a fair margin for so few acres, but when I consider that pent-up humble dwelling, with its small rooms, scanty furniture, and cheerless surroundings, together with the cheap, plain food upon which they subsist, and the unostentatious garments which they wear, I could understand how that amount could have been saved.

There seems to be a good deal of sociability and intermingling among the French farmers and their families. They live, mostly, in little villages and hamlets, huddled together, and are brought into daily contact with each other. Their small estates, so cut up and mixed up, tend to develop the essential virtues of patience and forbearance in cultivating their lands and maintaining division lines. Each hamlet seems to be a little community by itself. They are not only social, but peaceable, law-abiding, hospitable, and apparently contented with their lot. Their shelves are nearly bare of books, and periodicals are seldom seen upon their tables. As a rule, they stay at home, taxing their muscles and starving their intellects, and consequently know but little of the great world around them.

Whatever can be said of the degradation to which the farmers of Europe have been reduced by the influence of caste, prejudice, and the domineering spirit of wealth and aristocracy, yet it must be admitted that they have exhibited much skill in managing soils and in producing large returns from the same. They have learned the true theory of practical agriculture adapted to their circumstances, and understand enough of agricultural science to enable them to crop their land continuously without exhausting its productiveness. Farms which have been under constant cultivation for a thousand years or more are richer and more productive to-day than when first reclaimed from the forest or morass. Much of this has been accomplished through the direct influence of governmental aid.

Most of the governments of Europe acknowledge the truth of my first proposition, that "agriculture is the primary source of all wealth and prosperity," and through legislation have given to it substantial aid and encouragement.

I should weary your patience by attempting to give a detailed statement of the means employed and extent of aid granted to this industry by the different governments. A few brief mentions must suffice.

Perhaps no other country in the world places a higher estimate upon the value of agriculture for increasing the nation's wealth and general prosperity of the people than France; and in addition to a department of agriculture, presided over by a member of the president's cabinet, experimental farms, agricultural colleges and industrial schools have been established, and measures are now being inaugurated to have the elements of agricultural science taught in all the public schools of that country. Tax laws aim to require wealth and luxuries to bear their just and equal burdens. Direct and substantial aid is given to some important agricultural industries, among which is the production of sugar from beets. This industry has been so encouraged by the government that sugar enough is produced from this source, to supply the demands for home consumption, and leave a large surplus for exportation.

Grecian agriculture, which had made no advancement for a long number of years, but, on the contrary, had sank to a low and unprofitable condition, is being electrified into new life by government aid.

The government of Belgium has established a veterinary college, an agricultural college and two schools of practical horticulture. There are also "agricultural conferences" (institutes) held regularly in different parts of the country, under the auspices of the government. It is claimed that the cultivation of the soil and condition of farmers have been been greatly improved by these means. And yet, upon the battlefield of Waterloo, fertilized by the mingled blood of Europe, I saw women cutting wheat with the sickle and the knife, and plowing with one mule and a plow which reminded me of past ages.

Sweden has a royal agricultural academy, with an experimental farm attached, 5 schools of agricultural chemistry and physiology, 2 superior agricultural institutes, and 27 farm schools where practical and scientific agriculture are taught. In addition to all these, there is a government stock farm, where thoroughbred animals are raised and distributed among the farmers of the country, several model sheep farms, twelve model dairy farms, and three depots of stallions, containing several hundred choice animals of the most approved breeds for improving the horses of the country. The government employs fourteen "agricultural engineers," whose duty it is to deliver lectures in the country and furnish farmers generally with information upon all matters relating to practical and successful farming. Dairy schools have also been established, where practical and scientific butter and cheese making are taught.

Sweden has a rigorous climate, poor soil, and but a small portion of the soil is capable of cultivation, yet her agriculture has been made so prosperous that enough is produced to furnish her people with food, and leave quite a surplus for exportation. It is claimed that the expenditure of so large a sum of money for the encouragement of agriculture contributes not only to the general prosperity, but proves to be a wise measure of financial policy for the government.

Universal experience in European agriculture demonstrates that nothing in cultivation tends so much to exhaust the capabilities of the soil as repeated croppings by the same product. In some of the German provinces this is prohibited by statute law and the following compulsory system of rotation enforced:

First year, winter wheat.

Second year, spring wheat.

Third year, clover or vegetables.

After vegetables, either clover or heavy manuring must follow before another rotation begins. This system is denounced by many of the best farmers as being irrational and too circumscribed to be practical.

In thirty-six departments of France the following "biennial system" is practiced: First year, wheat, rye, oats or barley, sometimes followed with buckwheat the same year. Second, beets, potatoes, and other vegetables. This is followed by seeding to lucern, or heavy manuring before another rotation begins. In forty-six departments a "biennial system" similar to that of Germany and Hungary is practiced. The principal variation is, that winter wheat is followed the second year by rye, oats or barley, instead of spring wheat.

A new rotation, called the "quadrennial system," has lately been introduced into five departments, of which a French writer says: "In the substitution of the more rational and progressive quadrennial system for the triennial—which has already been notably improved in two of the rotations—you avoid the *succession of one cereal to another cereal.*"

This is substantially the English system; and the best farmers, both of England and France, are quite unanimous in the opinion that "*one cereal should not be followed by another cereal in the same rotation.*" Under this practice the average yield of wheat in England is 29 46-100 bushels per acre. While Hungary, with a soil and climate more favorable for the production of wheat, and 92½ per cent of the land in the whole country productive, has an average of only 12 1-5 bushels per acre. Nearly all of the methods of cultivation common to other European countries are practiced in Hungary; but in all of the rotations, however varied in other respects, winter wheat is invariably followed by spring wheat, or some other cereal. Hence, the conclusion seems irresistible that the elements of soil taken up by the wheat crop are the same that are required to produce other cereals, and the raising of wheat and oats from the same land for a series of years as practiced in many sections of the North and West of our country, without returning to the soil an equivalent for the elements removed, will eventually weaken if not destroy the productiveness of any soil. Hence, no good farmer in any of the countries of Europe thinks of raising crops without the aid of fertilizers; for this principle applies to all root crops and leguminous plants with equal force. The production and application of manures is therefore considered of equal importance to a rotation of crops. Land in constant cultivation must have a dressing of at least twenty loads per acre of good manure every third year. To obtain this every available resource is taxed. Muck, forest leaves, weeds from the fields, vegetable tops, etc., are carefully collected and placed in a compost heap, and to this is added lime, ashes, refuse, salt, slops from the kitchen, and sweepings and accumulations from the cities. Commercial fertilizers are also used, and the clover plant is considered to be indispensable. The roots of lucern will penetrate a porous subsoil to the depth of nine feet or more, acting as a thorough subsoiler, and adding by the decay of roots, immense quantities of humus to the soil.

Herds and flocks of the finest types and best races abound wherever grazing lands are available, and fill an important place in the work of reclaiming soils. It is interesting to observe what labor, skill and indomitable perserverance have done in changing sterile places into fertile fields, morasses into rich prairies, hill and mountain sides into vineyards; and in wresting from old Ocean's grasp the low lands of Holland, over which its billows once rolled and danced, and converting them into rich pasture lands on which graze thousands of the finest dairy cows in the world. A people who have done so much to improve and beautify the earth and bless mankind are entitled to the highest encomium that can be placed upon mortals, and illy deserve the humble lot assigned them in life and in society by an unfeeling and overbearing aristocracy. Notwithstanding all the valuable achievements of the farmers of the old world, in practical and scientific agriculture, and the great satisfaction experienced in studying their systems and witnessing their operations in the field, I turned from all these rejoicing that my lot had been cast in a more favored land; and I congratulate you farmers of Minnesota upon the proud distinction of being American farmers.

Of the necessities and demands of our American agriculture.

Much can be said.

How to raise crops at a profit, and at the same time keep up the fertility of the soil, is the greatest and most important question befre the farmers of this country.

While it can not be questioned but what greater progress has been made in this country during the last half century in systematizing labor, diversifying and extending farm operations, in the use of improved implements and machinery upon the farm, and in substituting brain power for mere muscular force, than in any other country in the world, yet in bringing to light the hidden mysteries of agricultural science, applying the same to the renovation of soils, and in perpetuating the fertility of the same, we are far behind the farmers of the older countries.

The productiveness of the soil is being rapidly exhausted in many portions of our country. This is especially true of the cotton land of the South and much of the wheat land of the North. The cotton states are dotted all over with worn-out and abandoned plantations; and the centre of wheat production has been gradually moving westward, seeking new soils to devour, until eight of the newer Western states now produce seven-tenths of all the wheat raised in the United States. Enormous as the production is, and notwithstanding the fact that it has been increased seventy-three per cent in the last decade, yet it does not require the gift of prophecy to warn us that the maximum will soon be reached, and then a retrograde will commence, unless a radical change in the system of cultivation is inaugurated.

Hence, our agriculture demands more science and practical skill in the cultivation and management of soils, and a more rational system of rotating crops. It demands that agricultural schools and colleges be established and made accessible to the sons and daughters of every farmer in the land, and that men and women be educated for agricultural pursuits, as well as for the learned professions. It demands that the bureau of agriculture be elevated, its scope extended, and its secretary be made a member of the president's cabinet, where he can have a voice and a vote direct with the government. In short, it demands more direct and substantial aid and encouragement from the general government. There is no other enlightened country in the world that does so little for the encouragement of its agriculture, according to its ability, as the United States. In 1877 France appropriated for the support of agriculture and commerce over $20,000,000; Russia, for agriculture and public lands, $15,000,000; Austria and Hungary, for agriculture alone, $5,500,000; Great Britain, $800,000; and Sweden, $650,000. The United States, for the same year, appropriated $174,686. From this it will be seen that Russia, our greatest competitor in the markets of the world for wheat and other cereal products, appropriated for the aid of her agriculture and care of her public lands, *seventy times* as much as this country, and little Sweden *three times* as much.

If further evidence is needed to show the indifference of the government towards this great interest, turn to the late message of the president of the United States, and you will find a document, as published in the daily journals, containing 1,464 lines, *four of which are devoted to agriculture.* This greatest business interest of the nation, in which one-half of our entire population is engaged, and from which the nation draws its very life-blood of existence, is almost entirely ignored or overlooked by the president.

It is not my purpose, however, to criticise the president for any omission in this respect, for he has done quite as well as most of his predecessors for the past forty years. I only aim to present the fact that this government has done but little to aid and encourage this great national industry; and whatever of progress has been made must be attributed to other causes rather than governmental aid. If the expenditure of such large sums for the encouragement of agriculture by the nations of Europe is good policy and wise statesmanship, is there any reason to infer that a similar liberal policy would not be beneficial here, where the strength and perpetuity of the government depends upon the intelligence and prosperity of the people? It is a fact which can not be controverted, that almost every other interest in this country is aided and encouraged by friendly legislation, to an extent unsurpassed by any other nation in the world; and that franchises have been so improvidently showered upon great corporations, as to enable them to grow rich by imposing unjust burdens upon agriculture, while the farmers, unorganized and unaided, have struggled in vain to make farming fairly remunerative. Sufficient evidence of this is to be found in the alarming increase of mortgaged farms and foreclosures. A radical change must take place in the legislation of the country, affecting business enterprises, if farming is to be made reasonably profitable, and the proprietorship of the soil to remain with the American farmers.

Horace Greeley, in an address delivered in this city in 1871, said: "In effect, a bevy of railroad kings have arbitrarily reduced the value of every farm, every quarter section of land and every bushel of grain in the great West."

In 1874 a special committee of the senate on transportation, with Minnesota's honored senator, Mr. Windom, as chairman, made the following startling announcement in their report:

"In the matter of taxation, there are to-day four men, representing the four great trunk lines between Chicago and New York, who possess, and do not unfrequently exercise, powers which the Congress of the United States would not venture to exert. They may at any time, and for any reason satisfactory to themselves, by a single stroke of the pen, reduce the value of property in this country by hundreds of millions of dollars. An additional charge of five cents per bushel on the transportation of cereals is equivalent to a tax of $45,000,000 on the crop of a single year."

A late attorney general of the United States (Judge Black) put upon record the following words concerning the operations of railroad managers:

"They boldly express their determination to charge as much as the traffic will bear; that is to say, they will take from the profits of every man's business as much as can be taken without compelling him to quit it. In the aggregate this amounts to the most enormous, oppressive and unjust tax that was ever laid upon the industry of any people under the sun."

Second only to the transportation monopoly in its damaging influence upon agriculture is the system of gambling in farm produce, practiced in our great marts of trade. This gambling in margins is a system of piracy, by which hundreds of millions of dollars are annually plundered from the industrial classes. It is the vampire that is sucking the life-blood of agriculture and commerce; it is the dragon that is destroying the moral vigor of our young men. It is treason to say it can not be put down; it must be put down, or it will destroy the nation. Governments are instituted for the protection of human rights, and legislative bodies are intrusted with power to enact laws only for the good of the people. Hence, every franchise given to a corporation, or privilege conferred upon any particular class or interest, which does not return some corresponding benefit to the community for the privilege granted, is an act of injustice and oppression. But if the interests of agriculture have been overlooked or neglected by the government, or if laws have been enacted for the benefit of other interests which are detrimental to its prosperity, to whom must the blame be charged? Let it not be forgotten, that in "a government of the people, by the people and for the people," every citizen is a sovereign, and has duties to perform in shaping the laws and directing the policy of the government; and no one is free from responsibility. If farmers as a class have neglected to exercise their rights and privileges in this respect, and have lost favor while others have profited by their neglect, they must take the blame right home to themselves, and continue to bear the burdens until they can agree to unite and work together for the protection of their own interests. Self-interest is a principle in our natures which leads us to study our own interest, gratification and comfort, and, when under proper restraint, forms the basis of real enterprise and progress. No class or interest ever found favor or gained prestige in community or among men in tacitly acknowledging weakness and dependency, by ignoring the demands of self-interest. It is the radical, aggressive, bold, brave men who gain recognition and favor. Success is but the result of effort, and equal rights, though inalienable, can only be accquired and maintained by eternal vigilance. If all other professions and avocations of men have organized and combined for the purpose of advancing their own interests, and have thus secured benefits and advantages to themselves, such action is commendable and worthy of all imitation.

In conclusion, I make no apology for briefly alluding to the organization of the Patrons of Husbandry, with which my connection is well understood. This organization was an imperative necessity, and a long-felt want among the farmers of this country. All other interests were rightfully organized and reaping benefits for themselves, regardless of the consequences to others. Farmers had no organization; they felt the necessity for one, assumed the right to organize, and have tried the experiment. No association was ever formed for the protection of human rights, with purer motives or nobler aims, nor which had greater or more difficult obstacles to overcome.

Farmers were isolated, and had but little intercourse with each other, consequently they were unsocial and distrustful; and our organization was like a ship launched upon an unknown ocean, manned by those unacquainted with the art of sailing or the science of navigation, yet ladened with a nation's hope. Soundings had to be made, a chart prepared, the compass set, and men trained to handle the ropes, lift at the windlass, and stand at the helm. The billows of prejudice beat against our frail bark, and a storm of opposition howled through its rigging. Our grange ship labored heavily; we had many timid ones on board, and a few "Jonahs." The timid ones we sent ashore in life boats (dimitted them), the Jonahs were thrown overboard, and our ship outrode the storms and came into port with colors flying and cannon booming. Our flag has been unfurled to every breeze from the Atlantic to the Pacific, and from the Gulf to Manitoba. Our declaration of principles, which elicits admiration and defies criticism, has allayed opposition and won for our cause the respect and approbation of all friends of progress; and our organization has become a fixed institution and one of the grandest achievements of the age. We have a national grange, thirty-two state granges, a county grange in the best organized counties, and subordinate granges in almost every neighborhood. Every subordinate and county grange is a school where farmers and their families meet regularly, for social and mental culture and refinement. In these meetings, questions relating to the farm and the household, also questions of public interest, which are not of a sectarian or partisan nature, are discussed. The following brief sentences from our declaration of purposes will indicate some of the objects we aim to accomplish:

"To develop a better and higher manhood and womanhood among ourselves; to enhance the comforts and attractions of our homes and strengthen our attachment to our own pursuits. To foster mutual understanding and co-operation. To buy less and produce more, in order to make our farms self-sustaining. To diversify our crops, and crop no more than we can cultivate. To condense the weight of our exports, selling less in the bushel, and more on hoof and in fleece. To systematize our work, and calculate intelligently on probabilities. To discountenance the credit system, the mortgage system, the fashion system, and every other system tending to prodigality and bankruptcy. To bring producers and consumers, farmers and manufacturers into the most direct and friendly relations possible. To encourage the building of railroads, canals and to open out the channels in Nature's great arteries, that the life-blood of commerce may flow freely. To remove the antagonism between capital and labor, by common consent and wise statesmanship. To oppose excessive salaries, high rates of interest, and the tyranny of monopolies. To suppress personal, local, sectional and national prejudices. To encourage education among ourselves and for our children, by all just means in our power. To induce farmers to take a more active part in the politics of the country, and to work together for good in the political parties to which they belong, putting down bribery, corruption and trickery and to see that honest men, who will unflinchingly stand by our industrial interests, are nominated for positions of trust, and to carry out the principle that the office should seek the man, and not the man the office."

These objects must commend themselves to every fair-minded person, and we invite all to consider well the claims of this organization and as far as consistent give it support and encouragement.

INDEX.

A COURSE OF LECTURES

ON THE

PRINCIPLES OF DOMESTIC ECONOMY

AND COOKERY,

BY MISS JULIET CORSON,

Superintendent of the New York School of Cookery.

DELIVERED IN THE FARMERS' LECTURE COURSE OF THE COLLEGE OF AGRICULTURE OF THE UNIVERSITY OF MINNESOTA.

APPENDIX TO SUPPLEMENT I.

FOURTH BIENNIAL REPORT OF

Board of Regents of the University of Minnesota.

1886.

PREFACE.

The following lectures were delivered in the "Farmers Lecture Course," at the College of Agriculture, Minneapolis, during the session of 1884. The topics selected at previous sessions had been such as to especially interest the male members of the large classes in attendance, and it was considered no more than fair to the women of the State that attention should be given to such matters as would aid them in the conduct of home duties. Influenced by this desire, I secured the services of Miss Juliet Corson, the superintendent of the New York School of Cookery, and so widely known wherever the English language is spoken, by her publications and writings upon all topics relating to domestic economy. The interest manifested in this course of lectures by the ladies of Minnesota was shown by the crowded audiences present at each exercise, nearly 1,200 of whom registered their names and addresses, a list of which is appended to this report.

The lectures were familiar, extemporaneous discourses upon the topics under discussion, and the lecturer was surrounded by all the appointments of a well-ordered kitchen. The dishes as prepared were passed to the audience for examination and criticism, and full opportunity allowed for discussion. This statement is necessary to explain the colloquial character of the discourses.

In placing these lectures before the public the editor does but simple justice to Miss Corson in stating that circumstances have prevented the preparation by her of a finished report, and have compelled the publication of the notes taken at the "cooking lessons." But if the *form* of the instruction is devoid of rhetorical style, the editor guarantees its *accuracy*.

Although Miss Corson is a steady worker, her usefulness is curtailed by serious illness. In this instance, therefore, indulgence is claimed for the method. Whatever graces of literature the reader seeks, may be found in the author's other published works; here the public is entreated to accept a very plain record of the work done at the State University by Miss Corson.

A word of explanation is due to the members of the class, who were promised copies of these lectures. I had full reports taken at the time, by a stenographer. They were written out shortly after, and sent to Miss Carson, as by her request, for review; but owing to her protracted and nearly fatal illness and very slow recovery, these notes have only recently been returned to me. I hope this statement will relieve me from any charges of neglect, which the ladies might otherwise be disposed to make.

EDWARD D. PORTER,
Professor in Charge.

INTRODUCTION.

This course of lectures is designed to meet the wants of two classes of persons:

First—Those who are experienced housekeepers, familiar with the principles and practice of cookery, but who desire information concerning the preparation of the finer dishes of the modern school.

Second—The young ladies in attendance at the University and others like them, who have had their time and attention so engrossed with studies and other duties that they have not had the opportunity to qualify themselves in this most important branch of a woman's education.

To meet the wants of the first class, the morning exercises will be devoted to the preparation of palatable and nutritious dishes, suitable for every day use in families of moderate means, and some of the finer dishes will be introduced.

As the afternoons are the only times at which the young ladies of the University can be present, these sessions will be devoted to practical illustrations of the elementary principles of household management and cookery. As time permits, some of the salient points in the chemistry of food and the physiology of nutrition will be briefly discussed.

BILL OF FARE

FOR

THE HOUSEKEEPERS' COURSE.

FIRST DAY.

Soup Stock.
Boiled Salmon, with Cream Sauce.
Potatoes, Stewed in Butter.
Quail, boned and broiled.
Omelettes.

SECOND DAY.

Clear Soup.
Caramel for coloring Soups and Sauces.
Baked Whitefish.
Beefsteak, broiled and fried.
Baked Apple Dumplings.

THIRD DAY.

Cream of Salmon.
Shoulder of Lamb, boned and roasted.
Forcemeat for Meats.
Potatoes, broiled and baked.
Cheese Crusts.

FOURTH DAY.

Pea Soup with Crusts.
Salt Codfish, stewed in Cream.
Venison with Currant Jelly.
Stewed Carrots.
Cabinet Pudding.

FIFTH DAY.

Tomato Soup.
Fried Pickerel.
Beef, *a la mode* Rolls.
Puree of Spinach.
Caramel Custard.

SIXTH DAY.

Oyster Soup.
Oysters, broiled and fried.
Oysters with Bacon.
Mobile Roast Oysters.
Welsh Rarebits.

THE UNIVERSITY COURSE.

AT 2 P. M. DAILY.

First Day—Soup Making, and Stews.
Second Day—Good Breads, Plain Pastry and Puddings.
Third Day—Fish and Poultry.
Fourth Day—Meats and Vegetables.
Fifth Day—Cheap Dishes and Rewarmed Foods.
Sixth Day—Cookery for the Sick.

Tea, Coffee, Omelettes, Sauces, and various small dishes will be treated when the occasion offers.

The last half hour of each day will be devoted to the discussion of questions referring to the subject in hand, and to the testing of dishes cooked.

FIRST LECTURE.

Our lesson this morning, ladies, will consist of the preparation of what is called soup stock, or beef broth, which is the basis of many kinds of soup; it is very easily made, simple in its composition, and exceedingly nutritious; the other dishes to be made are boiled salmon with cream sauce; potatoes, stewed in butter; and quail, boned and broiled. I give you the boned quail to show you what an exceedingly simple operation boning is. It is supposed to be very difficult, and it is done sometimes in curious ways; but the best way is the simplest and easiest. If we have time we will prepare a few omelettes.

As I shall begin with soup stock, you will take your receipt for that. For each quart of soup stock or broth which you intend to make, use one pound of meat and bone. By that I mean meat and bone weighed together. The cut which I have here is from the upper part of the leg, next to the round. You can use any cut of the leg, the shank, which is the lower part of the leg, or the neck; any of the cheaper parts of meat will answer for soup meat. First, cut the meat from the bone; the butcher will always do that for you; then have the bone broken in small pieces. The butcher, of course, will do that very much more easily than you can do it. Do not wash the meat; wipe it all over with a towel wet in cold water. Put the bones in the bottom of the soup kettle, laying the meat on the bones; then add cold water in the proportion of a quart to each pound of meat and bones. Set the soup kettle over the fire, and let the broth slowly head and boil. As it boils a scum will rise to the surface, which is to be removed in case you are preparing stock for clear soup. The scum is composed of the blood and the albumen of the meat, and is only removed for the purpose of clarifying the soup. It is nutritious, and for that reason it should always be saved. In France, and in kitchens where French cooks are employed, this scum is used either in thick soup—for instance, in vegetable soup, such as I shall make this afternoon—or put into brown sauces or gravies. Remember, it is nothing that is to be thrown away; it is to be saved because it is both nutritious and savory. It adds flavor and nutriment to any dish to which it is added. While the soup meat is being boiled for the first time, prepare the vegetables. For three or four pounds of meat, which will make as many quarts of soup, use one medium-size carrot, which is to be scraped, a turnip, which is to be peeled, and an onion, which is also to be peeled, in such a way as to prevent breaking apart; take off the outer dry skin of the onion without trimming it closely; do not cut it off at the top, because in that way you will cause the layers to break apart. After the onion is peeled stick a dozen whole cloves into it. The cloves are added to the soup for the purpose of flavoring it. You very often hear the remark made that the cookery of certain people has an indefinable taste, exceedingly nice, but something that you do not exactly understand. It is always produced by a combination of seasonings and flavorings. In this soup I shall use for seasoning not only the cloves in the onions, but a dozen peppercorns—that is, unground grains of pepper, instead of ground pepper, because I want the soup to be perfectly clear. I shall use also bay leaves, which may be new to some of you; they are the dried leaves of the laurel or bay tree, and can be bought at any drug store. You can buy five cents' worth of them and they will last you a year or more. The seasoning is slightly aromatic; for four quarts of soup use only a little leaf, or a piece of a large leaf; use also a blade of mace, and a sprig of any dried herb except sage.

The peppercorns, the bay leaf, the blade of mace, and the sprig of sweet herb are tied in the midst of a little bunch of parsley, the stalk with all the leaves on, and if it is ever marketed here with the root on, use that as well; the root of the parsley has all the flavor of the leaf intensified, and you have only to thoroughly wish it, and then use it. All these dried herbs are to be gathered inside of the parsley and tied in a little bunch; tie the parsley by winding string around it, inclosing all the dried herbs; this little bunch is called in cooking books a *fagot* or bouquet of herbs; it is what gives soups and sauces that indefinable spicy, delicate flavor so much liked.

After the soup stock boils remove whatever scum has risen, put in the *fagot*, the turnip, the carrot, the onion stuck with cloves, and for the four quarts of soup a heaping tablespoonful of salt. Keep the soup stock covered as much as possible while it is heating; and after you have put in the vegetables keep it covered all the time. Let it boil very slowly. After all the vegetables are in set the kettle back so that the heat of the fire strikes from one side; let it boil from one side and gently; in that way you begin the clarifying. You will find if you boil the stock from one side, and very gently, then when you strain it after it is done it already will be as clear as most clear soup. After it has been strained, to-morrow, we shall clarify it in order to show the process, which is very simple. Then it will be what is called on hotel bills of fare clear soup.

After the vegetables have been added let the stock boil for at least two hours. In that length of time the flavor of the vegetables and the nourishment from the meat will be extracted, but not the gelatine from the bones. It is the gelatine in the bones which makes broth or stock jelly when it is cold; in order to extract the gelatine it is necessary to boil the soup meat and bones at least five hours. The soup can be strained at the end of two hours, or boiled five or six hours, keeping it covered so that none of it wastes or evaporates. When the soup is boiled, strain it; use an earthen bowl or jar; set a colander in it, and lay a towel folded twice in the colander, having the colander either over the bowl or jar; pour the soup into the towel, and let it run through without squeezing, because if you squeeze the towel you will force small particles of scum through, and thus cloud the soup. After the soup has run through the towel let it cool; do not cover it while it is cooling unless you are afraid of flies or insects getting into it; in that case cover it with a sieve. If you cover it with a solid earthen cover or plate the steam arising from the soup will condense on the under part of the cover and fall back into the soup; if the weather is warm, or if it is a close, rainy day, the steam condensed falling back into the warm soup will cause it to sour. For this reason when you put away a dish of meat or vegetables after dinner do not cover them until they are cold.

BOILED SALMON WITH CREAM SAUCE.

In boiling a whole fish, or a large piece, use cold water. If you put a large piece of fish into boiling water, the outside will be cooked before it is done near the bone. Nothing is more disagreeable than a piece of fish half raw at the bone; it is uneatable. For a small piece of fish, such as I have here, use boiling salted water enough to cover it, and boil it until the flakes begin to separate, or until, by testing a fin, you can easily pull it out. That will probably be, if you use cold water, soon after the water boils; if you put the fish into boiling water, it may be five or more minutes. Boil the fish, whether it is large or small, until you can pull out a fin, or until the flakes separate. Then drain it, and serve it with any nice sauce. To-day I will make a very simple one—cream sauce. Of course you would always make the sauce while you were boiling the fish, taking care to have both done at the same time. For a pint of sauce, use a heaping tablespoonful of butter and a tablespoonful of flour; put them in a saucepan over the fire, and stir them together until they are smoothly mixed; then begin to add hot milk, half a cupful at a time; when the first half cupful of milk is stirred in, put in another half cupful and again stir until it is smooth; continue to add milk until you have used a pint, or until the sauce is about the consistency of thick cream. There will always be a margin there for a little discretion, because some flour will thicken very much more than others. Flour that is very rich in gluten will thicken more than that which has most starch in it. But you have there about the right proportions—a tablespoonful of floor, a tablespoonful of butter, a pint of milk. Add more or less milk as is required to make the sauce the consistency of thick cream, or of a thickness which will coat the spoon; that is, if you dip a spoon in and hold it up, the sauce will not all run off like water; when all the milk has been used, season the sauce with a level teaspoonful of salt and about a quarter of a salt spoon of white pepper. I speak of white pepper particularly because in making a white sauce, if you use the ordinary black pepper, the sauce will be full of little black specks. The white pepper is quite as cheap, quite as plentiful as the black pepper; all the grocers keep it, and its flavor is nicer, rather more delicate, scarcely as pungent as the black pepper; there is a certain biting, acrid flavor in the black pepper which does not exist in the white pepper; the latter contains all the stimulating property and all the aromatic flavor.

After the same is finished, keep it hot by setting the sauce pan containing it in a pan of hot water, on the back of the stove. A perfectly plain white sauce (which can be made the basis of an infinite variety of other sauces) is made by substituting water for milk; by leaving out the pepper and salt, and using sugar for sweetening, you can make a nice pudding sauce. If you add a tablespoonful of chopped parsley to a pint of white sauce, you make parsley sauce. Putting a few capers into it, makes caper sauce. A teaspoonful of anchovies dissolved in it makes anchovy sauce. It is easily made the basis of a great many sauces, the name of which depends on preferred addition to the white sauce. Egg sauce is made by adding chopped hard boiled eggs to white sauce.

Question by a Lady. Would you ever substitute cornstarch for flour?

MISS CORSON. You can if you wish. You must use your own discretion about the quantities. Simply get the thickness of thick cream.

Question. Is it better to use a porcelain vessel, or will tin do?

MISS CORSON. Use any saucepan made of material thick enough to prevent burning.

Question. Do you put the fish right into the water, or have you a fish kettle?

MISS CORSON. If you are using a fish kettle you will have a little wire frame. You can lay the fish on that, or you can tie it up in a cloth, if you wish to.

Question. Then how can you tell when it is done?

MISS CORSON. If you tie it in a cloth you must leave a little space so that you can test it.

Question. How much pepper did you say to put in the sauce?

MISS CORSON. About a quarter of a salt spoon; that is, a good pinch of pepper. One of the ladies asked me about using a thick sauce pan — porcelain-lined sauce pan; you will find the advantage of thick sauce pans of all kinds is that they are less likely to burn than thin ones. The thinner the metal the sauce pan is made of, the more likely it is to burn. There are so many different kinds of utensils that every lady can take her own choice. Black sauce pans, lined with tin or with porcelain; tin sauce pans, thin ones, and thick ones made of block tin. You notice that I use copper sauce pans. Coppers are the most durable; they are lined with tin, and they have to be relined about once a year; the cost of relining is very little — comparatively little; I think it costs me about three cents a foot to have them relined, and the copper never wears out. If you buy a copper sauce pan you have got something that lasts you all your life, and you can leave it as an heirloom; if you don't want to do that, you can sell it for old copper for nearly as much as you paid for it. In using copper, you must never let them become bare on the inside. If the tin wears off and the copper is exposed to any acid in the food cooked, it is apt to form a poisonous combination. But with proper care and cleanliness, copper sauce pans are pefectly safe.

Question. Do you prefer them to the galvanized iron?

MISS CORSON. Yes, I do, on the score of cleanliness, economy and ease in cooking.

Question. Do you use a wooden spoon from choice?

MISS CORSON. Yes; of course you can understand, ladies, that I could very soon scrape the tin off of the inside of a sauce pan with a metal spoon, a knife, or anything of that sort. Copper sauce pans should be cleaned with a rag, a little Sapolio and hot water. If they are cleaned as fast as they are used they are no more trouble to keep clean than any other sauce pan. I use in stirring simply a small pudding stick—an old-fashioned wooden pudding stick. It does not scrape the sauce pans, and there is no danger of uncooked flour accumulating on the sticks, as it does in the bowl of a spoon. If you are stirring with a spoon, some of the half-cooked flour might get in the bowl of the spoon, and then your sauce would have the taste of the raw flour. I will leave the stick in the sauce pan and pass it about so that you can see what I mean. Anyone can whittle these little sticks out, using any kind of hard wood. Do not use soft wood. You will have noticed, ladies, if you have ever put sauce of this kind, thick sauce, to keep hot, it may have grown very much thicker by standing; in such case add a little more milk or water, and a little more seasoning when you are ready to use it.

Question. How do you make perfectly clear sauce?

MISS CORSON. You can make a nearly clear thick sauce by using arrow root. Of course, a clear thin sauce is simply sugar dissolved in water, with butter or flavoring as you like.

POTATOES, STEWED IN BUTTER.

The potatoes are peeled and sliced in rather small slices of even size; put them over the fire in enough salted boiling water to cover them, boil them until they begin to grow tender; not till they break, but just till they begin to grow tender; after the potatoes are boiled tender drain them, and suppose you have a pint bowl full of potatoes, use about two heaping tablespoonfuls of butter; melt the butter in a scant half cupful of milk. When the butter is melted put the potatoes into it, and with a spoon lift them very carefully from the bottom, always without breaking them, until they have absorbed the milk and butter; then season them with salt and white pepper, and they will be ready to serve. Season them palatably; I could not give you the quantity of seasoning because it would depend upon the salt that the potatoes had absorbed from the water. You should taste them first before seasoning at all, and then if they need any more salt add a very little at a time. If you simply want the potatoes nicely stewed you don't add so much butter, a scant tablespoonful, and milk enough to moisten them; but this receipt is an exceedingly nice one — rather rich, but very nice.

(At this point the fish was done, and Miss Corson continued.)

You notice, ladies, that I take off the skin of the fish before taking it up. That is very easy; it slips off easily, and without it the fish is much nicer to serve at the table. In serving sauce with fish you pour some around it, not over it; or you serve the fish on a napkin, and the sauce in a dish, as you prefer. If you serve the fish in a folded napkin garnish it with a few sprigs of parsley, if you can get them, or with a lemon sliced, if you do not live — as some unfortunate people do — "fifty miles from a lemon." Lemons are very nice always with any kind of fish. Parsley can be bought here all winter long. I have learned that from the advertisements in the papers already; and a little of it makes a great difference in the appearence of a dish.

Question. Can you tell us how we can tell whether a frozen fish is stale or fresh?

MISS CORSON. You can after you have thawed it in cold water; you can tell by the smell. (Laughter.) The way to thaw frozen fish is to put it into perfectly cold water and keep it in a cold place until all the frost is drawn out. Of course the most of the fish in this market would be frozen in the winter. This one has been frozen.

Question. Can you tell us how to carve a whole fish?

MISS CORSON. You would have a rather sharp knife and spoon; a fish knife, though it looks pretty, is not good to serve fish with because it is apt to be dull; you want a knife that will cut down through the fish without tearing it, without attempting to cut down through the bone, unless you know where the joints are located.

Question. Would you cook a fish with the fins?

MISS CORSON. The latest fancy of fish lovers in New York, the members of the Ichotyophagus Club, who are supposed to be the leaders in the fashions of fish, is to have the fish served with the fins, head and tail on; and with some fish they want even the scales; and then they simply lift off the skin, the entire skin, before they begin to serve it. They have the fish thoroughly washed and drawn, and then cooked with the scales and fins on. You can judge how easy it would be to do that, because you saw how easily that skin came off this fish. The skin comes off easily if the fish is properly cooked — cooked enough.

Question. What kind of fish can be cooked with the scales on?

MISS CORSON. I think the black bass, and some kinds of sea fish. The idea is that if the fish are not scaled they will keep their flavor; a fish properly dressed retains enough of its flavor even if it is scalded before it is cooked.

OMELETTES.

First, I will make a plain breakfast omelette. Use for two or three people not more than three eggs. You can not very well manage more than three in an ordinary pan. It is better to make several omelettes, especially because people are not apt to come to the table all at once, and an omelette to be nice must be eaten directly it is cooked. Say three eggs; break them into a cup or bowl; add to them a saltspoonful of salt, quarter of a saltspoonful of pepper, and mix them just enough to thoroughly break the whites and yolks together. Put over the fire a frying pan with a heaping teaspoonful of butter in it. Let the butter get hot. If you like an omelette brown let the butter begin to brown. After pouring the eggs into the hot frying pan break the omelette on the bottom of the pan with a fork, just a little, so that you let the uncooked part run down on the bottom of the pan. I do not mean to stir the omelette as you would scrambled eggs, but just break it a little until it is cooked as much as you want it. French breakfast omelettes are always cooked so that they are slightly juicy in the middle; in order to accomplish that result of course you have them still liquid before you begin to turn them. When the omelette is done as much as you want it run a fork under one side of it and fold it half over, then fold it again; loosen it from the pan; have a platter hot, and turn the omelette out. Serve it the moment it is done.

Next I will make a light omelette. The same rule — three eggs, whites and yolks separate; beat the whites to a stiff froth; add seasoning to the yolks in the same proportion as before; mix the yolks slightly with the seasoning; after the white has been beaten quite stiff and the yolk seasoned, mix them very lightly together; have a heaping tablespoonful of butter in the frying pan over the fire, hot, just as for the plain omelette; mix the whites and the yolks together, without breaking down the white. Of course the lightness of the omelette depends on keeping all the air in the white of the egg that you have beaten into it. Put the eggs into the hot frying pan; run the fork under the omelette and lift it from the pan as it cooks; lift the cooked portions from the pan, and let them fall back on the top of the omelette, taking care not to pat the omelette down at all; but just lift the cooked portions and let them fall back on the top of the omelette, until it is done as much as you like. Usually this omelette is served soft — as soft as ice cream. When it is done as much as you want it, push it to the side of the pan, gently, and then turn it out on a hot platter. Always remember that the success of an omelette depends upon the quickness with which it is made and served; because, in the first place, you make it light by beating air into it; then, of course, the heat expands the air, and that makes the omelette still lighter; and you must get it served before the hot air escapes.

BONING QUAIL.

After the quail have been picked, cut the wings off at the first joint, cut the legs just above the joint of the drum-stick. Cut off the head, take out the crop, cut the quail down the back bone; from the inside, cut the joint where the wing joins the body; and having cut that wing joint, begin and cut close to the carcass of the bird till you get down to the leg joint, where the second joint of the leg unites with the body; break that joint, and keep on cutting the flesh from the carcass, taking care not to cut through the carcass so that you strike the intestines until you reach the ridge of the breast bone; close to the breast bone you will find that little division in the flesh of the breast which you have noticed in carving chickens and turkeys; it is called the little filet, and lies close to the breast bone; separate this natural division from the outside of the breast. Then beginning again on the other side, cut close to the carcass of the bird until you have reached the breast, as on the other side. Now the flesh is loose on both sides of the bird, and needs only to be taken off without breaking the skin of the breast. You would bone chickens and turkeys in the same way. Take the carcass out entire. Now take out the wing and leg bones from the inside. Do not tear the skin of the bird any more than you can help. Now lay the flesh on the table, with the skin down, and straight-en it out a little, distributing the flesh evenly over the skin, and it is ready to stuff. If I were making boned turkey I should have it all ready, just like this, and then put the force meat in, draw the bird up over the force meat, and sew it down the back. This bird is simply going to be broiled. Season with salt and pepper. In preparing boned birds you can use any kind of force meat — a layer of sausage meat, or any kind of chopped cold meat; season it with salt and pepper. Put the birds between the bars of the wire gridiron, and broil them with a very hot fire. The gridiron should be well buttered, so that the birds can not stick. By the time the bird is broiled brown on both sides it will be done. Of course you do half a dozen or a dozen in the same way, precisely. Remember, ladies, always, that to broil you should use the hottest fire you can get — the hottest and the clearest fire, because part of the success of broiling depends upon quickly cooking the outside, while the inside of anything you are broiling still remains juicy. If you had a wood fire you would broil over the fire. If you broil over the fire you must expect the blaze to rise, and you must naturally suppose the meat will be smoked; but you can make your fire clear — that is, have it alive; do not have it smoky and full of unburnt wood or coal; have a clear bed of coals if you are going to broil over the fire.

Question. Do you never wash the birds before boiling?

Answer. No; you will find that I am very *un*-neat about that. In the first place, I would not use a piece of meat or a bird of any kind that was really dirty enough to need washing. If it had anything on it that I could not get off by wiping with a wet cloth, I simply wouldn't use it. If you wash meat or poultry you destroy a certain amount of its flavoring and take away some of its nourishment.

Question. Sometimes a bird shot will have a great deal of the blood settle in the breast or in the flesh.

MISS CORSON. Yes; you want the blood; you want to keep the blood there. The blood is a part of the nourishment. The idea of washing meat comes from the old Hebrew prohibition which involved the removal of every particle of blood. You know that the Hebrews believed that the blood was the life and even to this day every particle of blood is taken away from their meat, not only by washing after it comes into the house, but before that by the treatment it receives from the butcher. The blood is a part of the nourishment, and you want to keep as much of it as you can; in some cooking it forms a very important part; for instance, in cooking a hare or rabbit, the blood which escapes in the dressing is saved and used.

Question. Would you treat prairie chicken, grouse or partridge in this way?

MISS CORSON. Yes, in the same way.

Question. Not if you were going to roast turkey?

MISS CORSON. One of my good friends in this far Northwest several years ago sent me a nice recipe for making a fricassee of chicken which I will tell you. The recipe said that after the chicken was picked you might wash it thoroughly with *nice soap*, then rinse it. (Laughter.) Now if you like you can prepare it that way. No, you will find, ladies, that if you use a cloth well wet in cold water you can remove all objectionable matter from the outside of meat or poultry. Indeed, if a piece of meat or poultry can not be cleaned with a wet cloth, it is not clean enough to use. One lady asks me about keeping meat for a long time. Of course that is a question of taste entirely, whether you like meat hung a long time or whether you like it fresh. Al meat, when it is first killed, whether it is poultry, or game, or the ordinary domestic meat, is very tender. It is tender until the flesh begins to grow cold, until the animal heat, etc., parts from the flesh. Then it beomes tough, rigid and hard, and remains so until the process of decomposition begins. I do not mean until it begins to taint, but until it begins to decompose; at that point it begins to grow tender; it is still fresh and good enough for food. Remember that the hanging of meat is for the purpose of allowing it to begin to decompose.

LECTURE SECOND.

Our lesson this afternoon will consist of some plain soups and stews of meat. I shall begin with a soup,—of yellow split peas. For four quarts of soup use an ordinary cupful of yellow split peas; pick them over and wash them in cold water, put them in a saucepan or a soup kettle with two quarts of cold water. Set the saucepan or soup kettle over the fire and let the water very gradually heat. When it boils put in some cold water,—part of a cupful, let them boil again; keep on putting in cold water every fifteen or twenty minutes, until you have used two quarts of cold water besides the first two quarts. The object of adding cold water slowly is this: You soften the peas by the gradual heating of the cold water. After the first boiling the addition of a little cold water lowers the temperature, and as the water heats again the peas are gradually softening; so that within an hour and a half or two hours you will find them quite tender enough. You will notice that I have used no salt; the salt would tend to harded the peas. You add salt after the soup is nearly finished. The old way of soaking the peas over night is a very good one, but this is rather better, for this reason: If you soak the peas over night you destroy a small portion of their nutritive properties; especially if you make the soup in warm water, there will be a slight fermentation. The object of soaking them over night is simply to soften them, and as you can soften them in this way you accomplish the same purpose by adding cold water gradually. You will notice that this is for perfectly plain pea soup. You can vary it by adding bones of cold ham, or of cold roast beef; you can boil the bones with the peas. In that way you get the flavor of whatever meat you add. A very nice soup is made simply with the peas without any meat, by the addition of a fried onion, for that soup you would peel and slice an onion and put it in the bottom of the soup kettle with a tablespoonful of butter or drippings,—beef drippings or poultry drippings,—and fry it light brown; then put on the peas and cold water and proceed just as we do to-day for a plain pea soup, without any addition except a seasoning of salt and pepper, and by and by a little flour and butter, which I shall put in at the close, the object of which Iwill explain to you then.

BEEF AND VEGETABLE SOUP.

For four quarts of soup use one cupful each of the ingredients which I shall name: lean beef cut in half-inch pieces; carrot, which must first be scraped and then cut in half-inch bits; turnip, which must be peeled and then cut in small pieces; rice, picked over, washed in cold water; tomatoes, peeled and sliced if they are fresh; but if you use canned tomatoes simply cut them in small pieces; half a cupful of onion, peeled and chopped rather fine; and four quarts of cold water. First put the water over the fire with the beef in it, and let it gradually heat; while it is heating get ready all the other ingredients that I have spoken of, and add them when the water is hot. Don't add salt for seasoning until after the soup has been cooking for a little while, because it would tend to harden the meat. When the soup is boiling, put in all the other ingredients; and after the soup has cooked for an hour, season it with salt and pepper. Cook it slowly for about two hours, or until the vegetables are tender. The length of time will depend somewhat on the season of the year. You will find that carrots and turnips, like all vegetables which have woody fibre in them, will cook more quickly early in the winter while they still have their natural moisture in them. The later in the winter it grows the drier they get, the harder the woody fibre is, and the longer it will take to cook them tender. So you will cook the soup until the vegetables are tender; and then, having seen that it is palatably seasoned, serve it with all the vegetables in it. You notice that this is a thick soup, made in an entirely different way from that which I made this morning. I think some of the ladies are here who were here this morning. Then we were making clear soup which is to be served without any vegetables in it. This is a good hearty soup for every-day use; in fact it is so hearty that you can make the bulk of a meal using this and bread or potatoes. When all the vegetables are quite tender then the soup simply is to be served.

Now, while I am preparing the soup, I want to say a little about the value of soup as a food. This comes properly into our afternoon course of instruction. Many of the ladies may not have thought of it in precisely the connection in which I am going to speak of it. Habitually, Americans do not use soup. Some have grown gradually accustomed to have soup as a part of their every-day dinner, but as a rule people have it once or twice a week. I am speaking now of average families. As a matter of fact, it ought to be used every day, because it is not only a very easy form in which to obtain nourishment, but you obtain from soup that which you would not get from any other dish; that is, you get every particle of the nourishment there is in the ingredients which you put into the soup. You can make a perfectly nutritious and palatable meal with soup at about one-half the cost of a meal without soup, because the soup, if it is savory, will be eaten with a relish; and it will satisfy the appetite for two reasons; the first I have already spoken of — because you get every particle of nourishment there is in the ingredients; and second, because directly you eat it — that is, directly it reaches the stomach, some of its nutritious liquid properties will begin to be absorbed at once. They pass directly into the system, by the process which is known in physiology as *osmosis* —that is, absorption by the coats of the stomach; so that the liquid part of the food is actually absorbed and passes into the circulation in less than five minutes after you have eaten it. A very familiar illustration of that fact was made by Sir Henry Thompson several years ago, in his exceedingly valuable article called "Food and Feeding," where he said that a hungry man eating clear soup for his dinner would feel a sense of refreshment in less than three minutes; that is, he would feel the effect of his plate of clear soup almost as soon as he would feel the stimulus which he would receive from a glass of wine. He would feel refreshed at once; his sense of hunger, which is the indication that his system needs food, would be practically appeased within three minutes from the time he had taken his soup.

Then there is another very important question; and that is the effect of soups and liquid foods on the appetite for stimulants. I am not a temperance advocate in the sense in which the word is usually understood. That is, I neither believe in nor advocate total abstinence; but I do believe in temperance—in the temperate use of everything; no matter whether it is drink, or food, or pleasure, in a life of work, so that I speak solely from the standpoint of an advocate of the moderate use of everything. The system requires a certain amount of liquid nourishment. We have to get that in the form of liquid, and many people take it by using water to excess—drinking quantities of water. On the other hand, there are some people who never drink more than a glass of water all day long. They must drink something—some kind of liquid—to make up the quantity of water that is absolutely required by the system in the course of twenty-four hours. Some persons take it in the form of tea and coffee; others drink beer and wine; but a certain amount of liquid the system must have. Now, you can easily see that you can supply a part of that liquid in the form of soups and stews. It is not possible for many people to drink much cold water: it does not seem to agree with them. The advocates of the latest craze, for hot water, will get their quantity of liquid, but they will get it in a form that by and by will make serious trouble for them; because, while under certain conditions the entire mucous membrane or lining of the digestive tract, warm water may be desirable, still the excessive use of it is very apt in time to produces a serious congestion. Now, the fact once admitted that we must have a certain amount of liquid supplied to the system every day, then the question comes of giving it in a form that will be the least injurious to the system. I think I have shown you one or two good reasons why soup supplies it well. On the score of economy there is no food which can be as cheaply prepared as soup — that is, no palatable, enjoyable, nutritious food. It is possible to make this soup, this thick soup which I am making now, in New York, and here also, I suppose, for less than ten cents a gallon, buying the materials at retail; and I am sure a gallon of this soup will go very far towards satisfying one's hunger. I presume, from what I have seen of the market reports in the papers, that it can be made here quite as cheaply as it can in New York.

Question. Does that make very strong soup — does it give a very good rich flavor of the meat, with one cupful of meat to a gallon of water?

MISS CORSON. That gives a perfectly nutritious soup. It gives as much nutriment from the meat as is needed by the system.

Question. Wouldn't a bone or two thrown in be a good thing?

MISS CORSON. You can put in bones if you want to. But I am giving you a recipe for a perfectly nutritious soup, made upon the most economical principles. The proportion of meat which I use here is all that is required by the system in connection with the other ingredients. We Americans have, as a rule, the idea that there is no nutritious food except meat. We think that we get all our nourishment from meat; and the other things — the vegetables and bread, and all those other articles of food that we eat, are what the dressmakers would call "trimmings." We do not regard them as real nourishing food, when in reality there are some vegetables which are nearly as nutritious as meat. Take for instance, lentils; I do not know if you are familiar with them. They are a variety of vetch or field pea, little flat, dried peas, that grow very abundantly; in fact, if they are once planted in a field it is almost impossible to root them out. They have been for ages used in all older countries, in Egypt, in Asia, all through Europe, especially in Germany. Within the last ten years they have become known in this country. Lentils, with the addition of a very little fat in the form of fat meat, suet, drippings or butter, are quite as nutritious as meat; that is, they sustain strength, and enable people to work just as well as meat. So, you see, that so far as actual nourishment is concerned, vegetables approach closely to meat. Next to lentils come peas and beans, dried peas and beans. I have not graded the different articles of food, but some day when we have more time I will give you a table of nutritive values of different articles of food so that you can form some comparison in your own mind. Remember this, that meat is not the only nutritious article of food in use, and we only need a certain quantity of it. For instance, for the purpose of health meat once a day will answer. It is very nice to have it two or even three times if we want it, or if we can afford it; but if we have it once a day we answer all the requirements of health, and in communities where it is not possible to have an abundant supply of fresh meat, a very small proportion of salt meat used in connection with the most nutritious vegetables keeps the health and strength of the really active laborers up to the working point.

MEAT STEWS.

For a brown stew, use any kind of dark meat. To day I am going to use some of the cooked round of beef; but you can use fresh beef; you can use raw beef, rare roast beef, or any of the dark meats; always use white meats for white stews. Presently we will make a white stew of veal; but for a brown stew use dark meats. Cut the meat in pieces about an inch and a half square, put it over the fire with enough fat of some kind to keep it from burning; use the fat of the meat, or drippings, or butter, and brown it as fast as possible. If you make a stew large enough for four or five people, use about three pounds of beef. As soon as the meat is brown, sprinkle a heaping tablespoonful of flour over it; then add enough boiling water to cover the meat, and three teaspoons of vinegar. The vinegar is used for the purpose of softening the fibres of the meat and making it tender. You will find that by adding vinegar to meat in cooking, you can always make it tender. When we come to treat of steak, I shall explain that. After the vinegar has been used, season the meat palatably with salt and pepper, cover it, and let it cook very gently for at least an hour, or until it is tender. To the stew add any vegetable you wish, or cook it perfectly plain, having only the meat and the gravy. To-day I am going to use carrots with it. For three pounds of beef use carrots enough to fill a pint bowl after they are cut in little slices, or in little quarters. Of course, if you add vegetables of any kind, carrots, turnips, or potatoes, you want to put them in long enough before the meat is done to insure their being perfectly cooked. For instance, carrots take from one to two hours to cook; I shall put the carrots in directly I make the gravy. Turnips, if they are fresh, will cook in about half an hour. Potatoes will cook in twenty minutes; small onions will cook in from half to three-quarters of an hour. The meat usually needs to cook about two hours. The meat being brown, I shall put in a tablespoonful of flour, stirring it, and then send it down to you so that you can see what it is like. The question naturally would arise about the color of this stew, throwing in raw flour, the white, uncooked flour. You can see for yourselves what the effect is.

Question. Does cold meat cook as long as raw?

MISS CORSON. If you use cold meat brown it just in the same way, just exactly as we browned this, first in drippings or butter and then putting in the flour; only if you use meat which already has been cooked, it will not take it so long to cook as it does this raw meat.

For a *white stew*, use any kind of white meat—veal, pork, poultry, or lamb. To-day I shall use veal. To go back to the question which was debated this morning about washing meat: first, wipe the meat all over with a wet towel. It is important to have the towel clean. Wet the towel in cold water and wipe the meat, then cut it in little pieces about two inches square. The butcher will crack all the bones, and if you wish he will cut the meat for you. At least he will crack the bones so that the meat can be easily cut in pieces about two inches square. Put it over the fire; suppose you have three pounds of meat; put it in cold water enough to cover it. Let it slowly boil; when it boils, add about a tablespoonful of salt and a dozen grains of peppercorns, or a small red pepper, or if you have not either of those seasonings, about half a saltspoonful of ordinary pepper; and let the meat boil slowly until it is tender. That will be in from an hour to two hours, according to the tenderness of the meat in the beginning. When the meat is tender lay a clean towel in a colander, set over a bowl or an earthen jar, and pour the meat and broth directly into the colander. Let the broth run through the towel. If the meat has any particles of scum on it, wipe the pieces with a wet towel to remove the scum. You can, in making the stew, remove the scum as you would from clear soup, but in that case you have not quite so richly flavored a stew. The better way is to wipe off the little particles after you have taken up the meat. Now you have the meat cooked quite tender and the broth strained. Then you make the sauce. Any of the ladies who were at the lesson this morning and saw the white sauce made, will understand the principle upon which the sauce is made for the stew. Put a heaping tablespoonful of butter and a heaping tablespoonful of flour into a saucepan for the quantity of broth which you would be likely to have from about three pounds of meat; that would be broth enough to cover it. Stir the butter and flour until they are smoothly mixed; then begin to add the meat broth gradually until you have used enough of the broth to make the sauce like thick cream. If you find that you have not enough broth from the meat, add a little hot water, to make the sauce or gravy like thick cream; then put the meat into it. Season it palatably with salt and pepper, remembering that you already have some seasoning in it. Stir the meat in the saucepan over the fire until it is hot, and then serve it. That gives you a plain white stew of meat. You can transform that into a dish called in French cookery books *blanquette*, or white stew of meat, by adding to it just before you take it off the fire a tablespoonful of chopped parsley and the yolk of one egg. You will add the egg by separating the yolk from the white, putting the yolk in a cup with two or three tablespoonfuls of gravy from the meat and mix it well; then turn it all among the meat, stir it and dish it at once. Don't let the stew go back on the fire after you put in the yolk of egg; it may curdle the egg if the sauce or the stew boils after the egg is added. So you see you have a plain white stew, or a stew with the addition of chopped parsley, or chopped parsley and the yolk of an egg. Do not use the white of the egg.

Question. Why is not the fat meat as good as the lean?

MISS CORSON. Do you mean why is it not as nutritious? Lean meat nourishes muscle and flesh. Fat meat affords heat to the system. That is the reason why we naturally crave more fat meat in cold weather. It is not so strengthening; it is heating and in that nutritious. A great deal of its substance, of course, is wasted in the cooking. That is another reason why, weight for weight, fat meat is not so nutritious as lean.

Question. In making this stew brown or white do you use bones?

MISS CORSON. You can use bones. In making the soup today I used cooked lean meat that was on hand over from the soup this morning. You can use the breast of any kind of brown meat; you can use the ends of the ribs of roast beef; you remember the rather fat ends of the ribs of roast beef? After cooking the beef have these cut up in small pieces; after you have cooked them in the stew if there is any excess of fat, as there probably will be, skim that off and put it by to add to any brown stew or gravy; the fat replaces drippings in that case. That is a very good way to use ends of ribs of beef. Cold beefsteak makes a nice brown stew, treated in this same way.

Question. Do you skim the stew?

MISS CORSON. No. Not unless you are going to make a perfectly clear soup need you ever skim; because, as I explained this morning, the scum which rises on the surface in boiling meat is not dirt, it is albumen and blood, with the same nutritious properties as the meat itself, and you do not want to remove them. If the water boils away in cooking soups and stews always add a little more; it will save time if you add boiling water, unless as in the case of peas, you add cold water for the purpose of softening them. You will find, if you are trying to cook dried beans, that it will be well to add cold water, and boil them gradually.

Question. In cooking beans isn't it a good way to let the beans come to a boil and then pour off the water and put on more cold?

MISS CORSON. That is simply a question of taste. It is not necessary to do it. If you pour away the first water in which they come to a boil, you pour away a certain amount of their nourishment, which already has escaped in the water. Some people say that they like to pour away that first water, because it carries off the strong taste of the beans. That is a question for any one to settle individually. The water would not have the strong taste of the beans if there were not some of the nourishment of the beans in it. While we are on the subject of beans I might tell you a good way to cook beans plainly, a favorite way in the south of France, the beans to be served with roast mutton. Cook them in just water enough to cover them, after having first washed them, adding only water enough to keep them covered all the time. They are dried white beans. Then at the last, when the beans are tender, leave off the cover of the sauce pan and let the beans cook, so that nearly all the water is evaporated, and the beans have about them simply water enough to form a very thick sauce, just enough to moisten them. Then they are seasoned with salt and pepper. In that way they are served as stewed beans, with roast mutton or roast lamb.

In regard to the lentils that I was talking to you about, I think you may be able to learn something more about them from Prof. Porter. He probably would know. You long ago have made their acquaintance in the form of the *tares* that the enemy sowed among the wheat. Lentils are really a species of tare or vetch. If you do not know about them — if they are not known in the market — it really would be worth while to make some inquiry which would lead to the introduction of them; but very likely if there are German people here, as I suppose there are,— there are always German people in every thriving city,— they will already have had them for sale in their special groceries; you can get them in that way, and they make a very good winter vegetable to use alternately with others. You cook them either by soaking them over night, or boil them just as we boiled the peas, until they are tender, and then drain them, and either heat them, with a little salt and pepper and butter, after they are drained, or fry them. They are exceedingly nice fried with a little chopped onion or parsley. If you have a pint bowl full of lentils, use a tablespoonful of chopped parsley, a tablespoonful of onion, very finely chopped; put the onion in the frying pan with a tablespoonful of butter or drippings, and let it brown; then put in the lentils and chopped parsley, a little salt and pepper, stir them till you have them hot, and serve them. They are exceedingly good.

PROF. PORTER. I may say that the first cousin of the lentils is well known among our Minnesota farmers in our wheat fields, and they are such an intolerable pest that we prefer paying the duties on the German article and importing them.

PEA SOUP—*Continued.*

(The pea soup being now about ready to take up, Miss Corson continued:)

You know how the flour of the peas settles to the bottom of the soup tureen or plate, and leaves the top clear? Prevent that by adding to the soup, just before it is dished, a little paste made of flour and butter. For four quarts of soup a tablespoonful of flour and a tablespoonful of butter; mix the flour and butter to a smooth paste just before the soup is done. After the peas are soft pour them into a fine sieve and rub them through the sieve with a potato masher; just a stout wire sieve. After you have rubbed them through the sieve put them back into the soup kettle with the soup, and mix the flour and butter in with them over the fire; stir them until they come to a boil, then season palatably with salt and pepper, and the soup is ready to serve. Remember this is a perfectly plain soup I am making to-day, without the addition of meat of any kind; but of course you will vary the flavor of the soup by adding the bones of ham or other meat, or a very little fried onion. Now, you can count for yourselves how cheap a soup that is.

Question. Can you give us your experience with regard to pea meal for soup?

MISS CORSON. I have used one form that has been put on the New York market. It was made of dried green peas. I do not know whether there is on this market a meal made of the yellow peas. There is a German preparation which is admirable. In New York it is for sale at the German stores; but the meal of which I speak, the meal made of dried green peas, was not at all satisfactory to me. Of course the meal of the green peas has not the flavor of the split peas. You will find in rubbing the peas through the sieve that if you moisten them a little once in a while they will go through more readily.

I have left the brown stew with all the fat on. It is a question not only of taste but of economy whether you leave on the fat in addition to the first butter in which you browned the meat, a question of economy and nourishment. If the people you are cooking for have good strong digestions you do not need to remove the fat. The bread or potatoes which are eaten with the stew will absorb it and will render it perfectly digestible; and, of course, as I have already told you, the fat serves certain purposes in nutrition. If you are cooking for people having weak digestions then you would take the fat off the stew. The white stew I am going to finish plain, without any parsley or egg—simply seasoned with salt and pepper.

LECTURE THIRD.

Our lesson this morning is the clarifying of soup, or the soup stock that we made yesterday; caramel for coloring soup, gravy and sauces; baked whitefish, after a very nice Western fashion; beefsteak, broiled and fried; and baked apple dumplings.

The first thing I prepare will be the whitefish, after a method which I learned from one of my Cleveland friends, who, by the way, is one of the nicest cooks I know of. I shall use only a little butter, and tell you about the wine which the recipe calls for. When the fish is prepared especially for gentlemen, wine is considered exceedingly nice, but that, as in all other cookery, is a matter of choice. We to-day will use some butter, pepper and salt. I will tell you the kind of wine, and the quantity that is used, when I come to cook the fish. In the winter, of course, all the fish is frozen. We were speaking of that yesterday, how to prepare frozen fish. In the first place, thaw it in plenty of cold water. Put it in a large pan of cold water and let it stay till it is perfectly thawed. Then cut it from the bone and take off the skin. Now, please write down the directions, and then watch and see how I do it. The fish simply has been scaled; to cut it from the bone, make one cut down to the bone through the middle of the side of the fish, lengthwise; having made that line, cut round under the head, to the bone; now lay the knife against the bone of the fish, and turn it until you have the blade cutting against the bone, holding the knife flat; it will take that entire piece of the fish off; cut two pieces from one side of the fish. Now I am going to cut from the other side in the same way, and then I shall take the skin off. First take the four pieces of fish off the bone; you will not find this at all difficult to do, ladies; after you have done it once or twice it will be very easy, and if you have fish that has not been frozen it will be much more easy to do than if you have frozen fish, which, of course, will break a little. It is not possible to keep the pieces entire, cutting from a frozen fish. One of the ladies asks if this can be done as well if the fish has been dressed by the fishmonger; that is, if the entrails have been taken out. Yes, quite as well. This is not dressed simply because it had been sent from market without being dressed. I did not take the trouble to have it dressed here, as I am not going to use the bone of the fish. After I have finished giving you the direction for taking off the skin, I am going to tell you how you could use the bone of the fish. To cut the skin off the fish, lay the pieces of fish skin down on the board; then, holding the knife down straight, cut through the fish until you feel the skin under the knife; as soon as you feel the skin under the knife, flatten the knife out so that it lies against the skin; cut away from you, holding the knife perfectly level, leaving the skin between the board and the knife. Hold the piece of fish in your fingers; lay it flat on the board, skin down, keeping hold of the skin all the time. That takes the skin off, and none of the fish; there is no waste there, and it certainly is very much easier to eat fish in this shape than it is if you have the skin and bone on it. Now, I assure you, ladies, if you only hold the knife flat, you will have no trouble whatever in taking the skin off. If you slant it you will cut through the skin of the fish, but if you hold it perfectly flat you will have no trouble. Of course, with certain kinds of fish there are bones that run transversely from the spine out through the sides of the fish. You do not take these bones out by this operation, but you take out the large back bone. It comes out every time, and I assure you it is a very easy operation.

After you have taken all the skin and bones from the fish, then, for this special dish, cut it in small slices three inches long and a couple of inches wide. Use two soup plates, or two dishes of the same size, deep dishes that you can send to the table. Butter them very thickly, both of them. Lay the fish in one of the dishes, season the layers with salt and pepper, and put a very little butter between each layer, and plenty of butter on the top. Turn the second plate over the first one, upside down on it. Put the dishes with the fish between them into the oven to bake for about twenty minutes, or until the fish flakes. You can tell about that by opening the oven at the end of twenty minutes, and lifting off the top plate; then you can see whether the fish is done or not. Now, in the recipe of which I spoke to you first, the addition of Sauterne wine is made. After the fish is put into the dish, being seasoned as I have told you, using less butter than you would without the wine, with half as much butter on the layers, pour on Sauterne wine,—that is a light, rather acid wine,—just enough to moisten the fish. In placing the fish into the dish it does not make any difference which side you put down. You simply want to put the pieces nicely together so that when you come to help them you can lift each piece out with a spoon. There is no acid that will take the place of the wine and give the same taste. The fish is very nice cooked simply with the butter, pepper and salt. You do not need the wine to make a nice dish, only wine is used by the lady of whom I speak. That is her special preparation of the dish. The wine is put in after the fish is in the dish, just enough wine to moisten it. You will notice that often I will make dishes that have no wine in them; if I make dishes that require wine, I of course put it in, saying that you may use the wine or not, as you please. In this instance I use butter, pepper and salt because it makes a very nice dish, a very nice plain dish, but it is a distinct dish, entirely different to the dish cooked with wine; simply two ways of cooking fish, making two different dishes. For a fish of this size—which probably weighed nearly three pounds—you may use about a heaping tablespoonful of butter in all; that is, besides what you put on the plates. You will butter the plates, and distribute butter throughout the dish. The oven should be moderately hot, not hot enough to brown it—hot enough to heat the plates, which are very thick, and to cook the fish within twenty or twenty-five minutes.

If you wash the board on which the fish is cut, at once, in plenty of hot water, with soap and a little soda or borax all the odor of the fish will be removed. Don't let any of the utensils stand with the fish drying on them, because if you do it will be very much harder to destroy the odor. And, by the way, ladies, the odor of onions is another thing that troubles some persons. The odor of onions on boards, knives and dishes you can do away with entirely by using parsley. If you take a knife with which you have cut onions, and chop a little parsley with it, or draw the knife through the root of parsley two or three times, it entirely destroys the odor of the onion. So that you see you never need have any trouble in that way in the kitchen.

One of the ladies asks me how to prevent the odor of onions going through the house when you are cooking them. What makes onions, cabbage and turnips smell when you are cooking them is the escape of an exceedingly volatile oil which they all contain; in all of them it has the same characteristics; it does not begin to escape until they are tender. The oil does not begin to escape until the vegetables are tender; if you continue to boil them after that, it will escape. If you take up cabbage or turnips as soon as they are tender, that is, as soon as their substance begins to grow tender, you will notice there will be comparatively little odor; but if you keep on boiling them, according to the old-fashioned rules, for an hour, two hours, or three hours,—you know you sometimes boil cabbage all day long,—you will be sure to have a nice odor through the house. In cutting the onions, of course, if you bend over them, that same oil rising from them escapes as you cut into their substance, and will be sure to make you cry; but if you hold them a little away from you in peeling them, or under water, or if you stand where there is a draught blowing over your hands, it will blow that oil away. In eating onions at the table, if you will subsequently eat parsley dipped in vinegar, you will find that there will be very little odor of the onion remaining in the breath.

Now to return to our fish. After you have taken the flesh of the fish off the bone, you still would see a little of the fish remaining, even if you cut closely. Then draw the fish, and trim the bone; that is, cut off the head, and the fins, and the tail, and take out the entrails of the fish; then make a paste of dry mustard, salt, and a dust of Cayenne pepper. For a bone the size we have here, a long bone like that, use two heaping tablespoonfuls of mustard, a dust of Cayenne pepper and enough vinegar, or Worcestershire sauce, to moisten the mustard to make a paste, which is to be spread over the fishbone. Have the double wire gridiron very thickly buttered, put the bone into the gridiron, brown it quickly at a hot fire, and serve it simply as a relish. A sort of Barmecide feast, but I assure you it is very nice with bread or crackers and butter. It makes a very nice little relish. I might say, ladies, that you can treat any kind of bones in this way. Cold roast beef bones are exceedingly nice. Of course there will be more flesh on the beef bones than on the fish bones.

PLAIN PASTRY.

Use butter, or lard, or very finely chopped suet. If you can get good lard it makes nice pastry; by that I mean lard which has a very little water in it. A good deal of the lard that you buy in the stores has a large proportion of water in it, and I believe in these days it is apt to be sophisticated with several articles which are not exactly lard, so that home-made lard is decidedly the best; that which you try out yourself. First take the butter, or whatever shortening you use,—butter, lard, or suet,—and mix it with twice the quantity of flour. For instance, if you are going to use a pound of flour allow half a pound of shortening. Take half the shortening and mix it with the flour, using a knife. Then wet the mixed flour and butter with just enough cold water to form a paste which you can roll out. If you mix with a knife or spoon you avoid heating the pastry. After the flour and the first half of the shortening have been mixed to a paste roll it out, about half an inch thick, and put the rest of the shortening in flakes on it. One of the ladies asks about putting flour on the pastry board: Extra flour, of course, besides the quantity that you put in the pastry. The only object in washing the butter is to get out any buttermilk that there may be in it. After putting the butter—the second half of the butter—over the pastry in rather large pieces, put just a little flour over it, fold the pastry in such a way that the edge is turned up all round to inclose the butter; that is about an inch and a half all round. Fold the pastry together thin, and roll it out, and fold it several times. Remember that the oftener you fold it and roll it the more flakes you will have in the cooked pastry. Take care to use flour enough to keep it from sticking to the board or the roller. You will remember the pastry is not salted and unless the shortening has enough salt in it to salt the flour, you must add it. Good lard makes a more tender pastry than butter.

Question. Do you ever mix them?

MISS CORSON. Yes, you can mix them if you like, using part lard and part butter. To roll out the pastry, roll it in a rather long strip, that is, a strip about three times as long as it is wide. That enables you then to fold it and keep it in a nice shape. It does not make any difference whether you roll it from you or towards you. As many times as you roll and fold it you give it three additional layers. Now I might keep on rolling and folding indefinitely, and I simply should make the pastry have more layers than this has, but I think you thoroughly understand that, so that I will roll it out, and make our dumplings now. Only remember that the more times you roll it the more folds you make, the more layers you have in the pastry. Keep it as cool as possible all the time. If you roll and fold it three times remember that you have nine layers of butter and pastry. You can roll it out more than that if you want to. Puff paste, which is rolled and folded in this way, has what is called nine turns. Rolling and folding it three times makes a turn. The object of using marble or stone pastry slabs is to keep the pastry cool.

If you make more pastry than you want to use, wrap it in a floured towel and put it in a very cool place; then when you are ready to use it roll and fold it two or three times, and it will be very much better than when first made. I am going to roll up a strip of the pastry that I cut off the edge in such a way that you will see how the layers are formed, and you can pass it about. One of the ladies has asked me about heating the flour. It is not necessary to heat the flour for pastry, on the contrary, it would rather tend to spoil it. You want to keep it as cool as possible. But in the winter when you are going to make bread, if you heat the flour it facilitates the rising of the bread; there you need the heat.

BAKED APPLE DUMPLINGS.

For apple dumplings, after the pastry is made, cut it in pieces about four inches square and about a quarter of an inch thick. One of the ladies asks about sifting the flour. That is necessary, always. For apple dumplings, peel the apples and take out the cores, leaving the apples as whole as possible. The corer that I have here is nothing but a round tin cylinder. Use any apple corer that will take the core out without breaking the apple. For this purpose Greening apples are the nicest. These are table apples. Put an apple on each piece of pastry. In the core of the apple put as much sugar as it will hold, and a very small pinch of powdered cinnamon—about a quarter of a saltspoonful of powdered cinnamon, or any powdered spice you prefer. Then fold the corners of the square pieces of pastry up over the apple so that they will lap over on the top of the apple. Fasten the corners by moistening them a little with cold water. After the dumplings are all made, brush them over the top with water, or with melted butter, or with egg, beaten; the entire egg, or if you have the white or the yolk, you can beat that up; of course if you use just the yolk you make them a little yellower. If you use the yolk of an egg, beat it with a little water. Ladies are asking me about that little rolling pin. It is like that little knife, it is bewitched, but the magic consists simply in keeping the rolling pin perfectly smooth, and the knife sharp. That is made of hard wood, and is polished so that it is perfectly smooth, and of course I keep it so by not having it soaked in water. Instead of putting water and soap on to clean it, it simply will be wiped with a wet cloth, and then with a dry one. The thousand dents it has in it it has got by travel; it has been knocked around in my traveling trunk for the last five years. The dents did not get in it by using it. It may be made of any hard wood. One of the ladies asks me why I leave the corners of the dumpling open. I could pat the crust around and bring it right up close to the apple, but it would not be so light in the first place. The crust will hold together, it will not break apart in baking, and you leave the ends nice and light; and it makes a nicer-looking dumpling. The idea seems to be that if I should close up the corners the juice of the apples would stay in. It won't boil out much, anyway.

Now, ladies, I am going to take a little of the soup stock that we made yesterday out in a cup and pass it, so you can see what it looks like before it is clarified. That is the soup stock or broth that we made yesterday. You will remember where your recipe ended yesterday, about the soup stock being poured into a bowl and allowed to cool. That is the condition in which the stock is now. After a little, I am going to tell you about the clarifying of it, but now I want to finish telling you about dumplings, so you will have all your dumpling recipes in one place.

The question was asked, I believe, about the temperature of the oven. About the same as for the fish—a moderate oven, so you can put your hand in and count, say fifteen, quickly. It takes from half an hour to three-quarters to bake the dumplings. Be careful not to brown them. If the pastry seems to be browning before the apples get done,—and something will depend upon the kind of apples you use,—cover the pastry with a buttered paper. The object of the egg on the dumplings is to make them a little glossy. Use either butter, or egg, or water for brushing over the tops.

STEAMED APPLE DUMPLINGS.

For steamed dumplings usually a suet crust is used. You could use this crust if you wanted to, but it would not be sure to be light. It might possibly absorb a little of the steam. For suet crust you would use half a pound of suet chopped very fine, a teaspoonful of salt and a pound of flour. Mix carefully the flour and suet and salt with enough cold water to make a pastry just soft enough to roll out. Roll it out about a quarter of an inch thick, and then cut it in little squares; prepare the apples just as I prepare them for the baked dumpling; instead of folding the crust up and leaving the corners open, pat it with your hands so that you entirely inclose the apple. Just roll the pastry out once and then inclose the apples in it, and put the dumpling into the steamer; that is, an ordinary tin steamer; set over a pot of boiling water and steam the dumplings until they are done. You must decide that by running a trussing needle or knitting needle through the pastry into the apple. It may take an hour and a half to steam the dumplings; be sure they are done.

For another kind of pastry that has been described to me by enthusiastic gentlemen who used to have mothers, a kind of pastry "that melted in your mouth;" it is very easy to make that; not a flaky pastry, but a soft, exceedingly tender pastry that really crumbles. To do that you simply rub all of the shortening into the flour. Half a pound of shortening and a pound of flour; put the shortening into the flour with the salt; rub them with your hands till you have the shortening thoroughly mixed with the flour. It looks like meal; the ingredients must be thoroughly mixed, but not melted together; then use just enough cold water to make the pastry, and roll it out just once, and use it; be sure to keep it cool.

Question. Did you say an hour and a half for steamed dumpling?

MISS CORSON. It will take nearly that, but you must try them; try them at the end of an hour. For the dumpling you can use one of the sauces I told you of yesterday morning, white cream sauce, or you can use simply powdered sugar, or powdered sugar mixed with a little cinnamon. You can use a hard sauce, which is butter and sugar mixed together in equal quantities, with any flavoring you like.

FRIED BEEFSTEAK.

That is supposed to be the great abomination of American cooking, so that we are going now to see whether it can not be nearly as nicely fried as broiled. It seems a heresy, but it is true, and there are very many occasions where it is not possible to broil in an ordinary kitchen; the fire may not be good, or uncovering it may cool the oven. There is a very important secret in frying beefsteak, or chops, and that is to have the pan hot before you put the meat into it. It doesn't make any difference what kind of a pan you use. Use the ordinary iron frying pan, the old-fashioned spider, or dripping pan, if you wish to; but have the pan hot; have the pan hot enough to sear the outside of the meat directly it touches it; after the pan is hot put the beefsteak, or chops—because they are both cooked in the same way—into the hot pan. If the meat is entirely lean, if there is not a particle of fat on it, you may put not more than half a teaspoonful of butter in the pan; run it quickly over the bottom of the pan. But I never saw meat yet so lean, unless the fat was all trimmed off, that there was not fat enough to cook any chop or steak. The portion of fat you will usually find on meat is about one-third, unless you take the meat from the short loin; that is called the porterhouse, or tenderloin steak. In that case you have an excess of fat; there is more than one-third, reckoning in the kidney fat, or suet. You may cut away some of the fat, unless the butchers have cut it away. The butcher has already cut it away from this pieee, and, by the way, I notice that Minneapolis butchers cut a very long and thin steak. Now I would not advise the cooking, broiling or frying of that thin end. I would rather buy two steaks of that kind and cut off that and use it for stewing, because it would stew very nicely; broiled it will be rather tough.

As my frying pan is small I am going to cut the steak short. These steaks are cut too thin. A beefsteak to be nice should be over an inch thick—an inch and a half thick. You can easily economise on a thick steak by simply cutting it in halves, and using only as much of it as you want at once, because in almost any weather steak will keep at least over night. Have it too thick rather than too thin. Have it just the thickness you want and then cut it in two, using part only if you only need part of it. Trim off the outside skin, the tough skin; scrape the steak to make sure that there are no particles of bone on it. That bone, of course, comes in sawing the steak. Cut off the cartilage at the top of the steak, otherwise the steak may curl up. Have your pan hot enough to make it sear. Put the steak in and brown it quickly, first on one side and then on the other. In turning the steak run a knife or fork under it and lift it. Don't stick a fork into it, because by doing that you make little holes in the fibre of the steak and so let the juice escape.

Question. Will you pound your steak?

MISS CARSON. No, decidedly not; that lets out the juice. You make little holes in the steak if you stick a fork into it, and by pounding you let the juice out. Now, you want to keep all the juice in the steak, all the juice that you can; so that, in turning the steak simply lift it with a fork or knife and turn it over;

when it is brown on both sides push the frying pan back toward the back part of the fire, and finish cooking it until it is done to your taste. After it is brown on one side, turn it over; and then, after that, you can turn it once or twice; the frequent turning does not make any difference after you have got it browned on both sides and you can keep all the juice in. Turn it as soon as it is brown at first; have the hottest kind of a fire; get it brown on the under side as fast as you can; don't be afraid of burning it; then turn it over and brown it on the other side; after that you can turn it as often as you please. Some people like their steak rare, some medium rare, and some well done. To test steak, do not cut into it to see if it is done, but press your finger on it, on the substance of the steak. If you do that quickly you won't burn your finger. As long as the steak is very rare the fibre of the meat will be elastic, and directly you take your finger up the fibre will press up again; there will be no dent there. When it is medium rare just a little dent will remain from the pressure, because the fibre is less elastic. When it is well done you can press on it and make a little hollow that will stay there. Do not season the meat until after it is done; don't put salt on any meat before cooking; you draw out the juice by salting it.

Now for the seasoning of the steak. I have already said that to apply salt to the cut fibre of meat will be sure to draw out the juice, so that you do not want to season a steak until it is done. When it is done season it with salt, pepper and butter. The quantities you use depend upon the taste. That rule applies whether steak is broiled or fried. On that plate you will see the drippings, all that was in the frying pan. There is no juice of the meat there; it is simply browned fat. Whatever juice there was in the meat is still there. Broiled steak is cooked on precisely the same principle. It is to be put just as near the fire as you can get it. After the broiled steak is browned on one side and then on the other, just as fast as you can brown it; don't be afraid of burning it; you need to watch it; then move it away from the fire, and let it cook as much as you like. Test it in the same way I told you to test fried steak. When it is done put it on a hot dish; put butter, pepper and salt on it, and serve it hot.

Question. What do you do when the fat drops in the fire and blazes?

MISS CARSON. Of course it will do that, but that will help brown the steak. If it is possible to broil under the fire it is very much nicer. Sometimes the front of the stove is so arranged that you can let it down and run the gridiron under it; before you begin to broil over the fire you can get the top of the fire very red and clear by throwing a little salt upon it; that will help to destroy the odor. If the meat is frozen you should put it in cold water to thaw before cooking it; you can not avoid in that case washing the meat. To return to the matter of pounding steak: If you pound or break the fibre of meat in any way you let the juice escape; that makes the meat dry.

Question. What do you say to the notion that so many have, that pounding the meat makes it tender?

MISS CORSON. You do nothing but break the fibre and save yourself the trouble of chewing the steak. To encourage laziness it is a very good idea. But remember, if you drive the juice out of the steak by pounding you destroy its nutriment. You need the juice in the steak. Now, there is a remedy for the toughness of steak, which I can give you, depending upon whether you like salad oil. If you do not, you ought to learn to, because it is one of the most nutritious and purest of the fats when it is perfectly good. Good sweet salad oil is preferable to any animal or vegetable fat for purposes of nutriment. There is no reason why you should not use salad oil on the score of health. A great many people object to it; they do not like the idea; they think it is rather foreign, and to some people it is distasteful, but they have very strong memories of childhood and another kind of oil. You know even that kind of oil in these days does not taste badly. Olive oil, the peanut oil, or lard oil, when they are fresh and sweet, are very desirable. To soften the fibre of the meat with vinegar and salad oil put on the platter about three tablespoonfuls of salad oil, and half a teacupful of vinegar and a pinch of pepper; no salt. Put these on the platter; then lay the raw steak on the platter, and let it stand at least an hour; then turn it over and let it stand another hour. The longer you can let it stand, if it is in the daytime, turning it over every hour, the tenderer you will make it. The vinegar makes the fibre of the meat tender, and the oil keeps it so. That is, the vinegar softens the fibre of the meat and the oil keeps it soft. If you want to prepare it for over night put it in the oil and vinegar about 6 o'clock, about supper time, and let it stand till bed time, then turn it over, and let it stand till morning. When you come to cook the steak do not wipe the oil and vinegar off; simply let what will run off, and then lay the meat on the gridiron and broil it, or fry it; there will be no taste perceptible if the oil is good.

CARAMEL FOR COLORING SOUP.

A heaping tablespoonful of common brown sugar if you have it; if not, use any kind of sugar; put it in the frying pan and stir it until it is dark brown; that is, until it is on the point of burning; see that it browns evenly. Then put in a tablespoonful of water, either hot or cold—it does not make any difference; stir that until it is mixed with the sugar; then another tablespoonful, until you have used about half a cupful of water. If you should pour the water all in at once the sugar would simply boil over and burn you. Use about half a cupfull of water, adding it gradually, and stirring until the burnt sugar is dissolved. That gives you the caramel. Now, while I am making the caramel, I will describe to you the clarifying of the soup.

CLARIFYING SOUP.

To clarify soup stock: For each quart use the white and shell of one egg and one tablespoonful of cold water. Put the white and shell of the egg and the cold water into the bottom of the saucepan, and mix them together. Then put in the soup stock. Set the saucepan over the fire and let it boil gradually, stirring it every minute to mix the egg thoroughly so that it will not cake on the bottom of the pan before it begins to boil. When you have the stock made quite hot, when it begins to boil, then you do not need to stir it; but let it boil until the egg rises to the surface in the form of a thick, white scum, and the soup underneath looks perfectly clear, like sherry wine. Then strain it. When the egg is thick and white, as you see this, and the soup is clear underneath, set a colander in an earthen bowl, put a folded towel, doubled, in it, pour the soup into the bowl, and let it run through the colander without squeezing the towel. You see that is a repetition of the direction I gave you for straining the soup in the first place. The egg is in the towel. Now, I am going to put some of the soup into a goblet before coloring it, so that you can see the natural color. A light straw-color is the proper color for clear soup. You will very often find clear soup served to you, even at nice hotels, much darker than that; as dark as what I am going to make now, which is the proper color for the luncheon soups called *bouillon.* The coloring is a matter of taste. The clear soup, or *consomme*, is to be served plain like that, or with the addition of any macaroni paste, or poached eggs, and then it takes its name from the additional ingredient which goes into the clear soup. Julienne soup is served with strips of vegetables in it, as I may tell you in some subsequent lesson.

LECTURE FOURTH.

SLICED APPLE PIE.

Half a pound of shortening to a pound of flour, the shortening to be rubbed into the flour with the hands until it is so thoroughly mixed that it seems like meal, but not at all melted or softened; then just enough cold water to make a pastry which will roll out. Roll out the pastry and use it at once to line the pie plates. Fill the plates with sliced apples, or with any fruit or mince meat. To-day I shall use sliced apples. Sprinkle flour over the pastry, and then roll it out and line the plates; wet the lower crust to make the upper crust stick to it. Cut two or three little slits in the upper crust. Take care not to press the outer edges of the crust together. After the upper crust has been put on the pie brush it with beaten egg, if you wish it to be glossy when it is done. Then put it in a moderate oven and bake it for three-quarters of an hour, until you are very sure that the apple is done. You can tell that by trying the apple through the little cuts that you make in the pastry. This morning, in making pastry, you remember that we rolled and folded it a number of times. I simply roll this out once, just enough to get it thin enough to use for my pie. First roll out the pastry, and cut off the cover for the top of the pie. Lay it one side, and then roll out the rest and use it for the pie, as I have already directed. Use Greening apples if you can get them. These are table apples. They are not so good for pies for two or three reasons. They will not keep their form when they are baked in the pie, and they may not be perfectly tender. These will break and grow very soft as soon as they begin to cook.

I might, while I am making our pie, say a little about flour for general use in the family. As a rule I use what is called pastry flour, best for pie crusts. Pastry flour has more starch in it than ordinary family flour, or bread flour. The starch is the interior of the grain. The family flour is the grain ground entire, only the husk being removed. From grain ground in that way none of the nutritious elements are removed. You get a greater proportion of gluten, and some of the mineral elements of the grain that lie close to the husk; the flour that has an excess of gluten in it will absorb more water than pastry flour, or flour composed chiefly of starch, and it will make a tougher dough, either in the form of pie crust or bread than a flour which has the most starch in it. It is more nutritious than starchy flour, so that if you want tender, rather white pastry and bread, you must make up your minds to sacrifice some of the nutritious elements of the flour. All through the West the flour which is marketed is made, I think, from the entire wheat, and that is more thoroughly good, and more nutritious, than the so-called choice pastry flour. In the West you have a better flour than we at the East do, if we depend upon the Eastern mills. There are some very good brands of flour made in New York State, but as a rule they are not so full of gluten and not so nutritious as the Western flours. Where flour is made from winter wheat, which lies in the ground all winter long and gathers more of the mineral elements of the soil than spring wheat does, the flour is superior.

The pie is now heaped full of sliced apples by using about half a dozen rather small apples. I suppose you think this is a rather extravagant way to make a pie, but you do not need to put so many apples in unless you want to; we want a nice thick pie. This is cinnamon that I am using for flavoring. Put two heaping tablespoonfuls of sugar on top of the apples in the pie. Finally brush the top of the pie, either with beaten egg or with a little sugar and water dissolved, and put it into the oven to bake.

BREAD MAKING.

Now take your recipe for bread making. Use the compressed yeast which you buy at the grocery store. For two small loaves of bread or a large pan of biscuit use a whole cake of yeast. Dissolve the yeast in lukewarm water, a cupful of lukewarm water. Then add enough flour to form a thick batter; that will be about a cupful of flour; a thick batter which will cling to the mixing spoon when you lift the spoon and let a drop fall on the surface. Cover the bowl with a towel folded several times, or a thick cloth, so that all the heat can be retained. Then set the bowl somewhere near the fire, in a place not too hot to bear your hand, and let it stand for about half an hour, or until the batter is light and foamy. Keep the bowl covered all the time, and take care that you do not have it in too hot a place. Don't have it in a place where you can not bear your hand. After the sponge — as the batter is called — is light and foaming, mix in another cupful of lukewarm water in which a teaspoonful of salt is dissolved. After the second cupful of lukewarm water with the teaspoonful of salt dissolved in it, add enough flour to form a dough stiff enough to knead with the hands. Knead the dough on the board for just five minutes. Some good housekeepers would declare that just five minutes' kneading is flying in the face of Providence in the way of bread making, but I assure you it is enough. That is, it is enough to give you bread of a firm, fine grain, perfectly even in its consistency. It won't be full of large, uneven holes; it will be firm, fine bread. After you have kneaded the bread five minutes make it up in a little loaf, or two loaves, as you like; put them in small iron pans, buttered — black iron bread pans — and set them again by the fire, where you can bear your hand, and let the little loaves of dough rise until they are just twice as large as when you put them down. That generally will take about half an hour if the yeast is good. Brush the loaves over the top with a little melted butter, or with a teaspoonful of sugar dissolved in water. Put them in the oven and bake them. The bread is to be baked until you can run a sharp knife or trussing needle in through the thickest part of the loaf without the bread sticking in any way. If the needle or knife comes out clean and bright the bread is done. It may take from half an hour to an hour to bake the bread. In the stove that I used the first morning over in the other building I have baked a loaf of bread, the size of those I am going to show you, in eleven minutes. I had not realized that bread could be baked thoroughly in so short a time, but one day in Northampton, Mass., one of my class timed the baking of the bread. A loaf of bread of that size was baked in eleven minutes. This same bread dough you can make up in the form of little rolls. I will make part of it up in rolls. Of course you will understand that the smaller the piece of dough the more rapidly it will rise the second time, and the quicker you will be enabled to bake it. So if you are in a hurry, and want bread baked quickly, you will make it in the form of little rolls; when I make the rolls I will describe the process.

Question. Should bread be baked a long or a short time?

MISS CORSON. The sooner it can be baked the better. There is no special object to be gained in the baking of bread except to thoroughly cook the dough. It can not affect the nutriment of the flour very much whether it takes a longer or a shorter time. The nutriment of the flour might be slightly wasted if it took a very long time. There is no objection to baking bread as quickly as it can be done.

Now before I begin to make the pudding I will answer a question that has been asked about the best yeast and the quick rising of bread. The object of raising bread is simply to make it digestible by separating the mass of the dough. If it is firm and solid, that is, if the bread is heavy, it can not be easily penetrated by the gastric juice, and consequently is indigestible. So that the most healthy bread is that which is sufficiently light and porous to allow the gastric juice to penetrate it easily. Only a mechanical operation is required to make the bread light. Now that process which will most quickly make the bread dough light is the most desirable. The longer you take to raise bread, the more slowly you raise, the more of the nutriment of the flour you destroy by the process of fermentation that lightens the bread. The yeast combining with water at a certain temperature causes fermentation, and from that fermentation carbolic acid gas is evolved, which forces its way up through the dough and fills it with little bubbles,—in other words, makes it light. Now the more quickly you can accomplish that fermentation, or rather lightening of the dough by the formation of little air cells, the more you will preserve the nutriment of the flour.

The idea prevails to some extent that if ladies use as much yeast as I have to-day the bread will taste of the yeast. It will not if the yeast is fresh. If the yeast is old or sour it will taste. But you can use as much as I have shown you and not have the bread taste after it is done. You see my object in using a great deal of yeast, proportionately, is to accomplish the lightening of the dough in a very short time. The best bread that ever was made or that ever was put on the market was raised mechanically, without the action of yeast; it was called aerated bread. It was bread dough lightened by a mechanical process. Carbonic acid gas was driven into the dough by machinery after the flour was mixed with salt water; and the bread made was very light and every particle of the nourishment preserved in that way.

Question. Do you ever put sugar in bread?

MISS CORSON. You can put in anything you like. You can put sugar, or milk, or anything you like in the bread to vary it. I will use nothing to-day but yeast, flour, water, and salt. This is perfectly plain, wholesome bread. You put milk in bread and it makes it dry quicker. Vienna bread, which is made partly of milk, dries more quickly than any other bread that is made. You can make any variation you like from the recipe I have given you. I have given you a perfectly plain home-made bread.

Question. Do you ever scald the flour for bread?

MISS CORSON. You can scald the flour if you wish, but you do not accomplish any special purpose by it. In the winter time, if you heat the flour before you mix it with yeast and warm water, you increase the rapidity with which the bread dough rises.

Question. How would you make brown bread — ordinary graham bread?

MISS CORSON. Use graham flour; mix your white flour with it, if it is for graham bread proper; if it is for graham gems use simply graham flour, water and salt, beaten together. Graham flour, salt and water beaten together into a form and baked in little buttered tins is the graham bread pure and simple of the Grahamites. It is not necessary to knead bread more than once to secure lightness. I have already said that the longer you prolong the process of bread making the more of the nourishment of the flour you destroy. You will see when the bread is baked to-day, if we are fortunate in our baking, that the bread is perfectly light and of even grain.

BREAD AND APPLE PUDDING.

Stale bread cut in slices or small pieces, fill a pudding dish of medium size, only three eggs, or if eggs are very dear, four tablespoonfuls of sugar, and a pint of milk, or enough more milk to saturate the bread. If the bread is very stale and dry you will have to use a pint and a half of milk. Three eggs, a pint of milk, four tablespoons of sugar, will make about a quart of liquid. The custard you pour over the bread; let the custard soak into the bread; then on the top of the pudding put a layer of fruit about an inch thick. You may vary the fruit, using sliced apples, or dried apples which have been soaked over night, and then stewed tender, dried peaches treated in the same way, or canned peaches, canned pears—any fruit you like. In the summer, in berry season, use berries. If the fruit is sour sprinkle it with sugar; then put the pudding in the oven and bake it. You can use dried fruit with this pudding, such as raisins or currants, but you put the fruit in through the pudding instead of on top. If you want to make the pudding particularly good you will separate the white and yolks of the eggs, mix the yolks of the eggs with the milk and sugar; save the whites until the pudding is done; in that case you have to use a little more milk proportionately. Save the whites until the pudding is done, then beat them to a stiff froth and add to it three heaping tablespoons of powdered sugar, very gently mixing them, just as I mixed that light omelette yesterday. That makes what is called a *meringue*. Put the *meringue* over the top of the pudding after it is done; run it through the oven for about a minute, just long enough to color it slightly, and then serve the pudding.

If you want the pudding entirely smooth when it is done, you must break the bread up in the custard before you bake it. My way is simply to saturate the bread with the custard. You can beat it if you wish. The pudding will be slightly liquid, like bread pudding, and then the fruit, if it is juicy, makes it still more liquid, and if you add the *meringue*, that of itself is a sauce. You will notice, as a rule, that I make everything as plain as possible, because I wish to demonstrate that plain dishes cooked with simple and few materials, can be very good. Perforated tin pie plates bake very nicely. Of course you want to take care to have the bottom crust thick enough, so that none of the juice from fruit pies will run through. If the oven is very hot on the bottom, it will not do to set a pie on the very bottom; a grating must be used. You will have to use your judgment about baking, watching the pie, and taking care that it does not get burnt.

(Returning to the bread making, Miss Corson continued:)

Now I am going to put the second cup of water and flour into the dough. You want to remember, in raising bread, to keep it always at the same temperature until you get it light. It should be set where you can put your hand without burning. Keep the bowl, containing the sponge, just warm. You don't want it anywhere where it will get so hot as to scald the sponge. You can set the bowl in winter over boiling water to keep the temperature equal.

(A question was asked in regard to rhubarb pie.)

MISS CORSON. Some ladies put the rhubarb raw into the pies when they make rhubarb pies, trusting to its cooking while the crust is baking; others stew it with sugar before they put it in the pies. When it comes in from the market it should be cut in little pieces about half an inch long, and the outside, or thin skin, stripped off. It requires a great deal of sugar, whether you put it into the pie uncooked, or you first cook it. It makes an exceedingly nice acid pie. Usually the best way is to stew it first before you put it in the pie. That gives it to you in the form of a pulp. If you put it raw into the pie, to a certain extent the form is perfect, that is, it retains its little block-like shape after it is cooked.

(The bread now being ready to knead, Miss Corson recurred to that subject.)

I will take for the dough three cups of flour, about three heaping cupfuls besides the first one. There was an old adage to the effect that some imaginary substance called "elbow grease" was necessary in kneading bread. I presume that is another name for force. But there is no special strength necessary. The bread is kneaded for the purpose of entangling a little more air in it, and you accomplish that by folding and refolding it, as I am doing; just using enough flour to keep it from sticking to your hands. In five minutes you will find that you have a rather smooth, soft dough, that does not stick to your hands. That is all you want. You will always find perfectly good yeast in any town, or you can make the yeast yourself.

Question. If you use twice as much flour would you use twice as much yeast?

MISS CORSON. If you want to raise the bread quickly you can increase the quantity of yeast in the same proportion that I have given it you here to-day, until you reach as much as six or seven pounds of flour, and then you would not need to use proportionately as much yeast. You could diminish the quantity a little. You see, the object of using plenty of yeast is to get the bread raised quickly.

Question. Doesn't home-made yeast make heartier bread than the other?

MISS CORSON. It makes bread less digestible—it may be heartier in that sense; the Irishman does not like his potatoes quite done; he thinks them heartier when they are somewhat indigestible. There could not be more nutritious or wholesome bread than this quickly raised bread. I have given you several very good reasons for raising bread as quickly as possible. Bread raised more slowly is not so nutritious, because some of the nutritive elements are destroyed in the fermentation which goes on in the slow process.

To make rolls, take small pieces of dough and make them round, and cut them nearly through the centre. Put the rolls in a buttered pan; cover them up with a cloth and let them rise double their original size, where you can bear your hand. Then bake them. Let the dough always rise until it is twice its size before baking. I think I have already explained to you that if you want the bread or roll glossy you can brush it with sugar and water, or melted butter. These rolls will be set on the top of the stove to rise, just like bread. As soon as they are twice their size they go into the oven to bake.

Question. Do you ever use any shortening in the rolls?

MISS CORSON. You can use it if you want to. Knead butter in the part of the dough that is designed for rolls — say a tablespoonful of butter; put it in when you are doing the five minutes' kneading. There is no reason why you should not knead in anything that your fancy calls for, providing it is edible.

Now I will show you how you can prevent the juice running out of fruit pies. For fruit pies — pies made in the summer time, of juicy fruits — better use no under crust. Take a deep dish; put the fruit into the dish, heaping it a little, just as I heaped the apples; wet the edges of the dish with cold water; lay the pastry on the dish and press it very slightly, *not on the edge itself*, because that makes the pastry heavy, but just inside of the edge. As I press it I leave the edge intact; press the pastry against the dish all the way round; then with your finger make a little groove all the way round your pie, inside the edge of the crust; then, with a little knife, cut holes in the groove. Now, when the juice of the fruit boils out, as it will, instead of forcing its way out of the edges, the crust will be held upon the wet dish, and the fruit juice will boil out in the little groove and stay there. To serve the pie, you cut the upper crust with a sharp knife, and serve with a spoon, taking a piece of crust and plenty of fruit out on each plate. No under crust is there. If you have an under crust with very juicy pie it will be pretty sure to be soggy and heavy. The English way of serving these pies is a very nice one, and is, as I have described, with whipped cream. Serve whipped cream with a fruit pie. Among other nice things that we can not get in this country is Devonshire cream, which is a cream almost as thick as the hard sauce you make by mixing powdered sugar and egg together; it is thick enough almost to cut. We can not get that cream here, but use thick, nice cream, sweetened or not, as you like. One of my English friends, who first taught me this way of serving pie, said that at her home they never sweetened the cream; they simply whipped it to a froth and served it piled up on a dish by the side of the pie. The pie was taken out on a plate, and then two or three spoonfuls of this whipped cream laid on the plate by the side of the pie. You can sweeten it if you like.

MERINGUE.

I will next make a *meringue.* I have already told you to use the whites of three eggs, three tablespoonfuls of powdered sugar — and that really must be pulverized very fine and sifted. In beating the eggs you can always get them light very quickly, if they are reasonably cold in the beginning, by beating with a change of movement. Beat until your hand grows tired, and then simply change the way you hold the beater. Don't stop beating. Of course you can use any kind of an egg-whip you like. This which I use is made of twisted wire. Only take care to have the egg beaten entirely stiff. Do not have any liquid egg in the bottom of the bowl. In the summer time you can cool the egg by putting in a little pinch of salt if it does not beat stiff at once. I would not advise using an egg that had the least odor about it. As soon as the custard in the pudding is done we are going to take the pudding out of the oven, and put the *meringue* on the top, whether the apples are done or not. It does not do any harm to stop beating for awhile. Mix this, using a cutting motion, not a stirring motion. Mix until the sugar and egg are smoothly blended, and the *meringue* is ready to use.

LECTURE FIFTH.

Our lesson this morning is cream of salmon; shoulder of lamb, boned and roasted; force meat or stuffing for roast meats; potatoes, boiled and baked; and cheese crusts. I shall begin with the lamb or mutton.

Remove the bone first, then stuff and bake the meat, as I have no facilities for roasting with this stove; but I will have something to say about the process of roasting in the course of the lesson. A great many of the ladies think that the shoulder or fore quarters of meat is not so desirable a piece for use as the loin or hind quarter, but that is a mistake. In the first place the proportion of bone in the fore quarter is very much less than in the hind quarter. In one lesson that I gave, about a week ago, at Cleveland, I had a butcher remove all the bones from a fore quarter weighing between five and six pounds, and then weighed the bones: They weighed a pound and a quarter. I also had him remove the bones from the hind quarters and weighed them, and they weighed more. The meat of the fore quarter is sweeter, and quite as nutritious as the meat of the hind quarter, and the fore quarter is always cheaper. So that, you see, on the score of flavor and economy, the fore quarter is more desirable for use than the hind quarter. In England, where mutton is always in perfection, it is the fore quarter or shoulder of mutton that is served to guests, and the hind quarter is the one that is used for the family dinner.

To make the dish which I am going to prepare this morning, I have had the whole quarter brought in so that I can show you how the shoulder should be cut off. Simply with a large piece of the outside skin attached. Usually the butcher might cut the shoulder square off close, but I want this large piece of skin for stuffing. There is a natural division between the shoulder and the ribs, so that the shoulder comes off with perfect ease. If you buy an entire fore quarter like that you will have the butcher cut off the shoulder for roasting or baking, then let him cut the neck in rather small pieces for stews or mutton broth. What is called the rack or ribs would be cut into chops for broiling or frying, and the breast would be cut off entire to be stewed or roasted or baked. A very nice way to prepare the breast is to have the bones all taken out, spread a layer of nice force meat or stuffing over it, roll it up, and tie it. Then it can be baked, or roasted, or stewed. Another nice way to cook the breast is to boil it until it is tender enough to enable you to pull the bones out without any difficulty; then take out all the bones, put it on a platter, set another platter on top of it with a heavy weight on the top platter, and press it until it is cold. Then cut it in rather small pieces, about two or three inches square, and bread and fry it. The process of breading and frying is accomplished in this way. You have cracker crumbs — cracker crumbs rolled and sifted — or bread crumbs, stale bread, dried in the oven and rolled and sifted, in a large dish. In another dish beat a couple of eggs until they are liquid. It does not need to be frothy, but simply to have the substance of the egg well broken; then dip the little pieces of boiled lamb, first in the cracker dust, then in the beaten egg, then again in the cracker dust. That is called breading. To fry properly, so that you have no grease, you want the frying kettle half full of fat. You don't want a little fat in a frying pan, but a frying kettle like that which you use in frying doughnuts. Put the kettle over the fire and let the fat get hot, that is, let it get so hot that it begins to smoke. When the fat begins to smoke you plunge whatever article you wish to fry into it. If you take the precaution to do that, have plenty of fat and let it get smoking hot and then fry in it, you will never have anything greasy. The action of the hot fat at once so carbonizes the surface of what you wish to fry, and prevents the soaking of the fat. Fry whatever article you are treating until it is a light brown, then take it out of the fat with a skimmer, and lay it on brown paper for a moment — coarse brown paper — and that will absorb the very little fat on the surface. It will be perfectly free from grease. You can season before you bread an article, or you can season the bread crumbs or cracker dust which you use in breading, just as you like. Or, after the article is fried you can season it with salt and pepper. Some things are seasoned after the frying — for instance, Saratoga potatoes — they are always salted after frying. You can make bread crumbs very fine by using a fine sieve and sifting. If you have cracker meal already prepared you will see that it is as fine as Indian meal; it is sold in the grocery stores and at the cracker factories, and it is cheaper to buy cracker dust or cracker meal than it is to make it at home, if you buy the whole crackers, because, of course the manufacturers can afford to use their broken crackers — they are all perfectly good—in making cracker meal and sell that very much cheaper than they can sell the whole crackers. The question of the digestibility of fried articles of food is very often raised. You understand that the hard fried surface is less digestible than any soft surface, and many fried articles are indigestible because of the quantity of grease they contain. If you fry in the way I have told you, you will not have that excess of grease.

To take the bone from the shoulder, first cut from the inside and take out the shoulder blade, cutting from the inside, avoiding as far as possible cutting through the skin on the outside. The butcher will always do this for you probably, if you tell him about what you want doue. First, the shoulder blade is taken out, then the bone which follows down along the leg. After the shoulder blade is taken out put it into a kettle of water, over the fire, and boil it for awhile until you can scrape all the meat off of it. You will have to use it in finishing the dish. After taking out the shoulder blade the cutting must all be done from the inside. There will be two or three places where you may possibly cut through the skin, where it is drawn very close over the bone, but cut as little as possible. When the meat is freshly killed before the skin is dried, you may not always cut through there, but where the skin is dried fast to the bone you will have to. This may seem a slight waste of time, but this dish is desirable for several reasons. In the first place, the bone being entirely taken out you can carve it without any waste whatever and with a great deal of erase. In the next place it gives you a very ornamental dish. In fact, I am going to show you how to make a duck out of it. And as I say, if you get the butcher to do it, it will not make any difference to you if it does take time.

Always in sewing meat or poultry, ladies, take very large stitches, not with fine thread. Use cord, so that you can see where the threads are when the meat is done. Any kind of a large needle will answer for sewing, large enough to carry your cord. Always leave long ends too.

To stuff the meat, season it nicely with pepper and salt and any herb that you are going to use in making stuffing. Sage, of course, would be very good with fat meat; put onion in the stuffing to make it imitate duck. For a force meat of bread, a teaspoonful of chopped onion; fry it in a tablespoonful of butter until it is light brown. While the onion is frying soak a cupful of stale bread in cold water until it is soft, then squeeze out the water. Put the soaked bread with the fried onion, add a teaspoonful of salt, a teaspoonful of any herb that you decide for seasoning, any dried sweet herb, half a saltspoonful of pepper, and stir all these ingredients over the fire until they are scalding hot. Use that force meat for stuffing any kind of meat or poultry. Of course there are a great many ways of making force meats; this is only one, and a very simple one. Another good stuffing for duck or for this dish, if you wish it more closely to imitate duck, would be to increase the quantity of onion—use much more onion, half a cupful of onion, or even more when you want to make onion stuffing. Another way is to use dry bread without cooking, a chopped onion, herbs, butter; some ladies like to put an egg in stuffing. There are a great many different methods of making it. Cold, chopped meat is very nice added to stuffing or dressing.

After the shoulder is stuffed thus, run a needle entirely round the edge in a large, over-hand stitch, so that you can draw it up like a purse; stitches at least an inch and a half long. That draws the edge up. Then take two or three stitches in such a way as to hold the stuffing in. Remember always to leave long ends in tying the cord used in sewing. Then curl the leg up like the neck of a duck and fasten with a cord. After it is prepared like that it is to be put into a pan in the oven, or before a hot fire, and browned quickly on the outside. It may be seasoned after it is browned. There will be a little drippings in the pan; baste it with the drippings; bake it or roast it, allowing, if you want it well done, about twenty minutes to the pound. A shoulder like that will weigh about two pounds and a half or three pounds. It will do in an hour's time in a pretty quick oven; in an hour and a half in a moderate one. Use no water in the baking pan, because water never can get as hot as the fat outside of the meat. The temperature of the hot fat is higher than the temperature of hot water, and the result of putting water around meat in a baking pan is to draw out the juice. The object is to keep all the juice in the meat. You will always find that there will be drippings enough from any ordinary cut of meat for the purpose of basting. If you have an absolutely lean piece of meat pour about a couple of tablespoonfuls of drippings, or butter, in the baking-pan, but no water, and use the drippings for basting. A nice gravy is very easily made from the drippings in the pan. I will tell you about that later. If the meat appears to be baking too quickly, if there is any danger of its burning, put a sheet of buttered paper over it.

Baste the meat every fifteen or twenty minutes. You can drench it with flour, just before basting, if you want to. That gives it a rough surface. The flour browns with the fat. If you are basting with water of course the flour would not brown so quickly. I think I have given you good reasons for not basting it with water.

CREAM OF SALMON.

A cupful of boiled salmon separated from the skin and bone and rubbed through a sieve with a potato masher, mixed with a quart of cream soup, gives you cream of salmon. Any of the ladies who have seen cream sauce made will understand the making of the cream soup. Put a slice of salmon that will make a cupful, over the fire in enough boiling water to cover it, with a heaping tablespoonful of salt, and boil it until the flakes separate. That will be perhaps ten minutes. Watch it a little. When the flakes separate drain it, take away the skin and bones and put it into a fine colander or stout wire sieve, and rub it through with a potato masher.

Question. Do you use canned salmon?

MISS CORSON. Yes, you can use canned salmon. That is already cooked, and you simply would rub it through the sieve. The fresh salmon is to be boiled in salted water. If you use canned salmon you do not need to boil it. After the salmon is rubbed through the sieve it is called *puree* or pulp of salmon.

Now to make a quart of cream soup: For each quart of soup put in the sauce pan a heaping tablespoonful of butter, a heaping tablespoonful of flour; put them over the fire and stir them until they are quite smooth. Then begin to add hot milk, half a cupful at a time, stirring each half cupful smoothly with the butter and flour before you add any more, till you have added a quart, or if milk is scarce a pint of milk and a pint of water. If you haven't any milk at all, a quart of water. That gives you a white soup, if you add simply water; if you add milk it is called cream soup. If you are very fortunate and have lots of cream, in place of some of the milk, use cream, and then you will have genuine cream soup. After the milk or water is all added, then season the soup palatably with salt and pepper—white pepper. I have told you about white pepper. It is to be had at all the grocery stores; it costs no more than black pepper and is very much nicer for any white soup or white sauce. Salt and pepper to taste, and a very little grated nutmeg; a quarter of a saltspoonful, a little pinch of grated nutmeg. After the soup is seasoned stir in the salmon. I have told you already how to prepare the salmon. Stir the soup constantly until it boils for a couple of minutes. By that time you will find that the salmon is stirred smoothly all through it. Then it will be ready to serve, and it is very good. You can use any other kind of fish in the same way, and your soup will take its name from the fish that you use. Halibut or codfish, trout or any fish. Only remember if you want the soup to be white you must use the white part of the fish. For instance, if you had a large dark fish you would want to take off the brown parts and use only the white parts. Otherwise the brown parts of the fish will color the soup. You can use cream soup as the basis for vegetable soups that are very nice. Prepare the vegetables in the same way; boil them, and rub them through a sieve with a potato masher. Then stir them into the cream soup. Use asparagus, celery, cucumbers, green peas, string beans, Jerusalem artichokes, —those little root artichokes,—any vegetable, in fact, varying the quantity of vegetable in this way. You will find that some vegetables will give a much more decided flavor than others. For instance, celery has a very strong flavor, and cucumbers have rather a decided flavor. You want to use enough vegetables to flavor the soup, if it is a white vegetable. If it is a vegetable that has a decided color like carrots, for instance, or beets,—by the way, beets make a delicious soup, and a very pretty one is made with spinach, —you want to use enough to color the soup. The beets, boiled so that all the color is preserved, and then rubbed through a sieve, make a very pretty soup. One of our New York pupils calls it a "pink velvet soup." Spinach makes a very nice green soup if it is properly boiled. We shall try to get some spinach for one of the lessons. We have *puree* of spinach on our list, and if we can get any spinach I will show you how to boil it so as to keep its color.

BOILED POTATOES.

The boiling of potatoes is a very simple operation, but there is a good deal of talking to be done in connection with it. It does not make any difference whether you use hot water or cold in boiling potatoes. What you want to watch is the stage at which you take the potatoes out of the water. That is what determines whether they are to be mealy or not. The cause of the potatoes being mealy is the rupture of the starch cells and the escape of the steam just at the right moment, just when the potatoes are tender; and if you leave them in the water after they are tender, then the membrane of the starch cells being broken permits the water to penetrate; even if the skins are not cut or broken, the moisture in the starch cells themselves will condense and make the potato heavy, so that you want to give the steam a chance to escape as soon as the potatoes are tender. If you will do that you are sure of mealy potatoes, provided the potatoes are ripe. Unripe potatoes, or new potatoes, or sprouted or frosted potatoes, you can not well make mealy, because the starch cells in the new potatoes are not fully matured, in the old sprouted potatoes they are disorganized, especially as the little sprouts take up the nutritive properties which enable them to grow. But if you use ripe potatoes, before they are beginning to sprout, and pour the water off of them when they are tender and allow the steam to escape, you will be sure to have the potatoes mealy, unless they are watery potatoes; the ordinary market potatoes will be sure to be mealy. Now you can insure the escape of the steam by draining the potatoes and covering them with a towel folded several times; that is, draining off all the water as soon as the potatoes are tender enough to enable you to run a fork through them. Do not wait until they begin to break apart, because by that time the starch cells are being broken up, and the water will have begun to penetrate to the interior of the potato.

After boiling the potatoes, either in cold or hot water, until they are tender, drain them and put a folded towel over them in the sauce pan. Set the sauce pan on the back part of the stove where the potatoes can not burn, or put it up on a brick on the back part of the stove. The potatoes may be peeled or not, as you choose; if you peel the potatoes in the most careful way, that is, cutting the thinnest possible skin off, you will waste at least an ounce in every pound. A very good way to peel potatoes is to take off just a little rim of the skin all around them and boil them; then if you want to peel them before they go to the table, it will be easy to strip off the two pieces of skin remaining. In order to save time I shall put the potatoes into boiling water enough to cover them, with a tablespoonful of salt. Take about a quart of water and a tablespoonful of salt. I have already said that as soon as the potatoes are tender enough to pierce with a fork, not when they are beginning to break, and they are drained, cover them with a cloth and keep them hot as long as you like. In about three or four minutes after they have been covered with the cloth they will begin to grow mealy, as the steam escapes; and you can keep them hot and mealy for three or four hours. It makes very little difference with potatoes, although with some kinds of vegetables it makes a decided difference, whether you boil them in hard or soft water. But as a rule soft water is best for boiling vegetables. You can always soften the water by putting a very little carbonate of soda in it, to counteract the extreme hardness of the water, which is caused by lime or mineral elements. The hardness of water slightly hardens the surface of vegetables, but it has an entirely different action on meats. It slightly hardens the surface — not enough to make the vegetable tough, by any means, but enough to retain all the juices and all the flavors. Do not have the potatoes tightly covered after they are cooked, because the steam will condense on the inside of the cover and fall back on the potatoes, thus making them watery. In serving potatoes on the table after they are cooked, do not put a cover on the dish; put a folded napkin over the potatoes. Do not put the dish cover on — it will have the same effect that it would have if you put the cover on the pot. The steam arising would condense, and fall back on the potatoes in the form of moisture, and make the potatoes watery.

In baking potatoes, the same general principles apply. That is, at the moment when the potatoes are tender — and that of course depends upon the oven in which you bake them — the starch cells are ruptured and the moisture is at the point of escaping if you give it vent by slightly breaking the potato, then the potatoes will keep mealy for a little while. But baked potatoes deteriorate every moment they stand after they are tender. You should serve baked potatoes just the moment they are done, if you want them to be perfect. If you wrap them up in a napkin it keeps in the steam. The longer they stand, the more of the hard skin forms on them, and if you let them stand for half an hour or more you find the skin sometimes a sixteenth of an inch thick. You can take a little slice off the end without breaking them, to permit the escape of the steam. But serve them just as quick as you can. In sending them to the table do not put the dish cover on them. Throw a napkin over them to keep the heat in. I have found that in baking potatoes that the hotter the oven the better the potatoes would be; that is, the more quickly they would be baked. I have been able to bake them sometimes in twenty minutes.

To soak potatoes in cold water restores a little of their moisture that may have been lost by the natural evaporation. For instance, late in the winter you will find potatoes slightly shriveled. That is caused by the escape of the moisture. If you had weighed them in the fall, and weighed them again at that time you would find they weighed less. To soak them for an hour or more before you cook them is to restore that wasted water and to increase the substance of the potato. There is very little nutriment lost in the waste of the moisture; it is only the bulk of the potato. You do not need to salt the water in which the potatoes are soaked. The only effect of salting water would be to make it colder. In soaking green vegetables it is well to salt the water, because if there are any insects in the vegetables they are killed by the action of the salt. In lettuce, or cabbage, or cauliflower, there are insects that hide away among the leaves, and salt kills them. In regard to the soaking of the green vegetables, of course, directly the insects are dead they naturally fall of their own weight from among the leaves. But if the leaves are closely packed, as sometimes they are in cabbage or lettuce; you want to hold the vegetable by the root and turn it up and with your hands separate the leaves without tearing; if lettuce is used, take care not to tear them; if cauliflower is being washed, take hold of the root and shake it well through the water, so that the motion will dislodge the little creatures.

CHEESE CRUSTS.

For cheese crusts use bread that is a day or two old, baker's bread or home-made bread; baker's bread is the best for toast of all kinds, and this is a sort of toast. Cut the bread in even slices, rather small, cutting off the crusts. There is no waste in doing that, for I have already told you how to use up pieces of stale bread by making them into crumbs. Grate some cheese so that you have a tablespoonful of cheese for each little slice of bread. On each of the little pieces of bread put a tablespoonful of the grated cheese, a very little dust of pepper and salt and a small piece of butter not larger than a white dried bean. Put the pieces of bread in a pan, set the pan in a rather quick oven, and just brown the cheese crusts. If the oven is in a good condition it will toast the bread and brown the cheese in about ten minutes, or even less; they are very good, those little chese crusts. You can use them either hot or cold. They are a very nice supper dish. They are very good with salad at dinner, with any green salad. Of course, if you serve them hot the cheese is a little more tender. Any kind of cheese will answer for making the crusts. I think that the ordinary American factory cheese is about as good as any other cheese. You do not want a rich expensive cheese for cheese crusts.

(At this point the stuffed shoulder of mutton was brought forth, done, the fan-shaped shoulder blade being stuck in to represent the tail of the duck, which the whole dish strongly resembled.)

GRAVY FOR MEAT.

There are about two tablespoonfuls of drippings in the pan. I am going to put a heaping tablespoonful of flour with it and stir until it is brown; then I am going to stir in gradually about a pint of boiling water, and season it with salt and pepper, and then I will send it down and show it to you. Make gravy in this way for any baked meat.

LECTURE SIXTH.

Our first dish this afternoon, ladies, will be roast chicken. The lesson will include fish and poultry. First, to choose a tender chicken, examine the tip end of the breastbone—the lower end of the breast bone, to see if it is soft; if it bends without breaking under pressure; in other words, if the cartilage has not hardened into bone, you may be sure that the chicken is young, and consequently probably tender. The market people have a favorite way of showing you that the chicken is tender by taking hold of the wing and giving the joint a twist. They say, "You see how tender it is!" But that is no test except of strength. But there is no ingenuity which can simulate that soft cartilage on the end of the breast bone. That is always a sure test. After choosing the chicken—of course now I am speaking of dressed chicken, or chickens that are killed—after choosing the chicken, have it carefully picked and singed; then, if it is undrawn, wipe it with a wet towel, and proceed to draw it carefully without breaking the intestines. If it is drawn already the chances are that it will be imperfectly drawn and you will have to wash it. There is the disadvantage of having poultry drawn before it goes to the market, because where people draw poultry in large quantities they are very apt to do it carelessly. In that case it is necessary to wash it, but if you draw it carefully yourself you will not have to do that. By washing, you of course take away the flavor, as I told you the other day, because you lose more or less of the blood.

Cut the skin of the back of the neck and take out the crop, then cut off the neck close to the body, that leaves the skin so that you can draw it up and fasten it back. If this chicken was not already cut for drawing I should cut it at one side under one of the legs, so that when I came to sew it up and dress it I could hide the cut. This chicken has been drawn carefully and does not seem to need washing. The liver and gizzard have been laid back inside. The entrails are all taken away. You can always tell by looking at the chicken whether the entrails are broken and whether it needs washing. After you have drawn the chicken very carefully separate the gall from the liver. The gall is that little greenish bag that lies on one side of the liver; and you want to cut it off without breaking, because if you break it it will make bitter everything that it touches. Save whatever fat there is about the entrails, and put it in the baking pan with the chicken. The gizzard has been cut open from one side and the inside bag which contains gravel and straw taken out. But a very much easier way to dress the gizzard instead of opening it, is to cut away the bluish skin which lies on the outside, on both sides, without opening the gizzard at all, and cut out that piece of flesh. That is the only valuable portion of the gizzard; if you dress the gizzard in this way when it is not already opened you save yourself a great deal of trouble, for it is a very hard matter to open a gizzard like that and take away the bag which contains the gravel, especially if the poultry has been frozen, as the bag is apt to break and let out the gravel. Use the gizzard and liver for making gravy, and the neck also. Cut out the oil sac or bag which lies at the back of the tail. Then the chicken is ready for stuffing. In cutting off the feet cut them below the joint, not just at the joint. If you cut them just at the joint the skin and flesh will draw up in cooking. But if you cut them just below the joint you will find that they do not draw up. After cutting off the feet scrape the skin all round to make sure that there are no bits of feather or anything of that sort, and wipe it with a wet towel and you have the chicken in readiness to stuff.

Stuff it with anyforce meat that you like. You remember this morning that we made force meat by chopping a teaspoonful of onion and frying it in a tablespoonful of butter, then putting in with the fried onion a cupful of stale bread soaked in cold water, seasoning with salt and pepper and sweet herbs. I said also that you could add chopped meat, cold meat or eggs, or to make any desired addition to the force meat in the way of seasoning. A little grated cheese in stuffing is very nice. You scarcely will realize what the seasoning is. I will use a little grated cheese this afternoon to make a force meat—very like what I made this morning, except in addition to the chopped onion fried in a tablespoonful of butter, seasoned with salt and pepper, I shall put in half a cupful of grated cheese. You may like to know my way of choping onion. In the first place, I make a lot of little cuts in one direction as far down as I think I shall need in order to get my teaspoonful; then I make little cuts in the other direction, and then by slicing it across you get your chopped onion. A very nice addition to force meat is chestnuts, either our ordinary American chestnut, or French or Italian chestnuts. These are quite large. I presume they are for sale at the fruit stores here. Our ordinary American chestnut is very good. Choose rather large chestnuts and either roast or boil them; take off the husks and skins and thus use them to stuff the chicken with, either simply using the chestnuts seasoned with salt, pepper and butter, or if you have boiled or roasted and skinned them, mix them with bread and seasoning. Then, after having prepared the force meat, you put it into the chicken, sew it up and truss it into shape. I will show you directly how to do that so as to keep the chicken plump, and so that it does not, in roasting, spread apart. I shall sew it with a trussing needle and a cord, or you might accomplish the same purpose, by using skewers, putting the skewers just where I put the cords. In sewing up a chicken after it is stuffed, remember what Isaid this morning; take large stitches with coarse cord so that you can easily see where to take the threads out when the chicken is done. After the chicken is trussed, if you are going to bake it, put it into a pan without any water, for the same reason that I gave you this morning. The water will soak it, half simmer it; you do not need water to keep it from burning, becausea little drippings will soon come from the chicken; brown it and then dredge it with flour, and baste it every fifteen minutes or so. Bake it until it is tender and nicely brown; the time of course depends upon the heat of the oven. Truss the chicken first, pushing the legs as far up as you can towards the breast, and run the trussing needle, which is simply a long needle, through so as to hold the legs fast. Then either bend the wings back in turning them, or simply fold them together and secure them with the same string. By drawing the string tight, you keep the bird plump; keep it drawn together, and when the bird is done all you have to do is to take these two ends of string in one hand, make one cut and pull the string out.

The liver, the gizzard, the heart, the neck and the feet, use in making gravy. Of course the gizzard, liver and heart are all right as they are now prepared. If you wish to add the feet, you will scald them and scrape off the skin. Then cut off the ends of the claws, and you have the feet perfectly clean; put them with the gizzard, liver and heart to boil as the basis of your gravy. The French people always save all the feet of all kinds of poultry. They prepare them in this way and put them into soups; sometimes they cook them till the bones grow gelatinous, till they are very soft and tender; they dress them with sauce and serve them as what they call an *entree* or side dish. They make a dish which is more delicate than pigs' feet. Of course in a large kitchen where a great deal of poultry is used it is possible to make a very good-sized dish of them.

FRICASSEED CHICKEN.

I shall use this chicken for fricassee; it has been singed, picked and wiped with a wet towel.

First, cut the skin down back of the neck, and cut off the neck. I shall talk about this chicken as if it was not drawn at all. Showing you how to cut it up and draw it at the same time. Cut off the neck and take out the crop, as I showed you with the other chicken. Then cut off the wings, taking a little of the breast with the wings. Find the joint where the wings join the body, cut at that joint; then, instead of cutting the wing right off short, take a little piece of the breast with it. That gives you a nice piece. Then cut the wing in two, and cut off the tip, which is dry; that you can cook in the fricassee, or not, as you please. It flavors, but there is very little meat on it. The other part of the wing you want, of course, to use. Put the pieces of chicken on two plates, putting the good pieces on one plate and the inferior pieces on the other. Having taken off the wing, take off what is called the wing side bone. Then cut forward and break off the shoulder bone. The idea is to cut the breast into several good-sized pieces. Cutting in this way you sacrifice what is called the merry-thought or wishbone. You either can cut off the side bone or not. Cut off the other wing in the same way. Then cut off the leg and second joint together. Instead of cutting the leg in two pieces at both joints, cut it in three pieces, that gives you two pieces of the second joint. In cooking chicken for fricassee you want to have the pieces about one size, so that they will cook easily. Then if they are one size they are much easier to help.

Next, to separate the breast from the back bone, cut down through the ribs on each side. If the chicken has not been drawn be careful with your knife, not to cut into the entrails. Then you can take the breast off, and if the chicken is not drawn, all the entrails will be exposed, and you can draw it with perfect ease. The lungs of the chicken, which are those light red organs on the side of the back bone, are always used by the French in cookery, not only those organs in chicken but in the larger carcasses of meat. They are quite as much food as the heart or liver. I am not in the habit of using them, but they are quite as available. After the breast has been taken off, cut it up in several pieces. First, cut off the entire tip, leaving that in one piece. Then cut the remainder in two or four pieces, according to its size. Next cut the back bone. There is a natural division in the upper part of the back bone that breaks there; cut that off and trim off the ribs. In cutting the lower part of the back bone, instead of cutting it just in two, making rather queer pieces to help, cut off the upper part of it leaving it entire, not splitting that part of it. In that way, cut off the portion called the "oysters,"—two little pieces of flesh in the upper part of the back bone, that are considered very nice. On one plate we have the inferior parts, on the other the nice parts of the chicken, being all cut in pieces of one size. It is easy to help, it cooks more evenly, and is rather nicer than if you had it in two or three sizes. Part of the chicken I am going to make into a brown fricassee, and part of it I am going to fry. There would be thirteen pieces if we counted the two pieces of the back bone. There are half a dozen of the poor pieces, not counting the wing pieces or neck. The question is asked whether the cords or sinews should be drawn from the legs. You can do that with old poultry if you want to, because those cords never get very tender. It is not necessary to do it with medium tender poultry.

First brown the chicken, using either some of the chicken fat, or butter, or salad oil for browning it. Now, since the question of using salad oil in cooking has come up, suppose I cook this chicken with salad oil so that you can taste it. After all, that is the best test you possibly can have as to whether you like salad oil in cooking. I shall put in just salad oil enough to cover the bottom of the sauce pan. That is enough to prevent sticking. For a chicken of three pounds take about three or four tablespoonfuls of salad oil; just enough to cover the bottom of the sauce pan. First put the sauce pan containing the salad oil over the fire and let it get hot; then put in the chicken and brown it. Now, can you notice the slightly aromatic odor? That is the oil, and directly you notice that odor, and the oil begins to smoke, it is hot enough. As soon as the chicken is brown,—and you can brown it just as fast as you want to,—then put a heaping tablespoonful of flour over it—some of the ladies will have seen the same process in making the brown stew of meat the other day—and stir the chicken until the flour is brown. When the flour is brown on the chicken,—and that will be by the time you get it well stirred up,—then add boiling water enough to cover it. When the flour is brown among the chicken, put in boiling water enough to cover it, season it with pepper and salt, palatably, and let it cook until it is tender. That will take from half an hour to two hours, according to the toughness of the chicken. Remember the more slowly you cook it after it once begins to cook, the nicer it will be. Cover up the sauce pan after the fricassee is seasoned, and cook it until it is tender. In the cooking of chicken the gravy that you make by putting boiling water on seems to boil away, and you may want to add a little more; just keep enough gravy over it to cover it, and when it is tender it is ready to serve. The odor you notice now is the aromatic odor of that salad oil, and is all that you will get in cooking with olive oil.

FRIED CHICKENS.

Next the fried chicken, Maryland style, will be prepared. We will fry the chicken, and then I will tell you about hominy. The Southern cooks use lard for frying, either lard entirely or half lard and half butter; enough to cover the bottom of the frying pan about half an inch. Let the fat get hot, put some flour on a plate, season it with salt and pepper, and roll the pieces of chicken in it. When the fat is hot in the pan and the chicken has been rolled in the flour, put it into the hot fat and fry it brown, first on one side and then on the other. Of course tender chicken is generally used for this dish so that by the time it is fried brown it is done. Fry the chicken until it is tender and brown. Take up the chicken when it is brown, put it on a hot dish; in the frying pan where it was fried, put enough cream to make a good gravy, stirring it constantly. You see there will be flour on the pan off the fried chicken that will thicken the gravy. Season the gravy with salt and pepper, pour it over the chicken and serve it. Some of the colored cooks whom I have seen prepare this dish first dip their chicken in water before rolling it in the butter and flour. That is for the purpose of making more flour stick to it; but there is always this disadvantage, if you do that there will be some particles of water remaining, and when you put it in the hot fat it will sputter very much. You can do that or not as you like. While the chicken is being browned I will tell you how to prepare the hominy. Of course the chicken is to be seasoned with more pepper and salt if you wish, in addition to what you put on in the first place with the flour.

HOMINY.

First pick the hominy over and wash it. Fine hominy is generally used for this dish. Put it over the fire in cold water, a cupful of hominy to about four cupfuls of water. Boil it and stir it often enough to prevent sticking, until it begins to be tender. Boil it for an hour, until it begins to grow tender. Then place it where there is no danger of burning, pour off the water, or leave off the cover of the sauce pan so that the water will evaporate. The hominy will need to cook pretty nearly an hour, and when it is done or nearly done it should be as thick as hasty pudding. If you have a double boileryou can put in very much less water, for there is no danger of burning. I think you would need only about half or a little more than half as much water. Only take care to leave the cover off the kettle if you find that the hominy is going to be thinner than hasty pudding when it is nearly done. If the hominy is used rather coarse, about five minutes before it is done mix a tablespoonful of flour with just enough water or milk to make it a thin liquid, and stir it into the hominy. That will hold it together when it is cold, so that it can be cut into slices. In making hasty pudding you can put that tablespoonful of flour in to hold it together when it is cold. You want to allow long enough for the flour to boil thoroughly; before dishing the hominy when it is tender pour it into an earthen dish or shallow tin pan wet with cold water, and let it get cold and hard. Always make this in advance of your fried chicken. You want the hominy cold and solid so that you can cut it. Cut it in little cakes about an inch thick and two inches square. These little cakes of hominy are to be fried either in the pan with the chicken or in another pan by the side of the chicken, and served on a dish with the chicken.

FRIED FISH.

I have here some fish which I shall fry. We will not try broiled fish, because this has been frozen; we will do that some other day. In frying fish use either Indian meal or flour, seasoned with salt and pepper, to roll the fish in. Fry the fish in lard or the drippings from salt pork. In case you use salt pork, fry it brown. Olive oil is one of the nicest fats for frying fish. You may have your choice whether I fry with lard or oil. We will fry in oil. If you use lard at all you want it to be very nice. In the frying pan I shall put about half an inch of oil; that is less than half a cupful. Put it over the fire and let it get hot, just as I did for the chicken. This is frozen fish that has been thawed. Cut the fish in pieces about two inches square and roll them either in flour seasoned with pepper and salt, or Indian meal, as I told you; put them into the oil when the oil is hot. As soon as the fish is browned nicely it will be done. You can add more seasoning than there is in the flour. Use Indian meal with pork; it is particularly nice.

LECTURE SEVENTH.

Our lesson this morning, ladies, will begin with pea soup with crusts. This soup I shall make with the addition of a little onion. You remember the other day we made pea soup perfectly plain. We shall cook salt codfish stewed in cream, venison with currant jelly, stewed carrots, and cabinet pudding. First the peas will be put on the fire to boil, and I shall begin to make the pudding.

CABINET PUDDING.

The cabinet pudding as I shall make it to-day will be rather elaborate. You can make it more plainly. It is made of cake, — sponge cake is the best, — French candied fruit, eggs and milk. So that, first, I shall give you the recipe for the pudding as I make it to-day, and then I will give you the recipe for the plainer form. For the pudding use a pudding mould of the size I have in my hand (holding about a quart), about half a pound of French candied fruit, which you can get at the confectionaries here; I have to-day candied cherries, a little candied pear, a green lime candied, a small orange, and an apricot. I shall also use a very little citron, about an ounce of citron. That I want simply for the effect of the green part of the citron. Put the citron in the form of small leaves. The large fruits cut in slices, which you may leave round or cut in the form of stars or to imitate a flower bud. After you have cut the fruit, butter a perfectly plain tin pudding mould thickly with cold butter, —quite thickly. Have the butter cold; lay the fruit against the mould in the form of a wreath, or a star, or any fanciful form you like, some on the bottom of the mould and some on the sides. The cold butter will hold the fruit in place. After part of the fruit is laid against the sides and bottom of the mould, then cut the sponge cake in large slices about half an inch thick, one slice the size and shape of the bottom of the mould, and either one long slice that will go round the sides of the mould inside, or two or three pieces, according to the size of your cake. Generally, in cities where there are confectionaries, you can buy sponge cake baked in large thin sheets. You know the form in which it is used for the bakers' *charlotte russe*. This is baked in large sheets; cut it in small sheets and fit it into the moulds. Because it is very thin you can work with it very much better than you can with that which is thicker. This will be very apt to break, because it is very stiff. If you are to shape the cake to your mould the cake should be perfectly soft and flexible.

After the first layer of cake is put against the mould, then use the rest of the cake cut in small pieces, or broken, and put into the mould in layers with the rest of the fruit. You see, first you use some of the fruit to ornament the inside of the mould, then some of the cake to line the inside of the mould. That gives you what will be the outside of your pudding when it is done. Then when the mould is decorated with fruit and lined with cake, put the rest of the cake and fruit into the mould in layers. Make a custard of a pint of milk and six eggs, because for this pudding the custard must be firm enough to hold the pudding in shape so that it can be turned out of the mould; also a quarter of a pound of sugar; that is about four heaping tablespoonfuls of sugar.

After the custard is made, pour it into the mould which you have filled with cake and fruit, and let it stand so that all the custard may be absorbed by the cake. When the custard has been entirely absorbed by the cake, set the mould in the steamer or in the sauce pan with water to reach two-thirds up the side of the mould. Put the cover on the steamer, or sauce pan, and steam it until the custard is firm. That will generally take about an hour and a half. It may take a little longer, but be quite sure that the custard is firm. Do not cook the custard first, just mix it up. In order to be sure that the custard is firm before you attempt to turn the pudding out, you want to run a fork or a small knife down through the thickest part in the middle of the pudding; move it backward and forward; look into the pudding to make sure that the custard is done. As long as the custard looks liquid at all, you must keep on cooking. When the pudding is done take the mould out of the steamer, using a towel, because the mould will be hot. Take a dish or platter that fits just over the top of the mould; have the inside of the platter the size of the top of the mould; put the platter over the mould and turn it upside down; then you will find that you can lift the mould from the pudding without any trouble, and the pudding will remain there on the platter. This pudding I shall serve with powdered sugar. It is exceedingly rich. It is not necessary to have a sauce with it because it is so rich. But you can use, if you wish, any of the nice pudding sauces that I have told you of. This is a pudding which in Europe is served as the greatest luxury. It takes its name "cabinet" pudding from the fact that it is served in the little rooms, or cabinets, that is, the private rooms where special dinners or suppers are given in the European restaurants. What is called cabinet pudding in the restaurants and hotels in this country is usually a nice bread pudding made with fruit, and it is not decorated in this way. Trouble is not taken to decorate the mould. It is simply a nice bread pudding made with custard, with some raisins or currants in it. That is what is called cabinet pudding in this country in the restaurants and hotels. So you can make the memorandum that you can use instead of the cake, bread; and instead of the French fruit, simply raisins, currants and citron. You can spend as much time and ingenuity decorating the pudding as you like, but I have done this very quickly and very simply. The pudding can be served hot, or it can be cooled and then put on the ice and made very cold. You noticed that in filling the mould I pressed the cake down on the inside, because, as it is saturated with the custard, of course it would sink down. You want to press the cake well down in the mould, and have a layer of cake on top, the last layer of cake.

Question. If you made it of bread wouldn't you have to use more sugar in it?

MISS CORSON. Yes, if you use bread you would have to use more sugar.

Question. Do you have any salt in it?

MISS CORSON. You don't need to put any salt in it. You can if you want to. There is no necessity for it, because there will be salt both in your bread and in your cake.

Question. Do you flavor the custard?

MISS CORSON. No, just the plainest custard. You will find that the French fruit will give the custard all the flavor you require. You will find that if you put the custard into a pitcher after it is made you can pour it into the pudding very much more readily than if you try to pour it from the bowl. Either put it into a pitcher or use a cup, because you will have to pour it slowly in order to let it thoroughly absorb.

PEA SOUP WITH CRUSTS.

Next take the recipe for pea soup. Some of the ladies who were at the Monday afternoon lesson will need only to make one or two notes, and the others will take the full recipe. For pea soup, four quarts, use a cupful of dried peas, yellow split peas. Pick them over, wash them in cold water, put them over the fire in two quarts of cold water and let them heat slowly. As the water heats it softens the peas. When it is boiling add half a cupful more of cold water and let that heat; then add more cold water; continue to add cold water, half a cupful at a time, until you have used two quarts more of cold water in addition to the first two quarts. The object of adding cold water slowly is to soften the peas, by reducing the heat of the water and then gradually increasing it again you soften the peas so that you can cook them in from an hour and a half to two hours. Boil them very slowly without the addition of salt until they are soft enough to rub through a sieve with a potato masher. After they are rubbed through the sieve put them again into the soup kettle with a tablespoonful of butter and a tablespoonful of flour rubbed to a smooth paste. Stir the soup over the fire until the butter and flour are entirely dissolved; then season the soup palatably with salt and pepper and let it boil for two or three minutes. While it is boiling cut two slices of stale bread—bakers' bread is the best, or very light home-made bread—in little dice about half an inch square. Put a couple of tablespoonfuls of butter in a frying pan over the fire and let the butter begin to brown, then throw the dice of stale bread into the butter and stir the bread until it is brown. Take it out of the butter with a skimmer, if it has not absorbed all the butter, and lay it for a moment on brown paper, and then put it on a hot dish to send to the table with the soup. Do not put the bread into the soup unless you are going to serve at once, because it will soften a little; but you will find that fried bread will soften less quickly than toasted bread. A great many people put small squares of toast in the pea soup, but that softens at once, If you have a frying kettle which you use for doughnuts or fritters, or anything of that sort, partly full of frying fat, you can heat it and fry the bread in that instead of frying it with the butter in a frying pan. Have the fat smoking hot; the bread browns very quickly; take it out on a skimmer and lay it on a brown paper for a moment; then it is ready for the soup. These little fried crusts of bread are called *croutons* or crusts in the cookery books. I am going to add an onion fried in butter to the soup to-day. Put that in, if you use it, when you first begin to cook the soup. One onion, peeled, sliced, and fried light brown in a tablespoonful of butter. You could also use the bones from ham, cold roast ham, cold boiled ham, or the bones of beef either raw or cooked, in the place of the onion, or in addition to the onion, as you like. Remember all those things give distinct flavors to the pea soup. If you put any kind of bones in, put them in with the peas at the beginning and boil them with the peas.

SALT CODFISH, STEWED IN CREAM.

Next take the recipe for salt codfish, stewed in cream. First, to freshen salt codfish; that, of course, is always the first thing you do with salt codfish, no matter how you finish. You can do that by soaking it over night in cold water; if it has any skin on it be sure to have the skin side up. If you put it in the water with the skin side down, the salt which soaks out of the fibre of the fish simply falls against the skin and stays there. The fish does not get any fresher. A great deal of codfish in these days is sent to the market without either skin or bone. Supposing we have the regulation dried codfish, we skin and bone it, then soak it over night in cold water, and next morning put it over the fire in more cold water, plenty of it, and put the kettle or pan containing the fish and the cold water on the back part of the stove, where it will heat very gradually. Do not let it boil at all, but keep it at a scalding heat. Do not more than let it simmer. The effect of the boiling on any salted fibre, whether it is fish or meat, is simply to harden it. Keep it at a scalding heat until the fish is tender. Of course that will depend upon the dryness of the fish. It may take a half hour, it may take an hour. That is one way to freshen fish. Another way—the way I am doing now—is accomplished more quickly by putting the fish over the fire in plenty of cold water, enough to cover it; set it on the stove where it will heat gradually. When the water is nearly hot on the fish pour it off and put more cold water on. Let that get scalding hot; do not let it boil at all; simply let it get scalding hot—that is, let the steam begin to rise from it. Change the water as often as it gets scalding hot, until the fish is tender. If you are careful to change the water often enough, that is, if you do not let it begin to boil, probably the fish will be tender in half an hour—from half to three-quarters of an hour. The time will depend upon the dryness of the fibre of the fish. Generally in about half an hour it will be tender. As soon as the fish is tender drain it, and then it is ready to dress in any way you wish to use it. To-day I shall make a little cream sauce, and heat the fish in it. That will be codfish stewed in cream sauce. Boiled codfish you would serve with boiled potatoes, and the white sauce is made either with water or milk and hard-boiled eggs. That is the old New England salt fish dinner. Usually, with a salt codfish dinner there were boiled parsnips and sometimes boiled beets; and it is very nice if you like codfish. For codfish hash, the old-fashioned codfish hash, use simply boiled codfish torn apart, forked in little fine flakes or chopped in fine flakes; of course all the skin and bone is taken off, mixed with an equal quantity of boiled potatoes, either mashed or chopped fine. palatably seasoned with pepper; of course the fish would be salt enough, usually; for a pint bowl full of fish and potatoes, use a tablespoonful of butter. The fish and potatoes are thoroughly mixed, then put into a frying pan, with just enough butter or drippings to keep it from burning. You may put, for the quantity I have given you, a heaping tablespoonful of butter in the frying pan, and let it melt; then put in the fish, and continue stirring it. Remember there is some butter in the hash already, and that will melt with the heat and probably be enough; but if you need any more to prevent its burning, add a tablespoonful. Stir the hash until it is scalding hot; then push it to one side of the frying pan with the knife you are stirring it with, and form it into a little oval cake at one side of the frying pan. When the hash is thoroughly hot, the butter in it will begin to fry out of it, and there probably will be butter enough to prevent its burning. Let it stand in the little cake at the side of the pan until it is browned on the bottom. You want to watch it a little, and now and then run a knife under it and loosen it from the pan, to make sure that it is not burning. Then, when the bottom is browned, hold a plate in one hand and the frying pan in the other, and turn the fish out in a little cake on the plate or dish.

CODFISH CAKES.

To make codfish cakes, first make the fish fine; after freshening it and taking off the skin and bone, chop it or tear it in fine flakes; mix it with an equal quantity of potato either mashed or chopped — mashed potato is rather better for codfish cakes because you can pack it a little more closely in the form of cakes. To a pint bowlfull of codfish hash add a tablespoonful of butter, a palatable seasoning of pepper and the yolk of one raw egg. That is, half codfish, half potato, a tablespoonful of butter and the yolk of one raw egg, and a palatable seasoning of pepper. Then dust your hands, with dry flour; take a tablespoonful of this mixture up in your hand and either form it in the shape of a round ball or flat cake, as you like. Have ready a frying kettle or deep frying pan with enough fat or drippings, or lard, in it to cover three or four of the codfish cakes or balls, when you drop them into it. So that if you use a frying pan you must have a deep frying pan. You may make in that case codfish cakes, not balls. If you have a frying kettle you can make little round balls. When the fat is smoking hot drop the codfish cakes or balls into it and fry them just a golden brown, light brown. Take them out of the fat with a skimmer and lay them on brown paper for a moment to free them from greese, then serve them hot.

You will notice that I always tell you in frying everything to take it out of the fat and lay it for a moment on brown paper, because then you are sure to free it from greese. Not necessarily very coarse paper; just ordinary brown wrapping paper. I do not mean manilla paper, but the common brown wrapping paper that comes around groceries and meat, that tradesmen generally use. The paper must be porous so that the greese will be easily absorbed. That is the only point you have to remember. The usual way of frying codfish cakes is simply to put fat enough in the pan to keep them from sticking, and in that way they are not browned all over, that is, they are not browned on the sides. They are simply browned on the top and on the bottom, and the fat has, of course, generally soaked into them so that you get them thoroughly greasy unless you have fat enough to cover them and have the fat smoking hot when you put them in. In frying it is very easy to use the fat repeatedly, if you only remember one thing. The fat you fry fish in you want to keep always for fish; then you can fry anything else, meat, chicken, fritters or doughnuts, in the other fat. Generally keep two jars or crocks of fat, and take care only to let the fat get smoking hot in frying, and as soon as you have done frying set the kettle off the stove so that the fat does not burn; let it cool a very little, then strain it through a cloth into an earthen bowl and let it get cold. Wash the frying kettle out and clean it thoroughly, and then you can put the fat back in it, and it will be ready for the next time, if you use a porcelain-lined kettle; if you use a metal kettle for frying, tin or anything of that sort, do not put the fat in it till you are ready to use it again, because it might rust it a little. If you strain it through an ordinarily thick towel there will be no sediment. If you strain it through a sieve there will be a little sediment that will settle to the bottom of the fat, and you can turn the cake of fat out of the bowl when it is cold and scrape that off. The best way is to strain through a cloth in the first place. If you are careful with the fat you can use it repeatedly, —use it a dozen times or more, until it really is nearly used up. But if you are careless and let it burn, of course you very soon get it so dark in color that it colors anything directly you put it in, before it is cooked, and it has a burnt taste. But if you use it at the heat I tell you, just smoking hot, and do not let it burn, you can use it repeatedly. Sometimes you can lift it out in one solid cake when it is cold; sometimes you will have to break it and take it off in more than one piece. On the bottom of the cake you will find a little brownish sediment which you must scrape off. Then you have the fat clarified and ready for use. For ordinary frying purposes the straining through the towel will answer. An earthen bowl is the best for keeping the fat in the kitchen, very much better than metal of any kind.

STEWED CARROTS.

Next take the recipe for stewed carrots. Carrots, peeled, as many as you wish to make a dishful; cut them in rather small slices, a quarter of an inch thick, put them over the fire in salted boiling water enough to cover them; boil them steadily until they are tender. That will be in perhaps half or three-quarters of an hour; if the carrots are young and fresh they will boil in half an hour; longer as the season advances and the carrots grow denser in their fibre. Late in the winter it may take an hour or even an hour and a half if they are very large and woody. Boil them until they are tender. Then drain them and throw them into plenty of cold water, and let them get thoroughly cold. While they are cooling make a sauce of water or of milk, as you like. If you have an ordinary vegetable dish full of carrots you want about a pint of sauce. In that case you will make the sauce as I have told you several times: a tablespoonful of butter, and a tablespoonful of flour for a pint of sauce; melt the butter and flour together over the fire, stirring them constantly until they bubble and are smoothly mixed; then begin to add half a cupful at a time the milk or water that you are going to use in making the sauce; stir each half cupful in smooth before you add any more water. If the milk or water is hot, of course the sauce will be cooked all the more quickly. Let the sauce boil for a minute, stirring all the time, then season with a level teaspoonful of salt for a pint of sauce, a quarter of a saltspoonful of pepper, remembering what I have said about using white pepper. Drain the carrots from the cold water and put them into the sauce to heat. While they are heating — and that will only take three or four minutes — chop a tablespoonful of parsley fine, and stir it among the carrots; then serve them as soon as they are hot. You may make the addition of parsley or not, as you like, but it is very nice. In some seasons of the year you can not have the parsley. If you have not parsley, and have made the sauce of water, you will improve the dish very much if you stir the yolk of a raw egg into the sauce and carrots when you take them off the fire, just before you dish them. I will do that to-day. I will make a sauce of water and add the yolk of an egg. You had better put two or three tablespoons of sauce into a cup with the egg and mix it, and then pour that into the sauce and stir it well. In chopping parsley use just the leaves, not the stalks; put them in the chopping bowl and chop them fine. If you chop on a board steady the point of a knife with one hand and use an up-and-down motion with the other hand. Of course you can understand that using a long knife in chopping you can chop very much more quickly than you could in a chopping bowl, where you only get a circular cut. One of the ladies asks me the object of putting the carrots in cold water. They are put first in boiling salted water to set their color. The action of the salt in the boiling water slightly hardens the surface so that the color does not boil out. Then if you take them at the point when they are tender you check the boiling at once by the cold water and secure the color entirely. Of course you will understand that by draining them and throwing them into cold water you check the heat at once. If you simply let them stand in the water and gradually soften and soak, letting the water keep warm, you would soak the color out. That follows with all boiled vegetables. Where we want to preserve the color this is the simplest and easiest way to do it.

Question. Can the color of beets be preserved in the way you speak of?

MISS CORSON. No, beats have to be boiled differently from any other vegetable. If you break the skin of beats, or cut them in any way, the color escapes in the water. So that to prepare the beets for boiling, wash them very carefully without breaking the skin. Do not cut off the roots or the tops of the beets close; leave some of the roots and three or four inches of the stalk. Do not trim them off close, because if you cut the roots or stalks close to the beet you make a cut whence the color can escape; wash them very carefully without breaking the skin. Put them over the fire in boiling water. You do not need to salt it, in fact, it is better not to salt it. Boil them until they grow tender to the touch. If you puncture the beet with a fork or knife, to try it, you let the color out, but you can take one of the beets up on a skimmer and use a thick towel and hold it in your hand and squeeze it to see if it is growing soft. Do not break the skin, always remember that. When the beet is tender you will find that it will yield a little, between your fingers, and the length of time required for cooking them will be from half an hour to two hours and a half, perhaps even longer than that. Young, tender, juicy beets may be cooked in half an hour. The older they are, the later it is in the season, the harder the woody fibre will be, and the longer it will take to cook them. After they are cooked really tender, then throw them into a bowl of cold water and rub off the skin with a wet towel. Do not leave them soaking in cold water.

VENISON WITH CURRANT JELLY.

Take the recipe for venison now, ladies. Enough butter to cover the bottom of the pan about a quarter of an inch. Let it get smoking hot, then put in the venison. You must have the pan large enough to hold the venison. As soon as the venison is brown on one side turn it and brown it on the other. Brown it very fast. As soon as the venison is browned put with it the currant jelly. For every pound of venison use two tablespoonfuls of currant jelly—not heaping spoonfuls; or you might put one heaping tablespoonful for every pound of venison. As soon as the venison is brown put the currant jelly in with it. Put the pan back where it will not be too hot, and finish cooking the venison until it is done to suit your taste. It will cook, if it is an inch thick, pretty well done in about twenty minutes. Season it with salt and pepper, and when it is done put it on the platter and pour the currant jelly and butter over it. The cooking of the jelly with the venison makes it a nice sauce or gravy.

Question. Wouldn't this be a nice way to cook buffalo or any other kind of game?

MISS CORSON. Yes, it is a very good way.

LECTURE EIGHTH.

MEATS AND VEGETABLES.

We will begin to-day with so-called roast beef, it is really baked. This is what is called a shoulder cut of beef, and is just as the butcher has sent it home, that is, without any of the bones being taken out. This thin part of the beef can be either roasted with the rest or cut off and used as a stew. It is not very available at the table. It almost always is tough, and there is a great deal of fat proportionately. The lean that is there is very apt to dry and harden in the baking. So that the best way to use the part is to cut it off and cook it separately. Have the beef cut large enough to give a roast from the thickest part. The white line of cartilage will be sure to bother in carving, and the best way is to cut it out before you cook the meat. You can cut it out without any difficulty. You can also cut off the bone entirely. You will not find that doing this will make the meat waste if you bake it or roast it properly, and you can carve it more easily and more economically. Carving when the bone is in the meat you are sure to leave more meat on than you really want to, and it is quite a difficult matter to carve even slices when the bone is in the meat. It is a very easy matter to take the bone out, and then either use the bone for soup meat or put it in the pan with the meat and let it bake as the basis for gravy. You will notice both in cutting the cartilage and the bone, I do not take off any meat. I simply cut close, and take away the parts I wish to remove without wasting any of the meat. That leaves a solid piece of meat which offers no difficulty in carving; you can either fasten it in shape by tying a string around it or by running a few skewers through it. The better way is to tie it with a string, because the skewers will make holes and permit the juice to escape. You can either take off the thin, outside skin of the beef or wipe it as I have already said, with a wet towel. With good beef the skin is so exceedingly thin that it is not objectionable in carving or to the taste. With poor beef, the skin is decidedly leathery, and then it is advisable to take it off.

Question. How many pounds were there in your piece altogether, before you began to cut it?

MISS CORSON. Oh, I fancy it weighed five or six pounds. Of course you use the number of pounds that your family requires. I am speaking of dividing the meat so as to cook it in the most economical manner. You would buy a sufficiently large piece in weight to give you the thick part—large enough for your family for the roast, and the other part you use for the stew subsequently. We made a beef stew one day, here, I think. Roasting is cooking meat before the direct blaze of the open fire. Baking is cooking it in the oven. Nearly all the so-called roast beef that we get is baked beef. It is not quite so delicate as real roast beef. You can accomplish the roasting of beef with any range or kitchen stove that has a large grate, that is, a grate where you can have a clear surface of coals against the grate, by using what is called a Dutch oven. This is a tin box, with one side open and a little hook in the top of the box, from which you can hang the meat. Then in the bottom part of the tin case there is a pan that catches the drippings. After you have got the meat all ready, you put the Dutch oven in front of the grate, standing it so that the open side of the Dutch oven is directly in front of the grate of your stove or range. You will find that the bright tin of the oven will reflect heat enough to cook the meat nicely. There you get a genuine roast. You do not get an old-fashioned roast on a spit before the open fire, but you get a nice roast. Generally those little hooks are so arranged that the meat swings a little—swings and turns, and if the hooks are not so arranged, once in a while, say once in half an hour, you want to turn it.

Now, suppose you have not that oven, but still have an open fire, you can roast. I have roasted a chicken before a grate fire in the sitting room. You can roast small birds of any kind in that way, by putting something on the mantel piece heavy enough to support the weight of the bird. Tie a string around the bird or around the piece of beef and let it hang down in front of the fire. Put a platter under it or a dripping pan, and put the blower up in front of it. You might be amused at the idea of doing that as an experiment. I have made coffee in an old tomato can as an experiment, to see whether it can be done, and it is just as nice as any you could possibly make in the finest French coffee pot. After all there are many expedients that you can resort to in cooking with good results.

After the meat is browned on the outside, whether you are roasting or baking, season it. Get it browned first on the outside very quickly, then season it with salt and pepper, and after that moderate the heat of the oven, or draw the Dutch oven a little away from the fire, and finish cooking till the meat is done, allowing fifteen minutes to the pound if you want it medium rare, about twenty minutes to the pound if you want it very well done. If you are baking the meat put it in the hottest oven, without any seasoning at all, without any water in the pan. You will find that the meat will yield drippings enough for basting. Our chicken that we basted yesterday,—do you remember how nice and brown that was? Pretty well basted, wasn't it? That had nothing in the pan for basting except the drippings which flowed from the chicken itself. Put the meat in the hottest oven until it is browned, and then moderate the heat and cook the meat fifteen minutes to the pound. We might do what the French call braise the end of the roast, if you like to see the effect of slow cooking. One difficulty that we labor under here is that we have to use a very intense heat, otherwise the flame of this vapor stove goes out. In order to braise successfully you want a very gentle and continuous heat,—such as you would get on the back part of a cooking stove,—just heat enough to keep the meat simmering. We will do as well as we can by keeping the sauce pan at one side of the fire, and then I will describe the braising process, so that you can do it perfectly at home. If we have any cabbage we will braise the meat with it. That makes a dish that is used very much in the north of Europe, in Poland and Sweden. I think I will give you the recipe, whether we have our cabbage or not.

Use a large pot or sauce pan, large enough to allow you to lay the piece of meat on the bottom; or, you can use a thick, deep, iron pan. I remember, several days ago, seeing in the hardware stores pans about ten inches high, pans made of Russia iron, oval. You can use that for quite a large piece of meat if you have not a sauce pan. You want a pan deep enough to allow the water to come just over the beef. Put water in the pan, enough to cover the beef, and let it get boiling hot. I will give you two methods of braising. When the water is boiling hot, put the beef in it; watch it carefully until it just begins to boil again. The moment it boils, push back the pot or pan in which it is far enough away from the hot part of the stove to keep the water only simmering, only bubbling, not boiling. Put in whatever seasoning you like. If you use spice, cloves for instance, or mace, use it whole. If you use simply salt and pepper, of course use them in the powder. Keep the cover very tightly over the pot or sauce pan, and cook the meat in that slow, gentle way, for at least two hours. A piece weighing not more than four or five pounds you want to cook at least two hours, or until it is tender. Remember to cook very, very slowly. That is a very simple and easy way of braising, which any one can accomplish.

Now I am going to give you the French method of braising. Cut part of the fat off the meat, about half the fat off the meat. Put the part that you cut off in the bottom of the pot. Lay the meat on the fat. That is the way we will cook our meat to-day, because I have decided to cook the cabbage in another way. After you have put the fat in the bottom of the sauce pan, lay the meat on it, with the fat part up, so that, you see, you have fat under and over the meat. On top or by the side of the meat put an onion of medium size, peeled and stuck with about a dozen cloves. Put parsley, if you have it, about a tablespoonful of leaves, or some stalks, or parsley root; but remember that the flavor of parsley root is very much stronger than the leaf, so that you will use proportionately less root. One bay leaf, a tablespoonful of carrot, sliced, about a tablespoonful of turnip, sliced, and a level teaspoonful of peppercorns—unground pepper—or a small red pepper. Then boiling water enough just to cover the meat. Then put on the cover of the sauce pan, and put the meat where it will simmer very gently until it is quite tender. The French always braise in what is called a braising pan; that is, two oval pans made in such a way that one sets into the other, and goes about a third of the way down. They put the article that is to be braised in the bottom pan, and then in the top pan they put hot ashes, or coals of wood or charcoal, mixed with ashes; so that there is heat top and bottom; then they put their braising pan by the side of the fire or at the back of the stove, where it will have a gentle heat, and cook it for a very long time. They braise it four or five hours, and it makes the toughest meat tender. After you once bring the meat to the boiling point you must not boil it fast; if you boil it fast you will make it very much tougher. After you get it to the boiling point keep it there, and cook it slowly, and long enough so that it will be sure to be tender. If you are sure the meat is tough in the beginning, put half a cupful of vinegar into the water with it. You won't notice the vinegar when you come to eat the meat, and it will help to make the meat tender. The French, of course, use the ordinary wine of the country,—a sour wine,—it has the same effect; it is about as sour as vinegar, and has about the same effect. I think, indeed, that is the reason why the French use so much wine in cooking meat. They use a very acid wine always, and probably use it for the purpose of making the meat tender in many instances. Put in salt, but not too much, for the effect of salt, while the meat is boiling, would be to harden it. Just a little salt, and then in seasoning your gravy you can add more salt. After the meat is braised French fashion, it is taken out of the broth, and the broth is strained and then used as a broth or soup, or made into a gravy.

To make the gravy, for each pint of gravy that you wish to make, use a tablespoonful of butter or beef drippings and a tablespoonful of flour. Stir the drippings and flour over the fire in a sauce pan until they are brown. Then begin to add the seasoned broth in which the meat was cooked, half a cupful at a time, stirring it until it is smooth each time, until it boils; then season it with salt and pepper, remembering that the broth is already seasoned, so that you have to taste it. That makes a very nice gravy or sauce. Of course, you have plenty of broth, so you can make as much of it as you like.

Take now a recipe for cooking cabbage to serve with braised meat. For a cabbage of medium size,— that is, a cabbage about as large as a breakfast plate,— first wash the cabbage thoroughly, cutting away any part of the stock that seems woody. Then cut the cabbage in rather thin slices. That is very easy. Lay it on the board and cut it down through. You would need a large sauce pan to cook a cabbage as large as a breakfast plate, because remember when it is cut up it takes up more space. Put in the bottom of the sauce pan a tablespoonful of butter or drippings. If you are braising your meat you can open the pot and dip some of the drippings out of it. A tablespoonful of butter or drippings, half a cupful of vinegar, a tablespoonful of cloves, a teaspoonful of peppercorns and a tablespoonful of brown sugar. Then put in the cabbage on top of these things. Put the cover on the sauce pan, set it over the fire where it will steam. Be very careful not to let it burn. Keep it on the back part of the fire where it will simmer. Keep it covered. Every fifteen minutes take off the cover, and with a large fork or spoon lift the cabbage from the bottom so that the top uncooked part goes down to the bottom. In about an hour the cabbage will be tender. You do not need to begin to cook that until within, say an hour and a quarter of the time the beef is likely to be done. To serve it, turn it on a dish, leaving the spice, cloves and pepper in with it, and lay the beef on it. Just moisten the cabbage with a little gravy or broth from the beef, and serve the rest of the gravy in a bowl; remember that the broth from the meat is salted, and that in moistening the cabbage it seasons it, or if you like very much salt you can put a little with the cabbage in cooking.

Now, to boil cabbage quickly, and without odor: After thoroughly washing it take off the decayed leaves, cut it in rather small pieces, but do not use the stalk of the cabbage—avoid that. Put over the fire a sauce pan large enough to hold the cabbage twice over. Have plenty of space in your sauce pan or kettle, fill it half full of water, put plenty of salt in the water,—that is, a level tablespoonful of salt to about a quart of water.—let the water boil; be sure that it is boiling fast. Then put in the cabbage; get it boiling again just as fast as you can, and continue to boil it just as fast as you can until it is tender. That will be in from ten to twenty-five minutes, according to the age of the cabbage. Young cabbage, early in the season, will boil tender in ten minutes; or it may take 15, 20 or 25. It never takes over a half hour unless the cabbage is very old or dry. The cabbage is done the moment the stalk is tender. A great many people have the idea that they must boil the cabbage until the leaf is almost dissolved. It needs only to be boiled as tender as you boil the stalks of cauliflower, and you would try, of course, the thickest part, which would be near the stalk. Remember, in the first place you would cut out any tough, woody stalk, but the tender stalk you would leave in, and that is the part you would try. If you boil it fast it will not take over thirty or thirty-five minutes at the outside, probably not more than twenty. Just as soon as the cabbage is tender drain it and put with it whatever sauce or dressing you are going to serve with it. That sometimes is vinegar, butter, pepper, and salt. Sometimes a little milk, butter, pepper, and salt. In that case it is called cabbage stewed with cream. Sometimes you would simply serve it without any further seasoning, only remember that the moment it is tender, drain it and serve. As I told you the other day, the odor of the cabbage comes from letting it boil until after the substance of the cabbage is so soft that the oil begins to escape from it, the volatile oil. That makes a strong odor in the room. As soon as the cabbage is tender it is ready to eat, and should be taken from the fire.

TURNIPS.

To bake turnips, peel the turnips, either white or yellow ones, cut them in rather small slices, a quarter of an inch thick; put them over the fire in salted boiling water enough to cover them, and boil them fast until they are tender. It may take ten or fifteen minutes, possibly twenty minutes, according to the age of the turnips. Of course you will understand that if the turnips are old and corky they will not be as nice when they are done as if they are in good condition. But as soon as the turnips are tender, drain them, put them in an earthen pudding dish, make a little white sauce, either with milk or water, — for a pint, a tablespoonful of butter, tablespoonful of flour; stir over the fire; then milk added gradually and stirred smooth; seasoned with salt and pepper, — make enough of the white sauce just to moisten the turnips; pour it over the turnips; dust over the top some cracker dust or bread crumbs, just enough to cover the top of the turnips; put a little salt and pepper over the crumbs, and a scant tablespoonful of butter over the top of the crumbs. Then put the dish into the hot oven, and just brown the crumbs on the top of the dish. Serve it as soon as the bread crumbs are brown. That is a very nice and easy dish. If you have cold boiled turnips, slice them, cover them with white sauce and bread crumbs, and cook them just in the same way.

(At this point Miss Corson announced that the cabbags was done, after being in between nine and ten minutes, and no smell was perceptible in the room.)

I am going to moisten the cabbage with cream sauce, — that is white sauce made with milk, — and heat it for a moment and then it will be done.

I will now answer a question that has been asked about cooking corned beef. The same principle applies to the cooking of corned beef that applies to the cooking of salted fish. You remember this morning in talking about codfish I said, if you boil the salted fibre hard and fast, you make it hard and toughen it. That holds good in relation to salted meat or corned meat. You want to boil it very gently. There is comparatively little juice left in corned beef, so that the action of cold water is not so disastrous to it as it would be to fresh meat. Sometimes the beef is so very salt that it is desirable to change the water upon it. Put it over the fire in cold water. Let it slowly reach the boiling point, and then try and see if it is too salt. If the water itself seems very salt, change it. Put fresh water in, let it gradually heat, and boil very gently always. As soon as the meat reaches the boiling point, push it to the back part of the stove and boil it very gently until it is tender. It usually takes about twenty minutes to a pound, but boil it very gently and slowly. Then it will be tender. If you boil it fast it will be hard and tough. If you put a whole dried red pepper in with the beef in boiling, you will find that it will improve the flavor very much. If you intend to use the beef cold, leave it in the water in which it is boiled; take the pot off the stove and let it cool in the water in which it was boiled. Those same directions apply to boiling smoked or salted tongue.

The turnips were just fifteen minutes in boiling.

Nice points about boiled dinners are asked for. I think I have given you the nicest point in cooking beef, so that you will be sure to get it tender, and to cook cabbage so that it is tender and does not smell. Cabbage always goes with a New England boiled dinner, potatoes, onions, parsnips and squash. I told you about cooking beets this morning. All the other vegetables you may cook in boiling water, and salt to suit the taste. The old-fashioned way was to boil all the vegetables in the pot with the beef, adding the vegetables in succession, so that each one was put in just long enough before the beef was done to have it done at the time the beef was done; each one except the squash. The squash is best peeled and cut in small pieces and steamed. If you boil it you want to put it in boiling salted water until it is tender, and then put it into a towel and squeeze it, so as to get out the water; then season it with butter, salt and pepper, and serve it.

I made gravy yesterday; I think if I give you the recipe to-day it will answer. Pour the drippings out of the pan, all except about a tablespoonful; put a tablespoonful of flower in with the brown drippings; set the pan over the fire; stir the drippings and flour together until they are quite brown; then begin to put in boiling water, a little at a time, not more than half a cupful, and stir until the gravy is smooth; then season it palatably with salt and pepper. Onions are very nice cooked precisely as I have cooked cabbage to-day; that is, cooked until they are tender, and dressed with the white sauce that I used in dressing the carrot.

For pressed corn beef the nicest cut is the brisket. Have the cut rather long and narrow, and not a short chunk or piece. Take a long piece of meat, a foot long, or more; have all the bones cut out and roll it up tight. Tie it compactly, in the same way that I tied this meat. Tie it so that you have it in a tight bundle. Then boil it according to the directions I have already given you. After it is done let it partly cool in the liquor; then take it out and lay it on the platter; lay another platter on top of it, and put a heavy weight on the platter, and press it with the string still on until it is cold; then cut off the string and you have it in nice shape. If you want to use part of it hot for dinner, and then have it cold, you would have to boil it, and when it is done cut off enough for your dinner; then press the rest of it between two platters. You could double it over, but you could not press it so very well in shape. Cut it in slices; put it into a tin mould or tin pan and boil down the broth in which you have cooked it until it begins to look thick. Or, you could dissolve a little gelatine in the broth to thicken it, and pour it over the slices of corned beef in the mould. In that case you would depend upon the gelatine to thicken the broth, without boiling it down.

LECTURE NINTH.

BEEF A LA MODE ROLLS.

Our lesson this morning will begin with beef *a la mode* rolls. Use the round of the beef or the end of sirloin steak. I have here a piece of round of beef. Cut the beef in pieces about two inches wide and five long; lay these strips of meat on the cutting board and season them with salt and pepper. In the middle of each one put a little piece of salt pork about a quarter of an inch thick. Roll the meat up in such a way that the pork is inclosed in the middle of the little roll. Tie the roll to keep it in shape. You can use instead of salt pork pieces of fat from the meat. After all the little rolls are tied up put a very small quantity of beef drippings or butter in the bottom of the sauce pan or kettle. Put the sauce pan over the fire with the drippings or butter in it and let the fat get hot. As soon as it is hot put the little rolls of meat in it and let them brown. As soon as the little rolls of meat are brown sprinkle flour over them, a tablespoonful of dry flour to half a dozen little rolls of meat. Let the flour brown.

As soon as the flour is brown pour in boiling water enough to cover the rolls; add salt. Then put the cover on the sauce pan and set the meat where it will cook very gently. Remember what I have told you about cooking meat slowly if you want it to be tender. When the meat is quite tender — and that will be in from half an hour to an hour and a half — the time will depend, of course, upon the fibre of the meat, then take off the strings and serve the rolls in the gravy in which they have been cooking. You see the brown flour and water and butter will have make a nice gravy for the rolls. Now if the meat is very tough remember what I have told you about the action of the vinegar on the meat fibre. For a pound of meat add about two tablespoonfuls of vinegar, when you begin to stew the meat, and let it cook with the meat; that will make it tender. You can vary the dish by cooking with it vegetables of any kind that you like to use. Add potatoes when it is within half an hour of being done, turnips peeled, cut in small pieces; carrots peeled and sliced.

CARAMEL CUSTARD.

I will make a caramel custard next. For caramel custard use a plain tin mould, oval or square in shape, that will hold about three pints. Put a teaspoonful of sugar in the bottom of the mould and set the mould on the top of the stove where the sugar will brown. You may want to shake the mould a little to scatter the sugar evenly over the bottom. When the sugar is brown set the mould off the fire on the table where the burnt sugar will get cold; that forms what is called a caramel or coat of burnt sugar on the bottom of the mould. Make a custard by beating together six eggs, a quarter of a pound of sugar and a pint of milk. After the custard is made pour it into the mould and set the mould in a sauce pan with boiling water that will come half way up the sides of the mould, and steam the custard until it is firm. When the custard is firm you can turn it out of the mold and use it hot or leave it until it is quite cold and use it cold. I have used granulated sugar this time. You can make the same custard, preparing it just exactly as for steaming, but bake it, if you like, only you would set the mould in the dripping pan with water in it, baking it just until it is firm, in a moderate oven. You could make it in teacups; in that case you would burn the sugar in an iron spoon or in the frying pan and while it still is liquid put just a little in the bottom of each cup, because you remember it hardens directly. Then bake the cups of custard in a pan of water. Use the custard in the cups either hot or cold. If the custard is to be used cold leave it in the mould; it will stand better than if it is turned out hot. But it is stiff enough to retain its form even when it is hot. And the sugar that is in the mould forms a little sauce around it on thedish.

TOMATO SOUP.

Next take a recipe for tomato soup. A can of tomatoes; put them over the fire. In the summer use about two quarts of fresh tomatoes. You will find that about two quarts will be sufficient. After the fresh tomatoes are peeled and sliced (you will remember canned tomatoes are already peeled), put them over the fire and stew them gently for about half an hour, or until they are tender. If the canned tomatoes are entirely solid you may need to add a little liquid, but I find there is generally more liquid in the can than you need. When the tomatoes are tender enough to rub through a sieve, put them through the sieve with a potato masher. That gives you pulp, or *puree*, of tomatoes. And you will add to the tomatoes, after they have been passed through the sieve, half a salt spoon of baking soda, and then milk enough to thin them to the proper consistency of soup. Season with salt and pepper, and let them boil, and serve the soup. If you want a thick soup, add to the tomatoes a quart of milk, and thicken the soup with cracker dust, very finely powdered and sifted. Thicken as much as you like, beginning with two heaping tablespoonfuls; add more if you want it. Of course you can put butter in either of these soups, but it is not necessary. The way I shall make the soup to-day will be to thicken it with butter and flour after the tomatoes have been passed through the sieve. Do not confuse these two recipes. You have got one of thin soup; you have got another with milk, salt and pepper, thickened with cracker dust. Now a third: Put a tablespoonful of butter and a tablespoonful of flour in a saucepan. Stir them over the fire until they are melted together, then put in a pint of water gradually — a pint of hot water — stirring it smooth; and the tomato pulp. If that does not make the soup as thin as you desire — and it should be about the consistency of good cream — add a little more boiling water. Season with salt and pepper, and stir it until it boils, and then it is ready to use.

Next take directions for boiling vegetables, so that the color is perfectly kept. I told you yesterday that we should have spinach if we could get it, if not, that we would use lettuce. I think that next week, in the course of the lessons, I shall succeed in having some spinach from Cleveland. However, I shall use lettuce to-day. First, thoroughly wash it in salted water. For a quart of water use a tablespoonful of salt. As I told you the other day, the salt in the water is for the purpose of killing any little insects that are in the leaves, especially of the lettuce. You know that it is very troublesome to dislodge them, but the salt kills them, and of course you can wash them out. As long as they are alive they cling there. If you sprinkle salt on the leaves it will wither them, but if you put it in the water it will not. Salted water is intensely cold, you know, and it would restore the freshness of the leaves of lettuce, even if they were wilted, unless they were really on the verge of decay. If you will remind me, after I have finished giving the recipe for cooking the vegetables, I will tell you how to keep lettuce fresh. After your vegetables, whatever they may be, whether lettuce, or spinach, or asparagus, or string beans, are washed perfectly clean — I do not say wash peas, and I will tell you after a little the reason why — after they are thoroughly washed put them over the fire in enough boiling salted water to more than cover them — plenty of water, so that they can float about — the water to be salted with a tablespoonful of salt in a quart of water, and to be actually boiling when you put in the vegetables. This same rule applies to the cooking of peas, only that the peas are treated a little differently in the cleaning, but they are cooked in the same way. Boil the vegetable (whatever it is) in salted water, fast, just till they are tender. Remember what I said about boiling carrots yesterday. As soon as the vegetables are tender, drain them and throw them into plenty of cold water. Leave them in the cold water until you want to use them. Then, if peas or beans, drain them, heat them quickly, with a little salt and pepper and butter, very quickly, or any sauce or gravy you wish to serve them in, and serve them hot. If lettuce or spinach, to make a *puree*, after having boiled in boiling salted water and then put in cold water, rub them through a sieve with a potato masher. After they are rubbed through the sieve they are ready to be used in different ways. In Europe the *puree* of lettuce is served as a vegetable, just as the *puree* of spinach is. We do not often cook it in that way, but it is very nice; it is such an exceedingly tender vegetable that it takes proportionately more than of spinach. After the lettuce or spinach is rubbed through the colander or sieve with a potato masher it is ready to be seasoned with salt, pepper and vinegar, or any sauce you like, and used as a vegetable, or used in soup. You remember what I told you about spinach soup yesterday—*puree* of spinach with cream soup, colored green with spinach. Put in just enough spinach to cover it. If I succeed in getting spinach next week I shall make, at one of the lessons, spinach soup, and also boil and serve some as a vegetable.

Now about peas. I spoke about washing string beans but not washing peas. If the shells of the peas are at all dirty, and sometimes they are so that they blacken your fingers in shelling, wash the shells of the peas before you begin to shell them, but do not wash the peas after they are shelled. Of course the inside of the pod is perfectly clean, and if your hands are clean and the shells are clean, you do not need to wash them. In using green peas in summer time it is well to have a quantity of them, perhaps twice as many as you are likely to use for one meal, and shell them, because you know they are of different sizes always. Shell them and separate them into two different sizes, the smallest and the largest, and then cook one size for one day, putting the others in a very cool place, or refrigerator, and cook them the next day, because if you have the large and small ones mixed they do not cook evenly. You will find them very much nicer; if you keep them in a cool place it will not hurt to keep them.

The length of time that it takes to boil lettuce or spinach depends somewhat on the time of the year. The tenderer the spinach is, of course, the quicker it will boil; when it is very young and tender it will boil in two or thre minutes; when it is older it may take as long as ten minutes. Ladies very often make the mistake in boiling spinach that they do in boiling cabbage. They boil it sometimes until the leaves are destroyed, in order to soften the stalk. The better way is to tear away the stalk and use only the leaf. Of course, that gives you a smaller quantity of spinach than if you use the stalk, but when you use the tough, woody stalk you waste the leaf in boiling. Lettuce usually boils in a couple of minutes. One of the ladies speaks about cooking spinach without any water. You can do that if you wish. Just put in a sauce pan, after having carefully picked it over and washed it; stir it a little once in a while to be sure that the uncooked top goes down to the bottom. There is no special advantage in it, because if you boil it as I tell you, only until it is tender, the water has no effect upon it except to cook it more quickly. It is the English way to cook it without water. If you use boiling salted water, as I told you, it can not possibly affect the nutriment of the vegetable. It is when you boil vegetables a long time, and boil them away before you take up the dish, that you waste the nutriment. These rules apply to every vegetable that has color in it except beets. Beets have to be cooked without cutting the skin or trimming them in any way, in order to keep the color.

Now to keep lettuce fresh. I have kept it fresh, even in the summer time, for two or three days in this way: When it first comes in from the market wash it thoroughly in plenty of cold salted water. You do not need to tear it apart. You know I told you the other day about separating the leaves slightly from the head of the lettuce and shaking it in cold salted water. Trim off the outside wilted leaves. Wash it thoroughly in cold salted water, then wet a towel and lay the lettuce in it, fold it loosely up over the roots and if you have ice lay the towel on the cake of ice in the refrigerator or by the side of the cake of ice. If you haven't any ice and have a cold cellar, after you have washed the lettuce and wrapped it in the wet towel, put it in a box; a tight wooden box is the best, or a thick pasteboard box if it is not broken; and put it in the cellar in the coldest place you can find. If you wrap it in a wet towel and put it on the ice you do not want to look at it. It will keep fresh at least two days, and sometimes longer; but if you put it in the cellar you will have to wet the towel thoroughly twice a day, morning and night; and you will find that you will have to take away some of the leaves that have wilted, but if you have it upon the ice the chances are that you will not lose any leaves. And it is very much nicer than it is to let it wilt and then try to restore it by soaking it in water.

FRIED PICKEREL.

Next take a recipe for fried pickerel. Some of the ladies will remember that a few days ago we were talking about frying fish in this way with salt pork. If any of the ladies have the recipe, of course they do not need to take it again. For fried fish of any kind, enough salt pork to cover the bottom of the frying pan that you are going to use for the fish. You find you have three or four

12

pounds of fish; you will need at least half a pound of salt pork. Cut the pork in very thin slices; fat salt pork is the best. Put it in the frying pan and fry it until it is light brown. While the pork is being fried get ready the fish, having it thoroughly cleaned by washing it in cold water. If the fish is small you do not need to cut it; if it is large, cut it in pieces about three or four inches square. After the fish has been cleaned dry it in a towel; season some Indian meal with salt and pepper, roll the fish in the Indian meal. When the pork is brown take it out of the fat and put the fish into the drippings and fry the fish brown, first on one side and then on the other. When the fish is browned nicely serve it in a dish with the pork — fried pork and fish in one dish. This fish will not get very brown to-day, because it is still frozen. It did not come in long enough ago for us to get it thawed out, so, of course, there will be a little water in the fat, and it will not get quite so brown.

LECTURE TENTH.

CHEAP DISHES AND REWARMED FOODS.

We begin our lesson this afternoon with a dish of rice,— piloff of rice,—any cold meat cut in small squares, an onion peeled and chopped fine, and if you have tomatoes, either canned, fresh, or cold stewed tomatoes, a cupful. Sometimes the dish is made with tomatoes, sometimes without. Put the onion in the sauce pan with a tablespoonful of drippings; set it over the fire and let it get light brown. When it is light brown put with it a cupful of rice, picked over and washed and dried by the fire. After the onion begins to brown put the rice with it and stir until the rice is light brown; then put in a quart of hot water, the meat and tomatoes and a palatable seasoning of salt and pepper. Of course, the quantity of salt and pepper that you use will depend on the seasoning of the meat, and this may be any kind of meat. Then cover the sauce pan in which you have all these things and let the rice, meat, tomatoes and water all cook together gently. Every ten minutes you must look to see whether the rice has absorbed all the water. If it has you must add a little more water, not more than half a cupful at a time, keeping the rice just moist until it is tender. You will find that probably in about half an hour the rice will be tender, and when the dish is done it should not have the gravy about it; it simply needs to be moist, so you will have to add water cautiously after the first quart.

If the meat that you use is very fat, —and sometimes beef like this is very fat,—you may cook the meat, fat and lean together in with the onion in the first place instead of the tablespoonful of butter or drippings. If you have no meat you can make the dish in the same way using tomato, onion and rice; and if you have cold gravy of any kind put that in it.

FRENCH HASH.

Next take the recipe for a dish called French hash. There is no potato in it, it is simply meat and gravy, so that you must not let the name mislead you. Little slices of cold meat, fat and lean together. For a pint bowlful of meat use about a tablespoonful of chopped onion. First slightly brown the onion with a tablespoonful of butter or drippings or fat from the meat; then when the onion begins to brown put in the meat and let that brown. Next a tablespoonful of dried flour; stir the flour with the brown meat and onion until the flour is quite brown; then cover the meat with pork gravy or boiling water. After you have covered the meat with water or cold gravy just let the water or gravy boil, then season it palatably with salt and pepper; of course, the seasoning will depend upon whether you have used gravy or broth or water. If you have used gravy or broth that already will have been seasoned, so that you want to taste for the seasoning. After the gravy is both boiled and seasoned take the sauce pan off the fire and stir in the yolk of one raw egg with it and dish at once. You must not put the hash back on the fire after putting the egg in. If you do you will curdle it. Do not stir the egg in till you are ready to serve it, on toast or plain.

BAKED TENDERLOINS.

The next recipe will be for baked tenderloins. Split the pork tenderloins in such a way as to make rather thick slices. Tenderloins are so thick that by cutting you spread them out. Inside the slice of tenderloin put any stuffing that you like. I have given two or three recipes for different kinds of stuffing. For this to-day I shall use a little stale bread, crumbed, seasoned with salt and pepper, and moistened with butter; a tablespoonful of butter to a scant cupful of bread, or in place of butter you could use an egg. After you put a little stuffing in the tenderlonis fold them together and either tie or sew them so as to keep the stuffing inside. Put the tenderloins in the dripping pan in the oven and bake them until they are thoroughly browned. Then take off the strings and serve them. They are very nice if you bake potatoes in the pan with them. If the oven is hot the potatoes and tenderloins will bake in about the same time. The potatoes should be peeled. Remember what I told you about always taking large stitches in sewing up meat, so that you can see to pull them out when the meat is done. Of course, pork tenderloins will be pretty sure to yield drippings enough to baste with. I have spoken about that in the baking of meats two or three times. No water is needed in preparing them. The tenderloins, when sewed up, will resume their original shape.

FRIED LIVER.

First, wash the liver in cold water, then pour scalding water on it and let it stand for about ten minutes to draw out the blood; slice it about half an inch thick. After the liver is scalded and sliced, roll it in flour, season it with salt and pepper and put it into the frying pan containing about a quarter of an inch of hot fat, which may be drippings or fat from bacon or salt pork. In that case you first would fry the salt pork or bacon to get the fat or drippings, and put the slices of pork or bacon to keep warm when they are done. After the pork or bacon is fried put it on a dish to keep warm, and then fry the liver in the drippings. As soon as the liver is browned on both sides serve it on a dish with the fried pork or bacon. Fried liver needs to be cooked as quickly as possible, making sure that it is done. The more quickly you can cook it the tenderer it will always be. You can take that as a rule in regard to liver, heart and tongue, that the fatter they can be cooked the tenderer they will be. To-day I simply have fried this with drippings. I have not fried the bacon with it, but I have told you how to fry it.

BAKED HASH.

Next take a recipe for baked hash. Equal quantities of chopped meat and stale bread, meat of any kind. Suppose you have a pint bowl of each. Mix with the meat and the bread a heaping tablespoonful of butter, a palatable seasoning of salt and pepper, and that, of course, will depend upon the seasoning of the meat. You may use corned beef or highly seasoned meat, and then you will not need so much seasoning as you would if you used fresh meat. A heaping teaspoonful of chopped parsley, enough cold gravy, if you have it, or broth to moisten the hash,—just to moisten it, not make it sloppy,—or if you have not gravy or broth you must use water and butter. Mix the hash very thoroughly. Have ready an earthen dish, buttered. See that the oven is hot, then very quickly dissolve a teaspoonful of baking powder in a teaspoonful of water or broth and stir it into the hash just as fast as you can and put it into the oven to bake. As soon as the hash is brown on top it will be done.

CORNED BEEF HASH.

Now I will give you a recipe for corned beef hash. Yesterday we spoke about boiling corned beef. You will take cold corned beef and boiled potatoes, either hot or cold, about equal quantities. Sometimes people like a little more potato than meat. Mix the meat and potato together; add just enough water or broth to moisten the meat and potato. Season palatably with salt and pepper and butter; have the hash nicely mixed together; put into the frying pan; suppose you have a quart of hash, about two tablespoonfuls of butter and let it get hot, then put in the hash. Stir the hash in the butter until it is nearly hot. Then, using a knife, form it into a cake on one side of the frying pan and let the bottom brown. Loosen the hash once in a while from the bottom of the pan to make sure it is not burning and when it is brown on the bottom turn it out on a dish with the brown side up. Another form of hash is the moist hash. That is simply prepared and warmed without browning it, using broth or butter and hot water for moistening it.

LECTURE ELEVENTH.

OYSTERS.

We begin our lecture this morning with roast oysters, Mobile style. All oysters, when cooked in any way, should be first put in a colander and the juice allowed to drain off, then strain the juice. Always take each oyster in the hand and carefully remove all fragments of shell from the gills. The shells of oysters are dangerous to swallow, and serious illness is often the result. Hold the oyster by the hard part, removing pieces of shell with the finger. Then wipe the oyster with a wet towl. Keep the most perfect specimens for broiling, as the more imperfect ones will do sufficiently well for soups or stews. For roasting oysters in the Mobile style, have as many deep oyster shells as you intend to have oysters, scrubbed very clean; put the shells in a dripping pan and place them in the oven, until they become so hot as to melt butter when put into them. When quite hot take the shells out of the oven and put a small piece of butter and a very little pepper in each shell. If the oysters are large lay one in each shell, if they are small put two or three in each shell and put them back in the oven directly. By the time the edges of the oysters curl they will be done. Oysters when heated through are done. Do not put any salt on them. Serve them on the shells. As they are served in Mobile, a large shell is used, laid on a small charcoal furnace, putting the shell on top of the furnace to get very hot; the furnace is brought to the table and the oysters opened and dropped into the hot shell and turned once. The regulation way of roasting oysters is to thoroughly wash the outside of the shell and lay them on the fire with the large end down. As soon as the oysters open serve them.

To use the liquor, take a pint of the oyster liquor after it has been strained; sift a heaping cupful of flour; mix with it a level teaspoonful of salt and a heaping teaspoonful of baking powder. Have the griddle as hot as you would for pancakes. Very quickly stir into the flour enough of the oyster liquor to make a batter, and fry just as any pancake; serve hot with butter.

Next take a recipe for oyster fritters. Have the frying kettle half full of fat, as you would for doughnuts. Strain the oysters and remove all bits of shell. In the meantime the lard should be heating on the back of the stove. Cut the oysters slightly. For a pint of oysters use a pint of flour, sifted, and mixed with a level teaspoonful of salt. Put the flour in a mixing bowl with the yolk of one egg, a tablespoonful of salad oil, and a pinch of peper. Use enough of the oyster liquor to make a batter thick enough to drop from the spoon. Beat the white of an egg to a stiff froth. Mix the oysters and the white of egg lightly with the batter, and as soon as it is mixed drop by the large spoonful into the hot lard. As soon as brown take the fritters out and lay them for a moment on brown paper to drain the grease off. In order to keep them hot while you are frying the rest lay the paper on a dripping pan and set it in the oven.

Take next a recipe for oyster soup, thickened with cracker dust. For a quart of oysters, remove all bits of shell, as usual, and mix the oyster liquor with enough to make a quart. Take one tablespoonful of butter, a very little white pepper, if you have it, two tablespoonfuls of cracker dust finely powdered, As I told you the other day, the cracker dust which you buy at the cracker factories is the nicest. Stir all together over the fire, and when it comes to a boil put in the oysters, with a level teaspoonful of salt. Stir till the edges of the oysters curl; then serve. To thicken with flour, stir one tablespoonful of flour and one of butter together over the fire. Season with pepper, and put in one quart of liquor and milk.

For plain broiled oysters, prepare the oysters as above directed and lay them on a towel. Take a double-wire broiler and butter it thickly, taking care to have the fire hot. Season the oysters lightly with pepper and but very little, if any, salt. Put the oysters between the broiler, and broil them; serve them on toast.

For breaded oysters, prepare as before, and dip the oysters in melted butter seasoned with pepper and salt, and roll them in cracker crumbs. Put them on the gridiron and broil them until they are light brown.

For oysters broiled with bacon, cut very thin slices of breakfast bacon, as many slices as oysters, and stick them on little skewers, half a dozen oysters on each skewer, first a slice of bacon and then an oyster, until you have half a dozen on each skewer. Flatten them so that they will lie a little apart. Put the skewer between the buttered bars of the gridiron, dust them a little with pepper and brown them. The bacon should be cut very thin and about the size of the oyster. Serve them on the skewers.

For oysters in the Philadelphia style, prepare the oysters by draining the juice from them and removing the small pieces of shells. Use for one dozen large oysters one tablespoonful of lard, two tablespoonfuls of salad oil. As soon as the fat is hot put the oysters in and fry them till the edges curl. Season them with pepper and salt. Fry them plain or rolled in flour.

WELSH RAREBIT.

For a rarebit large enough for three or four persons, put in a sauce pan a quarter of a pound of grated cheese, two tablespoonfuls of butter, a saltspoonful of salt, two tablespoonfuls of ale, one teaspoonful of mustard, a little dust of cayenne pepper, stir all these together over the fire and serve on toast.

LECTURE TWELFTH.

Cookery for the Sick.

BROILED CHICKEN.

For broiled chicken choose always a tender chicken. Remove all the feathers, singe it over the fire, and wipe the chicken with a wet towel. Split the chicken down the back. In doing that one can remove the entrails without breaking. Take out the entrails and crop; lay the chicken open on the gridiron. It is better to use a double gridiron, well buttered. If the chicken is not tender, break the joints so the chicken will lie flat on the gridiron. Put the inside of the chicken to the fire first and brown it. Do not put it too close to the fire. Broil it fifteen or twenty minutes, for it will require about that time to get well done. When the inside is brown, turn it and broil the outside, allowing about ten minutes. Take time enough to brown it nicely without burning. If you have a very young spring chicken less time will be required. Do not broil a chicken that weighs over three pounds. If the chicken is very large it is better to put it in a very hot oven in a pan, with no butter unless the chicken is very lean. Season with salt, pepper and butter, if desired, when it is removed from the oven.

BARBECUED CHICKEN.

Split down the back, and after breaking the joints dress and lay it open. Use two tablespoonfuls of butter and one cup of water. Season with salt and pepper. Brown the chicken well, dredge it wi thflour and baste it every fifteen minutes with drippings from the pan until tender. Pour over it the gravy that you find in the pan, and serve. The Southerners, with whom this dish is a great favorite, usually put in this gravy some nice table sauce.

JELLIED OATMEAL.

Take one-half cup of very finely ground oatmeal and put it over the fire with a pint of boiling water and a level teaspoonful of salt. Boil it very slowly until it becomes transparent. This will require two hours or longer. Do not add any more water unless it is positively necessary. When it is done it should be stiff and hold its form when it is turned out. It makes a dish which is very nice and nutritious for sick people, when it is quite gelatinous. Add sugar, if it is desired, and put it in a mould. Serve when cold and solid with cream and powdered sugar.

BOILED TROUT.

Boiled trout makes an excellent dish for convalescents and it is very nutritious. Have the fish cleaned and the scales removed. The entrails should be drawn from the gills. After the fish has been thoroughly washed boil it in salted boiling water till you can easily pull a fin out, then serve it with a white sauce either made plain or with milk. French canned green peas are nice with trout. If the peas are served with the trout put the peas on the dish and lay the trout on them.

Clam soup may be given to invalids with beef tea, alternating. Clam soup may be given when beef tea can not be digested. It is very nutritious. Drain off the juice and remove all bits of shell as with oysters. If the clams are whole put the shells over the fire until they are heated; remove the clams and simply season the juice very lightly with salt and pepper and use the broth in that shape. If you are using canned clams heat the clams in the juice, then remove the juice and season slightly, using the juice. Strain the juice. Take the clams and cut away the hard part from the soft part. Boil the juice, with the hard part, long enough to extract the flavor. Use the juice to make the soup, adding water or milk. When the soup is made season it, putting the soft part of the clam in it. Boil it a couple of minutes and serve it. Use butter and flour in the same manner as for thickening oyster soup.

Make orange salad to serve with broiled chicken in the following manner: For a small chicken use two small sour oranges, sliced very thin. Arrange them nicely on a dish. Place over the slices of orange a very little salt, a little cayenne pepper, and three tablespoonfuls of salad oil. If the oranges are sweet a few drops of vinegar or lemon juice must be added. Serve the chicken on top of the orange salad.

RENNET CUSTARD.

Heat a half pint of milk until it is lukewarm. While the milk is heating beat one egg with a teaspoonful of powdered sugar and stir the egg and sugar in with it. When the milk is lukewarm add one teaspoonful of liquid rennet and one teaspoonful of wine or one tablespoonful of rennet wine. Mix all together and let it become cold. Rennet custard may be given safely when the invalid is not able to take more than broth.

BEAF TEA.

For a pint of beef tea take one pound of beef chopped very fine. All the fat is to be cut away. Put it in a bowl with a pint of cold water. Let it stand in an earthern bowl at least an hour, and longer if possible. Put the water and beef in the sauce pan over the fire, and heat them very slowly indeed. When the beef tea arrives at the boiling point pour it into a wire sieve to allow the juice and the little particles of meat — not the fibres — to pass through. Season it very lightly, and if any particles of fat are visible lay little pieces of white porous paper on top of the tea to absorb the fat; serve it hot or cold.

INDEX

TO

MISS CORSON'S LECTURES.

INDEX.

NAMES AND ADDRESSES OF PERSONS IN ATTENDANCE UPON THIS COURSE.

Alexander, Jane A....30 Prince Street, Minneapolis, E. D.
Asire, Mrs. Dr. L....258 First Avenue South, Minneapolis.
Aasland, G. P.... 1315 Seventh Street, S. E., City.
Abbott, Mrs. A. L....1115 Fifth Street, E. D.
Adams, Mrs. S. E....Care of Carrier 3, West Side.
Ainsworth, Mrs. C. F....404 Nicollet Avenue, Minneapolis.
Amy, Jennie M.... 1809 Portland Avenue, "
Anderson, Hannah.... 2215 Park Avenue, "
Adair, Mrs. Mary....206 Tenth Street South, "
Arnold, Mrs. E. L....513 Eighth Avenue South, "
Adams, Miss Alice....University of Minnesota, "
Allen, Mrs. M. L....312 Fourth Avenue Southeast, "
Angbe, Mary....Box 1829, "
Adams, Mrs. August....Care of Carrier 3, "
Abraham, Miss M. P....1025 Hennepin Avenue, "
Anderson, Henrietta....525 University Avenue Southeast, "
Alden, Jennie M....Box 143, "
Athens, Mrs....801 Fifth Street Southeast, "
Anderson, Mrs. R.... 1025 Eighth Street Southeast, "
Anderson, Anna E....618 Fourth Avenue Southeast, "
Adams, Mrs. Charles....107 Island Avenue, "
Allen, Miss Kitty....St. Cloud, Minn.
Anderson, Miss Mary....701 Union Avenue, Minneapolis.
Ames, Mrs. C. W....233 Western Avenue, St. Paul.
Avery, Mrs. G. W....725 Fourteenth Avenue Southeast, Minneapolis.
Alden, Bertha.... 1227 Fifth Street Southeast, "
Alexander, Mrs. Jane....52 Prince Street E. D., "
Allen, Mrs. E. S....Jacksonville, Vermont.
Alger, Mrs. Q. D.... 1227 University Avenue, Minneapolis.
Asire, Mollie....258 First Avenue South, "
Andrews, Mrs. F. P....527 Fifth Street Southeast, "
Austin, Mrs. M. P.... 1212 Eighth Street South, "
Anderson, Martha....Eden Prairie, Minn.
Billings, Miss Ida P....70 North Twelfth Street, Minneapolis.
Bicknell, Mrs. Chas. A....416 Nineteenth Avenue Southeast, "
Bicknell, Miss F. E.... 1805 Fourth Street Southeast, "
Beach, Mrs. W. H.... 1509 Park Avenue, "
Berry, Flora....300 Fourth Street Southeast, "

Barrows, Miss Nellie.............. ......227 Fourth Street Southeast, Minneapolis.
Beach, Miss M. P... 1509 Park Avenue, "
Brown, Mrs. E. J.................... ....61 Highland Avenue, "
Barrett, Nellie..................................611 Second Avenue North, "
Buhtolph, Mrs. F. G........................1829 Fifth Street Southeast, "
Butler, H. E.................................. 1829 Fifth Street Southeast, "
Berry, Miss Olive........................ 1906 Fourth Street Southeast, "
Bradley, Miss Anna...................... 1901 Fourth Street Southeast, "
Brown, Mrs. Elwood...............................425 University Avenue, "
Bartlett, C. J..Care *Tribune*, "
Beveridge, Miss Nellie..............................43 Royalston Avenue, "
Bolton, Lettie E.................. 1529 University Avenue Southeast, "
Benton, Mary L...........................419 Eighth Avenue Southeast, "
Bausman, Miss Bertha...........................320 South Tenth Street, "
Budington, Miss Anna........................ 1209 Hawthorne Avenue, "
Barry, Mrs. J. L................................218 Twelfth Street South, "
Bolton, Mrs. N. H.............................. 1529 University Avenue, "
Bell, Mrs. J. F..Long Prairie, Minn.
Bradford, Belle..................................1313 Fifth Street Southeast, Minneapolis.
Bardwell, Mrs. Wm..Excelsior, Minn.
Bradley, Mrs. R..........................1910 Fourth Street Southeast, Minneapolis.
Bettman, Mrs. P. H..........................35 Sixteenth Street North, "
Bernard, Mrs. M. M.....................517 Ninth Avenue Southeast, "
Billings, Mrs. A. L.............................70 North Twelfth Street, "
Butler, Mrs. L....................................808 Third Avenue South, "
Brown, Miss Nellie...................625 Fifteenth Avenue Southeast, "
Butler, Mrs. H. E....................................1829 Western Avenue, "
Blake, Miss S. C......................................324 Hennepin Avenue, "
Bardwell, Mrs. C. T.....................................1800 Park Avenue, "
Bolton, Miss L. F...........................1801 Fourth Street Southeast, "
Bacon, Mrs. W. H.........................401 Sixth Avenue Northeast, "
Bentliff, Mrs..
Bevan, Mrs...801 Fifth Street Southeast, "
Bosworth, Inez..................................502 Fifth Street Southeast, "
Berry, Mrs. R. W...............................502 Fifth Street Southeast, "
Bemis, E. W......................................502 Fifth Street Southeast, "
Butler, Mrs. G. S.....Room 3 Lindley Block, corner Seventh Street
and Nicollet Avenue.. "
Burtliff, Mrs. G.................................1806 Sixth Avenue South, "
Bredyman, Mrs. C..St. Cloud, Minn.
Bridgeman, Anna J.......................837 Fifteenth Avenue South, Minneapolis.
Burce, I. M..College Hospital, "
Brown, Paul.................................625 Fifteenth Avenue Southeast, "
Bell, Annie D...............................616 Fourth Avenue Southeast, "
Brooks, Mrs. D. T.................................. ....Minneiska, Minn.
Brown, Clara...1129 Hennepin Avenue, Minneapolis.
Beveridge, Miss Kate................................43 Royalston Avenue, "
Bonfoy, Anna H..............823 Twenty-second Avenue Southwest, Minneapolis.
Burch, Mrs. Lottie J..Excelsior, Minn.

Blaisdell, Ada..Box 178, Minneapolis.
Bragg, Mrs. W. F.. "
Brooks, Mrs. Jabez........ .... 1708 Laurel Avenue, "
Boeland, Mrs. Geo..Iowa City, Iowa.
Baldwin, Mrs. R. J..........................423 Seventh Street South, Minneapolis.
Blaisdell, Miss Sadie..Box 178, "
Ball, Mrs. Sarah...... ....Excelsior, Minn.
Beebe, Mrs. R. P.....................................614 Franklin Avenue, Minneapolis.
Bolton, Mrs. A. C... 1801 Fourth Street and Eighteenth Ave. S E., "
Brown, Estelle........................625 Fifteenth Avenue Southeast, "
Baker, Sibyl B............................ 1611 Sixth Street Southeast, "
Blanchard, Carrie W..........................University of Minnesota, "
Cheney, Mrs. Isaac.......................238 Fourth Street Southeast, "
Carriel, Mrs. D. S.................................... 1808 Fourth Avenue, "
Connor, Miss A. A.......................... 1415 University Avenue, "
Cheney, Miss Nellie A..Corner Franklin Avenue and Minnehaha, "
Cheney, Mrs. E...........Corner Franklin Avenue and Minnehaha, "
Cantwell, Miss M. J........... 1215 Chestnut Avenue, Minneapolis, "
Cummings, Mrs. R........................325 Sixth Avenue Southeast, "
Cooley, Mrs. E.............................121 Cess. Avenue Southeast, "
Coe, C. E.................... ....Room 59, 315 Hennepin Avenue, "
Coe, Helen..........................619 Thirteenth Avenue Southeast, "
Cooper, Mrs. Preston......Fourth Street and Third Avenue South, "
Castner, Mrs. F. H...............725 Fourteenth Avenue Southeast, "
Covey, Hattie D.............................508 Eighth Avenue South, "
Cuzner, Mrs. A. B..Twelfth Ave. Southeast, bet. Com. and Palm, "
Cooke, Mrs. J............................. 1521 Fifth Street Southeast, "
Cole, Miss Carrie A.....................113 Pleasant Street Southeast, "
Cole, Mrs. Alida..........................113 Pleasant Street Southeast, "
Camp, Mrs. A. R.......................... 1405 Fifth Street Southeast, "
Curtis, Mrs. E. F.......................527 Second Avenue Southeast, "
Clark, Prudy...Eden Prairie, Minn.
Crane, Tremont......................... 1113 Fourth Street Southeast, Minneapolis
Conklin, Miss Margaret ....2215 Park Avenue, "
Chapman, Mrs. Dr. O. S.................. 1123 Fourth Avenue South, "
Carpenter, Mrs. G. W..........................117 University Avenue, "
Carver, Miss Linda.. "
Carver, Mr. R. I......................... 1226 Sixth Street Southeast, "
Cunningham, Miss......Portland Avenue, between Eighteenth and Nineteenth streets .... "
Cantwell, Mrs. P. P............................ 1215 Chestnut Avenue, "
Chunt, Miss B. A............................. 1133 Ninth Street North, "
Chapman, Miss............................204 Fifth Avenue Southeast, "
Caswell, Mrs. Vesta.. ....Litchfield, Minn.
Caswell, Mrs. Martha...Coon Creek, Minn.
Clark, Mrs. Frank............................616 Sixth Avenue North, Minneapolis.
Cone, Mrs. J. W.................. ....701 Sixth Street Southeast, "
Crafts, Lettie...................................610 Fifth Street Southeast, "
Croswell, Mrs. H. J. G.................. 1301 Fifth Street Southeast, "

Cary, Mrs. N. H.....................................2216 Portland Place, Minneapolis.
Cook, Mrs. Nordy .... "
Cole, Mrs. E................................Seventeenth and Vine Streets, "
Cone, Mrs. M. D........Stearns Avenue and Twenty-eighth Street, "
Chamberlain, Mrs. W. E...Anoka, Minn.
Crafts, Mrs. A..................................610 Fifth Street Southeast, Minneapolis.
Crocker, Mrs. E. B..................................2222 Portland Place, "
Coe, Mrs. C. A..... ....619 Thirteenth Avenue Southeast, "
Conner, Mrs. J. L.............................252 Second Avenue South, "
Chute, Mrs. S. H...................................15 University Avenue, "
Cady, Louise...University of Minnesota, "
Cummings, Miss L........................325 Sixth Avenue Southeast, "
Crippen, Miss..34 Seventh Street, "
Cuzner, Mrs. E. A.. "
Cummings, Miss M..........................325 Sixth Avenue Southeast, "
Coplin, Mrs. Chas...........................318 Fourth Street Southeast, "
Creelman, Mrs. M. J.......................................5 Eastman Avenue, "
Coverdale, Mrs. J. W........................336 South Eighteenth Street, "
Caskin, Miss E. C.......428 Eighth Street and Fifth Avenue South, "
Christian, Mrs. Geo. H...Corner Eighth Street and Fourth Avenue South.. "
Coverdale, Daniel..........................336 Eighteenth Street South, "
Cumming, Mrs. Gussie...Taylors Falls, Minn.
Calderwood, Mrs. J. T..................................415 Grant Street, Minneapolis.
Cummings, Mrs. Henry.........................726 First Avenue North, "
Connell, Miss Kate B...........................70 North Twelfth Street, "
Coe, Mrs........ ....1906 Hawthorn Avenue, "
Christian, Mrs. L............Eighth Street and Fifth Avenue South, "
Clark, Mrs. G. A.................................809 Seventh Street South, "
Calhoun, Mrs. J. F.................................60 South Tenth Street, "
Coffin, Mrs. W. F.....................1013 Sixteenth Avenue Southeast, "
Coykendall, Mrs. J. R.........................715 Sixteenth Street South, "
Chapin, Mrs. N. C..................319 University Avenue Southeast, "
Cordell, D. W...904 University Avenue, "
Crosby, Mrs. Judge..Hastings, Minn.
Cook, Mrs. Alma...Anoka, Minn.
Campbell, Mrs. L. W......................1100 Fifth Street Southeast, Minneapolis.
Carey, Mrs. Maggie...........................926 Second Avenue South, "
Connor, Mrs. E. H...........................1105 Sixth Street Southeast, "
Carswell, Mrs. J. F.......................................43 Eastman Avenue, "
Canfield, Miss Maggie...Corner Cedar Avenue and Twenty-sixth Street,.. "
Cheney, Jennie L...........................325 Fourth Street Southeast, "
Christie, Mrs. J. O..................714 University Avenue Southeast, "
Cone, Mrs. E. C......................714 University Avenue Southeast, "
Dean, O. A..Bloomington, Minn.
Dexter, Mrs. Chas..63 Island Avenue, Minneapolis.
Davidson, Mrs. E. B...............................1021 Hennepin Avenue, "

Donnell, Mrs.....Nineteenth Street between Sixth and Seventh Avenues South.. Minneapolis.
Dorsett, Mrs. C. W.. "
Dix, Mrs. S. A.....................................27 South Twelfth Street, "
Dyer, Mrs. C. E.......................624 University Avenue Southeast, "
Durkee, Mrs. H. O..Rochester, Minn.
Dodson, Mrs. E. F.................................1509 Portland Avenue, Minneapolis.
Donovan, Mrs. M...................................Street Railway Office, "
Derickson, Mrs. G. P...............................24 Highland Avenue, "
Davenport, Mrs. E. J......................................63 Oak Grove, "
Dudley, Mrs. D. W...2030 Place, "
Dennison, Mrs. J. E.... ....1413 Seventh Street Southeast, "
Dodge, Mrs. J. A........................417 Eighth Avenue Southeast, "
Dowers, Mrs. E..........................110 Washington Avenue South, "
Dennett, Miss S. E...............................716 University Avenue, "
Doolittle, Mrs. L. A..........................727 Sixth Street Southeast, "
Deveau, Miss Gertrude.......................804 Sixth Avenue South, "
Dickinson, Mrs. G. L........................1301 First Avenue South, "
Donthwaite, Mrs. M. A...Bloomington, Minn.
Donald, Mrs. M..............................903 Main Street Southeast, Minneapolis.
Downey, Mrs. Stella.....................801 Seventh Street Southeast, "
Davenport, Mrs. Jason...........................57 South Tenth Street, "
Doerr, Mrs. Henry.............................25 Washington Avenue, "
Davenport, Mrs. G. C...............................619 Mississippi Street, St. Paul.
Daniel, Mrs..319 University Avenue, Minneapolis.
De Mott, Mrs. H. V..Seventeenth St., bet. Nicollet and Hennepin, "
Davison, Mrs. R. A ....Box 440, "
De Laittre, Mrs. Jno.................................24 Grove Place, Nicollet Island.
Dailey, Mrs. C. W...Box 717 Brainerd, Minn.
Dailey, Miss A. E..................714 University Avenue Southeast, Minneapolis.
Dailey, Mrs. M. A..................714 University Avenue Southeast, "
Elliot, Mrs. J. R...........Cor. Tenth Street and Tenth Ave. South, "
Elliott, Mrs. A. F....................................429 Nicollet Avenue, "
Emery, Mrs. Fanny................................ 2030 Portland Place, "
Emery, Mrs. H. F..............................724 Fourth Street South, "
Elliot, Mrs. D................................ 1415 Sixth Avenue South, "
Eustis, Miss Emma..................................University Avenue, "
Eustis, Miss Nellie................................ University Avenue, "
Eustis, Mrs. E. S.................................... University Avenue, "
Eastman, Mrs. Geo. H............... 18 Grove Place, Nicollet Island, "
Einstein, Mrs. Kate................................ 620 Nicollet Avenue, "
Eastman, Mrs. John W..........................716 University Avenue, "
Eastman, Mrs. H. D................. 20 Grove Place, Nicollet Island, "
Elliot, Mrs. M. E..............................814 Third Avenue South, "
Edgerly, Mrs. Frank..............609 Thirteenth Avenue Southeast, "
Erickson, Mrs. O. P.............. 609 Thirteenth Avenue Southeast, "
Elwell, Mrs. Jas. P.. "
Ermentrouh, Mrs. C. H...........................1820 Nicollet Avenue, "
Edwards, Mrs. John.................................617 Seventh Avenue, "

Edwards, Miss Flora.. Box 888, Brainerd, Minn.
Eaton, Mrs. Chas. A................................First Avenue North, Minneapolis.
Emery, Mrs. J. C.................................2030 Portland Place, "
Emery, Dr. Mary.. 433 Dayton Avenue, St. Paul.
Elwell, Mary W...................................1002 Elwell's Addition, Minneapolis.
Elwell, Mrs. George...............................1002 Elwell's Addition, "
Edwards, Miss Fanny..................... 617 Seventh Avenue South, "
Eastman, Mrs. C. C.....................24 Grove Place, Nicollet Island, "
Eastman, Mrs. C. H....................................Dedham, Audubon County, Iowa.
Emery, Mrs. H. F....................1721 Fourth Street South, E. D., Minneapolis.
Eastman, Mrs. A. M.............................716 University Avenue, "
Fowle, Anna R....................................33 Sixteenth Street North, "
Foster, Mrs. C. E................................ 1401 University Avenue, "
Fuller, Jennie, M. D...433 Dayton Avenue, St. Paul
Foset, Mrs. C. E...........................521 Ninth Avenue Southeast, Minneapolis.
Farrier, Mrs. G. W...........................Room 59, Hennepin Block, "
Fish, Mrs. A. M...................................49 Third Street South, "
Fosberg, Lottie................................228 Fifth Street Southeast, "
Fosberg, Kate.............................. 520 Fourth Street Southeast, "
Fules, Ida.................................. 2118 Portland Avenue South, "
Folwell, Mrs. M. H....................... 1020 Fifth Street Southeast, "
Fobwle, Mrs. E. B.......................... 409 Sixth Street Southeast, "
Foster, Mrs. F. P......................... 1323 Fourth Street Southeast, "
Firkins, Ina....................................... University of Minnesota, "
Fairly, Mrs. William..613 Cedar Avenue, "
Foster, Miss L..2216 Portland Place, "
Foster, Mrs. Robert...........................1327 Fifth Street Southeast, "
Francis, Miss Emma.....................................Care A. B. Barton, "
Foster, Mrs. S. E............................518 Eighth Street Southeast, "
Foster, Flora.........Between Fourth and Fifth Avenues Southeast, "
Fullerton, Mrs. C. F..........................203 Eleventh Street South, "
Furber, Mrs. Geo.........Corner Sixteenth Avenue, Elwell's Add., "
Flemming, Annie R...............312 Nineteenth Avenue Southeast, "
Felt, Mrs. E. S....................................34 Seventh Street South, "
Field, Mrs. Ellen M........Twenty-first Avenue and Twelfth Street North.. "
Folds, Mrs. William B....................... 607 Second Avenue South, "
Foster, Mrs. A. F..............................916 Seventh Street South, "
Fairchild, Mrs. E. K..........................409 Fifth Street Southeast, "
Forbes, Carrie E..21 Eastman Avenue, "
Fratzke, Ida...602 South Tenth Street, "
Francisca, Mrs. G. E.........................409 Eighth Street Southeast, "
Gould, Mrs. Lucy.....................................527 Ninth Street South, "
Guild, S. A...1214 Harmon Place, "
Graham, Mrs. D. M...................................1527 Sixth Street North, "
Garfield, Mrs. J. M.........Corner Nicollet and Hennepin Avenues, "
Gould, Helen M...Excelsior, Minn.
Grimes, Mrs. J. T..................609 Thirteenth Avenue Southeast, Minneapolis.
Goodale, Mrs. P. H..........................1019 Fifth Street Southeast, "

Goss, Mrs. S. M..Olympia, Washington Territory.
Gage, Mrs. H. C................................21 South Twelfth Street, Minneapolis.
Gallow, Mrs. J. E..............................University of Minnnesota, "
Grindale, Mrs. C. J........................515 Fourth Avenue Southeast, "
Gardner, Mrs. E..............................631 Fifteenth Street South, "
Greenleaf, Mrs. L. L..Beloit, Wis.
Gray, Mrs. W. R........................... .....57 North Twelfth Street, Minneapolis.
Gray, Miss Mamie...Care J. R. Hoflin, "
Gillette, Mrs. L. S ....1301 Fourth Street Southeast, "
Gallinger, Mrs. H. E........................1103 South Seventh Street, "
Grimes, Emma..Fergus Falls, Minn.
Gukell, Mrs. Joseph............................38 North Twelfth Street, Minneapolis.
Gudley, Mrs. J. C..Victor, Iowa.
Graham, Miss R......................................1224 Nicollet Avenue, Minneapolis.
Gilpatrick, Mrs. Thos...........................1018 Fifth Street South, "
Gilpatrick, Mrs. Eva........................411 Eighth Street Southeast, "
Gordon, Mrs. E. P...................409 Madison Street, East Division, "
Gorham, Mrs. J. E.......Corner Fourteenth Street and Vine Place, "
Griffith, Mrs. O. J........................... 1307 Fourth Avenue South, "
Graves, Mrs. A. R............................513 Seventh Avenue South, "
Godfrey, Mrs. A. C..Minnehaha, Minn.
Gray, Mrs. T. J...St. Cloud, Minn.
Gilmore, Mrs. D. M...............................1600 Laurel Avenue, Minneapolis.
Gale, Mrs. S. C...Care Gale & Co., "
Graham, Mrs. J...........................1112 Fourth Street Southeast, "
Griffith, Mrs. O. J.............................1307 Fourth Avenue South, "
Grimes, Mrs E. E... "
Goodrich, Mrs. F. B.............................713 Eighth Street South, "
Gilfillan, Mrs. J. B.......... ....Corner Fourth Street and Tenth
Avenue Southeast... "
Galpin, Mrs....1328 Cor. Sixth St. and Fourteenth Ave. Southeast, "
Gould, Mrs. M. S..Excelsior, Minn.
Gould, Lucy M.......................................1214 Harmon Place, Minneapolis.
Goodfellow, Mrs. R. S...............................33 South Ninth Street, "
Grimes, Mary.........................509 Thirteenth Avenue Southeast, "
Holbrook, Mattie... ....210 Central Avenue, "
Hawes, Mrs. W. W...........................419 Sixth Street Southeast, "
Hawes, Mrs. J......... Eighth Street and Tenth Avenue Southeast, "
Hughes, Helen G..............................1104 Eighth Street Southeast, "
Holbrook, Mrs. E. R................................. .29 Eastman Avenue, "
Hughes, Mrs. T. E......................................38 Oak Grove Street, "
Hayes, Mrs. M. P.................................525 University Avenue, "
Holmes, Mrs. J. V...Beloit, Wis.
Hinshaw, Mrs. A...........................414 Sixth Avenue Northeast, Minneapolis.
Hatch, Mrs. A. P.................................907 First Avenue North, "
Huntington, Florence................ ....121 Fourth Street North, "
Hall, C. W..904 University Avenue, "
Hudson, Mrs. James...........................Corner Ninth and Broadway, St. Paul.
Huntley, Mrs J. S...................... 1025 Eighth Street Southeast, Minneapolis.

Hoyt, Mrs. C. J .... 628 Sixteenth Street, Minneapolis.
How, Lizzie .... 425 Fourth Street Southeast, "
Hicks, Mrs. H. G .... 120 Third Avenue South, "
Harmon, Miss Irene .... 421 First Avenue South, "
Harmon, Mrs. E. A .... 421 First Avenue South, "
Hoit, Mrs. J. R .... Pillsbury "A" Mill, "
Henderson, Laura E .... 217 Fifth Street Southeast, "
Hutchins, Mrs. Dr .... 30 Thirteenth Street South, "
Hendrickson, Mrs. E. H .... Room 20, F. & M. Block, St. Paul.
Hayes, Miss Carrie .... 525 University Avenue Southeast, Minneapolis.
Ham, Minnie .... 640 Sixth Avenue North, "
Hayes, Amy N .... 1226 Fifth Street Southeast, "
Heath, Mrs. S. F .... 1323 Fourth Street Southeast, "
Hurkinson, Zenobia .... Fourth Street and Tenth Avenue, "
Hagan, Mrs. A. R .... 1013 Sixth Street Southeast, "
Hall, Mrs. C. W .... 904 University Avenue Southeast, "
Hush, Mrs. V. J ...... Corner Tenth Street and Second Ave. South, "
Holman, Miss M. B .... 1423 Fifth Street Southeast, "
Hoflin, Mrs. J. R .... 1521 Nicollet Avenue, "
Hermes, Miss Sarah .... 1219 Fourth Street Southeast, "
Henshaw, I. M .... 414 Sixth Avenue Northeast, "
Halnosson, Mrs. Emma .... 30 South Tenth Street, "
Hammond, Mrs. Mary .... Lake City, Minn.
Harrison, Mrs. John .... 700 Hennepin Avenue, Minneapolis.
Haight, Miss Mamie .... Bismarck, Dakota Territory.
Hurlburt, Mrs. Wm. H .... Winona, Minn.
Hoag, Mrs. W. R .... 1113 Fourth Street South, E. D., Minneapolis.
Henderson, Mrs. A. C .... 217 Fifth Street Southeast, "
Hance, Mrs. S. F .... 720 Sixth Avenue South, "
Howey, Mrs. J. F .... 316 Eighth Street South, "
Howell, Miss .... 307 Tenth Street South, "
Heath, Mrs. L. M .... 1324 Fourth Street, Southeast, "
Haskell, Mrs. Frank .... Box 586, "
Hughs, Mrs. T. E .... 38 Oak Grove Street, "
Hall, Mrs. E. I .... 714 University Avenue, "
Hastings, Mrs. W. H .... 1816 Fifth Avenue South, "
Hubbard, Mrs. R. M .... 804 Sixth Avenue South, "
Hendrickson, Minnie M .... Room 20, F. & M. Block, St. Paul.
Havens, Mrs. H. R .... 413 Grant Street, Minneapolis.
Hall, Mrs. John ..... Bet. Eighteenth and Nineteenth Aves. South, "
Houghton, Mrs. A. C .... 1604 Park Avenue, "
Harper, Mrs. J. L .... 34 South Seventh Street West, "
Hurd, Mrs. B. C .... 714 First Avenue North, "
Holmes, Mrs. H. A .... 113 Pleasant Street, E. D., "
Hall, Mrs. P. D .... 1305 Hawthorne Avenue, "
Holden, Mrs. W. H .... Hastings, Minn.
Harrington, Mrs. L. G .... Mankato, Minn.
Hyde, Mrs. E. R .... Chelsea, Orange County, Vt.
Hudson, Mrs. H. H .... Bridgewater Corner, Vt.

Haglin, Mrs. C. F	321 South Eighth Street, Minneapolis.
Hemiup, Mrs. D. D.	604 Fifth Street Southeast, "
Hayes, Mrs. Geo	1018 Nicollet Avenue, "
Hagan, Fannie	1013 Sixth Street Southeast, "
Hawes, Mrs. W. W	419 Sixth Street Southeast, "
Holmes, Mrs. H. W	820 Uuniversity Avenue Southeast, "
Hastings, Mrs. A. W	427 Eighth Avenue Southeast, "
Hager, Mrs. P. F	1010 Fourteenth Avenue Southeast, "
Irving, Mary E	University of Minnesota, "
Irwin, Mrs. E. F	Richfield, Minn.
Jones, Mrs. C. C	1529 Fourth Street Southeast, Minneapolis.
Jefferson, Annie H	1021 Fourth Street Southeast, "
Jones, A. W	University of Minnesota, "
Jones, Mrs. Dr	Red Wing, Minn.
Jamison, Mrs. Robt	1409 Fifth Street Southeast, Minneapolis.
Johnson, Miss Bessie	227 Fourth Street Southeast, "
Jones, Mrs. Bertha	88 South Fourteenth Street, "
Jones, Mrs. Howard	88 South Fourteenth Street, "
Jones, Jennie L	1529 Fourth Street Southeast, "
Johnson, Mrs. R. H	30 Seventh Street South, "
Joy, Miss Inez E	Corner Tenth Street and Tenth Ave. South, "
Joslin, Mrs. E. O	404 Nicollet Avenue, "
Jones, Mrs. Jos	Oskaloosa, Iowa.
Jefferson, Mrs. C. A	1021 Fourth Street Southeast, Minneapolis.
Jones, Mrs. J. J	1221 First Avenue North, "
James, Mrs. W. A	1910 Hawthorne Avenue, "
Johnson, Hannah	2500 Stevens Avenue, "
Jones, Mira C	502 Fifth Street Southeast, "
Johnson, Miss F. M	927 Fifth Avenue South, "
Jones, Miss Annie	122 First Avenue North, "
Johnson, Lena	720 Third Avenue South, "
Joslin, Mrs. J. C	1203 Hennepin Avenue, "
Jackson, Mrs. Geo	1914 Hawthorne Avenue, "
Jackson, Mrs. A. B	Care of Jackson & Pond, "
Jerome, Mrs. Chas. P	620 Second Avenue South, "
Johnson, Mrs. L. G	329 University Avenue, "
Jackson, Mrs. A. B	715 Sixteenth Avenue South, "
Jenkins, Mrs. J. H	Oshkosh, Wis.
Jones, Mrs. Chas	Bradford, Orange County, Vt.
Johnson, Anna	Sixth Street and Eighth Avenue, Minneapolis.
Johnson, A. L	622 Fourteenth Avenue Southeast, "
Jackson, Mrs. H. N	89 Franklin Avenue, "
Jones, Mrs. M. H	Excelsior, Minn.
Jackson, Mrs. J. G	Minneapolis.
Johnson, Miss Margaret	714 University Avenue Southeast, "
Kingsley, Miss Mary	212 Grant Street Southeast, "
Kennedy, Julia	21 Eastman Avenue, "
Kennedy, Miss Mary	428 University Avenue, "
Kiehle, Louisa	1719 Fifth Avenue South, "

Kiehle, Ada M	1719 Fifth Avenue South,	Minneapolis.
Kirkwood, Mrs. H	614 Hennepin Avenue,	"
Knotson, Miss Martha	30 Tenth Street South,	"
Kittridge, Mrs. C. L	710 University Avenue,	"
Kennedy, Mrs. P. A	428 University Avenue,	"
Kennedy, Miss Kate	428 University Avenue.	"
Kitteridge, Mary R	1021 Fourth Street Southeast,	"
Kitteridge, Mrs. T	1021 Fourth Street Southeast,	"
Knieff, Emma	1513 Fifteenth Avenue Southeast,	"
Knox, Miss Florence	1005 Seventh Street Southeast,	"
Kennedy, Ernest	428 University Avenue,	"
Kelly, Miss Kate	1529 Fourth Street Southeast,	"
Kuderer, Miss Frances	419 Sixth Street Southeast,	"
Kelley, Mrs. L. E	1203 First Avenue North,	"
Koon, Mrs. M. B	Ninth Street and Fourth Avenue,	"
Kitchel, Mrs. Spanley R	128 Highland Avenue,	"
Kent, Mrs. Chas	2030 Portland Place,	"
Kiehle, Mrs. D. L	1719 Fifth Avenue South,	"
Knight, Mrs. S. H	2018 Eighth Avenue South,	"
Klopp, Mrs. M. J	63 Island Avenue,	"
Kelley, Mrs. H. H	803 University Avenue Southeast,	"
Kelson, Mrs. W. H	714 University Avenue Southeast,	"
Little, Jennie E	24 Fourteenth Street South,	"
Lewis, Ruth C	1310 First Avenue South,	"
Lyte, Mrs. F. A	1222 Fifth Street Southeast,	"
Loye, Mrs. Wm	613 Cedar Avenue South,	"
Larson, Miss Martha		"
Long, Miss Alva	420 First Avenue South,	"
Le Duc, Miss M. C	1600 Fourth Street Southeast,	"
Lackor, Miss Ida F	224 Grant Street,	"
Lackor, Mrs. H. L	224 Grant Street,	"
Lloyd, Mrs. Helen M		Toledo, Ohio.
Lawley, Mrs. Frank	229 First Street North,	Minneapolis.
Lunt, Mrs. J. H	1800 Fourth Street Southeast,	"
Lewis, Mrs. D. J	1600 Fifth Street Southeast,	"
Lingrin, Pina	Care of S. C. Gale,	"
Lee, Miss	1227 Hennepin Avenue,	"
Larson, Miss Emma	1025 Fifth Street Southeast,	"
Lyle, Mrs. Robert	1123 University Avenue Southeast,	"
Lawrence, Lucy C	1219 Fourth Street Southeast,	"
Lovejoy, Mrs. Loren K	715 Fourth Street Southeast,	"
Lewis, Mrs. L. M	30 Seventh Street South,	"
Laythe, Miss Bessie	803 Fourth Street Southeast,	"
Laraway, Mrs. L. D	2215 Thirteenth Avenue South,	"
Lyall, Maude J	University of Minnesota,	"
Lovell, C. P	131 Highland Avenue,	"
Leathers, Mrs. Oliver		Princeton, Minn.
Laurence Mrs. A. W	622 Fifth Street Southeast,	Minneapolis.

Lyman, Mrs. J. P...Grinnell, Iowa.
Lyall, Miss M. E........................ 326 Fifth Street Northeast, Minneapolis.
Lisk, Miss............................ ....504 Fourth Street, E. D., "
Lee, Mrs. J. W...Box 51, "
Latz, Mrs. F. W......................1401 Washington Avenue South, "
Lyons, Wm...Box 685, "
Lumley, Mrs. Chas...Corner Seventh Ave. and Sixth Street South, "
Linton, Mrs. Abner...................................Grand Forks, Dakota Territory.
Latz, Mrs. Dr......................1816 Two-and-a-Half Street South, Minneapolis.
Longee, Mrs. C. D.........................1103 Fifth Street Southeast, "
Leonard, Mrs. L. D...........................812 Third Avenue South, "
Long, Mrs. M. C..... ....443 Carroll Street, St. Paul
Linton, Mrs. A. H...Box 240, Minneapolis.
Lumbert, Mrs. E. R.................................469 Bluff Street, Dubuque, Iowa.
Leavitt, Mrs. Elizabeth..........................31 Royalston Avenue, Minneapolis.
Leighton, Mrs. H......... ....803 Fourth Street, "
Lochren, Mrs. Wm........ ....422 Tenth Avenue Southeast, "
Lundeen, Mrs. John A..Fort Snelling, Minn.
Lund, Mrs. ....315 University Avenue Southeast, Minneapolis.
Lobdell, Mrs. Leila.................2706 Twenty-eighth Street South, "
Lobdell, Mrs. C.......................2910 Thirty-first Avenue South, "
Longbrake, Mrs. L. L............. ....University Avenue, "
Lovejoy, Mrs. J. A..............1013 University Avenue Southeast, "
Long, Mrs. E. H....................111 University Avenue Southeast, "
Linton, Mrs. A. H...................................79 Sixth Street South, "
Lamborn, Mrs. E. F...........................724 First Avenue North, "
Lee, Mrs. J. B.............................1228 Fourth Street Southeast, "
Libby, Minnie.......................................2617 Nicollet Avenue, "
Lyon, Mrs. R. C....................1010 Fourteenth Avenue Southeast, "
Lockwood, Mrs. Phillip.................202 Thirteenth Street South, "
McDougall, Mrs. J. E................. 1515 Seventh Street Southeast, "
Montgomery, Mrs. M. W................720 Eleventh Avenue South, "
Markus, Emma.................................1910 Hawthorne Avenue, "
Morrisson, Miss J. E.......................328 Fourth Street Southeast, "
Mann, Ida V...................................1512 Sixth Avenue South, "
McMahon, Miss Kate...............................Care A. B. Barton, "
Myers, Evelyn H............................1214 Fifth Street Southeast, "
McNair, Will..................................814 Fifth Street Southeast, "
McIntyre, M. Eva................................1833 Portland Avenue, "
Murray, Margaret A......................... 2720 Third Avenue South, "
McLaughlin, Miss M...........................229 First Street North, "
Marsh, Mrs. C. A. J....... ....324 Franklin Avenue, "
Marshall, Mrs. J..............................500 Eighth Avenue South, "
McSorley, Miss Florence..........421 Thirteenth Avenue Southeast, "
Mann, Mrs. G. T............................ 1512 Sixth Avenue South, "
Morris, M. L.......................................700 Hennepin Avenue, "
Marrs, Josephine......................................2211 Park Avenue, "
Milliken, Mrs. W. P..Lake City, Minn.

Martin, Mrs. John..............................425 University Avenue, Minneapolis.
Miner, V. F..Flat 5, Hale Block, "
Mitchell, Luella.........................1414 Sixth Street Southeast, "
Marston, Mrs. M.....................................2211 Park Avenue, "
McKenney, Mrs. A. E........... 311 University Avenue Southeast, "
Merrick, L. L.............Nicollet Avenue between Eighteenth and
Nineteenth Streets.. "
Moore, Mrs. J. P................................30 South Seventh Street, "
Moore, Mrs. Kate................................30 South Seventh Street, "
Matthews, B. E..........................727 Sixth Street Southeast, "
McNair, Mrs. Isaac.. "
McCleary, Mrs. T......................... 820 Fourth Street Southeast, "
McNair, Miss A. W...................................North Sparta, Lee County, N. Y.
McNair, Miss Louise................................ North Sparta, Lee County, N. Y.
Marsh, Helen B............................ 417 Second Avenue North, Minneapolis.
Mayor, Mrs. Belle................................ 928 Hennepin Avenue, "
Morse, Mrs. Susie K......................................Care Gale & Co., "
McMillan, Mrs. P. D...Fifth Street and Tenth Avenue Southeast, "
Morse, Mrs. W. A................................ 1231 Chestnut Avenue, "
Major, Mrs. Mollie S.............................917 Hennepin Avenue, "
Morrison, Mrs. H. G. O.....Cor. Nicollet Ave. and Fourteenth St., "
McNair, Marie L.............................1200 Second Avenue South, "
Morse, Mrs. F. L.........Cor. Nineteenth St. and Hawthorne Ave., "
Merrick, Mrs. A. N............................Room 4, Hurlburt Block, "
McNiece, Mrs. Ettie..................622 Fifteenth Avenue Southeast, "
McCord, Mrs. J... La Crosse, Wis.
Moffett, Mrs. Chas. W......................3105 Sixth Avenue South, Minneapolis.
McIntyre, Miss....................................324 Hennepin Avenue, "
Moore, Mrs. Geo. C..................... 1608 Fourth Street Southeast, "
McCann, Mrs. M. A.................... 2745 Fifteenth Avenue South, "
Moore, Mrs. H. L..........................301 Fourth Street Southeast, "
Moore, Mrs. A. G..........................301 Fourth Street Southeast, "
Moulton, Miss Maddie................. 902 Seventh Street Southeast, "
McClellan, Eva...........................2512 Sixteenth Avenue South, "
McCulloch, Mrs. A. S...............................1400 Stevens Avenue, "
McDonald, Mrs. F. S....................... 1212 Eighth Street South, "
May, Mrs. C.. "
May, Miss Mary O.........................1202 Fourth Street Southeast, "
Mills, Mrs. A. W.. "
McCulloch, Mrs. F. B............................1400 Stevens Avenue, "
Monthei, Mrs. H.....................1206 Washington Avenue South, "
Moore, Miss Mabel.................................140 Highland Avenue, "
Manchester, Mrs. M. S................. 1412 Sixth Street Southeast, "
Mason, Mrs. M. T........................... 1103 Seventh Street South, "
Morrison, Mrs. L. L............................. 1512 Nicollet Avenue, "
Milligan, Mrs. J. G.....................1202 Fourth Street Southeast, "
Mitchell, Mrs. Nancy.. Excelsior, Minn.
Martin, Miss Ellen.................................93 Sixth Street South, Minneapolis.
Morse, Mrs. Frank............................1819 Hawthorne Avenue, "

McClary, Maggie A.......... 316 Sixth Street Southesst, Minneaplis.
Molynew, Mrs. B. S.......... ..702 Seventh Street, "
Martin, Mrs. C. J..........602 Tenth Street South, "
Marshall, Mrs. Jas..........500 Eighth Avenue South, "
Miller, Nellie M..........21 Eastman Avenue, "
Miller, Miss Mattie... ....17 Eastman Avenue, "
Miller, Mrs. G. W..........21 Eastman Avenue, "
Miller, Mrs. P. A..........Cascade, Dubuque County, Iowa.
Mills, Mrs. S.......... Minneapolis.
Morse, Mrs. Chas.......... 317 Eighth Street, South, "
McNair, Minnie.......... Care I. McNair, "
McLeod, Mrs. Jennie..........725 Fourteenth Avenue Southeast, "
Mansfield, Miss A..........709 Fourth Street Southeast, "
Moody, Mrs. F. F.......... 39 North Nineteenth Street, "
Merriam, Mrs. G. N.......... ...828 Second Avenue South, "
Miller, Mrs. W. A..........916 Mary Place, "
Moore, Mrs. G. A..........1119 Sixth Street Southeast, "
Meader, Mrs. S. B.......... 601 Second Avenue South, "
Nelson, Emma C..........113 First Street South, "
Nettleton, Miss Carrie M..........927 Fifth Avenue South, "
Nind, J. Newton.......... "
Nelson, Miss Annie..........1020 First Street Southeast, "
Noblit, Mrs. J. H..........30 Seventh Street Southeast, "
Naylor, Mrs. Geo. M..........1418 Spruce Place, "
Norton, Mrs. L. B.........Northwestern Hospital, Three-and-a-half Avenue South .... "
Newcomb, Mrs. S.......... "
Nicol, Miss Ida..........914 Seventh Street Southeast, "
Newman, Mrs..........Sixth Street and Ninth Avenue Southeast, "
Nettleton, Mrs. A. B..........927 Fifth Avenue South, "
Nah, Miss Mary..........421 First Avenue South, "
Notervan, Mrs. R. E..........617 Seventh Avenue South, "
Nelson, Ellen M..........1401 Sixth Street Southeast, "
Nickell, Mrs. J. H..........619 First Avenue South, "
Norton, Miss Carrie..........715 Fourth Street Southeast, "
Norton, Mrs. H. A..........715 Fourth Street Southeast, "
Newten, Miss H..........Corner Fourteenth Avenue and Eighth Street Southeast .... "
Nichols, Miss Lillie..........1206 Eighth Street South, "
Outcalt, Miss F. B..........1827 Third Street Southeast, "
Outcalt, Miss Cora..........1827 Third Street Southeast, "
Overmire, Kate..........2022 Seventh Avenue South, "
Overmire, Mrs. S..........2022 Park Avenue South, "
Olson, Miss Olive..........88 South Fourteenth Street, "
Oxnard, Mrs. M. A..........829 Second Avenue South, "
O'Brien, Mrs. W.......... 411 Eighth Street Southeast, "
Owen, Miss Jennie..........St. Cloud, Minn
Orborough, W. A..........Bloomington, Minn.
Otto, Tilly.......... 63 Tenth Street South, Minneapolis.

Osgood, Mrs. C. N..........................720 Sixth Avenue South, Minneapolis.
Peterson, Carrie.. "
Preston, Jennie..38 Prince Street, "
Pike, Mrs. W. A...............................University of Minnesota, "
Payne, Mrs. D. W...........................1415 University Avenue, "
Powell, Mrs. C. F........................1025 Fifth Street Southeast, "
Pratt, Mrs. E. A........ ....27 Twelfth Street South, "
Perkins, Mrs. G. D............................701 University Avenue, "
Plant, Mrs...408 Nicollet Avenue, "
Peck, Mrs. D. G.................................13 North Ninth Street, "
Pearson, Miss S. P...............................1101 Harmon Place, "
Pickard, Mrs. F. W.....................1300 Sixth Street Southeast, "
Penney, Mrs. Robert L....... ....16 South Twelfth Street, "
Peterson, Miss Minnie..1211 Second Street and Twelfth Ave. South, "
Pardee, Mrs. W. S...Eleventh Street and Twenty-second Ave. North, "
Porter, M. Estella..Box 30, "
Porter, Katie P...Box 30, "
Porter, Lillie C...Box 30, "
Parker, Mrs. H. M............................57 North Twelfth Street, "
Plant, Mrs. James C.........................210 Ninth Street South, "
Plummer, Mrs. G. A..............................1915 Nicollet Avenue, "
Patten, Mrs.................................168 Seventh Street Southeast, "
Payne, Mrs. D. C.............................17 North Eleventh Street, "
Parker, Mrs. Dr. J. A.......................17 North Eleventh Street, "
Parker, Mrs. Ed..... ....908 Seventh Street Southeast, "
Potter, Miss Elma.................... 623 Fifteenth Avenue Southeast, "
Pillsbury, Addie..............Fifth Street and Tenth Ave. Southeast, "
Pratt, Mrs. C. H..............................727 Sixth Street Southeast, "
Parker, Mrs. Geo. A......................516 Fourth Street Southeast, "
Paine, Mrs. J. M...................................2200 Nicollet Avenue, "
Pabody, Mrs. E. F..............................808 Third Avenue South, "
Paine, Miss Alice.......................... 73 Fourteenth Street South, "
Potter, Mrs. A. R.......................... 24 Thirteenth Street South, "
Pearson, Clara E.....................................1101 Harman Place, "
Page, Mrs. R. C.................................1236 First Avenue North, "
Parsons, Annie.. 107 Island Avenue, "
Patton, Dr. E. A ....1228 Second Avenue South, "
Plummer, Mrs. L. P............. ....1117 Second Avenue South, "
Page, Mrs. Dr.. Sandusky, Ohio.
Pratt, Mrs. C. H..............................727 Sixth Street Southeast, Minneapolis.
Phelps, Mrs. Chas.................................... 60 Highland Avenue, "
Pond, Mrs. C. M.......................................56 Highland Avenue, "
Phillips, Mrs. C. M.................................. 69 Highland Avenue, "
Palsepp, Anna D............................. 2803 Third Avenue South, "
Palmer, Mrs. Chas. R........... 2205 Three-and-a-Half Ave. South, "
Packer, Mrs. Mary.....................................413 Hennepin Avenue, "
Pillsbury, Mrs. J. S.............Fifth St. and Tenth Ave. Southeast, "
Pound, Jessie M........................... 1402 Second Avenue South, "
Pratt, Mrs. Frank...... ....2747 First Avenue South, "

Phillips, Mrs. B., Jr........................Care C. A. Pillsbury & Co., Minneapolis.
Quigley, Mrs. James........................316 Sixth Street Southeast, "
Rieley, Mrs. A...........................1513 Seventh Street Southeast, "
Rutz, Augusta..............................529 Eighth Avenue Southeast, "
Rahmon, Laura..............................822 Fourth Street Southeast, "
Rockwood, Mrs. C. J......................33 Nineteenth Street North, "
Ryan, Mary A...La Crosse, Wis.
Ryan, Julia.................................... 418 Second Avenue South, Minneapolis.
Russell, Mrs. O. M.................................. 608 Nicollet Avenue, "
Rich, Mrs. W. W........................529 Eighth Avenue Southeast, "
Russell, Mrs. Geo. V..............................614 Hennepin Avenue, "
Reynolds, Clara E..............................21 Thirteenth Street South, "
Richardson, Mrs. L. H.....................73 Fourteenth Street South, "
Rourke, Miss Nellie......................702 Second Avenue Southeast, "
Ripley, Dr. Martha G..........................48 Eighth Street South, "
Remington, Mrs..Box 51, "
Rose, Virginia........ ....Monticello, Minn.
Rose, Mrs. A. H.............................321 Fourth Street Southeast, Minneapolis.
Rinker, Mrs. Andrew................................1015 Harmon Place, "
Raymond, Miss M. A........................727 Sixth Street Southeast, "
Richardson, Mrs. A. F..........................111 Sixth Street South, "
Rickard, Mrs. C. F........................701 Seventh Street Southeast, "
Rolfe, Mrs. J. H................................1910 Hawthorne Avenue, "
Rand, Miss Kate.............Cor. Seventh Street and Sixth Avenue, "
Reynolds, Mrs. A. S...........................422 South Seventh Street, "
Rickey, Mrs. Jas......Tenth St. bet. Nicollet and Hennepin Aves., "
Robinson, Mrs. S. C..................................1812 Park Avenue, "
Read, Mrs. J. H.............................615 Fourth Avenue Southeast, "
Reeves, Mrs. T. H.................727 University Avenue Southeast, "
Rich, Mrs. W. W........................ 529 Eighth Avenue Southeast, "
Rich, Mrs. J. O...........................529 Eighth Avenue Southeast, "
Robedeau, Mrs. C. T...........................508 Fifth Avenue South, "
Rust, Mrs. Geo. H...............................1114 Hennepin Avenue, "
Rolph, Mrs. W. T....................... 416 Third Avenue Southeast, "
Rockwood, Mrs. C. J.........Nineteenth Street between Laurel and
Hawthorne Avenues.. "
Ricker, Mrs. H. M................................716 University Avenue, "
Shepard, Miss F.......................................1409 Stevens Avenue, "
Springate, Mrs. J. L...............................917 Hennepin Avenue. "
Soutar, Mrs........ Sixteenth Avenue and Seventh Street Southeast, "
Shaw, Mrs. J. M...................................527 Ninth Street South, "
Simmons, Laura.......... 328 Thirteenth Avenue and Fourth Street
Southeast .... "
Starr, C. M...Box 499, "
Shockey, Mrs. C. C...........................1320 Fourth Avenue South, "
Simpson, Mrs. M. E.....3, corner Central Avenue and Fifth Street, "
Stacy, Miss Frances.........................1113 Fourth Street Southeast, "
Smith, Mabel L.....................622 Fourteenth Avenue Southeast, "
Starr, Mrs. C. M.. ......Box 499, "

Stagg, Nettie..................................... 255 Hennepin Avenue, Minneapolis.
Shenehon, Frances S......................1113 Fourth Street Southeast, "
Siebert, Mrs. A C.......................Eighteenth Avenue Southeast, "
Stillman, Miss Nellie.........................2120 Third Avenue South, "
Sillowey, Mrs. R. A.......................1914 Fourth Street Southeast, "
Sure, Mrs. E. M.............................1320 Fifth Street Southeast, "
Sheffer, Miss Ada..............................1811 Fourth Street North, "
Sprague, L. E. P.......................................6 Highland Avenue, "
Secombe, Mrs. D. A........................927 Fourth Street Southeast, "
Smith, Mrs. Thomas......Corner Fifteenth Street and Spruce Place, "
Spear, Mrs. S. C.......................713 Fifteenth Avenue Southeast, "
Stillman, Mrs. W. F...Oshkosh, Wis.
Sewall, E. Q................. ....481 Carroll Street, St. Paul.
Shillock, Anna..............................1811 Fourth Avenue South, Minneapolis.
Smith, Mrs. C. F..........................457 Fourth Street Southeast, "
Swanson, Miss Hannah.......................201 Eleventh Street South, "
Spear, Minnie E............................1614 Fourth Street Southeast, "
Say, G. I................................727 Fifteenth Avenue Southeast, "
Strothinham, Mrs. J. H.....................629 Fifteenth Street South, "
Salisbury, Mrs. M. F.......................719 Eleventh Avenue South, "
Shuman, Mrs. Geo. W............................1001 Eighth Avenue, "
Shaw, Mrs. F. H.................................1509 Sixth Avenue South, "
Sheldon, Miss Emma F......... ....717 Eleventh Avenue South, "
Shaw, Mrs. Geo. K..................................1205 Hennepin Avenue, "
Shoemaker, Mrs. H. J..............................1903 Western Avenue, "
Selene, Miss Maggie......................417 Eighth Avenue Southeast, "
Shillock, Miss.......................................University of Minnesota, "
Stillman, Mrs. R. L..........................2720 Third Avenue South, "
Selden, Emma R....................................14 Tenth Street South, "
Stark, Mrs. Theo. F.................................134 Highland Avenue, "
Sweet, Mrs. O. T..........................702 Fourth Street Southeast, "
Smith, Mrs. Dr. C.............1102 South Seventh Street Southeast, "
Seaton, Miss Rose...........................902 Seventh Street Southeast, "
Slosson, Mrs. Theo...........................419 Sixth Street Southeast, "
Scudder, Mrs. M. C......................521 Eighth Avenue Southeast, "
Smith, Mrs. D. L...........................516 Fourth Street Southeast, "
Stacy, Alice M...............................1401 Sixth Street Southeast. "
Strever, Mrs.........................101 University Avenue Southeast, "
Sisson, Mary..College Hospital, "
Siddall, Mrs. W. A.........................73 Fourteenth Street South, "
Smith, Carrie E.....,..............................1800 Park Avenue South, "
Seaton, Mrs. J. K..................................902 7th Street Southeast, "
Sheldon, Mrs. S................. ....Care Dr. A. F. Elliott, "
Shepley, Mrs. L. C.........Cedar Avenue and Twenty-sixth Street, "
Shepley, Mrs. O. H... "
Swift, Grace H...1204 Chestnut Avenue, "
Swift, Mrs. L.. 1204 Chestnut Avenue, "
Spaulding, Mrs. W. A.................................. 1424 Vine Place, "
Smith, Mrs. D. C..................Cor. Fifth and Hennepin Avenues, "

Stark, Miss J. Mary.......134 Highland Avenue, Minneapolis.
Sewall, A. R....... 481 Carroll Street, St. Paul.
Sewall, Miss Ida....... 481 Carroll Street, St. Paul.
Shuey, Mrs. A. M....... 65 Highland Avenue, Minneapolis.
Scribner, Mrs. D. M.......1512 Nicollet Avenue, "
Sawyer, Mrs. T. J.......1512 Nicollet Avenue, "
Sauter, Miss Laura......Eighteenth Avenue, bet. Fourth and Fifth Streets, E. D....... "
Scharpf, Mrs. Geo.......84 South Thirteenth Street, "
Scribner, Mrs. D. M.......1512 Nicollet Avenue, "
Soutar, Mrs. Geo.......Luverne, Minn.
Sheldon, Mrs. H. G.......Richfield, Minn.
Smith, Mrs. E. T.......66 Highland Avenue, Minneapolis.
Smith, Mrs. Frank.......Ft. Snelling, Minn.
Spaulding, Mrs. G. S.......319 University Avenue South, Minneapolis.
Sprague, Mrs. J. J....... Oshkosh, Wis.
Shepherd, Mrs. Geo. B...Cor. First Ave. and Sixteenth St. South, Minneapolis.
Sheldon, Miss Mary....... Excelsior, Minn.
Steele, Mrs. J. A....... 103 Ninth Street South, Minneapolis.
Secombe, Kittie E.......927 Fourth Street Southeast, "
Spear, Mrs Edward.......502 Eighth Avenue South, "
Scudder, M. C.......521 Eighth Avenue Southeast, "
Scudder, Mrs. J. L....... 425 Eighth Avenue Southeast, "
Stone, Mrs. J. W....... 1015 First Avenue North, "
Smith, Mrs. W. K.......100 Royalston Avenue, "
Swett, Ella A.......702 Fourth Street, "
Shatto, Mrs. C. W....... "
Tweedie, Mrs. Wm.......1815 Seventh Street South, "
Tucker, Mrs. Henry.......826 First Avenue South, "
Taylor, Mrs. Benjamin.......2200 Chicago Avenue, "
Taylor, Mrs. B. L.......620 Fifth Street South, "
Talbert, Mrs. M. J.......1423 Fifth Street Southeast, "
Trogner, Miss....... 1315 Second Street North, "
Tupper, Mrs. D. W.......1113 Fourth Street Southeast, "
Thompson, Clara A....... 701 Fifteenth Avenue Southeast, "
Thompson, Mrs. P. M....... 701 Fifteenth Avenue Southeast, "
Twichell, Mary....... 400 Ninth Street Southeast, "
Teall, Mrs. B. F.......1510 Sixth Avenue South, "
Taylor, Miss Virgi.......Seventeenth Street, near Nicollet Avenue, "
Truesdell, Mrs. J. A....... 246 Farrington Avenue, St. Paul.
Trail, Jane.......Sixteenth Avenue and Seventh Street Southeast, Minneapolis.
Turner, L. H....... 2910 Thirty-first Avenue South, "
Townsend, Mrs. L. R.......19 Thirteenth Street South, "
Twichell, Miss M. H....... 1604 Park Avenue, "
Todd, Mary W.......504 Fourth Street Southeast, "
Taylor, Miss E....... 720 Sixth Avenue South, "
Thompson, Mrs. Anna.......Northern Pacific Junction, "
Tuller, Mrs. C. S.......Seventh Street, Lyons, Iowa
Truman, Mrs. B. H.......39 Fifteenth Street South, Minneapolis.

Todd, Mrs. S. D..............................504 Fourth Street, E. D., Minneapolis.
Trevellyan, Mrs. Am.................... 508 First Avenue Northeast, "
Tenney, Mrs. Wm.....Cor. Third Ave. South and Twelfth Street, "
Thomberg, Mrs. John......................... 86 Twelfth Street South, "
Turner, Mrs. Rev. W...Poynette, Wis.
Thomberg, Miss Kate.........................86 Twelfth Street South, Minneapolis.
Tice, Mrs. W. H.................................26 Eastman Avenue, "
Thompson, Miss Mettie......................... 613 Hennepin Avenue, "
Turner, Mrs. Murtz..Fifield, Wis.
Tully, Miss Maggie...........2527 Three-and-a-Half Avenue South, Minneapolis.
Thompson, Mrs. H. E................................ ..161 Pleasant Avenue, St. Paul.
Taylor, Mrs. K. M..Anoka, Minn.
Townsend, Mrs. L. R.....................19 South Thirteenth Street, Minneapolis.
Twickham, Mrs. Willis...Richfield, Minn.
Turner, Miss Minnie E.............2706 Thirty-first Avenue South, Minneapolis.
Turner, Mrs. Alvira.................. 2910 Thirty-first Avenue South, "
Thomas, Mrs. W........................ .. 409 Eighth Street Southeast, "
Ullmer, Mrs. M.....................207 University Avenue Northeast, "
Vind, Mrs. C. L....................710 University Avenue Southeast, "
Vrooman, Mrs. W ....8 Holden Street, "
Varney, Mrs. J. M...........1700 Three-and-a-Half Avenue South, "
Vosburg, Mrs. A.............................1103 Seventh Street South, "
Van Norman, J. D..Box 123, "
Van Cleve, Mrs. E. M....................520 Fourth Street Southeast, "
Van Cleve, Mrs. H. S.........................604 Fifth Street Southeast, "
Wilcox, Mrs. A. G..................................105 Highland Avenue, "
White, Mrs. C. A...1512 Vine Place, "
White, Miss Elburta.........................1804 Fourth Avenue South, "
Welles, Mrs. M. H.................... 1315 Seventh Street Southeast, "
Wornenninde, Miss....................................353 Franklin Street, "
Webster, W. W..Clearwater, Minn.
Wahlstrom, Albert.......................................210 Third Street, Minneapolis.
Wilder, Mrs. J. A.........................1021 Fourth Street Southeast, "
Warnock, A. May...................... ....1408 Nicollet Avenue, "
Wheaton, Mrs. Geo.......................119 Fourth Street Southeast, "
White, Mrs. M. C..........................1319 Fifth Street Southeast, "
Waltemath, Miss.......................120 Fourteenth Avenue North, "
Williams, Mrs. A. P....................... .....255 Hennepin Avenue, "
Whitcomb, Mrs. M. B..........................70 North Twelfth Street, "
Willenaw, Mrs. F..............................2014 Third Avenue North, "
Winterer, Edward.........................1113 Fourth Street Southeast, "
Worley, Mrs. Charlotte.....................88 South Fourteenth Street, "
Whipple, Mrs. Wm..Winona, Minn.
Winterer, Miss Ellen...................1113 Fourth Street Southeast, Minneapolis.
Weller, Miss Marian................................16 South Twelfth Street, "
Woodward, Frances G................................189 Island Avenue, "
Wyman, Mrs. William....................415 Fourth Street Southeast, "
Winston, Mrs. Fred R..................1013 University Avenue South, "
Wetherald, A. E...235 Fourteenth Street, St. Paul.

Woodburn, Miss Ida.........................30 South Seventh Street, Minneapolis.
Woodburn, Mrs. J. A.........................30 South Seventh Street, "
Walcott, Mrs. Reynolds.............................61 Oak Grove Street, "
Williams, Mrs. E. S.....................1729 Eleventh Avenue South, "
Winchell, Mrs. C. S.. "
Wilson, Helen E.........................505 Eighth Avenue Southeast, "
Webber, Mrs. Minnie....................................General Delivery, "
Wilson, Mrs. J. P.......................505 Eighth Avenue Southeast, "
Wells, Mrs. Genevive..........................903 First Avenue North, "
Whitney, Mrs. F. W..Beloit, Wis.
Wells, Mrs. S. R.......................................Buffalo, Wright County, Minn.
Woods, Mrs. Chas...............................33 South Tenth Street, Minneapolis.
Weller, Mrs. J. H...................................1824 Nicollet Avenue, "
Williams, Mrs. A. C.....................Ninth Street, near Mary Place, "
White, Miss Ida E...............................1015 Nicollet Avenue, "
White, Miss M. E.................................1015 Nicollet Avenue, "
Wadleigh, H. L............................1417 Sixth Street Southeast, "
Wells, Mrs. C. W..................................2500 Stevens Avenue, "
Wadleigh, E. H............................1417 Sixth Street Southeast, "
Wade, Mrs. C. H......................................262 Central Avenue, "
Wilcox, Mrs. J .P..Richfield, Minn.
Wullweber, Mrs. M. R..Iowa City, Iowa.
Woodmansee, Mrs. D. W...............1214 Fifth Street Southeast, Minneapolis.
Warner, A. A..St. Cloud, Minn.
Whiting, Mrs. A. V..St. Cloud, Minn.
Weber, Mary L...........................1401 Sixth Street Southeast, Minneapolis.
Williams, Mrs. H. R.....................837 Fifteenth Avenue South, "
Ware, Mrs. J. L....................312 Nineteenth Avenue Southeast, "
Wolfrum, Miss O...........................312 Fifth Street Northeast, "
White, Mrs. S. B..Watervliet, Mich.
Walke, Mrs. Chas.............................1129 Hennepin Avenue, Minneapolis.
Watson, Mrs. B. K........................39 Seventeenth Street South, "
Westcott, Mrs. Dr...............................1909 Hawthorne Avenue, "
Williams, Mrs. S. B.............................12 Eighth Street North, "
Walker, Miss May............................726 First Avenue North, "
White, Ida E......................................1015 Nicollet Avenue, "
Wheeler, Mrs. Wm....................................Sixth Street North, "
Williams, Mrs. B. H...........................34 South Seventh Street, "
Wilson, Mrs. E. M..........................1300 Hawthorne Avenue, "
Watts, Miss Martha................425 University Avenue Southeast, "
Wakefield, Annie L..............................1812 Nicollet Avenue, "
White, Miss Flora......................529 Eighth Avenue Southeast, "
White, Mrs. E.......................................616 Franklin Avenue, "
Whitney, Mrs. A.......................................413 Grant Street, "
Wilson, Mrs. N. G........................424 Third Avenue Northeast, "
Willmas, Mrs. J. R.......................510 First Avenue Northeast, "
West, Mrs. H. G..........................200 Fourth Street Northeast, "
Wells, Mrs. T. B... "
Wilson, Mrs. M. G.........................1115 Fifth Street Southeast, "

Wood, Mrs. Emma		Excelsior, Minn.
Walker, Mrs. P. B	726 First Avenue North,	Minneapolis.
Walker, Mrs. James	716 University Avenue,	"
White, Mrs. S. B	1228 Fourth Street Southeast,	"
Wilcox, Mrs. M. L	716 University Avenue Southeast,	"
Watson, Mrs. Geo. C	2618 First Avenue South,	"
Wolverton, Mrs. I. A	802 Sixth Avenue South,	"
Wolford, Mrs. W. L	59 Tenth Street South,	"
Whitney, Mrs. C. L	Box 178,	"
Young, Mrs. S. J	1721 Fourth Street Southeast,	"
Yenney, P. F. P		St. Cloud, Minn.
Ziegler, Mrs. C. C	2123 Lyndale Avenue North,	Minneapolis.