AGRICULTURE
and the
FARMING BUSINESS

OSCAR H. BENSON
and
GEORGE HERBERT BETTS

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WITH ILLUSTRATIONS, CHARTS AND DIAGRAMS

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PREFACE

This book deals with the business of farming. It attempts what has not yet been accomplished for the farmer—the bringing together in one simple non-technical volume of a wide range of practical scientific information directly related to the every-day problems of the farm and home.

Progressive farmers are everywhere proving that they are eager students of scientific matter bearing on agricultural practise. They are constantly seeking for the knowledge and the methods that will further their own success, improve agriculture and promote the general prosperity. They stand ready to apply what scientific investigations, experiments, tests and actual experience have proved to be sound practise and of definite value.

Farmers as a class are very busy, and they have neither the time nor the requisite training to search through the technical scientific treatises for the information and directions they require. The very abundance and thoroughness of the large quantities of reports, circulars and agricultural bulletins, as well as the farm journals, posters, special leaflets and what-not, are a source of confusion and often lead the general reader to bewilderment.

The present volume aims to serve as a clearing-house for this mass of valuable scientific information, and thereby render it available for the farmer. It seeks to simplify in form and statement without reducing in scientific accuracy the teachings and discoveries of expert authorities in the field of agriculture. It deals with almost every typical interest and problem to be met on the modern farm, and applies to the discussion the proved results of scientific investigation. It summarizes and renders easily intelligible much valuable material produced by agricultural colleges and experiment stations which, in its original form of publication, would prove too severe a strain on the time and patience of the busy men and women of the farm. It presents in plain and condensed language the results of much fruitful experimentation and many costly investigations conducted by the United States Department of Agriculture and the experiment stations. In short, it gathers its material from every available source, and undertakes to relate and apply it simply, directly and concretely to the practical problems of farming.

It is planned that every member of the farm household may find something of interest and value in many of the chapters. The book also aims to be of equal service to those living in towns and cities who have dreams of a future country home. Nor is it forgotten that the city boys and girls are entitled to a knowledge of some of the opportunities and inspirations of rural life. Through these pages it is hoped that many of them will be led to a more intimate acquaintance with the fields, the forests, the gardens and the birds. At the same time it is believed that their education will be broadened by a better knowledge of America's greatest industry, farming.

The book will also be of interest to the men of the shop, to clerks, business men and professional workers who, because of their sedentary work, are in constant need of a motive for outdoor occupations. The information and guidance needed by such persons are here assembled in a form that will not require a large expenditure of money or of time for their acquisition. In short, it has been the desire of the authors so to represent the business of farming that all who wish a better knowledge of its problems or practise, whether this be for actual use or only for general information, will find the volume serviceable. It is also hoped that the broad range of information, many practical suggestions, and directions for practise will make the book of value in the schools and public libraries.

The style and phrasing have been kept very simple and direct. Technical terms are almost wholly omitted. Untried theories have no place. Scientific facts are stated in plain language that will present no difficulty for any reader. It is the sincere hope of the authors that those who read the following pages may do so with pleasure, and that the lessons learned *may add much to the satisfaction and profit from the business of farming!*

THE AUTHORS.

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CHAPTER I

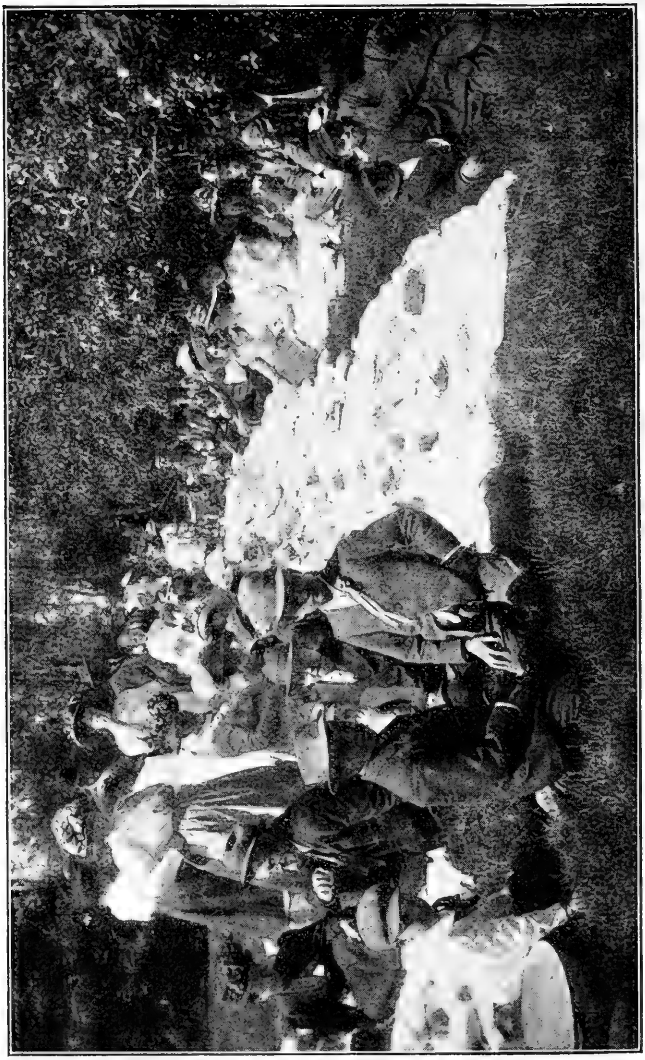
BUSINESS METHODS IN FARMING

AMERICA is the land of farms, and agriculture is its most important and fundamental industry. All other occupations must go back to the soil, either directly or indirectly, for their support, if not for their very existence. The success and welfare of every class of our population, therefore, depend on the business of farming.

A favored land.—The United States is especially favored in the fertility of its virgin soil, its vast areas of tillable land, and its wide ranges of climate adapted to the growing of many crops. America leads the world in agricultural opportunity. No other people possess the advantages and natural wealth that we have in our farms.

Wasteful Use of the Soil

Yet the very fact that our soil is rich and our land plentiful contains an element of danger. For nature's kindness and prodigality have led us into carelessness in the use of this the most important of our natural resources. We have been almost criminally wasteful of the fertility of our soil.



An annual school community picnic.

Farming that depletes the land.—Our first care has been to get the largest possible returns out of a given amount of highly expensive labor—for land has been plentiful and cheap, while labor has been dear. In few regions have we learned the meaning of intensive farming such as must constantly be practised in most countries of Europe and Asia in order to feed the population.

When more food has seemed necessary for our ever increasing population, we have only "gone West" and opened up vast fields of virgin territory. Often this has been done after robbing the eastern or southern soil of most of its fertility. Here the older fields have been given over to idleness for the more promising fields of the West. During the last three hundreds years of American history, we have been continually looking to the frontier states for farms and future homes. First, the white-covered "prairie schooners," and, later, the railway trains have carried a sturdy race of pioneers toward the setting sun and this country, the dream of plenty.

Our debt to the pioneer.—This constantly moving population has been the direct cause of the rapid settlement and development of many of our best agricultural sections. It has given us an enterprising and progressive farming population,—men and women consecrated to the cause of transforming wild prairies and untamed forests into fertile acres and productive fields. Everywhere they have gone we now find beautiful gardens, orchards and homes as monuments to their endurance, industry and persistence.

Need of Conserving Soil Fertility

The frontiers of this nation, however, are fast becoming a thing of the past. Most of our best land has already been opened up to settlement and divided into farms. We now have under cultivation the larger part of the land available to feed our ever-increasing population. True, there are vast fields of our great plains and millions of acres of forest land yet to be reclaimed. All this, however, will have to be made productive at much greater expense of money and energy than was required for the earlier lands now occupied by the American farmers. Most of the land in order to be put under tillage will require permanent and costly systems of irrigation. Such regions will finally be reclaimed by science and good business management; for we need the land, and must have it. Both federal and state governments are even now doing all in their power to aid in its reclamation. But we should first of all conserve and use to the best advantage the land we now have under cultivation.

Responsibility upon the farmer.—The tiller of the soil is one of our most important economic factors. On his success and prosperity the welfare of the nation depends. His intelligence and progress will have a far-reaching effect upon our entire industrial history, and will go far to determine our place among nations. We have no peasantry. American farmers, as a class, are intelligent; they are ambitious; they are men of affairs. The American farmer is not infrequently called upon to serve as state legislator, congressman or senator. From his ranks we have taken governors and presidents.

The Age of Industrial Changes

In all American industries there have recently been great changes. Inventions, better education and a new outlook upon life have led to prosperity; the farming business and this prosperity have worked toward greater efficiency. During the past generation, and especially during the past ten years, the entire face of the earth industrially has been making over very rapidly. New manufacturing machinery has been introduced, greater systems devised, the cost of production reduced and the amount increased.

Advance in agriculture.—Among all of our industries, however, none has experienced a greater growth and development than the business of farming. It is no longer to be classed as unskilled labor, a catch-all job for the man who can not find an opening elsewhere. The farmer of to-day would find himself greatly handicapped if he should undertake to think and act in terms of the past. A generation ago one could find plenty of careless practitioners, but almost no practical scientists among our farmers; on the other hand, there were a considerable number known as agricultural theorists, but who knew little or nothing about real farm practise. Consequently, there developed misunderstanding between the practitioner and the scientist. They had very little of common interest.

The progressive farmers of to-day, however, are practical scientists; they know how to translate scientific information into common practise. To succeed in farming, one must understand the care of the soil and how to conserve it; he must be thoroughly informed in matters of fertilizing, systems of rotating crops and the tillage of various soils. Every farmer must be a business manager, salesman, bookkeeper and an all-around man of ability and skill. In a measure, the farmer must be both a bacteriologist and an entomologist, for unless he knows how to combat the insect pests and plant diseases of growing crops, trees and farm animals, he will sooner or later meet his Waterloo in the battle with these enemies.

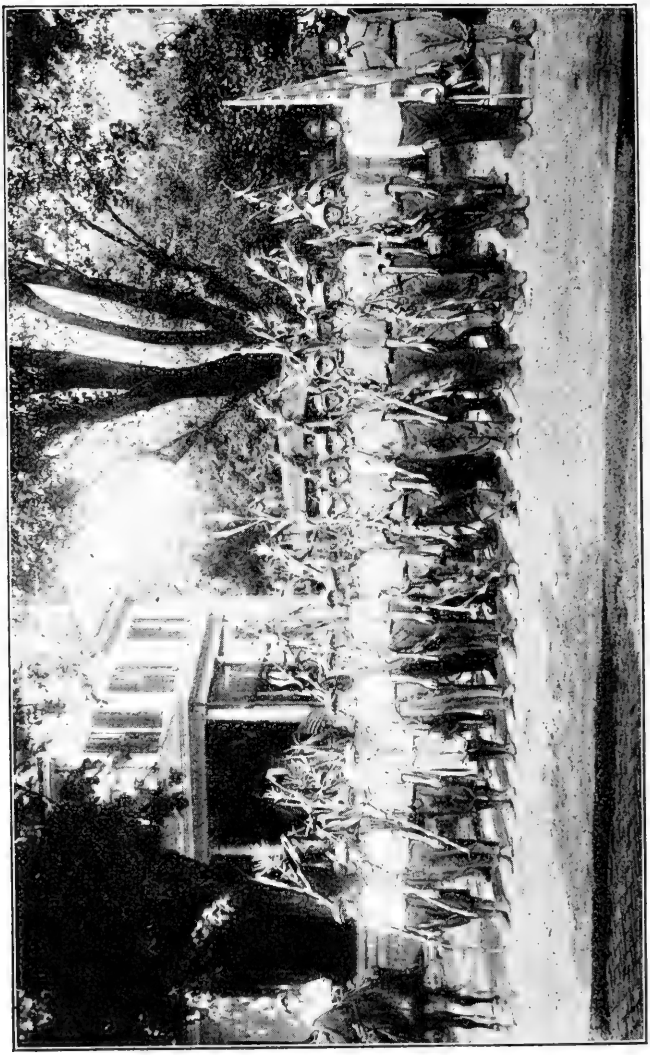
What the farmer must know.—Scientific breeding of stock and the fitting of every farm enterprise into the farming business as a whole are of utmost importance. A man must understand markets and methods of marketing. The adjustment of time in the use of labor, machinery, animals and acres, so as to secure a maximum return from a minimum investment, this is most imperative in these days of business competition and ever increasing land and food values.

The home is the true center of all farm interests and activities. It is to build homes that we buy our farms, build up our enterprises and apply our best skill in labor. If the farm neglects the domestic life, the happiness and well-being of the family, if it forgets its obligations to the community, the church and state, not only the farm, but society in general surely will suffer the consequences. All of these relations and many others call for the greatest degree of intelligence, for good business sense, and for constant fidelity to the cause of American rural life as well as all-around farm efficiency.

New Interest in Agriculture

Recent years have shown increased and unusual interest on the part of the whole world in the business of farming. This is not merely philanthropic, nor is it a sentimental necessity. People in other occupations, particularly those in business and commerce, have come to appreciate that farming is the economic basis of every type of work and enterprise. All members of society to-day wish the farmer well, and are willing to advance his prosperity, not alone because they are interested in the farmer as a social equal and a fellow citizen, but because they recognize that they must ultimately go back to the tiller of the soil for food, shelter and practically all the comforts of life. They want the farmer to raise larger and better crops, produce more and better stock, and himself be happy and prosperous because of the inevitable prosperity that it brings to all others.

Economic interest centered in farm.—At the present time we are told that the American population is increasing many times faster than is the production of our food supplies. During the last twenty years the cost of living has practically doubled. If this continue for the next decade, it will be difficult to judge the economic and social consequences. It is, therefore, important that every acre of land in the United States be made increasingly efficient, to produce more and better food. And this means



A corn club cavalry troop.

intensive farming; but this does not necessarily bar *extensive farming.*

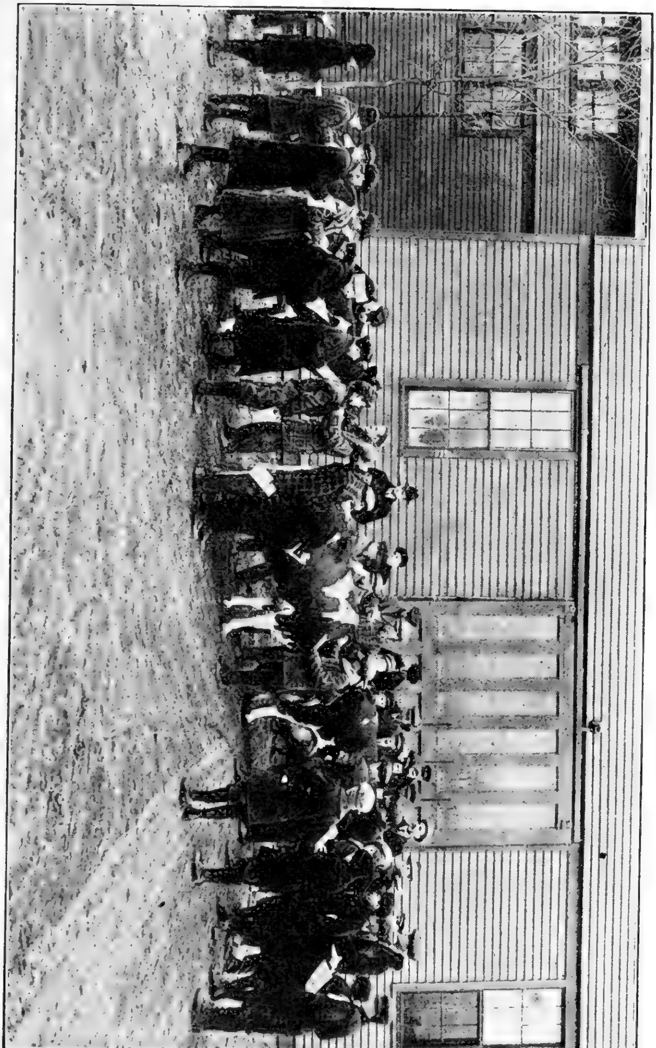
There is yet a large area of our land untouched by the hand of tillage. On these barren acres, which science and business enterprise will yet make fruitful, there is room for thousands of those who are now living in filth, poverty and obscurity in the congested centers of our large cities. But they must be able to possess themselves of the promised land—they must be *trained to the business of farming.*

Unclaimed resources.—So also in the southern states, where the growing season is long, rainfall plentiful and where every conceivable kind of food will grow and thrive, there is only a comparatively small percentage of the total area of the land under cultivation. When one travels over these areas of untilled acres which will surely one day be the garden spot of America, he can not but feel that some very definite policy should be adopted toward offering to the millions of our poverty-stricken city dwellers a chance to work out their salvation and be better fed from the soil. But this can not be done simply by transferring them from city to open country. They must first be educated in the science and practise of agriculture, stock-raising and farm management, else they would suffer in the country as surely as in the city.

Agencies to Help the Farmer

The new interest in agriculture has resulted in the organization of many agencies to help the farmer. The federal government is now spending millions of dollars every year in agricultural extension work, farm demonstrations, farm surveys, experimentation, and in scientific research in agriculture. New varieties of crops are being tested and new breeds of animals produced. Successful attempts are being made to control the ravages caused by insect and plant enemies of farm crops and animals, and many other lines of investigation pursued. Every state has its experiment station, its extension force and its college of agriculture, with an array of farm experts who are doing everything in their power to advance the interests of agriculture and the farmer. The nation and the state join in employing farm agents, trained in both practical and scientific agriculture, to work with the farmers in the solution of their immediate problems. Farm bulletins are being printed and distributed free of charge by the United States Department of Agriculture and the state agricultural colleges. Extension lectures and agricultural experts are going into every community, teaching the application of science to all crop and animal production. Various commercial organizations, bankers' associations and business men's clubs are everywhere contributing generously to the advancement of agricultural education and progress.

New spirit among farmers.—The farmers themselves are in most instances responding to their opportunities and endeavoring faithfully to meet the many new problems that have been thrust upon them. Progressive farmers everywhere are eagerly studying the scientific investigations being made in the field of agriculture. They are reading the books and bulletins, attending the agricultural short courses



Judging dairy cows.

at the state colleges, supporting farmers' institutes, studying stock and grain judging and in every way doing their best to place farming upon the scientific basis that our new conditions demand.

Farming as a Career

The business of farming to-day offers a career second to none to be found among the industrial or business vocations. It has opportunities for the man of intelligence and ambition. It requires and rewards initiative and enterprise. It demands and is willing to pay for the best intellect and industry that our country affords. The farmer will always be an important factor in American wealth and progress, and is destined to take still higher rank as a contributor to industrial and social welfare.

It is the purpose of the present volume to aid all earnest and progressive farmers by supplying them with such practical information and help as can be rendered through its pages. It will also furnish the city dweller who is interested in the subject of agriculture an opportunity to make a careful study of many of the problems related to the farm, and to rural interests. This book is, therefore, ***dedicated to the best interests of the American farmer.***

CHAPTER II

FARM MANAGEMENT

FARMING, like banking or running a railroad, requires good business management. Not hard work alone, but careful planning is necessary to success. Brains are coming to be quite as essential on a modern farm as muscle. Nor is it enough to *know* what to do. Many of us have

A farm perspective.

enough information, but fail to put it into practise. We are in a sense passively progressive; we educate our heads, and fill them with scientific knowledge about farming—but we do not always put that knowledge into practical use. We all need to be actively progressive; we need to have the energy, ambition and business ability to organize and manage our farm in accordance with the best available methods.

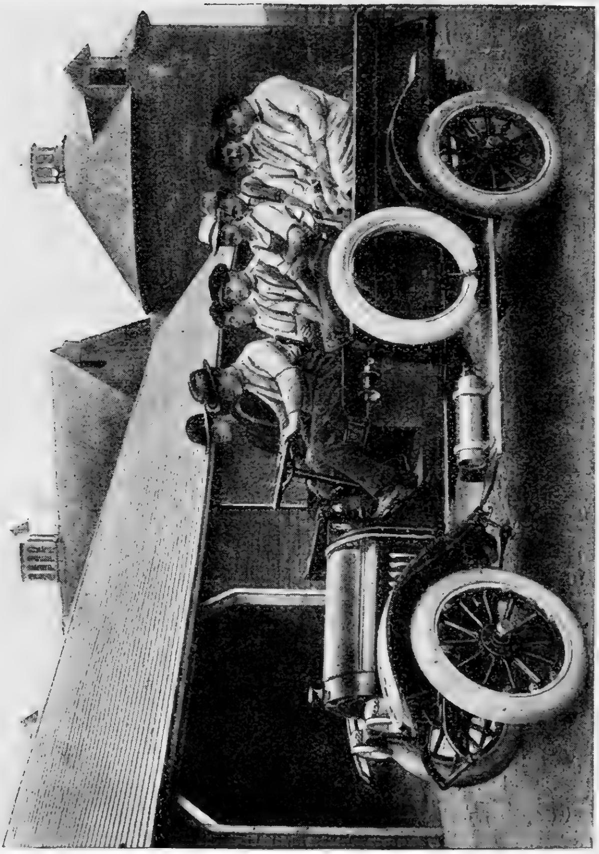
Need for business management.—We often pride ourselves on being practical. But what is being practical? Ex-Governor Hoard of Wisconsin, a great agricultural editor and successful dairyman, says: "The practical in agriculture is putting anything profitable into practise." First, we are to study, investigate, inform ourselves. But we do not stop here. When we discover some method of farming, some system of stock breeding or feeding, some way of marketing, or some type of farm building or machinery more profitable than the system we are now employing, we *put our discovery into practise.* This requires *organization* and *administration,* and these together constitute *farm management.* Many hard working, intelligent farmers fall short of the highest success because they do not organize and administer their farms; they may be called fair agriculturists, but poor managers. Look about in any neighborhood, and you will find such farmers.

Planning the Farm for Profit

No one person can know the whole subject of agriculture or be an expert in every branch of farming. Every enterprising farmer may, nevertheless, easily learn how to prevent many of the losses that were a heavy burden on the generation that preceded us. When we allow the codling moth to destroy our crop of apples because we failed to spray the orchard; when we let cholera claim our herd of hogs because we neglected to use the serum; or when clover and alfalfa fail in our soil because we did not use line, the fault is ours. For we know better, and our fathers and grandfathers did not. With them it was lack of knowledge; with us, lack of business management.

Stopping the leaks from small losses.—The well managed farm aims at securing a profit from every enterprise. All possible losses, large and small, are eliminated. The profits from one enterprise are not eaten up by the losses from another. Knowing that some dairy cows do not pay for their keep, but are mere boarders, living off the income from the rest of the herd, the progressive farmer will find out whether he has any such, and if so get rid of them. Knowing that not a little of our tilled land is worked at an actual loss, the good manager will make a study of each section of his cropping system and eliminate the losses. Every angle of the farm's work and its business will be watched for profits and losses—crops, animals, machinery, buildings, sales and purchases, and whatever else goes to make up the enterprises of the farm. And once a leakage of profits is discovered, the defective spot will at once be remedied by good management.

Farm management is, then, the *selection, organization and administration of farm enterprises,* so that profits accrue and so that the farm is constantly built up. *It consists largely of the application of business principles and scientific management* to the farming business. When the mutual relations growing out of the problems of work with soils, crops and live stock are so combined that they build up a *type* of farming, and when with such problems we consider the selection of machinery, the buying of farm sup-



Farm manager taking his men to work.

plies and the marketing of products, we then have the typical problems of farm management.

Problems of farm management.—The most important problems that arise under farm management can be grouped under seven main heads: (1) *Type* of farming. (2) *Magnitude* of operations; (3) *Organization* of enterprises; (4) *Administration* of activities; (5) *Quality* of product; (6) *Care* and *use* of all products; and (7) *Buying* and *selling* of farm necessities and products.

Type of Farming

In Europe, land is high and labor cheap; in the United States, land is comparatively cheap and labor expensive. The first principle for the American farmer therefore is so to select his farm and organize its enterprises as to make the best possible use of the labor available upon it. This is to say that the farm enterprises should be so diversified as to give the largest possible number of working days during the year to the family, hired help, teams and machinery. Idleness soon eats up the profits of labor, whether it be man, beast or machine that is idle.

The farmer who is a good manager does not try to raise every kind of crop or animal that can be produced on his farm. He does not even try to raise every kind that can be grown with profit. He has only so much time, labor and energy to expend, and he tries to obtain from these the *largest* profit.

Deciding upon farm enterprises.—The good manager will not only take into account the nature of his soil, the climate and length of season, but also the question of location and markets. For example, the farm but two miles from a good market-place is adapted to a different range of enterprises from the one that is fifteen miles distant. Under prevailing conditions fifteen miles' distance from market will make the direct sale of milk and most fruits and vegetables unprofitable. It will reduce the acreage of

Well-arranged cattle yards.

potatoes, and hinder the profitable sale of hay, straw or corn stover. Such a location will encourage the production of live stock, grain, clover seed and any other products having a high value for their bulk and weight.

The degree to which intensive agriculture shall be carried on is another question that concerns the type of farming. It is highly desirable that our acreage should produce high yields. But it is also highly desirable that a day's labor shall produce the largest possible returns. Our farms must be managed to combine high production with good wage returns, and neither be allowed to cut in on the other. It has been carefully estimated that an acre of Iowa land is 22% more efficient than an acre of Bavarian land; but the Iowa farmer is *four times* as efficient as the Bavarian farmer. In man efficiency, the American farmer should lead all mankind. And there is every reason to believe that this leadership will be made possible through the scientific study of agriculture and the application of good business management.

Conservatism with progress.—It is usually a mistake for any one farmer to depart radically from the general type of farming practised in his community. The type that practical experience has tried and found adapted to the region is ordinarily most profitable. Yet certain changes in the type will often greatly increase the profits. For example, a western farmer, deeply in debt, tried to borrow money from a banker. The farm was producing nothing but grain. The banker offered to loan the money on condition that a part of it should be used in stocking the farm with a few good cows, half a dozen pigs, and a flock of chickens. The stock and the grain together made the right combination, and in five years the farmer was out of debt and owned his farm. In like manner many a southern cotton farmer has found that the addition of corn and legumes has brought him from poverty to comfort.

The Magnitude of the Farm and Its Enterprises

The size of a farm must be adapted to its particular type of enterprises and the number of these undertaken. For the great corn and wheat belt of the Middle West, a forty acre farm is too small for profitable farming, while this acreage may be wholly adequate for fruit farming, and far too large for intensive truck farming. The dry-land farmer of the semi-arid western region may require a section of land, and the citrus fruit grower of California or Florida succeed with ten acres.

The size of the farm.—Catch-phrases, like "a small farm well tilled," a "farmer for every forty acres," "ten acres enough for a good living," may sound well, but they are misleading if the application is to be general. Under ordinary cropping conditions a small farm means little machinery and much hard labor. Forty acres can not support hay loaders and stackers, gang-plows, auto trucks, manure spreaders and other labor-saving machinery. Both European and American statistics show that small farms ordinarily mean a low labor income, few comforts and no luxuries for the homes, and a life of heavy toil and drudgery both for the farmer and for his family.

Yet within reasonable limits the size of the business done on a farm is not strictly limited by the number of acres. A Wisconsin farmer had an eighty acre farm and could not buy any adjoining land. He decided to increase the size of his business by changing his type of farming. He gradually disposed of his scrub cows and replaced them with pure-bred. He selected corn and alfalfa as the most profitable crops to grow in connection with the dairy business. Alfalfa takes the place of clover, because, on this farm, it produces at least fifty per cent. more food per acre, and the yields are much more uniform. Pastures have entirely disappeared, because the owner has demonstrated that one acre of corn or one acre of alfalfa furnishes more feed on his farm than five acres of pasture. He has now a large net income from market milk and the sale of purebred Guernsey cattle. Here was a large increase in magnitude of business without a change in the size of the farm.

Management counts most.—From a farm survey by the United States Department of Agriculture of about six hundred farms in a dairy section have been taken the following summaries from (1) the twenty poorest, and (2) the twenty best farms of from eighty to one hundred and twenty acres run by their owners.

Report of Twenty Poorest Farms

Farms 80 to 120 Acres. Average Area 99 Acres.

RECEIPTS		EXPENSES	
Potatoes	$ 103	Labor	$ 385
Wheat	113	Feed	146
Hay	244	Seeds	36
Other crops	56	Fertilizers	102
Cattle	225	Live stock	172
Hogs	18	Machinery and repairs	97
Poultry	84	Taxes and insurance	87
Eggs	102	Miscellaneous	88
Milk	475	Inventory loss	93
Inventory gain	93	Total	$1,206
Total	$1,513		

CAPITAL INVESTED		SUMMARY	
Land and buildings	$ 8,194	Receipts	$1,513
Machinery and tools	459	Expenses	1,206
Live stock	1,055	Farm income	477
Supplies	217	Int. on capital at 5%	500
Working capital (cash)	105	Labor income	–24
Total	$10,030		

The average crop area was 56 acres; number of cows milking, 9.4 for 12 months in the year; per cent. of income from crops, 34; crop area per horse, 16.3 acres; number of horses, 3.7; receipts per cow, $48; working capital other than land and buildings, $1,835; crop index compared with 100 per cent., 84 per cent.

Compare these unsuccessful farmers who actually gave $24 in labor for the privilege of farming, with twenty farmers (below) who are making an income of over $2,000 per year and getting house rent, milk, eggs, garden truck, fruit and much of their fuel besides.

Average of Twenty Best Farms

From 80 to 120 Acres. Average Area 101 Acres.

RECEIPTS		EXPENSES	
Potatoes	$ 400	Labor	$ 602
Wheat	245	Feed	408
Hay	335	Seeds	58
Other crops	89	Fertilizers	164
Cattle	360	Live stock	308
Hogs	105	Machinery and repairs	311
Poultry	92	Taxes and insurance	101
Eggs	159	Miscellaneous	155
Milk	2,238	Inventory loss	18
Miscellaneous	130		
Inventory gain	702	Total	$2,125
Total	$4,855		

CAPITAL		SUMMARY	
Land and buildings	$ 9,480	Receipts	$4,855
Machinery and tools	974	Expenses	2,125
Live stock	2,941	Farm income	2,730
Supplies	399	Int. on capital at 5%	697
Working capital (cash)	153	Labor income	2,033
Total	$13,947		

The average crop area was 63 acres; number of cows milking, 20; number of horses, 5; receipts per cow, $106.50; crop acres per horse, 12.6; crop index, 117; working capital, $4,468.

It is entirely probable that many farmers with moderate sized farms could, by slightly modifying their type of farming and general management secure greater profits than by buying more land. This much at least is certain: that it pays no farmer to undertake more than he can do well. Poorly prepared seed beds, poorly cultivated crops, harvesting delayed because of too much work to do, will never pay. The wise manager drives his work, and does not allow his work to drive him.

Farm Organization

The organization of the farm is of highest importance. Farm organization includes such matters as the proper division of the farm into fields; planning a rotation of crops, computing the amount of each kind of crop or the number of each kind of stock that can be made most profitable; maintaining the right balance between crop and live stock production; the determination of the proper amount and kind of farm machinery; the seasonable distribution of labor, both of men and animals; the best types and location of farm buildings, and other problems of like character.

Problems of farm organization.—Every progressive farmer recognizes the importance of the right solution of such questions. For example, to cut a farm into the right number of fields of approximately equal size or equal productivity, at the same time providing for conveniently located cattle and hog pastures is no easy task. To provide for the right amount of each kind of feed for live stock, so that profits will not be reduced by buying high-priced grain or roughage requires careful figuring; yet it must be done. So to plan the farm work as to distribute the labor and not allow it to bunch too greatly at certain seasons demands careful planning and must be worked out if the highest profits are to be realized.

The margin of profits on the average farm is so small that they may easily be reduced to the vanishing point by the feeding of idle horses, the paying of hired help asleep in the haymow, or the housing and up-keep of little-used machinery. Careful investigations show that even on well managed farms, the farm horses work an average of only three and one-half hours a day.

The farmer needs to be something of an architect and landscape gardener in planning the construction and location of the farm buildings. The direction of the prevailing winds should be taken into account in guarding against danger from fires and to prevent the carrying of disagreeable smells to the house. The well must be located so that it will be convenient and yet escape pollution. Barns must be so placed with reference to one another and the distance between them that no unnecessary steps need be taken or time lost. The whole plan must look attractive and businesslike when it is carried out; for these are things through which the farmer advertises his business ideas and ability to the community.

Administration of Farm Enterprises

Organization of farm enterprises and the outlining of definite plans only mean getting ready to operate; administration controls and directs the enterprises when they are in operation. *Organization* plans for a season, a year, a life-time, all at the same time; *administration* must be on the job every day carrying these plans into execution. Organization provides for the seasonal distribution of labor; administration directs the labor to secure the largest profits.

Problems of farm administration.—Good administration of farm enterprises keeps men and horses constantly busy at profitable work, as far as is possible, regardless of weather and season. It superintends the proper preparation of the soil; careful cultivation and harvesting of crops; breeding, feeding and housing of live stock; and the prevention of losses from insect enemies and plant and animal diseases. Administration sees to the skilful buying and selling of pure-bred live stock, the successful marketing of general farm products, the care and repair of machinery, buildings and fences, the keeping of expenses lower than income, and the successful financing of the farm as a business unit.

The farmer must know how to buy and sell. The paying of too much or selling for too little will make all the difference between farming at a loss and farming at a profit. The real administrator is therefore a student of values. He is a judge of the quality of supplies to be bought for the farm, and he knows what these should cost. The parcel-post and rural-mail delivery make the farmer in a measure independent in many lines of supplies where these can not be bought at local markets. The good farm administrator knows how and when to sell his products. He understands the factors affecting market conditions, and studies crop reports with reference to probable market prices. He is able to figure the shrinkage on stored grain or roughage and compute whether it will pay to hold for a higher price or sell earlier at a lower figure. Not to inform yourself on such problems as these and make their solution a part of the administration of your farm is to invite less than full returns for your labor.

Looking after machinery.—The successful administrator looks after his machinery. As each machine is needed, it is found to be in a state of repair and ready for operation. Machines are not left out-of-doors exposed to the weather when not in use. Rust and rot are allowed to take no toll from the life and service of plows, reapers, wagons, hay loaders and the like. Their housing is as much a matter of concern as the housing of the live stock.

A self-binder, a hay rake or a plow standing for weeks or months out in the field where it was last used is about the best advertisement a farmer could make of the inefficiency of his administrative ability.

The management of hired help is one of the most difficult of all farm problems. Particularly is this true when

Good machinery is a profitable investment.

a rush season demands that extra help be secured. No longer do we depend on "exchanging work" or calling in the neighbors' boys to help us out. Not infrequently are we obliged to employ tramp help, who have no interest in the work, and little sense of honor in earning their hire.

The problem of hired help.—No one is ready to offer a solution for the hired help problem. Its solution should aim at full justice both to employer and laborer, and will include the fair and respectful treatment of help. The employing of help for the entire year or even a series of years is important; the catch-job or seasonable employment of labor is disastrous to all concerned. The small but comfortable tenant house with vegetable garden and chicken yard attached has been found by many farmers to be a paying investment, as it has often enabled them to secure good, substantial, married men at reasonable wages. This may, in a measure, help in the final solution of this most difficult problem. Certain it is that the farmer's family is entitled to a home life all their own. This can not be secured with a lot of hired help living in the same house.

Quality or Excellence of Product

He who can make two blades of grass grow where but one grew before has been called the benefactor of his race. The world must have food and clothing. These must come from the farm. All are vitally interested in the farmer's success. Every one wants his acres to double their yield, and his animals to increase their output of goods and clothing. The serious-minded farmer realizes his responsibility. He wants to increase his own profits to be sure, but he also wants to fulfill his responsibility to those who must be fed and clothed. Besides this, the truly progressive farmer is prompted by a spirit of *artistry.* He wants to play the game to win. He is not satisfied with small returns or with poor products, because *it is in him to do better* and he is ashamed to do less than his best.

Maximum returns.—In many respects large crop yields are desirable; yet there is such a thing as increasing the yield beyond the point of profit. The farm records on file in the United States Department of Agriculture indicate that, under present conditions, a ten to twenty per cent. increase above the average gives minimum returns. Efficient farming depends very largely on getting this increase by improving the quality of the various farm enterprises. In a recent survey of a hundred farms in a northern dairy district, the survey records showed very good crops but exceptionally poor cows. In round numbers the average value of these cows was forty dollars and the average income per cow fifty dollars. In that region it costs about seventy-five dollars per year per cow for feed and care. Here was a direct loss of twenty-five dollars a year on each cow kept in that district. As might have been expected, low or minus labor incomes were almost universal.

We hear many uncomplimentary things said about the unprofitable dairy cow, the *"boarder cow"* that is supported from the profits of the remainder of the herd. On many farms the unprofitable dairy cow is not the only "boarder." Low yielding acres, like boarder cows, are often fatal to successful farming. Recent farm survey records show that areas of poorly drained, compact and sour soils, or soils low in humus, greatly reduce net profits and are a frequent cause of low labor income. These records show that sometimes as much as thirty per cent. of the entire farm acreage does not produce enough to pay its way.

Making every part of investment yield its share.—One farm, on which records were recently taken, has forty acres of poorly drained land that in its present condition is practically worthless. Twenty-five dollars per acre spent in drainage will make this forty-acre tract the equal of any in that district, and good land is selling there at one hundred fifty dollars per acre.

The successful business man always tries to weed out all unprofitable enterprises and to expand those that pay a profit. Unprofitable acres can not always be disposed of so readily as boarder cows, but usually they can be improved until they become profit bearing. If the income from such land can not be increased, it is quite possible that the labor spent upon it can be reduced until the income at least pays a little more than the cost of labor.

Ten Important Points in Farm Administration

Doctor W. J. Spillman, of the office of Farm Management, United States Department of Agriculture, gives the following factors as underlying successful farming:

1. Low real estate prices for the land cultivated.
2. Production of commodities for which the supply is less than the demand.
3. Management of the business on as large a scale as capital and managerial ability will permit.
4. Production of commodities of the higher quality.
5. A reputation for reliability.
6. Location for good markets, and ability to buy and sell profitably.
7. Keeping only animals of highest productive capacity.
8. Large yields with relatively little labor and fertilizer.
9. Producton at low cost.
10. Production of staple commodities for permanent profits.

Need of Specialists in Farm Management

Enough has been said even in this brief discussion to show that farm management is no simple problem. Yet the problems of farm management must be met by every farmer. The nearer a farmer can be a specialist in farm management, the greater his chances of success. The farmer of the future will be an educated man. Successful farmers of to-day are educated men,—not always in books,

It pays to build good fences.

but not all education comes from books. To know how to work out a proper balance between various crops and live stock, to understand organizing, equipping and administering a farm, to be familiar with the various soils and know how to conserve their fertility,— to know the best systems of marketing and buying,—and *knowing* all these things, to *be able to do them,* requires as much mental keenness and executive ability as to run a bank, administer a church or manage a large law practise. Every farmer should strive to become efficient in farm management, for upon the principles of good management hang most of the law and the profits.

Ten Commandments of Agriculture

The following ten commandments for southern agriculture as taught by the late Doctor Seaman A. Knapp, will be of value to all who are interested in farm management. Doctor Knapp says:

"At an early period it was found necessary to evolve from the mass of ethical teaching a few general rules for living, called 'The Ten Commandments,' by which a man could be moral without going through a course of theology. Just so, in order to instruct the average farmer how successfully to conduct his farm operations so as to secure a greater net gain from the farm, it is necessary first to reduce from the mass of agricultural teachings a few general rules of procedure. They are called 'The Ten Commandments of Agriculture,' by the practise of which a man may be a good farmer in any State without being a graduate from a college of Agriculture."

1. Prepare a deep and thoroughly pulverized seed bed, well drained; break in the fall to the depth of eight, ten or twelve inches, according to the soil, with implements that will not bring too much of the subsoil to the surface (the foregoing depths should be reached gradually).
2. Use seed of the best variety, intelligently selected and carefully stored.
3. In cultivated crops, give the rows and the plants in the rows a space suited to the plant, the soil and the climate.
4. Use intensive tillage during the growing period of the crops.
5. Secure a high content of humus in the soil by the use of legumes, barnyard manure, farm refuse, and commercial fertilizers.
6. Carry out a systematic rotation with a winter cover crop on southern farms.

7. Accomplish more work in a day by using more horse-power and better implements.

8. Increase the farm stock to the extent of utilizing all the waste products and idle lands of the farm.

9. Produce all the food required for the men and animals on the farm.

10. Keep an account of each farm product, in order to know from which the gain or loss arises.

The following summary of farm management principles taken from Bulletin 4 of the Wisconsin Agricultural Experiment Station, is of especial interest in connection with the study of this chapter:

WITH EVERY TON OF GRAIN SOLD

At the Elevator the farm loses:	At the "Yards" as meat animals, the farm loses:	At the Creamery as butter fat, the farm loses:
5 to 6 dollars in fertility.	1 to 1.20 dollars in fertility.	20 cents in fertility.

EXCLUSIVE GRAIN FARMING MEANS

1. Selling the farm by the wagon load.
2. Uncertain returns and, in the end, crop failure.
3. More and more ditches and gullies.
4. Unsteady employment of men and reduced labor efficiency.
5. Sale of unfinished products and hence lower prices.
6. More tenant farmers.
7. More temporary agriculture (unless soil is artificially fertilized or green manuring practised).

PROFITABLE MEAT PRODUCTION MEANS

1. Keeping on the farm much of the fertility produced.
2. Crop insurance and increased returns.
3. Better use of untilled land.
4. Better help and better distribution of labor.
5. Manufacture of crops into meat.

6. More farms operated by owners.
7. More permanent agriculture.

PROFITABLE DAIRYING MEANS

1. Enriching the soil.
2. A regular income and a growing bank account.
3. Fewer gullies and ditches and land made more tillable.
4. Steady employment of labor and better men.
5. Manufacture of high-priced finished products, better prices and higher returns.
6. Better business methods and, in the end, land ownership.
7. More permanent agriculture.

(We are indebted to J. C. McDowell, Office of Farm Management, for some valuable suggestions in the above chapter.)

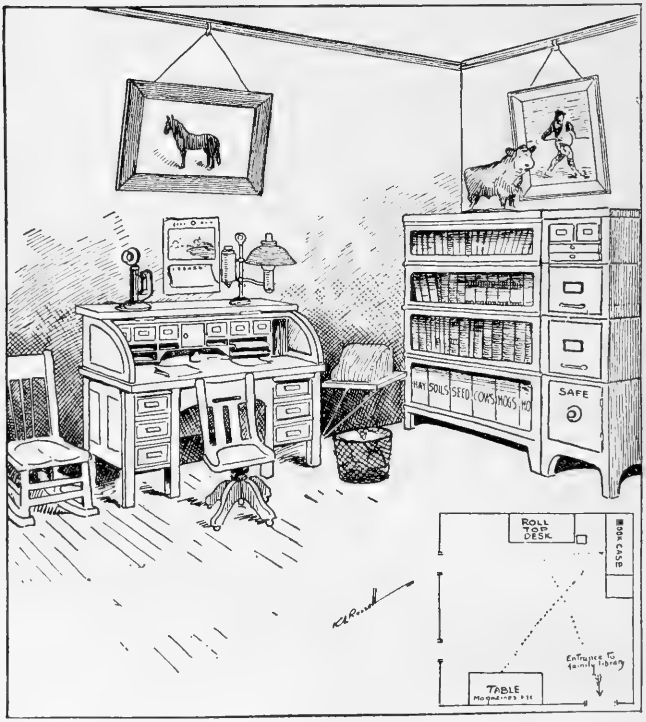
CHAPTER III

FARM OFFICE AND ACCOUNTS

THE business of farming, like every other business, requires intelligent planning, organization, business management and the keeping of definite records and accounts. All of this emphasizes the necessity of the farm office, conveniently arranged and adequately equipped for the intelligent handling of all business papers, plans, records, accounts and correspondence in connection with the buying, selling and advertising of farm products.

The farm office.—Every architect or owner, when planning a farm home, should definitely provide for a well lighted, properly ventilated office as well as for such rooms as parlor, bedrooms, bathrooms and the kitchen. The office need not be large, but may be anything from a six by eight foot den to a roomy office accommodating the business of a large, well organized ranch affording managers, foremen, experts, etc.

Whenever possible the farm office should be planned as a separate room aside from the family library, and may be maintained for business purposes only; it should be a convenient place that will permit the farm manager or the home manager to go for business interviews or business thinking and planning. Such a place need not be extravagantly furnished and equipped; a small room with an expenditure of from fifty to one hundred and fifty dollars will serve. If a separate room is impossible, then a part

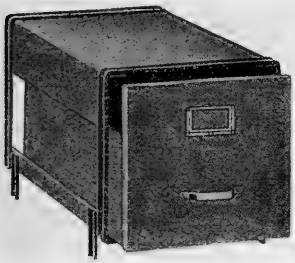


A farm office.

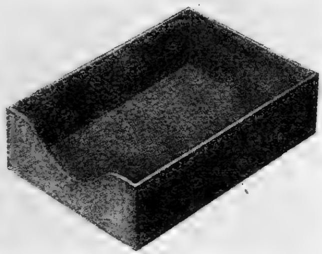
or corner of another room, preferably the family library, should be provided.

When planning a new farm-house it is always cheaper and more satisfactory to arrange for the office and build library case, filing space and a place for the safe into the inner wall of this room.

Furniture and equipment.—The amount and quality of office furniture and equipment will, of course, depend upon the size of the business, as well as the available funds for such purpose. Size and amount of furniture must



Filing case for letters, clippings, etc.



A desk tray.

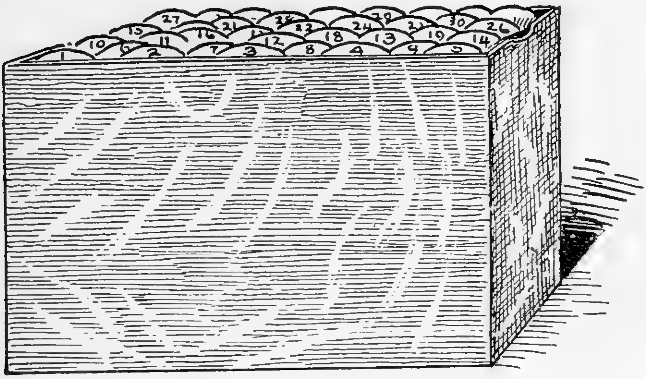
be carefully planned to accommodate the size of the business—a farmer with a small business may need but very little furniture and only a convenient corner of some room, while the large farm may need a great deal more and a good-sized office. If the farmer and his sons are handy with tools, and trained in the art of woodcraft, then all of the furniture can be made at home with but little cost for material. It will cost no more to have furniture, walls, rug and wall pictures *harmonize* in both color and design. The combination library desk is not a piece of furniture for a farm office, as it has neither strength nor convenient space for desk work required in such a place of business. A good-sized, flat-top desk, or the new sanitary roll-top desk illustrated in this chapter, is both convenient and practical. If funds are not available for the purchase of new furniture, excellent second-hand office furniture can often be purchased at a saving of from fifty to seventy-five per cent. of original cost.

We suggest in the following an itemized statement of furniture and supplies needed for a complete office and the probable cost of same if purchased new.

Quantity	Items—Furniture and Supplies	Cost
1	Flat or roll-top desk	$ 25.00
1	Swivel chair (for desk)	5.00
1	Small rug	5.00
1	Desk tickler	1.00
1	4 section (top and bottom bookcase)	12.00
1	Doz. Farm Reference Library	12.00
1	Dictionary	1.25
1	Extra chair or rocker	2.50
12	Box letter files, @30	3.60
1	Ledger	1.00
1	Cash book	1.00
1	Plan book	1.00
1	General record book	1.00
1	Pencil sharpener	1.00
1	Small safe	10.00
1	General supplies—Letterheads, envelopes, pencils, ink, etc.	4.50
1	Blotter pad	1.00
1	Stationery box	1.00
1	Typewriter and stand	50.00
1	Wall pictures, farm scene	3.00
1	Farm name seal	1.00
	Total cost	$142.85

The above list without typewriter, safe, rug and sectional bookcase would only cost $65.85. An expenditure of this kind would be a good investment, as it would offer "first aid" to the much neglected business side of farming and would encourage better planning of farm enterprises and would facilitate farm management.

Farm name and stationery.—Every well managed farm, regardless of size, should have a name, and this name



Small desk "tickler."

and the quality of farm products, stock, etc., should be inseparably known. The following names are suggestive:

Prairie Del Poultry Farm, Meadow Lark Grain Farm, Blue Ribbon Dairy Farm, Babies' Milk Farm, Hickory Grove Stock Farm, White Plains Pony Farm, Franklin & Son's Fruit Farm, Science Hill Nut Farm. The name should mean something and should, of course, have advertising value in connection with the sale of the farm products. Every farmer will want to have his own stationery, printed-to-order letterheads and envelopes, and a *trade-mark or farm seal* bearing the trade-mark and name of farm.

Suggestions for Letterhead

Every Chick a Pure Bred Every Chick a Live One

MEADOW LARK EGG-CHICK FARM

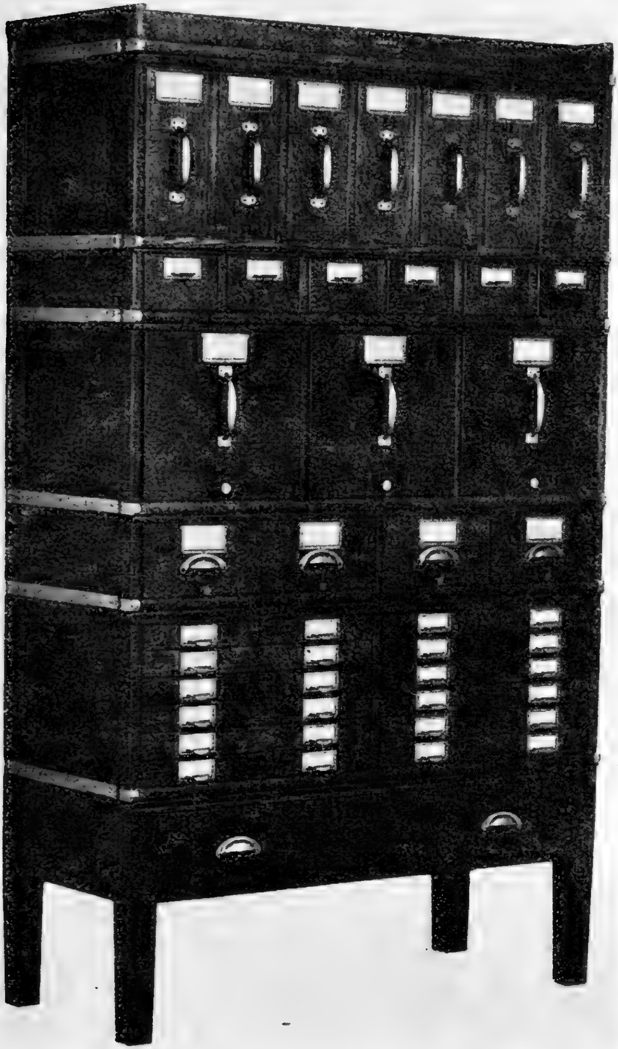
O. B. HERMAN & SON,

Eggville, Ill., ________________________

Envelope

After five days return to
MEADOW LARK FARM
Eggville, Ill.

A seal bearing the name and trade-mark may be secured from almost any regular office supply company. A rubber stamp of the seal will cost from seventy-five cents to two



A complete combination file.

dollars. A regular official seal will, of course, cost more. Sticker seals are as a rule desirable and not very expensive when purchased in quantities and can be used on eggs, boxes, tags, labels, etc., in marketing of all products.

Farm records.—Such form records as the following will be of great value in the management of a farm: Litter Records, Breeding Records, Dairy Cow Records, Birth, Name and Pedigree Records of farm animals; Feeding Records; Records of Planting and Harvesting of Farm Crops; Milk and Butter Fat Records; Egg Laying Records; Records of Names and Addresses for buying and selling purposes, and records of all engagements, both business and social.

A special record book should be provided for the home manager and it should show definitely the household expenses, such as, food, clothing, education, charity and recreation and other costs for the entire family. The keeping of these records and accounts by the wife and daughter is important in the business of farming and for the maintenance of the proper balance of the home expense with that of all farm enterprises.

LITTER RECORD, Herd of____ P. O.____ Litter No.____, 19

Date of birth_______ Sire _______________ Dam ______________

No. pigs born______ Reg. No. __________ Reg. No. __________

No. pigs raised_____ Herd No. _________ Herd No. _________

Herd numbers of pigs ______________________________________

DESCRIPTION OF INDIVIDUALS

1 ____

2 ____

3 ____

4 ____

5 ____

6 ____

7 ____

8 ____

9 ____

10 ____

11 ____

12 ____

13 ____

14 ____

15 ____

BREEDING RECORD OF INDIVIDUAL ANIMAL

Herd of____________	P. O.____________	Herd No.____________
Name ____________	Sire ____________	Dam ____________
Reg. No. __________	Reg. No. __________	Reg. No. __________
Date of birth______	Herd No. _________	Herd No. _________

____

____

____

Animal Bred to—

Date.	Name.	Herd No.	Date of Delivery.	No. M. F.	Herd Numbers of Young.	Remarks.

The farmer who desires to keep track of the amount of labor going into each of his farm enterprises will find a record form like the following helpful. In most cases it will probably not be necessary to keep up such a record constantly, but such a system followed for several months will give a better idea of the labor cost of different classes of farm animals, or the status of the farm home as a business and social unit.

TABLE SHOWING HOURS (OR TIME SPENT) OF MAN LABOR IN CONNECTION WITH FARM ANIMALS

	Horses		Cows		Poultry		Hogs	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
May 1 -------	1½	30	4	30	----	45	1	10
May 2 -------	----	----	----	----	----	----	----	----
May 3 -------	----	----	----	----	----	----	----	---
May 4 -------	----	----	----	----	----	----	----	--
Etc. -------	----	----	----	----	----	----	----	----

If horses are used in the chore work, extra columns must be ruled under each heading to provide a place for the entry of hours and minutes of horse labor.

A simple time record or card for hired help, indicating the enterprises to be charged with their services can be ruled like the following:

FRANK ANDERSON — TIME CARD — MARCH, 1916

	Date Employed	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Dairy		1	$\frac{3}{4}$	1	1																	
Poultry																						
Swine																						
Teams		1	1	1	1																	
Orchard			$1\frac{1}{4}$																			
Wheatfield		8	6	8	9																	
Oat field																						
Cornfield																						
Potatoes																						
Fencing																						
Miscellaneous																						

Of course no set or type of farm records are alike applicable to all farms. They must be changed to accommodate the different enterprises and divisions that characterize the business. The forms given may easily be adapted to different needs.

Farm accounts.—A course in bookkeeping and farm accounting is not necessary in order to succeed in farm accounts, and in this way through the farm office to have all values, expenses, receipts and balances properly kept and well understood at all times. Every farmer with ordinary ability can learn to keep all these accounts by making a careful study of this chapter and then practising for a few evenings in making the records, inventories and accounts as suggested by the forms shown. Take blank paper, rule to proper form, then apply to the business of your own farm and see if you can not master in a comparatively short time the bookkeeping work essential to good farm management.

The inventory.—The first duty in all farm accounting is the making of the "Inventory." This, of course, should be taken at the beginning of the year in a separate book and should show the amount of crops, grain, stock, machinery, supplies, etc., and their cost or the actual value when inventory is taken. Then from ledger and cash-book records it will be possible to strike a balance at the end of the year and know exactly the financial standing of the farm, its profit or loss for the year. It will also form an intelligent basis for the betterment of all farm enterprises or the reorganization of the farm in case it is found necessary.

The following inventory form and inventory balance sheet will show how to handle this part of the business of farming. The forms are the same or similar to those shown in *Farmers' Bulletin* No. 311, United States Department of Agriculture.

Farm Inventory

Name of Farm____

Amount________________ Date__________________

Acres of land @________________________ $
Rods of 4 wire fence @________________
Rods of hog tight fence @____________
Head of horses @____________________
Head of cows @______________________
Head of other cattle @________________
Head of hogs @______________________
Poultry @ __________________________
Sets of harness @____________________
Vehicles @ __________________________
Auto truck @________________________
Farm machinery @____________________
Tons hay @__________________________
Bushels corn @______________________
Bushels wheat @_____________________
Bushels oats @______________________
Bushels potatoes @___________________
Bushels apples @_____________________
Other farm products___________________
Household furniture ___________________

Total____

Inventory and Statement

Amount________________ Date________________

10 horses	$1,415.00	
21 dairy cows	810.00	
14 hogs	380.00	
250 chickens	100.00	
Farm machinery	319.00	
Auto truck	600.00	
Silo	275.00	
Harness and fly nets	48.00	
Hay and ensilage	200.00	
1400 bushels corn @ 50c	700.00	
20 bushels seed corn @ $2	40.00	
600 bushels of oats @ 45c	270.00	
2 straw stacks	15.00	
40 bushels potatoes @ 60c	24.00	
Cash in State Bank of Indianapolis	252.56	
Cash on hand	6.50	
		$5,455.06
Bills and rent not paid	$ 318.00	
Notes not paid	256.62	
Balance on silo not paid	100.50	
		675.12
Balance Jan. 1, 1919		$4,779.94
Balance Jan. 1, 1918		$2,391.88
Gain from Jan. 1, 1918, to Jan. 1, 1919		$2,388.06

The inventory should be carefully taken again at the close of the year's business, and it should always include the cash on hand, bills payable and bills receivable, or all items due you as well as all items due others. This will, of course, make it possible for one to know the total gain or loss of the business for the year.

The ledger and cost accounts.—The ledger is one of the important account books for the farm business, in fact it is the one book that may contain all necessary records, plans and accounts, including inventories and annual statements of the business. It is, however, desirable to have different books, which may be of uniform size and form and all blank, so that they may be named and classified or ruled to accommodate the four special divisions of records and accounts. The books may be denominated as follows: (1) farm records; (2) ledger; (3) cash book and (4) plan book. The ledger, when used as one of the set of four books, should contain the following accounts—all personal debit and credit accounts, accounts with all farm animals, crops, household expenses, buying and selling agencies, groceries, etc.

Debit all accounts when cash *goes out* and credit the account when cash *comes in.* When keeping a regular cash account you reverse the order, or debit all cash received and credit when paid out. When keeping a ledger account place debit items on left hand column or left-hand page of book; all credit items are placed to the right of book or page. The following illustrates the correct entry of items with a corn account:

Ledger—Left			CORN.	Dr	
1916					
Jan.	20	To	10 bu. seed corn	40	00
"	30	"	shelling seed 2 days	4	00
May	6	"	plowing, etc.	30	00
July	15	"	cultivating	19	00
Oct.	10	"	field selection	12	00
Nov.	20	"	husking 10 days	34	00
"	24	"	corn crib repairs	18	00
Dec.	16	"	hauling	28	00
		"	balance	2795	00
				2980	00

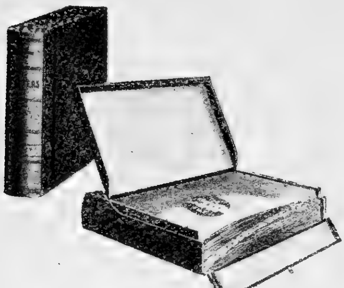
Ledger—Right				Cr	
1916					
Aug.	8	By	2 ton fodder	16	00
Nov.	28	"	32 bu. seed corn @ $3	96	00
"	30	"	280 bu. @ 60c	168	00
Dec.	20	"	5400 bu. corn @ 50c	2700	00
				2980	00

It will be noted that the balance, $2,795.00, represents the gain on the corn crop without relation to investment, and is found by adding the debit and credit columns and finding their difference. If the debit side is the lighter the balance shows a gain; if the credit side is lighter, the balance represents a loss. After adding the balance to the lighter side, the totals of both columns should be the same.

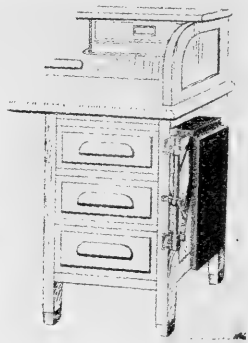
In precisely the same way accounts with the creamery, lumber company, dairy, orchard, home garden, hogs, sheep, etc., are kept.

Instead of a ledger book, some farmers prefer keeping their farm accounts on specially prepared account forms or blanks, put up in tablet form or in the shape of filing cards with index guides.

Pocket record book.—The most important single thing in connection with the keeping of farm records and accounts, is to be in a position to note down in a small *pocket record book* or memorandum each item or transaction as it occurs. A neglect to do this usually results in a



Handy letter files for farm office.



Showing shelf-typewriter arrangement when not in use.

neglect of the business end of farming or in the keeping of inaccurate accounts. In the evening or at the end of each week, the farm manager may enter all items in the cash book, office ledger and record book.

The cash book.—Every business man in shop or on the farm should keep a cash account, and in this way keep acquainted with his cash deposit or checking balance at the bank. The local bank with its check book system and conveniences is an advantage to every patron, as in this way farmers are able to keep constantly informed, and at the same time transact practically all business by the use of personal checks and without the necessity of keeping on hand large sums of money. The stubs of the checks should serve as receipts and at the same time offer a checking system against the cash accounts, whether they are kept in the ledger or in a separate cash book. The cash book should be used for cash items only and should be used in connection with the bank check book, stubs and cancelled vouchers returned by the bank. These should correspond to the cash book balances.

All cash received constitutes debit items and should be entered on the left-hand side or page; all cash paid out constitutes credit items and belongs on the right-hand side. The following forms illustrate two practical methods employed by successful farmers all over the country.

Old Form, Debit and Credit on Same Page

CASH.

CR		(Right) Item	Rec'd	
Mo.				
1916				
Jan.	1	Cash on hand	480	60
"	10	Sold hogs, 22	186	40
"	27	" eggs, 4 dz. @ 30c	1	20
Feb.	1	Cream check	62	00
"	18	Sold 6 cows	300	00
"	25	" 400 bu. corn @ 50c	200	00

DR		(Left) Item	Paid	
Mo.				
1916				
Jan.	2	Pd. clothing	16	00
"	9	" lumber	86	00
"	16	" groceries	6	50
"	26	" repairs auto	9	80
Feb.	2	" labor	25	00
"	7	" coal and gas	16	25

The *cash on hand* or *overdrawn* at the bank is shown by the difference between the credit and debit totals.

New Forms of Cash Accounts. Debit Items on Left-hand Page, Credit Items on Right-hand Page

Page 1. **CASH RECEIVED** DR

Month	Date	Garden		Poultry	Dairy	Hogs	Corn	Wheat	Hay	Total
Jan.	1	Brought forward								480.60
"	10	Sold 22 hogs				186.40				
"	27	" 4 dz. eggs @ 30c		1.20						
Feb.	1	" cream			62.00					
"	18	" 6 cows			300.00					
"	25	" 400 bu. corn					200.00			
Mar.	20	" 50 bu. wheat @ 1.20						60.00		
"	22	" 120 qts. canned veg.	24.00							
"	24	" 10 tons hay							120.00	
Apr.	2	" 15 bu. potatoes	15.00							
		Item totals	39.00	1.20	362.00	186.40	200.00	60.00	120.00	1449.20

Total Cash Received

In a similar way all credit items are entered on the second, or right-hand page and show what has been paid out on all items, such as garden, poultry, dairy, hogs, corn, etc.

The plan book.—A very practical and helpful book for the farm office is a general plan book in which drawings, farm and field maps, designs, etc., may be made. The farm manager will need to make definite plans with a view to both the present and the future development of the farming business. This will include such matters as systems of crop rotations for the permanent upbuilding of the soil, arrangements of fields, meadows and pastures, planning of drainage or irrigation systems, laying out of wood lots, orchards, gardens, playgrounds for children, and the making of a farmstead plan for the convenience of the entire family for both the present and the future. All these plans should be worked out carefully during the winter months, stormy days and slack periods, with a view to giving both time and opportunity for study and investigation, with a proper use of the business library. The plan book may also be used for the assembly of illustrations, clippings, drawings and photos, all of which will furnish helpful material and suggestions for the work in farm and home planning.

The typewriter.—A typewriter is a very convenient and helpful part of the office equipment. Every farmer can with a little practise, learn to operate a typewriter and in this way get out important business letters, statements, contracts, etc., in a businesslike way. If the farmer can not afford to purchase a new machine, he may be able to get for twenty or forty dollars a second-hand or slightly used machine which will serve the purpose quite as well.

The business library.—Every farm office should have a business library; this library may be assembled with but little expense and trouble. A convenient bookcase should be provided, with file boxes for farmers' bulletins, circulars

Typewriter desk for the office.

and clippings. These should all be classified for convenient use under the leading farm subjects and enterprises, such as soils and fertilizers, corn, dairy, farm mechanics, kitchen, housekeeping, forage, etc. A series of well selected books on farm and home subjects should be available for the use of every farmer. He is quite as much in need of his professional library as are the lawyers, teachers and doctors.

Farm Office Suggestions

1. Keep office neat, clean and conveniently organized.

2. Do not allow office desk to be littered with unnecessary material, newspapers, etc.

3. Make carbon copies of all important business letters, file them in letter files, arranged alphabetically.

4. Answer all correspondence of a business character promptly.

5. Use a memorandum pad or desk tickler on which all engagements, promises and reminders are recorded. Do not trust but train your memory.

6. Your office is your school and class room in which you give form and system to your experience and education—through it you are getting a universal business education.

7. Make your office help you solve the problems of farm and home economy and furnish motives for thrift and education for all members of your household.

8. Do not allow your business office to rob wife, children and friends of their just claim upon your time and energy—evenings, Sundays and holidays belong chiefly to them, not to the business of office.

CHAPTER IV

CORN CULTURE

CORN is king of farm crops. The value of the corn is almost equal to that of cotton, wheat and oats combined, and totals more than a billion dollars annually. We feed our stock upon corn, eat it for our own food and use it in many other ways. The welfare and prosperity of millions of people are dependent on securing a good crop of corn.

Three-fourths of the corn crop of the world is grown in the United States. Each year we produce more than 2,500,000,000 bushels and not infrequently as much as 3,000,000,000 bushels. Should we load this enormous crop into wagons, fifty bushels to the load, and allow twenty feet for each wagon and team, the line would reach from eight to nine times around the earth at the equator.

The corn region.—The greater corn belt of the United States consists of Illinois, Iowa, Nebraska, Missouri, Kansas, Indiana and Ohio. These seven states have up to the present raised about half of the world's crop of corn. The average yield in these states is about forty bushels to the acre, while the average for the entire country is less than thirty bushels to the acre.

During the last ten years the cultivation of corn as a staple farm crop has made rapid advance in all the southern states. The subtropical climate, the favorable soil, the long seasons for maturing, and the copious rainfall make the southern states admirably adapted to the growing of corn.

The Corn Plant

Corn belongs to the *grass* family; that is, it is a member of the same group of plants as timothy, wheat, rye or blue-grass. It differs from most of the grasses in that it produces the head or fruit, which we call the ear, on a short side branch.

How the roots grow.—The roots of the corn plant are tough and fibrous. They branch freely and do not possess a central tap root. By earing time the roots of a vigorous plant may extend down several feet and spread out so that they meet the roots from other hills. The ground of the corn-field may thus be completely filled up with roots. In dry seasons the roots strike deeper than in wet, through seeking for the moisture. The rooting is also deeper in black porous soil than in soil that has a hard clay subsoil underneath.

Nature has shown her wonderful adaptability in providing that some of the roots shall start from several inches above the top of the ground. These are called *brace* roots. They serve the same purpose as the guy ropes of a tent pole, and hold the stalk steady in the winds. If these are broken off by close plowing, or destroyed by worms, the corn is easily blown down.

The stem.—The corn stem or stalk varies in length from two to three feet up to as much as fifteen feet. The length of the stalk depends upon the particular variety of corn, differences in the season, and the quality of soil. Contrary to the belief of many farmers, a very tall stalk is not desirable. An extreme growth of stalk uses up the nourishment from the soil and also exposes the plant to more danger from high winds and storms.

The leaves are important in the growth of the plant, since in them the plant food is worked over and assimilated, and through them the respiration, or breathing, of the plant is done. The leaves are large, and hence have to stand much tugging in the wind. They are stronger because of their sheath-like form of attachment. Large vigorous leaves indicate a healthy plant. In very dry weather, the leaves curl up from the edges. This is a useful habit, since the leaf when thus rolled up does not lose so much moisture as when fully open.

Tassel and silk.—The tassel and silk are important parts of the corn plant. The tassel represents the male part and the silk the female part of the flower. The work of the tassel is to produce *pollen*. This sifts off in fine grains just as the corn is silking. A particle of pollen lodges on the tip of a silk, and a growth is carried through the center of the tiny thread to its root, where the kernel forms. The pollen in this way *fertilizes* the silks, one silk for each kernel of corn. If for any reason no fertilization occurs, no kernels will be formed.

The pollen grains are very light, and may be carried by the wind for many rods, thus fertilizing the silks of other corn plants than their own. This is called *cross-fertilization.* The reason different varieties of corn planted in near-by fields mix is because the pollen is carried from one field to the other.

Importance of a Good Stand

In order to raise a full yield of corn we must first of all have a *good stand.* Corn is usually planted in rows about three and a half feet apart each way. On good corn land, especially in the corn belt or central states, three stalks seem to make the best hill. It is plain that if the hills have but one or two stalks each, or if whole hills are frequently missing, there can not be a full crop, and loss is sure to result.

Loss from poor stand.—For example, it was estimated by experts that the farmers of Indiana in a recent season averaged 70 per cent. of a perfect stand of corn; and that approximately a perfect stand could have been had through three additional expedients—the proper selection of seed corn, the testing of the seed and better preparation of the soil for planting. The farmers of Indiana planted 5,000,000 acres of corn for that season's crop. But a 70 per cent. stand means that only 3,500,000 acres actually grew corn. Thus the farmers of one state were plowing, planting, cultivating and paying interest or rental on 1,500,000 acres of land for which they received no return, simply because they had no crop growing on it. The annual loss to the farmers of Indiana from this one source amounts to nearly 60,000,000 bushels of corn, or enough when sold to support three public school systems as expensive as their own, or to build several thousand miles of excellent highways. And besides this, the world, already paying far too high a price for food products, is deprived of a vast amount of food to which it has a right.

Similar illustrations may be found in any agricultural state. The average corn yield in Kentucky for a recent year was twenty-nine bushels to the acre. But that same year the champion club boy of Kentucky produced one hundred and forty-eight bushels on his acre. Experts tell us that Iowa can easily raise on an average of seventy-five bushels to the acre; all that is needed are better methods of farming. But Iowa actually produces a little less than forty bushels. This means that Iowa farmers are annually paying some 200,000,000 bushels of corn as the price for poor stand and inferior methods of cultivation.

Loss from barren stalks.—There are several causes for barren stalks. Barrenness may be produced by weak seed, insect enemies and diseases, unfavorable soil or climatic conditions and too thick planting. It is probable that weak seed more than anything else is responsible for barrenness. Since the ear is the first part of the plant to suffer, however, any cause that checks growth will tend to produce barren stalks.

Loss from suckers.—Suckers are another class of unprofitable stalks. Corn sends out but one stalk from each kernel of seed; but occasionally one or more branches, called suckers, spring from the joints near the ground. Suckers have no independent root system, and so draw all their nourishment from the parent plant. They seldom produce ears, and are, therefore, clear waste, adding nothing themselves to the yield, while robbing the main stalk. Suckers are usually most plentiful in thin planting, especially if the soil be rich. There are also certain strains of corn that produce more suckers than others. Seed from sucker-bearing plants, or from strains addicted to sucker-bearing should not be planted.

It is an interesting and profitable experiment for any farmer to go out into his corn-field and count the stand and the barren stalks on a representative section of the field, and then compute the percentage of loss from these sources. It is probable that on average years a ninety-five per cent. bearing stand can be obtained if care is used.

Corn Enemies

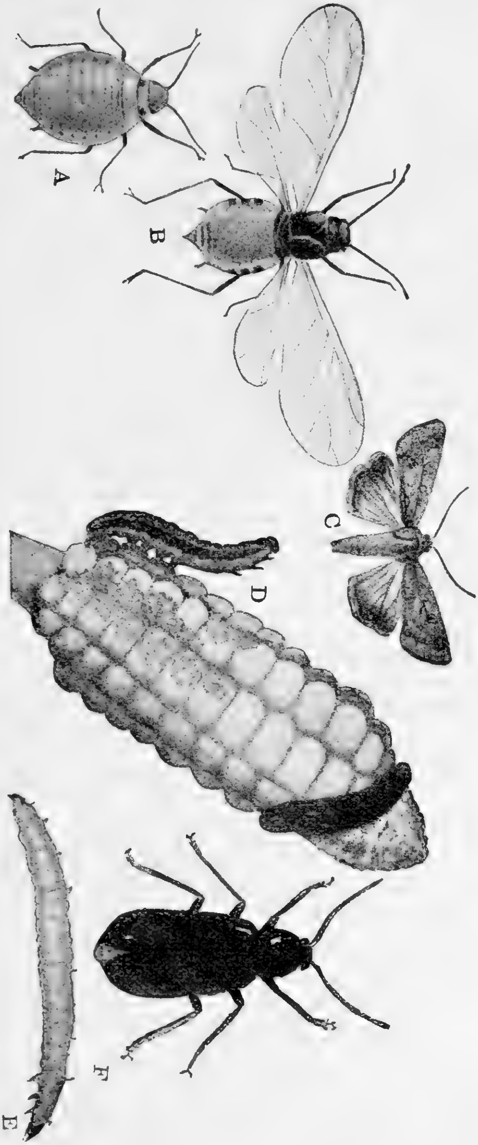
Plants, like animals, are subject to certain diseases. Corn is usually a healthy plant, and not affected by as many diseases as some of the other crops. The most serious enemies of corn are various insects, such as the corn-root worm, the corn-root aphis or louse, the cutworm, the ear worm; and such animals as gophers, squirrels and birds.

The corn-root worm.—This pest is responsible, over a large area of the country, for greater loss to the corn crop than any other cause except poor seed, and often probably inflicts more damage than all other insects put together. It has been estimated that its damage in the corn belt alone exceeds 200,000,000 bushels annually. Because the root worm is very small and does its work underground, it is seldom seen, and probably could not be identified by many farmers to whom it has caused thousands of dollars of loss. It is present in some degree in almost every cornfield.

At full size the root worm is about one-third inch in length, and as large around as a pin. It is whitish in color, with its head and the first segment of its body brown. The root worm hatches in June or early July, and reaches its full growth by the first of August. Soon after this it goes into the pupa state, and in a few days comes out a small green beetle. This beetle lays the eggs, which remain in the ground over winter and hatch the next generation of root worms the following spring.

As soon as the young worms are hatched they enter the roots of the growing corn, burrowing back and forth just under the outside covering. Half a dozen worms are sometimes found in the one root, and as many as two hundred in a single hill. The worm destroys the tender part of the root, which turns brown and rots off, leaving only the stubs of roots. As a result, the stalk of corn is deprived of its means of securing moisture and nourishment. It seems to stand still instead of making a vigorous growth, and fares badly during the dry weather of July and August. It is easily blown over, especially after a rain when the ground is soft. The yield is greatly reduced, and the ears are light and chaffy; many stalks are barren. The growth of the plant is retarded, and the crop is late in maturing.

There is no way of stopping these pests once they begin on a field of corn. But the remedy is possible for the next



(A) The corn-root aphis. (B) The winged female. (C) The common ear-worm moth. (D) The corn-ear worm. (E) The corn-root worm. (F) The beetle.

year—whenever practical *plant the field to some other crop.* For this will leave the young worms with no food, and they will all die. The field can then be planted to corn again, and should be free from root worms for at least the first year. Usually corn should not be raised for more than two years in succession on the same field. Especially if the corn goes down in spots in August, and if the roots show the working of these worms, corn should not follow corn the next season. If proper rotation of crops is practised, there will be little or no loss from the root worm.

The corn-root aphis or louse.—Second to the root worm, the *worst enemy of corn is the corn-root aphis.* This is a small louse, no larger than the head of a pin, and of a bluish-green color. These lice are found in groups on the roots of corn, from which they suck the juices intended for the growth of the plant.

The corn-root aphis is always found accompanied by ants. Indeed, it is the ants which carry the lice to the corn roots, or to the roots of certain weeds after the corn roots have become hard. The ants take this care of the aphis because it gives out a sweet substance called "honey dew," upon which the ants feed. The presence of many ants in the corn-field, especially ant-holes in the hill, is a sign of root aphis.

The worst damage by the aphis is done while the corn is very young. The lice sometimes destroy the roots even before the plant comes up. The effect of their work on the corn roots causes the plant to turn yellow and take on a sickly appearance. If they are very severe in their attack, the tips of the leaves become purplish, and the stems reddish in color. The yield of the crop is greatly reduced, and its ripening delayed.

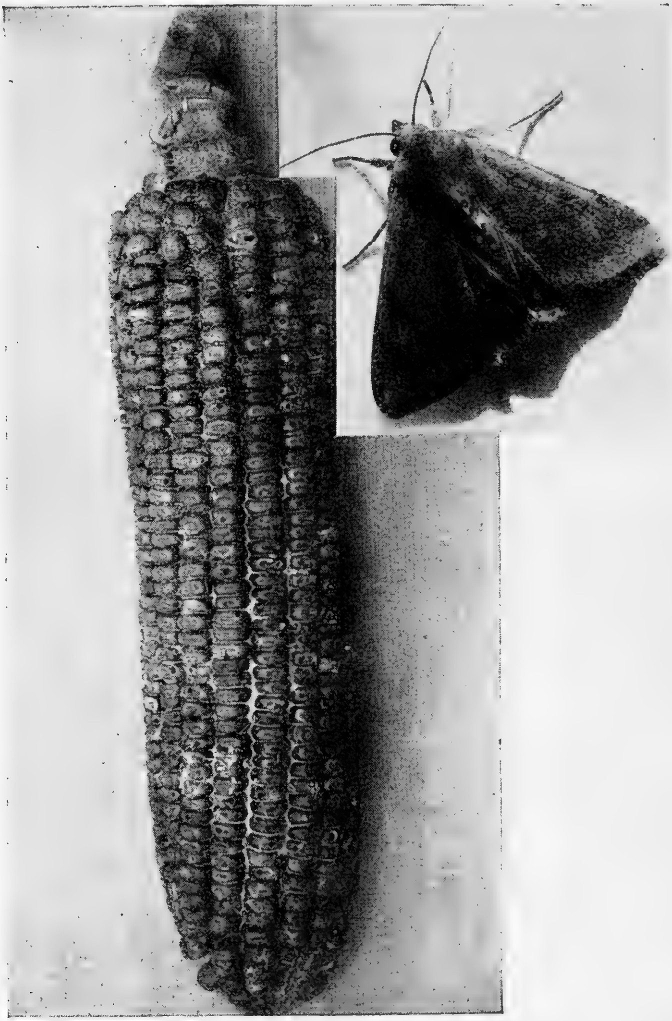
Rotation of crops is one of the surest remedies against this pest. *Harrowing the field before the corn comes up,* or while it is small, interferes with the work of the ants, and hence checks the ravages of the aphis. Keeping the fields clean of weeds is also necessary, since the lice thrive on the roots of such plants as smartweed and foxtail.

Cutworms.—Cutworms do little damage except on sod land which has been in meadow or pasture for a number of years. They are a grayish-brown color, and grow to an inch or more in length. Cutworms work at night, cutting the young stalk of corn off at the surface of the ground.

One remedy for cutworms is the fall plowing of sod, thus exposing the insects to the freezing of winter. This will greatly reduce their number. A shorter rotation of crops, leaving the field in sod but one or two years, will also tend to destroy the cutworms.

Wireworms.—Wireworms also make their home in sod, and hence are worst in newly broken ground. They are the larvæ of the click-beetle, whose eggs are laid in meadows and pastures in the fall. They hatch out as small reddish-brown worms in the early spring. The worms attack the sprouting kernel, and also bore holes through the young plant. Fall plowing and rotation of crops are the best remedies against the wireworm.

The ear worm.—The worm is usually found working



Corn ear injured by corn moth during storage. One of the South's greatest enemies to stored corn.

in the tips of corn ears. It attacks not only corn, but cotton and many other plants.

The corn-ear worm lives through the winter in the pupa stage, and comes out in the spring as a moth. There are several broods each season, but only the last does any great damage to the corn. The harm done by the ear worm is not great, except to sweet corn intended for canning. There is no certain remedy known, though fall plowing is thought to reduce its number.

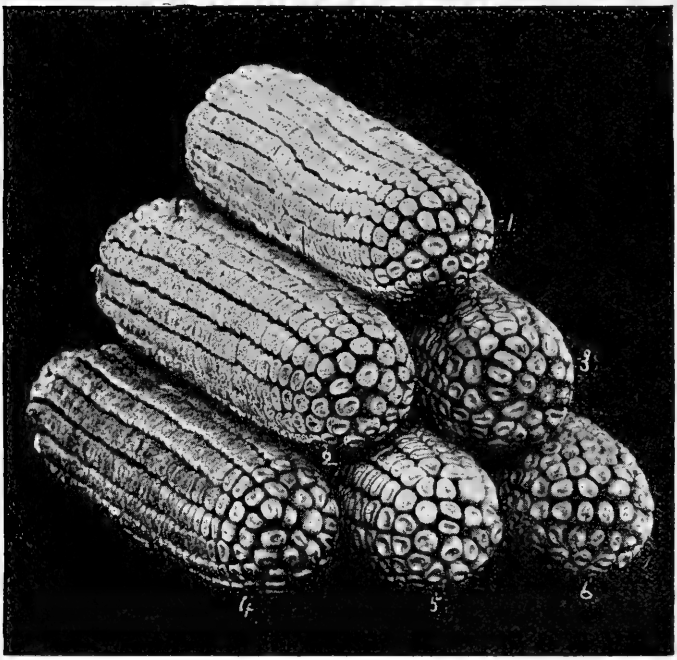
Smut.—The most common disease affecting corn is smut. The smut masses seen on growing corn are produced by a small parasitic plant which lives on the juices of the corn plant. Smut spores, corresponding to seeds, live over winter in the soil, or may be distributed in manure spread on the field, or may even be blown considerable distances from other fields.

The slimy black masses of smut are found on the stalk, leaves, tassel or ear. Since smut must live off the strength of its host, it is evident that the corn plant is weakened and the yield reduced by the presence of this disease. There is no effective remedy for corn smut, though the burning of smut balls, keeping it from the manure used on the field and the rotation of crops, all tend to control it.

Saving the Seed

The first care if we would secure a good stand of corn is the seed. We must have seed that will grow and show strong vitality. Most of the poor stands, except those due to bad weather or poorly prepared seed beds, come from seed that either fails to germinate, or else throws out plants so weak that they are unable to live through the cold damp weather of early spring.

Loss from poor seed.—The loss from the planting of



A sample of corn showing good tip ends.

poor seed is enormous. There are more than one hundred million acres of corn planted every year in the United States. This requires some sixteen million bushels of seed. But of these sixteen million bushels, it has been estimated by government experts that three million bushels fail to grow or produce barren stalks. Think of planting three million bushels of worthless seed corn each year!

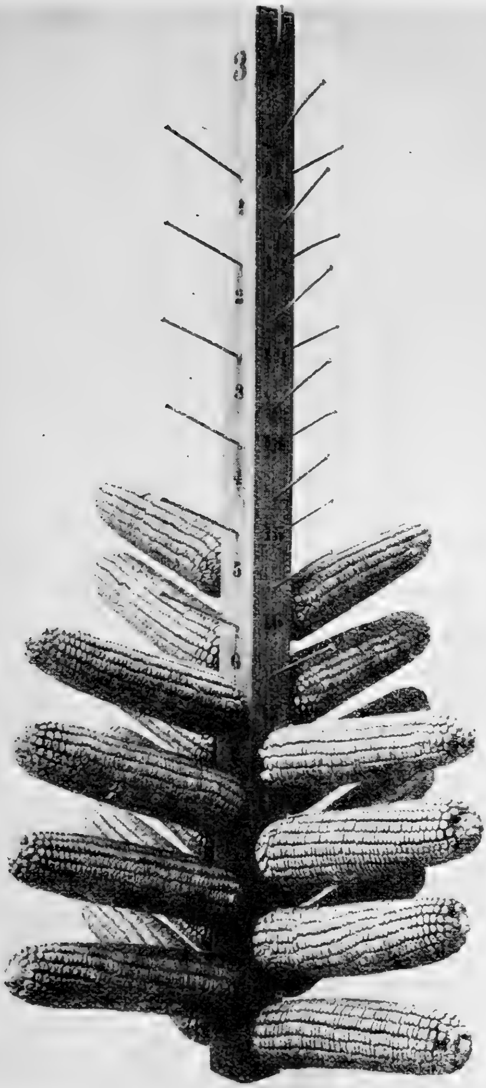
Let us see what this great waste means. The average yield of corn to the acre in the United States is slightly under thirty bushels, or only one small ear to the hill. For, counting 3,556 hills to the acre, one ten-ounce ear to the hill would yield almost thirty-two bushels to the acre; and an ear weighing only ten ounces is little more than a nubbin. Our farmers are therefore averaging but one small ear to the hill in all their corn-fields. If they should increase the stand and improve the corn so that from each hill they get two medium-sized ears, each weighing twelve and one-half ounces, the yield will be eighty bushels to the acre instead of thirty bushels. Will it not pay to select good seed?

Time for saving seed.—There is no more important work on the farm than the selection and care of seed corn for the next crop. Freezing before it is fully dry almost always injures the seed so that it either will fail to sprout, or else will produce a weak plant. Seed corn should therefore be gathered as early in the fall as it is well ripened. The time for saving seed in the "corn belt" is from September twentieth to October tenth.

How to gather seed corn.—Securing good seed requires that seed corn shall be gathered from the field before the general crop is harvested. The proper way to select seed corn is to pass through the best parts of the field, row by row, with a sack slung over the shoulder, examining each promising-looking ear from a good stalk and full hill, and taking the ear if it proves acceptable. This looks like a good deal of work, but when it is remembered that twelve to fifteen ears will plant an acre, and that the difference between a yield of thirty bushels or of sixty bushels to the acre may result from having good seed, it is well worth the time. From three to five bushels a day may be selected in this way—enough to plant from twenty-five to forty acres of next season's crop.

The right kind of seed hill.—In selecting ears for seed it is important to take into account all the surroundings of the plant. It is plain that ears grown on stalks which stand but one in a hill, or next to missing hills, have a better chance to grow large than those from full hills. A large ear grown under such favorable conditions might not produce so well as somewhat smaller ears grown under less favorable conditions. We want to be sure that the ear is good size because of something in *the nature of the ear itself,* rather than from what has happened to it while growing. Mature good ears from hills *having three stalks* are desirable, for this condition promises a good yield. The stalk should be sturdy, not too tall, and have plenty of broad full leaves.

Caring for the seed.—Caring for the seed after it is picked is as important as its selection. The great thing in caring for seed corn just picked from the field is to give it a chance to dry gradually but thoroughly. To do this, it must be where it can get plenty of circulating air. The ears should not touch one another, for then they will not dry evenly. Seed corn should therefore never be stacked in



Drying seed corn.

piles or thrown into a crib after it is gathered, but should be hung up in some open place sheltered from the direct sun, if the weather is still hot, and from all rain or other forms of moisture.

One of the simplest and best ways to hang seed corn is by stringing it. By this method each string contains a dozen or fourteen ears—enough to plant an acre. To hang corn in this way, cut a string of binding twine twelve feet long, and tie the ends together, thus forming a loop. One person should operate the string, and another handle the ears. Place the first ear in the strings, and pass one end of the loop through the other end, tightening down to the ear. Place the next ear in the same way, and keep on until the string has all been taken up. Hang the stringer of ears up in a uniformly dry place and it will need no more attention until time comes for testing the seed. This plan should be followed after each day's picking, not even allowing the corn to lie over night before being hung to dry.

Another plan of drying out seed corn is to lay the ears side by side on a rack, made especially as a seed dryer. It should permit a free circulation of air, and should be placed where mice and rats can not reach the corn. Where this plan is followed, the shelves should be made of slats, and not of solid boards, so as to allow the air to get to all parts of the ear.

Hanging the ears by tying a part of the husk together works well, but takes more time, and also takes up more room than to use the twine loop for hanging ears in one string. Still another method is to drive ten-penny finishing nails four inches apart in a post, sticking the butt of the ear on the nail.

Types of Corn

There are altogether seven different types of corn. These are: (1) pod corn, (2) soft corn, (3) sweet corn, (4) pop-corn, (5) Kafir corn, (6) flint corn, and (7) dent corn.

Pod corn.—Most of those who will read this book have never seen pod corn grown. It has a thin husk around each separate kernel. This type of corn is of interest chiefly because it is thought to be the oldest type, from which all other types have developed. The chaff or scale at the base of the kernels of our common varieties is probably a remnant of the kernel husk of the old pod corn. Pod corn will grow in almost any temperate region.

Soft corn.—Soft corn, like pod corn, is not grown as a staple crop in the United States. This is the *Mondamin* of the American Indians, and was favored by them because it was very easily ground. Its softness is caused by the fact that its endosperm is all of soft white starch, wholly lacking the horny starch of the other types. Little of this type is grown except in the South.

Sweet corn.—Sweet corn is widely grown for human food. It is used green as "roasting-ears," and is canned while green and kept in this state for almost any length of time. Sweet corn does not produce so large a yield as some other kinds, and hence is not grown for feeding stock It is grown throughout the entire United States.

Pop-corn.—Pop-corn is distinguished for the hardness of its kernel. It is just the opposite of soft corn, and has an endosperm nearly all of hard horny starch. When the kernels are heated and the moisture in them expands, an explosion occurs which we call popping. Pop-corn can be raised in all parts of the corn region.

Kafir corn.—Botanically Kafir is not really a member of the corn family, but belongs to the sorghums. For agricultural purposes, however, Kafir may be considered a type of corn. Its medium-sized seeds grow in a cylindrical or oblong head instead of on an ear. Kafir is grown in the semi-arid regions of the Southwest. It is a good substitute for corn in the ration of all farm animals.

Flint corn.—Flint corn is the prevailing type yet raised in New England and in New York. It is to be recognized by the long slender ears, and by the hard flinty kernel, which contains a large amount of horny starch. Flint corn does not require so long a growing season as dent corn, and hence is preferred in some northern regions where there is danger of the crop being caught by the frost before it is ripe. As early varieties of dent corn are being developed, they are displacing flint corn in many regions.

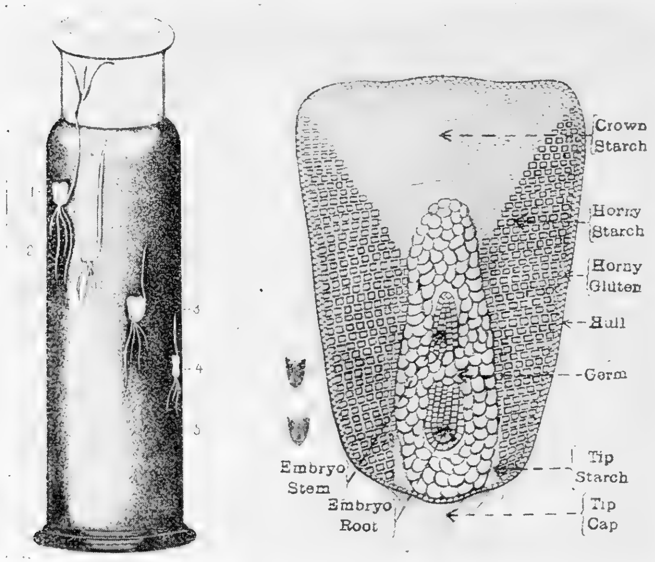
Dent corn.—This is the principal corn raised in the great corn producing regions of the United States. In fact, it supplies the greater part of the world's corn crop. It is called *dent* corn because the soft starch of the crown shrinks slightly in ripening, thus causing a depression in the top of the kernel. It is the type grown almost exclusively for feeding stock, and all the commercial corn products, such as glucose, starch, sirup, etc., are made from it. Dent corn has two varieties: (1) *single ear,* or one ear to the stalk, as grown in the corn belt; and (2) *prolific,* or many ears to the stalk, as grown in the South.

Types and varieties.—Each different *type* of corn may have many *varieties* or strains. As a matter of fact, however, the types that are most grown have the largest number of varieties, or strains. Varieties of corn are produced in three different ways: (1) by selecting some exceptional or peculiar ear, and using it for seed, picking out for seed each year the ears most nearly like the original parent ear until the variety is established; (2) by cross breeding; and (3) by selecting each year for planting the best ears,—the *earliest* ears, the *largest* ears, the *best shaped* ears, or ears that possess whatever quality is wanted in the new variety. If this same quality is selected year after year, the variety will after a time have a tendency to "breed true"; that is, all to be like the ears selected for seed.

Selecting the best variety.—Different varieties are suited for different climates and for different soils. It is therefore important in selecting a variety of corn to know whether it is adapted to the conditions under which it is to be raised.

Raising Seed in a Selection Bed

The first step necessary in improving corn is to improve the seed. Not only must we make sure that the corn selected for seed will grow, but it must be as nearly up to standard in every way as possible. For *heredity* works in plants as well as in animals. We select the best stock for breeding; we should do the same in choosing the seed we plant. Good, strong, well-formed ears will tend to produce corn of the same kind, while small, irregular, or weak ears will breed the characteristics of their kind.



Demonstrations showing results of planting corn at different depths. Diagram of kernel of corn.

Choosing the selection bed.—So important is the matter of the very best corn for seed, that many farmers are now using what is called the *selection bed* for the raising of seed. The selection bed should be a choice plot of ground of from one to three acres, depending on the size of the farm. This plot is specially prepared, planted with the choicest seed tested for growth and vitality, and is given the best of care.

The selection bed should be by itself if you want pure seed. It may be a part of the general field, if located at the south or southwest side, so that the prevailing summer winds may carry the pollen to all parts of the plot, and even to the remainder of the field. This plot should never be placed where it will receive the pollen from some neighboring field of different variety, of mixed or poor grade corn.

Care at tasseling time.—At tasseling time the selection bed requires special attention. As already explained, this is because the tassel, which is the male flower of the corn, bears the *pollen* necessary to fertilize the silk, which is the female flower. There is one *silk* for each kernel. The silk has to be *fertilized* by a single grain of pollen falling upon it. If pollen from a different variety of corn fertilizes the silks, the result is a mixed breed. If the pollen comes from weak or faulty stalks, the ears formed are imperfect, or the stalk may remain barren.

In the selection bed, as in the remainder of the field, there will be found weak stalks, barren stalks and suckers, all of which may bear tassels, and hence produce pollen. But the pollen from these faulty stalks should not be allowed to fertilize the ear-bearing stalks. To prevent this, it is necessary to go into the selection bed when the first tassels begin to appear, and *cut out all the faulty stalks,* so that their pollen may do no damage. This is a very important matter in raising good seed, and should never be neglected.

Weak parentage in corn, as in stock, should be prevented.

Taking seed from selection bed.—The same care should be observed in selecting seed from the selection bed as from the general field. Each year the choicest and strongest ears should be used in planting the selection bed. In this way, almost any variety of corn can be improved, and much larger and better yields obtained.

Home-grown seed the best.—As a rule, home-grown seed is best, provided it is carefully selected, and kept improving from year to year. It takes corn shipped in from another region several years to adapt itself to the new conditions so that it will do as well as in its home place. Corn does not "run out," as many farmers believe, but is run out by farmers who are careless in selecting seed.

Testing the Seed Corn

No seed corn should ever be planted that has not been tested ear by ear to see whether it will germinate and produce a strong growth. For, even if the seed is carefully selected and cared for, there are always some ears that will fail to grow, or else produce plants so weak as to be barren or raise but worthless nubbins.

Corn Judging with Score-Card

What qualities, together, make a good ear of corn? We are now ready for a somewhat more careful study of the ear to answer this question. For this purpose we might judge a sample of ten ears by the use of the *score-card.*

The score-card requires that we grade the ear on each of its different qualities, and then sum these markings all together for the final "standing" or value of the ear.

This method of judging corn is much more accurate and scientific than estimating the value of an ear in an offhand way. It is the method used by a number of the corn experts.

All ears to be judged as if for seed.—No matter for what purpose corn is to be used, it is always best to judge the ears *as if they were intended for seed.* This is because the ear that is best for seed is also best for every other purpose. The ear which would show best in an agricultural exhibit, the one which would be best for yield, or feeding, or any other use, is the one which grades highest as a seed ear.

The four qualities on which the ear is judged.—The score-card is arranged to judge the corn on four different qualities, each quality, if perfect, being counted as twenty-five points, one hundred points therefore being a perfect score.

The *first* great question about an ear is: Will it *yield* well; has it a good constitution, so that it will do well even under unfavorable conditions? The *second* question is: Will it *ripen,* and not get caught by the frost and so produce a crop of soft corn? The *third* question is: Will it *grow,* is it of good vitality, so that it will give a good stand, and strong plants? The *fourth* question is: Does it show *improvement;* or is it of clear type and corn that will breed true, and not show mixed breeds?

Will the ear yield?—The chief factors in the yield are the size of ear, depth of kernel, filling at tip and butt, and reasonably close set rows. The size of the ear must be adapted to the locality. Much larger ears can be raised in Missouri, for example, than in Minnesota, because of the difference in length of season.

Will the ear ripen?—In general, ears that have a large circumference are slower in ripening than slender ears. Long kernels also indicate late maturity, as do large, coarse, pithy cobs. Such characteristics are therefore not adapted to regions having short seasons.

Will the ear grow?—In an ear of good vitality the grain is of a bright and cheerful appearance, and the germ and embryo of clear whitish color, somewhat shiny from the oil it contains. All discoloring or signs of molding indicate lack of vitality.

Does the corn show improvement?—In corn that is improving instead of running out, the color is clear and free from mixture, true to the variety represented. Both ears and kernels should be constant in shape, and conform to the variety type.

Let us study these four points a little more in detail, and then we shall be ready to score our samples according to the points of the score-card which follows:

SCORE-CARD FOR CORN

I. WILL IT YIELD? 25 POINTS

That is, will it yield well; has it constitution; can we depend on it even when conditions are unfavorable?

			NUMBERS OF EARS									
I	WILL IT YIELD?	Perf. Score	1	2	3	4	5	6	7	8	9	10
1	Size of Ear	6										
2	Solidity or Heaviness	4										
3	Depth of Kernels	3										
4	Cheerfulness	3										
5	Size of Germs	2										
6	Fullness of Middle	2										
7	Filling of Butts	1										
8	Filling of Tips	1										
9	Space at Cob	1										
10	Furrows between Rows	1										
11	Size and Condition of Cob	1										
	Total	25										

II. WILL IT RIPEN? 25 POINTS

That is, will it mature; will it ripen every year; is it safe for the locality? Will it be of good quality?

			NUMBERS OF EARS									
II	WILL IT RIPEN?	Perf Score	1	2	3	4	5	6	7	8	9	10
1	Size of Ear	6										
2	Depth of Kernels	4										
3	Starchiness	3										
4	Sappiness	3										
5	Chaffiness	3										
6	Size of Cob	2										
7	Plumpness of Tips of Kernels	2										
8	Adherence of Chaff to Tip Caps Kernel	1										
9	Adherence of Tip Caps to Cob	1										
	Total	25										

III. WILL IT GROW? 25 POINTS

That is, has it vitality; will it germinate; will it all grow and grow uniformly, giving strong vigorous plants?

			NUMBERS OF EARS									
III	WILL IT GROW?	Perf Score	1	2	3	4	5	6	7	8	9	10
1	Color, Condition of Germ, Embryo	10										
2	Starchiness	3										
3	Sappiness	3										
4	Chaffiness	2										
5	Mouldiness of Cob	1										
6	Plumpness of Tips of Kernels	1										
7	Size of Germs	1										
8	Smoothness of back of Kernel	1										
9	Smoothness of Germs	1										
10	Adherence of Chaff to Tip Caps	1										
11	Adherence of Tip Caps to Cob	1										
	Total	25										

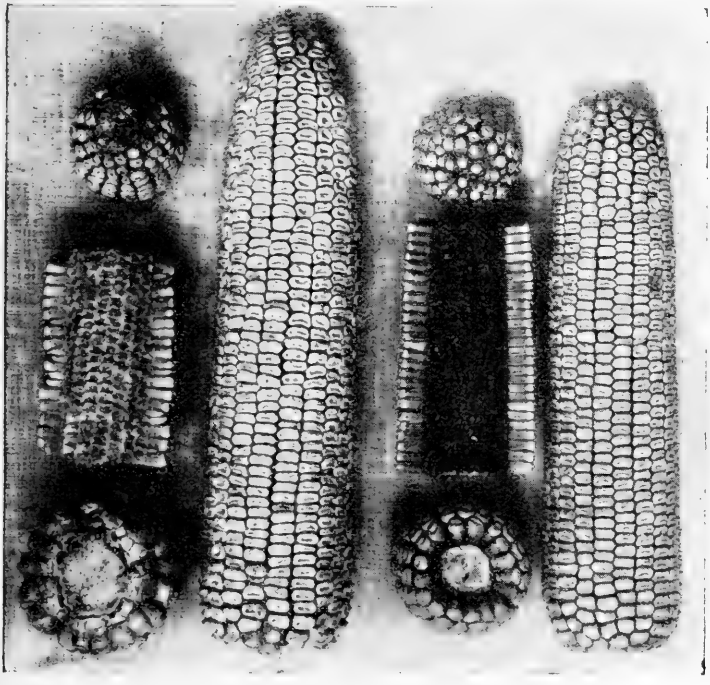
IV. DOES IT SHOW IMPROVEMENT? 25 POINTS

That is, has it breeding; has it a distinct type; will it reproduce itself; has it several years of careful selection and improvement back of it?

			NUMBERS OF EARS									
IV	DOES IT SHOW IMPROVEMENT?	Perf. Score	1	2	3	4	5	6	7	8	9	10
1	Purity of Color of Grain and Cob	10										
2	Shape of Ear	3										
3	Shape of Kernels	3										
4	Uniformity in Size and Shape of Ear	3										
5	Uniformity in Size, Shape of Kernels	3										
6	Character of Dent	2										
7	Straightness, Arrangement of Rows	1										
	Total	25										

	(SUMMARY)		NUMBERS OF EARS									
	Total Score		1	2	3	4	5	6	7	8	9	10
I	Will it Yield?	25										
II	Will it Ripen?	25										
III	Will it Grow?	25										
IV	Show Improvement?	25										
	Grand Total	100										

Since it takes but a dozen or fifteen ears to plant an acre, and since an acre of average ground should yield at least sixty bushels, each ear of seed represents from four to five bushels of crop. The farmer's time can be spent

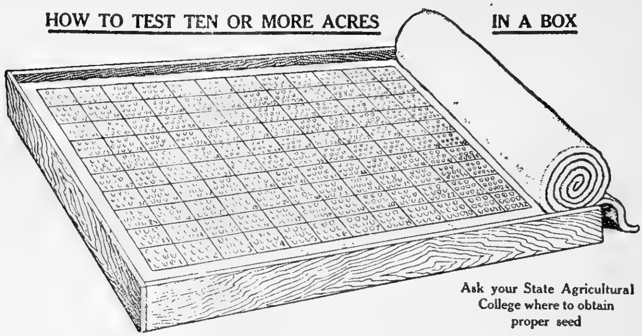


A good ear and a poor ear of corn.

in no more profitable way than in making sure that every ear of seed corn planted is sure to grow. The testing should be done late in the winter, or in the early spring before the farm work opens.

Preparing for testing.—Testing the seed corn costs practically nothing but a little time, care and attention. For, while there are several excellent seed-corn testers on the market, none is superior to one that can easily be made at home.

The *sawdust germination box* may be prepared as follows: Construct a box thirty inches square and four inches deep. Put some sawdust in a bag and soak it in warm water until it is well saturated. Fill the box half full



of the sawdust, packing it well. Take a piece of good white cloth and rule it off in two-and-one-half-inch squares, making one hundred squares in all, and numbering them from one to one hundred. Place the cloth on the sawdust so that there will be a margin of at least two inches between the sides of the box and the squares. Tack the cloth to the edges of the box.

Now take one hundred ears of corn to be tested and lay them out in a row on a table or planks. Drive a nail into the table every tenth ear, separating the entire lot into ten groups of ten ears each. Number the ears from one to one hundred to correspond with the squares in the tester.

This may be done by numbering the places on the edge of the table if care is taken not to change the places of the ears.

Making the test.—Remove one kernel from near the butt, one from near the middle, and one from near the tip of the ear; turn the ear over and remove three kernels from corresponding positions on the other side of the ear. These six kernels are to be placed, germ side up and tips all toward one side of the box, in the squares over the sawdust, those from ear No. 1 in square No. 1, and so on, until six kernels have been taken from each of the one hundred ears and placed in the tester.

After the kernels are all in position, thus filling the one hundred squares, lay a piece of cloth over them, taking care not to disturb their positions. Sprinkle this cloth well with warm water. Now lay over this another cloth about twice the size of the box. Fill in on top about two inches of damp sawdust, packing it down very firmly. Then fold the edges of the cloth over the sawdust, covering it so that it will not dry out.

The germination box is now ready to set away for the kernels to sprout. The box should be kept in a fairly warm place, and must not be allowed to freeze. The kernels should be allowed from six to eight days for sprouting, depending on the temperature. It is not enough that the germination has merely started; it must be allowed to go on for some days to show whether the new plant has good vitality.

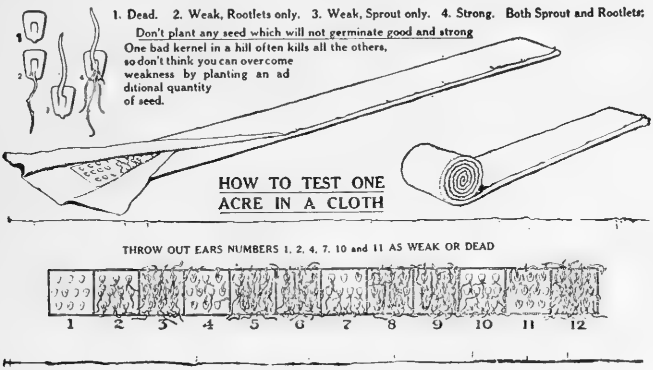
The number of germination boxes required will depend on the amount of seed to be tested. Several can be used at the same time, stacking one on top of another as they are filled. The ears must, of course, remain in their original positions on the tables until the results of the test are determined.

Reading the test.—At the end of the germination period the cover must be removed without disturbing the kernels. This can be done by carefully rolling up the top pad of sawdust in its cloth. The sprouts will be some two inches long, and may in some cases have grown through the first cloth covering.

It is easy now to tell which are the good and which are the bad seed ears. An ear should be rejected if even *one* of the six kernels failed to sprout. For a loss of one out of six means sixteen and two-thirds per cent. of the crop gone if all ears were of this kind.

Ears whose six kernels may all sprout, but which start weakly, should also be thrown out. For it is these weak plants that later turn out to be barren, or prove an easy prey to dry weather or some insect enemy. If only those ears are planted whose six kernels all produce strong vigorous sprouts in the germination box, the greatest obstacle in the way of a perfect stand will have been removed.

The "rag-doll" tester.—A very simple and effective tester is made of a strip of cloth and is called the "rag doll." To make this form of tester, use nine-inch strips of muslin five feet long. Draw a pencil line lengthwise down the middle of the strip, and draw cross lines every three inches, leaving about fifteen inches at each end of the strip with no lines. Number the spaces. Wet the cloth thoroughly, and place the kernels in the spaces as in the sawdust tester. Roll the strip up from one end, and tie a string around the roll. Now stand the roll, with the tips of the kernels down, in a bucket of tepid water for several hours. Place the roll in a box or under an inverted bucket so that the moisture will not dry out. Of course as many of these rolls may be used as are required for the amount of corn to be tested.



Rag-doll tester.

Commercial testers.—Several forms of commercial testers are now available, and most of them are fairly satisfactory. There is little need, however, for buying testers when they can be so easily made at home, and when the home-made testers are so simple and effective.

Preparing Seed Corn for the Planter

After testing the seed, the next step is to *grade* it for the planter. This means to divide the seed corn into lots according to the size of the kernels. It is impossible to secure a regular drop with the planter unless the kernels are of fairly uniform size. And no matter how good the seed, if one hill receives two kernels and the next four or five, the stand will be irregular and the crop reduced.

Grading seed corn.—The grading of seed corn can be done in the winter when general farm work is slack. It may well follow immediately after the testing, or even be carried on in connection with it.

The first step in grading is to shell off the butts and tips by hand. The end kernels are always more or less irregular, and differ in size from the remainder of the ear. They should never be planted.

The ears are then to be shelled, one at a time, and the kernels inspected to determine whether they are *large* or *small;* if the variation is great, it will be well to have also a *medium* grade. As each ear is shelled, the seed is put into its proper grade; when the shelling is completed, the supply of seed will therefore be in either two or three lots, based on the size of the kernels. All ears with exceptionally large or exceptionally small kernels should be rejected, as they will fit neither grade.

Hand picking the seed.—But even after the most careful grading by ears, there will still be a surprisingly large number of irregular, broken, diseased, or imperfect kernels. To remove these, the corn should be spread out on a table, a few handfuls at a time, and all the imperfect kernels thrown out. Running the seed through a "sorter" saves time in the hand picking. The seed-corn sorter consists of a sieve with large oblong meshes.

Caring for the shelled seed.—After the seed has been tested and graded it must be given good care to prevent it from becoming damp and molding, or getting too dry as from artificial heat. It should be placed in sacks holding not more than half a bushel each, and hung in a protected place, such as an attic. The sacks should be labeled to show the grade that each contains.

Testing the planter.—Before planting time, the planter should be carefully tested for each grade of seed, and the right size of plates determined. This is done by placing a quantity of each grade of seed in the planter boxes in succession, throwing the drop by hand, and keeping accurate count of the number of kernels dropped each time for from twenty-five to one hundred hills.

In well graded seed it should be possible to secure a drop of three kernels more than seventy-five per cent. of the time. Whether whatever variation there is should be chiefly in the direction of two, or of four, kernels will depend on the richness of the soil. If the seed has been carefully tested, the effort should be to plant three kernels to the hill in just as many cases as possible.

The Seed Bed and Planting

The roots of growing corn require, besides the nutrients of the soil, *heat, air* and *moisture.* Let any of these fall short, and the crop is injured. Loose soil absorbs both moisture and air better than hard soil. Loose soil also holds its moisture better than hard soil, since it does not favor such rapid evaporation. And, since evaporation is always accompanied by a loss of heat, hard soil loses heat more rapidly at night or during cold spells. The supply of heat, air and moisture therefore depends on having the soil loose and finely pulverized.

How corn roots grow.—Corn roots grow by pushing the root tip out through the soil, drawing food from the tiny particles of earth, and drinking the film of water that surrounds each particle of soil. If the ground is hard or soggy, the root tips can not easily push through it, nor can they get enough air. If it is coarse and full of clods, the roots can not reach across the open place between the clods. In soil of this character roots also suffer from lack of moisture, for they must be packed about by fine particles in order to drink in the water. Even if the soil be so wet as to have water standing around the roots, they can not use water in this form. Indeed, water standing around the roots will injure them by keeping them too cold, and by shutting the air from them. Not until water is absorbed by millions of minute particles of fine soil is it ready for plant roots to drink.

Preparing the seed bed.—Ground is plowed in order to loosen it. Fall plowing is usually best for corn. Fall plowed ground presents a rough surface which holds the snow better, and it also takes in and retains a larger supply of moisture. Fall plowing also has plenty of time to settle, so that it is in better condition for the crop than spring plowing, and allows earlier planting. Spring plowed ground, not having much time to settle, dries out more easily than ground plowed in the fall. Especially should sod land be plowed in the fall, so that the sod may have a chance to rot and settle down on the subsoil. There is also less danger from cutworms in fall plowed, sod land. Stubble ground should usually be plowed early, and sod late in the fall.

Ground should not be plowed while it is wet, for most soils, if turned while wet, have a tendency to bake and form into clods that are hard to pulverize. Fall plowed ground should not be harrowed until spring, but should be disked or harrowed as soon as oat seeding is done. This will kill young weeds, and save the moisture from drying out. Spring plowing should usually be harrowed within a few hours after it is turned, for it is then much more easily pulverized than after it has dried. In very fine and mellow soil this may not be necessary, but many farmers harrow what they have plowed at the close of each half-day.

Spring plowing should be disked and harrowed enough to press the loosened soil down on the furrow bottom, so that it will make good connection with the subsoil. This will do much to prevent drying out. In fact, it is impossible to work spring plowing too much in this way. Much harrowing packs the soil thoroughly, makes a loose bed for the seed, and provides a fine mulch to prevent loss of moisture through evaporation. Thorough disking or harrowing of fall plowing is necessary to loosen the soil and prepare the bed for the seed.

Killing the weeds.—It is well to harrow just before planting, as this kills the sprouting weeds, and allows the corn to get started ahead of them. By far the easiest time to kill weeds is when they are just starting, and a few harrowings early in the season will save much trouble with weeds later on. From two to four harrowings, or their equivalent in disking, will usually pay on average fields.

Time for planting.—Corn should be planted as early in the spring as the ground can be made ready and the soil is warm enough. The average date of planting varies from the eleventh of March in Florida to the twenty-sixth of May in Maine. The first two weeks of May are the corn-planting time in the states of the great middle region of the United States. The average air temperature at which corn is planted is about fifty-five degrees. The Indians had a rule that corn should be planted when the leaves of the maple were as large as squirrels' ears.

Depth of planting.—A mistake is often made in planting corn too deep. Some say that by planting deep they give the roots a deep setting. This, however, is not the case. For, no matter how deep the seed is planted, the roots adapt themselves to conditions. If the planting is too deep, the permanent roots finally start out nearer the surface, and time has been lost and energy wasted in compelling the plant to readjust itself to unnatural conditions.

Corn should usually not be planted more than one and a half inches deep, and frequently not more than an inch. Especially in cold weather or in wet soils, should the planting be shallow. Careful experiments have been made by the agricultural colleges of many states as to the best depth for planting corn, and they have found that almost universally the shallow planting is best. The only exception is for a very dry soil, or a dry season.

Cultivating the Corn

Why corn needs to be cultivated.—Corn is to be cultivated after planting for three main purposes: (1) to kill the weeds, (2) to admit air to the roots, and (3) to preserve the moisture of the soil.

From the time germination begins the growth of the plant must be unchecked if a full crop is to be secured. When the corn has become yellow and spindling from being choked by weeds, or from the baking of uncultivated soil around it, it is permanently injured and will never fully recover. Only the rich green color and sturdy stock of the rapidly growing plant give promise of a full yield.

When to begin cultivation.—Cultivation should begin early. Under average conditions, two harrowings should be given before the corn comes up. This will keep the soil from baking, and keep the weeds down until the plants are large enough to cultivate. The time to kill weeds is just as they are starting. Let them once get well rooted, and they are hard to keep down. The spring-tooth weeder is sometimes used instead of the harrow for early cultivation. It is valuable where there are many stones or ruts in the field.

The shovel or disk cultivator should be started as soon as the corn is well up, so that the rows can be easily followed. Even if the weeds do not seem to be starting, they are surely taking root. Cultivation will also break up the crusted soil, and admit air to the growing roots. And this must be done or their growth will be checked.

Methods of cultivation.—Four or five cultivations are usually enough after the corn comes up, though this must depend on the character of the soil, the weeds and the amount of moisture. The present tendency is toward shallow cultivation, though this also must depend on whether

Shallow cultivating of corn with riding cultivator conserves moisture for dry season.

the soil seems to pack heavily and become hard underneath. If it does, the first should be of some depth. The important thing is not to break or injure the growing roots. For a broken root always means loss of vitality and food to the plant.

From thirty or sixty days after planting, the roots have often spread so far that they meet between the rows, thus occupying all the ground. Especially is this true if the season has up to this time been rather wet. For in wet and loose soils the roots spread out near the surface, while in dry soil they spread less and run deeper into the ground.

It is evident that deep cultivation after the roots are well spread is injurious. The old method of setting the shovels deep and "hilling up" the corn the last time through is no longer followed in scientific farming. The cultivations should be shallow. Cultivation may continue with advantage up to the time the corn is tasseling if care is taken not to break the roots. In dry seasons this late cultivation is a very great advantage, because it keeps a loose soil mulch, which does much to prevent evaporation of the sub-surface moisture.

Harvesting and Storing the Corn

Corn is harvested in three principal ways: (1) it is husked from the standing stalks and the ears stored in cribs; (2) it is cut while partially green and either shocked in the field or stored in a silo; and (3) stock, especially hogs, are turned into the field to do the harvesting for themselves.

Field husking.—By far the greater part of the corn produced, especially in the great corn belt, is husked in the field from the standing stalks. This is the method used when corn is raised for the grain, and the fodder, or stover, is a secondary consideration.

Field husking is the cheapest and quickest way of securing the grain. In good corn, from sixty to more than one hundred bushels a day can be gathered by one man with a team, at a cost of from three to four cents a bushel. Machines for husking from the standing stalks are also in use on many large farms. Corn can be picked by a husking machine at the rate of from seven to eight acres a day, and, where the acreage is large, at a cost per bushel slightly less than for hand picking. No machine yet invented does the husking as satisfactorily as by hand. The machine misses some ears, breaks others, shells off more or less corn, and pulls up or breaks many stalks.

One advantage of field husking is that the harvesting can be delayed until the fall rush with other crops is over. The ears should be well cured before being cribbed, or there is danger of molding. This is especially true if the fall and winter should happen to be warm and moist.

Corn should be stored in well protected cribs. The use of rail or other forms of uncovered cribs is a source of great loss. The grain may seem to keep well during the winter in the open crib, but when shelled and sold to the elevators in the spring it often heats and spoils. This tends to reduce the price of corn, and has caused a prejudice in European countries against American corn as a food. No rain or snow should reach the corn after it is cribbed, for it is sure to injure the quality of the grain.

Harvesting by cutting.—In average corn the ear supplies about sixty-four per cent. of the food value and the plant thirty-six per cent. Thus the stover in a field is worth for feeding purposes more than half as much as the grain. If the corn is cut just as it is becoming well glazed the stover is worth from five to ten dollars a ton.

The time for cutting corn depends on the use to which it is to be put. If the corn is grown chiefly for the grain, it should not be cut until the kernels are well dented and the husks partially dry. The stover will still make good feed if it is properly cared for. After a heavy frost, or after most of the leaves have become brown, the stover will not pay for the expense of cutting and feeding. Cutting while the corn is in the roasting-ear stage makes a more palatable stover, but the feeding value of the crop is considerably less than if cut in the glazing stage.

The corn binder.—The corn binder is widely used in northern states. It works successfully in corn from five to nine feet high. In regions where the stalks grow from ten to twelve feet in height, the binder does not meet with favor, since it is not yet built to handle corn of this size.

On account of the expense of owning and operating a corn binder, it is doubtful whether it pays to purchase one unless at least twenty acres per season are to be cut. From seven to eight acres a day can be harvested with the corn binder, at a cost of about one dollar and a half an acre for cutting and shocking.

The corn shocker.—The corn shocker cuts the corn and forms it into a shock carried on the machine. When the shock is completed it is tied by hand, and lifted from the machine by a crane and set on the ground. From four to five acres per day can be harvested with a shocker at a cost of about a dollar and ten cents an acre.

Shocking the corn.—No matter how the corn is cut, it should be shocked so that it will stand erect and keep the fodder dry. Fallen and twisted shocks result in the loss of millions of dollars' worth of stover, and not a small amount of grain as well. Shocks should be tied as soon as they are made, and then tightened in a week or ten days. Binding twine makes a convenient tie. The band should be within about two feet of the top, so that the shock may turn the rain.

Fodder should not be left in the shock longer than necessary to become well cured. It should then be stored in ricks or barns. The practise of leaving shocks in the field over winter can not be too severely condemned. For the rains and wind destroy the most palatable and nutritious part of the plant and rob it of a large part of its food value.

Harvesting by "hogging down."—Under certain conditions corn may be profitably harvested by "hogging down." This means that at the proper time a drove of hogs are turned into the field and allowed to feed themselves upon the corn. This method will work well only in cases where there is a drove of considerable number, and when the fields of corn are not too large. The field should be all cleaned up in from two to four weeks after the hogs are turned in, since rain and mud are likely to injure corn left too long on the ground.

It has been found by farmers who have made careful tests of feeding corn in this way that more pork can be produced per bushel of corn when the hogs are allowed to feed themselves from the field than when they are hand fed. The labor of gathering and feeding the corn is also saved, and manure evenly distributed over the field. Fences are usually set up to divide the larger fields into small corn lots. Twenty-six-inch woven wire is suitable for this use. The wire is attached to well set, corner posts, and tightly stretched. It is then tied to the corn stalks for posts. This type of fence will last as long as is required for cleaning up the field.

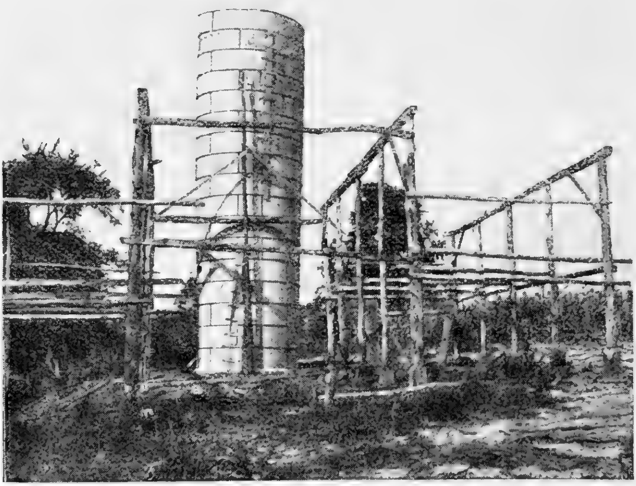
The Silo

The silo has come into general use, especially on the best managed dairy farms. Although it will preserve any green, succulent growth such as clover, sorghum, cabbage, sugar beets, etc., the silo is employed almost wholly in this country for the storing, or "home canning," of corn without curing.

For silage, the corn, when cut, should be ripened enough so that it has somewhat glazed, well-dented kernels, and the husks and leaves should have begun to die. If cut much earlier than this a great proportion of the feeding value of the crop will be lost. If cut much later, it will not pack well in the silo, nor be so palatable.

Storing green corn in a silo is like canning vegetables. In fact, the silo is nothing but a large jar, air tight except at the top. When the green silage is put in, it soon begins to decay, and thus generates a great deal of heat. This process uses up all the air in the silage, producing a large amount of carbon dioxide. Finally, the heat and the lack of air stop all decay, and the silage will keep for almost any length of time. Several inches of the silage on the top is certain to spoil, for it has sufficient air to keep up the decay. Decay will also take place where there is any leakage of air through the walls of the silo.

Advantages in use of silo.—There are many advantages in the use of the silo. Even the harder and coarser parts of the stover, because cut when green and shredded into small pieces, are eaten. Probably about double the feeding value can be taken from an acre of corn by putting it into a silo rather than by shocking and feeding it from the field. This will allow nearly twice as much stock to



Silo construction showing the use of rail framework for support during construction.

be kept on a farm by use of the silo. Animals also need such a laxative food as the silage provides.

Stock relish silage better than dry fodder, eat more of it and thrive better on it. Cattle prefer it to clover hay and eat it greedily even when fresh from good pasturage. Many farmers who make a business of dairying are coming to feed silage all through the summer as a supplement to pasturage. This has been found to pay because of the increased supply of milk produced.

Size of the silo.—The size of the silo must depend on the number of the herd to be fed from it. Silage exposed to the air decays rapidly, especially in warm weather. In order to avoid waste it is necessary to feed from one and one-half to two inches daily from the surface of the silage. If the herd is small or the silo too great in diameter, this is impossible.

Owing to the closer packing, silage is better in quality as the depth increases. It is, therefore, better to build a silo of considerable height rather than low and of greater diameter. Moderate-sized silos are built from thirty to forty feet deep. Silos are now being constructed with a water-tank in the top, into which water for house and barn use is pumped by a windmill. This gives the necessary pressure without the cost of building a tower for the tank.

The following table shows the size of silos required for herds of different sizes (allows each cow forty pounds a day for one hundred eighty days):

Number of Cows	Estimated Capacity in tons	Silo Diameter in Feet	Silo Height in Feet
7	26	10	20
14	51	10	32
21	73	12	32
27	101	14	32
33	119	16	36
43	155	16	36
54	196	18	36

An average acre of corn will yield from eight to twelve tons of silage. Hence, knowing the capacity of the silo in tons, it is easy to compute the acreage of corn required to fill it.

Twelve Silo Reasons

(T. E. Woodward in *Farmers' Bulletin* 556.)

1. More feed can be stored in a given space in the form of silage than in the form of fodder or hay.

2. There is a smaller loss of food material when a crop is made into silage than when cured as fodder or hay.

3. Corn silage is a better feed than corn fodder.

4. An acre of corn can be placed in the silo at less cost than the same area can be husked and shredded.

5. Crops can be put in the silo during weather that could not be utilized in making hay or curing fodder.

6. More stock can be kept on a given area of land when silage is the basis of the ration.

7. There is less waste in feeding silage than in feeding fodder. Good silage properly fed is all consumed.

8. Silage is very palatable.

9. Silage, like other succulent feeds, has a beneficial effect upon the digestive organs.

10. Silage is the cheapest and best form in which a succulent feed can be provided for winter use.

11. Silage can be used for supplementing pasture more economically than can soiling crops, because it requires less labor, and silage is more palatable.

12. Converting the corn crop into silage cleans the land and leaves it ready for another crop.

The Uses of Corn

Corn as human food.—Corn is a native of America. It was cultivated by the Indians before the coming of white men. Corn was the principal grain food used by the Indians, and was also widely used by the early colonists. Its use as a human food has now spread throughout almost the entire world, but it is still most widely used in this country. Corn-meal is the principal food product derived from corn, but hominy, hulled corn, corn grits, flaked corn and other specially prepared breakfast foods are also eaten. Corn starch is also a common food product. The unripe ears are extensively used and the canning of green corn through boys' corn-club work has become an important industry.

Corn as food for animals.—By far the larger part of the corn crop is used, however, as food for animals. Corn is the basis of the great meat producing industry of the United States and along with grass constitutes the chief food of the animals used for meat. Farmers have found it more paying to fatten stock with corn and then sell the stock than to sell the corn itself. One reason for this is that it costs less to ship the meat produced by a bushel of corn than to ship the corn itself to a central market. One bushel of corn will produce from ten to twelve pounds of pork, which can be shipped more cheaply than could the bushel of corn.

Commercial uses of corn.—Besides its use as a food for man and beast, corn is employed in manufacturing some thirty or forty different products. For example, from corn are made several different kinds of glucose used by refiners of table sirups, by brewers, by leather manufacturers, by jelly makers, by fruit preservers, and by apothecaries. Corn also produces four different kinds of crystal glucose used in making candies and two kinds of grape sugar used by brewers and tanners. From corn there is made a sugar used in the manufacture of ale and beer. The pearl starch used by cotton and paper mills is made from corn, as is powdered starch used by the manufacturers of baking powder and by the cotton and paper mills. Florine used by flour mixers, and dextrins used in the making of white fabrics, paper boxes and the manufacture of mucilage and glue come from corn.

From corn there is also manufactured a substitute for rubber, which is extensively used commercially. Corn is the chief source of the manufacture of all alcohol and whisky, and is the cheapest material now available for the making of denatured alcohol, which is used for heating, lighting and other commercial purposes.

Uses of the corn stalk.—Even the corn stalk has numerous uses. For example, from its pith comes the cellulose used for packing in war-ships. The corn pith has the quality of expanding when wet, and hence will immediately swell and close any small hole in the vessel caused by the enemy's shot. Corn stalks are also used in the manufacture of paper pulp and in various kinds of stock foods. Corn cobs are used in the making of corks and pipes. A special variety of corn with a large cob is raised in Missouri for the manufacture of pipes. It is estimated that approximately fifty million bushels of corn are used annually for various corn products in addition to those intended as food for people and animals.

The importance of corn as a food is increasing and scientists are discovering new ways of manufacturing or cooking it to make it both palatable and digestible. The very worst use that can be made of corn is to manufacture it into spirituous liquors, since the use of alcohol as a beverage injures those who drink it and brings sorrow, disgrace and poverty to the user.

CHAPTER V

WHEAT

BREAD is the staff of life. Whatever else we may have on our tables we usually have bread. It is so common and necessary an article of food that we describe poverty by saying, "Not a crust of bread in the house."

Yet the bread that you and I eat—wheat bread—is really a rather recent addition to the world's food. True, wheat has been known for many centuries. But not until the last few generations has it been found possible to raise enough so that the great mass of people can have it daily for food.

And even yet wheat as a common article of food is almost unknown in many nations. Probably more than half the people living in the world to-day have never tasted wheat bread such as we eat daily. Either wheat is not grown, or it costs more than other foods and can not be afforded by the common people. In its stead they eat rice, barley and vegetables.

Origin of wheat.—Just where wheat came from none can say. Some think it originated in the Valley of the Nile, or the Euphrates, or possibly that it may have come from Sicily. As far back as history goes there was wheat. Wherever it originated it seems to have developed from one of the wild grasses. Certain scientists think that it descended from the lily. Others tell us that it is probably a descendant of wild ammer.

But wherever wheat came from and however it may have developed, it is now one of the most important of grains, and from the point of view of human food, by far the most important. If one were compelled to live on a single type of food, wheat bread would no doubt carry him farther than any other one food article.

It is in the United States that the raising of wheat has received its greatest impetus, for it was in this country that the practical reaper and the thrashing machine were invented and perfected, making it possible to harvest and thrash great crops of wheat, thus insuring cheap bread.

Importance of Wheat as a Crop

The United States raises more wheat than any other nation, and approximately half as much as all Europe combined. We supply about one-fifth of all the wheat grown in the world. Our annual crop is nearly 700,000,000 bushels, enough if loaded into cars to make two solid trains, one reaching from New York to San Francisco, and the other from Regina to New Orleans.

There is every reason why Americans have a right to be great wheat bread eaters, and we eat more wheat than the people of any other nation. The average for every person in the United States is about five bushels a year. These five bushels are passed through the flouring mill, coming out as a full barrel of flour, which is then baked up into some two hundred and fifty loaves of bread.

A continuous harvest.—Wheat is a widely distributed crop. It has been said that the sun never sets on the harvest fields of the world. If the click of the reaper is not heard round the world, it can at least be heard in some region during the greater part of the year. The annual wheat harvest begins in the month of January in Argentine and New Zealand. By February it has moved northward to East India, upper Egypt and Chili.

With April the reapers are at work in lower Egypt, Asia Minor and Mexico. May sees the harvesting begin in Central America, China, Japan and Texas. By June the self-binders are at work in the fields of Turkey, in historic Spain, in beautiful France and in California, where giant reapers are drawn by twenty horses or by gasoline or steam tractors. At the same time the harvesters are busy at work in Tennessee, Virginia, Kentucky, Kansas, Utah and Missouri. By July the harvest is on in Rumania, Austria Hungary, southern Russia, England and Germany. During the same month in America the reapers are clicking in Oregon, Nebraska, Iowa, Wisconsin, Colorado, the group of central states, New England and eastern Canada.

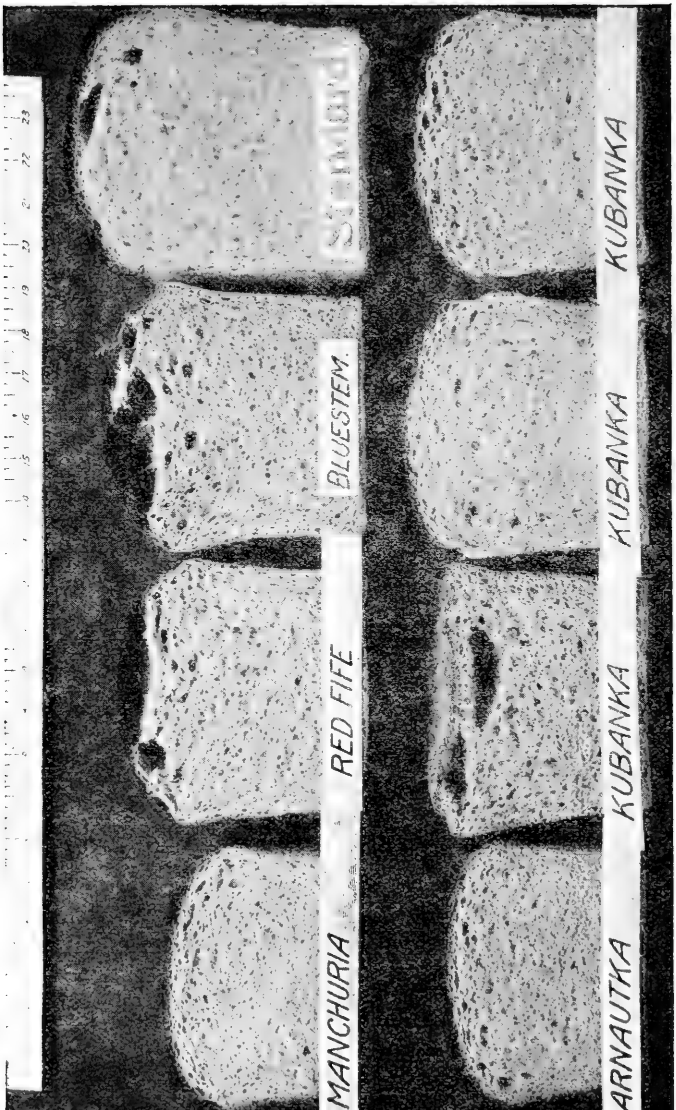
August is not quite so busy a month as July, but the wheat harvest is busy in Holland, Belgium, Denmark, Poland, the Dakotas, northern Minnesota and western Canada.

September brings the harvest to Scotland, Sweden, Norway, northern Russia and Siberia, where the busy reaper continues gathering the golden wheat well on into October. November finds the harvesters at work in southern Africa and in Peru. The year's harvest gleanings are completed in the month of December in Uruguay and Australia. There is thus not a month in the year when the golden stream of wheat is not issuing to feed hungry mouths in some region of the earth.

Use of wheat increasing.—With modern methods of farming in vogue, the supply of wheat should constantly increase and its use be extended among peoples to whom it has heretofore been unknown. The present-day farmer, by the application of modern scientific knowledge and the use of modern machinery, can, with three months' labor, produce as much wheat as could the old Roman farmer working ten hours a day every day of his life for three score years and ten. In the time of Nero four and one-half days of labor were required to produce one bushel of wheat. At the time when McCormick invented his reaper, three hours were required to produce a bushel. In these days ten minutes of time will serve to grow a bushel. Thus brains, energy and invention unite to save labor and to increase the world's food supply.

The wheat belt of the United States.—The best wheat producing regions are in the Middle West and North. Kansas, North Dakota and Minnesota produce not far from one-third of all the wheat grown in the United States. If to these we add the following twelve states, Nebraska, South Dakota, Washington, Indiana, Illinois, Ohio, Missouri, Pennsylvania, Oklahoma, California, Michigan and Oregon, we shall have the fifteen states that produce more than four-fifths of all our wheat.

The yield of wheat.—The average yield of wheat for



Samples of bread made from different types of wheat.

the entire country is about half what it is for corn, or fourteen bushels to the acre. The states that produce the largest amount of wheat are not necessarily the ones that show the largest yield per acre. Taking the average for ten years, the ten states producing the largest amount of wheat rank in the following order in the yield per acre: Washington, first; Nebraska, second; Ohio, third; Illinois, fourth; Indiana, fifth; Missouri, sixth; Minnesota, seventh; Kansas, eighth; South Dakota, ninth; North Dakota, tenth.

The average yield of wheat is gradually increasing, but all too slowly. With still better methods of farming and with better selection of seed and improvement of the soil much larger crops of wheat can be raised. And this means cheaper bread, and more profit in farming.

Types of Wheat

Wheat is classed as *winter* wheat or *spring* wheat, depending on whether it is planted in the fall or the spring. It is also classed as *hard* or *soft* in accordance with the quality of the grain.

There are three or more distinct types of winter wheat, and three of spring wheat, as follows:

1. Soft winter wheat.
2. Semi-hard winter wheat.
3. Hard winter wheat.

1. Soft spring wheat.
2. Hard spring wheat.
3. Macaroni wheat.

These types furnish a great many different varieties, so many that it would be a hopeless task to try to learn them all. The United States Department of Agriculture and the state experiment stations have tested as many as one thousand different varieties since 1895.

A good stand of wheat, raised by a Georgia club boy.

Climate and type.—In general, the more humid climate produces the soft wheats and dryer climates the hard wheats. The introduction of hard wheats has opened up vast western regions to wheat raising which were too dry for the soft varieties.

Better flour is made from hard than from soft wheat, though a very excellent grade is made by mixing the two. Macaroni wheat is the hardest type, and is chiefly used in the manufacture of macaroni, though some of this type is now being used for flour. Macaroni thus far has not been made from the soft wheats.

Winter wheat.—Winter wheat is planted in the fall, lives through the winter and ripens the following summer. It requires about one hundred days to mature after growing weather has come in the spring.

About two-thirds of all the wheat grown in the United States is of winter varieties. In regions where winter wheat will withstand the extremes of temperature it is preferred to spring varieties, since it (1) yields more, and (2) is more free from disease and from injury by the various insect pests.

Kansas and Nebraska are the great centers for the hard winter varieties, while east of the Mississippi River the softer winter varieties are chiefly grown. More than sixty per cent. of all the winter wheat grown in the United States is raised in the states of Kansas, Indiana, Nebraska, Illinois, Ohio, Missouri, Pennsylvania, Oklahoma and Texas.

Spring wheat.—Spring wheat is adapted to localities where climatic conditions are not favorable to winter varieties. About one-third of our wheat comes from the spring-sowed crop. Most varieties of spring wheat require from one hundred to one hundred and twenty-five days from the date of planting to mature them.

Minnesota, North Dakota and South Dakota are the principal spring wheat regions of the country. These three states supply seventy per cent. of all the spring wheat grown in the United States.

The grain dealers' National Association has adopted certain classifications and grading of wheat for market purposes. These grades are as follows:

White winter wheat Nos. 1, 2, 3 and 4.
Red winter wheat, Nos. 1, 2, 3 and 4.
Hard winter wheat, Nos. 1, 2, 3 and 4.
Northern spring wheat, Nos. 1, 2, 3 and 4.
Spring wheat, Nos. 1, 2, 3 and 4.
Durum wheat, Nos. 1, 2, 3 and 4.
Velvet chaff wheat, Nos. 1, 2, 3 and 4.
Pacific Coast red wheat, Nos. 1, 2 and 3.
Pacific Coast white wheat, Nos. 1, 2 and 3.

It is therefore seen that most types of wheat are divided into four classes, the Pacific Coast Red, and the Pacific Coast White wheat being the only two types given but three grades. The distinction between the different grades within any one type is shown by the following rules which govern in the grading and market quotations of hard winter wheat:

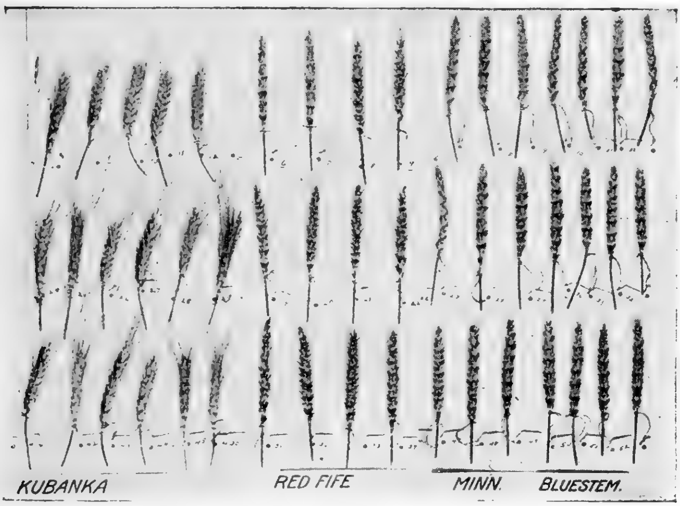
No. 1 hard winter wheat shall include all varieties of pure, hard winter wheat, sound, plump, dry and well cleaned, and weigh not less than sixty-one pounds to the measured bushel.

No. 2 hard winter wheat shall include all varieties of hard winter wheat of both light and dark colors, dry, sound, sweet and clean, and weigh not less than fifty-nine pounds to the measured bushel.

No. 3 hard winter wheat shall include all varieties of hard winter wheat of both light and dark colors, not clean or plump enough for No. 2 and weigh not less than fifty-six pounds to the measured bushel.

No. 4 hard winter wheat shall include all varieties of hard winter wheat of both light and dark colors. It may be damp, musty, or dirty, and weigh not less than fifty pounds to the measured bushel.

Similar rules govern the grading of the other types.



Common varieties of wheat.

Growing the Wheat Crop

Wheat grows best on virgin soil, or on land that has been renewed by means of forage crops, such as clover, alfalfa, manure, or some other form of fertilizer. The new regions opened up in the West at first produce large crops, but soon fail in yield if wheat is raised continuously without a plan of rotation with other crops.

Preparing the seed bed.—Since wheat is one of the crops that can not be cultivated after planting, the seed bed should be prepared with especial care. The ground should be plowed, and then disked or harrowed until it is well packed and finely pulverized. The preparation for the fall and spring seeding is essentially the same. If the ground is new, the plowing may be shallow. The older soils require deeper plowing.

Spring wheat is sometimes disked in on corn land without first plowing the ground. This, however, is a careless method of farming, and has been proved by careful experiments not to secure so large a yield as from plowed land.

Selecting and preparing the seed.—As in the case of corn, the best seed for wheat is usually that grown near home. New varieties and seed grown at a distance should not be used for the general crop until carefully tested by agricultural experiment stations and found adapted to the climate and soil of your locality.

Wheat selected for seed should possess the following qualities: (1) a plump bright grain of good wheat; (2) a stiff straw, able to withstand adverse weather; (3) a compact head, ripening early, and not easily shattered; (4) good bread qualities; and (5) ability to resist insect enemies and diseases.

Once the type and variety selected for seed are decided upon, the wheat should be run through a fanning mill. This will select the heaviest and plumpest grains, as well as remove the seed of noxious weeds. If care is taken thus to secure the best of the crop for seed each year, there need be no fear of the seed "running out." On the contrary, the variety may actually be improved.

Methods of planting.—The method formerly used in planting wheat was to sow it broadcast on the plowed ground, and then harrow it in. This is a very wasteful way of planting, however, since some of the wheat fails to be covered, and is picked up by the birds; some of it is just barely covered, and fails to secure good roots; and some of it is covered too deep, and grows imperfectly.

The method now used in all successful farming is to plant the wheat with a drill. This sets the seed at a uniform depth, and gives it a moist fine bed of soil. Numerous experiments have shown that the best depth to plant wheat for average years is from one and a half to three inches. Wheat, like corn, loses both time and strength by being planted too deep.

Wherever possible, wheat should be drilled in rows running east and west. In dry regions, the prevailing winds then blow snow and dirt into the drills instead of out of them, as is the case when the rows run north and south. In east-and-west rows the drill also tends to shade the roots of the plant, and so protect them from the frequent thawings and freezings which occur in the case of winter wheat when the sun shines directly into the drill. Because of these uses of the drill ridges, the ground should not be harrowed after the wheat is sown.

Harvesting the wheat.—Except in the great plains or semi-arid regions of the West where practically no rain falls during the harvest season, wheat should be cut as soon as it is ripe enough. Many farmers allow their wheat to become so ripe as to shatter, and much loss results. It may be cut while the grain is still soft, so that it can be crushed between the thumb and finger. This will not injure very much the quality of the grain, and the straw will be of much greater value if cut slightly green. Early cutting also reduces the risk of storms.

Harvesting wheat with a modern binder.

In regions where the grain can be allowed to stand without shattering until it has become fully ripe and dry, the cutting and thrashing are often accomplished in one process. This is done by a combination harvester and thrasher drawn by from twenty to thirty horses, or by a tractor engine or motor.

Wheat cut with the harvester should be carefully shocked, usually in nine-bundle shocks, eight bundles standing firmly on the ground in the form of a circle, and the ninth used for a cap-sheaf. Careless shocking is responsible for much loss from weathering.

When the wheat is well dried in the shock, it should at once be thrashed, or else stacked in well-built stacks. Wheat is too valuable to leave standing long in the field waiting for a thrashing machine. If once put in stacks, it should be allowed to stand for several weeks before thrashing in order that it may "pass through the sweat."

Diseases and Insect Enemies of Wheat

Wheat is the prey of many different diseases and insect enemies, which sometimes almost totally destroy the crop. Many of these are coming to be better understood, and remedies for them devised. Three principal diseases attacking wheat are *scab, rust* and *smut.* These are all caused by the growth of *fungi* on the wheat plant. A fungus is a tiny plant organism that grows upon some other plant, or on animal tissue, and draws its living from its host. We call any organism that gets its living off another organism in this or a similar way a *parasite.*

Scab in wheat.—Scab is the least common of the three diseases mentioned, yet it sometimes causes much loss in certain localities. It attacks the *glumes,* or chaff, which surround the kernels of wheat in the head. The entire head is seldom destroyed, only a few of the glumes being affected. Scab results in a shrinkage of the kernels, and hence a reduction in the yield and an injury of the quality of the wheat. No cure has yet been discovered for wheat scab. A second crop of wheat should not follow wheat that has been affected with scab. If this is necessary, however, the stubble of the first crop should be burned to destroy as much of the scab as possible.

Rust in wheat.—Rust is one of the most serious enemies of the wheat crop. It is nearly always present in some degree, and has at times almost wholly destroyed the crop over considerable areas. There are two kinds of rust, one attacking the leaves and the other the stems of the plants. The stem rust is much more destructive than the leaf rust.

Rust may in some cases live over winter on the old plants, and be ready to attack the new crop if wheat is again planted on the field. Wheat rust also lives on other plants, especially the barberry, and is spread from them by birds or insects to wheat-fields. Laws have been passed in some states requiring the destruction of barberry hedges because of their part in spreading rust.

Moist seasons are more favorable to the ravages of rust than dry. Rust results in weakening the stem of the wheat plant, and reducing the size and quality of the grain. In some cases the heads even fail to fill, and the crop is a total failure. There is no known cure for rust, though certain varieties of wheat are better able to resist it than others. The earlier varieties are usually safer than the later.

Smut in wheat.—There are two kinds of smut that attack the wheat plant, *loose smut* and *stinking smut*. Loose smut usually destroys both the glumes and the kernels, leaving only the bare stem. Stinking smut grows inside the glumes, destroying the kernel only, and taking its place.

Stinking smut of wheat; smutted head and smut balls at right; sound head and kernels at left.

The spores from which stinking smut grows attach themselves to the kernels of wheat, and are therefore often sown with the seed. This fact makes it possible to combat this type of smut by treating wheat seed in such a way as to kill any smut spores that may be present.

One of the surest and cheapest ways of treating the seed for stinking smut is by the application of a solution of *formalin.* One pint of forty per cent. formalin mixed in forty-five gallons of water will treat one hundred bushels of wheat. The wheat may be spread out thin on a tight floor and sprinkled with the moisture, shoveling it over so that each grain is sure to become dampened.

After it is well sprinkled the wheat should be covered with sacks or blankets to keep it from drying out too rapidly. After a few hours, it may be spread out, or stirred, to hasten the drying in preparation for sowing. Ten pounds of *copper sulphate* dissolved in twenty-five gallons of water may be used instead of the formalin.

Loose smut may be prevented by what is called the *hot-water* treatment of the seed. The wheat is put into sacks and immersed in tubs of water warmed to a temperature of one hundred and twenty degrees Fahrenheit. When the wheat has become thoroughly warmed, it is taken out, drained and again dipped in water, this time heated to a temperature of one hundred and thirty-five degrees. The sacks may now be dipped at once in cold water, which will serve to keep the kernels from swelling. The wheat should then be spread where it will dry quickly. The general use

Loose smut of wheat. Sound head at left; different stages of smutted development at right.

of these well tested remedies should make smut of rare occurrence.

The Hessian fly.—Among the insect enemies of the wheat crop, probably none does more damage than the Hessian fly. On years when this insect is particularly bad hundreds of thousands of acres are either totally destroyed or so injured that the yield is only half or one-fourth what it should otherwise be.

The Hessian fly was brought to this country, probably from Europe, at some time during the latter half of the eighteenth century. It was thought by some to have been imported by the Hessians in the straw used for their bedding while they were being brought over by the British to fight against the Americans in the Revolutionary War.

The insect is small and mosquito-like, the body being about one-tenth of an inch long and of a dark color. The larvæ attack the young wheat plant, sapping its strength and causing the straw to break over before harvest.

Methods for controlling the Hessian fly are, as in the case of many other insect enemies, not wholly successful. The danger can be guarded against however, by sowing only the best of seed, in thoroughly prepared, fertile soil. For winter wheat the seeding should be rather late, after the major portion of the fall brood of insects has made its appearance and passed out of existence. For spring sowing the best plan is to seed as early as possible, allowing the plant to get well under way before the flies are ready for the attack. It is safer for either winter or spring wheat to avoid sowing on the ground used for wheat the preceding year. Rotation of crops, as in the case of other grains, leaves the insect pests without food and causes them to migrate in order to continue their existence.

Chinch-bugs.—Chinch-bugs are among the worst of the insect enemies of wheat. They are easily recognized as a small dark-colored insect, with white wing covers. Chinch-bugs damage the wheat by sucking the sap from the plant, and thus checking its growth. The mature bugs live over winter, lay their eggs in the spring, and the young are soon hatched out, showing at first a reddish color.

No effective way of controlling chinch-bugs has yet been discovered. It is, however, helpful to burn the rubbish of any infected field in the fall, as this will destroy large numbers of the bugs, and leave many of the remainder to perish during winter without hiding-places.

Grasshoppers.—Grasshoppers are less to be dreaded now than in earlier years, though they occasionally do great damage to the wheat crop. The grasshopper lays its eggs in the summer, and they do not hatch until the following spring. It is possible greatly to reduce their number by late, deep fall plowing, which buries the eggs so deep that the young when hatched do not find their way to the surface. Poisonous sprays are also used to destroy the young hoppers.

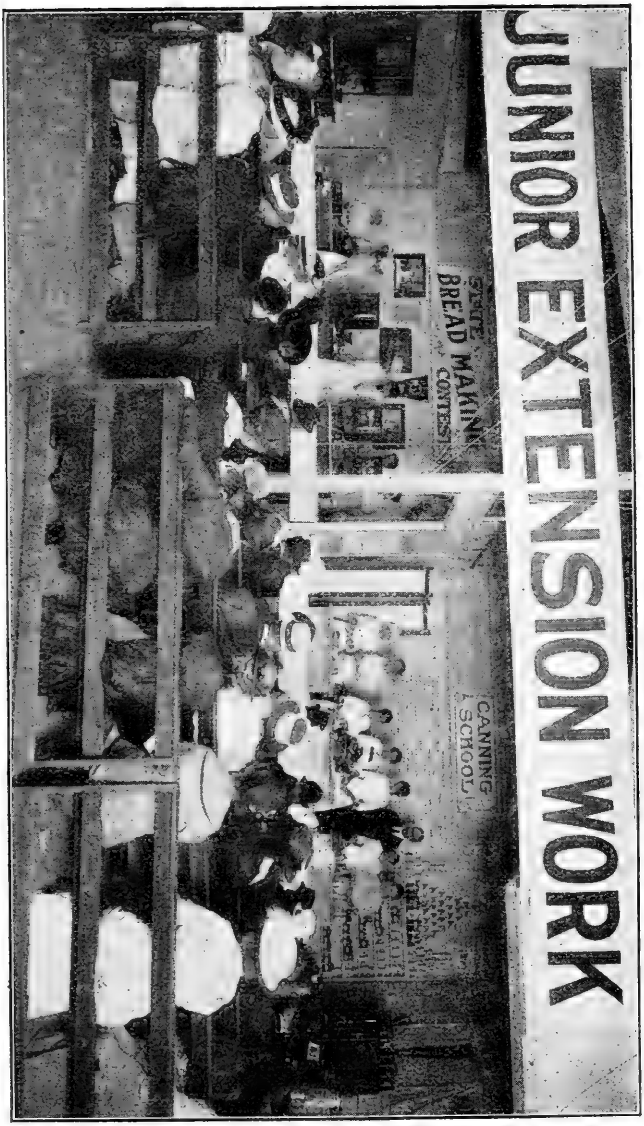
Improving Wheat

Wheat is somewhat easier to improve than corn, owing to the fact that wheat is usually close-fertilized and therefore does not have a tendency to mix as does corn. One may grow several varieties of wheat on adjoining plats and each plat will produce pure seed regardless of the surrounding varieties.

Improvement by selection.—The improving of wheat is commonly carried on by what is called *selection.* A considerable number of wheat plants grown on a special plat, or even under ordinary field conditions, are examined and all the poorer plants, or those that show any undesirable qualities, are destroyed. The desirable plants, or those showing the special qualities sought, are allowed to mature and the grains used as seed for the next crop. This is the method that Burbank has used in producing some of his most wonderful results in plant breeding.

In order to unite desirable characters in two varieties of wheat, artificial fertilizing is sometimes resorted to. This is to say that ripe pollen is taken from the head of one plant and dusted on the stigmas of the head of another from which the anthers have been removed. The uniting of two varieties in this way will often produce striking results. It requires several generations to fix the particular character or quality of the wheat plant sought by the crossing of varieties. While it is possible to produce desirable varieties in this way, by far the greater number of our most valuable types of wheat have been developed as the result of selection.

The United States Department of Agriculture and each of the state colleges of agriculture has a score-card for



Minnesota State Fair Bread and Home Canning Contest, conducted by the state leader in charge of the club work.

the judging of wheat. These differ some of course, but the following is a fair sample:

SCORE-CARD FOR SEED WHEAT

Minnesota Experiment Station

		Standard Score
YIELD 30 Points	Weight per bushel Uniformity	25 5
VARIETY CHARACTERS 15 Points	Color Purity Kernel Shape	3 10 2
VITALITY 30 Points	Luster Plumpness Germ Odor	5 15 3 7
MARKET CONDITION 25 Points	Weed Seed Dirt and Dust Injured Kernels Smut, etc. Condition of Bran	10 3 2 5 5
100 Points	Total	100

CHAPTER VI

OATS

OATS are one of the world's most most important grain crops. Like our other cultivated grains, the oat originated in some wild ancestral form,—just when and how is not definitely known. There is reason to believe that oats are a later development than wheat or barley, and were not known to the early Egyptians, Greeks or Romans.

Origin of oats.—As a cultivated crop, oats were probably first raised in central and northern Europe over territory now comprising Austria and Russia. At first oats were used only for the feeding of animals, and were employed as human food only during times of scarcity of other grains. It is only in comparatively recent years that oats have been thought of as one of the prominent food cereals.

Oats were brought to this country by the early settlers and are now grown in every state. The United States produces about one-fourth of all of the oats grown in the world. The crop does best in cool moist climate, and its production is practically confined to temperate zones.

Importance of the Oat Crop

Our oat crop is slightly more than a billion bushels a year, or a total yield of about one-third more than wheat.

A fine crop of oats, showing the result of well prepared seed bed, careful seed selection, cleaning and treatment.

Because of the higher price of wheat, however, the value of the oat crop is only about half that of wheat. Among all farm crops, oats rank fifth in value, being surpassed only by corn, cotton, wheat and hay.

The oat region.—The great oat producing region of the United States extends from New York and Pennsylvania westward to Nebraska, Kansas and the Dakotas. Each state in this great chain plants more than a million acres of oats annually.

The following thirteen states produce about four-fifths of all the oats raised in the United States: Iowa, Illinois, Minnesota, Wisconsin, Ohio, Indiana, North Dakota, Nebraska, Michigan, Kansas, New York, South Dakota, Pennsylvania.

The yield and profit.—The average yield per acre throughout the United States is about thirty bushels. The highest yields are in the far Northwest, where the rainfall is heavy during the growing season, or where irrigation is used. Here the crop not uncommonly runs from one hundred to one hundred and twenty-five bushels to the acre, and sometimes reaches one hundred and fifty bushels.

Sixteen southern states have an aggregate of about twelve per cent. of the oat acreage of the United States, and produce nine per cent. of the total crop. While the average yield for the United States is thirty bushels, it is twenty-two bushels for the southern states. Owing to the higher price per bushel generally ruling in the South oats yield about as big returns in this region as in the North.

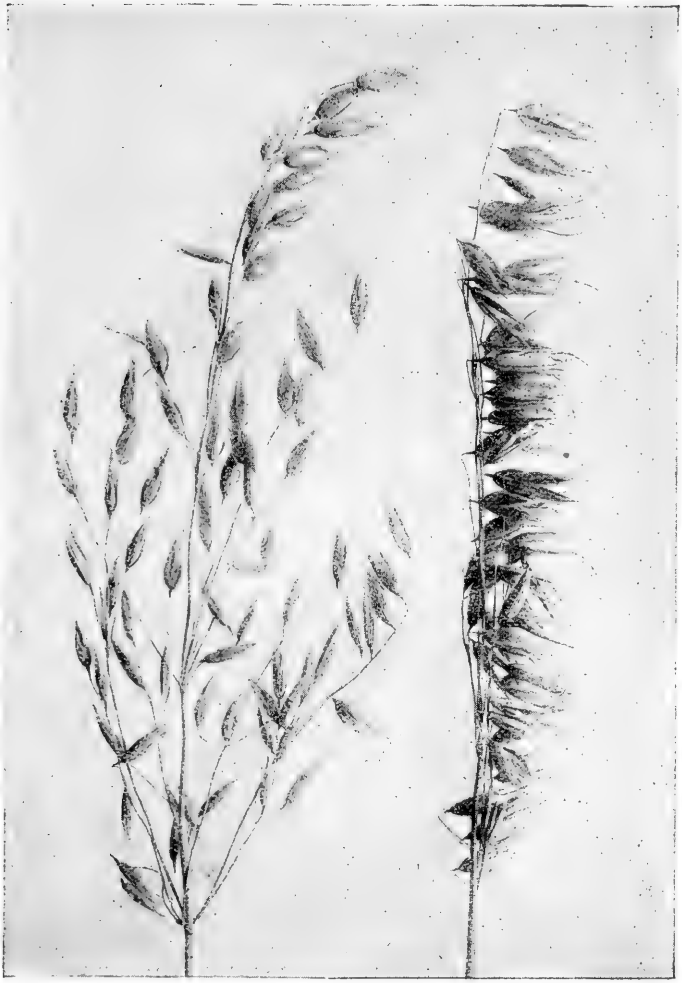
In the corn belt, oats are usually a less profitable crop than corn. The yield is less per acre, and the market price lower, while the cost of production is about the same. Iowa and Illinois are the two leading states in the amount of oats produced. The cost of growing an acre of oats if we include the rental value of the land, will average from ten to twelve dollars. When oats are thirty-five cents a bushel, it is evident that a crop of thirty bushels to the acre leaves no margin of profit.

While oats do not pay so well as corn, it is necessary, nevertheless, to raise them, even in the corn region. For oats are needed, (1) to make possible the rotation of crops, and (2) as a food for stock, especially working horses. This crop, like corn and wheat, can easily be increased in yield and profit by improving the soil and employing better methods of seed selection and tillage. It is not impossible to secure an average yield of from fifty to seventy-five bushels to the acre throughout the oat region.

Types of Oats

Two general types or classes of oats are easily distinguished—the spreading, or *panicled,* and the side-bearing or *horse-mane.* The former has a spreading, bush-like head, branching from all sides of the central stem; the latter carries the grains on short branches, all of which are attached to one side of the stem.

Varieties for different regions.—It is impossible to tell how many different varieties of these two types exist. As in the case of wheat and corn, new varieties are being



Two types of oat heads: spreading or panicled on the left; side or horse-mane on the right.

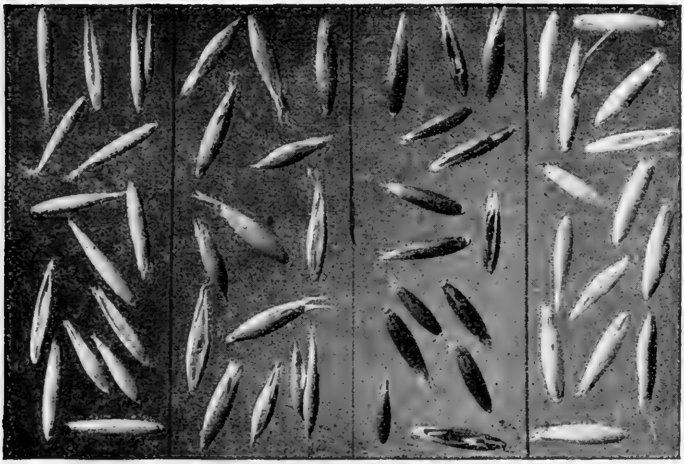
developed from year to year. Several hundred different varieties are now shown in the seed lists.

In New England, the northern tier of states and the Rocky Mountain region, white oats of rather late-maturing, large-grained varieties are usually most successful.

Two common varieties of oats.

Some examples of these varieties belonging to the *spreading* type are: Clydesdale, Big Four, Swedish Select and Lincoln; of the *horse-mane* type, White Russian and Tartarian are well known.

In the Missouri, Mississippi and Ohio River regions, extending as far south as Kansas, Missouri, Kentucky, Tennessee and Texas, and as far east as Ohio, small-grained, early, yellow varieties have proved the best. The Kherson, Silvermine, Big Four and Sixty Day are examples of these varieties.



A B C D

(A) Sixty Day, grain medium-sized, slender, yellow; (B) Red Rustproof, grain large, plump, reddish-brown; (C) North Finnish Black, grain medium-sized, plump, black; (D) Swedish Select, grain white, large and plump.

Successful fall seeding of oats is possible only in the southern states. For southern fall seeding, Winter Turf and Red Rustproof are the varieties most used. For spring seeding in this region the Burt and Red Rustproof are quite satisfactory.

Raising the Crop

Oats are usually planted with less care than any other crop. Where they follow corn in the rotation of crops, they are often sown broadcast on the corn land without previous cultivation or preparation of the ground. The field is then either disked or gone over with a cultivator and harrowed. This is a careless method of farming, and undoubtedly results in a diminished yield.

Preparing the seed bed.—When oats are sown after corn the seed bed should be prepared by plowing or two thorough diskings before seeding. The oats may then be covered by harrowing. The corn stalks should be broken down before disking. This can easily be done by means of a heavy pole dragged broadside across the rows when the ground is frozen. A still better method is to cut the stalks with a corn cutter. If the growth of stalks and weeds is especially heavy on the field, it is best to rake and burn the rubbish to get it out of the way of cultivation.

It sometimes may not be necessary to plow the ground for oats following a well cultivated crop. Especially is this true if the plowing can not be done in the fall. One of the things most necessary in growing oats is to get the seed into the ground as early as it can be worked in the spring. And the seeding can be done more quickly by disking than by plowing. There is little or no danger to oats from freezing after they are sown, and the seed will sprout and grow in a much colder temperature than that necessary for corn.

Methods of seeding.—Oats are sown by two methods, (1) scattering the seed *broadcast* over the ground, and (2) *drilling*. The old method of broadcast seeding was to scatter the seed by hand from a sack slung over the shoulder. Machines for seeding have been devised which can be operated by hand, and another which may be attached to the end-gate of a wagon. The seeder is driven by one of the rear wheels of the wagon by means of a sprocket and chain.

Drilling has been found to result in a larger yield than broadcast seeding. The drill plants the seed uniformly over the field and covers it well. The drilled crop comes up more evenly, and ripens more nearly at the same time than that from broadcast sowing. Less seed is required when the planting is done with the drill, since practically all the seed is covered and given a chance to grow. This is impossible with broadcast seeding.

A mistake is often made in planting oats too deep. The ground is usually moist when the planting is done, and depth is not required to secure moisture to start growth. Many agricultural experiment stations have tested different depths of planting, and recommend about one inch as the best depth for most regions.

Preparing the seed.—Seed oats should never be taken directly from the bin and sown, no matter how promising the grain looks. For oats ordinarily contain more dirt, weed seed and light grains than wheat.

The seed should always be run through the fanning mill. The current of air blows out the light grains and much of the rubbish, and the smaller grains are removed by the sieves. This process of cleaning should generally exclude one-third or one-fourth of the oats run through the mill. If the seed is very light a still larger proportion will need to be rejected.

Careful tests have shown that seed prepared in this way will yield several bushels to the acre more than if sown directly from the bin. Many of the light grains fail to sprout, and most of those that grow produce weak plants that yield little or nothing. It will well pay every farmer to take time in the winter to prepare his seed oats.

Improvement of the seed.—It is possible greatly to improve a variety of oats by careful selection of the seed. This may be done by going into the field just before the crop is harvested, and gathering, head by head, the strongest, largest grained and best yielding plants, also giving preference to those that are freest from disease. From a peck to a bushel or more thus selected is thrashed out, the small, light or imperfect grains rejected, and the choice seed sown on a special seed plat to raise seed for the coming year's crop.

Harvesting the crop.—Oats are harvested with the grain binder, the header, the mowing machine, and the combined harvester and thrasher. By far the greater part of our oat crop is cut with the binder.

The best time for cutting oats is just as they are passing out of the hard-dough stage of ripening. On account of the fact that they shatter rather easily when ripe, it may be necessary, especially if the acreage is large, to begin when the grain is passing out of the milk stage. Cutting too early leaves the grain slightly lighter and of a greenish color.

The best method of shocking oats depends on the ripeness of the crop when harvested. If the oats are in the hard-dough stage when cut, they should be shocked in well-built, round shocks. If the grain is green and the straw heavy or full of weeds, the long shock is better, since it allows freer curing. Either type of shock should be capped, except in regions where the winds are usually strong enough to blow a cap sheaf off, in which case it takes damage from lying on the ground.

Thrashing.—Oats may be thrashed from the shock, or stacked and thrashed any time during the fall. A somewhat better grade of oats is obtained by stacking and allowing the oats to "go through the sweat" before thrashing. The straw is also worth more for feed when the oats have cured in the stack.

The custom followed by careless farmers of leaving grain standing for weeks in the shock exposed to the weather while waiting for the thrashing machine can not be too strongly condemned. A period of hot wet weather is almost certain to start the oats to molding or sprouting in the shock. On the other hand, if the weather is very dry, the oats shatter, and many bushels are lost in handling. If the thrashing machine can not be secured as soon as the oats have dried sufficiently to thrash, they should be stacked in well-built round stacks so constructed as to turn the rains.

Insect Enemies and Diseases

Oats are, on the whole, subject to fewer diseases, and the prey of fewer insects than wheat. The crop is, therefore, less liable to total failure from these causes.

Insect enemies.—Chinch-bugs attack oats, as well as wheat, though they usually do much less damage to oats than to wheat. They can be controlled only as already described in the case of wheat.

In some seasons the army worm has caused much loss to oats, but usually not over extensive areas. There is no satisfactory method known of controlling its ravages. What is known as the *green bug,* a grain aphis, is one of the most prominent enemies of oats. Grasshoppers occasionally consume the greater part of the crop in relatively small areas.

Diseases of oats.—The chief diseases attacking oats are rusts and smuts. These are of the same general character as the rusts and smuts of wheat, fungous growths feeding on the growing plant.

The rusts are of two chief types: (1) *leaf rust,* which is of a reddish-brown color, and attacks the leaves, and in some degree the stems, of oats shortly before ripening time; and (2) *stem rust,* which is to be recognized as black spots appearing on the stems and leaves of oats just before they ripen.

Stem rust is less common than leaf rust, but when present is far more injurious to the crop. The rusts are more serious as an enemy of oats in the South than in the

Smut of oats: smutted head at right; sound head at left.

North, appearing in the South almost every year, and greatly reducing the yield. Rust is far worse in moist hot seasons than in dry seasons. No sure cure has been discovered for rust in oats, though some varieties are more able to resist its attack than others.

Smut ordinarily causes more injury to oats than any other disease. It has been estimated that from two to three per cent. of the entire crop is destroyed every year by smut, causing a loss of from \$6,000,000 to \$10,000,000.

The smut of oats is easily recognized a little time before the crop is ripe. Instead of the kernels are found small masses of smut dust which have taken the place of the grain. Sometimes these smut balls are covered by the chaff, much as the kernel should be, and other times the chaff is lacking and the smut fully exposed.

While there are two kinds of smut in oats, both will yield to the same treatment. Smut may be wholly prevented by treating the seed with formalin, as described for the treatment of wheat. It may sometimes be effectually prevented by the hot-water treatment. In either treatment the method is practically the same as for the seed wheat. With so simple and sure a remedy for smut, every farmer who lives in a smut region should treat his seed before sowing. It costs very little, and may result in an increase of several bushels of oats to the acre.

CHAPTER VII

AGRICULTURE IN THE SOUTH

AGRICULTURE is the chief of southern industries, and the South and Southwest are favored above many other regions of the United States in agricultural conditions. This territory has an excellent climate, long growing seasons, and, in most regions, a naturally rich, productive soil. Almost every crop that can be raised in the North will grow successfully in the South, and many others besides. The South has no long hard winters to close the soil to cultivation and enforce idleness upon the farmers.

Almost every class of farm animal thrives throughout the South. Cattle, horses, hogs and poultry can be grown more cheaply here than in northern regions, for forage is available most of the year; warm and expensive barns are not required; nor must a large amount of feed be stored against the long winter months. Hence the profit on live stock should be greater.

More home production needed.—In spite of natural advantages, however, the South has not diversified its industries so widely as has the North. From this it results that the South buys from the North many things it could easily produce at home. Farm machinery, clothing, canned fruits and vegetables, cereal foods, meats, furniture and

North Carolina, South Carolina and Virginia corn champions. Lowest yield of four champions is 150 bushels of Boone County white corn to the acre. Corn farming is greatly needed in the South to encourage greater diversification of crops, and more live stock.

household utensils, and many other articles are shipped in and paid for out of the proceeds of a relatively narrow range of crops and manufacturing industries. But the South is awakening industrially and, when it has fully realized its wonderful resources and opportunities, it will then be able successfully to compete with other regions for wealth and commercial supremacy.

Diversified Farming in the South

By diversified farming is meant the growing of a number of different crops instead of devoting practically the whole farm to one crop, such as cotton.

Tendency to one-crop system.—Not only in the South but in many regions of the North and West as well, there has been a tendency to a one-crop system. Great areas of the North have been devoted to corn or wheat, while many new regions of the West raise wheat almost exclusively. The principal crop of many regions of the South has been cotton, which has in some places been grown successively on the same soil for twenty-five or fifty years.

Several causes have led to a one-crop system of agriculture. In certain cases the soil is better adapted to some one crop than to others and will therefore yield a larger profit to the farmer. The natural tendency therefore is to plant chiefly the crop that will bring the largest immediate returns. Again, where but one crop is raised a smaller assortment of tools and implements is required; hence less expense is needed for equipment. It is also easier to learn the art of farming where but one crop is used than where a number are grown, each requiring a different system of planting, cultivating and harvesting. Certain crops may also find a more ready and constant market than others, thus encouraging farmers to grow the product that can be most easily turned into cash.

Disadvantages of one-crop system.—There are a great many disadvantages, however, connected with the one-crop system. These disadvantages are at present felt more in the South than in any other region of the United States, largely because cotton has been almost the only crop raised. It is probably not too much to say that cotton, while it has been a source of wealth to the South, has also been its greatest industrial handicap. For many southern regions that should produce a wide variety of crops have devoted practically all their energies to the raising of cotton. And any one-crop system invites disaster in the end.

First, any one-crop system is sure to wear out the soil. This is easily seen from the fact that the crop must remove the same elements from the soil year after year. And, without the return of sufficient fertilizer to make up this loss, the soil is depleted until only a fraction of its original fertility remains. Northern and western regions where virgin prairie soil easily produced forty to fifty bushels of wheat to the acre found that after some years of wheat growing without any rotation of crops the yield had been reduced to a half or a quarter of what it was upon the new soil. In a similar way, thousands of acres of southern land that originally produced large crops of cotton have now become so impoverished as to yield only a small part

Single cropping and "Dixie" plow-horse power responsible for much of poverty of both soil and rural population. (Insert) A one-horse farmer.

of what the soil is capable of producing, and must be carefully reclaimed by rotation of crops, fertilization and special methods of cultivation.

Second, a one-crop system encourages the growth of plant enemies in the soil. The insects that feed upon the crop one season are left upon the field ready to reproduce their kind and attack the next season's crop. Various bacteria and fungous enemies also have a tendency to multiply when the same crop is produced from year to year. Let the crop be changed, however, and the insects and fungi, not finding the necessary food, die and the field is in a measure cleared of their danger. Weed enemies disappear in a similar way in the presence of the new crop.

Third, a one-crop system always leaves the farmer at the mercy of weather conditions. If the season turns out too dry or too wet, or in any other way unfavorable so that a failure of the crop results, the farmer is left without resources and faces financial failure. If, on the other hand, he has a variety of crops, seasonal troubles which affect one crop may not affect others, so that the farmer does not suffer an entire loss. If he raises but one crop and the insect enemies or other reverses prove strong enough to ruin the crop, he is left in poverty. But the various plant enemies require different seasonal conditions for their best thriving; hence when they attack one crop they are not so likely to injure others.

Fourth, one of the most serious disadvantages of a one-crop system is the changing market conditions. If for any reason the market happens to fail for the particular crop raised, no matter how good the yield may have been, the farmer is helpless with the crop left on his hands. This was well illustrated when in the season of 1914 the South had hundreds of thousands of bales of cotton for which there was no market because of the European war. Thousands of southern farmers found themselves almost bankrupt with a large cotton crop on their hands. And throughout the European war the shipping of cotton was so uncertain as to demoralize the market and leave the whole financial situation in the South in a chaotic state. The farmer who produced several different crops instead of one could not be caught in this condition.

Fifth, diversified farming produces an income for the farmer at different seasons of the year, whereas a one-crop system brings in all its returns at one time, leaving the remainder of the year practically without income. In this case the running expenses of the home must often cause the farmer to go into debt, and his crop is not infrequently mortgaged before it is harvested, and must be sold even at a low price in order to meet the debt.

Sixth, no one-crop system affords a wide enough range of forage and grains to enable the farmer to raise the stock which every farm should have. Successful farmers everywhere are coming to depend more and more on farm stock as a large part of the profit from agriculture.

Advantages from diversified farming.—From these facts it is easy to see some of the chief advantages of diversified farming. Through raising a variety of products and thereby rotating the crops the farmer can build up and renovate the soil. He can free his crops from the worst dangers of insects and other enemies. He can relieve himself of the danger of entire failure coming from an adverse season or other conditions threatening the success of one particular crop. He can become relatively independent of poor market conditions affecting any one crop or can secure for his farm an income that is distributed throughout the year so that he need not go into debt for the current expenses of his farm and household. Diversified farming includes the raising of a variety of stock as well as a variety of crops, and thus adds to the income while at the same time it reduces the danger of failure through the loss of any one crop.

Crops Suitable for Southern Farms

Frequent failure of cotton to find a profitable market and the ravages of the boll weevil have induced many southern farmers to add crops which they had not previously raised on their farms.

The cereals.—Corn can be raised in most regions of the South as profitably as in the North. Indeed the long growing season makes it possible to produce a much more prolific variety of corn than is possible in northern states. Under right cultural conditions much of the land now used for growing cotton can be more profitably employed in the raising of corn. It is evident that this will give an opportunity for rotation and thereby secure all its advantages. Oats can also be grown in most regions of the South and prove almost as profitable as corn. Wheat may also find a larger place in southern agriculture, especially when the right variety for this region can be found.

Vegetable raising.—The South is the great vegetable region of the United States and can more profitably produce most varieties than can any other section. Potatoes can be grown to good advantage in many of the states. Cabbages,

Field of cow-peas ready to plow under as green manure.

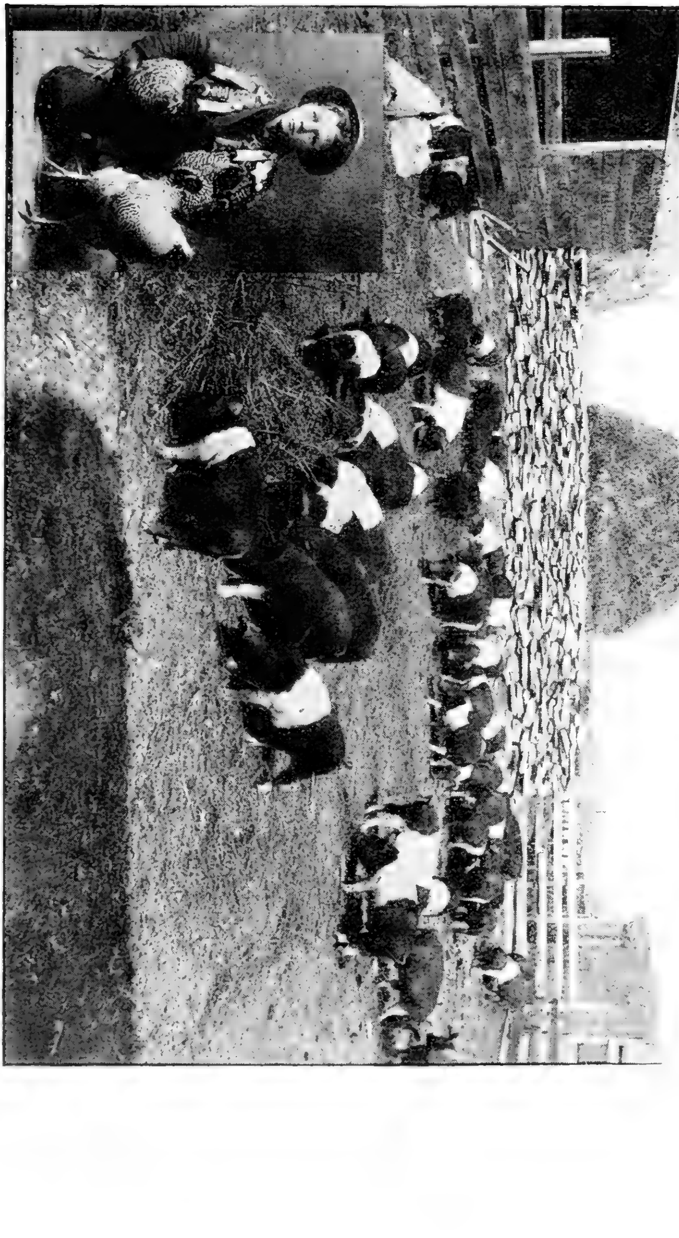
tomatoes, melons, sweet potatoes, onions, celery, and nearly every other garden vegetable will thrive in most southern states and will, on good soil, produce two or even three crops a year.

Many southern gardeners and truck raisers are now finding in the North a profitable winter and early spring market for their vegetables.. Improved shipping facilities and the increasing public demand for fresh vegetables and fruit all the year around open up a new opportunity for southern farmers. Many of the winter vegetables now raised under glass in northern regions can be more economically grown in the South and distributed to northern markets. There is no reason why southern-raised produce should not find favor in the North, at least during a considerable portion of the year.

While certain of the forage crops most successful in the North are not adapted to the South, there is a wide range both of grasses and legumes suited to southern conditions. Alfalfa, Johnson grass, cow-peas, soy-beans, Bermuda grass, lespedeza and the vetches are freely grown in their respective regions. Agricultural scientists from the United States Department of Agriculture and the state agricultural colleges are busy in experimenting upon suitable forage crops for the South and demonstrating their value. It is not too much to expect that this region will soon have available at least as wide a range of profitable grasses and legumes as the North.

Animals Adapted to Southern Farming

Cattle.—Cattle can be more cheaply and profitably produced in the South than in any other part of the country. This is because of the mild climate making it possible to use pastures for the greater part of the feed, and also because of the absence of the long period of cold which not only requires more expensive feeding but reduces the amount of beef or milk. Both dairy and beef cattle should be grown more extensively through the southern states than is now the case.



Blue Ribbon Boy and his poultry. Hogs, poultry and forage are a fine combination in American agriculture.

Hogs in the South.—Southern farmers have not yet entered very largely upon the raising of hogs, though they can probably be produced fully as cheaply in the South as the North. The southern people consume more meat per capita than the people of any other section. Millions of pounds of fresh meats are annually shipped to southern markets from northern and western farms. This means a double loss to the South, hence the importance of a more general study of the swine industry. For money is paid out for what could well be raised at home, and a most profitable industry is thus omitted from the farms.

Horses and mules.—The same conditions that make it profitable to raise cattle and hogs in the South also make profitable the production of horses and mules. Pastures are available almost the entire year and crops of forage can be raised following grain or cotton crops, so that the income from horses or mules can, on many farms, be made almost clear profit.

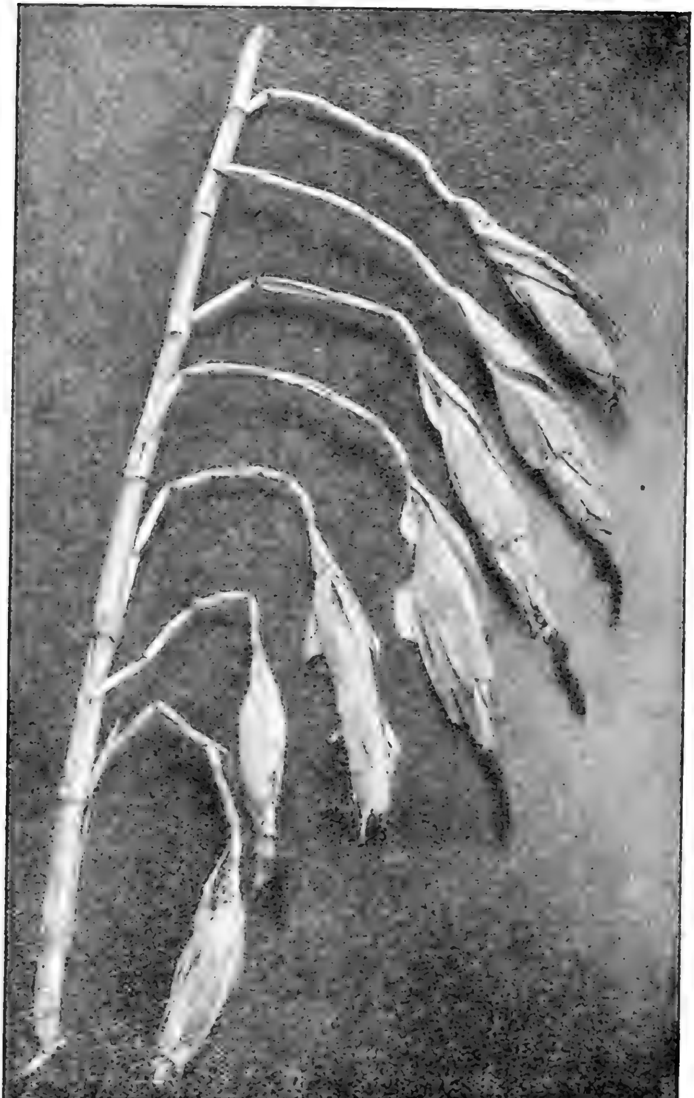
Poultry.—Probably no more important and profitable extension of farm products in the South can be made than through the raising of more poultry. The feed required can be grown very cheaply, while the shelter may also be inexpensive. Southern farmers could add many millions of dollars to the income of their farms every year by raising more chickens, as well as turkeys, ducks, geese and squabs.

Soil Management in the South

The management of the soil in the southern states needs careful study with reference to the long growing season, the open winters, lack of winter rest periods, and the thin and rather exhausted condition of a great deal of southern soil.

There are two important methods of fertilizing the soil. *First,* and most important, is to enrich it by deep tillage, the growing of legumes, following a carefully planned system of crop rotation, and the adding of natural barnyard manures. *Second,* these methods should be supplemented by adding commercial fertilizers such as experience and experimental investigation prove practical. Owing to the impoverished condition of much of the soil resulting from single cropping, commercial fertilizers will need to be freely used in many southern regions. Local needs and conditions must always govern in the selection and application of the fertilizer, and the help of scientists from the state agricultural college or the United States Department of Agriculture should be freely used.

Fall plowing.—Most of the southern land should be given fall plowing from eight to fourteen inches in depth. This will enable the soil to "breathe," taking the place of the freezing of the soil in the North. It also permits the seed bed to absorb the rains of the fall and winter and conserve them for the next season's crop. On deep fall-plowed land southern crops flourish in dry winters, because the plants are strong and have great feeding areas for the root system. They also do better on deep-plowed soil during the rainy winters because of improved drainage. Fall plowing prevents washing and leaching of the soils during



A stalk of prolific corn well adapted to southern agriculture.

the winter, and lessens the burden of work during the rush of spring farming.

Winter cover crops.—In the southern states the winter *cover crop* is one of the important factors in good farm management. This is because the soil needs to be covered to protect it from the winds of the winter months and to save it from washing and leaching. The cover crop also furnishes forage for stock. In the spring of the year the forage crop can be plowed under to fertilize the soil. Soy-beans, cow-peas, the vetches, Japan clover and a number of different grasses are being successfully used for winter cover crops.

Terracing of hillsides.—Thin clay soils or sandy rolling land should be protected against washing rains. Terraces are usually arranged so as to break the long slope of the hillside. All hillside land should be plowed deep and cultivation should all be done on a parallel with the base. A great deal of hillside land now being used for the production of grains might better be used for pasture, wood lot, and the growing of legumes. The roots of grasses and trees bind the soil together and prevent erosion.

Rotation of crops needs to be carefully studied and applied in southern agriculture. Haphazard planning must give way to a scientific mode of procedure that will make one crop prepare for the next, through renewing the soil and the elimination of insect, weed or fungous enemies of crops. Not to know how to work out a practical rotation indicates that one is uninformed as to his business; not to have the enterprise to carry out such a rotation indicates indolence or lack of initiative and business ability.

The following "safety first" measures are recommended by Mr. Bradford Knapp, chief in charge of the Southern Extension Office, United States Department of Agriculture, for southern farms:

1. Produce a home garden on the farm for every family, the year round, paying special attention to a plot of Irish or

Oliver Thompson won a silver trophy on ten ears of corn at first National Club Show.

sweet potatoes sufficient to supply the family with food of this character. Where feasible, have a patch of sorghum or other cane to produce sirup for the family.

2. Produce the corn necessary to support all of the people on the farm and the live stock, with absolute safety.

3. Produce the necessary oats and other small grain to supplement the corn as food. Pay attention to winter grazing.

4. Produce hay and forage from some forage crop, sufficient to supply all of the live stock on the farm. Use legumes such as clover, cow-peas, velvet beans, soy-beans, and alfalfa for the production of hay and to enrich the soil with nitrogen and humus.

5. Produce the meat necessary to supply the people, through increased attention to poultry and hogs, especially. Plan to increase gradually the number of cattle and other live stock, so as to have a sufficient number to consume the waste products of the farm and make the waste lands productive.

6. After all of these things have been amply provided for, produce cotton for the market.

CHAPTER VIII

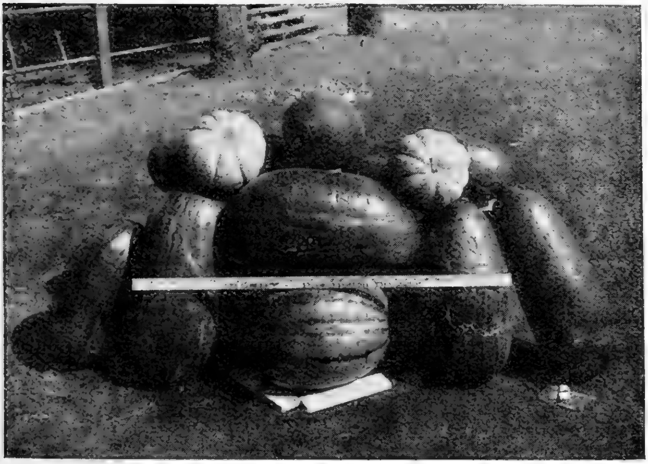
AGRICULTURE IN WESTERN STATES

Western Farming Conditions

AN almost infinite variety of climatic conditions abounds in the western states. From the Canadian line on the north to the Mexican boundary on the south are to be

"Round-up" from arid and semi-arid lands of New Mexico.

found nearly every range of plant life from subarctic to subtropical. Here also exist many types of soils from the thin, gravelly or volcanic ash covering the mountain ranges to the richest silt of river valleys. The rainfall varies so greatly that while it is possible to farm in many regions under normal humid conditions, either irrigation or dry-farming methods must be employed in other places to secure and maintain sufficient moisture. Added to these conditions are great differences in altitude, so that all ranges of climate from arctic to warm temperature may be found in traveling a few miles from mountain slope to valley. Great ranges of slopes subjected to north or south,



Western crops are varied and of excellent quality.

east or west exposures also affect both climate and crop conditions.

Wide range of crops and animals.—Almost every crop known to man will thrive in some parts of the great West. Here we find the richest yields of the cereals, the most abundant forage crops, potatoes, sugar beets, sorghum, vegetables, and a wider variety of fruits than is grown in any other country in the world.

Farm animals thrive throughout the West and on the Great Plains in no less variety. This region was the original home of great herds of cattle, horses and buffalo, which ranged the endless prairies and mountain slopes. For many years the eastern markets secured a large portion of their beef and many of their horses from range-fed stock. These immense ranges are now being cut up into smaller farms, put under tillage, and farm stock kept under more domestic conditions.

Soil management in the West.—So great is the variety of climate, soil and moisture in the West that it is impossible to treat all the conditions fully in any one book. Only the more general and fundamental principles can be stated. The local conditions will require study for each particular crop and region.

For convenience in the study of western agriculture we may divide farm practise into three classes: (1) farming under *humid* conditions, (2) under *irrigation,* and (3) under *dry-farming* conditions. Farm practise under humid conditions in the West should not differ sufficiently in method from good farm practise elsewhere to require separate treatment. Farming under arid or semi-arid conditions, however, requires special methods and very careful management. This phase of agriculture is so important in the West that the present chapter will be given principally to its discussion. Hundreds of thousands of acres are now being farmed and managed as dry-farming land, while millions of acres are available for similar purposes just as soon as good farming methods are employed, suitable crops adapted, and good business methods adopted and applied to the new conditions.

Dry-Farming

By dry-farming is meant the management and carrying on of agriculture, such as the production of field crops,

Machine power at work in the vast fields of the Northwest.

vegetables and fruit, and the raising of stock, in regions where the rainfall is not sufficiently heavy for successful plant growth and crop production under the common methods of farming—especially the careless methods followed in some sections of our country where rainfall and soil conditions are more encouraging for profitable crop production.

The use of terms.—Territory that has an annual rainfall of above thirty inches is called *humid* and will do well under ordinary agricultural practises. Regions that receive less than ten inches of rainfall annually are called *arid,* and can not be successfully farmed by the methods now practised in the central and eastern states without irrigation. Regions that receive from ten to twenty inches annually are called *semi-arid,* and those that receive from twenty to thirty inches, *sub-humid.* By the best methods now known to dry-farming practise, most semi-arid and sub-humid land may be successfully and profitably farmed.

A surprisingly large proportion of the land surface of the earth is either arid, semi-arid, or sub-humid. The following table gives the proportions of the earth's surface receiving varying amounts of precipitation: (Widtsoe, *Dry Farming.*)

Annual Precipitation	*Earth's Surface*
Under 10 inches	25 per cent.
From 10 to 20 inches	30 per cent.
From 20 to 40 inches	20 per cent.
From 40 to 60 inches	11 per cent.
From 60 to 80 inches	9 per cent.
From 80 to 120 inches	4 per cent.
From 120 to 160 inches	0.5 per cent.
Above 160 inches	0.5 per cent.
	100.0 per cent.

It is seen from this table that the greater portion of the land surface of the earth receives less than thirty inches of precipitation annually, and must therefore be reclaimed by the best known dry-farming method if at all. What a gigantic problem for scientific agriculture!

Dry-farm areas of the United States.—Almost three-fifths of the area of the United States receive less than thirty inches of rainfall annually, and more than one-half receives less than twenty inches. All of this great region is therefore dependent on either dry-farming or irrigation for its agricultural success.

Typical scene in the Southwest, showing sage-brush in the foreground.

Eighteen states, most of them of large area, comprise this territory. For convenience in study they may be classed in groups as follows:

Arid to semi-arid group: Arizona, California, Colorado, Idaho, Nevada, Utah, Wyoming, and part of New Mexico.

Semi-arid to sub-humid group: Montana, western part of Nebraska, New Mexico, North Dakota, Oregon and Washington.

Sub-humid to humid group: western half of Nebraska, and sections of Minnesota, Oklahoma, Texas and Kansas.*

Dry-Farming Practise

The careless and shiftless methods employed in some humid regions will not return a profit to the operator from his dry-farm. The adoption of the best known methods of managing the soil, planting, cultivating and determining the crops to be produced are required. The dry-farmer should be thoroughly trained if he would succeed.

Principles involved.—The success of dry-farming depends on the use of methods that will eliminate unnecessary and unprofitable labor, store moisture in the soil, keep it there until needed by the growing crops, and then release it to the roots of the plants. It is evident first of all that the soil must be of such nature as will allow it to retain water. Hence a gravelly soil is not well adapted to dry-farming, while a clay loam is. The cultivation must be directed chiefly toward preventing evaporation. The crops to be grown must be selected (1) for their adaptability to dry-farming conditions and (2) for their economy in the use of water during the growing period.

Plowing.—Dry-farm land, many maintain, should as a

Note: Send to the United States Department of Agriculture, Washington, D. C., and ask for Farmers' Bulletin entitled "The Effects of Cultural Methods of Crop Production in the Great Plains" written by E. C. Chilcott, Agriculturist in Charge of Dry Land Agriculture, J. S. Cole, Assistant, and W. W. Burr, Assistant. This bulletin contains the results of a number of years' experimenting in cultural methods at several of the dry-land farming stations.

rule be plowed early in the fall, and to a depth of eight to ten inches. In case the subsoil is lacking in plant food the ground should be plowed more shallow at first, then a little deeper each year until a depth suitable to the locality is reached. Some consider fall plowing to be important as it allows the soil more readily to take in the winter moisture

Horse power in the wheat-fields of the Northwest.

and permits winter weathering, which improves the physical condition of the soil. There is also considerable evidence as to the necessity of deep plowing when we consult the results of continued experiments of the experiment stations of the Great Plains.

A good stand of wheat in the Northwest. Result of good management of semi-arid land.

Providing the dust mulch.—Dry-farming requires, on the whole, more thorough and frequent cultivation than humid farming. Land that is soon to be planted to crops should be disked and harrowed immediately after the plowing. This tends to produce a loose soil mulch and will do much to prevent evaporation. Fall plowed land that is to lie fallow through the winter should be left in a rough condition and without cultivation, as this will favor the taking in of winter rains or snow. If the winters are dry the ground should be well pulverized after the plowing. Disking should be started as early in the spring as possible and followed by harrowing.

Crop cultivation.—As soon as the crops are planted harrowing should be started, and continued as long as possible without injuring the crop. Every rain that falls is so much treasure added to the soil. After each rain, therefore, the ground should be cultivated as soon as possible in order to break the crust, establish a new mulch and so prevent evaporation. All crops should be cultivated as far into the season as possible. Weeds must be kept down at any cost, for they both hinder the growth of the crop and rob the soil of water which belongs to the cultivated plants.

As soon as the crop is removed the ground should be plowed, disked and harrowed. The farmer who is not willing to follow the intensive tillage and careful management required for dry-farming conditions ought not to engage in this type of agriculture.

Summer fallowing.—In a large part of the semi-arid region it is found necessary to store up the moisture of two seasons in order to produce a single crop successfully. This is accomplished by what is known as *summer fallowing.* The process consists of plowing the ground as if for immediate planting, and then keeping it well cultivated without a crop during the season, thus conserving most of the moisture that falls.

Fallowing is usually practised every second year in regions having less than fifteen inches of rainfall. Where the rainfall is from fifteen to twenty inches the fallowing may be limited to every third or even every fourth year. The fallowed soil should be kept wholly free from weeds as they use up moisture, encourage insects and make the ground foul. In various regions of the Great Plains increased frequency of cultivation has been found to take in some degree the place of fallowing. Wherever this system can be successfully used it should, of course, be adopted, as it saves the loss from idle land during the fallowing period. Fallow fields also often lose fertility through the blowing of loose soil in high winds.

Management of the Dry-Farm

Dry-farm crops.—A great degree of the success of dry-farming depends on the selection of crops that are capable of growing with a minimum supply of moisture. While many of the crops grown under humid conditions can be successfully produced by dry-farming methods, yet certain varieties are better adapted to resist drought than others and should therefore be used.

A second factor to be taken into account is that plants have the power of adapting themselves to the conditions under which they grow. Varieties that have become accustomed to dry-farming regions and methods of cultivation should be selected. This also suggests that home grown seed should generally be used rather than seed brought from humid territory.

Wheat as a dry-farm crop.—Wheat is at present the most important dry-farm crop, and will probably retain this preeminence. Experimentation is still going on to determine the best varieties for dry-farming conditions. Among the hard spring wheats, *Common* or *Durum* is at present regarded the best, while among the winter wheats the semi-hard and the soft wheats take the lead.

Other grains.—Oats, especially such varieties as *Sixty-day, Kherson, Burt* and *Swedish Select,* are a profitable dry-farm crop. Barley, rye and emmer are also successful cereals for dry-farming regions. Corn can be profitably grown under semi-arid conditions if proper varieties are selected, as can the sorghums, feterita and millet.

Alfalfa and other legumes.—On account of its deep rooting system alfalfa can be made a successful forage crop where the rainfall is as much as twelve to fifteen inches. Field peas, beans and other legumes are also adapted to dry-farming.

Potatoes.—Potatoes are one of the most promising of dry-farming crops. They can be profitably raised with a rainfall of fifteen inches. The following varieties have been recommended as dry-farm varieties: *Ohio, Mammoth, Pearl, Rural New Yorker* and *Burbank.*

Conserving soil fertility.—Dry-farming areas possess soil of unusual fertility. Nor does the fertility exhaust as fast as under humid conditions. Dry-farms in many sections that have been continuously cropped for many years show but little loss of fertility or decrease in the yield of crops. Yet this fertility will finally be exhausted if care is not used to conserve or replace it.

Cultivating a young orange grove to conserve moisture.

Intelligent dry-farming will therefore plan from the first to maintain fertility. The farms hould be stocked and the manure returned to the soil. Straw left from the header, and stubble, should be plowed under. Legumes should be grown to aid in maintaining the supply of nitrogen. A careful system of rotation of crops should be adopted and carefully followed.

Dry-farm machinery.—Dry-farming usually employs a large acreage of tilled land. It also demands frequent and thorough cultivation. These facts suggest the need of plenty of good machinery, adapted to the work required. Plowing is often done by the gang-plow drawn by a steam or gasoline tractor. Grain is cut by a combination header and thrasher. Large disks, harrows and drills are used. The intelligent dry-farmer will not so much seek to economize on necessary machinery, as to save by giving it the required care for its up-keep.

Water for the home.—The dry-land farmer's home should be provided with an abundance of clean pure water. The barns and the stock should have plenty of water, and a supply is needed for the irrigation of the vegetable garden, shade trees and fruit. The most progressive dry-land farmers provide a reservoir which is continually kept full of water pumped by a windmill, gasoline engine, or other power. If this reservoir is elevated it may easily provide for a running system of water, thus supplying the home, its kitchen and bathroom, with some of the modern conveniences not otherwise available.

CHAPTER IX

FARMING UNDER IRRIGATION

ABOUT 300,000,000 acres in the United States of otherwise tillable land have been unproductive because of lack of moisture. This area, which is approximately as large as Iowa, Illinois, Indiana, Ohio, Missouri, Minnesota, Wisconsin and Michigan, comprises what is known as the arid and semi-arid region of the United States. The soil in most cases contains abundant plant food and has been found highly productive when the necessary amount of moisture is supplied. Much of the arid West formerly called the "Great American Desert" can be transformed into a veritable garden of America by proper irrigation and management.

This territory extends from the Canadian boundary to the Gulf of Mexico and includes large tracts of practically all of the states in the West, such as Washington, Montana, North Dakota, South Dakota, Idaho, Wyoming, Utah, Colorado, Oregon, Nevada, California, New Mexico, Arizona, Texas, Oklahoma, western Kansas and Nebraska, as well as a part of Florida.

Causes of Aridity

There are three chief reasons why much of the western dry territory is deprived of the normal rainfall. The *first* is that the Rocky Mountains rob the ocean breezes of their moistures before they have reached the tillable lands. The *second* is the altitude of a great portion of this territory; millions of acres are at an altitude which makes the production of much rain impossible. The *third* is the lack of vegetation and forests, which encourages the evaporation of moisture and its loss after rains by rapid surface drainage.

Seasonal distribution of rainfall.—In considerable portions of the arid territory there is sufficient rainfall within a year's time to produce crops. Yet irrigation is necessary because the distribution of the moisture is not seasonable, but irregular or at the wrong time. In most cases the rains come during the time of the year when the crops are not in the ground. In some parts of Florida where the annual rainfall is from sixty to seventy inches it is impossible to grow a crop without irrigation because the precipitation comes during the winter months.

Regions of late summer droughts.—In the central west and eastern states there is considerable territory that suffers more or less during the months of July and August, for want of sufficient rainfall to set and mature the grain, fruit or trucking crops. In a very large number of cases irrigation could be supplied without great expense to protect the farmer, fruit grower or truck gardener against failures of crop and so prove highly profitable.

Even in the fruit sections of the Allegheny and Blue Ridge Mountains where irrigation has not been seriously considered, many farmers would profit greatly by planning systems of irrigation and by so doing extend the growing season. Where now they are producing but one crop in trucking, with the aid of irrigation and a carefully planned system of rotation, it would be possible to produce two and in some cases three crops. Much of this land could be fed from the mountain streams and rivers with but little cost.

Reclamation of Arid and Semi-arid Land

By reclaimed land we mean land that otherwise would be unproductive and of little or no value because of its arid or semi-arid condition. This land is reclaimed by some system of *irrigation* making it possible for the farmer to supply water in sufficient quantities and at the proper time. The United States government, through its reclamation service, has reclaimed millions of acres of land in the West which formerly was a bleak desert, or at best covered with sage-brush, mesquit and cacti, and populated by prairie-dogs and rattle snakes. In this region are now beautiful and thriving citrus orchards, grain and alfalfa fields, and a great variety of truck crops. Some of the most beautiful farming sections of the West can be found on these reclaimed lands and on what is known as territory under irrigation. Millions of dollars are being spent annually, not only by the federal government, but also by the states and by private reclamation companies to reclaim this land.

Practise of irrigation not new.—While irrigation has only recently been developed into an important agricultural science or received the attention of statesmen and men of affairs, it is by no means a modern invention. It was very commonly practised in Egypt, India, Spain, Mexico and Peru thousands of years ago. When the Spaniards first came to America they found irrigation fairly well developed in both Mexico and Peru. The Indians were the first to irrigate land in the United States and in old Mexico. Even at the present time there can be found a number of Indian tribes practising the same arts of irrigation followed by

Regulating gates and inverted siphon, Chestnut Valley, Missouri River, Montana.

their forefathers hundreds of years ago. In many of the western arid plains from which the Indians have long since been driven there are still remaining signs of their irrigation systems. The first white people in America to develop and organize definite systems of irrigation were the Mormons, who located in the Salt River Valley of Utah.

Sources of water supply.—Water for irrigation purposes is secured from a variety of sources, such as artesian wells, canals, reservoirs, streams, lakes, and sometimes from the regular wells from which the water is pumped by windmills, electricity, steam or other power.

Systems of Irrigation

There are now in use in various sections of the country three different systems of irrigation. These are known as the *surface, sub-surface* and *overhead* systems.

Surface irrigation.—This is the system in most common use, not because it is always the most satisfactory and efficient, but because it can be installed with the least labor and expense. Where water is scarce, or the rental is high, surface irrigation is wasteful, since a large amount of water is lost by evaporation and by running off into fields, lowlands or streams where it is not needed. And in irrigation territory water has a direct money value and should be handled as economically as possible.

Application of water in surface irrigation.—The method to be followed in surface irrigation depends on the source of water supply, the physical condition of the soil, the topography of the field, and the kind of farming to be undertaken. Two principal methods of applying the water are (1) by *flooding,* and (2) by the use of *furrowing,* or *corrugation,* of the field.

When flooding is used, the water is spread from the source of supply over the entire field at regular or necessary intervals. It seeps into the soil and around the root systems of the plants from every point of the surface. When furrowing is employed the water is turned into the

Flooding from cement ditches.

Method of making small irrigation ditches.

furrows from the head lateral ditches. From the furrows it seeps through the soil to the roots of the plants. It is evident that for the successful use of either of these methods the fields must be relatively level and only a trifle sloping.

Saving the water.—The only methods known to prevent lavish waste of water through surface irrigation are

"Checking back" to avoid waste of irrigation water, California.

(1) by economy in the application of water, and (2) by keeping a light surface mulch through frequent and shallow cultivation. This system will produce a greater amount of plant products at less water cost. For most of the fruit, trucking and grain crops the furrow, or corrugation, method is conceded to be more practical and economical than flooding.

Sub-surface irrigation.—Under favorable conditions sub-surface irrigation proves most satisfactory, chiefly because there is little or no waste of water, and because the supply can be more easily controlled.

In this system the water is applied by means of pipes placed beneath the surface. The pipes are full of small holes through which the water enters the soil. A serious objection to this method is that clay soil and small plant roots are likely to clog up the holes. Hence the sub-surface pipes are adapted only to light open soils. Another sub-surface method is by a system of tile or drainage pipes from which the water is forced up through perpendicular pipe outlets or holes.

A third method of sub-surface watering is employed where the land has a natural slope and *a clay subsoil of hardpan.* The water is applied by the head ditch and allowed to seep down through the soil to the hardpan. It then rises to the surface by soil capillarity, where it is available for the use of the plants. This method is practical only in a few localities where the source of water supply and the physical conditions of the field are adapted to its use.

Overhead irrigation.—Overhead irrigation is accomplished by a system of overhead piping so placed that water can be applied to an entire field or garden at one time or by a shifting or portable piping arrangement. The pipes are perforated with many small holes through which are forced fine streams or a spray of water. This method is very effective, but its expense limits its usefulness principally to gardening and trucking. Not only is

Sub-irrigating method. Continuous piping system.

the cost prohibitive for large fields, but the piping is in the way for cultivation when using horses and machinery.

Determining the method of irrigation.—What method of irrigation is best must be decided by certain important factors. Among these are (1) the available water supply, and its expense, (2) the location and level of the water table, (3) the nature of the soil, (4) the variety of crops to be irrigated, (5) the size of the field. Irrigating small grain, forage crops, alfalfa, etc., is usually best accomplished by the surface corrugated methods, though flooding may prove satisfactory if the land is well drained. Orchard and trucking crops are most economically served by the furrow method.

Crop Management under Irrigation

The application of water.—Water is usually applied as needed from seed time to harvest in from two to six applications. A few irrigations from June to September as a rule insure better results than many. Too much water is the cause of many irrigation difficulties and is quite as harmful to the crops as not enough. The time of application is more important than the quantity of water applied.

Care of the crop.—The general management of crops under irrigation, as to planting, tillage and harvesting, is very little different from the management of the same crops under humid conditions, except in three particulars. *First,* all work must protect the irrigation system, such as ditches, furrows and piping, being careful not to damage them in cultivating the crop. *Second,* the tillage must be

Overhead spraying system, showing pressure gage, Rancocas, New Jersey. Strawberries.

performed with a definite view to conserving the moisture in all possible ways. *Third,* the management of the farm must be more carefully planned as the cost of production is greater on irrigated land than on humid land, and a mate-

Shoshone project, Wyoming.

rial increase of production per acre must result if a substantial profit is to be assured.

Rotation.—The desire for immediate cash returns makes the tendency to single cropping as pronounced on irrigated projects as in the central states or the cotton territory. Yet the fact that the land is new makes diversification and a carefully planned system of rotation even more desirable than in most other regions. For not a little of the new land which is being brought under irrigation is almost entirely devoid of organic matter. This is due to the fact that for many years it has been entirely without vegetation. For this reason and for the purpose of keeping up the natural fertility and the enriching of the soil, it is important to plan a practical system of crop rotation from the start.

Every irrigation farmer should keep in close touch with the state college of agriculture and state experiment station of his state by visiting the institution and reading its bulletins. In this way he can secure guidance and information from experts who have been provided with both time and money to investigate and experiment in order to discover the safest and best methods for the farmer.

Dangers from Over-irrigation

The dangers from over-irrigation need to be guarded against as carefully as those of shortage of moisture. The Utah Agricultural College and the Utah Conservation Commission have jointly issued the following suggestions to irrigation farmers:

OVER-IRRIGATION IS A MENACE TO UTAH, BECAUSE

1. Smaller crop yields are obtained for each unit of water used.

2. More plant food is taken up by the plant for each pound of crop.
3. The quality of the crops is greatly reduced.
4. Straw is produced at the expense of grain.
5. Plant food is washed out of the soil.
6. Lower-lying lands become water-logged.
7. Other dry lands are cheated of irrigation water.
8. The extension of the irrigated area is hindered.
9. A wholesome community spirit is lowered wherever water is wastefully used.

The same authorities have set forth the following irrigation rules, which are worth the attention of all who are interested in the ultimate success of all irrigation.

1. **Store the rainfall in the soil.**—Deep thorough plowing enables the soil to absorb and retain most of the rain and snow water. The more rainfall is stored in the soil the less irrigation water will be needed.

2. **Use the spring and fall water.**—Where the winters are dry, fall irrigation or early spring irrigation will reduce the irrigation water needed during the growing season.

3. **Cultivate frequently and thoroughly.**—Water is easily lost from soils by evaporation. The soil should be thoroughly cultivated early in the spring, as soon as possible after irrigation, and usually once or more between irrigations. Thorough cultivation will reduce the water needed in irrigation.

4. **Keep the soil fertile.**—The more fertile a soil is, the less water is needed to produce a pound or ton of the crop. Plow deeply, cultivate thoroughly, use barnyard manure, and less irrigation water will be needed.

5. **Plant in well-moistened soil.**—Well-moistened soil at planting time permits better root development, and delays the time of the first irrigation, and thus saves irrigation water during the summer. If rains and snow do not moisten soils sufficiently for planting, irrigate in fall, or in early spring, before planting.

6. **Don't irrigate too early.**—By postponing as long as possible the first irrigation after planting, a better root develop-

ment is secured and less irrigation water is needed to produce the crop.

7. **Irrigate by the correct method.**—Where water is plentiful, the flooding method may be used; where water is scarce, the furrow method only should be employed. Lead the waste water from the furrows to other fields.

8. **Irrigate at the proper time.**—Withhold water until the crop is in real need. When irrigating, apply enough water to supply the crop for at least ten days. Irrigate thoroughly, when potatoes are in bloom; corn in tassel or silk; lucerne just beginning to bud, and grains forming seed.

9. **Use water in moderation.**—The acre yield of a crop increases as more water is used, up to a certain limit, beyond which more water causes a decrease in the yield.

10. **Spread the water over larger areas.**—The yield of crop per unit of water always becomes smaller as more water is added. The less water is used in irrigation, the more crop is obtained for the water used. In Utah, land is plentiful, water is scarce; it is more important to get a large crop for each acre-foot of water than for each acre of land.

11. **Kill the weeds.**—Weeds use up as much water as do many profitable crops. It costs usually one ton of water to produce one pound of weeds. Killing the weeds will leave more water for our crops.

12. **Repair the leaky ditches.**—Tremendous quantities of water seep from most of our canals and ditches. Stop the leaky places! It will often pay to cement the whole canal.

13. **Measure the water.**—Land is measured carefully, but water, more valuable than land, is seldom measured. Great progress will be made by Utah as soon as farmers faithfully measure and keep an account of the water used on the land. This is one of Utah's greatest irrigation needs. The Cippoletti Weir may be used by any farmer for the measurement of water.

CHAPTER X

COTTON

COTTON is one of the oldest of the fabric-producing plants. Its origin dates back so far that it is not known where the plant originated, but it is thought to have been a native of India. Certain it is that Columbus found cotton growing here when he came to America. Cotton has, from the beginning of our history, been one of the chief agricultural products and ranks third in value of all farm crops after the cereals and the forage crops in the United States. In a number of the southern states it outranks all other crops combined, both in acreage and value. The annual cotton crop is worth over three-fourths of a billion dollars.

The cotton plant is raised chiefly for its fiber, though other parts of the plant are also useful. The seed furnishes valuable oils for lighting, cooking and other purposes. The hulls and seed meal and flour left from the manufacture of the oils are used for bread for human food, stock feeding and fertilizers. The root barks are sometimes used for medicine while the stalk fiber is employed for the manufacture of coarse cloth bags. Some paper manufacturers are also using the stalk.

Typical cotton-picking scene in the South.

The Cotton Region

Most of our cotton is raised in the following twelve southern states, which are named in the order of the amount of cotton they produce: Texas, Georgia, South Carolina, Mississippi, Alabama, North Carolina, Arkansas, Louisiana, Tennessee, Florida, Oklahoma, Missouri. Cotton is also profitably raised in southern Virginia and in parts of Kentucky. It has recently been introduced with success in Arizona, southern Utah, New Mexico, and in southern California, where the long staple varieties are especially successful.

Proportion of land in cotton.—Mississippi, Texas, Alabama, Georgia and South Carolina devote approximately one-half of their tilled land to the raising of cotton, the remainder of the list, from twelve to about twenty-five per cent. The tendency at present is to diversify the farming in the cotton states, raising a smaller acreage of cotton, and adding corn, oats, legumes and other forage crops. With better methods of growing cotton, this can be done without reducing the amount of cotton produced.

Varieties of cotton.—The two leading varieties of cotton are the *Sea Island* and the *Upland.* Sea Island cotton is grown over a small area located in the southern part of South Carolina, southeastern Georgia and northern Florida. Upland cotton occupies the greater part of the remainder of the cotton area.

The United States produces the best grade of Sea Island cotton grown in the world. It is the long, silky fibers of the Sea Island variety that are used for spinning the finest fabrics, laces and threads. Sea Island cotton also possesses far greater strength and durability than other varieties and is used wherever wearing qualities are of paramount importance. For example, it is this variety that is employed in the manufacture of mail bags and in the making of pneumatic tires, where strength and durability are put to the severest tests.

Upland cotton, while never approximating Sea Island in length and fineness of fiber, is, nevertheless, produced in fine quality in various regions of the South.

Grades of cotton.—For convenience in marketing, cotton is divided into grades and classes which are so standardized that quotations can be made for certain grades or standards without seeing the product. The official grades as prepared at the present time by the United States Department of Agriculture include the following:

Above Middling.	Below Middling.
1. Middling Fair	5. Middling
2. Strict Good Middling	6. Strict Low Middling
3. Good Middling	7. Low Middling
4. Strict Middling	8. Strict Good Ordinary

9. Good Ordinary

Samples have been prepared representing each of these grades, and are widely distributed throughout the cotton regions at the cost of making up the samples. It is well for every cotton grower to know the grades of cotton he is producing and its relation to markets, and it of course pays to produce as high a grade as possible. The principal points considered in deciding the grade of cotton are:

(1) Foreign matter, such as leaves, dirt, sand, strings and the like, mixed in with the fiber.

(2) Injured or gin-cut fiber, cut seed, or unripe fiber.

(3) The color.

(4) Length and quality of lint or fiber.

Raising the Crop

Soil requirements—Well-drained clay or sandy loam soil is considered best for cotton. As a rule, bottom lands are not well adapted to the growth of cotton, because most of the fertility of the soil goes into the production of stalk rather than bolls. There are two important reasons why cotton should be planted only on fertile soil, and given the best of cultivation: (1) A better quality of cotton and larger yields are produced; (2) an earlier crop is secured and the danger from the boll weevil and other insect enemies is greatly reduced.

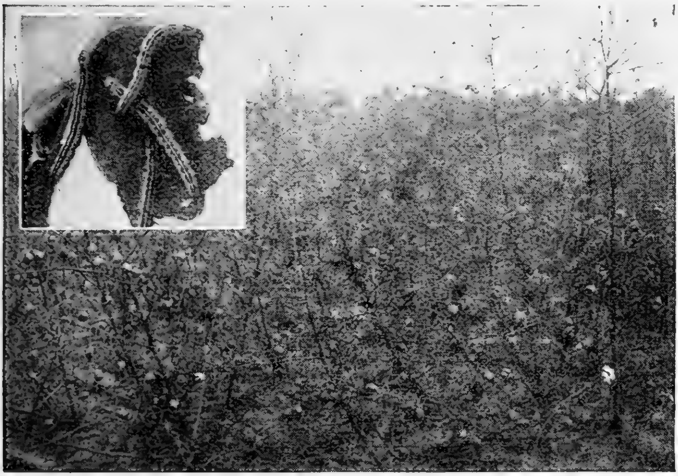
Preparation of the seed bed.—The ground in most parts of the South should be plowed deep for cotton. This brings to the surface new soil, and opens up deeper levels for the roots of the plants. Many successful cotton farmers plow not less than eight or ten inches deep, and then follow with a subsoiler that breaks the bottom of the furrow open to an additional depth of four or more inches. It is usually advisable to plow the land in the fall, and then disk or harrow well just before the planting season. Cotton grows better on a well bedded soil than on newly prepared land.

Applying fertilizers.—Cotton land should be rich in humus or vegetable matter. This keeps the soil from packing, increases the capacity for water, and adds to the fertility. Barnyard manure should therefore be added whenever possible. Legumes should be grown, alternating with cotton, and an occasional crop of soy-beans, cow-peas or clover plowed under.

Commercial fertilizers will pay on certain soils. It is well to secure the advice of an expert as to what fertilizing elements are most needed. Acid phosphate is commonly used to increase the yield and hasten maturity. Cottonseed-meal may be used especially to stimulate stalk growth.

Planting.—Cotton should be planted as early as the season will permit. Not only will a better grade of cotton result, but the danger from the boll weevil will be greatly lessened, as the weevils do not become very numerous before the latter part of July. In Texas the cotton is planted in March; in North Carolina not until May. The plant requires about six months to mature, hence it is easy to see why the cotton territory is so limited. In some sections it is considered good practise to plant the seed on ridges thrown up about four feet apart. On very dry soils the ground should be kept level. About four feet is the proper distance between rows, and the plants should be set from twelve to twenty inches apart in the row. About thirty pounds of good seed are required to the acre.

New system of culture.—Recent experiments in the raising of cotton have developed a new system of cotton culture. By this system the cotton plants are at the beginning left closer in the row than is customary, and thinned at a later date than usual. The object in this system is to restrict the growth of vegetative branches, or those that result in foliage only, and thereby induce an earlier developing of the fruiting branches. The effect of this system is to secure an early short-seasoned crop, thereby defeating in some degree the ravages of the boll weevil and other cotton enemies, and at the same time getting the crop ready for the market at an earlier date.



Field injured by cotton worm. (Insert) cotton worms.

The spacing of the plants and the time at which thinning should take place will depend so much upon local conditions and the variety of cotton grown that no specific directions can be given. The principle involved, however, is clear, and every cotton grower should investigate the possibilities of the closer planting, later thinning system and apply the results to his own crop. It is thought that this system will do much to reduce the amount of damage occasioned by the weevil and would probably be justified from this standpoint alone.

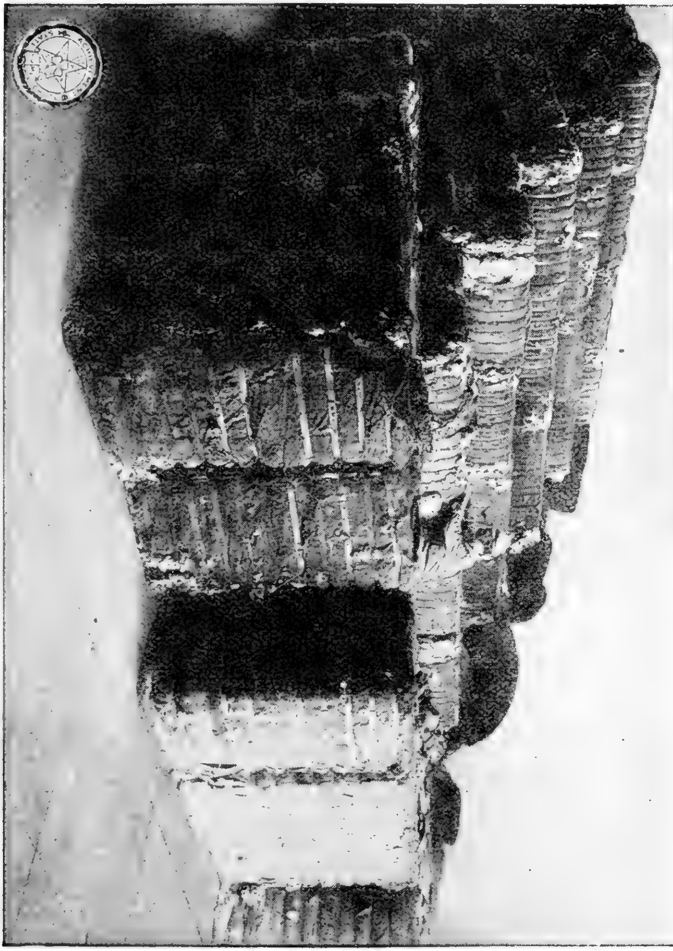
Cotton requires good cultivation to kill the weeds, keep the soil loose and preserve a dust mulch to conserve the moisture. Cultivation should begin with the harrow before the young plants come up. When the cotton is about five days old the cultivation should be repeated. Disk and shovel cultivators are suitable for the later cultivations. Deep plowing should be avoided later in the season, so that the roots may not be injured.

Harvesting.—The greatest labor connected with cotton production is the picking of the crop. It is a very slow and costly operation and has been performed entirely by hand labor. The invention of the cotton gin by Eli Whitney for the ginning of the cotton or the removal of the seed from the lint was one of the greatest boons to cotton culture that has come to the South. After the cotton has been ginned it is made up into large bundles called bales, each weighing about five hundred pounds. These bales are shipped to the mills by train or boat, after which they are manufactured into thread and all kinds of cloth.

Enemies of Cotton

Cotton, like other farm crops, is subject to attack by various insects and diseases.

The boll weevil.—The boll weevil is said to be the most harmful insect known to agriculture in this country. It came to the United States from Mexico about 1892, first

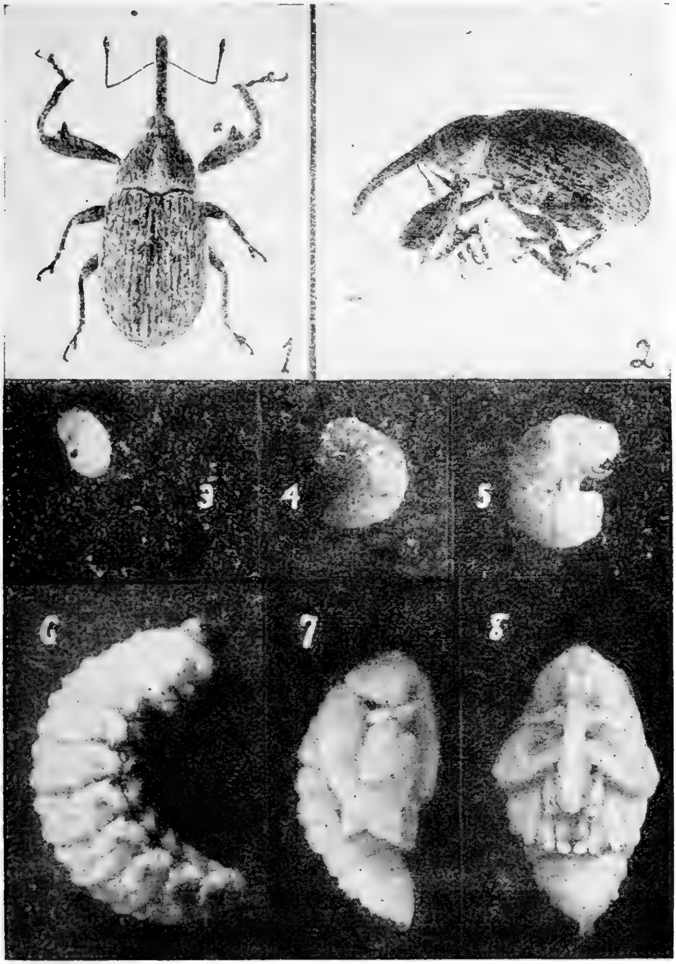


Baled cotton in storage ready for shipment.

beginning its ravages in Texas. Since that time it has spread over most of the cotton area, and caused the loss of millions of dollars annually to cotton growers.

Life history of the boll weevil.—In the spring and throughout the fruiting season eggs are laid in small holes made by the female in the cotton square or boll. In about three days the egg hatches into a grub, which at once begins feeding on the plant. In a little more than a week the grub passes into the pupa stage, which lasts from three to five days, when the second generation of adult, the beetle, is developed. It requires from two to three weeks for the weevil to develop from egg to adult, hence a number of generations are produced in a season. The offspring of a single pair in a season may exceed twelve million individuals.

Fighting the boll weevil.—Since the weevil life is spent and damage done chiefly in the square or boll, methods of poisoning and picking have not proved very satisfactory. The most important step in the destruction of the weevil is to kill as large a proportion of them by exposure during the winter months as possible. In order to do this the fields should be cleaned of all of the stalks and rubbish and the seed bed prepared in the early fall. Cotton stalks should be thoroughly uprooted and if possible plowed under just as soon as the crop is picked. Then the ground should be well dragged and packed close so as to shut all crevices through which the beetle might come to the surface. Rubbish left upon the ground during the winter months will be sure to furnish a safe hiding-place and protection for the weevil, hence should be burned.



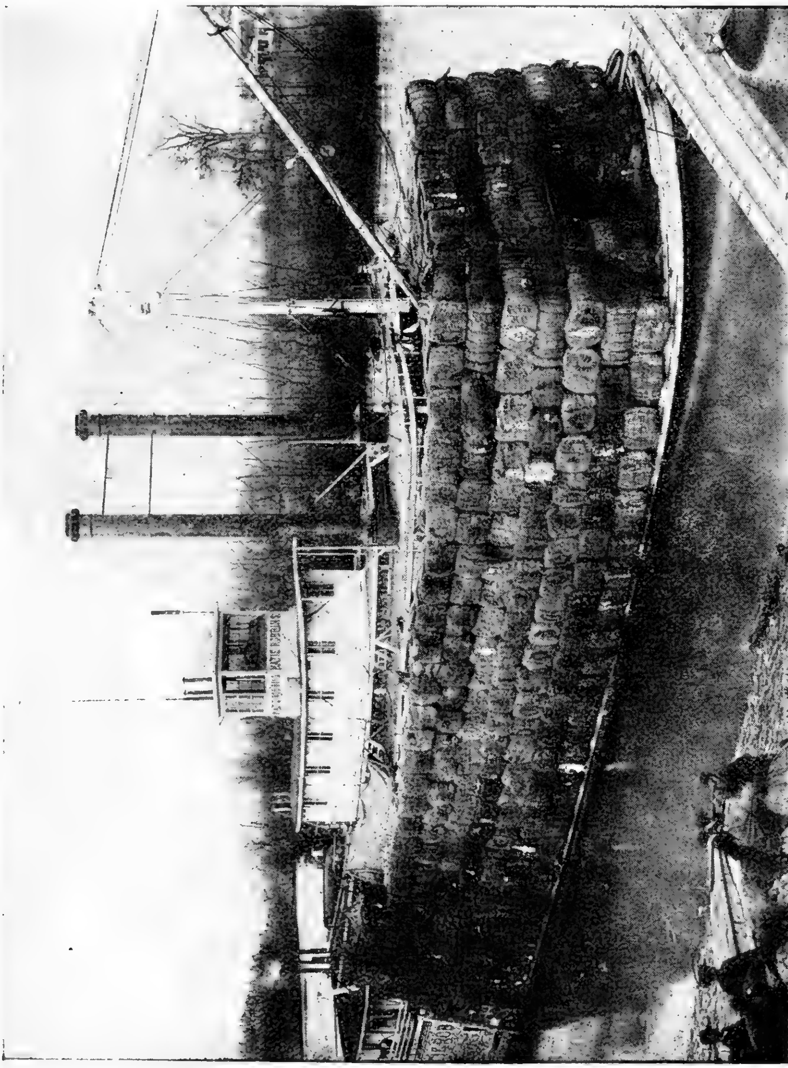
THE BOLL WEEVIL AND ITS STAGES.

Fig. 1, Adult boll weevil, viewed from above; *a*, two teeth on fore femur; fig. 2, adult weevil, side view; fig. 3, egg of weevil; fig. 4, grub about two days old; fig. 5, grub at entrance to second stage after shedding first skin, about three days old; fig. 6, grub fully grown, about ten days from egg; fig. 7, transformation or pupal stage, side view, snout, legs and wings forming; fig. 8, pupal stage, front view of fig. 7. Figs. 1, 2, 6, 7 and 8 enlarged about ten diameters; figs. 3, 4 and 5 enlarged about twenty diameters.

The next most important step is the planting of an early variety in order to get the crop well out of the way of the larger broods of weevils. Through a system of seed selection it is possible to develop a plant that is very strongly resistant to the attacks of the boll weevil.

Since the weevils live mainly upon the cotton boll and the cotton plant, it is easy to understand why it is important to rotate the crop. Cotton should not be grown on the same piece of ground in boll weevil territory a second year. This plan, if followed, is also bound to bring about the diversification of farming so greatly needed in the South. The weevils can not possibly live in the soil for more than twelve months without direct contact with a source of food supply, hence the effectiveness of a three-, four- and five-year rotation having the cotton-field for each successive year sufficiently separated so as not to make it easy for the weevil to pass from one field to the other. Cotton seed should be treated with *carbon bisulphide* in order to make sure that no weevils are carried into new soil.

The cotton anthracnose or boll rot.—Next to the boll weevil, this is considered one of the destructive enemies to cotton production. It is usually referred to as *boll rot* and is a disease caused by fungous growth which attacks the seedlings, the stems and the boll pedicels. It causes the loss of many millions of dollars every year. It develops readily in hot muggy weather and where the planting has been close. The best way to prevent this disease is by careful seed selection. Healthy seed is very important and



Shipping cotton to foreign markets through Panama Canal.

the systematic rotation of crops necessary as the disease spores will live upon dead bolls from year to year. It is also possible to develop through selection of seed from healthy stalks a plant quite resistant to the disease.

CHAPTER XI

THE POTATO

THE common white, or Irish, potato is grown in every state of the Union. It is a native of South America and was first brought to North America by the early Spanish settlers. It has so far played its most important part in the farming of the northern states. While many of the southern states are admirably adapted to potato growing, it is only recently that southern farmers have begun to make the potato an important factor among their crops. Potatoes are one of the chief vegetables in the world's food supply. The annual world-production of the Irish potato is about five billion bushels. Of this immense supply, the United States produces three hundred million bushels, or somewhat more than one-twentieth of the entire amount. Potatoes are one of the most profitable crops, especially for intensive agriculture, wherever climate and soil conditions are favorable.

The plant.—The potato plant varies from one and one-half to five feet in height, though it does not show this great a height owing to its spreading habits of growth. The terminal clusters of flower bear seeds, from which new varieties are often developed. For practical purposes the plant is always reproduced from the tubers.

Strong and weak tuber units. Nos. 1a and 2a, the yield from Nos. 1 and 2, respectively, Nos. 1b and 2b are the yield from five tubers planted from 1a and 2a, respectively.

Though both plant and roots die upon the ripening of the seed and tubers, the potato is a perennial and the plant is reproduced by means of the tuber. Since the tubers are destroyed by freezing, they are harvested before frost. Potatoes are annuals in all regions where the soil freezes during the winter.

Examining a tuber, which is the food part of the potato plant, one notes small indentations commonly called "eyes." These contain the buds from which the new plants are produced. The end at which the eyes are thickest is called the seed end. Some varieties produce tubers that are more deeply indented at the eyes and more irregular in shape than others. The smoother and more uniform the tuber, other things being equal, the more valuable and marketable.

Though there are hundreds of wild plants belonging to the same genus as potatoes, comparatively few of these are known as cultivated plants. Among the most closely related cultivated plants are the tomato and tobacco, which belong to the same family.

Potatoes as a Farm Crop

Potatoes are raised in every state, though the chief potato region consists of ten or fifteen northern states reaching from the Missouri River eastward to the Atlantic. More than three million acres are planted with potatoes in the United States each year. The annual crop of from three hundred to three hundred and fifty million bushels represents nearly four bushels to every inhabitant.

The yield.—Potatoes, like other crops, vary greatly in yield owing to differences in the fertility of the soil, and the care taken in raising the crop. The average for the United States during the last ten-year period has been about ninety-six bushels to the acre. It is somewhat humiliating to know, that, in spite of our improved machinery and scientific knowledge of the soil and plant diseases, we are now securing only about the same yield of potatoes that was produced at the close of the Civil War. Experts tell us that this yield can easily be doubled, with comparatively small expense and trouble.

No farmer with good soil ought to be satisfied with a yield under two hundred bushels to the acre on average seasons. The state of Maine, which is one of the leading potato regions of the country, not infrequently averages considerably above this amount. The success of the Maine potato raisers is probably due more to the excellence of their cultural methods than to any superiority in the soil, climate, or variety of tubers grown.

Raising the Crop

The soil.—Potatoes thrive best in a rich sandy loam containing a good supply of *humus*. Hard stiff soils or heavy clay are not well adapted to potato raising. The best soil on the farm should be devoted to the potato field, both because potatoes demand a better soil than most other crops, and because the value of potatoes per acre is greater than almost any other field crop.

Ground that has recently raised clover, alfalfa or some other legume is especially suited to potatoes. While barnyard manure will greatly increase the yield, it will also favor the ravages of scab and other potato diseases, and so lower the quality of the crop. It is usually a mistake to plant potatoes on a freshly manured field. If manure is used, it is better to follow a heavy manuring with a crop of corn, and then plant potatoes for the second year crop.

An Iowa potato club boy and a part of his crop.

Green manuring, that is, the plowing under of green crops such as clover or alfalfa, will add greatly to the yield. If the sod is old, it is usually better to grow one crop of corn before potatoes are planted on the field. Commercial fertilizers can be used to advantage for potatoes on most soils.

The seed bed.—Potatoes should have an especially well prepared seed bed. The plowing should be deeper than for most crops, since the seed is planted deeper and loose soil must be had for the roots and tubers. In average soils the plow should be set to a depth of not less than eight inches.

The seed bed must be well pulverized and thoroughly packed. Usually not less than four harrowings and diskings are required for the best results. Experiments have shown that the difference in yield caused by harrowing part of a field four times and the remainder of it but twice may be as much as twenty per cent. of the crop in favor of the better preparation.

The planting.—Potatoes should be planted not less than four inches deep. If less than this depth it will not give room for the tubers to grow without protruding from the ground. This is sure to result in injury from sunburn. Most potato growers drill the seed, dropping single pieces of seed from twelve to fifteen inches apart in the row. In some regions potatoes are planted in cross rows like corn, with three cuts of seed to the hill.

The date for planting differs in various regions, but the greater part of the crop in the northern states is planted during the last half of May. From twelve to twenty bushels of seed are required for an acre, depending on how the tubers are cut for planting. Where crops of any considerable size are raised, the dropping is usually done with a machine or planter, some makes of which are arranged to distribute commercial fertilizer at the same time.

Where potatoes are not raised as a commercial crop, the planting is ordinarily done by hand. There are two chief types of potato planters generally employed under commercial conditions. In the one type of planter, the seed pieces are picked up and distributed by small steel forks or pickers, and in the other type the pieces are caught in pockets on the revolving disk and delivered from this into the furrow. The usual potato planter is a two-horse machine. The first type of planter can be operated by one man. The disk machine requires a second man to attend to the seed distribution for the disk and insure a more perfect stand. Either type of machine will plant about five acres a day. The machines are equipped with an attachment for the distribution of commercial fertilizer. From one-half to three-quarters of a ton per acre can be profitably applied. By this system the fertilizer is distributed directly in the drills and not broadcast.

Cultivating the crop.—Potatoes demand good cultivation. Harrowing should be done before the potatoes are up. From one to two harrowings may be given after the plants appear. Throughout the growing season a fine soil mulch should at all times be maintained by means of frequent cultivation. Especially after a rain should the soil crust be broken. The cultivation should be rather shallow, and potatoes should not be hilled up as is so frequently done.

Harvesting the crop.—When the vines have died the potatoes have stopped growing and the crop is ready to harvest. In the case of small fields, potatoes are often harvested by being plowed out with an ordinary plow, the tubers being picked up by hand, and the field afterward harrowed to uncover any that have been missed.

In regions where potatoes are grown in large quantities the digging is done with machines, several kinds of which are now on the market. The average machine will turn out about three acres in a day, and will require from five to ten pickers to keep up with it.

Storing the crop.—In order to keep well, potatoes must be stored in a cool place. The house cellar is usually too warm for them, and they also give out an unpleasant odor that permeates the house. A common type of vegetable cellar to be found on many farms is built with concrete or stone walls, the excavation being made on a side hill. It is covered with a shingle roof, and has a board floor on a level with the ground at the upper side, thus making an excellent tool and machinery house over the space used for vegetables.

Improvement Through Selection of Seed

One of the first factors in successful potato growing is the securing of good seed. Without this, fertility of soil and careful cultivation are largely wasted.

Good seed will possess the following qualities: It must (1) be *pure,* that is, free from mixtures of varieties; (2) be taken from *productive* plants, "hills selected"; (3) be *uniform* in size and shape; (4) be *firm and sound,* not shrunken or decayed; (5) be entirely *free from disease;* (6) *not wholly mature* when harvested; (7) have *sprouts just showing* at time of planting.

It has been estimated by experts that attention to these points would add at least ten per cent. to the potato crop each year. This would mean an increase of nearly thirty-five million bushels, worth about twenty-one million dollars.

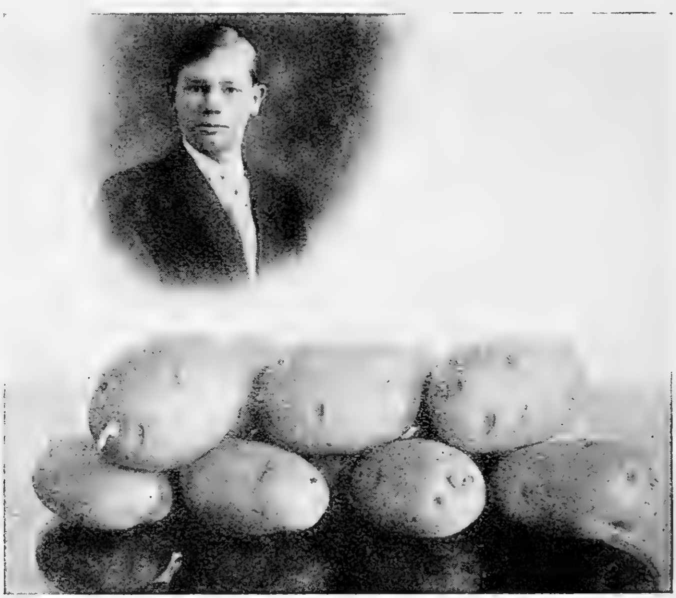
Pure seed.—Mixed varieties present several disadvantages in potato growing. The crop will not mature evenly. Thus, when the earlier variety has ripened and is ready for the market or table, the later one will have the potatoes just setting, and unfit for use. Mixed varieties do not cook evenly, and when baked or broiled together some will be overdone before others have softened. General mixture of varieties in potatoes as in other crops tends to degeneration and running out of the strain or breed.

Seed from productive plants.—Seed should be taken only from the strongest and most productive plants, no matter what the variety. This can not be accomplished by selecting seed from the potato bin, any more than the best seed corn can be selected from the crib or wagon. For a certain tuber may itself be of good size and look promising, but have come from a plant that produced but one or two potatoes, or that grew only one tuber of fair size, with several culls.

One of the most successful methods of developing high-grade seed potatoes is what is called the *tuber-unit* method. This consists of selecting from the seed bin a quantity of the most perfect tubers, each to weigh from six to eight ounces.

These are cut for planting by splitting the tuber into four quarters, from seed end to stem end.

The tuber-unit method.—The four pieces of each potato are planted in succession twelve inches apart in the row. A longer space is left between the sets of fours, thus mak-



Club boy, and prize seed potatoes, sprouted enough for planting.

ing it possible to watch the outcome of each tuber by itself. Before the plants begin to die, careful inspection is made, and any mixtures, and imperfect or weak plants are marked for rejection. Only the most promising and uniform are reserved for the selection of seed.

When the crop is harvested, each set of four is dug by itself. A further selection is made by rejecting the total product if any one of the four plants has failed to produce uniform, desirable tubers. The potatoes produced by each set of four selected for seed are put into separate sacks and kept for further examination.

Finally, the contents of each sack are inspected for the weight of marketable and unmarketable tubers, and other desirable qualities of the type. From each of the four-plant units the best ten tubers are to be selected for the next year's planting. This selected seed is planted the following year, with forty plants to the unit instead of four. The product from the best forty-hill rows is kept for seed for the general crop for the following year. By thus keeping a breeding plat for seed, potatoes can be greatly improved, and the yield much increased.

The tuber-unit method can be rendered even more effective by making the first selection from the field instead of the potato bin. This is done by going into the field before the vines begin to die and marking a number of the most vigorous and desirable plants. These are harvested separately before wholly mature, and seed taken from the best hills.

The practise of planting for seed the small and unmarketable potato culls can not be too strongly condemned. It lessens the yield, lowers the quality of the crop and causes the variety to deteriorate or "run out."

Cutting seed potatoes.—Whether it pays better to cut potatoes for seed or plant the whole tuber has been much discussed. It is believed by many potato growers that under average conditions the yield will be greater when quarters are planted than when pieces with single eyes are used, and that halves will produce more than quarters. It is not sure that whole tubers will produce a larger yield than that produced from halves. The weight of experience seems to favor planting halves.

Immature seed.—For vitality, high yield and good market qualities, potatoes intended for seed should be harvested before entirely ripe (by hill selection); that is, before the vines are dead. Many experiments have shown that immature seed will produce a considerably higher yield than seed allowed to ripen before digging.

Contrary to the rule with most farm crops, seed brought from another region often produces a better crop of potatoes than home-grown seed. Especially is this true when northern grown potatoes are taken farther south. Not only is the yield increased, but the time required for maturing is shortened by securing seed from colder regions. Great care should be taken in importing seed tubers not to introduce new forms of potato diseases.

Potato Enemies

Potatoes have many enemies, and the number seems to be increasing, owing to diseases being brought in from other countries.

Scab.—Scab is one of the most wide-spread and destructive of potato diseases. It causes a rough, pitted, scabby condition which may attack the tuber in patches, or extend over the entire surface. Whether scab is caused by a fungous growth or a species of soil bacteria is not certain. It is fortunate, however, that a very simple and effective remedy is known. This consists in treating seed potatoes before planting.

There are several mixtures used for this purpose; the cheapest and most easily applied is a formalin solution. This is prepared by mixing one pint of formalin with thirty gallons of water. The seed potatoes are soaked in the solution for two hours, and then planted without allowing them to come into contact with bags or utensils in which scabby potatoes have been kept.

Leaf, on early blight.—Leaf blight is another common potato disease. It attacks the leaves and stems, first showing about the time that the tubers begin to form. Its presence may be detected by the presence of grayish brown spots on the leaves, the part of the leaf attacked soon becoming hard and brittle. Within three or four weeks the leaves are all killed, and the stem is also affected. The tubers grow but little after the leaves are first attacked; hence the crop is ruined unless the blight can be checked.

The ravages of leaf blight can be almost if not wholly prevented by spraying the plants with the Bordeaux mixture (see page 399). This solution is applied with a spraying machine at the rate of about fifty gallons to the acre. From three to five sprayings during the season are required when leaf blight threatens. One pound of Paris green to the acre at the first spraying, and the same amount later in the season will also destroy the potato beetles, which often prove such a pest.

Late blight, or rot.—The blotches and blackish streaks often seen running through tubers are caused by late blight, or potato rot. This disease first attacks the leaves and stems, causing them to soften and decay and producing a bad smell. Late blight often appears suddenly, and spreads through a field with great rapidity. A green, healthy-looking field may turn almost black in a day or two.

The treatment for late blight is the same as for leaf blight, and should never be neglected in regions where blight is common. It is far better to commence the spraying before either form of blight begins to appear, for this is the easiest time to prevent it.

Rules for Protecting Against Potato Diseases

The University of Wisconsin offers the following advice concerning certain potato diseases:

Powdery Scab.—A bad European disease, recently brought into Canada and some eastern states. Hard to control. Keep it out of Wisconsin. Do not buy eastern seed. Send any suspicious potatoes to the Experiment Station for examination.

Common Scab.—Found wherever potatoes are grown. Germs live over on tubers and in soil. Lime and ashes and horse manure increase disease; plowing under green crops (clover, etc.) checks. Use disinfected seed on clean soil, rotate crops.

Black Scurf.—Common. Does little harm under Wisconsin conditions, but serious south and west, hence seed for these sections should be free from it. Rotate crop and where needed disinfect seed.

Silver Scurf.—Not serious, chief damage from shriveling in storage. Use clean seed on clean soil, rotate. Seed disinfection only partially successful.

Black Leg and Rot.—Germs on seed tuber. This rots after planting, giving weak or partial stand. Rot spreads from seed tuber up base of stem; plants narrow, spindling, yellowish. May cause soft rot in crop. Probably does not live over in soil. Use only sound seed, disinfect.

Late Blight and Rot.—Sometimes very destructive. Worse in northern counties and heavy soil. (Do not confuse with early blight and tip burn which are leaf diseases only.) Late or wet rot (if heavy wet soil). Winters over inside tubers. Get seed from healthy fields. Spraying, Bordeaux mixture on leaves, controls.

Black Wart.—Has spread rapidly through Europe. Attacks eyes, deforms with repulsive warty growths. No remedy known. European potatoes quarantined to keep this out.

To Disinfect Seed Potatoes.—Soak seed tubers for two hours in either of the following: 1. Formaldehyde (formalin, 40% strength) one pint in thirty gallons of water. Can use same solution repeatedly. Fully effective for common scab and black leg; helps with other scab and scurf diseases. 2. Corrosive sublimate (mercuric chloride; deadly poison) one part by weight to 1000 parts water (or four ounces in thirty gallons of water). Equal to formaldehyde for scab and better for scurf, especially black scurf.

CHAPTER XII

SUGAR FARMING

SUGAR is one of our most important foods. It has great nutritive value, is easily digested, and is palatable to nearly every one. We consume about four million tons a year, or more than eighty pounds for each person in the United States. In less prosperous nations sugar is found too expensive a food, and a much smaller proportion is used. Only about one-fourth of the sugar required for home consumption is grown in this country, the remainder being imported.

There are five principal varieties of sugar used: *cane* sugar, *beet* sugar, *maple* sugar, *corn* sugar and *sorghum*. Cane sugar leads both in the amount used, and in the number of grades produced. Most of the finer table and manufacturing sugars are from cane. Beet sugar comes next in amount. Maple sugar is not produced in large amounts. Large quantities of corn sugar and sorghum are used in the form of sirup, or molasses. Less important varieties are *grape* sugar, from starch; *fruit* sugar, from fruits and honey; *malt* sugar, from malted grains; and *milk* sugar from the milk of cows, goats, etc. The chemist usually divides all sugars into two classes, *saccharose* and *glucose*.

Great quantities of sugar are produced in Cuba, Porto

Rico and other of the West Indies Islands. The northernmost countries of South America also grow and manufacture much sugar, as do the Dutch East Indies. Hawaii has large sugar industries. Germany and France are leaders in the raising of sugar beets and their manufacture into sugar. Russia and Austria are also important beet sugar countries.

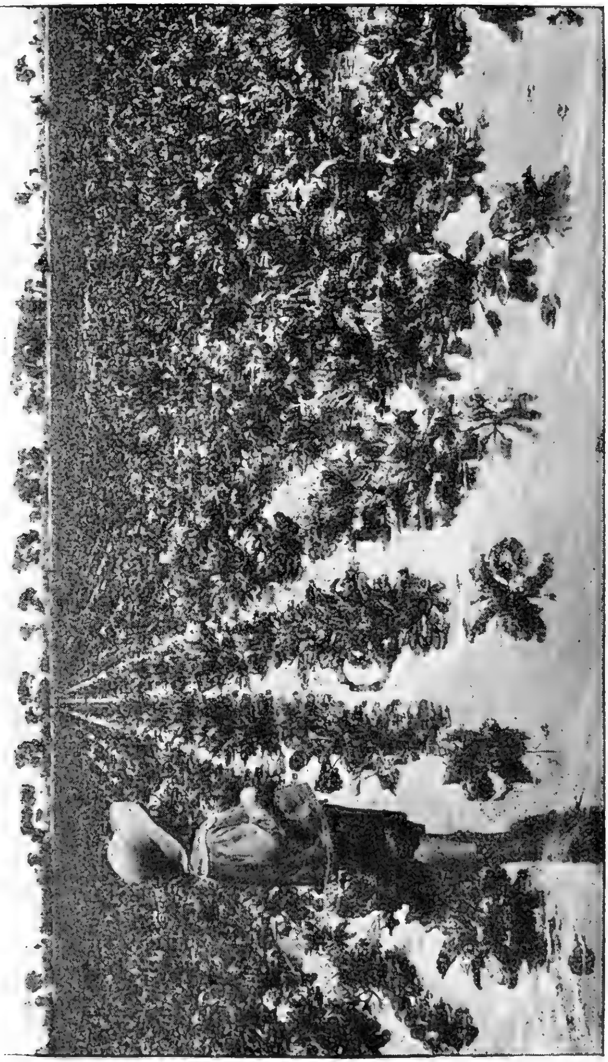
The Sugar Regions

Nearly every state grows some amount of one of the five principal kinds of sugar.

Cane sugar region.—By far the greater part of the sugar used in this country is made from sugar cane. Only a small proportion of what we require is produced here, most of it being imported from the West Indies and other tropical or semi-tropical regions. Practically all our home-grown cane sugar is raised in the following states, which are named in the order of the amount produced: Louisiana, Georgia, Texas, Alabama, Mississippi, Florida, South Carolina, California, North Carolina. Of these states, Louisiana has produced more than twice as much as the other eight states combined.

Beet sugar region.—The beet sugar region is far more widely distributed than the cane sugar region. The following are some of the leading beet sugar states: Colorado, California, Michigan, Utah, Idaho, Wisconsin, Montana, Ohio, Kansas, Iowa and Nebraska. This wide area indicates that sugar beets will thrive in a great variety of climates and soils.

Sorghum sugar regions.—Sorghum also thrives over



Four hundred acres of sugar beets under irrigation, Salt River Valley, Utah.

a wide range of territory, as will be seen from the distribution of the following leading sorghum producing states: Kentucky, Tennessee, Missouri, Texas, North Carolina, Illinois, Oklahoma, Indiana, Alabama, Mississippi, Louisiana and Ohio.

Maple sugar region.—The leading maple sugar states are Vermont, New York and Ohio. New Hampshire, Pennsylvania, Michigan and Indiana also produce considerable quantities.

Producing Cane Sugar

The cane sugar plant, which grows much like corn, was originally a tropical plant, but most varieties under cultivation will thrive best in a semi-tropical climate. Some varieties will even succeed in temperate regions. Territories having a temperature of from sixty-five degrees to ninety degrees Fahrenheit during midsummer are considered best. Under good conditions the plants will grow from twelve to twenty feet high.

Sugar cane was first introduced into Europe by the Moors. It was known as the "honey-bearing Indian reed." Plantations were later established in Spain and Sicily. Spanish sailors then carried the seed to the Azores, Canaries, West Indies and other islands. From these sources the plant was brought to America.

Varieties of sugar cane.—The most common varieties grown in the United States are *Louisiana Purple*, which is known in Georgia as *Red Cane; Louisiana Striped* or *Ribbon Cane;* a strain known as *D-74*, and another known as *D-75*.

Moisture.—Cane sugar, because of the large amount of foliage, requires abundant moisture during the growing season. The average rainfall should be from two to four and one-half inches per month during the period of greatest growth. The cane may be successfully grown by irrigation, as it is capable of drawing from the soil practically all the water supply necessary for its development.

Soil requirements.—The soil requirements of the cane sugar plant are very much the same as those of the sugar beet, corn, potato and trucking crops. The soil should be well filled with humus, light and well-drained. The plant requires a well-prepared seed bed and is thought to produce the largest quantity of sugar content where the soil is best adapted for the production of corn and heavy forage crops. The cane sugar plant resists drought better than corn and is sometimes grown successfully in the semi-arid land of Oklahoma, Texas, Kansas and Nebraska.

Cultivation and management of crop.—The cultivation and general management of the soil before planting are similar to those required for successful corn production. After the seed bed has been thoroughly prepared by deep plowing and subsoiling where possible, the soil should be pulverized thoroughly, and a fine surface mulch should be maintained throughout the growing season. This is best done by shallow cultivation, and harrowing. The crop should be kept entirely free from weeds and should be thinned so as to permit the proper development of the canes.

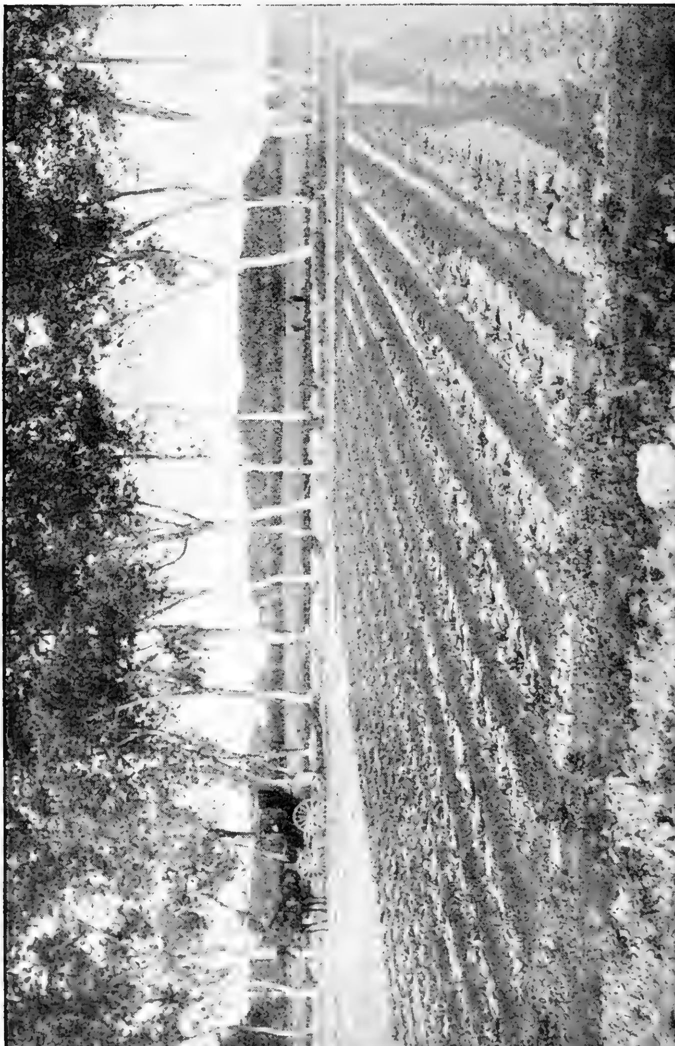
Harvesting and manufacturing.—When the cane is used for forage purposes, as is often done, it is usually cut early in the season, when it has attained a height of about three or four feet. It can be fed at once, or put into a silo, or even cured in the field as hay and fed during the winter months.

When used for sirup or sugar the cane should be cut before frost, or as soon as the heads are past the milk stage and before they harden. The heads or tops should be cut off and leaves stripped and kept for forage purposes. These are valuable for farm stock and the seed is especially prized for poultry. For seed purposes the best heads are cut when nearly ripe and hung up to dry.

After the tops and leaves have been stripped, the canes are cut and hauled to the sugar house where they are run several times through crushers. The juices extracted from the cane are strained, allowed to settle in order to remove the impurities, and then evaporated to the proper consistency. If used as sirup the juice is canned in tin, if used for sugar it is kept in form of sap and then purified, evaporated and refined, finally becoming either *white, granulated, brown,* or *open kettle* sugar, or *New Orleans molasses.*

Growing Sugar Beets

Under right conditions of climate and soil and with a sugar factory near at hand the raising of sugar beets can be made a very profitable industry. A farmer who drives to the factory with a ton of sugar beets has in them about two hundred and eighty pounds of pure sugar. Nature has



Irrigating sugar beets, New Mexico.

stored up in these ugly looking roots a large amount of sweetness and a valuable food. She has also made it possible for the American farmer to make much profit in growing sugar content in his beet fields.

Soil.—Sugar beets grow successfully in any soil that will produce a good crop of corn, wheat, potatoes, or other common crops. New soil, so favorable for most crops, is not so good as cropped soil for sugar beets, especially if the soil contains much decaying vegetable matter. Beets are a good reclaimer of run-down soils, and may sometimes be used to help improve worn out or depleted land.

Climate and moisture.—As far as temperature alone is concerned, regions having an average of seventy degrees Fahrenheit for June, July and August are most favorable for sugar beets.

Sugar beets require a fair amount of moisture. This may be provided (1) by rainfall averaging from two to four inches per month during the growing season; (2) by irrigation; or (3) by sub-surface water seeping upward to the roots through soil of such a nature as to favor this method of irrigation.

Sugar beets on irrigated land.—No more favorable conditions for raising sugar beets can be found than on the irrigated lands of the West. Nor can a more profitable crop be discovered for many semi-arid regions than beets. It has been estimated that one million acres of western irrigated land devoted to the raising of sugar beets under intensive cultivation would increase our sugar crop to such an extent that we could raise all we need instead of only twenty-five per cent. of it.

Raising the crop.—Special methods are required for the successful raising of sugar beets. The ground should be plowed not less than nine inches deep. The plow should be followed furrow by furrow with a subsoiler, loosening the soil to a depth of six or eight inches and more if possible. The weeds must be kept down, as beets are not good fighters of such enemies. Frequent cultivation is required to maintain a loose soil and a fine mulch for the preservation of moisture.

In the manufacture of beet sugar the beets are hauled to the factory, dumped into a sort of flume through which water is flowing, and elevated by a large auger-like arrangement, to the upper story of the factory. By the time they have arrived at this stage they are thoroughly washed and ready for the slicer which cuts them up into long thin, diamond-shaped pieces. They are next run into wrought-iron tanks where they are allowed to stand in water under pressure. By repetition of this process from tank to tank, the water gradually absorbs the sugar from the beets, robbing them to within one-tenth of one per cent. of all they contain. This sweet juice is of a chocolate-brown color and needs much treatment before it is ready for use as table sugar. A succession of boiling, filtering and clarifying, together with the addition of lime for purifying and removing organic matter, brings the product to the sirup consistency. The sirup is put into large whirling drums and by centrifugal force the fine sugar grains are separated and prepared for the market.

Producing Saccharine Sorghum

The sorghums comprise a wide range of varieties, which may be divided into two great groups, (1) grain sorghums; and (2) saccharine sorghums, used for forage purposes as well as sirup and sugar.

Varieties of saccharine sorghums.—There are seven important saccharine sorghums: *Sumac, Amber, Orange, Planter, Gooseneck, Honey* and *Sapling.* Of these, the Sumac has proved the best for southern regions, and the Amber for northern regions.

The Sumac is the sweetest, has the largest supply of leaves and yields best of the saccharine varieties. It requires from one hundred and eight to one hundred and fourteen days to mature seed. The Amber is more slender of stem, has fewer leaves, and matures seed in from ninety to ninety-four days.

Climate and soil.—Sorghum will grow in any climate and soil that will successfully produce corn. It roots more deeply than corn, and often does well for one or two crops on soil too much exhausted for a good yield of corn. Sorghum is, however, hard on the soil, since it produces so large an amount of forage and grain. Sorghum resists drought better than corn. It has proved successful in southwestern regions too dry for good corn production. The methods of fertilizing and cultivating suitable for dent corn are equally practical for production of the sorghum plant.

Harvesting and manufacturing.—Sweet sorghum used as forage may be cut green from the time it is two or three feet high until it is ripe, and fed at once or cured for hay. If the sorghum is to be used for sirup or sugar, it should be cut from the time the seeds are well on in the milk stage until they are hard. The crop should be harvested before frost.

The stalks are cut about six inches above the ground. The seed tops are cut off and saved for forage. The canes are run through a roller crusher to extract the juice, which is treated much the same as the juice from sugar cane in the process of its manufacture.

Producing Maple Sugar

The United States and Canada are the only regions where maple sugar is made. The American Indians understood the art of making sugar from maple trees before the earliest explorers reached this continent.

The sugar maple region.—While all maple trees have sweet sap, only a few varieties produce sugar in paying quantities. The *sugar maple* stands first and the *black maple* second in importance. The red maple, silver maple and Oregon maple produce sugar sap, but hardly in paying quantities.

The sugar maple is spread over a wide area, but occurs in large enough quantities for commercial sugar production only in New England, New York, Pennsylvania, the states of the Ohio Valley and around the Great Lakes.

Tapping the trees.—Tapping should be done as early in the season as the run of sap begins. Not only does this insure a larger quantity of sap, but the first runs are the

Tapping maple trees in Vermont. Too many taps.

sweetest. The time of tapping varies with the season and locality, usually from late in February till the middle of April.

The hole bored in the tree should be from three-eights to one-half inch in diameter, and from one and a half to two inches deep. It should slant slightly upward into the tree so that the sap will easily drain out. As a rule only one tap to the tree should be made. Spouts, preferably of metal, are fitted into the holes, and covered buckets hung from the spouts to collect the sap.

Making the sugar.—The sap should be kept free from dirt, strained and evaporated while the sap is fresh and sweet. Old sap which has been allowed to stand for any length of time will not make a high-grade product. It is usually evaporated by boiling in kettles, tanks, or other specially adapted apparatus. When the right consistency has been reached, the sirup is poured into molds and allowed to cool. It is then ready for market. Maple sugar is considered a delicacy, and many attempts have been made to produce substitutes as acceptable as the genuine article. Some of these have been so successful that it is often difficult to tell the imitation from the real. One authority says that were all the maple trees cut down we would continue to have "maple sirup" on the market. It is hoped, however, that the pure sirups, such as are now being produced in Vermont, New Hampshire, Maine and New York, will be produced in increasing quantities and that the hillsides of much of this country will be reforested with maple trees and the maple sugar industry not only conserved but greatly encouraged and enlarged.

CHAPTER XIII

TOBACCO CULTURE

FOUR of the leading agricultural plants have been given to the world by America. They are the white potato, the sweet potato, corn and tobacco.

Tobacco belongs to the order of plants known as the nightshades, of which there are a countless number of varieties.

History of tobacco.—The Indians of North America were probably the first users of tobacco. It is certain that they cultivated the plant long before the coming of the white men. Marquette and LaSalle, the early French explorers, found it in cultivation and used by Indian tribes up and down the Mississippi and Ohio Rivers and their tributaries, as early as the last half of the seventeenth century. Other explorers found the Indian tribes at various points in what are now the states of Ohio and Kentucky raising and using the tobacco plant.

The white men soon became addicted to the use of tobacco and began its systematic cultivation, particularly in Virginia and North Carolina. When pioneers from these colonies pushed westward into Kentucky they brought the tobacco with them and began its cultivation in this new region. It was found that Kentucky and the surrounding states were particularly well adapted to the growing of tobacco and its production soon became a leading industry. So important did tobacco become as a commercial product that it became a medium of exchange and took the place of money in the payment of debts.

Although portions of the crop were from the first exported to European countries, the steadily increasing demand of the home market kept most of the crop in this country. It was not until after the Civil War that any considerable foreign market was supplied. Since that time, however, American tobacco has found its way into practically every country of the globe, and certain varieties now bring the highest price in England, France, Spain, Germany and other European nations.

The Tobacco Region

Soil and climate.—Tobacco may be successfully grown in all latitudes in the United States from Canada to the Gulf of Mexico. Yet the quality and flavor of the plants are so greatly affected by climate and soil that the crop is nearly all raised in a relatively small area. On fertile clay soil the tobacco plant grows large and heavy with leaves rich in oil or gum and cures dark red or black. In light sandy soil the same strain will produce thin leaves, fine texture, and will cure yellow or mahogany color, hence the necessity of selecting the soil carefully. Kentucky and the states bordering upon it produce more than half of our native crop.

The best tobacco soil, both for productivity and also for color and flavor, seems to be cleared timber land. Soil of this type is light, friable, reasonably clear of weeds, and possesses the fertility required for tobacco production. Where timber land is not available, brush land is often cleared and used for tobacco. In regions where neither is available, prairie land is pressed into service and is found, in many places, to yield excellent results. Tobacco growers have found that blue-grass sod land gives tobacco an excellent color and flavor. Where blue-grass is not available it is desirable to plow under clover or some other legume, to increase soil fertility and add organic matter.

The tobacco states.—The twelve leading states in tobacco production are: Kentucky, Virginia, North Carolina, Tennessee, Ohio, Pennsylvania, New York, Wisconsin, South Carolina, Connecticut, Maryland and Missouri. This territory grows more than ninety-five per cent. of the native commercial crop.

Uses and Classes of Tobacco

In accordance with the use to which it is put tobacco may roughly be divided into two great classes: (1) cigar tobaccos, and (2) tobaccos for other lines of manufacture. Each of these classes has several types or varieties.

Cigar tobaccos.—A cigar consists of three different parts, *wrapper,* or the outer layer of tobacco leaves; *binder,* or the second layer; and *filler,* or the central portion. Each of these parts requires a different type of tobacco. The tobacco in a single cigar may therefore come from three widely separated regions.

For example, the Connecticut valley and parts of Florida and Georgia are the principal wrapper-leaf sections of the United States. Wisconsin and Pennsylvania produce chiefly a binder-leaf type. Certain districts in Pennsylvania, Ohio and New York, and small areas in Florida, Georgia and Texas grow the filler-leaf types.

Three important varieties comprise most of the cigar tobaccos produced in this country. These are: (1) the *Broadleaf,* or Seedleaf, group, grown chiefly for wrapper and binder purposes; (2) the *Havana Seed* group, a wrapper and binder variety, though grown also for filler; and (3) the *Cuban* group, grown principally in southern regions for use as filler.

Manufacturing tobacco.—Kentucky and parts of adjoining states are the chief region of the United States for the production of manufacturing tobacco. Many different varieties are grown, chief among which are *White Burley, Maryland, Oronoca* and *Pryor.*

These and other similar strains are also produced in most states of the South.

Raising the Crop

Tobacco requires more careful cultivation than almost any other farm crop. This, in part, is because the plant is very sensitive to soil and climatic conditions, and in part because the flavor is affected by the soil conditions and the care given the plants.

Soil and seed bed.—Rapid and unhindered growth from time of planting to maturity is necessary to secure fine texture and good flavor. The seed bed should therefore be worked to the finest tilth

Tobacco, like cotton and corn, requires a rich soil and a careful rotation of crops. A free use of fertilizer, especially nitrogen and potash, is necessary for the best results. From ten to twenty tons of stable manure to the acre should be plowed under, preferably in the fall, and the ground well cultivated in the spring before planting. Commercial fertilizers containing nitrogen, phosphorus and potassium are often profitably used in addition to manure. Most tobacco soils also require the application of lime, not alone to improve the growth of the plant, but also to better its quality.

An eight-year rotation of crops with tobacco the predominating interest is recommended by the United States Department of Agriculture in Bul. No. 343, and is as follows:

(1) Tobacco.
(2) Tobacco.
(3) Wheat.
(4) Clover, timothy, blue-grass.
(5) Clover, timothy, blue-grass.
(6) Timothy, blue-grass.
(7) Timothy, blue-grass.
(8) Blue-grass.

It is noted that in this rotation, clover, timothy and blue-grass are used after the third year. If these three grasses are sown together, they will all appear the first and second years after their seeding. By the third year the clover has practically died out, leaving but timothy and blue-grass. By the fifth year timothy has also disappeared, and blue-grass is supreme. The sod can now be plowed under and tobacco again planted.

Two shorter rotations particularly for the Kentucky region are recommended as follows:

(1) Tobacco.	(1) Tobacco.
(2) Wheat.	(2) Wheat.
(3) Wheat.	(3) Clover.
(4) Clover.	(4) Corn.

Burning the seed bed.—Many tobacco growers find it profitable to burn the rubbish of the seed bed surface before planting the crop. This is usually done either (1) by shoveling the top two or three inches of soil into a specially constructed sheet-iron box heated by a wood fire and moved over the field; or (2) by the application of steam heat directed to the surface of the field by means of apparatus devised for the purpose. The object of this heating of the soil is to kill the weeds and other tobacco enemies and thereby give the plants a better chance for free growth.

Burning is an expensive process and it is doubted by some growers whether it pays, provided clean cultivation is used to keep the weeds down and rotation is practised to hinder the development of insect enemies. Burning has but little effect on soil fertility, possibly favoring certain elements and hindering others. Humus and other forms of organic matter so necessary to the soil are in some degree injured or destroyed by the burning process.

Seed selection.—The seed from the tobacco plant should be as carefully selected from the mother stalk as is the cotton or seed corn. Seed should be taken from the healthy plants with well-shaped leaves free from suckers.

The proper standard of a plant for quality and high production should be considered.

Planting and cultivation.—Tobacco plants are grown from seed planted in hotbeds or cold-frames. The plants

A typical Connecticut tobacco field.

are transplanted to the field in rows about three and one-half feet apart. The transplanting may be done by hand or with a horse machine. Cultivation should begin as soon as the plants have started to grow and continue as long as the size of plants will permit. The first cultivation should be deep,

New cigar leaf, Cooley hybrid plant.

and the later ones should be shallow to avoid cutting the roots and to conserve the soil moisture.

Certain types of tobacco, as for example the Burley, require topping in order to produce the best results. This process involves breaking or cutting out the top of the

Curing tobacco in barn on a large Kentucky plantation.

plant when the growth has attained from ten to fourteen inches, so that the leaves will spread and develop proper body and thickness. Topping requires certain skill and judgment on the part of the grower. Each plant must be judged and the right amount taken from the top. A slow growing plant should not be topped so high as a rapid grower. Similarly, plants produced on poor soil should not be topped so high as those grown on rich soil. If the topping is skilfully done, the plants will produce leaves of about equal body and all will ripen at approximately the same time.

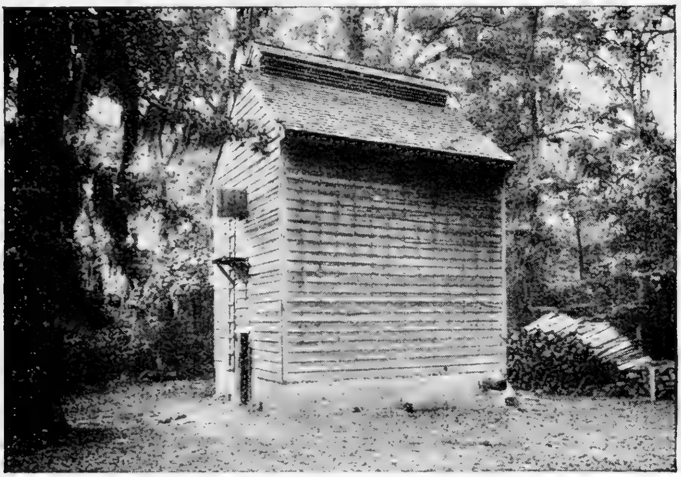
Harvesting the crop.—Tobacco is harvested by one of two different methods. Either (1) the entire plant is cut off near the ground when the middle leaves are ripe, allowed to wilt for a time, and then hung under cover to cure; or (2) several pickings of leaves are made by beginning with those nearest the ground, which ripen first, and stripping them from the central stalk. When this plan is followed the leaves are carried to the curing barn when partly wilted and hung in rows to dry. Usually five pickings are required for harvesting the entire crop.

Insect Enemies

The tobacco plant is subject to fewer enemies than most other farm crops, yet much damage at times results from the ravages of certain insects.

The tobacco flea-beetle.—The tobacco flea-beetle or "flea bug" is widely distributed and does much harm to growing tobacco. It is a small insect, oval in shape and reddish-brown in color. The beetles usually appear in July, beginning their attack on the lower leaves and gradually proceeding to the upper. The leaves upon which the beetles have fed show small dry spots which later become holes through the leaf. As the leaf is the valuable part of the plant it is evident that great damage may be done the crop by these pests.

A few simple remedies are effective in large degree in destroying the tobacco flea-beetle. *First,* since the insect thrives on several different kinds of weeds, such as the jimson and various nightshades, the margins of the field



Small farm tobacco curing barn, South Carolina.

should be kept clear of all weeds that might serve to harbor the beetles. *Second,* a few clumps of such weeds may be left at certain places about the field to attract the insects and these clumps then treated with arsenate of lead or any other of the arsenical sprays. *Third,* the tobacco plants themselves may be sprayed with similar poisons.

The hornblower.—The "hornblower" is also found in almost every part of the tobacco region, and it frequently causes great damage. The horn worm is the larva, or caterpillar, of either one of two species of sphinx moths. The worm is from two to three inches in length, green in color, with the horn, or tail, end of the body either red or black, depending on the species to which it belongs.

The row to row variety test of a tobacco experiment station, North Carolina.

Since the horn worm feeds on the leaves of the plant, it may be controlled in the same way as the flea-beetle, by the use of arsenical sprays. Some planters depend on hand picking of the worms when the number is not too great. The moths from which the caterpillars come are sometimes poisoned by placing sweetened *cobalt* in the flowers of the jimson weed from which the insects suck honey.

Tobacco bud worms.—Two different species of worms attack the buds of growing tobacco, biting holes in the young leaves. One of these, called the *true bud worm*, occurs frequently in southern tobacco regions. The moth from which the caterpillar comes is small and of a greenish color. The other species, called the *false bud worm*, is the same caterpillar that attacks cotton, corn, tomatoes and various other crops. It is familiar throughout the South as the *cotton boll worm*, and in the North as the *corn-ear worm*.

The best remedy so far devised for these pests is the arsenical sprays already recommended. Rotation of crops, clean culture and freedom from weed fringes about the fields will also tend to reduce their number.

CHAPTER XIV

FORAGE CROPS

THE forage crops in the United States rank next in value after corn and cotton. The total acreage of improved pastures and harvested forage crops is considerably greater than that of all of the grain crops put together. Besides the improved pastures and harvested crops there are millions of acres of wild land, timber land and other so-called waste places, covered with grasses capable of feeding thousands of head of live stock.

Two groups of forage plants.—In thinking of our forage plants it must not be forgotten that our great cereals, corn, wheat, oats, barley, rice, rye and so on, are members of the grass family and so belong to the forage group. Besides producing grain they yield thousands of tons of roughage, indispensable in the feeding of certain animals. The two great classes of forage plants are, (1) *grasses,* and (2) *legumes.*

Classes of Grasses

Grasses differ from legumes in that they bear their seeds either in a spike like wheat, barley or timothy, or else in a panicle, like oats, blue-grass or meadow fescue; legumes produce their seeds in pod-like structures, as in the case of beans and peas. Most of the grasses have hollow stems with nodes or joints dividing the stems into sections. The grasses have widely differing roots, but practically all are alike in the fibrous and spreading quality of their root structure. Some of the grasses are *annuals,* that is, they make their growth, flower, and produce seed and die all in one season. Such is the case with oats, corn or wheat. These and other annual grasses must be planted afresh from the seed each year. Other grasses are *perennial;* they live on from season to season without replanting, as timothy, Bermuda grass, redtop and many others. In such grasses the stems die down to the ground each season, but the roots live on, throwing up a new plant when the growing time comes again.

Timothy.—Probably one of the most important of the grasses, considering the extent of territory over which it thrives and its feeding value, is timothy. Timothy grows throughout all of the northern, central and eastern portions of the United States, being especially luxuriant throughout the great corn belt. It commands the highest price of any of the grasses, especially for the feeding of horses. Timothy does not do well in the cotton region, except in the extreme northern section and does not well withstand the drought of the semi-arid regions of the West.

Blue-grass.—Kentucky blue-grass is one of the two most important forage plants, which also grow best in northern, central and eastern regions. It makes its best growth in the fall and spring and remains green throughout the winter, thereby affording excellent picking for stock in northern regions when other grasses are dead. Redtop, or herd's-grass, while it is seldom used alone either for hay or grazing, is an important factor in both meadows and pastures. It makes its best growth on soils that are damp and too poorly drained for most other crops, thereby making productive much land that otherwise would be relatively useless. Redtop, like blue-grass, is excellent for winter grazing.

Fescue.—Meadow fescue may be made an important grass for certain regions, but has so far been raised chiefly in the eastern part of Nebraska and Kansas. It is adapted to the entire central and eastern portion of the United States and is a better resistant of drought than blue-grass. Meadow fescue is perennial, with long fibrous roots, a panicle head and a stalk that grows to the height of twenty-four inches on good soil. It will survive well in wet places, even when trampled by stock, and is therefore of value in the pasture mixture. It is palatable to all grass-eating animals and will probably be used far more extensively as its value becomes known.

Bermuda grass.—Bermuda grass is the foundation of many permanent pastures in the South and in many localities is important for its yield of hay. It endures severe drought and is an excellent grazing grass from spring until late fall. Bermuda grass is desirable for lawns and its thick tough root system makes it excellent for binding levees and ditch banks which are in danger of washing. It thrives best in rich heavy soil. Carpet grass is to the light sandy soils of the South what Bermuda grass is to the richer soils. It is found in its greatest perfection near the Gulf coast where it volunteers very quickly where the land is pastured or heavily trampled. Carpet grass, while valuable for grazing, is worth little for hay, since it does not grow to sufficient height for harvesting.

Johnson grass.—Johnson grass, also adapted to southern conditions, makes an excellent hay and gives good grazing. It is, however, so hard to eliminate when growing in fields where it is not wanted, that is comes dangerously near making a pest of itself and can as yet hardly be recommended for general use.

Soudan grass.—A new grass recently introduced into the South came from Khartoum, Soudan, in 1909, and is called *Soudan grass.* In appearance it resembles Johnson grass, but is taller, more erect, and has a broader leaf. It also lacks the underground root-stocks of the Johnson grass, and hence does not cause trouble by spreading where it is not wanted. Several cuttings a season can be made under favorable conditions, the yield varying from one to eight tons of cured hay to the acre. This new grass promises to become the great hay grass of the South as timothy is of the North. It also bids fair to find a place in irrigated regions as a forage to combine with alfalfa hay.

Millet.—Another important group of grasses are the millets, which comprise a wide range of cereal- producing grasses, whose seeds are usually small as compared with other cereals, such as wheat, oats or barley. Millets are not only important as forage plants, but in many parts of the world they constitute one of the most important parts of the human food supply. It has been estimated that they form one of the most important articles of food for about one-third of the inhabitants of the globe. India produces nearly forty million acres of millets each year, and Japan uses annually some thirty-five million bushels of millet seed for human food. Korea, China and other countries of Asia also use large quantities of the millets for food.

It is doubtful whether the millets should be made the chief crop in any section of the United States. Their place on the farm is rather a supplementary one,—a "catch crop," where corn has failed because of hail, poor seed or unfavorable weather, or as a substitute for corn in regions where that crop is not easily or profitably grown. Millet is also an excellent crop to put on foul land to get rid of weeds. It is considered in some sections a good supplement to the regular and permanent pastures and meadows where the forage supply is short from other sources. Farmers should be familiar with the value and mode of cultivation of the millets and bring them into service wherever they promise profitable results.

The Legumes

The legumes constitute as great a variety of forage plants as the grasses. While few of them will thrive equally well in all parts of the United States, there is no region where some legumes can not be grown with profit. Not only do legumes furnish as good a forage crop as the grasses, but added to this they can be made to contribute greatly to the conservation and upbuilding of the soil, both as to its fertility and physical qualities. Both grasses and legumes tend to improve the soil through their decaying roots, stems and leaves. This decaying organic matter forms, after certain chemical changes have taken place, the important part of the soil called *humus*. This vegetable matter not only enriches the soil, but makes it lighter and more porous so that air can better get to the roots of growing plants. The porosity of the soil favored by the presence of this vegetable matter also results in better drainage for wet soils.

Legumes as nitrogen gatherers.—Legumes, however, enrich the soil in a special way, and are widely cultivated for this purpose. In order to understand how legumes do their work of improving the soil, it must be known that plants demand certain foods from the soil. One of the most necessary plant foods is *nitrogen*. If this is lacking in the soil, the crop does not grow well, and the yield is reduced. For example, wheat takes much nitrogen from the soil; this is the main reason why wheat can not be grown profitably on the same land year after year. The nitrogen becomes exhausted. The soil is "worn out." It is estimated that a twenty-bushel crop of wheat removes about thirty-five pounds of nitrogen from each acre.

Nitrogen may be returned to the soil in several ways. One of the most common ways is by means of barnyard manure, which is rich in nitrogen. Another way is through commercial fertilizers, such as sodium nitrate, ammonium sulphate, or dried blood saved from slaughter-houses. But the amount of manure is limited, and the commercial fertilizers are expensive. And this is where the legumes come in to help. Legumes *are able to gather nitrogen from the air and deposit it in the soil at very little expense to the farmer.*

Nitrifying bacteria.—There are millions of pounds of nitrogen in the atmosphere resting on every acre of ground. But the plants can not make use of this nitrogen in the form in which it exists in the air. It has to be made over for them. *This is accomplished by bacteria* which have their homes in the tubercles or nodules found on the roots of leguminous plants.

In the small tubercles to be seen on the roots of clover, alfalfa, soy-beans or cow-peas are millions of bacteria, each able in the process of its own growth to take nitrogen from the air, change it into the form needed by growing plants, and leave it in the soil for the next crop. In this way the legume is able not only to secure its own growth, but to leave the soil richer through the action of these bacteria friends. The raising of legumes is, therefore, one of the best and most economical ways of enriching the soil. So important is the group of legumes that a separate chapter will be given to the most important ones.

Forage Producing Region

Measured by the acreage and also by the value, the most important forage-producing region in the United States is found in the north central states, reaching from Michigan and Ohio on the east to Kansas and Nebraska on the west, and as far south as the cotton region. It is in this territory that we find the great dairy herds and the largest number of beef cattle and of horses. Where good pasturage is available, little or no grain is fed to growing stock, and often none even to milk cows; and when grain is used to fatten stock or give strength as in the case of work horses, forage is essential to supply the volatile oils and mineral content, as well as the bulk and coarseness necessary to digestion. Forage in the form of clover and alfalfa is also coming to be recognized as one of the most profitable foods for growing pigs.

Forage crops in South and West.—Forage grasses and legumes adapted to southern and southwestern regions are now being studied and tested with great care and there is every reason to believe that these territories, as well as the great central section, will soon have available a considerable range of forage plants, enabling them to compete still more successfully with other sections and countries in economic production of live stock and in the upbuilding of their soils.

CHAPTER XV

MEADOWS AND PASTURES

ALTHOUGH meadows and pastures claim more than half of all the farm land of the United States, they receive far less attention than any other part of the farm. About one-fourth of the acreage from which hay is harvested is native wild meadow; this is chiefly located in the newer portions of the West. Pastures are often used from year to year with no care taken to improve them. Yet in many cases meadows and pastures well repay the time and expense necessary to make them more productive.

Meadows

Requirements of a meadow.—Meadows are commonly used for a double purpose—the production of hay, and providing the rotation of crops required to maintain the fertility of the soil. It is necessary therefore to select such plants for the meadow as will serve both of these ends. This is possible with our wide range of grasses and legumes from which to choose.

Meadow plants should (1) yield well; (2) be palatable; (3) tend to improve the soil; (4) grow strong and thick enough to keep down the weeds; (5) produce an even firm sod, free from high tufts or bunches.

The surface of the meadow should be smooth and free from obstructions of all kinds that will interfere with the harvesting of the hay crop.

Meadow grasses and legumes.—Most of our meadows are mixtures of grasses, or of grasses with legumes. Alfalfa seems to thrive best alone, but most meadow plants grow well in company with some other variety. Red or

Baling hay in the West directly from the meadow.

crimson clover and timothy, for example, are commonly found growing together.

Several advantages come from planting mixed meadows: the different plants draw their nourishment from various depths of the soil, thus using its full strength more completely and increasing the yield of hay; mixtures accommodate themselves to peculiarities of seasons, sometimes one grass and sometimes another thriving better; mixed forage provides variety for stock, making the feed more palatable and affording a wider range of food elements.

When hay is raised for market instead of being fed on the farm, however, it is often best to devote the meadow to one plant alone, thus producing what is called a "pure" hay. Timothy is the favorite meadow grass for pure hay, and leads the market in all the great hay-buying centers. For working horses, timothy is thought by many to be superior to clover or to mixed forage. Pure red clover or alfalfa is often desired for fattening stock.

Meadow mixtures.—The mixture to be used in seeding a meadow will depend on the climate, soil and use to which the forage is to be put. Red clover and timothy are the most common mixture found throughout the northern states, the proportion of seed used being about three-fifths timothy and two-fifths clover. For damp undrained soil, alsike clover is substituted for red clover, or mixed with it. A very common mixture for average soils is the following amounts per acre:

Timothy	15 pounds
Red clover	6 "
Alsike clover	4 "

This combination will produce about a half-and-half mixture of hay the first year, with timothy predominating the second year, and pure timothy thereafter. On very wet soils, redtop may be substituted for the red clover. If the soil is also strong in acid, it is best to omit both clovers, and use the redtop with the timothy.

Management of meadows.—Under our system of rotation of crops meadows are usually not left down more than from two to four years, with sometimes a year or two of pasturing before the sod is broken up for other crops. Most of our meadows are therefore new and, like a strawberry bed, must be constantly remade.

One of the chief enemies of the meadow are weeds. They not only hinder the newly seeded meadow from getting a good start, but injure the value of hay, reducing the market price. If allowed to grow in the meadow from year to year, the weeds will also leave the soil foul for the crops that follow when the meadow is again tilled.

Spring seeded meadows should not be pastured the following fall even if the plants look thriving. This is sure to reduce the yield of hay the following season, and may cause the plants to winter kill by exposing the roots. The *aftermath,* or second growth, on older meadows may be pastured, though it does not pay to feed them close. Especially should new meadows not be trampled by stock while wet.

Permanent meadows.—Many meadows are located on wet ground, or on soil that for some reason is not cropped. In other cases there is neglect to rotate the meadow land with the remainder of the fields in the crop series. It is often found that meadows that are thus left for a number of years have a tendency to "run out."

The yield of hay on almost any meadow left without attention for several years *decreases from one-third to one-half.* Weeds begin to appear, and patches here and there become thin or die out. The less desirable grasses crowd out the better ones. Such a meadow is highly unprofitable. If tillable, it should be plowed up and put into other crops.

If not tillable, it should be improved and its quality kept up.

It is not hard to keep permanent meadows in a state of high production, but it requires some labor and expense. The following treatment will do much to keep permanent meadows in good condition: (1) No weeds are to be allowed to go to seed; (2) if the soil is run down, the field should be manured or other fertilizer used on it; (3) the soil should be loosened and the sod-bound condition relieved by disking; (4) fresh pure grass seed should be scattered, especially over thin or weedy places.

Pastures

More improved farm land is devoted to pastures than to any cultivated crop. Pasturage supplies the greater proportion of the feed for the production of milk, butter, beef, mutton and wool and is an important factor in the production of poultry and pork. The annual value of our pasturage is more than that of any other crop raised.

Requirements of a pasture.—Pastures should possess in general the same qualities as meadows. They should (1) yield well; (2) have such grasses as will start early and continue to grow late; (3) be palatable and nutritious to stock; (4) form a firm tough sod that will stand trampling; (5) have fine rather than coarse grasses; and (6) be free from weeds.

Pasture grasses and legumes.—The best meadow grasses are not always the best pasture grasses. For example, *timothy,* the queen of hay grasses, is too coarse when used alone for the best pasture grass, and does not stand trampling so well as some others.

Pastures should usually be made of a mixture of plants. This will provide some varieties that start earlier than others, root at different depths, adjust themselves to various kinds of seasons, supply variety for stock, and endure longer without running out. Pasture mixtures should contain a much greater variety than meadow mixtures.

Hay loader at work. Second-year timothy.

Pasture mixtures.—Over the greater portion of the United States north of the cotton belt and the region west of the Missouri River, Kentucky blue-grass and white clover are the most common and valuable pasture grasses. No matter what mixture is sown, one or both of these grasses is sure to make its appearance, and gradually force most other grasses out. When blue-grass and white clover have taken possession of a pasture they grow reasonably well together, though in some seasons one of them will predominate, and again the other.

Throughout the South, Bermuda grass is the chief pasture plant, though it is commonly mixed with Rhodes grass for dry soils and with orchard grass for wet regions. Redtop is successful on wet heavy soil. Bermuda is a perennial plant spreading rapidly by root stocks, and may become a troublesome weed where it is not wanted. It is an excellent grass for hay and makes a good foundation for southern lawns.

For starting a pasture on good land in northern regions, a mixture may be made of something like the following proportions:

Timothy	10	pounds
Red clover	3	"
Alsike clover	2	"
White clover	2	"
Kentucky blue-grass	3	"
Brome-grass	2	"
Meadow fescue	2	"
Orchard grass	2	"

This will make sufficient seed for one acre. If the pasture is on very wet undrained land, the red clover may be omitted and redtop substituted in its stead. Even though timothy will soon be driven out by blue-grass and white clover, it should head the mixture as it roots more quickly than the others, and acts as a cover crop while the slower grasses are getting started.

Care of pastures.—If permanent pastures are to be kept up to a high state of efficiency they demand even more care than meadows.

On fairly good soils, pastures do not usually require manuring, though a light coat of manure will increase the yield of any pasture. Nearly every pasture needs the assistance of a mower to keep down the weeds. This is because stock do not find most weeds palatable, and so eat the grass, leaving the weeds to flourish. Many pastures are thickly sprinkled with weeds which not only rob the soil but prevent cattle from eating the grass growing

Stacking by means of modern machinery saves much labor.

close to their roots, thus adding to the waste. Weeds should be cut from the pasture each year before they bear seed.

Grazing stock not only reject the weeds for the more palatable grass, but also have their preference among grasses. All have noted that the uplands in a pasture are grazed close, while low wet areas are hardly touched. In many cases the low parts of a pasture are almost wasted, because the redtop and other wet-soil grasses are less palatable than the blue-grass and clovers which thrive only on well-drained soil. Such marshy places should be drained; the better pasture grasses will then soon take possession.

Pastures, like meadows, may become sod-bound. Almost every pasture can be improved by disking or cultivating with a knife-toothed harrow. When this is done, fresh grass seed should be scattered on thin places, or a desirable new variety added to the plants already established.

After being grazed, pastures grow better if they have a rest from trampling and cropping during the wet season. It is therefore best to have two pastures, using them alternately, instead of feeding the one continuously throughout the season. Such an arrangement usually requires only the expense of a partition fence, which the increased yield and comfort to animals from the pasture will well repay.

CHAPTER XVI

THE CLOVERS

CLOVERS are the most widely grown family of legumes among the farm crops. There are many different types of clover, such as red clover, white clover, alsike clover and crimson clover. The most important of these is the red clover, especially throughout the central and northeastern quarters of the United States. The great red-clover section reaches from Maine to Virginia, and as far west as the Missouri River. Either alone, or mixed with grasses for hay and pasture, red clover claims from one-eighth to one-third of all the cultivated land throughout the northeastern and north central states. It is now also being successfully grown in Montana, Washington, Oregon and in the far Southwest.

Red clover is so common a plant that every one is familiar with it wherever it grows. It has a larger and more deeply penetrating root system than timothy and its rootlets, particularly during the early part of the growing season, bear many tubercles inhabited by the nitrifying bacteria.

Value of Red Clover on the Farm

Red clover as forage for stock.—Red clover makes an ideal forage crop for all classes of farm stock. Besides being highly palatable, it contains a large proportion of *protein,* one of the most necessary elements of food for animals. So essential is protein for the growth of animals and the production of milk and butter, that bran, oil meal, and cottonseed-meal are commonly fed to supply this element. Where red clover can be successfully raised it largely takes the place of the more costly foods, and at the same time supplies the roughage needed by all animals. When grain is fed, as to chickens, hogs or cattle, red clover, either green or cured, forms a most valuable item of food.

The worth of clover as an animal food has not been fully understood. It has been computed by experts that a ton of red-clover hay has almost two-thirds as much feeding value for farm stock as a ton of wheat bran, and more than two-thirds the feeding value of a ton of shelled corn.

Red clover as a soil renewer.—As a soil stimulant and fertilizer red clover is almost without a peer except alfalfa. By its use in the rotation of crops, it is possible to keep the supply of nitrogen and humus nearly undiminished in the soil, throughout years of cropping. The bacteria living in the root tubercles transform atmospheric nitrogen into soil nitrogen and leave it for other crops. The roots and stems, decaying, add to the humus.

At the average price for commercial fertilizers often used to enrich land, a ton of clover is worth nearly ten dollars to plow under as a fertilizer. Fields which have been in red clover frequently produce ten bushels more of grain to the acre than before the clover was grown.

In the use of clover as a fertilizer it must be remembered, however, that clover adds to the soil chiefly nitrogen and humus; and that if the crop is all removed each year, *none being plowed under and no manure returned,* the amounts of nitrogen and humus in the soil are increased but very little. Potash and phosphorus, two other plant foods often failing in worn soils, must be supplied either by the use of commercial fertilizers or barnyard manure.

The Raising of Red Clover

Red clover will grow successfully on any soil that will raise corn. Soil that is wet and heavy or lacking in humus will not produce a satisfactory stand of clover. Red clover has a remarkable root system, sending its main roots down as deep as six or eight feet in light friable soil. This enables plants which have received a good start to withstand considerable drought.

The seed bed.—The seed bed for clover should be finely pulverized, but well packed. If sown on freshly plowed land, it is necessary to harrow until the ground becomes firm, otherwise a poor stand is sure to follow. The ground should be clean, as clover is not a good fighter of weeds.

Red clover may be sown in the early spring on fields of winter wheat. In this case no preparation of the seed bed is required. The covering of the seed may be accomplished by weathering. A more certain way is to harrow the wheat after the clover has been sown, or even both before and after the seeding of the clover. If properly done this

A young red-clover plant, showing the characteristic nodules on the roots.

does not injure the wheat. Red clover is also often sown in the spring with oats as a nurse crop.

Another common method of seeding red clover is in a field of standing corn just following the last cultivation. This plan has worked successfully, especially in some of the eastern and southern states. If the crop of corn is heavy enough to shade the ground, or if the fall happens to be dry, a successful stand is uncertain.

Time of sowing.—In the larger part of the red-clover region, it does not seem to matter greatly whether the clover is sown in the spring or the fall. Which time is better depends on the season. Young clover plants do not easily withstand drought. If a dry season follows the seeding, the stand will not succeed no matter when the planting is done.

In spring seeding with a nurse crop of winter wheat, the clover should be sown at the earliest possible moment. If the ground is not to be harrowed to cover the seed, it may be sown on a late fall of snow. This gives the clover plants the advantage of a start before the moisture is out of the soil, and also before the nurse crop gets large enough to shade the young plants.

If the seeding is done in the fall, the crop should be sown early enough so that the clover plants will attain a growth of from four to six inches before the freezing weather. Otherwise they may not be able to live through the winter, especially in the northern states. Seeding after August fifteenth is unsafe in the northern states.

Clover seed.—A great deal of the trouble found in securing a good stand of red clover comes from poor seed.

Good red-clover seed should (1) be plump, and not shriveled; (2) look bright instead of dull; (3) vary in color

Seeds of red clover and many of the common impurities.

from violet to light yellow, but not be a dull brown; (4) show individual seeds medium to large size; (5) be free from all weed seed and rubbish; (6) be free from what is called "hard" seed. By hard seed is meant grains whose seed coat is such that the seed absorbs moisture but slowly, hence may not germinate for several weeks or even months. The seed of very new varieties may contain as much as fifty to sixty per cent. of hard seed.

As is the case with most other farm crops, it is safer to secure clover seed from near home than from a distance. In this way one may be sure that the variety is adapted to the season, climate and soil conditions of the vicinity, and be sure that the seed does not contain noxious weeds and other impurities.

Cleaning red-clover seed.—Ordinary red-clover seed contains many different kinds of weed seeds. Some of these look enough like clover grains that they may pass unnoticed. Sowing clover mixed with weeds not only reduces the stand of clover, but compels the clover to divide its moisture and food with its worst enemies, besides rendering the ground foul for other crops.

Screening red-clover seed through a sieve with twenty meshes to the inch will remove all the smaller weed seeds, while retaining the medium-sized and larger clover grains. Seeds of wild carrot, ragweed, thistles, buckthorn, wild chickory, and several other weeds bearing large seeds are not removed in this way. Clover seed should first of all be selected from a field that is as free as possible from weeds. Even then, screening will pay for the removal of the smaller clover and weed seeds.

Harvesting the Red-Clover Crop

Red clover should be cut for hay just as it is past full bloom. If cut much earlier than this the entire food value of the plant is not obtained; if it is allowed to stand too long the leaves begin to fall, and the stems become dry and stiff. If the second crop is to be cut for seed, it may be necessary to cut the first somewhat early.

The care of clover hay.—In stacking or mowing the hay in a barn, the important thing is to avoid exposure to the weather, or becoming dry enough so that the leaves crumble and are lost. For the leaves of red clover, while they are only about forty per cent. of the weight of the plant, contain almost two-thirds of the protein of the whole plant. Clover hay that has become too dry is also very dusty, and not so good for feed.

Red-clover hay does not shed rain so well as the grass hays, and should therefore be stored in a barn where possible. If it must be put into stacks, these should be built with the greatest care, keeping the middle of the stack full and well tramped. The top should be covered with canvas, or with a coating of grass or straw.

Care must be taken not to put red clover into the barn or stack when it is damp from dew or rain, as it has a tendency to heat. This heating not only damages the hay, but not infrequently sets fire to the stack or barn and burns it down.

Harvesting red-clover for seed.—Red-clover seed is usually secured from the second crop of the season, the first being harvested for hay. The clover is cut either with a mower or a special header, and run through a clover huller. By special adjustment an ordinary thrashing machine may be used for hulling the seed. Clover straw still possesses good feeding value after the seed is removed.

Second crop of red clover nearly ready to cut for seed. The first crop yielded two and one-half tons to the acre.

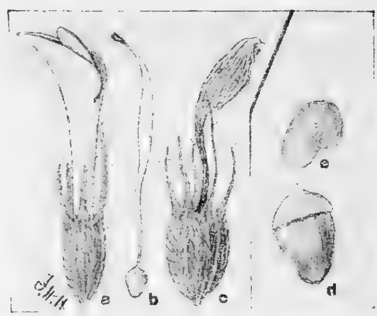
The Enemies of Red Clover

In the starting of the clover crop, the two principal enemies to be encountered are drought and hard winters. A stand not infrequently fails from one or the other of these natural causes, which can not be guarded against, except to sow the crop at proper times, and according to proper methods of seeding. Red clover is so valuable, however, that an occasional failure to secure a stand should only spur the farmer to try for better success.

Insect enemies.—Various insects seem to find red clover highly palatable, and hence feed upon it. Yet only a few of these do the crop any great damage.

One of the worst of these pests is a small species of beetle known as the *clover root-borer*. This beetle is of a brownish color, and grows about one-sixth of an inch in length. The larvæ of this insect attack the roots of the

Effect on clover seed of the chalcis fly.



Stages in development of red-clover seed: (a) flower; (b) immature seed vessel; (c) flower ripe; (d) mature seed vessel; (e) seed.

clover, usually during the second year of the crop. They have done the most damage in regions east of the Mississippi River, especially in Michigan, Indiana and Ohio. The only remedy so far found is to plow the damaged field as soon as the hay is removed. The larvæ are then without food and soon die, leaving the field free of their kind for a future crop.

The seed-bearing qualities of red clover are often seriously damaged by the *clover-seed chalcis fly*. This is an insect shaped like a wasp, and about the size of a seed of red clover. Just before the clover seed begins to harden this fly lays its eggs in the growing seed. As the larvæ develop they use the seed for food, entirely destroying it by the time they secure their growth. The chalcis fly is responsible for much of the poor yield of clover seed. It is one of the worst clover crop pests in the United States. It is thought that light pasturing in the early spring, or even mowing the clover soon after it starts will do much to reduce the danger.

Clover has at least one enemy that works after the crop is stacked or mowed; this is the *clover-hay worm*. It usually works in the bottom of the stack or mow, eating the softer portions of the plant, but also damaging the feeding qualities of the hay by its excrement and a web that it leaves. Salting the hay near the bottom of the stack or mow will do much toward stopping the work of this pest.

While the botanists tell us that red clover is a perennial, it is seldom able to maintain a stand for more than three or four years, when it must be reseeded. Red clover is usually followed by a grain crop before clover is again grown.

Other Types of Clover

White clover.—White clover is well known over most of the red-clover region. It differs in its manner of growth from red clover, being of a creeping habit, and therefore not well adapted to use as a hay crop. White clover is very hardy, and will often work its way into a pasture without seeding, the seeds being carried by winds and the birds. It makes an excellent pasture grass, and is also often used in lawn mixtures.

Alsike clover.—Alsike clover is named from a town in Sweden, where it is said to have originated. It resembles red clover but is of a finer, more delicate type, and therefore does not yield so well. While red clover will produce two crops each season, alsike clover will grow but one. This clover is especially suited to wet heavy soil which will not grow red clover, and in such regions proves a valuable crop.

Japan clover.—Japan clover, or lespedeza, comes from Asia, and was first noticed in this country in 1846. It has now spread so that it is to be found throughout the southeastern portion of the United States. Over most of this region it has been used chiefly for grazing, though in southern Missouri, Arkansas, Louisiana, Mississippi and Alabama it is cut for hay. Lespedeza will grow on almost every type of soil, including the pine barrens and gravelly wastes where other grasses fail. It has great feeding value, is highly palatable to live stock, will thrive under even most adverse conditions and will stand grazing well.

Crimson clover.—Crimson clover is to the southeastern portion of the United States what red clover is to the central regions. It has remarkable value as a soil renewer. It makes its growth during the fall and early spring and is ready for grazing long before most other grasses are available. Its feeding value is nearly equal to that of alfalfa, and it is highly palatable to farm animals.

Sweet clover on an Iowa farm.

A severe handicap in the raising of crimson clover has been the expense and difficulty of securing seed. The plant is a winter annual, and must be reseeded each year late in the fall. The seed has sold high, and from three to five million pounds have had to be imported each year to supply the demand. Various methods for collecting the seed more economically are being devised, and will in time make practicable the securing of a sufficient amount for our use.

Sweet clover.—The sweet clovers have been known for centuries, but only recently has their value been realized. The bitter taste of the foliage has kept sweet clover from being a favorite with farm animals. Yet it has been found by experiment that once animals are trained to eat it, it is as palatable as other kinds of forage and preferred before many. In feeding value it rivals alfalfa. Sweet clover is one of the best soil renewers known, and its large roots facilitate drainage and improve the tilth of the soils that lie below the reach of the plow. While sweet clover occurs as a weed along roadsides, it is not troublesome in cultivated fields except in irrigated regions of the West, where the seed is carried by the water.

CHAPTER XVII

ALFALFA

ALTHOUGH alfalfa is a relatively new crop in most parts of the United States, the plant is one of the oldest known to agriculture. Its original home seems to have been somewhere in the southwestern part of Asia, from which region it has spread to practically every part of the world where agriculture is pursued. The name, alfalfa, which comes to us from the Arabs, means "best fodder," and well describes the plant. In southern Europe the plant was called "lucerne" and this was the name first used in the eastern part of the United States. The term alfalfa, is, however, now commonly used throughout this country.

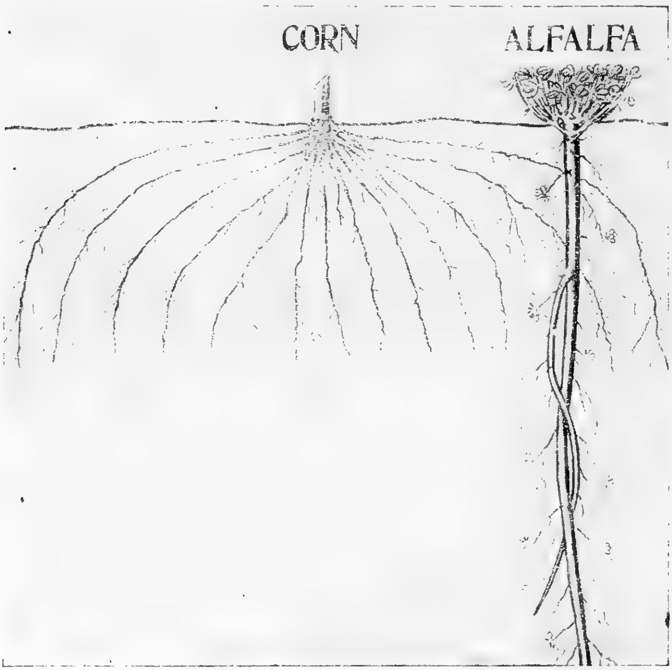
Alfalfa an old plant.—So old is alfalfa in agriculture that it was grown in Greece in the fifth century before Christ, having been carried there by the Persians. Italy grew alfalfa about the beginning of the Christian era. It was carried to Spain probably by the Moors in the eighth century. The Spaniards introduced it into Mexico and South America when they began their colonization in the New World.

Alfalfa has been grown in the eastern part of the United

States for at least two hundred and fifty years, having been brought to that region from England about 1650.

The Value of Alfalfa as a Forage Crop

Alfalfa is the queen of forage crops. It has the high-



Comparison of corn and alfalfa roots, showing why alfalfa is a drought resister.

est feeding value for practically all farm animals of any forage plant practicable to agriculture. It can be fed to all classes of farm stock, either green, as ensilage, or seasoned as hay. Like clover, alfalfa contains a high degree of that most important element in the ration of all animals, *protein*, which goes to make both bone and muscle. With such forage as timothy, corn stover, or straw fed to stock, protein must be supplied in the form of bran or some other such feed. Alfalfa serves the same purpose, and it is much cheaper to produce than are these special protein foods.

Feeding value of alfalfa.—The following table shows the feeding value of eight different kinds of feed, based on the digestible nutrient material in each: (*Farmers' Bulletin*, 339. These figures are only relative, since prices vary from year to year.)

Feed	Value per ton	Feed	Value per ton
Green alfalfa	$ 7.00	Timothy hay	$ 9.00
Green clover	5.96	Cow-pea hay	19.76
Alfalfa hay	20.16	Wheat bran	22.80
Clover hay	14.12	Shelled corn	20.16

It is seen that the feeding value of alfalfa hay is more than double that of timothy. It is almost equal to wheat bran, and just equal to shelled corn. Alfalfa has an additional value for feeding stock because it is highly palatable to almost every farm animal, even to poultry and hogs.

Bran costs an average of over twenty dollars a ton; to raise alfalfa hay costs an average of about five dollars a ton. Why not *grow* the protein needed by the farm animals instead of buying it? As farmers learn more of the value of alfalfa this is what they will do.

Digestible nutrients in 100 pounds.

Cured Hay	Pounds protein	Pounds carbohydrates	Pounds fat
Alfalfa	11.7	40.	1.0
Red clover	7.1	37.8	1.8
Alsike clover	8.4	39.7	1.1
Mixed grasses	4.2	42.0	1.3
Timothy	2.8	42.4	1.3
Orchard grass	4.9	42.4	1.4
Redtop	4.8	46.9	1.0
Kentucky blue-grass	4.4	40.2	0.7
Barley hay	5.7	43.6	1.0
Oat hay	4.7	36.7	1.7
Fodder corn	2.5	34.6	1.2
Corn stover	1.4	31.2	0.7

(Wis. Exp. Sta.)

Alfalfa and milk production.—The production of milk from dairy cows requires a high protein ration in order to get most profitable results. Tests made by the Tennessee Agricultural Experiment Station show that with alfalfa hay at ten dollars a ton and wheat bran at twenty dollars, a saving of two dollars and eighty cents for every one hundred pounds of butter, and two dollars for every thousand pounds of milk can be effected by substituting alfalfa for bran. A similar proportion of saving can be effected through using alfalfa as forage for the fattening of beef cattle. Alfalfa either green or in the form of hay has been found equally valuable as food for sheep, hogs, horses and poultry.

"There is no other combination of feeds so economical for the production of beef, pork, butter, and eggs, and for growing animals as corn and alfalfa. Neither will give the best results alone. We need alfalfa because it balances up the corn ration and saves the large waste of starch which always takes place where corn is fed alone. We need alfalfa because we can in this way grow on our own farms the protein more profitably than we can buy it as feed stuffs. We need alfalfa because it feeds the soil and enables us to grow larger crops of corn and oats. We need alfalfa because it produces on an average double the feed value per acre of clover or any other forage crop."—(Holden.)

Alfalfa As a Renewer of the Soil

Alfalfa is the best of the legumes as a renewer and conserver of the soil. The alfalfa plant has a most generous system of roots which commonly penetrate to a depth of from four or ten feet and, in the case of older plants and under favorable conditions, to a depth of twenty feet. Millions upon millions of nitrifying bacteria make their homes in the tubercles of the root system of one plant. Through the action of these bacteria, nitrogen is taken directly from the air and added to the soil in such form that it can be used by other crops. Since nitrogen is one of the soil elements first to become exhausted in most soils, it is clear that the production of alfalfa can do much to reclaim worn-out soils.

How alfalfa helps the soil.—The deep rooting system of the alfalfa plant also enables it to bring other minerals from the lower layer of the soil, and deposit them near the surface where other plants can use them. The roots upon decaying add much organic matter to the soil in the form of *humus*. The abundant roots also increase the porosity of the soil and so favor drainage and the introduction of air to the roots of growing plants.

One alfalfa enthusiast testifies as follows with reference to its value: "This wonder plant is to revolutionize agriculture, country life, the country school, the country church, and the country and village social life at a no far-distant day. It will transform the poor, hilly and clay wastes into fields rich in plant-food. It will enable the tenant to become the land-owner. It drills into the earth and reaches up into the air and sunshine for food which it transmutes into cash to enrich its fortunate owner. It toils on, day and night, winter and summer, to bring earth's hidden treasures to light and pour them into the lap of man. No other plant performs such enormous labors for the same length of time for the human race."

The Returns from Alfalfa

Under favorable conditions the return from alfalfa is probably greater than that from any other forage crop. This is from the fact that it is a perennial plant, enduring for many years without reseeding, and that it produces a high yield per acre of forage, exceedingly rich, as we have already seen, in nutritive value. One Illinois alfalfa grower testifies that his income from an acre of alfalfa is as great as from six acres of timothy and that he is obtaining three times as much profit from his acreage of alfalfa as from the same amount in corn.

Profits from alfalfa.—It has been found by the Wisconsin Agricultural Experiment Station that the weight of green forage per acre obtained for the season from alfalfa in that state is approximately double that of clover, three times the weight of timothy and five times the weight of brome grass. The proportions for hay are approximately the same as for the green forage. In another form of comparison, alfalfa yields three times as much protein per acre as clover, nine times as much protein as timothy, and twelve times as much protein as brome grass.

Alfalfa will produce from two to six or more cuttings per season, depending on the character of the soil, the climate and the amount of moisture available for the crop. The yield in dry hay per acre will run from two to nine or more tons each season. Since the feeding value of alfalfa is approximately that of wheat bran, which costs twenty dollars a ton, it is seen that the gross income per acre may run from forty to nearly two hundred dollars. The farmer who objected to alfalfa as a farm crop "because it had to be cut so often" had not figured closely on the profits to be obtained.

Where Alfalfa Can Be Grown

The adaptability of alfalfa to widely varying conditions is shown by the fact that it will thrive in almost every climate and in practically all types of soil in the United States. It is the staple leguminous forage crop throughout the western half of the country at the present time, and is being rapidly introduced in almost every part of the United

States. Alfalfa is grown several hundred feet below the sea level in the southern part of California, and at altitudes exceeding eight thousand feet in Colorado. Under irrigation it yields bounteous crops in the deserts of Arizona, which contain some of the hottest regions in the world. Hardy strains have been developed which are able to withstand the severe winters of the northern part of the United States, and some areas in Canada. It is successfully grown without irrigation in some of the semi-arid regions where the rainfall reaches not more than fourteen inches a year.

ESSENTIAL POINTS IN GROWING ALFALFA	OTHER THINGS THAT WILL HELP	ALFALFA DON'TS
WELL DRAINED SWEET SOIL	LIME	DON'T SOW ON SOUR WET GROUND
RICH FERTILE SOIL	STRONG CLEAN SEED	DON'T SOW ON WEEDY FOUL GROUND
WELL PREPARED FIRM SEED BED	HAY CAPS	DON'T SOW ON LOOSE PLOWED GROUND
CLEAN GROUND FREE FROM WEEDS	HARROWING AFTER CUTTING	DON'T EXPOSE INOCULATION TO THE SUN
INOCULATION	SEEDING BOTH WAYS	DON'T BE AFRAID TO CULTIVATE ALFALFA
CUT WHEN NEW SHOOTS START	SALTING THE HAY	DON'T WAIT TOO LONG TO CUT
	PHOSPHORUS ACID PHOSPHATE BONE MEAL	DON'T PASTURE TOO CLOSE
	LEAVE FALL GROWTH FOR WINTER PROTECTION	

It has also prospered in the Gulf states where the annual rainfall reaches from sixty to seventy inches.

Conditions favorable to alfalfa.—Experience shows that abundant sunshine, a fair amount of warmth and a deep rich soil supply the best conditions for the growth of the alfalfa crop. These conditions are easily obtainable in the West especially, and there is probably little cultivatable land in the entire western region upon which alfalfa can not profitably be grown.

We have as yet not fully appreciated the possibilities of alfalfa as a farm crop. At present barely one-tenth as many acres are devoted to alfalfa as to clover and timothy, and one-ninth as many as are put in wheat. We have twenty acres in corn to every acre of alfalfa. Yet the amount of land devoted to alfalfa is increasing with every year and it will soon become one of our principal forage crops. Its growth can be profitably extended in almost every region of the country, particularly through the great corn belt states, which are admirably adapted to its production, and in many regions of the South, where it is needed as a soil renewer and can be used in the long term of crop rotation.

Raising the Crop

Soil requirements for alfalfa.—It is especially important in raising alfalfa that soil naturally wet shall be well drained. While alfalfa requires a reasonable amount of moisture in growing, it will not stand the dampness of undrained soils. If submerged with water it will quickly die.

In heavy damp soil there is also likely to be more *acid* than is good for the alfalfa plant. Before sowing alfalfa it is, therefore, best to test the soil for acid. This can easily be done by taking a little of the soil when damp and placing it upon blue *litmus paper* (or by some of the other methods recommended by state experiment stations). If the paper turns to a pink color it indicates the presence of acid, and the soil should then have an application of *lime* to counteract the acid.

Starting alfalfa.—If proper methods are used it should be no harder to start alfalfa than clover. First of all, the seed must be most carefully selected, and should be tested before sowing. This can easily be done by means of a home-made tester, as in the case of clover.

Particularly should the seed be free from all noxious weeds or other impurities. For weeds are among the worst enemies of alfalfa. In some parts of the country the alfalfa

School children in Cook County, Illinois, studying the relation of alfalfa to corn growing. Extension Agent Farr in charge.

crop is completely killed out of certain fields in a few years by the increase of weeds.

The seed bed should be more carefully prepared than for almost any other farm crop. After plowing it must be harrowed so thoroughly as to pack it well and leave a fine mulch on top. If the seed bed can be prepared some time ahead of the sowing so as to give an opportunty for several harrowings so much the better. The seeding may be done either broadcast or with a drill. It has been found best in most parts of the country not to sow alfalfa with a nurse crop, since the nurse crop deprives the young alfalfa plants of moisture, nourishment and light. It is of great advantage to manure the field before seeding to alfalfa.

Inoculating the soil.—It is usually best to *inoculate* the soil before sowing alfalfa. This means to put into the soil some of the bacteria which inhabit the root nodules. Almost any soil suitable for alfalfa has some of these bacteria to begin with, so that alfalfa may often be started without inoculation. But where the supply of bacteria is very small, and where the soil is poor it will pay to inoculate. This may easily be accomplished by gathering the surface soil from a field on which alfalfa has been raised, and scattering it at the rate of one hundred to five hundred pounds to the acre over the field to be sown.

Similar results can be had by gathering soil in which sweet clover so commonly found along the roadsides has been growing. Care must be taken in gathering and scattering the soil not to allow it to be exposed to sunlight, as this will kill the bacteria. It is better therefore to secure the soil and spread it over the new field on cloudy days or in the late evening. The alfalfa seed should be sown immediately and harrowed in so that the bacteria may be covered, and be thus secure from the sunlight.

Time for seeding.—Late summer has been found the best time for seeding alfalfa in the East and the South, while in the West spring seeding is the rule. Spring seeding has also been found to work better in Minnesota, Wisconsin and the Dakotas. No general rule as to the time of seed-

An alfalfa plant several years old. Note the generous root system and the size of the plant.

ing can, however, be given. Much will depend on the climate, length of season and amount of rainfall or irrigation water available. The chief thing necessary is to seed as long as possible before the time of year that will be hardest on the plants. In the North this requires spring or early summer seeding in order that the plants may get sufficient growth before freezing to withstand the winter. Alfalfa plants less than six inches high do not ordinarily live well through the hard northern winters

In some regions there is trouble in getting the plants started before drought comes on to check their growth. Throughout the corn belt late summer seeding should usually be practised. Alfalfa sown during August and the first week of September will have the best chance throughout this region.

Harvesting the Crop

Time for cutting.—Alfalfa makes the best hay if cut while in early bloom. A better means of determining the time for cutting is, however, to watch the start of the new shoots from the base of the plant. These shoots make the growth for the succeeding crop. When they are from one to two inches in length is the best time to harvest. In this way the new growth goes on without interruption.

If the cutting takes place much earlier than this, there is a loss of growing time in waiting for the new shoots to develop. If, on the other hand, the cutting is delayed until these shoots are too long, the mower will clip them off and they must begin all over again, thus delaying the next crop. Usually it is possible to secure three cuttings of alfalfa in the corn region and as many as eight and even more in some of the irrigated regions of the West. It is evident that if the greatest number of cuttings is to be secured each crop must be cut as soon as it is ready in order to let the next crop get properly started.

Handling the hay.—Alfalfa, like clover, should be harvested so that the hay may reach the barn or stack with the least possible amount of handling or exposure to the weather. The alfalfa leaves contain a large proportion of

Side delivery raker in an alfalfa field, yielding two tons to the acre on second cutting.

the food value of the plant, and are easily crumbled and lost if the hay gets too dry.

Probably the best plan is to cock the hay when the stems are about half dry, stacking it when moisture no longer shows as a wisp of the plant is twisted by the fingers. In regions where frequent rains are the rule during the haying season, it pays to have haycock covers consisting of

A six-weeks-old field of alfalfa in North Dakota

Alfalfa curing under cover.

squares of muslin to the corners of which weights are attached, or pins to thrust into the hay or the ground.

Enemies of Alfalfa

Weed enemies.—Undoubtedly weeds are the worst enemies of alfalfa in most parts of the country. This is particularly true throughout the West and Southwest. Among the weed enemies are *witch-grass, crab-grass* and *dodder* in the West, *blue-grass* and *foxtail* throughout the Middle West, *crab-grass, wild clover, dandelions,* etc., in the South and East, *wild clover, crab-grass, ordinary weeds* and the *barleys* in the far West. Cultivation with the spring-tooth harrow or disk is the best means of killing most of the weeds.

An especially troublesome weed among alfalfa is *dodder.* Dodder is a plant which twines itself about the alfalfa seedlings, soon attaching its threadlike stems firmly to the alfalfa plant. The dodder stem then withers away near the ground and the dodder continues to live as a parasite on the alfalfa. It is almost impossible to exterminate dodder when it has once secured a foothold in an alfalfa field. Turning sheep into the field to graze is one remedy for this pest. Another is to cut the alfalfa very low or even remove it entirely on any spots in the field where dodder starts.

Insect enemies.—Alfalfa does not have so wide a range of insect enemies as some of the other farm plants. The alfalfa weevil and grasshoppers are probably the worst enemies of this kind, particularly in the regions of the

West. It has been found that disking an alfalfa field late in the fall in the northern states and mid-winter in east central states exposes the weevil and grasshopper young to freezing and the attacks of birds, and thus reduces their number.

CHAPTER XVIII

OTHER LEGUMES

WHILE the clovers and alfalfa are the most important leguminous plants for large portions of the United States, there are several other legumes that deserve attention. Chief among these are the *cow-pea,* grown chiefly in the South; the *vetches,* the *soy-bean,* the *peanut, field beans* and *peas,* and several others of lesser importance. These are produced (1) for forage, (2) for soil renovation, and (3) for their seeds.

The Cow-pea

The cow-pea is to the South what red clover and alfalfa are to the West and North. It grows successfully on almost any kind of soil found in the cotton belt, and its cultivation is being rapidly extended throughout this region.

The plant.—The cow-pea was but recently introduced into this country, coming from China. The plant resembles the ordinary garden bean in appearance and manner of growth. It reaches a height of from one to nearly five feet. The smaller varieties stand nearly erect, the taller varieties spreading out vine-like on the ground.

The leaves are broad, and grow in clusters of three. The flowers resemble those of the garden pea, and are

The cow-pea.

greenish-yellow in color. The pods, which are cylindrical in shape, grow from two to some seven inches in length. The roots, which penetrate deeply into the soil, bear tubercles, which are the home of nitrogen-gathering bacteria.

Cow-peas as forage.—Cow-peas, when harvested for hay, yield from two to three tons to the acre. The feeding value of cow-pea hay is fully equal to that of red clover, and nearly equal to alfalfa or wheat bran. It has been found a better forage feed for working animals in the South than grass hay. It is rich in protein, and therefore an acceptable substitute for corn or cottonseed-meal in the fattening of stock.

Since the cow-pea is an annual, it does not lend itself to the making of permanent meadows or pastures as does alfalfa. Cow-peas sowed in corn are profitably used as pasturage for hogs, the gain in weight being in some cases more than twice as fast with a mixed feed of cow-peas and corn as when corn alone is fed. Cattle also do well on a pasturage of cow-peas. Bloating is likely to occur, however, if grazing is allowed when the cow-peas are wet.

The cow-pea as a soil renovator.—The cow-pea improves the soil in two ways: (1) like other legumes, it is able through its root bacteria to gather nitrogen from the air and transfer it to the soil; and (2) its many roots, coarse stubble and stems, especially when the latter are plowed under as green manure, add much humus to the soil, making it more porous.

In many parts of the South cow-peas are coming to be largely used in crop rotation, with cotton the principal crop.

The field is planted with cotton either two or three years in succession, then a crop of corn and cow-peas grown, and then a return to cotton. In Missouri, Arkansas, Tennessee, Alabama and other states of this region, cow-peas are being successfully used in rotation with wheat and oats. An increase of from fifty to more than one hundred per cent. in other crops following cow-peas is not uncommon.

The Vetches

The vetches are another group of legumes, grown most extensively on the Pacific Coast, less commonly in the South, where their culture is rapidly increasing, and hardly at all in the North. Michigan, however, has made some excellent *hairy* vetch crop records. Although more than one hundred different varieties of vetch are known, but two are commonly grown in the United States, *common* vetch and *hairy* vetch.

Common vetch.—Common vetch is an annual, closely resembling the garden pea. Its stems are very slender, and grow from three to five feet or more in length. There are many different varieties of common vetch, of which the gray-seeded is most commonly grown in this country.

Low temperatures are fatal to common vetch; it can not be successfully raised in regions where the thermometer goes lower than about fifteen degrees Fahrenheit.

Hairy Vetch.—Hairy vetch is much more hardy than common vetch, and may be raised in almost any portion of the United States. It finds its greatest use in supplying a legume for forage and improving the soil where red clover

Hairy vetch.

or alfalfa does not succeed, or where a short rotation crop is desired.

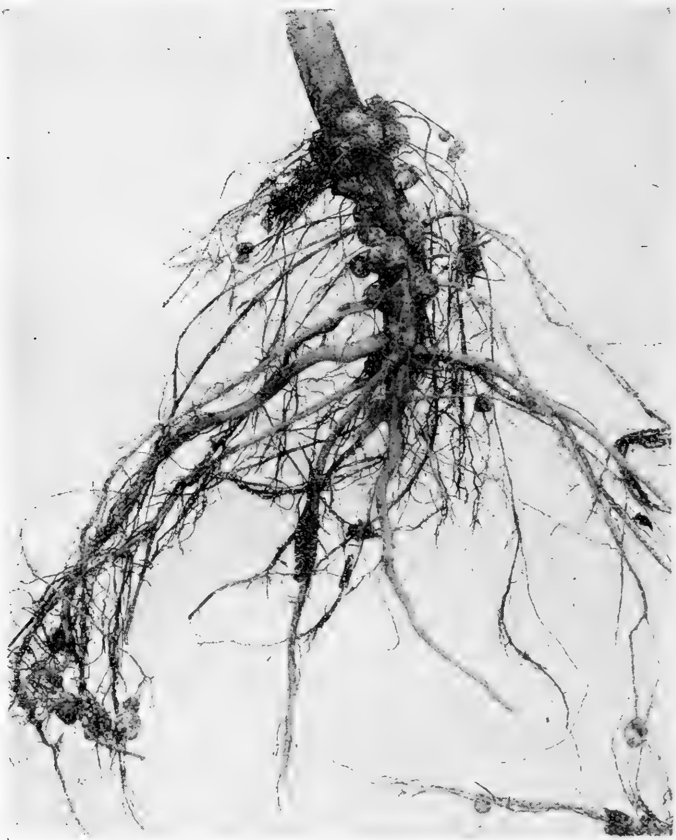
Hairy vetch has great power to resist drought, and does well on a sandy soil. It will also thrive on a soil so alkaline that most legumes refuse to grow on it.

Vetches are weak of stem and are usually planted with enough small grain to make about half a stand. This gives them the support they demand. Sixty pounds of common vetch seed are required per acre, and forty pounds of hairy vetch. In most regions it is necessary to inoculate the soil where vetch is being planted for the first time. It is best to inoculate from fields where vetch has been growing, rather then from a field that has produced other legumes.

Soy-Beans

Soy-beans are native to Asia, where they have been grown from time immemorial. In China, India and Japan, some two hundred varieties are cultivated for human food, furnishing a staple article of diet in many regions. They have not proved palatable to Americans, however, and are raised in this country chiefly as one of our forage crops.

Where red clover or alfalfa can be successfully grown, soy-beans will have little place, since they are less profitable. They are especially adapted to the cotton belt, however, and to the southern portion of the corn belt. Since soy-beans are drought resistant, they also grow well in the semi-arid regions of the West. They have as yet made little headway as a crop in this region because of the ravages of the rabbits, which find their foliage a savory delicacy.



Root of a soy-bean, showing bacteria-inhabited tubercles.

Feeding value.—The soy-bean has as great feeding value for stock as alfalfa, and is worth more than cotton-seed-meal as a food for hogs, sheep and cattle. The straw, after all the grain has been removed, is as valuable as timothy hay, and even more palatable to most farm animals.

The Peanut

It is not definitely known when and where the peanut originated but probably in the tropics of South America. The first peanuts were grown in the United States during colonial times, but the crop was of no commercial importance until about 1870. The use of peanuts has steadily increased, and the value of the crop is now in the neighborhood of fifteen million dollars annually. Peanuts will grow successfully throughout the southern half of the United States and in some of our island possessions.

The plant.—The peanut plant produces vines from one to two and one-half feet in length. It has rather small leaves growing three in a cluster. After flowering, the stem penetrates into the soil. The pods and nuts are produced beneath the surface. Like other legumes, the plant is a good nitrogen gatherer, and hence helps in soil renovation. Peanut hay is valuable for roughage and relished by most farm animals.

When the crop is ripe the roots are cut off under the ground by a plow, potato digger or some specially constructed device. The vines are then gathered, with the nuts clinging to them, dried and the nuts picked off. The nuts intended for roasting and selling in the shell by vending must go through a special cleaning process.

Uses of the peanut.—The uses to which the peanut is put are constantly increasing. It is eaten from the shell; it is shelled, salted and sold by the pound; it is used in making various kinds of candies and brittle; it is ground up into peanut butter; it forms one of the ingredients of

Intercroping velvet bean with corn.

"vegetable meats"; it is used in salad oils, and in various other ways. The cleanings and inferior stock are valuable as food for live stock. Some of the famous smoked hams and bacon come from hogs that are fed partly on peanuts.

The peanut is increasing in importance as a farm crop in the South. In many sections where clover or other legumes do not well withstand the heat and drought of the summer months, the peanut will thrive admirably. A crop of peanuts can be grown following oats or other spring crop, the tops used for hay and the hogs then turned in to root out the nuts. In several of the Gulf states the peanut is commonly planted between the corn rows when the corn is cultivated for the last time. After the corn crop is gathered, cattle are turned in to feed on the vines, and after them hogs to gather the nuts. In this way the full value of the crop as forage is secured, and most of the nitrogen gathered by the roots is stored in the soil.

CHAPTER XIX

THE VEGETABLE GARDEN

THE plan of every farm, village or suburban home should include a good vegetable garden to supply the table. Not only are vegetables a highly necessary food, but they are much more palatable when taken from the

A city boy in his garden, gathering and preparing vegetables for the table and market.

garden fresh as needed instead of bought in a market. Nor is a well stocked market easily available to most of our homes. Hence, unless the home raises its own supply of vegetables, those who surround the table are likely to suffer from lack of variety and the absence of certain food qualities required for health. Without vegetables the table is also more expensive because of requiring more of the high priced foods such as meats and bread.

The vegetable garden can be made the most profitable part of a farm. Half an acre of ground planted to a suitable variety of garden crop will, if properly cared for, yield over one hundred dollars' worth of vegetables each season for the family table. This is from ten to twenty times what the same amount of ground in farm crops will produce. Although the garden requires considerable attention, the labor demanded is not great compared with the returns in profits, good health and human efficiency.

Location and Soil

The location.—There is a double advantage in having the vegetable garden near the house: the vegetables can then be taken from the soil as needed, without loss of time; and spare moments free from other work or chores can be given to the care of the garden. Where the soil is suitable it is best to have the garden only a few rods from the kitchen door.

The soil.—Most vegetables require a well drained soil. Ground on which the water stands after a rain is not adapted to garden use. A slight slope to the south and east will favor the early maturing of the crops.

Plan of the Vegetable Garden

The vegetable garden should be carefully planned before time to begin planting, and a diagram made allotting to each crop its location and proper amount of space. This will save time in putting in the crop and insure a better arrangement.

The plan.—A well-planned garden provides (1) for a succession of crops supplying the table with fresh vegetables practically all the year, and by means of cold storage and home canning, fresh vegetables may be available *through-*

Marketing his crops.

out the winter, as well as during the spring and summer. This can be accomplished by selecting a reasonably wide range of crops and by successive plantings of certain kinds.

(2) The right proportion of space should be allowed for each vegetable, depending on the tastes of the family and allowing for the canning of a supply for home use. As a result of careless planning an over-supply of one vegetable often results in loss and waste.

(3) The crops should be arranged in the order of their

time of planting, so that the planting can begin at one side of the garden in the early spring, and proceed across until all are in. This arrangement saves much labor in cultivation without interfering with crops already planted.

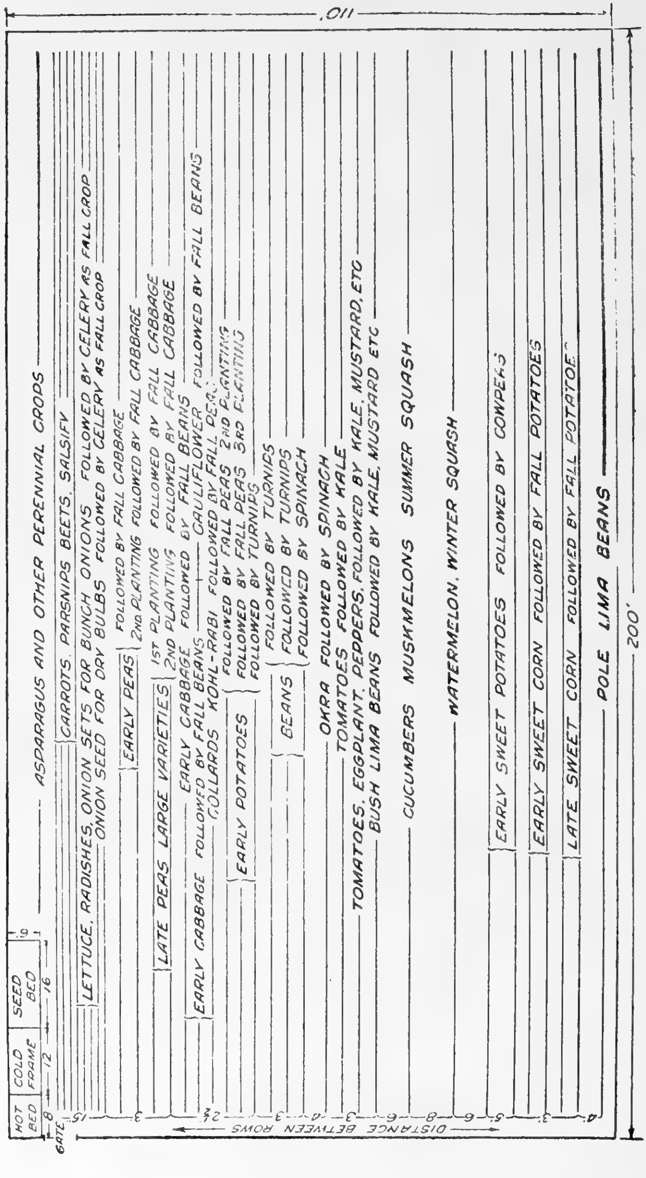
(4) If the cultivation is to be done with horse implements, as it should be in all larger gardens, the rows should run the long way, and a turf turning ground be left at each end. It also pays to place in each row plants that require the same kind of cultivation and that mature in about the same time so that together they will get out of the way of later plantings. Spade or plow and refertilize and plant all vacant space. Allow no idle land even to the extent of a square foot.

The plan on the following page (see *Farmers' Bulletin* 647) suggests how to carry on the principles stated in the text. These varieties will, of course, need to be modified to adapt them to the preferences of the family and to the soil and climate.

Planting time and maturity.—The time required for growth and the date of planting the common garden vegetables recommended by the United States Department of Agriculture are shown on page three hundred and nine.

Culture of the Garden Crops

Most of the vegetables named can be raised without technical training. A few, however, must have special treatment if they are to succeed, and if there is not sufficient time to give them extra attention they might better be left out of the garden plan.


110'
200'
HOT BED
COLD FRAME
SEED BED
GATE
ASPARAGUS AND OTHER PERENNIAL CROPS
CARROTS, PARSNIPS BEETS, SALSIFY
LETTUCE, RADISHES, ONION SETS FOR BUNCH ONIONS FOLLOWED BY CELERY AS FALL CROP
ONION SEED FOR DRY BULBS FOLLOWED BY CELERY AS FALL CROP
EARLY PEAS
FOLLOWED BY FALL CABBAGE
2ND PLANTING FOLLOWED BY FALL CABBAGE
LATE PEAS LARGE VARIETIES
1ST PLANTING FOLLOWED BY FALL CABBAGE
2ND PLANTING FOLLOWED BY FALL CABBAGE
EARLY CABBAGE FOLLOWED BY FALL BEANS
EARLY CABBAGE FOLLOWED BY FALL BEANS
CAULIFLOWER FOLLOWED BY FALL BEANS
EARLY CABBAGE FOLLOWED BY FALL BEANS
COLLARDS KOHL-RABI FOLLOWED BY FALL PEAS
EARLY POTATOES
FOLLOWED BY FALL PEAS 2ND PLANTING
FOLLOWED BY FALL PEAS 3RD PLANTING
FOLLOWED BY TURNIPS
BEANS
FOLLOWED BY TURNIPS
FOLLOWED BY SPINACH
OKRA FOLLOWED BY SPINACH
TOMATOES FOLLOWED BY KALE
TOMATOES, EGGPLANT, PEPPERS, FOLLOWED BY KALE, MUSTARD, ETC
BUSH LIMA BEANS FOLLOWED BY KALE, MUSTARD ETC
CUCUMBERS MUSKMELONS SUMMER SQUASH
WATERMELON, WINTER SQUASH
EARLY SWEET POTATOES FOLLOWED BY COWPEAS
EARLY SWEET CORN FOLLOWED BY FALL POTATOES
LATE SWEET CORN FOLLOWED BY FALL POTATOES
POLE LIMA BEANS
DISTANCE BETWEEN ROWS

Kind of Vegetable	Time of planting South	Time of planting North	Ready for use after planting
Asparagus	Fall or early spring	Early spring	1 to 3 years
Beans, bush	Feb. to Apr. (Aug. to Sept.)	Apr. to July	40 to 65 days
Beans, pole	Late spring	May and June	50 to 80 days
Beets	Feb. to Apr. (Aug. to Sept.)	Apr. to Aug.	60 to 80 days
Brussels sprouts	Jan. to July	May and June	90 to 120 days
Cabbage, early	Oct. to Dec.	Mar. and Apr.	90 to 130 days
Cabbage, late	June and July	May and June	90 to 130 days
Carrots	Mar. Apr. Sept.	Apr. to June	75 to 110 days
Cauliflower	Jan. Feb. June	Apr. to June	100 to 130 days
Celery	Aug. to Oct.	May and June	120 to 150 days
Corn, sweet	Feb. to Apr.	May to July	60 to 100 days
Cucumbers	Feb. Mch. Sept.	Apr. to July	60 to 80 days
Dasheen	Mar. to Apr.		140 to 180 days
Eggplant	Feb. to Apr.	Apr. and May	100 to 140 days
French endive	May to Oct.	May to June	100 to 130 days
Horseradish	Early spring	Early spring	1 to 2 years
Lettuce	Sept. to Mar.	March to Sept.	60 to 90 days
Melon, muskmelon	Feb. to Apr.	Apr. to June	120 to 150 days
Melon, watermelon	Mar. to May	May and June	100 to 120 days
Onions, seed	Oct. to Mar.	Apr. and May	130 to 150 days
Onion,sets	Early spring	Fall, Feb. to May	90 to 120 days
Peas	Sept. to Apr.	March to June	40 to 80 days
Peppers (all)	Early spring	May and June	100 to 140 days
Potatoes, Irish	Jan. to Apr.	March to June	80 to 140 days
Pumpkins	April and May	May to July	100 to 140 days
Radishes	Sept. to Apr.	March to Sept.	20 to 40 days
Rhubarb, plants	Sept. to Apr.	Fall or spring	1 to 3 years
Salsify	Sept. to Apr.	Early spring	120 to 180 days
Squash, bush	Spring	April to June	60 to 80 days
Squash, late	Spring	April to June	120 to 160 days
Swiss chard	Feb. to Apr.	Apr. to Aug.	60 to 80 days
Tomatoes	Dec. to Mar.	May and June	60 to 80 days
Turnips	Aug. to Oct.	April (July)	100 to 140 day
Chinese cabbage	May to July	March to Aug.	60 to 100 days
Fennel	May to July	March to Aug.	60 to 100 days

Garden crops requiring rich soil and much tillage.—Although the whole garden should be much richer than for the field crops, the following vegetables require an especially rich sandy loam soil: cabbage, cauliflower, Brussels sprouts, eggplant, celery, onions, dasheen, French endive, Swiss chard and melons. Melons may have the hills well manured and the remainder of the area no richer than the rest of the garden.

In general it may be said that the plants which demand a very rich soil also need a greater amount of tillage than the remainder of the garden.

Vegetables that require transplanting.—The season required for certain vegetables to mature for the table is so long that in the North and Northwest they must be started in hotbeds in the latter part of the winter and transplanted when the weather is warm enough. The common plants belonging to this group are cabbage, celery, cauliflower, Brussels sprouts, tomatoes, eggplant, pepper, sweet potato. Lettuce and muskmelons may also be transplanted to good advantage. Many of these may also be transplanted to advantage in the South.

The hotbed.—For small gardens the plants that are to be transplanted are often started in shallow boxes, egg shells, paper cups, or berry boxes. The more common method is, however, to use a hotbed.

A hotbed is made as follows: Select a sunny place sheltered by a building or fence from the north winds, and make a bed of coarse manure from the horse stalls eighteen inches deep, eight feet wide, and any multiple of three feet

Typical dasheen hill, a new vegetable substitute for the potato for the South and Southwest.

Hill of dasheen, showing reproduction of one corm in a season.

long. The manure must be fresh and contain a good amount of straw. Pack the bed well by thoroughly tramping.

Place on top of the bed a board frame six feet wide, twelve inches high at the north edge and six inches at the south. The frame may be as long as required. After placing the frame in position, put in it a rich garden loam to the depth of three to six inches, packing and smoothing it well. Cover the frame with thirty-six-inch glazed sash.

If the manure is in good condition it will begin heating almost at once, and will soon raise the temperature of the soil. Do not plant the seeds until the heating has been well tested and the temperature has begun to go down. This will be in about three days. The hotbed is now ready to receive the seed.

In raising the hotbed crop care must be taken to lift the sash during the warm part of bright days, and also to water sufficiently. Watering should be done in the morning on sunny days, otherwise the cooling may chill the plants. If the temperature grows too high the sash must be lifted, or the plants will be destroyed.

Transplanting.—When the time comes for transplanting to the open soil care must be used or the change may kill the tender plants or greatly check their growth. To avoid this, hotbed plants are often transplanted to another bed, called a cold-frame, covered with glass but not heated. This is known as the "hardening off" process. Transplanting almost any plant is of great advantage since it causes the multiplication of many small roots which add to its growth.

Vegetables that require special treatment.—The larger and later varieties of peas grow so high that they require support, so they will not spread out on the ground and the pods rot. Where an abundance of brush is available, rods may be stuck in the ground for them to run on. Woven chicken wire is an excellent substitute and takes much less time. Lima beans also need poles. Because of this, bush varieties are sometimes grown in their stead.

Celery and French endive, as well as most head lettuce varieties require bleaching to produce the best results. To accomplish this, the plants are usually set at the bottom of a trench which is gradually filled in as the plants grow; or the outer leaves may be folded up and tied around the heart of the plant to shade it from the sun. At the end of the season the rows may be hilled up so that the plants are covered to the top.

Insect Enemies of the Vegetable Garden

Fortunately, most of the garden vegetables are not subject to great injury from insects. Certain plants are, however, special targets for these pests, and must be protected or they will almost certainly be destroyed.

The most common enemy of cabbage and cauliflower is the cabbage-worm, which is the larvæ of the common white butterfly seen about the cabbage patches. The most effective remedy is spraying with the *arsenate of lead* preparation, made by mixing three pounds of the paste with fifty gallons of water. To this should be added a mixture of resin and lime, or soap, to cause the insecticide to stick to the leaves.

The white grub: (A) pupa; (B) beetle; (C) larva.

The cucumber beetle.—The worst enemy of cucumbers is a small striped beetle which eats the leaves of the young plants. When only a few hills are raised they may be kept off the plants by making a small wooden frame over which is stretched wire mosquito netting, and placing these boxes over the hills. These pests can also be controlled by spraying with the arsenate of lead compound. The roots of the plants are sometimes attacked by the larvæ of the beetle. Tobacco dust sprinkled on the roots is an effective remedy.

The cucumber beetle is also the most troublesome enemy of squash, muskmelons and watermelons. These plants may be protected in the same way as the cucumber.

The aphis.—The aphis, a small green fly, is a sucking insect that attacks lettuce, peas and other green leaf crops. It is also frequently found on flowering shrubs. It may be controlled by spraying with a mixture of soap and water, or with a nicofume preparation mixed according to directions on the package.

The cutworm.—The cutworm attacks a number of different vegetables, cutting them off just at or near the surface of the ground. The remedy is fall plowing, and poisoning. An effective method of attracting to the poison is to dip clover blossoms in Paris green, or add Paris green to a mixture of bran and molasses, and strew around the roots of the plants.

PLAN FOR SMALL HOME GARDEN

This garden plan is based upon very intensive cultivation, very fertile soil, and plenty of moisture throughout the entire growing season. In order to mature the beans, carrots, and tomatoes in mid-summer it will probably be necessary to irrigate when the rainfall is not sufficient for the garden. It will be noted that the plan calls for a second and third planting in the case of a number of vegetable. These should be planted in the same rows after maturity of the previous crop.

Nasturtiums or Astors for Border on One Side

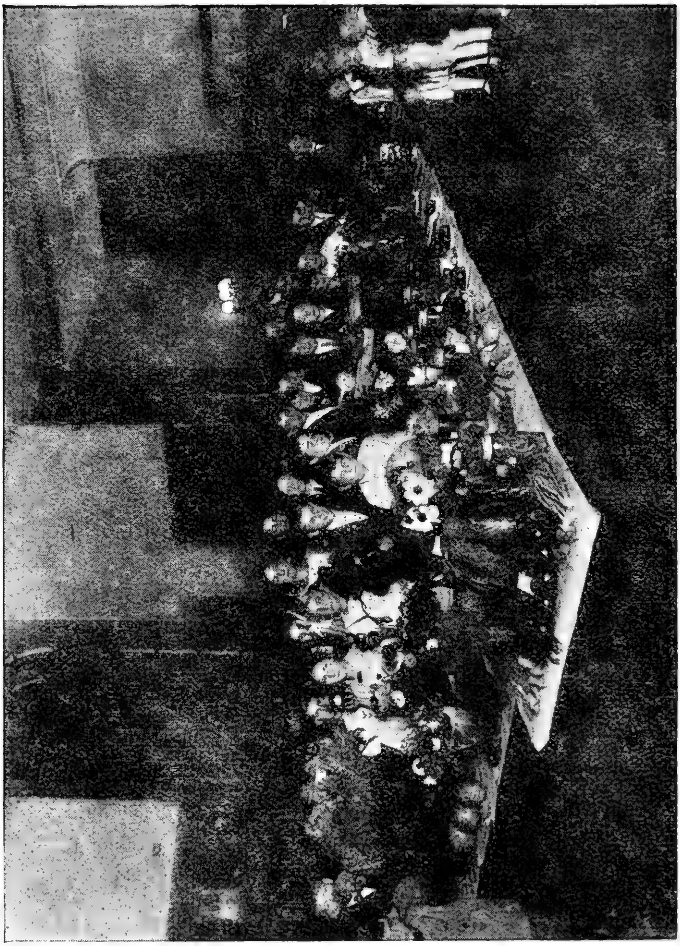
Greens—Spinach

Greens—Swiss Chard

First Planting	Second Planting	Third Planting
Tomatoes		
Carrots	Late Icicle Radish	
Stringless Beans		
Carrots		
Tomatoes		
Carrots		
Wax Beans	Late Icicle Radish	
Carrots		
Tomatoes		
Beets		
Stringless Beans	Late Head Lettuce	
Beets		
Tomatoes		
Onions		
Onions	Turnips	
Onions	Early Beans	Spinach
Radishes	Late Beans	
Radishes	Early Beans	Spinach
Lettuce	Late Beans	
Lettuce	Early Beans	Spinach
Lettuce	Late Beans	

Parsley and Mint (half of each) for Border

The eastern and western borders may be of vegetable greens, such as spinach, Swiss chard, etc. Distance between rows, nine inches. In place of two rows of carrots as shown in the plan it may be well to substitute peas. In the eastern states the early varieties will keep the ground occupied throughout the season. Instead of one or two rows of tomatoes use a row of salsify and a row of parsnips. The first row of onions should be onion sets, with the idea of harvesting them early



Club Festival and Home Garden exhibit, Public Library, Tacoma Park, Washington, D. C.

and getting them out of the way before the tomato plants are large. Bulbs of the early blooming flowers, such as tulips, crocuses, etc., may be placed in the ground late in the fall and much of their blooming completed before planting time for the garden. Fall greens such as spinach and kale should be planted as other crops mature. Plant asters and other fall blooming plants wherever possible. Leave no vacant space in your garden.

Profit From Home Canning of Vegetables and Fruit Purchased for Cash

(Canning work done at Pawtucket, R. I.)

Article	Quantity	Market Cost of Product	Sugar	Number of Jars	Market Returns for Canned Products
Asparagus	6 lb.	$0.45	-----	2	$1.00
Shell Beans	½ bu	.50	-----	4	2.40
String Beans	2 bu.	2.00	-----	32	16.00
Wax Beans	1 bu.	1.25	-----	16	8.00
Beets	10 bunch.	.25	-----	4	1.44
Carrots	10 bunch.	.25	-----	4	1.44
Cherries	2 qt.	.30	1 lb.	1	.60
Corn	13 dz. ears	1.30	-----	9½	9.50
Currants	10 pt.	.50	2 lb.	4	2.00
Peaches	41 qt.	3.45	14 lb.	27	13.50
Peas	2 bu.	2.00	-----	12	7.20
Peppers	8½ lb.	.92	-----	7	2.80
Pineapples	82	6.30	23 lb.	36½	21.90
Plums	12 doz.	.55	1 lb.	2	1.20
Raspberries	22 pt.	2.20	4 lb.	7½	7.50
Rhubarb	9 lb.	.18	-----	3	.75
Squash	10 lb.	.20	-----	5	1.50
Strawberries	20 qt.	3.00	10 lb.	10	10.00
		$25.60	55 lb. @6c–$3.30	186½	$108.73

Receipts:		
Market value of 186 jars		$108.73
Cost:		
Fruit and vegetables	$25.60	
Sugar	3.30	
Salt	1.10	
Fruit jars, 16 dozen	15.55	
Total cost	$44.55	44.55
Net profit		$ 64.18

Members of Market Garden and Home Canning Club packing vegetables for parcel-post shipment.

If a net profit of over one hundred per cent. or sixty-four dollars and eighteen cents can be made on canning food products purchased at a local market at regular prices how much more certain is a large profit in home canning if products are produced at home in your own garden!

CHAPTER XX

THE TOMATO

TOMATOES are becoming so important a garden and truck crop as to deserve a special chapter. They came originally from tropical regions, where the vines bear fruit all the year.

Importance of the Tomato

For a long time tomatoes were not known to have value as a food, but were thought to be poison. The plants were then cultivated for ornamental purposes and were known as "love apples."

Used now as food.—The chief value of tomatoes as a food lies in the sugars and protein, and in a stimulating effect on digestion. More than three hundred recipes have been worked out in preparing tomatoes for our tables. Many more people will use tomatoes as a part of their diet when they come to know more of their value.

Tomato growing states.—Tomatoes will grow successfully in almost every part of the United States. Maryland is one of the largest tomato producing states, and has the largest number of tomato canning factories. New Jersey, Indiana, California and Delaware rank next.

Hundreds of thousands of cases of tomatoes are now being grown and canned annually by the boys and girls of the home canning clubs. It is estimated that, after paying the expenses of raising his crop, a club member from ten to eighteen years of age can make from ten to twenty-five dollars a day for the time he puts in canning the crop.

A tomato garden in the city.

Varieties

In selecting the varieties for the home garden the length of season, quality, yield and appearance of the crop should be considered.

Early varieties.—There are a great many varieties from which to select. Among the favorites are: *Earliana*, Chalk's *Early Jewell*, *Bonnie Best*, *Globe* and *Prince's June Pink*.

Late varieties.—The chief late varieties are: *Stone, Matchless, Beauty, Ponderosa, Dwarf Stone, Acme* and *Trophy.*

Raising the Crop

Where the seasons are short it is necessary to start the plants in a hotbed and transplant them when all danger of frost is past. In the northern states it is well to use the cold-frame for hardening off the plants before setting in the garden. This process strengthens the plants and enables the crop to mature before freezing in the fall.

Transplanting.—Have the seed bed well prepared by deep spading or plowing, thoroughly manured with a well-rotted barnyard manure, and well pulverized. The plat should be marked off in rows three or four feet apart, according to the variety of tomatoes grown. The large hardy varieties will require a distance of four feet each way, while the dwarf varieties will do well three feet apart. In transplanting, have the holes opened up, remove the plants from cold-frames or hotbed without injuring the roots. Allow enough soil to accompany the roots so that the plant may go on growing without pause.

Pruning.—Much of the success of the tomato crop depends on proper pruning and staking. Tomatoes are especially liable to fungous and bacterial diseases, and therefore need to be kept from the ground and given an abundance of sunlight. The vines should be pruned at the time of transplanting or soon afterward by pinching off the suckers, or secondary leaf buds, found in the axils of the leaves. This will cause the plant to grow tall instead of

A plot of tomatoes in Geauga County, Ohio, produced by the Turner sisters of Cleveland, showing the result of careful pruning and staking.

spreading out. After each vine has developed four or five clusters of fruit the top bud should be pinched off to prevent the plant from growing too high.

Staking.—The method of pruning described requires staking to support the vines. For this purpose a single stake may be driven beside each hill, or a continuous meshed wire or other form of fence may be used. Soft twine or cloth should be used for tying the vines. No loop should be drawn tightly around the plant.

Spraying.—The tomato vines should be thoroughly sprayed with Bordeaux mixture several times during the season. The first spray should be given about the time the first fruit begins to form, or even earlier if the season is warm and moist. This will prevent the plants from being attacked by mildew. Remove at once any tomatoes that show a brownish discolored area about the blossom end. This will prevent the spread of disease.

Harvesting and Marketing

Gathering the crop.—Tomatoes should be gathered when ripe and firm and should be handled with great care to prevent crushing or bruising. For marketing they should be graded in three classes, *prime, medium* and *culls*. The more nearly uniform in size, shape and color, the more will the market offer for the product. Primes and even the medium may be wrapped in thin paper, placed in boxes, crates or baskets, and sold at a good price and by the pound.

Canning.—Tomatoes for canning purposes should be thoroughly ripened and be of a deep red color, smooth

Waterloo, Iowa, club girl demonstrating how to prune the tomato plant by pinching off the axillary bud.

and firm. They should be canned whole so as to permit the use of the tomato in as many different ways as is possible with the fresh tomato. Water should not be added to jars or cans when canning tomatoes, as this will dilute their flavor and injure their purity. The culls may be put up for such purposes as *puree,* for tomato soup and breaded tomatoes.

CHAPTER XXI

HOME CANNING OF FRUITS, VEGETABLES, MEATS AND SOUPS

IT is both practicable and economical to can the surplus vegetables, fruit, sweet corn, greens and other products that commonly go to waste in the orchard, field and garden.

Home Canned Products and the Table

When the average home has learned to can its surplus fresh food products, then the family may have a balanced ration every day in the year, the cost of living will be greatly reduced, and it will turn the garden and orchard by-products into net profits.

Home canned foods.—The average family should plan to have for table use from the home-canned supply *one quart of vegetables, one quart of fruit* and *one quart of greens* for every day in the year when these foods are not available fresh in the garden. The ration based on these foods and supplemented by meats is better balanced and less expensive than one based on meats with a scarcity of fruits and vegetables. Such a system will have a tendency to cut down both the doctor's bills and the grocery bills, and will furnish a more palatable diet.

Uncle Sam's canning kitchen in which field workers are trained in the art of home canning.

The surplus food products.—The importance of home canning is still more fully realized when we stop to consider that in most states probably from one-fifth to one-half of all the fruits and vegetables raised are allowed to go to waste. They are not needed for immediate consumption, and methods of grading, crating and marketing are not understood. Home canning may save all of this surplus.

Utah home canning girl and her exhibit of fifty-nine varieties of canned food products.

Successful canning not difficult.—By following simple directions and time-tables for sterilization, even school children may successfully can anything that grows in the garden, field or orchard. Once canned the product has a money value, and is as standard in the market as sugar or nails.

The list of directions and time-tables given in this chapter are written for use in connection with the usual home-canning utensils, and with the five distinct types of canning outfits. Such outfits are not expensive. They can be bought all the way from eighty-nine cents up to fifty dollars, depending on type and size. All kinds of glass jars, bottles and tin cans commonly used in the old methods of canning may be used with these devices and with this method.

The following recipes and canning instructions are taken from the "N. R." Series of Home Canning Club Instructions prepared by one of the authors and his assistant for the U. S. Department of Agriculture, Office of Extension Work, Northern and Western States. These instructions are equally valuable for home canning in any part of the United States, Canada, island possessions, Alaska and Europe.

Methods of Canning.—Home canning as now practised may be classified by the following methods:

1. *Open-Kettle Method.*—The oldest method is what is known as the "hot-pack" or "open-kettle" method, which requires the cooking of the food products before packing, and sealing the pack after the sterilization has been completed. This is the most laborious and the most unsatisfactory method, especially when canning vegetables and meats. Very few people succeed by this method in the conservation of their surplus vegetables, soups, meats and fish, though they may succeed very well in canning of the general and more expensive fruits.

2. *Intermittent Method.*—The "intermittent" process, or fractional sterilization method of canning of fruits, vegetables and meats is a method that requires the cooking or

sterilizing of food products for one hour periods for three or more successive days and is successful in so far as the sterilization of food products is concerned, but is very unsatisfactory, in that it requires too much time and consumes too much fuel as well as the energy of the already overworked housewife. There are few people who would be encouraged to go into extensive canning of the by-products and surplus fruits and vegetables, such as greens, peas, snap beans, lima beans, tomatoes and sweet corn, if the only way open to them would be through the intermittent process.

3. *Vacuum Seal Method.*—The vacuum seal method of canning is a method of home canning in which jars are sealed by a vacuum caused by exhausting or by use of an air pump. In using this method you can follow the cold-pack, one period directions given in this book excepting that you will have to secure in some cases the special vacuum seal jars.

4. The *cold-water method* of canning referred to by housewives is a method often used for the canning of rhubarb, green gooseberries, and a comparatively few other sour and highly acid vegetables and fruits. We do not recommend this method for the reason that most of these products will need to be cooked anyway before they can be used, either for pie-filling or sauces, and it is a saving of labor to do the cooking at the beginning, when the product is canned. For the benefit of those who wish to know the cold-water method, we simply suggest that the product is thoroughly washed, placed in a strainer, and

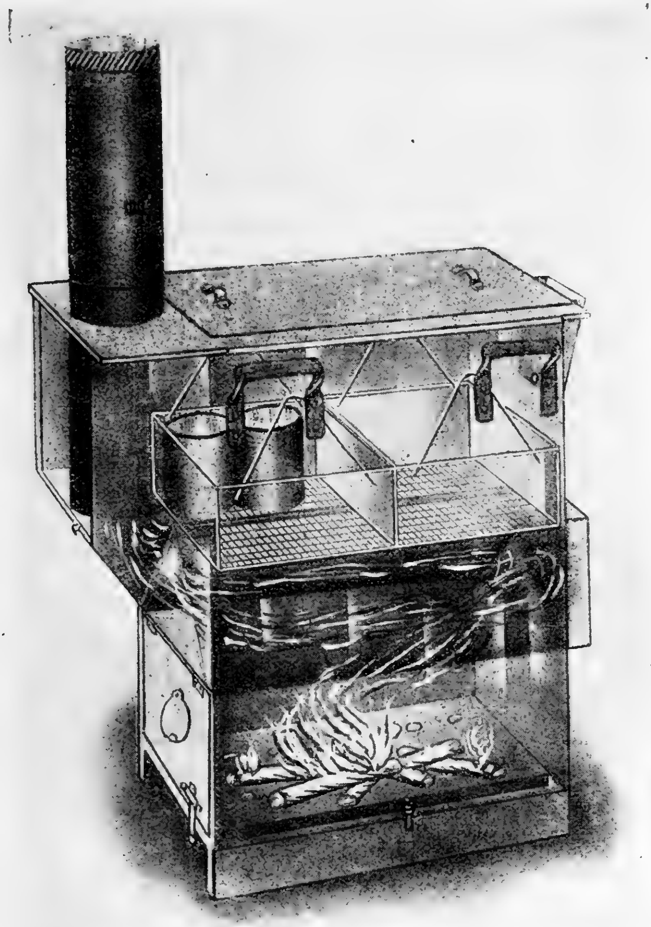
scalding hot water poured over the product very rapidly; then the product is packed in its fresh state, and cold pure water applied until the jar is full. Seal jar under water. If these steps are taken quickly, in rapid succession, the method may be successful, especially with rhubarb and gooseberries.

5. *Cold-pack Method.*—This method is used by the best canners in the United States and is known as the "cold-pack" and *single period method of canning.* This simply means that the fruits are packed in their fresh and natural state into the glass jar or container. No sirup is applied, and the sterilization is done in the jar or container after it is partially sealed, thus making it impossible for bacteria, spores and molds to enter or come in contact with the food product after the sterilization has taken place. By this method vegetables are blanched in boiling hot water, plunged quickly in cold water, skins removed and products cut in sections or prepared, then packed quickly in container and sterilized in partially sealed glass jars or the completely sealed tin cans. By this method, all food products, including general fruits, vegetables and meats can be successfully sterilized in a single period, with but one handling of the product. The double-shock effect upon bacteria in the preliminary steps is very important and should be taken quickly and the cover placed over each jar as soon as filled. There has been some misunderstanding as to the meaning of the term "cold-pack method of canning." It is often interpreted as meaning the *cold-water method* of canning, which is not true. The *cold-pack method simply* means

that the food products are packed in the containers, jars or tin cans, in their fresh state after blanching, and cold dipping and all sterilization or cooking performed after the pack has been completely or partially sealed. The cap is never removed after the cooking has been completed until the product is to be used during the year. All recipes given in this book are based upon this "Cold-Pack" method. The object of these instructions is to encourage the canning of *larger quantities* of the *cheaper food products,* available on practically every farm, and having these fresh vegetables and fruits available for three hundred and sixty-five days in the year, rather than for an occasional holiday or Sabbath, or for use when friends have been invited into the home. By adopting the single period method and sterilizing in closed packs and following the recipes given in this book it will be possible to reduce the cost of fuel for canning purposes to one-third of that required by the intermittent process, and it will reduce the amount of labor and time on the same basis. We trust, by the adoption of these methods, that it will not only be possible to have a larger supply of common vegetables and fruits for daily use, thus making a better-balanced ration for the family, but that it will result in a greater net profit to the average farmer, and a lower cost of living to both rural and city dwellers.

Canning Equipment

The *canning outfits* available for the sterilization of food products during the canning season may be divided into



A commercial hot water bath outfit for outdoor canning, showing interior arrangements of fire-box and sterilizing vat.

five general classes, and aside from these steamers, fireless cookers, and bake ovens are often used.

1. **Home-made** outfits, such as wash boilers, tin pails, milk cans, wash tubs and lard pails. These are made especially convenient and more efficient when false bottoms, with lifting handles, are added, and tight fitting covers are made possible.

Two types of canning outfits: (a) the water seal; (b) the aluminum steam pressure type, used by canning club members.

2. **Hot-water bath commercial outfits.** These outfits are constructed usually for out-of-door work and have sterilizing vat, lifting trays, fire-box, and smoke-pipe all combined into one piece. They should be light and convenient, and planned as portable outfits. The only advantage

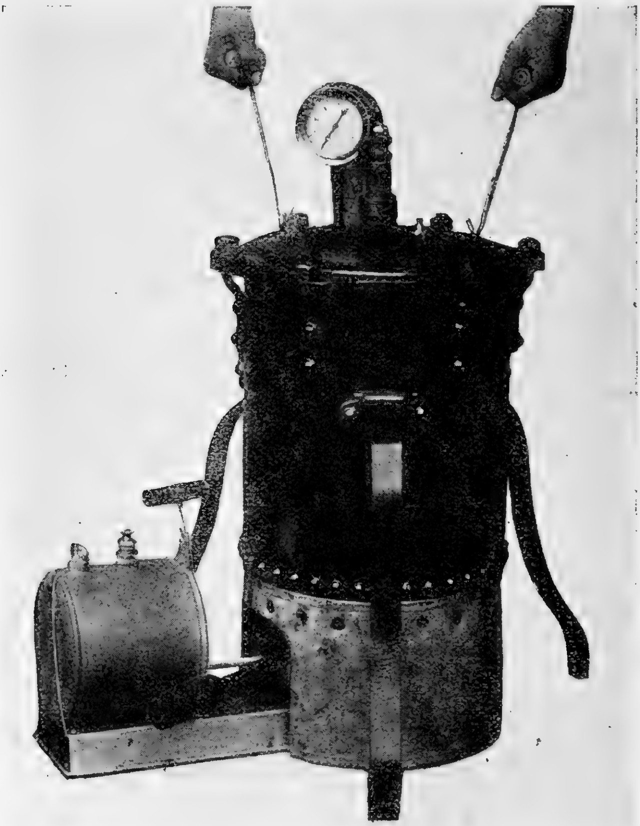
of these outfits over the home-made devices is that they are made for convenience and have all of the necessary equipment with which to can and operate the outfit. Both the home-made and hot-water commercial canners are classed as hot-water bath outfits. They contemplate that the sterilization of all food products will be done in boiling hot water with water over top of the highest jar or can.

3. **Water-seal outfits.** This is a type of canning outfit made with an inner seal and jacket and a cover that passes into seal and between the outer jacket and inner jacket, thus making three tin or galvanized jackets and two water columns between the sterilizing vat and the outer surface of the canner. The chief value of this type of canner is in the fact that one can maintain a higher temperature, and keep it more uniform than with the hot-water bath outfits. This is especially valuable in the canning of vegetables and meats, where the higher temperature means so much in the saving of time, fuel and energy in effecting a complete sterilization of the food products.

4. **Steam-pressure outfits.** This type of canner is manufactured so as to carry from five to thirty pounds of steam pressure and is equipped with vat, crate, cover, thermometer or pressure gage, safety valve and steam pet-cock. The safety valve can be easily regulated so as to carry different pressure values and thus accommodate the needs of various vegetables and food products.

5. **Aluminum pressure-cookers.** This is a combination outfit, which is used for both general cooking purposes and the canning of fruits, vegetables and meats. Because

of its general utility in the home, for the cooking of all kinds of meats, vegetables, soups, gravies and stews, it can



Steam pressure outfit made of cast iron and supplied with a gas heater.

be made to be of great labor-saving value to the housewife. It is considered the fastest canning outfit on the market. This is due to the fact that it is made entirely of aluminum and transmits heat very quickly and will carry as high as thirty pounds of steam pressure. Its make-up and necessary parts are practically the same as in the all steam-pressure outfits.

The new steam-pressure, safety-lock canner is properly classed with the steam-pressure outfits except that it has an automatic safety lock which will not permit lifting the cover until steam-pressure has been lowered or completely released.*

Temperature for Boiling Water at Different Altitudes

Water boils at sea level at 212° Fahrenheit. As the altitude increases, the degree at which water will boil gradually decreases. The following table is intended as a guide to determine the increase of time required for the sterilization of foodstuffs in the canning process:

500 feet above sea level, 211 degrees Fahrenheit.
1,000 feet above sea level, 210 degrees Fahrenheit.
2,000 feet above sea level, 208 degrees Fahrenheit.
3,000 feet above sea level, 206 degrees Fahrenheit.
4,000 feet above sea level, 204 plus degrees Fahrenheit.
5,000 feet above sea level, 202 plus degrees Fahrenheit.
6,000 feet above sea level, 201 plus degrees Fahrenheit.
7,000 feet above sea level, 199 plus degrees Fahrenheit.

The time table given in these instructions will be based upon the first altitude given, five hundred feet above sea

*The time scheduled for sterilization given in all of our recipes is made to accommodate the several distinct types of home canners. The home-made outfits and hot-water commercial outfits are classed as the same in all directions and under the head of "Hot-water bath outfits." The other four are classed in the order given above and under the same name, thus making the four classes with different time requirements.

level. For every four thousand feet increase in altitude it will be well to add twenty-five per cent. to the time requirements given in the time schedule for the canning of all kinds of fruits, vegetables, greens, meats and soups.

Containers

Glass Jars.—For home use it is conceded by most people that glass jars are the most desirable and economical for home canning, as they can be used from year to year, or indefinitely, by simply adding new rubbers and caps each year. Practically all of the various types of glass jars available on the market can be used successfully in the canning of all kinds of fruits, vegetables, meats and soups by the "cold-pack method" outlined in these instructions.

In the handling of all glass top jars, with the top and clamp springs, it is important to remember that the rubbers, caps and top spring are put in place, while the clamp spring is left up or raised during the entire period of sterilization.

In handling "screw top jars," it is important to remember that rubbers and caps are put in place and turned until they touch the rubber (sealed partially) not too tight. They should be loose enough to allow the escape of excessive or expanded air. All suction or self-seal tops such as Economy, Airseal, etc., are closed completely as possible before sterilizing the products.

Making of Brines and Sirups

Brines.—Brines are made by boiling salt and water together to a certain degree of density. This is what is meant by the expression "making a five per cent. brine."

Table for Making Brine

Salt	*Water*	*Per Cent.*
1 lb.	12½ gal.	1
1½ lb.	12½ gal.	1½
2 lb.	12½ gal.	2
4 lb.	12½ gal.	4
5 lb.	12½ gal.	5
10 lb.	12½ gal.	10

Sugar Sirups.—Fruit sirups are made by boiling sugar and water together to a certain density. This density is usually denominated by per cent. density and is measured by a density gage or in the absence of the instrument the estimates may be made by what is sometimes termed a "mental-finger gage," which should be explained as an approximate estimate of the thickness or density of sirups.

Table of Sirup Density

Sugar	*Water*	*Per Cent.*
1 pt.	2 pts.	14
1 pt.	1 pt.	24
1 pt.	½ pt.	32
1 pt.	1 gill.	40
2½ lb.	1 gal.	10
3½ lb.	1 gal.	15
4½ lb.	1 gal.	20
6½ lb.	1 gal.	30
8 lb.	1 gal.	40

The *Western* formula for sirup is three parts of sugar to two parts of water boiled to a *thin, medium thin, medium thick* or *thick sirup.* Two parts sugar to three parts of water may be used for sweet fruits.

The formula for sweet common fruits is made of three quarts of water to two quarts of sugar, boiled to a *thin, medium thin, medium thick* or *thick sirup.*

Density Terms Defined

1. *Thin sirup* is sugar and water boiled sufficiently to dissolve all sugar, not sticky.

2. *Medium thin* is when sirup has begun to thicken and becomes sticky when cooled on finger tip or spoon.

3. *Medium thick* is when sirup has thickened enough to roll or bank up over edge of spoon when you try to pour it out.

4. *Thick sirup* is when it has become so thick that it is difficult to pour out of spoon or container (not sugared).

Thin sirups are used for all sweet fruits that are not too delicate in texture and color, such as cherries, peaches, apples, etc.

Medium thin sirups are used in the canning of the medium sweet fruits, such as blackberries, dewberries, huckleberries, raspberries, etc.

Medium thick sirups are used in the canning of all sour fruits, such as gooseberries, apricots, sour apples, etc., and delicately colored fruits, such as strawberries and red raspberries.

Thick sirup is used for general preserving and in making all kinds of sun preserves.

Useful Tables

1,000 No. 2 empty tin cans will weigh 212 pounds.
1,000 No. 3 empty tin cans will weigh 310 pounds.
1 case for 24 empty No. 2 tin cans will weigh 13 pounds.
1 case for 24 empty No. 3 tin cans will weigh 17 pounds.

The following table will show approximately how many No. 2 and No. 3 cans can be filled from a bushel of various fruits and vegetables.

Product	*No. 2 cans or pint filled*	*No. 3 cans or quart filled*
1 bushel windfall apples	30	20
1 bushel standard peaches	25	18
1 bushel pears	45	30
1 bushel plums	45	30
1 bushel blackberries	50	30
1 bushel windfall oranges (sliced)	22	15
1 bushel windfall oranges (whole)	35	22
1 bushel tomatoes	22	15
1 bushel shelled lima beans	50	30
1 bushel string beans	30	20
1 bushel sweet corn	45	25
1 bushel shelled peas	16	10
1 bushel sweet potatoes	30	20

Reasons and Explanations for use of terms, "Scalding," "Blanching" and "Cold-Dipping"

Scalding.—The most important reasons for scalding fruits and vegetables are as follows:

1. To loosen the skins.
2. To eliminate objectionable acids and acrid flavors.
3. To kill spores, bacteria, etc., by the "double-shock" method.*
4. To make it unnecessary to exhaust the product before final cooking or sterilization.

The term "scalding" is used in connection with the handling of fruits and vegetables from which skins are to be removed, and simply means to place in boiling hot water or steam long enough to loosen the skin.

Blanching.—The important reasons for blanching are as follows:

1. To eliminate objectionable acids and acrid flavors.
2. To reduce the bulk of vegetable greens.
3. To make it unnecessary to use the exhaust period and intermittent process.
4. To kill spores, bacteria, etc., by the "double-shock" method.

The term "blanching" means to place product in hot water or greens in live steam for a sufficient time not only to loosen the skin, but remove excessive and objectionable acids and to reduce bulk.

Cold-dipping.—The important reasons for using the cold-dip in canning are:

1. To harden the pulp under the skin and thus permit the removal of skin without injury to the pulp.
2. To coagulate the coloring matter and make it harder to break down during the sterilization period.
3. To make it easier to handle the products in packing

*All bacteria and spores given to product from cold water are immediately subject to sudden (shock) change of temperature by adding hot water from kettle to product and placing rubber and top in position at once. These three steps must be taken in rapid succession in order to get best results.

and to shorten the time of processing by quickly removing them from hot and exposing them to cold water.

4. To kill spores, bacteria, etc., by the "double-shock"

Canning surplus vegetables "cold packed" method and by use of wash boiler as canner.

which means the sudden transfer from hot to cold water and from cold surface to hot water again.

DIRECTIONS FOR HOME CANNING, COLD PACK METHOD

Classification of Fruits and Directions for Canning

For convenience we suggest that fruits be classified into four distinct groups or classes, such as *soft* fruits, *sour berry* fruits, *hard* fruits and *citrus* fruits and that this simple method be followed rather than to apply a confusion of recipes to home canning work.

1. **Soft fruits,** such as strawberries, blackberries, dewberries, sweet cherries, blue berries, peaches, apricots, etc.

Directions for Canning Soft Fruits: Can the same day fruit is picked. Grade and rinse the fruit by pouring water over the fruit through a strainer. Cull, seed and stem. Pack immediately in glass jar or tin can. Add boiling hot sirup to top. Place rubber and top in place. Partially tighten. (Cap and tip tins.) Sterilize in hot-water bath outfit 16 minutes; in water-seal outfit 10 minutes; steam-pressure outfit, under 5 pounds of steam 8 minutes; in aluminum pressure-cooker, with 10 pounds of steam, 5 minutes. Remove. Tighten covers. Invert to cool and test joints. Wrap glass jars in paper to prevent bleaching and store.

Shrinkage of fruits before packing may be done by steaming the fruit for a few minutes before packing.

2. **Sour berry fruits,** such as currants, gooseberries, cranberries and sour cherries.

Directions for Canning Sour Berry Fruits: Can same day picked. Stem, seed, hull and clean. Blanch in hot water 2 minutes. Remove and dip quickly in cold water. Pack berries closely in container. Add hot sirup until full. Place rubber and cap in place. Seal partially, not tight. (Cap and tip cans completely.) Sterilize in hot-water bath outfit 16 minutes; in water-seal outfit, 12 minutes; in five-pound steam-pressure outfit, 10 minutes; in aluminum pressure-cooker outfit, under 10 pounds of steam, 5 minutes. Remove jars. Tighten covers and invert to cool and test joints. Wrap in paper and store.

3. **Hard fruits,** such as apples, pears, quince, etc.

Directions for Canning Hard Fruits: Grade. Blanch 1½ minutes, and plunge quickly into cold water. Remove skins if necessary. Core, pit or skin. Pack whole, quartered, or sliced, as desired. Add boiling hot sirup. Place rubbers and tops in position. Partially tighten. (Cap and tip tin cans.) Sterilize 20 minutes in hot-water bath outfit; 12 minutes in water-seal outfit; 8 minutes under 5 pounds of steam in steam-pressure outfit; 6 minutes in aluminum pressure-cooker, under 10 pounds of pressure. Remove jars. Tighten covers and invert to cool and test joints. Wrap glass jars in paper to prevent bleaching, and store.

4. **Citrus fruits.**—Oranges, canned whole for breakfast dishes or sliced for fruit salads. The object of canning citrus fruits is: first, to save the surplus and the get-away food products; second, to furnish wholesome fruits at reasonable cost to more people; third, to help producer to transform his by-products into net profits.

Directions for Canning Whole Oranges: Select windfall or packing plant culls. Use no unsound or decayed fruit. Remove skins and surface pulp. Blanch fruit in boiling hot water 1½ minutes or in live steam. Dip in cold water quickly. Pack containers full. Add boiling hot thin sirup about 18 or 20 per cent. density. Place rubber and cap in position. Partially seal, not tight. (Cap and tip tin cans.) Sterilize 12 minutes in hot-water bath outfit; 8 minutes in water-seal outfit; 6 minutes in steam-pressure outfit, under 5 pounds of steam; 4 minutes in aluminum pressure-cooker outfit, under 10 pounds of steam. Remove jars. Tighten covers. Invert to cool and test joints. Wrap glass jars with paper and store.

Directions for Canning Sliced Oranges for Salad Purposes: The oranges may be divided into their natural sections or sliced with a knife. Pack jar or container full. Pour over product hot sirup of 18 per cent. density. Place rubber and cap in position. Partially seal, not tight. (Cap and tip cans.) Sterilize 10 minutes in hot-water bath outfit; 6 minutes in water-seal outfit; 5 minutes in steam-pressure outfit, with 5 pounds of steam; 4 minutes in aluminum pressure-cooker outfit, under 10 pounds of steam. Remove jars. Tighten covers. Invert to cool and test the joints. Wrap glass jars with paper and store.

Classification of Vegetables and Directions for Canning

For convenience in the discussion of canning directions and methods of procedure, we divide vegetables into five classes.

1. **Vegetable greens,** both wild and domestic (30 varieties).

Directions for canning vegetable greens: Prepare and can the day picked. Sort and clean. Blanch in vessel with a little water under false bottom or in a regular steamer 10 to 15 minutes. Remove. Plunge quickly into cold water. Cut in convenient lengths. Pack in glass jar or other container closely and season by adding strip of bacon or a little chipped beef, olive oil, etc., to taste. Add hot water to fill crevices and level teaspoonful of salt to each quart. If using glass jars place rubber and top in position, partially seal; if using tin cans, cap and tip completely. Sterilize 90 minutes in hot-water bath outfit; 60 minutes in water-seal; 50 minutes in steam-pressure outfit, under 5 pounds of steam; 25 minutes in aluminum pressure-cooker outfit, at 15 pounds of steam. Remove from canner. Tighten covers. Invert to cool and test joints. Wrap in paper to prevent bleaching and store.

Edible Cultivated Greens: Swiss chard, kale, Chinese cabbage leaves, upland cress, French endive, cabbage sprouts, turnip tops, New Zealand spinach, asparagus, spinach, beet tops, cultivated dandelion, dasheen sprouts, native mustard, Russian mustard, collards, rape, fennel.

Edible Wild Greens: Pepper greens, lambs' quarter, sour dock, smartweed sprouts, purslane or "pusley," chicory, poke weed, dandelion, marshmarigold, wild mustard, milk weed, tender sprouts of red-root.

All are canned by the same directions.

Cabbage, Brussel Sprouts and Cauliflower—The directions for canning these vegetables is practically the same as for the above named vegetable greens and the same instructions may be followed, except that these products should be allowed to stand in cold, slightly salted water for 20 or 30 minutes before blanching.

Experience alone will teach the slight variations necessary in amount of time required for blanching, amount of seasoning necessary for the various vegetable greens, and the actual or best time required for sterilizing.

2. **Root and tuber vegetables,** such as carrots, parsnips, beets, turnips, sweet potatoes, etc.

Directions for Canning Root and Tuber Vegetables: Grade for size, color and degree of ripeness. Wash thoroughly. Use vegetable brush. Scald in boiling hot water, sufficiently to loosen skin. Plunge quickly in cold water. Scrape or pare to remove skin. Pack whole or cut in sections or cubes (sweet potatoes may be mashed if desired), as required by the home or market standard. Add boiling hot water and one teaspoonful of salt to the quart. Place rubbers and tops in position. Partially seal, but not too tight. (Cap and tip tin cans.) Sterilize 90 minutes in hot-water bath outfit; 75 minutes in water-seal outfit; 60 minutes in steam-pressure outfit, under 5 pounds of steam; 35 minutes in aluminum pressure-cooker, under 15 pounds of steam.

3. **Special vegetables,** tomatoes and corn.

Directions for Canning Tomatoes or Ripe Red Peppers: Grade for size, ripeness and color. Scald in hot water or steam enough to loosen skins. Plunge quickly in cold water (do not leave tomatoes or peppers in water while you skin and core them). Remove. Core and skin. Pack whole, crowd them closely into space. Fill container with whole product only. Add 1 level teaspoonful of salt to each quart. Place rubber and cap in position. Partially seal, but not tight. (Cap and tip tin cans.) Sterilize 32 minutes in hot-water bath outfit; 22 minutes in water-seal outfit; 15 minutes in steam-pressure outfit, under 5 pounds of steam; 10 minutes in aluminum pressure-cooker, under 10 pounds of steam. Remove jars. Tighten covers. Invert to cool and test joints. Wrap jars in paper and store.*

Directions for Canning Sweet Corn on the Cob: Can corn same day picked. Remove husks, silks, and grade for size. Blanch ears of corn in a steam chest or steamer 10 to 15 minutes. Plunge quickly in cold water. Pack ears, alternating butts and tips in half-gallon glass jars, or gallon tin cans. Pour over boiling hot water and add one level teaspoonful of salt and two tablespoonfuls of sugar to each gallon. Place rubbers and tops in position. Seal partially, but not tight. Cap and tip tin cans. Sterilize in hot-water bath outfit 180 minutes, one period; 90 minutes in water-seal outfit; 60 minutes in steam-pressure outfit under 5 pounds of steam; 40 minutes in aluminum pressure-cooker under 20 pounds of steam. Remove jars. Tighten covers. Invert to cool and test joints. Wrap glass jars with paper and store.†

Directions for Canning Sweet Corn off the Cob: Can the same day picked. Remove husks, silks. Blanch on the cob in steamer or boiling water 1 to 15 minutes. Plunge quickly in cold water. Cut the corn from the cob with a thin

*In handling the ripe hot peppers it will be necessary to use rubber gloves or handle so as to avoid getting the bare hands in contact with the hot peppers while coring and peeling.

†When sweet corn is taken from jar or tin can for table use, remove ears as soon as jar or can is opened. Heat corn, slightly buttered, in steamer. Do not allow ears to stand in water or to be boiled in water the second time.

sharp-bladed knife. Pack corn in jar tightly until full. Add 1 level teapsoonful of salt and two or more of sugar to each quart, and sufficient hot water to fill. Place rubber and top in position, seal partially but not tight. (Cap and tip tins.) Sterilize 180 minutes in hot-water bath outfits; 90 minutes in water-seal; 60 minutes in steam-pressure under 5 pounds of steam; 40 minutes in aluminum pressure-cooker under 15 pounds of steam. Remove jars. Tighten covers. Invert to cool and test joints. Wrap with paper and store.

4. **Other vegetables,** such as lima beans, string beans, peas, okra, etc.

Directions for Canning: Can same day vegetables are picked. Cull, string and grade. Blanch in boiling hot water or in steamer for 5 minutes. Remove and plunge quickly in cold water. Pack in container until full. Add boiling hot water to fill crevices. Add 1 level teaspoonful of salt to each quart. Place rubbers and tops in position. Partially seal but not tight. (Cap and tip tins.) Sterilize in hot-water bath outfit one period of 120 minutes; 90 minutes in water-seal outfit; 60 minutes in steam-pressure outfit, under 5 pounds of steam; 40 minutes in aluminum pressure-cooker, under 20 pounds of steam. Remove jars. Tighten covers and invert to cool. Wrap jars in paper and store.

5. **Pumpkin, squash, chayote fruit, etc.**

Directions for Canning (pie filling): Cut into convenient sections, core and remove skins. Cook for 30 minutes to reduce to pulp. Pack in glass jar or tin can. Add one cup of sugar, one teaspoonful of salt to each quart of pulp. Place rubber and top in position. Partially seal, but not too tight. Sterilize 60 minutes in hot-water bath outfit; 50 minutes in water-seal outfit; 40 minutes in steam-pressure outfit, under 5 pounds of steam; 30 minutes in aluminum pressure-cooker, under 15 pounds of steam. Remove. Tighten covers. Invert to cool and test joint. Wrap in paper and store.

Directions for Canning, Special Dishes (fried, creamed, baked): Cut the pumpkin, squash, chayote into small uniform-sized cubes. Blanch in boiling hot water for 10 minutes. Plunge quickly in cold water. Pack in jar until full. Add boiling hot water and 1 level teaspoonful of salt and one-half cup sugar to the quart. Place rubbers and caps in position, not tight. Sterilize 60 minutes in hot-water bath outfit; 45 minutes in water-seal outfit; 35 minutes in steam-pressure outfit, under 5 pounds of steam; 25 minutes in aluminum pressure-cooker, under 20 pounds of steam. Remove. Tighten covers. Invert to cool and test joint. Wrap in paper and store.

Canning of Windfall and Cull Apples

The windfall and cull apples may be divided into two grades. For first grade use the whole, reasonably sound fruit; for second grade use the sound portion of worm-eaten, partially decayed; do not allow apples to become over-ripe before canning.

Directions for Canning Whole, Reasonably Firm Apples: Wash apples. Remove core and blemishes. Place whole apples in blanching tray or blanching cloth, and blanch in boiling hot water or steam for two minutes. Remove and dip quickly into cold water. Pack in large, empty glass jars or gallon tin cans. Pour over the product a hot thin sirup of about 18 per cent. density. Place rubber and top in position, seal partially, not tight. (If using tin cans, cap and tip completely.) Process one-half gallon or gallon containers 20 minutes in boiling hot water, if using home-made or hot-water bath outfits; or 15 minutes in water-seal; or 10 minutes in steam-pressure outfit, with 5 pounds of steam pressure; or 5 minutes in aluminum pressure-cooker outfit, under 15 pounds of steam pressure. Remove jars, tighten covers, invert to cool and test joints. Wrap in paper and store. The time will have to be varied according to variety as well as ripeness and condition of the fruit. Use just enough time to sterilize perfectly, and yet not to change the color or reduce the pulp to sauce.

If the apples are firm and tart, the same recipe can be used in canning whole apples with both cores and peelings removed.

Daily Use of Above Canned Whole Apples.—1. Breakfast dish, with cream and sugar added. 2. Apple salad. 3. Apple dumpling. 4. Apple pot pie. 5. Baked apple. 6. Apple puddings and filling for pot roasts.

Directions for Canning Apple Pie Filling: Use second grade of windfalls or culls. Wash, core, pare and remove all decayed or injured spots. Slice apple quickly into a basin containing slightly salted cold water, to keep from discoloring. Pack fresh cold product in glass jars or tin cans. Add one teacupful of hot thin sirup to each quart of about 18 per cent. density. Place rubber and top in position; partially seal, but not tight. Cap and tip completely if using tin cans. Sterilize 12 minutes in hot-water bath, home-made outfit; 10 minutes in water-seal outfit; 6 minutes under 5 pounds of steam pressure; 4 minutes in aluminum pressure-cooker, under 10 pounds of steam pressure. Remove jars, tighten covers, invert to cool, and test joints. Wrap in paper and store.*

Directions for Canning Quartered Apples for Fruit Salads: Select best grade of culls, firm and rather tart varieties. Core, pare and quarter. Drop into a basin containing slightly salted cold water. Pack these quartered pieces tightly in jar or tin container. Add a teacupful of thin hot sirup to each quart. Place rubber and top in position; partial-

*When using this filling for apple pies, strain the sirup from the pulp and save for use, place sliced product on pie crust layer in the apple-pie tins, sprinkle with brown sugar, cinnamon or nutmeg, place pie dough over top, trim and bake in a properly heated oven for 10 or 12 minutes. The apple pie baked from this product will be as good, if not better, than the ordinary pie baked from fresh apples, and can be prepared and baked in less than half the time usually required when making pie from the fresh and more expensive fruit.

ly seal, not tight. Cap and tip completely tin cans. Sterilize 12 minutes in hot-water bath, home-made outfit; 10 minutes in water-seal outfit; 6 minutes under 5 pounds of steam pressure; 4 minutes in aluminum pressure-cooker under 10 pounds of steam pressure. Remove jars, tighten covers, invert to cool and test joints. Wrap in paper and store.*

Keeping Apple Juice Sweet by the Home Canning Method: Fill fruit jars with fresh apple juice. Add a tablespoonful of sugar to each quart. Place rubber and cap in position, partially tighten, or cap and tip the tin cans. Sterilize in hot-water bath outfit for 30 minutes, 180 degrees heat; in water-seal outfit for 20 minutes, same temperature. Remove jars, tighten cover, invert to cool and test joints. Do not undertake to sterilize apple juice or any other fruit juice under steam pressure or high temperature.

If using bottles, put a plug of cotton in neck and leave during sterilization period, then remove bottles and place cork or cap in position without removing the cotton plug.

Apple Sirup

The average fruit farmer may not be able to make apple sirup commercially profitable, but during seasons when there are a large number of culls and windfalls, when markets are glutted, it is a matter of business economy to utilize by-products and reduce these apples to food value of some kind. The making of apple sirup for the family's winter use is then quite worth while.

Reducing Sweet Apple Cider to Sirup: Wash apples, remove all decayed and worm-eaten spots. Use only sweet apple juice. The sterilizing, reducing vat or kettle should be a third larger than required to hold contents.

*Apples canned this way will sometimes discolor and deteriorate if allowed to stand over one year.

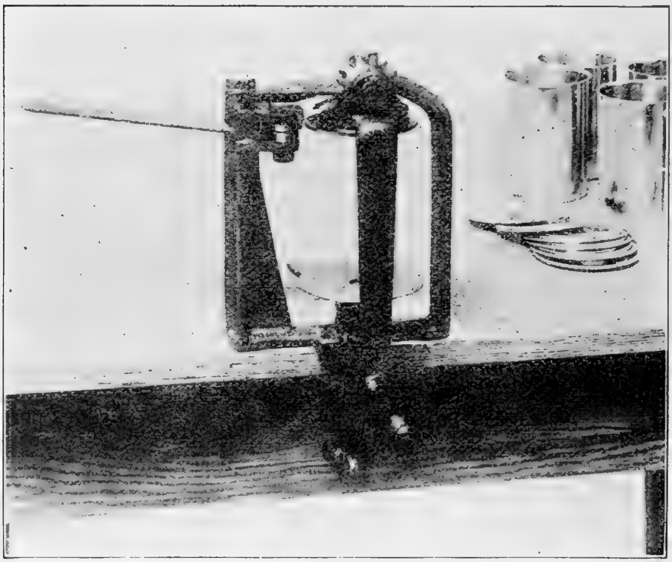
Directions for Making Apple Sirup: Add five ounces of powdered calcium carbonate* to seven gallons of apple cider. Boil in kettle or vat vigorously for a period of five minutes. Pour the liquid into vessels, preferably glass jars or pitchers, allow to stand six to eight hours or until perfectly clear. Pour the clear liquid into preserving kettle. Do not allow sediment at bottom to enter. Add to this one level teaspoonful of lime and stir thoroughly. The process is completed by boiling down rapidly to a clear liquid. Use density gage or a candy thermometer and bring it up to 204 degrees F., or without thermometer reduce bulk to one-seventh of original volume. Remove and cool rapidly in cold water until it shows same consistency as maple sirup. Do not allow to candy. Pour sirup into fruit jars, pitchers, bottles, etc., and allow to cool slowly. (Slow cooling is important.) The sirup can be cooled effectively in fireless cooker or wash boiler. The white sediment which settles during the cooling process is called by chemists malate of lime, and is a harmless compound of lime or acid of the apple. After this process the sirup is ready to be poured into fruit jars or bottles. Place rubber, cap or cork into position and not tight. Insert containers in hot water and sterilize for 12 minutes in hot-water or wash-boiler outfit; 10 minutes in water-seal outfits; 8 minutes in steam-pressure outfits under 5 pounds of steam, or 5 minutes in aluminum pressure-cooker under 15 pounds pressure.

Apple sirup made by this method is a very pure and high-grade product. Orchardists who have a large amount of waste every year would do well to establish a local apple sirup plant or perhaps a group of orchardists could combine and secure building, steam retort canners and convenient apparatus, simplify the method and get most successful and profitable results, by transforming windfall apples into sterile apple juice (canned cider) or apple sirups.

*Powdered calcium carbite is sometimes called carbonate of lime and is a low-priced, harmless chemical available at any drug store. It looks something like powdered chalk.

Tinning, Capping and Soldering, Repair Work

Tin cans.—The use of tin cans in the canning of the "get away" fruits and vegetables is entirely practical for the average farmer, trucker and fruit grower. The question of soldering and tipping the caps is a comparatively



A home can-sealer. Seals rim-seal cans without heat or solder.

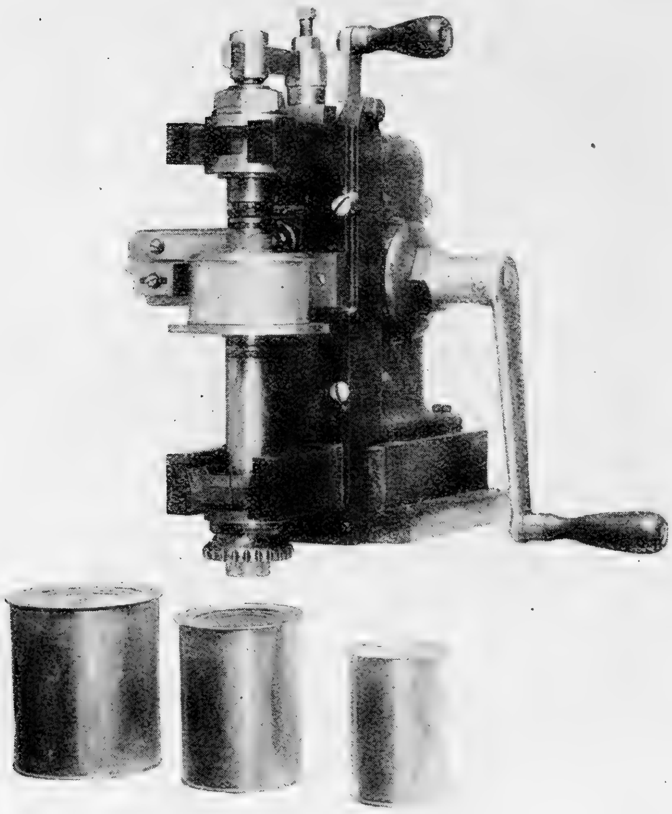
simple matter. Any child, twelve years of age or over, can easily learn how successfully to seal a tin can. It requires a hand capping iron and tipping steel, a little soldering flux, small brush, and a little practise. Self-heating capping irons are available and hand or automatic tin can sealers can be purchased or even rented by the year.

When tin cans are used for the canning of green vegetables, meats, fish, oysters, etc., it is sometimes desirable to use the lacquered or enameled cans.

Size of tin cans.—There are several standard sizes of tin cans in common use for canning purposes. They are denominated by number and with reference to the diameter of the opening. It is always necessary to state whether you desire plain tin cans, lacquered or enameled. In buying caps, always ask for the solder hemmed caps and give diameter of can opening. When buying tin cans to be used with the automatic sealing machines you will not need either solder or additional heat. Simply buy caps and the metal rims and paper rings or gaskets with your cans. For the other sealing device use the standard rim-seal cans.

Soldering equipment necessary.—Capping steel tipping copper, solder, sal ammoniac, a few scraps of zinc, two and seven-sixteenths inches opening tipping, solder flux, a small brush, porcelain, glass or stone cup in which to keep flux, a soft brick and a file. If using automatic sealer none of those things is needed.

Soldering flux.—Soldering flux, which may be purchased ready for use, is a solution of crude muriatic acid and zinc diluted with water and strained through a cloth. Flux is used for cleaning the irons and for brushing the tin and solder surfaces so as to make it possible for the solder in its melting condition to adhere to the tin. Powdered resin is sometimes used instead of the soldering flux. A soldering paste is also manufactured which is very



Automatic can sealing machine, seals without heat or solder. Sold, or rented by the year, to clubs and individual growers.

serviceable. The following soldering preparation or flux has been found to be very desirable, and is cleaner than the old flux:

Zinc chloride	3.6	oz.
Ammonium chloride	72.0	grains.
Water	1	quart.

Tinning a capping iron.—Purchase five or ten cents, worth of sal ammoniac at the drug store. Melt in this a little solder. Heat the capping iron enough so that it will melt the solder easily. Place the iron in the vessel containing the mixture of sal ammoniac and solder. Rotate iron in this until the soldering edge of the iron has become bright or thoroughly covered with the solder.

Tinning a tipping copper.—The tipping copper is tinned very much the same as the iron. Sometimes it is desirable, however, to file or scrape the tipping copper a bit so as to make it smooth and to correct the point. Heat the iron and rotate the tip of this iron in the mixture of sal ammoniac and solder until the tip has been covered with the melted solder and rendered bright as silver. The copper should be filed to nearly a sharp point. All particles of smudge, burned material, etc., should be removed from iron before tinning.

Capping a tin can.—When capping full cans, arrange them in rows upon the table while the capping and tipping irons are in the fire heating. Take a handful of solder-hemmed caps and place the caps on all cans, ready to be capped. Then take the flux jar and small brush. Place finger on vent hole, hold cap in place, and run the brush around the solder-hemmed cap evenly, with light

Capping iron, showing position of hand and upright rod. Also how iron is applied to solder hemmed cap.

stroke of the hand. Do this with all cans ready to be capped. Then take capping iron from the fire. Insert the upright steel in center. Hold capping iron above cap until center rod touches cap and holds it in place. (See page 360.) Then bring cap down in contact with all four points of solder-hemmed cap and rotate back and forth about three strokes. Do not bear down on tipping iron. A forward and

(A) Self-heating capping iron. (B) Flux jar and brush. (C) Solder-hemmed cap. (D) Ammonia bar for cleaning irons. (E) Wire solder. (F) Tipping copper and method of application.

back stroke of this kind, if properly applied, will perfectly solder the cap in place. Remove capping iron and inspect the joint.

If any pinholes are found, repair or recap. It may be necessary to use a piece of wire holder or a waste solder rim from a cap to add more solder to the broken or pinhole places of a cap.

Tipping a tin can.—Now take flux cap and brush. Dip brush lightly in flux and strike the vent hole a side stroke, lightly, with brush and flux.

Use the waste solder-hemmed cap rim or wire solder. Place point of wire solder over vent hole. Place upon this the point of the hot, bright tipping copper. Press down in a rotary motion. Remove quickly.

A little practise will not only make this easy, but a smooth perfect joint will be the result.*

Use of soldering tools for repair work in the home.—By the use of the solder, flux, sal ammoniac, capping steel and tipping iron, it is possible in a few minutes of time to solder the leaks in wash boiler, tin pails, milk pans and other vessels of kitchen, creamery, etc. This will not only save time for the farmer and the housewife, but will oftentimes save considerable expense and worry.

*After the fruits, soups, meats and vegetables have been sealed and processed the required length of time, they should be removed and cooled quickly. When using tin cans, it is best to plunge them into cold water at once after the sterilization has been completed.

CHAPTER XXII

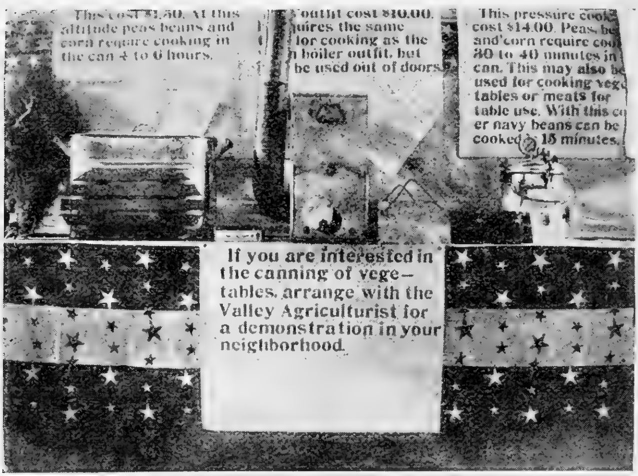
SPECIAL SUGGESTIONS FOR CANNING FRUITS, VEGETABLES AND SOUPS

THE following directions have been carefully tested by experts and practical housewives, and if carefully followed, will give excellent results.

Fruit Canning

Strawberries.—Can fresh, sound berries, same day picked. Hull (twist berries off hull), and place in strainer. Pour water over to cleanse. Place in very hot steam for 3 minutes to shrink berries to insure full pack. Pack in jar or tin without crushing. Pour medium thick hot sirup over berries to top. Put rubber and cap in position, not tight. (Cap and tip, if using enameled tin cans.) If using hot-water bath outfit sterilize 12 minutes, if using water-seal outfit or a five-pound steam-pressure outfit sterilize 6 minutes, or if using an aluminum pressure-cooker outfit, sterilize 4 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with a paper to prevent bleaching and store. (Sirup: 1½ quarts sugar to 1 quart water, boiled to medium thick.)

Strawberries.—(Berries canned by this recipe will not rise to top in sirup.) Use only fresh, ripe, firm and sound berries. Prepare berries. Add 8 oz. of sugar and 2 tablespoonfuls of water to each quart of berries. Boil slowly for 10 minutes in enameled or acid-proof kettle, covered with a well-fitted cover while boiling. Allow berries to cool and remain over night in a covered kettle. Pack cold berries in glass jars. Put rubber and cap in position, not tight. (Cap and tip if using enameled tin cans.) If



A canning exhibit at county fair showing three types of canners.

using hot-water bath outfit sterilize eight minutes, if using water-seal outfit or a five-pound steam-pressure outfit sterilize 6 minutes, or if using an aluminum pressure-cooker outfit sterilize 4 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to paper to prevent bleaching and store.

Strawberry Preserve.—Make a sirup of one quart of water and 11 pounds of sugar and cook in an open kettle until a candy thermometer registers 265° when placed in the sirup. Add 8 pounds of berries to the sirup. Cook very slowly, just at the boiling point. Stop the cooking when the thermometer registers 219° and pour into shallow pans to cool. Hasten cooling by pouring cold sirup over berries. Skim while cooling. Fill jars when cold and allow to stand unsealed for 4 days. Put rubber and cap in position, not tight. (Cap and tip, if using enameled tin cans.) If using hot-water bath outfit sterilize 10 minutes, if using water-seal outfit, or a five-pound steam-pressure outfit, or a pressure-cooker outfit, sterilize 8 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

Cherry Preserve.—Place one gallon of water in a kettle and add 10 pounds of pitted cherries. Boil slowly for 18 minutes. Add 12 pounds of granulated sugar and cook until product is boiling at temperature of 219°. Cool quickly in shallow pans. Pack into glass jars. Put rubber and cap in position, not tight. (Cap and tip if using tin cans.) If using hot-water bath outfit sterilize 20 minutes, if using water-seal outfit, or five-pound steam-pressure outfit, or a pressure-cooker outfit sterilize 15 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.*

Grapes.—Use fresh fruit evenly ripened. Pick carefully from the stem, wash and pack in glass jars. Cover with a thin sirup, boiling. Put rubbers and caps in posi-

*When using pressure-cooker outfits on preserves keep the valve open during period of sterilization; in all other recipes it must be closed.

tion, not tight. (Cap and tip if using tin cans.) If using hot-water bath outfit sterilize 20 minutes, if using water-seal outfit sterilize 15 minutes, if using five-pound steam-pressure outfit sterilize 10 minutes, or if using pressure-cooker outfit sterilize 5 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

Wild Grapes.—Use fresh fruit evenly ripened. Pick from stem and wash. Pack in glass jars. Cover with thick, boiling sirup. Put rubbers and caps in position, not tight. (Cap and tip if using tin cans.) If using hot-water bath outfit sterilize 20 minutes, if using water-seal outfit sterilize 15 minutes, if using 5-pound steam-pressure outfit sterilize 12 minutes, or if using pressure cooker outfit sterilize 8 minutes. Remove jars. Tighten covers. Invert to cool and test joint. Wrap jars with paper to prevent bleaching and store.

Pears.—Use sound ripe fruit. Prepare, peel and core. Remove all blemishes. Pack whole or in halves, and blanch 5 minutes. Dip in cold water. Pack in glass jars or tin cans. Pour on hot sirup, medium or thin. Put rubbers and cap in position, not tight. (Cap and tip if using tin cans.) If using hot-water bath outfit sterilize 30 minutes, if using water-seal outfit or a five-pound steam-pressure outfit sterilize 25 minutes, or if using a pressure-cooker outfit sterilize 18 minutes. Remove jars. Tighten covers. Invert to cool and test joint. Wrap jars with paper to prevent bleaching and store.

Wild or Damson Plum.—Grade fruit for size and ripeness. Wash and pack in glass jars. Fill with thin or medium thick hot sirup. Put rubbers and caps in position, not tight. (Cap and tip if using tin cans.) If using hot-water bath outfit sterilize 16 minutes, if using water-seal outfit or five-pound steam-pressure outfit sterilize 12 minutes, or if using pressure-cooker outfit sterilize 8 minutes. Remove jars. Tighten covers. Invert to cool and test joint. Wrap jars with paper to prevent bleaching and store.

Huckleberries.—Stem and clean huckleberries. Pack in glass jar or tin can. Fill with thin hot sirup. Put rubber and cap in position, not tight. (Cap and tip if using tin cans.) If using hot-water bath outfit sterilize 20 minutes, if using water-seal outfit or a five-pound steam-pressure outfit sterilize 15 minutes, or if using pressure-cooker outfit sterilize 10 minutes. Remove jars. Tighten covers. Invert to cool and test joint. Wrap jars with paper to prevent bleaching and store.

Figs.—Select and grade fruit. Blanch 6 minutes in boiling water or steam and cold dip. Pack in glass jar or tin cans. Fill with medium thick sirup. Put rubber and cap in position, not tight. (Cap and tip if using tin cans.) If using hot-water bath outfit sterilize 40 minutes, if using water-seal outfit sterilize 30 minutes, if using a five-pound steam-pressure outfit sterilize 25 minutes, or if using a pressure-cooker outfit sterilize 20 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

Egg Plant.—Remove the skin of the egg plant and slice across the fruit. Make slices about ½ or ¾ inches thick. Blanch three times in boiling water to which has been added a tablespoonful of salt per quart. Plunge into cold water and pack in glass jars. Fill with boiling hot water and add a level teaspoonful of salt and a little sugar to each quart. Put rubber and cap in position, not tight. (Cap and tip if using enameled tin cans.) If using hot-water bath outfit sterilize 60 minutes. If using water-seal outfit or a five-pound steam-pressure outfit sterilize 45 minutes, or if using an aluminum pressure-cooker outfit sterilize 30 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

Corn and Tomato (Combination).—Blanch fresh corn on the cob 6 minutes. Cold dip. Cut corn from cob. Blanch tomatoes 1½ minutes and cold dip. Remove skin and core. Chop tomatoes into medium pieces. Mix 2 parts of tomatoes with one part of corn and mix thoroughly. Pack in glass jars or tin cans. Add a level teaspoonful of salt, ¼ cup sugar per quart. Put rubber and cap in position, not tight. (Cap and tip if using enameled tin cans.) If using hot-water bath outfit sterilize 90 minutes. If using water-seal outfit sterilize 75 minutes. If using a five-pound steam-pressure outfit, sterilize 60 minutes, or if using an aluminum pressure-cooker outfit sterilize 45 minutes at 15 lbs. of steam. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

Corn, Tomatoes and String Beans. (Combination).—

Use one part of corn, one part of green string beans, and three parts of tomatoes. Blanch fresh corn on the cob for 10 minutes and cold dip. Cut corn from the cob, cutting from tip to butt. Prepare string beans and cut into convenient lengths. Blanch 4 minutes and cold dip. Scald tomatoes 1 to 3 minutes and cold dip. Remove skin and core. Cut into medium pieces. Mix the three products thoroughly. Pack in glass jars or enameled tin cans. Put rubbers and caps in position, not tight. (Cap and tip if using tin cans.) If using hot-water bath outfit sterilize 120 minutes, if using water-seal outfit sterilize 90 minutes, if using a five-pound steam-pressure outfit sterilize 60 minutes, or if using an aluminum pressure-cooker outfit sterilize 45 minutes at 15 lbs. of steam. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

Chili Peppers.—Use either red or green peppers. Place the peppers in the oven and bake until the skins separate from the pulp. Remove the skins. Take out seed and core if product is to be used for salads. Pack solid in glass jars or tin cans. Pour on boiling water and add one level teaspoonful of salt and a little sugar, per pint. Put rubber and cap in position, not tight. (Cap and tip if using tin cans.) If using hot-water bath outfit sterilize 90 minutes, if using water-seal outfit sterilize 75 minutes, if using a five-pound steam-pressure outfit sterilize 60 minutes, or if using an aluminum pressure-cooker outfit sterilize 40 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

Cabbage or Brussel Sprouts.—Use small solid heads. If cabbage, cut into convenient sections and remove core. Allow product to soak in cold salty water for 20 or 30 minutes. Blanch 10 minutes. Cold dip. (See cauliflower.) Pack in glass jars or tin cans. Pour on boiling water and add a level teaspoonful of salt per pint. Put rubbers and cap in position, not tight. (Cap and tip if using enameled tin cans.) If using hot-water bath outfit sterilize 90 minutes, if using water-seal outfit sterilize 75 minutes, if using a five-pound steam-pressure outfit sterilize 60 minutes, or if using an aluminum pressure-cooker outfit sterilize 45 minutes with 10 pounds of steam pressure. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

Cauliflower.—Use the flowered portion. After soaking in cold salty water for 30 minutes blanch three minutes. Dip into cold water. Pack in glass jars or enameled tin cans. Fill with boiling water and add level teaspoonful of salt per quart. Put rubber and cap in position, not tight. (Cap and tip if using tin cans.) If using hot-water bath outfit sterilize 45 minutes, if using water-seal outfit sterilize 35 minutes, if using a five-pound steam-pressure outfit sterilize 40 minutes, or if using an aluminum pressure-cooker outfit sterilize 30 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

Mushrooms.—Unless you are absolutely sure that you know a mushroom when you see it, do not run the risk of gathering and using for food what you may think are mushrooms. A very large number of people are poisoned every year because of carelessness along this line. There are many other plants of the mushroom-toadstool varieties that are very poisonous, and they resemble the edible mushrooms very much. (See *Farmers' Bulletin* 204, "Cultivation of Mushrooms.")

Canning of Mushrooms.—Wash and trim the mushrooms. If small, can them whole; if large, they may be cut into sections. Soak in cold salty water for 30 minutes. Blanch mushrooms in boiling water or steam for 10 minutes. Remove and plunge quickly into very cold water. Pack in glass jars, and add boiling hot water to cover at once; one level teaspoonful of salt to the quart. Place rubber and cap in position, not tight. If using hot-water bath outfit sterilize 90 minutes, if using water-seal outfit sterilize 60 minutes, if using a five-pound steam-pressure outfit sterilize 50 minutes, or if using an aluminum pressure-cooker outfit sterilize under 10 pounds of steam for 20 minutes. Remove jars. Tighten covers. Invert to cool and test joints. Wrap the glass jars in paper to prevent bleaching and store.

If canning mushrooms in tin, always use vulcanized or lacquered cans. Do not fail to blanch and cold-dip before packing, and empty the mushrooms immediately after opening the tin can.

Home Canning of Soups

Taken from Circular N. R. 34, Series of Follow Up Instructions in Home Canning Club Work
U. S. Dept. of Agriculture.

After you have learned to can fruits and vegetables successfully, the next logical step is to transform meat scraps, bones, ligaments, the odds and ends of vegetables and cereals, into an economical as well as palatable product for the home—something that can in a few moments' time be prepared and made ready for use as a hot dish for the winter months.

The canning of vegetable soups, purees and consommés is thoroughly practical, and should be a part of the canning work of every home. It will be a delight to the housewife to be able to reach to a shelf for a home-canned pack of soup, open it, heat and serve within a few moments of time.

Canning Directions

Soup Stock.—Secure 25 pounds of beef hocks, joints and bones containing marrow. Strip off fat and meat and crack bones with hatchet or cleaver. Place broken bones in a thin cloth sack and place the same in a large kettle containing 5 gallons of cold water. Simmer (do not boil) for 6 or 7 hours. Do not salt while simmering. Skim off all fat. This should make about 5 gallons of stock. Pack hot in glass jars, bottles, enameled or lacquered tin cans. Partially seal glass jars. Cap and tip tin cans. Sterilize 40 minutes if using hot-water bath outfit; 30 minutes if using water-seal or five-pound steam-pressure outfit; 25 minutes if using pressure-cooker outfit at 15 lbs. pressure.

Checking List.—Supplies needed before making soup stock. Check with this list before beginning work: 25 lb. of beef bones, 10 gal. water.

Vegetable Soup.—Soak 1/4 lb. lima beans and 1 lb. rice for 12 hours. Cook 1/2 lb. pearl barley for 2 hours. Blanch

1 lb. carrots, 1 lb. onions, 1 medium-sized potato, and 1 red pepper for 3 minutes and dip all in cold water quickly. Prepare the vegetables and cut into small cubes. Mix thoroughly lima beans, rice, barley, carrots, onions, potatoes, red peppers. Fill glass jar or the enameled tin cans three-fourths full of the above mixture of vegetables and cereals. Make a smooth paste of ½ lb. of wheat flour and blend in 5 gallons of soup stock. Boil 3 minutes and add 4 oz. salt. Pour this stock over vegetables and fill cans. Partially seal glass jars. Cap and tip tin cans. Sterilize 90 minutes if using the hot-water bath outfit; 75 minutes if using a water-seal or five-pound steam-pressure outfit; 30 minutes if using the pressure-cooker outfit at 15 lbs. pressure.

Checking List.—Supplies needed before making soup. After filling above requirements, check with this list and then sterilize: ¼ lb. lima beans, 1 lb. rice, ½ lb. pearl barley, 1 lb. carrots, 1 lb. onions, 1 medium-sized potato, 1 red pepper, ½ lb. flour, 4 oz. salt, 5 gal. soup stock.

Cream of Pea Soup.—Soak in cold water 8 lb. of dry peas overnight. Cook until soft. Mash fine. Add the mashed peas to 5½ gal. of soup stock and bring to boil. Pass the boiling liquid through a fine sieve. Make a smooth paste of ½ lb. flour and add paste, 10 oz. of sugar, and 3 oz. of salt to the soup stock. Cook until soup begins to thicken. Pack in glass jars or tin cans. Partially seal glass jars. Cap and tip tin cans. Process 90 minutes if using hot-water bath outfit; 80 minutes if using water-seal outfit; 70 minutes if using five-pound steam-pressure outfit; 45 minutes at 15 lbs. pressure if using pressure-cooker outfit.

Checking List.—5½ gal. soup stock, 8 lb. dry peas, 3 oz. salt, 10 oz. granulated sugar, ½ lb. flour.

Cream of Potato Soup.—Boil 1½ lb. of potatoes, sliced thin, and 5 gal. of soup stock for 10 minutes. Add 3 oz. of salt, ¼ teaspoonful of pepper, and ½ lb. of butter, and boil slowly for 5 minutes. Make 3 tablespoonfuls of flour into smooth paste and add to the above. Cook 3 minutes and pack in glass jars or tin cans while hot. Partially seal glass jars. Cap and tip cans. Sterilize 90 minutes if using hot-water bath outfit; 75 minutes if using water-seal outfit; 65 minutes if using five-pound steam-pressure outfit; 45 minutes if using a pressure-cooker outfit at 15 lbs. pressure.

Checking List.—5 gal. soup stock, 1½ lb. thin sliced potatoes (culls will do), 3 oz. salt, ¼ teaspoonful pepper (scant), ½ lb. butter, 3 tablespoonfuls flour.

Bean Soup.—Soak 3 lb. of beans 12 hours in cold water. Cut 2 lb. of ham meat into ¼-inch cubes and place in a small sack. Place beans, ham and 4 gals. of water in kettle and boil slowly until the beans are very soft. Remove the ham and beans from the liquor and mash the beans fine. Return ham and mashed beans to the liquor and add 5 gal. of soup stock and seasoning, and bring to boil. Fill into glass jars or tin cans while hot. Partially seal glass jars. Cap and tip tin cans. Process 2 hours if using hot-water bath outfit; 90 minutes if using water-seal outfit; 75 minutes if using five-pound steam-pressure outfit; 60 minutes if using pressure-cooker outfit at 15 lbs. pressure.

Checking List.—5 gal. stock, 3 lb. beans, 2 lb. lean ham, 4 gal. water. Salt and pepper to taste.

Okra Soup.—Slice 8 lb. okra into thin slices the round way. Blanch 10 minutes and cold dip. Boil 1½ lb. rice

Utah home canning club member in her potato starch factory.

for 25 minutes. Mix okra and rice and fill cans or jars half full. To 5 gal. soup stock add 5 oz. salt, ¼ teaspoonful of coriander seed, and ¼ teaspoonful of powdered cloves, and bring to boil. Fill remaining portion of jars or cans. Partially seal glass jars. Cap and tip tin cans. Process 2 hours if using hot-water bath outfit; 90 minutes if using water-seal outfit; 75 minuutes if using five-pound steam-pressure outfit; 60 minutes if using pressure-cooker outfit at 15 lbs. pressure.

Checking List.—5 gal. soup stock (see No. 1), 8 lb. okra, 1/4 teaspoonful coriander seed, 1/4 teaspoonful powdered cloves, 1 1/2 lb. rice, 5 oz. salt.

Tomato Pulp for Cream of Tomato Soup.—Place tomatoes in a wire basket or piece of cheesecloth and plunge into boiling water from 1 to 3 minutes. Plunge into cold water. Remove the skin and core. Place tomatoes in kettle and boil 30 minutes. Pass tomato pulp through a sieve. Pack in glass jars or tin cans while hot, and add a level teaspoonful of salt per quart. Partially seal glass jars. (Cap and tip tin cans.) Sterilize 20 minutes if using hot-water bath outfit; 18 minutes if using water-seal or five-pound steam-pressure outfit; 15 minutes if using pressure-cooker outfit.

Cream of Tomato Soup from Canned Tomato Pulp.—Place the contents of a quart glass jar or No. 3 can of tomato pulp in kettle. Add 1/8 teaspoonful of baking soda, pepper and salt to taste, 2 teaspoonfuls of granulated sugar. Boil for 7 minutes. Place 1 quart of milk and 2 tablespoonfuls of butter in a kettle and simmer for 7 minutes. Add contents of tomato kettle to contents of milk kettle and boil 5 minutes. The product is then ready to serve.

Checking List.—1 qt. or No. 3 can tomato pulp, 1/8 teaspoonful baking soda, 2 teaspoonfuls granulated sugar, 1 qt. milk, 2 tablespoonfuls butter. Salt and pepper to taste.

Chicken Soup Stock.—Place 30 lb. chicken in 10 gal. of cold water and simmer for 5 hours. Remove meat and bones and then strain. Add sufficient water to make 10 gal. of stock. Fill glass jars or tin cans with hot stock. Partially seal glass jars. Cap and tip tin cans. This stock is used to make soup where the term "chicken-soup stock" is used. Process 90 minutes if using hot-water bath outfit; 75 minutes if using water-seal outfit; 60 minutes if using five-pound steam-pressure outfit; 45 minutes if using pressure-cooker outfit at 15 lbs. pressure.

Checking List.—30 lb. chicken, 10 gal. water.

Chicken Broth with Rice.—For each gallon of soup stock use 12 oz. of rice. Boil rice 30 minutes. Fill jars or tin cans two-thirds full of rice and the remainder with soup stock. Partially seal glass jars. Cap and tip tin cans. Process 90 minutes if using hot-water bath outfit; 75 minutes if using water-seal outfit; 60 minutes if using five-pound steam-pressure outfit; 45 minutes if using pressure-cooker outfit at 15 lbs. pressure.

Checking List.—1 gal. chicken-soup stock, 12 oz. rice.

Chicken Gumbo.—Cut 2 lb. ham into small cubes and boil 30 minutes. Mince 3 lb. chicken and chop ½ lb. onions fine. Make a smooth paste of ½ lb. flour. Add above to 5 gal. of chicken-soup stock. Then add ½ lb. butter and ¼ lb. salt and boil 10 minutes. Then add 3 oz. powdered okra mixed with 1 pint water. Fill into glass jars or tin cans while hot. Partially seal glass jars. Cap and tip tin cans. Process 90 minutes if using hot-water bath outfit; 75 minutes if using water-seal outfit; 60 minutes if using five-pound steam-pressure outfit; 45 minutes if using pressure-cooker outfit.

Checking List.—5 gal. chicken-soup stock, 3 lb. minced chicken, 2 lb. ham, ½ lb. onions, ½ lb. butter, ¼ lb. salt, ½ lb. flour, 3 oz. powdered okra.

Vegetables (Mixed) Without Stock.—Many people would like vegetable soup during the winter season, but find it impracticable to secure the soup stock during the summer season when the vegetables are so abundant that they are rotting in the garden. It is suggested that the vegetable portion of the soup be canned during the summer and made available when the soup stock is prepared during the winter. It makes the preparation of soup a simple matter whenever the stock is available.

Soak 6 lb. lima beans and 4 lb. dry peas over night. Boil each ½ hour. Blanch 16 lb. carrots, 6 lb. cabbage, 3 lb. celery, 6 lb. turnips, 4 lb. okra, 1 lb. onions and 4 lb. parsley for 3 minutes and plunge quickly in cold water. Prepare vegetables and chop into small cubes. Chop the onions and celery extra fine. Mix all of the above thoroughly and season to taste. Pack in glass jars or tin cans. Fill with boiling water and add a little sugar. Partially seal glass jars. Cap and tip tin cans. Process 90 minutes if using hot-water bath outfit; 60 minutes if using water-seal outfit or five-pound steam-pressure outfit; 45 minutes if using pressure-cooker outfit.

Checking List.—16 lb. carrots (small), 6 lb. cabbage, 3 lb. celery (stems and leaves), 6 lb. turnips, 6 lb. lima beans, 4 lb. okra, 1 lb. onions, 4 lb. parsley, 4 lb. dry peas, salt and pepper to taste.

It is understood that when you have followed the above recipes faithfully and sterilized the required time that you will remove containers, seal, invert to cool and test joints, wrap and store in some manner as you do with fruits and vegetables.

Note.—These recipes are prepared for the canning of soups in the home and for home consumption. Families using these recipes for sale within the state should consult the Food Commissioner of the State. When the products are packed for interstate or foreign shipment, the packer should consult the Bureau of Chemistry, U. S. Department of Agriculture, Washington, D. C., for regulations governing measures, labels, trademarks and contents. The Bureau of Animal Industry, U. S. Department of Agriculture, Washington, D. C., should be consulted regarding meat-inspection regulations intended for interstate or foreign shipment when canned soups contain definite portions of meat.

CHAPTER XXIII

CULTURE OF FRUITS AND NUTS

FRUIT and nut farming have in recent years enjoyed a remarkable growth. The home fruit garden is coming to be considered no less important than the vegetable garden, and large commercial orchards are now an important factor on many of the reclamation projects of the semi-arid regions of the West and Southwest as well as in the humid sections of the United States. Millions of acres of land in all parts of the United States, especially in the South and in the dry regions, are yet available for the fruit and nut industry. The use of fruits and nuts as a part of the daily food supply is also rapidly extending to include almost every family in both this country and Europe.

The Home Fruit Garden

The home fruit garden, like the vegetable garden, should be planned for cultivation by means of horses. The rows should therefore run the long way of the garden. The fruit garden may well join the vegetable garden, and be approximately the same size, about ninety by two hundred and forty feet for a farm garden. The entire plat will then contain about one acre of ground.

All fruit trees should be treated with a dormant spray, applied at some time during the dormant season. A second spraying should be applied just after the leaf buds burst, and a third at blossoming time. Apples should be sprayed just as the petals fall, and pears just before the blossoms open. It is fully as important to spray at the right time as to use the right mixture. The successful orchardist must understand his fruit trees and the habits of

Fruit farms and orchards, Southwest.

their enemies, and understand the control of the common diseases.

Commercial Citrus Fruit Orchards

The citrus fruits constitute one of our most important orchard crops. The orange, the lemon and the grapefruit are coming into even greater use than the apple or other staple fruits. The lime and the tangarine are also growing in favor, and are finding a place in the citrus orchards of the South and Southwest. Improvement in transportation and the use of refrigerator cars make it possible to deliver these subtropical fruits to any part of the country in excellent condition. The citrus fruit industry is a highly specialized business, and requires high-grade intelligence, scientific knowledge and good business management.

Citrus orchard territory.—Florida and California are recognized as our leading citrus fruit states. The whole southern tier of states is developing the industry successfully, however, and some of them bid fair to rival the two mother states. There are to be found large and profitable orchards of oranges, grapefruit, limes and lemons in the southern portions of Arizona, New Mexico, Texas, Louisiana, Alabama, Mississippi and Georgia.

The orange.—The orange came originally from Asia, but now it is a native of nearly every country where a tropical or subtropical climate prevails. It is highly developed in Porto Rico, Hawaii, the Philippine Islands, South America, China, Japan, Spain, Portugal, Sicily and Asia Minor. The fruit is shipped from these countries in great boatloads to the markets of the world.

When Columbus and his men landed in America they found two kinds of citrus fruit growing in Florida, the rough lemon of the Everglades and the sour orange of the hummock lands farther north. When the Spaniards came a little later they planted the seeds of their cultivated oranges. From these seeds there developed the great seedling orange groves of the South. At the present time,

A typical Arizona orange tree.

however, there have been developed many budded and grafted varieties, and the orange now commonly known as the navel orange. In Florida alone there are hundreds of varieties. There is still shipped out to the northern markets a great deal of the seedling stock, but more and more the navel orange is coming to claim the best markets. The Parson Brown is a very early variety, sweet and wholesome. The Pineapple is somewhat later and is considered by many as the most delicious of southern varieties. The Florida Valencia is a late variety resembling the California Valencia. A considerable difference in flavor and texture exists between Florida oranges and those grown in the Southwest owing to the fact that the former are usually grown under humid conditions and the latter by irrigation.

The lemon.—The lemon tree grows very much the same as the orange except that it is smaller and has a lighter colored leaf. The flowers are tinged with red and the fruits is of a paler yellow with a distinct acid flavor. While the oranges are used largely for breakfast dishes, desserts and for general eating purposes, the lemon is used for sirups, beverages, flavoring extracts, etc.

The grapefruit.—The grapefruit tree is also in many respects like the orange tree. The fruit is larger and of a pale yellow color. The flesh is of a lighter texture than the orange, is sour and sometimes bitter. It is used extensively throughout the United States, and in fact much of the rest of the world as a very palatable breakfast fruit. It will grow in practically all sections where the orange can be produced. The grapefruit is a native of the Malayan and Polynesian Islands. It is a more hardy plant than the orange, and will adapt itself more readily to the local conditions. The grapefruit industry is at present developing very rapidly in Florida, California and several of the gulf states.

The lime.—The lime resembles the lemon in appearance, excepting that it is smaller. It is cultivated extensively in the West Indies, Florida, southern Mississippi, part of Alabama and to some extent in other gulf states. The tree is more thorny than other citrus trees. It bears white flowers. The fruit has a large amount of acid in its make-up, and is used extensively for beverages and sirups.

Soil and climate requirements.—Citrus fruits require a deep, fertile and well-drained loam soil. The soil needs lime, and should be kept rich in humus and nitrogen. All citrus fruits demand a warm, tropic or subtropical climate, a great deal of sunshine and freedom from cold winds, frost and cold nights. One of the greatest dangers to the citrus fruit industry of the United States is from frosts and the uncertainty of orchard localities in the matter of early and late freezing. The killing of fruit buds by late spring frosts must be met by some of the special methods, such as whitewashing, smudging and heating by means of oil pots. The last named method is probably the most used.

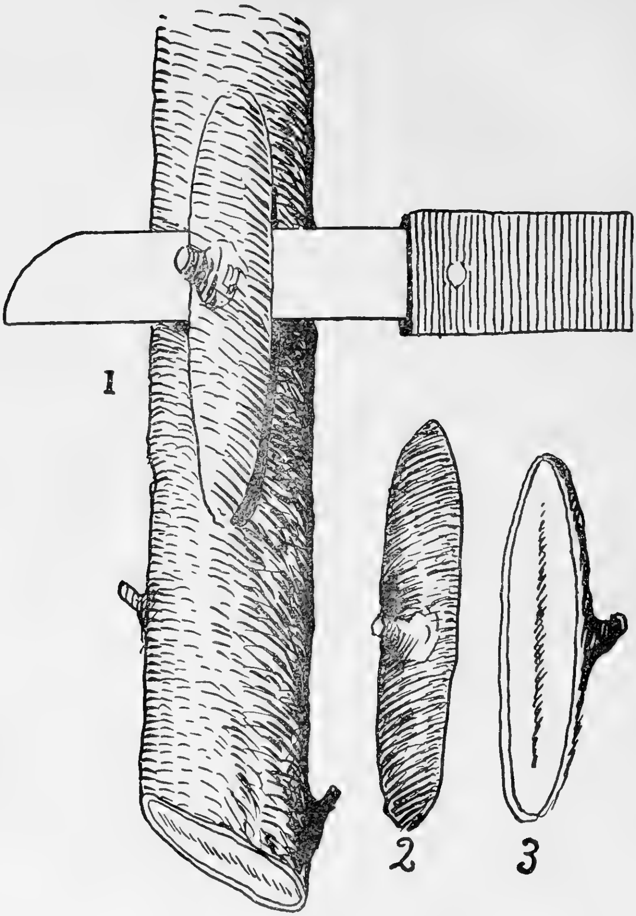
Cultivation and management.—No type of farming requires greater care in the matter of management and cultural methods. The orchard bed should be prepared by deep plowing and a thorough pulverizing of the top soil.

Clean cultivation and intercropping. Three-year-old apples trees—2,500 acres. Young Idaho orchard.

The soil should be kept free from weeds and a constant dust mulch maintained throughout the season for the conservation of the moisture. From the fact that an orchard will continue bearing for years there is great danger of depleting the soil of its fertility and making the orchard unproductive, hence the necessity of cover crops, the plowing under of legumes, the adding of barnyard manure, lime, potash and other fertilizing material from time to time as they are needed. In matters of tillage and cultivation the citrus orchard should be as carefully managed as a cornfield or a vegetable garden. The irrigated orchards of the Southwest require a little different type of management owing to the peculiar conditions under which the land is handled. Most of the irrigation of citrus orchards is done by surface irrigation, bringing the water from its source to the head of the orchard by means of lateral ditches and then distributing by sublaterals, furrows or corrugations. The water is conveyed from this head ditch down through the orchard and is absorbed by the root system by means of radiation.

Annual pruning, thinning and spraying of the orchards are of greatest importance in the management of citrus fruits. The neglect of these usually means not only a defeat for the following year, but an enormous loss for a number of succeeding years.

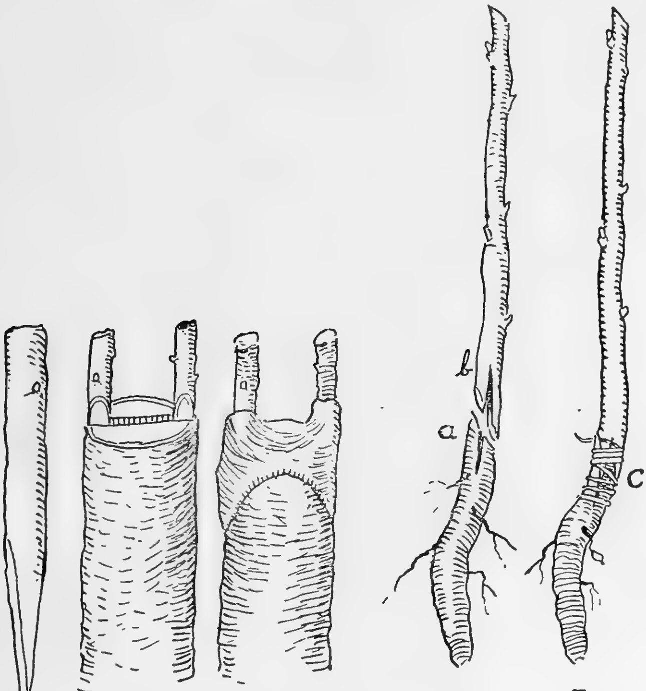
Picking and packing.—Great care and skill are required in the picking and packing of all citrus fruit. In the best commercial orchards we find great packing plants erected at considerable expense where the fruit is not only



Bud grafting.

1. Showing position of knife in removing bud. 2. Bud ready to be grafted. 3. Face of bud, to be treated and fitted to stem or tree trunk. Use grafting wax and then bind in position.

sorted and carefully crated, but washed and polished and then wrapped and placed in neat packages or in boxes ready for the market. Those who would make a success



1 A cleft graft. 2 Set to bring in contact with growing tissue. 3 Grafting wax. 4, 5 Root and stem cut ready for grafting.

of the citrus fruit business need to give a great deal of time and attention to this particular phase of the work.

Marketing.—Most of the citrus fruit at the present time is marketed through various associations. The individual grower is at a disadvantage when it comes to marketing his products, *first,* because he does not have enough in quantity to command the attention of leading buyers; *second,* because he can not secure the same transportation rates given to larger concerns; *third,* because he does not have time to study the markets and so exercise the best business judgment in a matter so essential to a profitable return from his fruit. The importance of the marketing end of this business is shown by the fact that some of the largest growers are investing thousands of dollars in packing and marketing facilities where in former years the packing was done in the orchards and marketing attended to only in a sort of haphazard way. Many of the companies and cooperative packing plants in California and Florida cost upward of ten thousand dollars.

Other Important Fruits of the South and West

The pineapple.—This is one of the desirable and promising fruits of southern Florida, southern California and southern Texas. The range of its territory will undoubtedly be considerably expanded within the next few years. Much of the region in the southern sections of the gulf states, as well as southern New Mexico and Arizona, especially when the land in the latter states has been reclaimed and water made available, will permit the growing of this fruit. The pineapple is widely used for sauces, salads and other desserts, as well as for flavoring extracts, marmalades, etc.

The olive.—The olive is one of the oldest fruits known to the world. It is fast becoming a profitable fruit industry in our southern states, especially in southern California. The olive tree is of a low branching, evergreen variety from fifteen to thirty-five feet high. It has small dark green leaves, and a dark green fruit which turns a brownish black when ripe. It is native to Africa, Asia and Greece. The commercial orchardists are growing the olive in Italy, France, Spain, Greece, Asia Minor, Mexico, Peru, Algeria, Tunis, and in the United States. Some very large commercial orchards are found in southern California. The trees will begin to bear when from six to eight years old. A good tree of this age will produce from five to eight gallons of oil, and the yield increases gradually up to as high as fifty gallons. An olive tree will bear profitably from forty to fifty years, but the tree itself will continue to live and appear hardy and strong for upward of a hundred years.

Figs.—The fig is a very valuable and profitable fruit. It grows well in Florida, southern Alabama, Mississippi, Louisiana, Texas, southern Utah, Arizona and southern California. The tree is propagated from cuttings taken from roots in the fall of the year or in early spring. The fig tree produces every year, and at the age of two or three years a tree will bear a considerable crop.

Peaches and pears.—Peaches and pears are grown extensively in practically the entire southern half of the United States. The fruits are very desirable not only for practical food dishes and dessert, but for canning. The peach and pear industry has greatly developed in recent years under more scientific management, the adaptation of varieties to climate and other local conditions. Increased facilities for transportation, cold storage, etc., have given

Four-year-old pear tree, Idaho. Orchard club members gathering fruit for home canning purposes.

great encouragement to this fruit industry. Peaches especially will not stand much handling, and are too perishable a product to ship a great distance from grower to consumer. Success in the handling of these orchards depends very largely upon the amount of business management and intelligence exercised.

Nut Farming

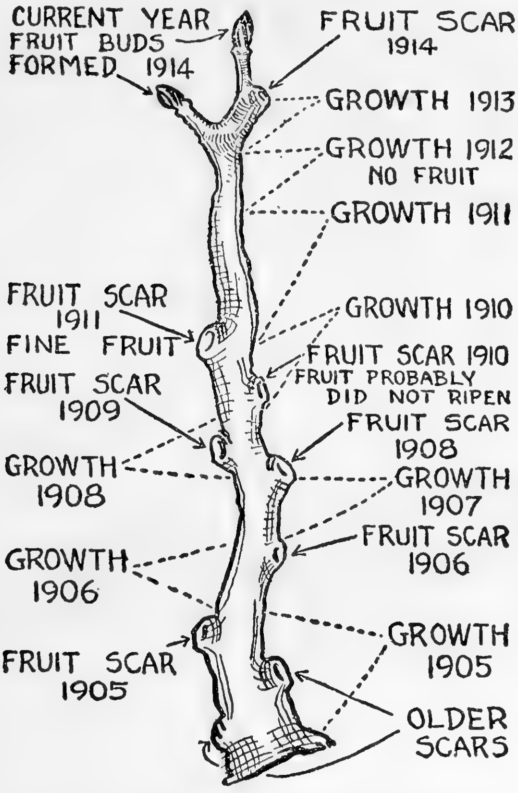
The largest commercial nut orchards of the United States are found in the southern and southwestern states. This industry has greatly developed during the last fifteen years, and as the cultural methods become better understood the area will be greatly increased. Nuts constitute a very important part of our daily diet. They furnish a very excellent substitute for meats, which are increasing so rapidly in cost to the consumer. Most of the nut trees grown in this country are considered very excellent trees for the farmer's wood lot, and for ornamental or shade purposes in our village and city lots. Some of the leading commercial varieties are the *almond, English walnut, pecan* and *filbert.*

The almond.—The almond tree very much resembles the peach tree in size, foliage and flower. The almond is a very valuable nut because of the high percentage of food to shell. When the fruit ripens the almond breaks open, the pulp dries, and the nut falls to the ground. It is then gathered and prepared for the market. The largest almond groves are found in the southern half of the states of Florida, Texas and California. Almonds were brought to this country from Spain and countries adjoining the Mediterranean Sea. They are used very extensively for confections, cooking purposes, medicine, flavoring extracts and sometimes for perfumery.

The English walnut.—The English walnut is one of the largest and finest nut trees of the South and Southwest. It will bear profitably at the age of six years and will continue to bear for thirty years. The walnut industry has not developed in this country nearly so far as is possible. It is conceded by the authorities that this nut will grow profitably in eight or ten states, yet at the present time it is confined largely to the southern half of California and southern Texas. It is found growing fairly well in states as far north as Illinois, Indiana, Delaware, Virginia, Maryland, Pennsylvania and New Jersey.

The pecan.—One of the most profitable nut industries of America is that of the pecan. The tree grows wild in a number of our states and is cultivated in practically all of the southern region, and particularly by some of the largest commercial orchardists in southern California, Texas, Louisiana, southern Mississippi and Georgia. The pecan industry has only fairly begun, and it is probable that the area and output will be greatly increased. The trees are produced in practically the same way as the citrus fruit trees, by budding and grafting. They are set about forty feet apart and will begin to bear at from five to eight years of age, and continue to bear from twenty-five to forty years. There are a large number of varieties of pecans. The best commercial varieties are the ones known as the Louisiana and the Texas Paper Shell. The tree is valued not only for its food qualities, but also for ornamental and shade purposes.

Other varieties of nuts.—The United States was at one time well covered with nut trees in the forests from the east to the west and as far north as the Canadian line. The deforestation which is constantly going on has, how-



History as It Is Written on an Apple Twig

ever, greatly reduced the number of wild nut trees. The black walnut, butternut, hickory nut, chinquapin, chestnut, and hazelnut are all fast becoming extinct as wild nuts, and sooner or later, in order to conserve these varieties, it will be necessary to produce them as domestic trees. Every farmer should be especially interested in including the nut trees in his work of reforestation or the development of his farm wood lot. In setting out shade trees in the cities, on vacant lots, in dooryards and back yards a careful selection of nut trees will be well worth while.

The apple.—The apple is without question one of the most important of all American fruits. The fruit is used in practically every home and is no longer considered a luxury, but a daily necessity. Apples are grown in all the eastern, central and western states with profit. The culture and success of the apple orchard depends on good management, clean culture and fertile soil, pruning, spraying and the business handling of the products fully as much as is required with any other fruit.

Score-Card for Apples—Exhibit of Ten

Name of Variety ______________Where Grown______________

Score of Points.	1	2	3	4	5	6	7	8	9	10	Average Score.
Uniformity of ten Samples __________	--	--	--	--	--	--	-	-	--	--	20
Freedom from blemishes ______________	-	--	--	--	--	--	--	--	--	--	20
Utility and market value ____________	--	--	--	--	--	--	--	--	--	--	20
Trueness to Type_____	--	--	--	--	--	--	--	-	--	--	20
Size, Form and Color_	--	--	--	--	--	--	--	--	--	--	20
Total ___________	--	--	--	--	--	--	--	--	--	--	100

Explanation of Score Points

1. **Uniformity of Samples**—Has particular reference to the uniformity of size, form, color, of all ten apples constituting the exhibit.

2. **Freedom From Blemishes**—This has particular reference as to whether the apples are free from rust, scale, scab, infection, worm eaten or broken surfaces. Every apple making up the exhibition should have a smooth, clear, clean coat or skin.

3. **Utility and Market Value**—This has reference to the practical and commercial value of apples for eating, cooking and marketing. (Will they prove of superior value in home for eating or cooking and will they command a uniformly high price on the market.)

4. **Trueness to Type**—This refers especially to the type of variety and in scoring upon this point, you should consider very carefully as to whether the samples conform properly to the size, form and color required for the type or variety they represent and also as to the locality requirements in which they are grown.

5. **Size, Form, Color**—In scoring these points, the question of the market requirements in size, form and color, should be considered. An apple above average size, clear in color and of true form, should be accepted. (Color has reference to whether the fruit is red, green, striped, blush, high russet, etc.) Clear and distinct coloring or blush should not be considered of great importance, uniformity should not be considered under this score.

Note.—The main object of a score-card of this kind is to teach a standard of perfection and call attention to the points that make up the standards.

Variety	Eating Quality	Cooking Quality	Months for Eating Common Storage	Months for Eating Cold Storage Will Include	Flavor, Etc.	Size (No. to Box)	Color	Origin
1. Gravenstein	Excellent	Excellent	Aug., Sept.	October	Juicy, crisp	72—150	Red and yellow striped	Germany
2. Tompkins King	Good	Good	Sept., Oct.	November	Mild, juicy	72—128	Red to yellow	New Jersey
3. McIntosh	Excellent	Fair	Sept., Oct.	Nov., Dec.	Pleasant, juicy	112—200	Bright red	Ontario
4. Jonathan	Excellent	Good	Oct., Nov.	December	Mild, juicy, crisp	96—225	Bright red	New York
5. Grimes	Excellent	Fair	Oct., Nov.	December	Mild, pleasant	112—165	Yellow, some pink blush	Virginia
6. Wagener	Excellent	Good	Oct., Nov.	December	Juicy, subacid	96—165	Red and yellow striped	New Jersey
7. Esopus (Spitzenberg)	Excellent	Excellent	Nov., Dec., Jan.	Feb., Mar.	Spicy, subacid, crisp, rich, juicy	80—150	Bright red	New York
8. Delicious	Excellent	Fair	Nov., Dec.	February	Mild, juicy, sweet	72—140	Red and yellow mottled	Iowa
9. Banana	Good	Fair	December	February	Mild	80—150	Yellow, pink blush	....
10. Ortley	Excellent	Excellent	Dec., Jan.	Feb., Mar.	Mild, juicy, subacid	80—150	Golden yellow	New Jersey
11. Monmouth (Red Cheek) Pippin)	Good	Good	Dec., Jan.	Feb., Mar., Apr.	Mild	80—150	Yellow, some pink blush	New Jersey
12. Stayman Winesap	Good	Fair	Dec., Jan.	Feb., Mar.	Mild, subacid	96—175	Yellow, red stripe	Kansas
13. Rome Beauty	Very Good	Good	Dec. Jan.	Feb., Mar., Apr.	Pleasant, subacid	72—165	Yellow and red mottled	Ohio
14. Yellow Newtown	Excellent	Excellent	Jan., Feb., Mar., Apr., May	....	Acid, very juicy, crisp	80—200	Yellow, some blush	New York
15. Winesap	Excellent	Good	Jan., Feb., Mar., Apr., May	....	Subacid, crisp, very juicy	128—225	Dark red	New Jersey
16. Arkansas Black	Fair	Good	Feb., Mar., Apr., May, June	....	Moderate	72—165	Deep dark red	Arkansas
17. Paragon	Good	Good	Jan., Feb., Mar., Apr., May	....	Mild, subacid, mod. juicy	72—165	Dark red	Tennessee

CHAPTER XXIV

GARDEN AND ORCHARD SPRAYS

POISONOUS sprays for the destruction of insects and fungi of gardens and orchards have come into general use. Upon their successful application often depends the value of the crop, both as to quantity and quality. Not infrequently an entire failure of yield results from the attack of these pests when they are not destroyed in time. Wormy and scabby apples, rotting peaches and plums, blighted berries and diseased vegetables prove the necessity for some effective means of stopping their ravages.

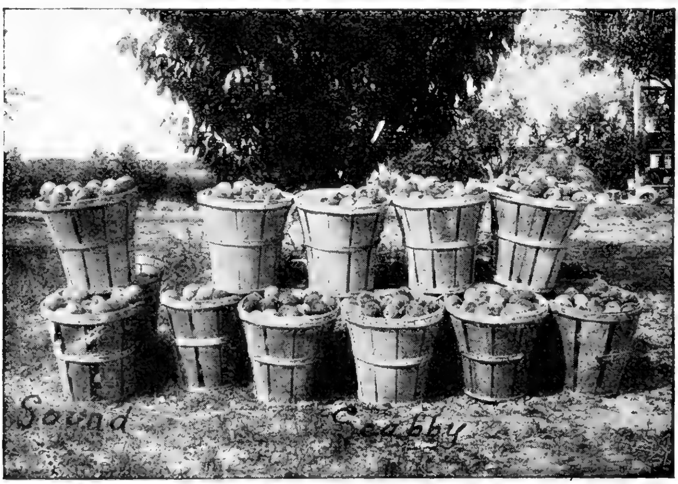
The purpose of the two classes of mixtures, *fungicides* and *insecticides,* is indicated by the name applied; the *cide* in each word means to kill. Only the more important and common fungicides and insecticides will be described here.

Bordeaux Mixture

Bordeaux mixture is one of the most successful and widely used fungicides. Used at proper strength it is harmless to most plants, though it has been found injurious to some, especially plums and, in less degree, peaches. It will also stain foliage and fruit upon which it falls.

Composition.—Bordeaux mixture is made when needed, of *copper sulphate* (blue vitriol) and *lime.* The

Crop from four sprayed peach trees; one basket of scabby fruit at the left; the remainder sound.



Crop from (same orchard referred to above) four unsprayed peach trees. Sound fruit in three baskets at left; the remainder scabby.

strength may be varied, depending on the required use. The proportions most generally accepted are:

4 pounds of copper sulphate.
6 pounds of fresh lime.
50 gallons of water.

The copper sulphate is the active agent in killing the fungi, while the lime prevents injury to the plant. Besides this "4-6-50" mixture, other formulas frequently used are of the proportions 4-4-50, and 5-5-50.

Making the mixture.—When but a small amount of spraying is to be done the only equipment required for making Bordeaux mixture is a fifty-gallon barrel, two twenty-five gallon tubs, buckets and a fine-mesh sieve.

Fill one of the smaller tubs with water, and suspend just below the surface four pounds of copper sulphate in a loose bag, giving it time to dissolve. This will require about an hour, though the process can be hastened by using hot water. Slake six pounds of lime in the other tub, using hot water and reducing the lime to a paste. When the lime has cooled, dilute to twenty-five gallons.

Now stir the contents of the tubs, and pour bucketfuls of each mixture simultaneously through a sieve into the larger barrel, making sure that the streams mix. Stir well, and the compound is ready for the spraying machine.

Use.—The amount needed for a garden can be judged from the fact that a tree in full leaf and having a spread of twenty-five feet will require about four gallons of the mixture. Most beginners use too little, hence fail to get the best results.

Bordeaux mixture is not effective against insects. If, however, *arsenate of lead* in the proportion of two pounds to each barrel of the mixture be combined with it, the compound will serve as a check on both insects and fungous diseases. Scab, apple blotch, bitter rot, wilt, mildew and brown rot are controlled by Bordeaux mixture.

Duchess apples, showing results of punctures of the plum curculio. This injury could have been saved by proper spraying.

Lime-Sulphur Mixture

The lime-sulphur mixture, besides being an insecticide for certain plant insects, is also a fungicide serving the same general purpose as Bordeaux mixture. It has the advantage of not injuring certain plants, such as peaches and plums, to which Bordeaux mixture is not adapted. Some fruit growers are coming to employ it as their principal fungicide.

Composition.—The strength of the mixture may vary, the proportion of the ingredients commonly being:

8 pounds of flour of sulphur.
8 pounds of fresh lime.
50 gallons of water.

Making the mixture.—The lime-sulphur compound may be made by several different processes, one of the sim-

Spraying apple trees.

plest of which is the *self-boiling* process. To make the self-boiled mixture, put eight pounds of lime to slake, and while the slaking process is going on, sift over the lime eight pounds of finely powdered sulphur. Stir constantly, adding water until a thin paste is secured. Dilute to fifty gallons, and strain before using.

Lime-sulphur may be purchased ready for use. Although it costs slightly more than the home-made product, the time saved makes the commercial form cheaper if but a small amount is required.

Use.—Lime-sulphur controls scale insects and curculio, as well as such fungous diseases as scab, leaf curl, brown rot, etc. Arsenate of lead may be used with this mixture also.

Arsenate of Lead

Arsenate of lead is one of the most important stomach insecticides known, and has largely taken the place of Paris green with most fruit growers. It seems to be palatable to all garden insects. It adheres well to foliage, hence does not easily wash off in showers as does Paris green. It will not injure plants no matter how strong the solution. And it also acts as a fungicide, especially when mixed with lime-sulphur.

Composition.—Arsenate of lead is easily compounded, the usual formula being:

22 ounces arsenate of lead dissolved in 2 gallons of warm water.
8 ounces arsenate of soda dissolved in 1 gallon of water. (Use wooden pail in each case.)

The two solutions are now poured together and diluted with water to make a mixture of fifty gallons, then it is ready to spray.

Arsenate of lead may also be procured in the form of a paste ready to dilute for the spraying machine. Three pounds of the commercial paste will make fifty gallons of spray. It will hardly pay to go to the trouble of mixing the compound at home, since the ready-made product usually costs no more than the ingredients for making the mixture.

Use.—The arsenate of lead mixture may be used alone or with fungicides for destroying nearly the whole range of biting insects attacking garden fruits. It has proved of the greatest service, especially in the spraying of apples.

Paris Green

Paris green is one of the oldest and best known of the insect poisons. Several thousand tons are used each year for this purpose.

Composition.—Paris green is often prepared for spraying by simply dissolving from four to eight ounces in fifty gallons of water. The standard formula, however, is:

4 ounces of Paris green.
½ pound of lime.
50 gallons of water.

The lime is to be slaked and mixed with the water. The Paris green is mixed to the form of paste in a small quantity of water, and then added to the water.

Use.—Paris green may be used in combination with the Bordeaux mixture, but not with lime-sulphur. When mixing it with Bordeaux, the Paris green should be combined with the diluted lime before it is brought in contact with the copper sulphate.

Kerosene Emulsion

Kerosene is one of the best of contact insecticides. A small particle of it on any part of the body means certain death to any insect. Pure kerosene, however, will injure most plants, hence must be used in a mixture. The best of these is what is known as kerosene emulsion.

Composition.—The formula for the mixture commonly used is:

½ pound hard laundry soap shaved fine.
1 gallon of soft water.
2 gallons of kerosene.

Making the emulsion.—One of the advantages in the use of this spray is the ease with which it can be made. Dissolve the soap in one gallon of boiling water; remove from the stove and at once add two gallons of kerosene. Stir while cooling until a soft, butter-like mass is obtained. Dilute one part of this stock solution with ten or twelve parts of water as needed for spraying.

Use.—Kerosene emulsion may be used on all kinds of tender foliage without injury. It will control the various kinds of plant lice, slugs, etc.

The Resin-Lime Mixture

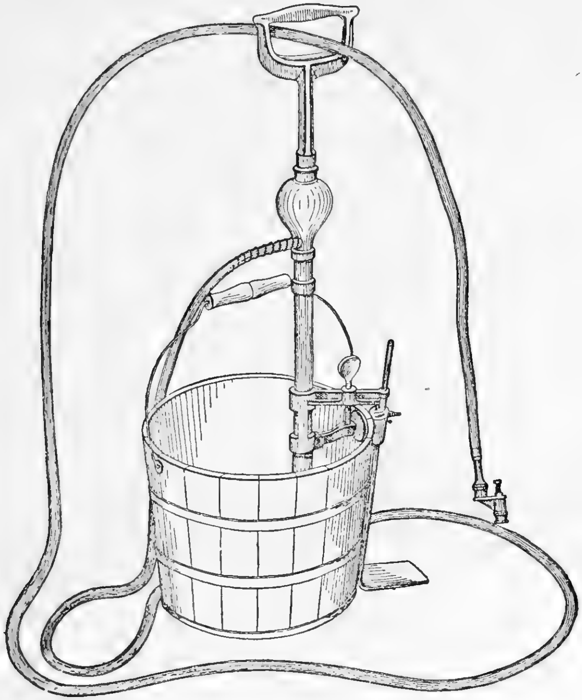
One of the difficulties in using many of the insecticides and fungicides is that they do not adhere well to the smooth foliage of the plants. The resin-lime mixture is often used in combination with other compounds to insure their sticking to the plants until they have done their work.

Composition.—The formula employed is:

5 pounds of pulverized resin.
1 pound of concentrated lye.
1 pint of fish or some other animal oil.
5 gallons of water.

This mixture is the stock solution, which is still further diluted as used.

Making the mixture.—The oil, resin and one gallon of cold water are to be put into an iron kettle and heated



A small hand spray.

until the resin softens. Add the lime and stir well. Then add four gallons of hot water and boil until a little mixed with cold water gives a clear amber-colored liquid. Add water to make up for what has boiled away, making five gallons of the compound.

Use.—This spray, besides causing other mixtures to adhere to the foliage of plants, is itself an excellent contact insecticide. Its principal effect is through making a smother-coating over the body of the insect. It is used in some regions as a dormant wash for the control of scale insects. When used with Paris green or Bordeaux, two gallons of resin-lime compound are mixed with eight gallons of water, and this added to forty gallons of the spray.

CHAPTER XXV

WEEDS

ONE of the most serious problems confronting the farmer is his trouble with and complete mastery of weeds. A weed has been defined as a plant growing out of the place where it is wanted. Any plant may become a weed when it insists on growing in the wrong place, when it spreads rapidly or when it brings on conditions hostile to the growth and prosperity of desired or cultivated crops. If the weed is particularly injurious, if it is unsightly, unusually persistent or very troublesome, it is classed as a *noxious* weed.

Classification of Weeds

Like other plants, weeds may be classified into groups in accordance with their length of life and consequent manner of growth and their method of reproduction.

Annuals.—Weeds are called annuals when they spring up from the seed, grow to full maturity, produce seed for the next crop and die, all in the same year. Among many examples of annuals are the foxtail, ragweed, smartweed, Spanish needle and mustard.

Biennials.—Biennial weeds are those that spring up from the seed and produce a leaf and stem growth the first season. The leaf and stem may die down during the winter but the next spring the roots send up a stem shoot which produces flowers and seeds, after which the plant dies. The seeds are then ready to start the life cycle over again. Familiar examples of biennials are mullein, bull thistle, wild carrot and black-eyed Susan.

Perennials.—Perennial weeds are those whose roots live on from year to year and do not require reseeding in order to assure the continuance of their lives. Familiar examples of weeds of this class are quack-grass, milkweed, or horsenettle, and the dandelion.

Many classes of weeds die out under conditions of cultivation which are hostile to their growth and welfare. Few classes of the prairie-growing weeds are now to be found in the older regions of the country. Marsh weeds disappear when the wet lands are drained. But in the place of the disappearing classes of weeds, new varieties are constantly appearing. Many of the weeds that are now so troublesome have been brought to us by immigration from Europe. It is said that more than six hundred species of weeds have been introduced into New England since the first cutting of the forests.

Damage Done by Weeds

The amount of damage done by weeds is almost incalculable. It has been carefully estimated that American farmers lose at least three hundred millions of dollars a year from the ravages of their weed enemies.

Add to this direct loss from weeds the labor required to free crops from their presence, and the indictment against these intruders is greatly increased in its strength.

We must not forget however that on the other hand weeds do some good as legumes and cover crops and protect against injuries caused by erosion of soils. There are other important duties not credited to them by farmers and experts.

How Weeds Injure the Farm

Weeds always cut down the yield of crops. A field can not successfully grow weeds and a maximum crop of grain at the same time. The weeds rob the plants of the room, the light, the plant food and the much-needed moisture which should go to the production of the crop. Two adjoining fields, one of which was badly infested with stink-weed, and the other field kept clean, showed a yield of forty bushels of oats to the acre for the clean field and only fifteen for the weedy field. Stunted stalks of corn which have been choked by weeds, clover strangled by dodder, oats crowded in spots so that they ripen unevenly and show irregularity of stand and yield are familiar examples of the effects of weeds.

Weeds usually an enemy.—Weeds do not injure plants solely by robbing and crowding them, however. Certain weeds seem to poison the soil and produce conditions affecting the health of the crop. Weeds also furnish a harbor for noxious insects and for fungous diseases of plants. It is known that a number of the worst enemies of farm crops are thus protected and encouraged by certain weed hosts.

In addition to all this, many weeds are unsightly. They always advertise a farm adversely and are a poor recommendation for its owner or tenant. Weedy fields actually reduce the market value of farm land, and a prospective buyer may well hesitate to purchase acres which will require time and labor to free from the weeds that are sure, unless checked, to defeat the manager in production of maximum crops.

How Weeds Spread

Probably the greatest agency in the spreading of weeds is unscreened grain or farm seed. Practically all of the small grains have weed seed mixed with the grain and unless the seed is cleansed, the farmer actually plants the weeds which later must be eradicated if his crop is not to suffer. No one should sow weed seed. There is plenty of it distributed to his land from other sources which he can not control. The farmer who lives in a state that has no pure seed law is particularly liable to imposition in purchasing seed from other states. For example, Canada has very strict laws on the subject of pure seed for use on Canadian farms. As a result much seed which can not legally be sold in Canada is sent across into the States where it finds a market. Similarly, seed that can not safely be sold in Indiana, which has a stringent seed law, may be shipped to border states which lack such laws.

Even comparatively pure seed contains many weeds. One sample of approved seed showed one and one-half per cent. of weed seed, which equaled about fifty-nine thousand weed seeds to the bushel of grain.

Various agencies for carrying weed seed.—Hay, straw and manure are other means of distributing weed seeds. Hay or straw that is shipped from one section of the country to another is almost sure to result in the distribution of certain weeds. The seeds of some weeds are carried great distances by the wind. This is particularly true of such plants as thistle, milkweed and dandelion, whose seeds are provided with wings or sails which enable them to carry great distances. Even such seeds as the ragweed, millet and the grains of oats and wheat have been known to carry several miles by high winds. It is easy to see, therefore, that the weeds grown on the land of a careless farmer injure not him alone, but also make trouble and expense for all his neighbors who live in the direction of the prevailing winds. Running water is also responsible for the distribution of weed seeds, and particularly is this true of spring or fall floods after the ground is frozen so that the water can not sink into the soil.

Birds, while they are good weed fighters, are also distributers of weed seed. All farm animals in some degree carry the seed of weeds from place to place. The same may be true of farm tools; for example, quack-grass may easily be carried from field to field by the teeth of the harrow. Thrashing machines, clover hullers and wheels of other machines may distribute large quantities of weed seed as they move from farm to farm or travel along the roadway.

Fighting the Weeds

Weeds must be fought. Left to themselves they will multiply until they have taken possession of our fields. It is a part of the education of every farmer to know at sight all the most troublesome weeds of his neighborhood. Not only should he be able to recognize the plant, but he should know the seed whenever and wherever it is seen.

Clean the seed.—No careful farmer will sow seed that he does not know to be reasonably clean of weeds. He will be so anxious to be on the safe side that he will take no chances, but will use a fanning mill and run all seed through it before planting. He will be inquisitive, if not suspicious, concerning seed shipped from a distance, and will make sure that he is not adding to his weed troubles before he makes a purchase of foreign grown seed.

Rotate the crops.—Rotation of crops is one of the most fruitful methods of handling the weed question. Weeds which escape annihilation in the methods of cultivation used in one crop may be destroyed by the different cultivation required in another variety of crop. Pasturing weedy ground with sheep or goats is a simple and easy method of clearing out certain weeds. Heavy crops of buckwheat, rape, hemp or millet if sown thickly, will smother out most perennial weeds. In fact the simplest and easiest, if not always the most practical way of keeping weeds out is to grow something else so thickly upon the soil that the weeds have no chance.

Cultivate.—In all cultivated crops the remedy against weeds after they are once started is, of course, thorough cultivation. The weedy corn-field proclaims to all observers that its owner did not cultivate sufficiently to control his worst enemy. Some few weeds of the most obnoxious sort need to be *dug* out wherever they are found. If the patch is small and the weeds really noxious, this will not only pay but it is the only safe way.

Develop community sentiment.—Above all, it is necessary to cultivate a community sentiment against weeds. All concerned should promote and obey laws against the selling of weed seed in grain intended for planting. A further requisite is to cultivate and enforce laws requiring the cutting of weeds along roadways, railroads, reservations and in other public places. If this is not done the farms adjoining such weed patches are seeded afresh each season, and require much additional labor and expense to keep them clear of the weed nuisance. Every foot of roadway in the United States should be kept so clear of weeds that none are allowed to grow seed from season to season. The small amount of money required to bring about this result would be abundantly repaid in the larger crops upon adjoining farms. The sentiment should also develop to the point where no careless farmer can remain in good standing in his community while he is constantly seeding his neighbors' farms with weeds profusely grown upon his own farm.

A TABLE OF COMMON FARM WEEDS.*

Common Names	Technical Name	Where Injurious	Time of Seeding	Place of Growth and Products Injured	Methods of Eradication
Barnyard grass, barn grass, cocksfoot	Panicum crus-galli	Minnesota to Montana	July to September	Fields; spring wheat	Prevention of seeding
Bracted plantain, rib grass, buckhorn western buckhorn	Plantago aristata	Ohio to Iowa	June to December	Meadows; pastures	Prevention of seeding; hoed crops
Buffalo bur, beaked horse-nettle	Solanum rostratum	Iowa to Colorado	July to November	Grain; hoed crops	Heavy seeding; close cultivation
Bull thistle, common thistle	Carduus lanceolatus	Everywhere	July to November	Meadows; winter wheat	Prevention of seeding; cutting in fall
Bur grass, hedgehog grass, Rocky Mountain sand bur, sand bur, sand spur	Cenchrus tribuloides	Everywhere	July to November	Sandy pastures; wool	Cultivation; burning
Burdock, great dock	Arctium lappa	New England to Wisconsin	August to October	Waste places; pastures; wool	Prevention of seeding; grubbing in summer

*Adapted from Farmers' Bulletin 28, United States Department of Agriculture.

Common Names	Technical Name	Where Injurious	Time of Seeding	Place of Growth and Products Injured	Methods of Eradication
Canada thistle	Carduus arvensis	New England to Iowa	July to October	Fields; grain; meadows	Alternate cultivation and heavy cropping
Charlock, wild mustard, yellow mustard	Brassica arvensis	New England to North Dakota	June to October	Fields; grain	Prevention of seeding; cultivation; hoed crops
Chess, cheat, wheat thief, Willard's brome grass	Bromus secalinus	New England to Washington	August to October	Fields; grain	Clean seed; cultivation
Chickweed	Stellaria media	New York to North Carolina	March to July	Lawns, gardens; spring crops	Cultivation in late fall and early spring
Clover dodder, alfalfa dodder, love vine	Cuscuta epithymum	Utah to Nebraska; New England	June to November	Clover; alfalfa	Clean seed; cultivation
Cockle, corn cockle, rose campion	Agrostemma githago	New England to Washington	July to September	Grain-fields; wheat	Clean seed; cultivation

Common Names	Technical Name	Where Injurious	Time of Seeding	Place of Growth and Products Injured	Methods of Eradication
Cocklebur, clot bur, ditch bur, small burdock	Xanthium canadense, Xanthium strumarium	Everywhere	August to November	Waste places; pastures; wool	Prevention of seeding; cultivation
Couch-grass, quack-grass, quick-grass, witch-grass, devil's grass	Agropyron repens	New England to Minnesota	August to September	Fields; all crops except hay	Alternate cultivation and heavy cropping; close grazing
Crab grass, finger grass, Polish millet	Panicum sanguinale	New Jersey to Missouri and south	July to October	Hoed crops	Prevention of seeding; closer cultivation
Curled dock, yellow dock	Rumex crispus	New England to Washington	July to October	Meadows; grain crops	Alternate cultivation and heavy cropping
Dandelion	Taraxacum taraxacum	Nearly everywhere	May to November	Meadows; lawns	Cultivation; digging roots in lawns
Dog fennel, Mayweed	Anthemis Cotula	Everywhere	July to September	Roadsides	Prevention of seeding

Common Names	Technical Name	Where Injurious	Time of Seeding	Place of Growth and Products Injured	Methods of Eradication
English bindweed, morning-glory	Convolvulus arvensis	New England and California	August to October	Grain-fields; hoed crops	Prevention of seeding; late cultivation
Field dodder, love vine, clover dodder	Cuscuta arvensis	New England to Ohio and southward	July to November	Clover; alfalfa	Clean seed; cultivation of crops other than clover
Great ragweed, hog-weed	Ambrosia trifida	Iowa to Louisiana and east	August to October	Bottom lands	Cultivation; heavy cropping
Gum plant, rosinweed, sunflower	Grindelia squarrosa	North Dakota to Utah	August to November	Meadows; pastures	Prevention of seeding; cultivation
Hedge bindweed, morning-glory	Convolvulus sepium	New Jersey to Illinois	August to October	Corn and wheat fields	Late cultivation
Horse-nettle, bull nettle, sand briar	Solanum carolinense	Iowa to New Jersey and south	August to November	Waste land; meadows; pastures	Alternate cultivation and heavy cropping
Horseweed butterweed, colt's-tail, fleabane	Leptilon canadense	Everywhere	July to October	Waste land; meadows; grain-fields	Prevention of seeding; late cultivation

Common Names	Technical Name	Where Injurious	Time of Seeding	Place of Growth and Products Injured	Methods of Eradication
Jimson weed, Jamestown weed, thorn apple	Datura tatula	Virginia to Texas	August to October	Waste places	Prevention of seeding
Johnson grass, Cuba grass, Australian millet, Egyptian millet, evergreen millet, Means's grass	Sorghum halepense	North Carolina to Texas and California	July to September	Cultivated fields; hoed crops	Alternate cultivation and heavy cropping
Lamb's-quarters, pigweed	Chenopodium album	Everywhere	August to November	Waste places	Prevention of seeding
Manroot, man-of-the-earth, morning-glory	Ipomoea Pandurata	Delaware to Missouri	August to October	Fields	Prevention of seeding; killing roots with coal oil
Milkweed, cottonweed, silkweed	Asclepias syriaca	New York to Nebraska	August to September	Fields	Prevention of seeding; cultivation; heavy cropping

Common Names	Technical Name	Where Injurious	Time of Seeding	Place of Growth and Products Injured	Methods of Eradication
Morning-glory	Ipomoea purpurea	Delaware and California	August to December	Cultivated fields	Prevention of seeding; thorough cultivation
Moth mullein	Verbascum blattaria	Maryland to Ohio and Oregon	July to November	Meadows	Sowing clean seed; cultivation; grubbing in fall
Narrow-leaved stickseed, beggar sticks	Lappula lappula	Everywhere	July to October	Everywhere; wool; crops	Sowing clean seed; cultivation
Nut sedge, nut grass, coco sedge	Cyperus rotundus	Maryland to Arkansas and Texas	August to November	In hoed crops	Alternate cultivation and smothering crops
Orange hawkweed, ladies' paintbrush	Hieracium aurantiacum	New York and westward	August to October	Meadows; pastures	Prevention of seeding; cultivation; salt
Oxeye daisy, white daisy, whiteweed	Chrysanthemum leucanthemum	Maine to Virginia and Ohio	July to October	Meadows; pastures	Prevention of seeding; cultivation; salt

Common Names	Technical Name	Where Injurious	Time of Seeding	Place of Growth and Products Injured	Methods of Eradication
Paraguay bur, sheep bur	Acanthospermum xanthioides	North Carolina to Florida	June to December	Waste places; pastures; wool	Cultivation
Pigeon grass, foxtail, yellow foxtail	Setaria glauca	Everywhere	July to November	Cultivated land; grain crops	Burning; thorough cultivation
Pigweed, careless weed, rough amaranth	Amarantus retroflexus	Everywhere	August to November	Cultivated land; all crops	Prevention of seeding; thorough cultivation
Poison ivy, poison oak, poison vine	Rhus radicans	Everywhere	July to August	Waste land; poisonous to man	Cultivation; repeated grubbing
Poverty weed	Iva axillaris	Montana to New Mexico	July to September	Cultivated land; all crops	Closer cultivation; smothering crops
Prickly lettuce, compass plant, wild lettuce	Lactuca scariola integrata	Ohio to Iowa, and Utah to Oregon	July to November	Everywhere; all crops	Prevention of seeding; burning
Prickly pear, cactus, Western prickly pear	Opuntia humifusa	Oklahoma, Texas, New Mexico	July to December	Pastures	Permitting grass to grow and burning
Purslane, garden purslane, pursely, pusley	Portulaca oleracea	Everywhere	June to December	Cultivated land; garden crops	Closer cultivation

Common Names	Technical Name	Where Injurious	Time of Seeding	Place of Growth and Products Injured	Methods of Eradication
Ragweed, bitterweed	Ambrosia artemisiaefolia	Everywhere	August to November	Everywhere; all crops	Prevention of seeding; burning
Rattlebox	Crotalaria sagittalis	Iowa to South Dakota	August to November	Pastures; poisonous to stock	Cultivation
Rib grass, black plantain, buckhorn, English plantain, lance-leafed plantain	Plantago lanceolata	Nearly everywhere	July to November	Everywhere; all crops	Clean seed; cultivation
Russian thistle, Russian cactus, Russian tumbleweed	Salsola kali tragus	Minnesota to Colorado	August to November	Everywhere; small grain	Cultivation; grazing; mowing for hay; burning
Shepherd's-purse	Capsella bursa-pastoris	Everywhere	May to December	Everywhere; all crops	Cultivation
Smartweed, swamp persicaria, shoe-strings	Polygonum amphibium emersum	Ohio to Nebraska	August to September	Lowland; corn, grain	Prevention of seeding; cultivation
Sorrel, field sorrel, red sorrel, sourweed	Rumex acetosella	Nearly everywhere	June to November	Meadows; pastures	Cultivation; smothering crops
Sow thistle, field sow thistle, perennial sow thistle	Sonchus arvensis	New England to Wisconsin	August to November	Meadows; pastures; grain-fields	Thorough cultivation and smothering crops

Common Names	Technical Name	Where Injurious	Time of Seeding	Place of Growth and Products Injured	Methods of Eradication
Spanish needles, bur marigold, beggar-ticks	Bidens bipinnata	Everywhere	July to November	Waste land; pastures	Prevention of seeding
Spiny cocklebur	Xanthium spinosum	Maryland to Texas and California	August to November	Waste land; pastures; wool	Prevention of seeding; cultivation
Stubble spurge, spotted spurge	Euphorbia nutans	Maryland to Missouri	August to November	Cultivated land	Prevention of seeding; burning stubble
Sunflower, common sunflower	Helianthus annuus	Nebraska to Louisiana	August to October	Cultivated land	Prevention of seeding
Toadflax, butter and eggs	Linaria linaria	New England to Wisconsin	August to November	Meadows; pastures	Cultivation; heavy cropping
Trefoil, black medic, nonesuch	Medicago lupulina	New York to Virginia	April to December	Meadows; lawns	Clean seed; cultivation
Tumbleweed, pigweed	Amaranthus graecizans	Minnesota to Kansas	August to October	Cultivated land	Prevention of seeding; burning

Common Names	Technical Name	Where Injurious	Time of Seeding	Place of Growth and Products Injured	Methods of Eradication
Wheat thief, corn gromwell, field gromwell, pigeon-weed	Lithospermum arvense	Michigan to Ohio	July to October	Grain-fields	Sowing clean seed; cultivation with hoed crops
White heath aster, frostweed aster, fall aster	Aster ericoides	Maryland to Indiana	September to December	Meadows; pastures	Mowing; grazing with sheep; rotation of crops
Wild buckwheat, black bindweed	Polygonum convolvulus	Michigan to North Dakota	July to October	Grain and wheat-fields	Sowing clean seed; cultivation
Wild carrot, bird's nest, devil's plague, Queen Anne's lace	Daucus carota	New England to Virginia	July to November	Meadows; pastures	Grubbing in fall; cultivation
Wild garlic, field garlic, crow garlic, wild onion	Allium vineale	Pennsylvania to South Carolina	August to September	Everywhere; dairy products; grain	Alternate cultivation and heavy cropping
Wild oats	Avena fatua	Minnesota to Oregon	July to September	Oat-fields	Sowing clean seed; burning; pasturing

Common Names	Technical Name	Where Injurious	Time of Seeding	Place of Growth and Products Injured	Methods of Eradication
Wild parsnip, queen-weed	Pastinaca sativa	New England to Wisconsin	July to October	Meadows; pastures	Prevention of seeding; cultivation
Yarrow, milfoil	Achillea millefolium	Massachusetts to Minnesota	June to August	Meadows; pastures	Grubbing
Yellow daisy, black-eyed Susan	Rudbeckia hirta	New England to Ohio	July to September	Meadows; pastures	Prevention of seeding; cultivation
Yellow dock, bitter dock, broad-leaved dock	Rumex obtusifolius	New England to Wisconsin	August to October	Meadows; pastures	Prevention of seeding; cultivation
Yellow dog fennel, bitter weed	Helenium tenuifolium	Texas to North Carolina	August to November	Waste land; pastures; dairy products	Prevention of seeding; cultivation

A poster bulletin of the University of Wisconsin Experiment Station contains the following:

HELP FIGHT THESE WEEDS

They Annually Cause Us a Loss of Millions of Dollars. We Can Rid Our Farms of These Pests if We Work Together.

HOW WEEDS TAX THE FARMER

1. They reduce crop yields by crowding and shading the plants, by robbing the crop of plant food and moisture.
2. They increase the cost of harvesting by causing extra wear and tear on machinery and heavier work for horses.
3. They lower the value of farm products by injuring the quality of grain, by causing waste of hay, by getting into and injuring wool.
4. They reduce profits in farming by reducing crop yields, by increasing cost of harvesting, by lowering quality of farm products and the value of land, and by increasing labor.

HOW WEEDS ARE SPREAD

1. By the scattering of the seed and by running roots.
2. By sowing impure seed and by the use of weedy hay.
3. By weed-seed-infested thrashing machines and other tools, binders, wagons, etc.
4. By feeding weedy grain without grinding.
5. By using unrotted manure. Manure containing weed seeds should be thoroughly rotted before being applied.
6. By the infested highways where weeds are allowed to seed.

HOW TO GET RID OF PERENNIAL WEEDS.

1. Pull, dig, or cut all scattered plants while in bloom. Burn them if seed has formed. Where weeds are few, cut off two or three inches below the surface of the ground, make funnel-shaped hole about the root and fill with strong brine or salt.
2. Smother with a rapid growing crop. Plow the weed infested field early in the fall, cultivating deeply and frequently until ground freezes. Plow again in spring. Cultivate frequently so as not to allow any growth above

ground. Then sow buckwheat or millet (rate, a bushel to the acre) the first of July.

3. Smother with paper. With small weed areas cover patch with overlapping strips of building paper, weighting it down and leaving it on during growing season.
4. Plant cultivated crops. Treat field the same as for smother crop. Harrow frequently with spring tooth harrow until corn or potato planting time. Plant potatoes or corn in check rows. Cultivate crop both ways, hoeing out weeds not killed by cultivation. Success can only be secured by most persistent work.

CHAPTER XXVI

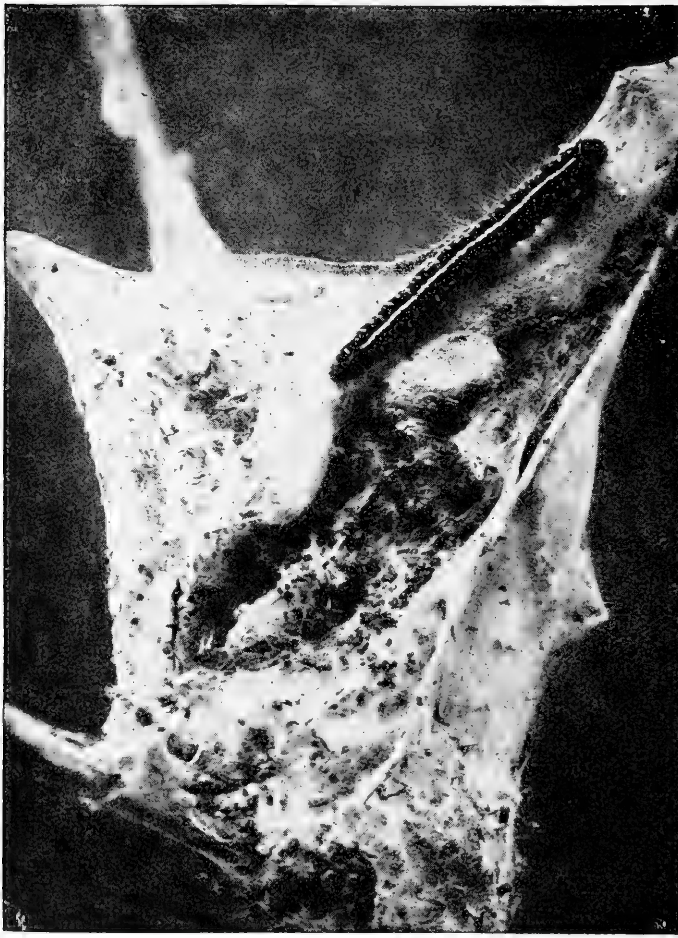
BIRDS AND OTHER INSECT DESTROYERS

ONE of the farmer's greatest problems is the protection of his crops against insect enemies and weeds. In this warfare he is greatly assisted by birds and other creatures that prey upon these pests for food. It is well that all who are interested in agriculture should come to know the birds that are most useful, that they may be protected and encouraged in every way possible.

Birds as "Policemen of the Air"

It has been carefully estimated by expert entomologists that insects yearly cause a loss of more than $700,000,000 to the farmers of the United States. Were it not for the work of our birds the amount of this loss would be incalculably greater. Indeed, some authorities claim that without the help of these feathered friends the insect enemies of farm crops would ultimately triumph and successful agriculture would come to an end.

Birds prey upon insects.—Not only do most birds in general find a considerable proportion of their diet among the harmful insects which so constantly levy tribute on the farmers' crops, but because of their powers of flight they can easily gather at points where any unusual outbreak of



A favorite food of the birds.

insects threaten completely to destroy the crops. For example, it has been noted that an unusual abundance of grasshoppers is sure to attract a large flock of birds from widely scattered areas and that these visitors leave the region only when they have exhausted the grasshopper supply. It has been similarly observed that any large increase in the number of small rodents, such as field mice, gophers and the like, quickly draws a large number of hawks and owls, which, while satisfying their own enormous appetites, produce a diminution in the number of the foe, if indeed they do not succeed in their entire extermination.

Birds require an unusual amount of food for their size and weight. While they are usually short lived they live at a rapid rate, breathing more rapidly and maintaining a higher temperature and a faster circulation than other vertebrates. This characteristic renders it necessary for birds to devote the greater part of their time to the hunting of insects, weeds, berries and whatever else may enter into their supply of food. Parent birds are also stimulated to additional activity and the industrious gathering of food during the time when their young are to be fed. For the young of birds which are not strictly insectivorous require large quantities of a food during the first few weeks of their lives. It is fortunate for the farmer that this carnivorous demand comes during the summer months and at the time when insects are most threatening to crops and gardens.

Number of insects destroyed by birds.—So industrious are birds in the collection of their food supply that they are not content to fill their stomachs with insects or seeds of weeds and plants, but after the stomach is stuffed so full that it will hold no more, they continue to eat everything they find until the crop or gullet is also crammed full. It is often found that when the digestive tract is opened and the contents of the stomach and gullet placed in a pile, the pile is two or three times as large as was the stomach when filled. The remarkable capacity of birds for eating a large supply of food is shown by the following facts learned by stomach examinations of many birds made by assistants of the United States Biological Survey:

"A tree swallow's stomach was found to contain 40 entire chinch bugs and fragments of many others, besides 10 other species of insects. A bank swallow in Texas devoured 68 cotton-boll weevils, one of the worst insect pests that ever invaded the southern half of the United States; and 35 cliff swallows had taken an average of 18 boll weevils each. Two stomachs of pine siskins from Haywards, California, contained 1,900 black olive scales and 300 plant lice. A killdeer's stomach taken in November in Texas contained over 300 mosquito larvæ. A flicker's stomach held 28 white grubs. A night-hawk's stomach collected in Kentucky contained 34 May beetles, the adult form of white grubs. Another night-hawk from New York had eaten 24 clover-leaf weevils and 375 ants. Still another night-hawk had eaten 340 grasshoppers, 52 bugs, 3 beetles, 2 wasps, and a spider. A boattailed grackle from Texas had eaten at one meal about 100 cotton bollworms, besides a few other insects. A ring-necked pheasant's crop

The meadow lark.

from Washington contained 8,000 seeds of chickweed and a dandelion head. More than 72,000 seeds have been found in a single duck stomach taken in Louisiana in February."

Birds Useful to the Farmer

It may in general be said that most of our birds found in the United States are useful and that but few of them are harmful. There are, however, but few that are always useful and never do any harm. For example, various insectivorous birds which destroy vast numbers of harmful insects, may also kill some insects or parasites which are themselves harmless and which prey upon harmful kinds. Such birds may also eat small quantities of fruit or grain, but taking the year round, nearly all of the common birds do vastly more good than harm and should in every way be encouraged around the farm and home.

Crows, hawks and owls.—Even the crow, which particularly during the spring season adds greatly to the farmer's trials by pulling up the newly planted corn, far more than earns his way on the farm by eating many insects, especially white grubs and cutworms. He also destroys many meadow mice and other such small rodents. Along with the crow, the hawks and owls, which usually receive a bad name and are freely hunted and killed wherever found, are to be classed among the useful types that should be protected because of their destroying vast numbers of insects and harmful rodents. While these birds are generally classed as thieves and robbers, a great majority of them spend most of their long life in pursuit of enemies of the farmer. As many as one hundred grasshoppers have been found in the stomach of a hawk, and this represented but a single meal. In the nest of a pair of barnfowls were found more than three thousand skulls, the greater part consisting of field mice, house mice and common rats. In another case nearly one-half bushel of the remains of pocket gophers was found adjoining the nest of a pair of this species. Wherever birds of prey of such sort are killed off there is immediately noticeable an increase in the number of noxious rodents. Only a few species of hawks are injurious, their depredations consisting chiefly in attacks on birds and chickens. The Cooper's hawk, the sharp-shinned hawk and the Goshawk are three species which should be known by every farmer and killed on sight.

Several years ago the state of Pennsylvania offered a bounty on hawks and owls. The result was the killing of more than one hundred thousand of these birds. It was estimated by Doctor C. H. Merriam of the United States Biological Survey that the state of Pennsylvania sustained a loss of nearly four million dollars in eighteen months through the killing of these birds. It is needless to say that the law was quickly repealed when the mistake in policy was discovered.

Other helpful birds. — The rapid-flying swallows, swifts and night hawks are especially adapted to the capturing of all flying insects, and the darting tireless flight of the swallow and its hunting mates results in a great reduction in the number of mosquitoes, flies and other annoying pests. Other birds are similarly adapted for their own peculiar work in reducing the farmer's insect enemies. For example, the woodpecker is provided with a remarkable set of claws by which to hold himself firmly while at work. He has a drill-like bill driven by powerful muscles with which to dig out insects; and he is even provided with an extensible tongue by means of which he can still further explore the hidden retreats of larvæ or insects which hide away from their foes.

Such birds as the creepers, tit-mice, warblers, fly-catchers, quails, doves and other families have each their own special adaptation to the work required for their food supply. And however these birds may differ in other qualities, they are all alike in the fact that they possess a boundless appetite for insects and weed seeds.

Birds as weed seed eaters.—The great value of birds as weed seed eaters is shown by an estimate made by experts in the United States Department of Agriculture: Their conclusion after careful computation is that the tree sparrow requires one-fourth ounce of weed seed per day as an average ration. On this basis the tree sparrows in a state like Iowa, annually eat approximately eight hundred and seventy-five tons of weed seeds. Only the farmer knows the harm which seeds do to his growing crops and can appreciate the great saving accomplished by the destruction of this vast quantity of weed seeds. If the comparison is extended to the entire United States, the estimate is that the tree sparrow saves to the farmers through its weed-eating habits, something like ninety millions of dollars each year.

Value of birds proved by scientific study.—As a still further example of what birds mean to the farmer, the following facts gathered from a report of the United States Biological Survey are of interest: The bluebird's diet consists of sixty-eight per cent. of insects to thirty-two per cent. of vegetable matter, the largest supply of insects being grasshoppers first, beetles second and caterpillars third. Almost none of the vegetable part comes from cultivated varieties. Robins live on almost every kind of insect available, being especially fond of earth worms. While half of the robin's food is fruit, this bird prefers wild varieties chiefly and does but little harm in orchards and gardens. Grasshoppers, beetles, caterpillars, bugs and spiders are the principal food of the house wren, though cutworms, weevils, ticks and plant lice are also acceptable.

The barn swallow gets more than one-half of its food supply from flies. Beetles stand next in order, while ants, wasps and bees follow. The purple martin finds more than three-fourths of its ration in such insects as wasps, various bugs, beetles, flies and moths. The rose-breasted grosbeak is so fond of potato beetles that it has been called the "potato bug bird."

The meadow lark lives chiefly on beetles, caterpillars, grasshoppers and weed seed. The quail or bob-white eats weed seeds, potato beetles, squash beetles, boll weevils, chinch bugs, grasshoppers and cutworms. Mourning doves live principally on weed seed with a small proportion of waste grain. Cuckoos select for their diet caterpillars, grasshoppers, beetles, moths and other harmful insects.

It will not be necessary to extend this list which might

The hairy and downy woodpeckers.

be made to include scores of other birds that join with the farmer in his effort to rid the crops of insects and weed enemies. Among the many species that should be encouraged and protected are: meadow-lark, house wren, song sparrow, oriole, scissor-tail fly catcher, mocking-bird, blue jay, red-winged blackbird, cardinal, red-headed woodpecker, killdeer, screech owl, robin, bluebird, snow bird, warbler, kinglet. In general, the birds are the farmer's friends and deserve his attention, protection and good will.

Harmful birds—A few species of birds do much more harm than good and therefore do not merit protection. The *English sparrow* has been declared a pest and should be exterminated. While in some regions it eats a certain proportion of weed seed and harmful insects, on the whole its diet consists of orchard fruits, young garden vegetables and field grains, especially wheat. It also eats the eggs and attacks the young of a score of useful birds, thus reducing their number. Campaigns of extermination have been waged against the English sparrow in various parts of the country.

The *house finch* and the sapsucker also do sufficient damage that they have no claim to the farmer's good will nor protection.

Other Enemies of Harmful Insects and Animals

Besides birds, a number of other creatures, most of them so lowly as all but to escape observation, are also good friends of the farmer.

The toad.—The common ugly toad, which we often either avoid or kick out of our path, deserves better treatment. Its food consists of flies, caterpillars, cutworms, June-bugs and other harmful insects.

The *horned lizard* fancies almost the same bill of fare and joins with the toad to protect our gardens from pests.

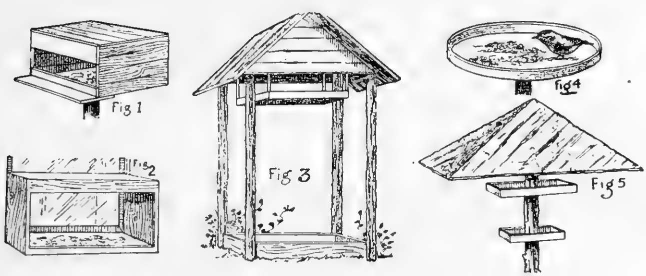
Snakes.—The small snakes common to most regions are entirely harmless, and live on our enemies, such as mice, various beetles and weevils. It is therefore a mistake to kill them.

Protecting Our Friends

Farmers should encourage their boys and girls to make a study of the life and habits of the humble friends who do their best to rid our fields and gardens of their enemies, and should always encourage and protect them.

Attracting the birds.—Bird houses consisting of small boxes roofed over, cans open at one end, or other suitable receptacles placed in trees or on posts in secluded places will do much to attract certain birds. The building of bird houses and feeding and watering devices should be encouraged in every neighborhood. This can be done by contests, through fairs, club festivals, and promoted by the schools in cooperation with their patrons. When deep snow covers the ground in winter, thus hiding the seeds and other food, it will pay well to scatter a little grain each day where the non-migrating birds will find it.

How to treat a friend.—Bird hunting should not be with a gun, but with a camera, field-glass or alert eyes for the purpose of becoming acquainted with our feathered friends. Birds' nests should never be disturbed, the eggs handled or the young worried during nesting time. The fashion which decorates hats with the plumage of birds, thus requiring their destruction, should be severely condemned. We should even come to look upon toads, lizards, snakes and frogs as our friends and treat them with intelligent consideration.



Feeding places for birds.

Fig. 1—Bird feed shelter for post. Fig. 2—Bird feed platform for side of building. Fig. 3—Bird shelter and feeding platform for lawn. Fig. 4—Bird watering platform for top of post. Fig. 5—Combination, shelter, feed and watering arrangement.

CHAPTER XXVII

NATURE OF SOIL

IN our discussion of plants and crops we have constantly referred to the soil. What is *soil?* Whence does it come? What relation does it bear to plant life, and hence to our own lives? Take a handful of "dirt" and crumble it between your fingers; of what does it consist, what is its nature?

Origin of the Soil

Soil did not always exist as it is to-day. When the earth was young and the crust was forming there was no soil types as they are found now. There was only *rock.* And it is out of the weathering of this surface rock that the soil has come; and the process is still going on whenever rock is exposed. Soil is but *particles of rock,* to which has been added *organic matter* coming from the plants and animals that have lived on it or in it.

The weathering of rock.—Rock is made into soil by two different processes, *disintegration* and *decomposition.* By disintegration is meant the breaking up of rock into small particles without changing their nature. By decomposition is meant such breaking up by chemical action that the nature of the particles is changed.

The chief agencies causing the *disintegration* of rocks are sudden changes of temperature and the action of frost.

When masses of rock are heated by the sun they expand; sudden cooling at night or from change of weather causes so rapid a contraction that they are rent asunder. Water freezing in crevices also constantly breaks masses of rock into smaller pieces.

Rocks undergo *decomposition* largely through changes due to the action of chemicals carried in water. The min-

A plowing contest offers sport as interesting to farm boys as baseball.

eral substances in the rocks are dissolved, and new products formed.

Surface and subsoil.—The terms *soil* and *subsoil* are used to distinguish the top portion from the soil that lies underneath. The line between the dark humus-colored part and the lighter soil below is sometimes spoken of as the division between soil and subsoil. Another distinction made is to call all that lies below the depth of tillage subsoil. No such dividing line can be sharply drawn, however, as much organic matter is found below the humus line, and the depth of tillage does not mark a natural division in layers of the soil. Surface soil differs from subsoil chiefly in the organic matter it contains. The depth of the surface, or cultivated soil can be increased by deep plowing, which brings up new layers to receive a supply of organic matter and mix with the upper soil.

Classes of Soils

Classes of soils based on origin.—It is evident that soils will differ in accordance with the nature or material of the rocks from which they come. They also vary on the basis of the mode of distribution or laying down of the layers; for example, some are formed from the rocks directly underneath, and others are transported long distances by water or wind. Still others are built up with a relatively small proportion of rock particles and a large proportion of organic matter called *humus*. On the basis of their *origin* the most important classes of soils are, (1) residual, (2) glacial, (3) loessial, (4) alluvial, and (5) humus.

(1) *Residual* soils, or those formed from the underlying rocks will of necessity partake of the nature of the mother-strata. In the formation of soil from granite rocks the quartz, refusing to decompose, remains as grains of sand. The feldspars, on partially decomposing, yield clay. Limestone when weathered produces a fine textural clay.

(2) Geologists tell us that large areas of North America and Europe were at one time in the grip of glaciers—gigantic fields of ice flowing slowly southward foot by foot,

like a great river only much slower. These enormous blocks of ice would, of course, gouge and scrape and wear the rocks over which they moved. They would push along great masses of soil, and gather other masses of soil and rocks from over-hanging cliffs against which they passed. In these ways the great ice rivers would transport and distribute soils over other regions than those where they were formed. They would carry granite boulders and leave them strewn over territory miles away from the home of the rocks. They would wear down the sharp angular hills and leave great masses of earth dumped where the ice field melted, thus giving us the more undulating hills and valleys of the great central region of the United States. Thus were the *glacial* soils formed.

(3) The wind is always at work carrying particles of soil from one place to another. Though these grains are small, the aggregate thus transported is gigantic, and large areas of the world have soils of this *loessial* formation. Such soils are found extensively in Iowa, Illinois, southwestern Wisconsin, eastern Kansas and Nebraska, Missouri, and southward along the Mississippi River. Since the prevailing winds in these regions are from the west, the general movement of the loessial soils over this territory is eastward. Since the formation of loessial soil continues, while glaciers are no longer at work except in extreme latitudes, it is evident that loess will overlie glacial deposits wherever it is being formed. Loessial soils, being carried from dry regions where the lime and other basic elements have not been washed out, are usually very fertile.

(4) Wherever water is found it holds certain soil elements in suspension or in solution. In running water, soil particles are constantly being carried downward toward lower levels. Where streams or sheets of water overflow, layers of sediment are deposited, thus producing *alluvial* soils. The drying up of lakes or other bodies of standing water also leaves an alluvial deposit in the former bed. All great river systems have, by their overflow, built up alluvial soils along their course. Since the coarser soil particles are heavier than the finer particles held in suspension in flowing water, the coarser particles will settle first, while the finer particles will be carried farther down-stream. This fact explains why alluvial soils along the upper courses of rivers are coarser than those along the lower courses. Streams formed by the melting glaciers carried immense deposits, sometimes filling valleys to a depth of fifty to two hundred feet with sand and gravel. Many such deposits are to be found throughout the northern part of the United States and in Canada. Large areas of clay and heavy silt soil in northwestern Minnesota and North Dakota were formed by the drying up of a gigantic glacial lake in that region.

(5) Humus soils are found wherever organic matter, either animal or vegetable, has a chance partially to decay underneath the surface. Under these conditions it changes into a blackish substance, giving the soil the well-known black surface observed in its top layers. Humus is chiefly derived from the roots of plants and the vegetable matter that is turned under in tilling cultivated land. Because of

the plentiful root system of most grasses, the prairie regions usually show the black humus soil to considerable depth. The maintenance of a generous supply of humus in soils is of prime importance in agriculture, as will be shown later.

Classes of soils as influenced by climate.—Strange as it may seem at first thought, climatic influences play a greater part in determining the nature of soils than do the mother rocks from which they came.

The prairie soils so common in the Mississippi Valley and other large regions of the world owe their chief characteristics to climatic conditions resulting in luxuriant crops of grass and to the conditions as to heat and drainage favoring the formation of humus. Tropical climates, because of their excessive heat and moisture hasten the decomposition of organic matter, hence humus does not readily form. The excessive rainfall also washes soluble salts from the soil and so deprives it of elements needed for fertility.

On the other hand, arid climates lack sufficient rainfall to carry away certain salts formed by the weathering of the soil. The accumulation of these salts results in what are called *alkali* soils. Wherever the annual rainfall is less than about fifteen inches in regions of moderate temperatures or less than twenty inches in regions of high temperature, alkali is likely to occur. Large regions of the semi-arid West have alkali soils.

Organic Matter in Soil

Examine carefully a lump of common field soil. Pulverize it and spread it out on a paper. In addition to the grains of sand, silt and clay which represent the rock portions, note all the different *organic* particles, such as pieces of roots, fibers of plants, and parts of insects. Place it under a magnifier, and see whether you can make still further discoveries.

Need of organic matter.—Although the rock particles make up far the greater part of the mass of the soil, organic matter is of the highest importance to plants. Indeed, it is practically impossible to raise crops on soil lacking in organic constituents. All the upper layers of ordinary soil contain from two to five per cent. of organic material, coming chiefly from the roots and stems of plants.

Humus.—When vegetation decays on top of the ground it is really burned up as effectually as if put into a stove, only more slowly. The gases pass off into the air and only a little ash remains on the soil. From this process the soil receives comparatively little benefit. If, however, decay takes place under the surface, where but little oxygen is present, a substance is produced which is called *humus*. All soil on which plants are grown is therefore constantly producing humus from the roots, and from the stubble and stems if these are turned under. Dig up a piece of timothy sod and note the mass of roots—about two tons of roots to the acre on a good field. Blue-grass yields some six tons of roots to the acre. Soils that are cropped continuously with the common cereals and the crops removed without returning manure to the field become deficient in humus, and the yield is decreased.

Effects of humus on the soil.—The most easily noted effect of humus is in the darkening of the soil. The so-called "black" soils get their color from the abundance of humus they contain. The coloring is accomplished by the partially decayed and partially preserved black organic matter coating over the small particles of the soil. The depth to which humus extends, ranging from a few inches to several feet, can be noted at any wayside ditch by the line between the dark soil on top and the lighter soil beneath.

Humus serves several very important uses in the soil: (1) it acts as a storehouse for different kinds of plant food; (2) it increases the capacity of the soil to hold water; (3) it aids in both creating and conserving heat in the soil; (4) it favors the growth of bacteria helpful to plants; (5) it improves the physical condition of the soil, making it more porous and more easily cultivated.

Living organisms.—Reference has already been made to the influence of certain bacteria in the fixing of nitrogen in the soil. The soil harbors many different kinds of bacteria and other organisms. It is fairly teeming with life, some of which is hostile to plant growth, but more of which is necessary to successful plant development.

Other organic matter.—Besides living organic matter and that which has undergone chemical changes converting it into humus, most soils contain a certain amount of vegetable matter in the form of roots and stems of plants which have not yet begun the process of decomposition. These affect the soil chiefly in making it more accessible to air and light, and more permeable to water.

Texture of Soils

Secure samples of three different field soils, (1) a clay soil, (2) a silt soil, and (3) a sandy soil. Place each of these one inch deep in a bottle. Now fill all three bottles with water and shake for several minutes. Put the bottles in a quiet place and let the contents settle. Note which soil settles to the bottom most quickly. The time it requires to settle depends on the coarseness or fineness of the texture. From the point of view of texture, soils are classified as follows: *clay, silt, sand,* or *gravel.*

Meaning of texture.—By texture of soil is meant *the degree of fineness or coarseness of the particles* of which it is composed. The finest soil particles, which will remain in suspension clouding water for hours, are called *clay.* The next finest, which will settle in about one hour, are *silt.* The coarser particles, which will settle almost at once, are called *sand* or gravel.

Most crop soils have all of the first three of these grades or sizes of particles in their make-up. The texture of the soil depends on the proportion of each in the mixture. Soils are named in accordance with the particular one of these elements that outweighs all others.

If the very fine particles are in excess, we speak of a *clay* soil; if the texture is intermediate, of a *loam* soil; and if coarse, of a *sandy* or gravelly soil. We also use the terms *clay loam, silt loam* and *sandy loam,* etc., to describe the texture.

Composition of three soil types.—A mechanical analysis of three types of soil texture made by the United

States Department of Agriculture shows the following proportions of soil particles in each:

Type of soil	Fine gravel	C'se sand	Med. sand	Fine sand	Very fine sand	Silt	Clay
Norfolk sand (truck soil)	3%	15%	22%	38%	10%	8%	4%
Wabash clay (riv. bot.)	0	1%	1%	3%	7%	49%	39%
Silt loam (corn soil)	0	1%	1%	2%	8%	73%	15%

From this table it is seen that Norfolk sand, which is an excellent soil for truck gardening on the Atlantic, is eighty-eight per cent. sand and gravel, and only twelve per cent. silt and clay combined. Middle western silt loam, such as grows most of our field corn, is three-fourths silt, and fifteen per cent. clay and twelve per cent. sand. River-bottom clay soils are slightly more than one-third clay, and almost one-half silt.

Structure of Soils

Take a piece of clay in your hand. Try to crumble it into small particles. Do the same with a piece of loam; with a lump of sandy soil. Note that some soils plow up in great clods, while others break up into small pieces, producing what is called a mellow condition. You have noticed that in some places the ground cakes and cracks open when it becomes very dry, while in other places it remains soft and unbroken no matter how dry it becomes? These differences are matters of soil *structure.*

Soil structure.—By soil structure is meant the mode in which particles adhere to one another, causing them to cling together in solid masses hard to break up, or forming but loosely joined lumps which are easily broken or pulverized.

Clay soils are of a heavy, dense, clinging structure, difficult to break apart, hence hard to plow. Silt loams and sand loams, on the other hand, are *friable;* that is, they are easily broken up. They plow or pulverize easily because they are not so adhesive. All soils that are lacking in humus tend to become dense and resisting in structure.

Causes affecting soil structure.—The chief adhesive force holding soil particles together in clusters, grains or lumps is the *water films* that surround the particles. Each separate particle is covered by a thin film of water, whose effect is much the same as a film of rubber. Let a number of small soil particles, each surrounded by its water film, come into contact, and their individual films all merge into one, and by its tension unites these particles in a single granule, or cluster. These clusters are in a similar way joined into still larger clusters, and so on until, in fine clay soils, one continuous mass is formed. As clay soils dry out the films break, shrinking occurs and the surface cracks open.

The greater adhesive power of clay soils comes from the fineness of their particles. The larger the number of particles in a given mass of soil, the greater the aggregate surface of these particles, and hence the greater the amount of water films needed to bind the particles together. Sandy soils do not form into granules, or lumps, because the aggregate surface of the particles is not sufficient to supply the binding force of water films necessary to hold them together.

It has been carefully estimated that the particles of a cubic foot of soil of different textures have the following aggregate amount of surface:

Coarse sandy loam	40,000	square	feet.
Sandy loam	65,000	"	"
Silt loam	100,000	"	"
Clay soil	150,000	"	"

From these comparisons it is clear that the water films are several times greater in area in clay soils than in sandy soils, hence the tendency to adhesiveness in clay soils is correspondingly increased.

Soil structure and tilth.—All have noticed that some seed beds are granular or full of lumps, with very little fine earth for packing about the seeds. Others are finely pulverized, and favorable for plant growth. The condition presented by the soil with reference to plant growth is called its *tilth.*

Tilth depends chiefly on soil structure. Dense heavy soils that have a tendency to form into lumps when plowed, or that easily bake after rain, make it difficult to maintain a good tilth. On the other hand, a good tilth is equally hard to maintain on soils that easily burn out in a drought, or that for any reason are not good reservoirs of water.

Erosion

Nature of erosion.—By *erosion* is meant the wearing or carrying away of soil by the action of running water and the wind. Erosion by running water takes place in some degree on all slopes; the hills are gradually but constantly being carried into the valleys. But it is on the steep hillsides where the velocity of the water is greatest that most damage is done. The reason for this is easily seen when it is remembered that the transporting power of water increases as the sixth power of its velocity. This means that doubling its velocity increases the carrying power sixty-four times;

A hillside, showing the effects of water erosion.

trebling its velocity increases the carrying power seven hundred and twenty-nine times, and so on.

The texture of the soil has much to do with erosion. All soils that permit ready absorption of water, as from rains or melting snow, leave less to run over the surface, and so are less subject to erosion than dense clay soils.

Effects of water erosion.—Erosion by running water not only produces gullies and ditches that interfere with cultivation, but greatly reduces the fertility of hilltops and slopes by general surface washing. For the best parts of the soil are carried away by erosion. Organic matter is relatively light, and so floats off; the finer clay and silt particles as we have seen, remain long in suspension in water and are carried away, while the coarser portions are left behind. And it is just this organic matter and the finer soil particles that contain the best part of the plant food. No wonder then that the hilltops have a thin poor soil, and that the valleys are noted for their fertility.

Prevention of erosion.—While soil erosion can not be wholly prevented, it can be greatly checked. And nature suggests one effective remedy in covering all soil with vegetation. It is bare soil that washes and blows away. Even a steep hillside when covered with grass is reasonably free from erosion. For the stems tend to delay the downward rush of water, thus causing it to soak into the ground, and the roots bind the soil together. This indicates that steep slopes should be used for pasturage, meadows and wood lots rather than for cropping. The addition of organic matter in the form of manure also lessens the danger from washing, since it increases the capacity of the soil to absorb water, and also tends to bind the soil together.

Hillsides when tilled should be plowed along the slope rather than up and down, and in many sections it is necessary to terrace the hillsides. This delays the forming of rivulets and favors absorption of water. Every furrow leading down the hill is the beginning of a gully in times of heavy rains. Even the marks left by the wheels of a corn planter, unless leveled over by harrowing, will serve as water channels and result in waste of soil and washing out of the seed or plants.

Gullies once started should be leveled immediately by use of the plow or other form of cultivation. Pack straw, hay, or manure at the head of the channel, or at intervals along its course, as this will do much to stop the erosion, especially if used in time. Sheet, or surface, washing is, however, a source of greater damage than the formation of gullies. For sheet erosion, though gradual, is constant on the slopes of all tilled fields.

CHAPTER XXVIII

SOIL FERTILITY AND PLANT GROWTH

PLANTS, lower animals and men all depend either directly or indirectly on the soil and air for their existence. The elements required to build up either plant or animal tissues must be drawn from these two sources. But animals can not draw food directly from the soil and air,—only plants have the power to appropriate food substances in these crude forms and make them over into living, organic matter. Plants may therefore be looked upon as minute factories, each at work building living tissues out of elementary substances not available to animals. All human food comes either from the plants themselves, or from animals that feed upon plants.

The Soil as the Home of the Plant

The soil is the home of the plant, at least of all plants cultivated in agriculture. There the plant must find all conditions necessary to its growth, health and prosperity. This means that just as a man requires more from his home than food for the body, so the plant must find in its soil home more than the food demanded for its development.

Must be adapted to roots of plant.—The plant must find in the soil congenial conditions for the distribution of its roots. For these are the plant's mouths, through which it drinks up the supply of food and moisture. The soil must be easily permeable by the delicate root-tips, which are the true growing points of the underground part of the plant, and through less than one-eighth of an inch of which at the very extremity of each growing rootlet the plant gets its nourishment.

The tilth and general physical condition of the soil must be such that the roots of the plant can "breathe." For plants, like animals, require oxygen in their growth. Soils that are baked or water-logged are to the plant what a tightly sealed room would be to a person—both suffer from want of air, and growth is checked and often the life forfeited.

Must prove congenial to plant nature.—The soil must be free from the various toxins, or poisons, detrimental to the plant. Yet we must remember that, as in the case of animals, what may be harmful to one may benefit another. For example, while acid in soils is fatal to the best growth of clover, alfalfa and other legumes, cranberries and certain other crops do best on an acid soil. Poisons from many of the weeds are a distinct damage to cultivated crops. Alkali in certain western regions prevents the successful raising of many of the farm plants.

In addition to these conditions belonging particularly to the soil itself, all plants must have adequate heat and moisture. While these are not supplied directly by the soil, its condition, as previously shown, has much to do with the maintenance of heat and the conservation of moisture.

The plant which finds its soil home congenial in all such matters—in its physical condition, in its air supply, in its heat and moisture and freedom from hostile toxins, is in condition to appropriate and profit by the plant food contained in the soil. Lacking any of these necessary conditions the available plant food, that is the soil *fertility*, may go for naught and the crop fail. Fertility is therefore only one of the essential factors in plant production.

Plant Food and Soil Fertility

Fertility and the capacity of the soil for plant production are different terms. Fertility is a question of what the soil is capable of doing under most favorable conditions—the quantity of available plant foods ready for the growing crop. The producing power depends on the presence of fertility plus the conditions discussed in the preceding section. This is to say that different modes of cultivation or soil treatment in general may result in very different crop yields in soils of the same fertility. In order to reap the full advantage of fertile soils or to secure the benefits from the fertilizers applied good tillage must be practised.

Food required by plants.—Agricultural plants require, in all, ten principal chemical elements for their growth. These are:

Carbon Hydrogen Oxygen	Supplied by air and water.
Calcium Magnesium Iron Sulphur	Supplied by the soil. Quantity practically inexhaustible.
Nitrogen Phosphorus Potassium	**Supplied by the soil. Quantity limited.**

The first of these ten plant elements—carbon—is supplied in the form of carbon dioxide by the atmosphere, and hence forms no part of the soil's fertility. Hydrogen and oxygen, which are the elements that compose water, are taken up by the plant directly from the water of the soil. The next four of the list, calcium, magnesium, iron and sulphur, are found in practically all soils in quantities sufficient for ordinary plant growth. The fertility of the soil therefore depends chiefly on the supply of the last three, *nitrogen, phosphorus* and *potassium.*

Rich or fertile soils are those that contain an abundance of these three elements. Every crop removes some amount of *each* of the seven elements supplied by the soil; but since calcium, magnesium, iron and sulphur are practically inexhaustible, they do not have to be replaced in order to maintain the soil's fertility. Nitrogen, phosphorus and potassium, however, must constantly be returned to the soil if it is not to become exhausted and the crops reduced. As the strength of a chain is measured by its weakest link, so the fertility of the soil is for most crops measured by the amount of these elements available.

It must not be understood, however, that nitrogen, phosphorus and potassium are in any way linked together so that when one is short all must be lacking, or that when one is present in sufficient quantity all must be in abundance. Each of these three elements is independent of the others. Lack of fertility and consequent failure of crops may be due,

Field showing the effect of legumes and proper treatment of the soil. On the left manure was used; on the right, limestone, rock-phosphate and manure.

therefore, to a shortage of any one element, the other being present in abundant supply.

Danger of loss of fertility.—One of our chief agricultural problems is to maintain the fertility of the soil. We must all live from its products, no matter what our occupation. A large proportion of the tillable land of the United

States is now occupied. Our people must be fed from the land; there is no other source of supply.

This means that we should not only keep up the fertility of the soil, but actually increase it as time goes on. It is estimated that our population is increasing five times as fast as our food supply. This fact explains in part, at least, the high cost of living.

Much land has been rendered almost valueless by means of single cropping, and by rental of land on short-term leases to farmers who have robbed the soil of its nitrogen, phosphorus and potassium. Farms located within a hundred miles of the great eastern and southern markets have recently been bought for from ten dollars to twenty dollars an acre, when middle western land is selling for one hundred dollars to two hundred seventy-five dollars an acre. Much of this eastern and southern land was originally as good as the western, and would be worth three hundred dollars an acre if it had been properly farmed to conserve its fertility.

The importance of soil conservation is thus emphasized by Doctor C. G. Hopkins of the University of Illinois:

"The greatest material problem of the United States, is not in the development of the waterways, not in the preservation of forests, and not in the conservation of our coal and iron, important as these all are; but the problem that is vastly greater than all of these, is to bring about the adoption of systems that will maintain or increase the productive power of American soils.

"Not only on the black cotton soils of India, where five acres of land are now required to produce one bale of cotton; not only on the black earth soils of Russia where eight bushels is the average yield of wheat after a year of fallow—but also on the black corn soils of America—the practice of the art of agriculture tends toward land ruin.

"Whenever the hundreds of thousands of acres of level or gently undulating, depleted or abandoned farm lands of New York and old Virginia are redeemed and made equal to the newer lands of the Central West which are now in their prime, some of them paying good interest on $200 an acre, then, and not until then can there be any other material problem of the United States that compares with this in reference to the future welfare of America."

Soil Nitrogen

Nitrogen constitutes one of the most important food elements supplied by plants, especially in all protein-producing foods. This nitrogen must be secured by the plant from the soil. The soil comes by its nitrogen from three sources: (1) a very small amount is added to the soil by the rainfall; (2) from the organic matter of plants and animals which, when partially decaying underneath the surface, produces humus; and (3) from the air, through the action of nitrifying bacteria living on the roots of leguminous plants. Every successive crop removes some amount of nitrogen from the soil. Nitrogen is also lost through *leaching,* through *erosion,* and through the process called *denitrification.* It is evident that this loss must in some way be made good if fertility is to be maintained.

Amount of nitrogen available.—Careful investigations have shown that the amount of nitrogen in the top eight inches of an acre of Wisconsin soils varies from fifteen hundred pounds in light colored sands to five thousand pounds in loams, and ten thousand pounds in muck or peat soils. Upland prairie soils in Illinois showed in the first seven inches of an acre from twenty-eight hundred to thirty-three hundred pounds of nitrogen, and upland timber soils about fifteen hundred pounds.

A thirty bushel crop of wheat removes from an acre about forty-eight pounds of nitrogen; a fifty bushel crop of oats, fifty pounds, and a sixty-five bushel crop of corn, eighty-five pounds. The amount of nitrogen lost by leaching depends largely on the form in which the nitrogen exists and the amount of rainfall. Most nitrogen compounds are not easily soluble in water, but nitrogen in the form of nitrates is easily soluble and so easily lost by leaching. The nitrates formed under conditions of heavy manuring of truck crops are subject to a considerable amount of loss. Nitrogen also leaches more readily from cultivated than from sod land.

Loss of nitrogen.—Whenever soil is subject to erosion, nitrogen is, of course, being carried away with the humus or other forms of organic compounds in which it exists. Winter cover crops are coming to be quite generally used in the South to prevent both erosion and leaching.

By denitrification is meant the loss of nitrogen from the soil in gaseous form. This is caused by the action of certain bacteria. These bacteria thrive best in the absence of air; hence loss of nitrogen from this source is greatest in wet, poorly cultivated soils which lack aeration. Poorly rotted manure contains large numbers of denitrifying bacteria. An excessive use of such manure may even reduce the amount of nitrogen already in the soil. This would suggest a moderate application of manure at frequent intervals rather than an excessive application at longer periods.

Phosphorus in Soils

The phosphorus of the soil originates in the rock from which the basis of all soils comes. It occurs in large quantities in the mineral opatile. The amount of phosphorus found even in virgin soils differs greatly, varying from about four hundred to three thousand pounds.

Exhaustion of phosphorus.—A thirty bushel crop of wheat will remove from an acre of soil nine and two-tenths pounds of phosphorus; a fifty-bushel crop of oats, seven and eight-tenths pounds; a sixty-five bushel crop of corn, fourteen pounds. Analysis of the depleted soils of parts of India, Turkey, and various sections of Asia show hardly a trace of phosphorus remaining. A similar test of the soil from the exhausted farms of our own eastern states reveals nearly the same condition in many instances. And this is what will happen to the richest of our virgin soils unless steps are taken to maintain the supply of phosphorus.

Under ordinary farming conditions, phosphorus is constantly being lost from the soil. When the grain produced is sold, three-fourths of the phosphates taken from the soil are removed from the farm. Milk and cheese sold off the farm also carry away a considerable amount of phosphorus. Phosphoric acid up to some fifteen per cent. of the whole amount is lost from farm manures under prevailing methods of handling them. From these facts it is plainly evident that phosphorus must be returned to the soil in some form if its productivity is to continue.

How to conserve phosphorus.—The available supply of phosphorus is to be maintained or increased, (1) through feeding the crops and returning the barnyard manures carefully to the soil, (2) through the buying of feeds such as bran or other concentrated nutrients and using them for the maintenance of farm stock, and (3) through the use of commercial fertilizers. It is fortunate for farmers whose soil is depleted of phosphorus that commercial fertilizers can now be bought at reasonable prices to remedy the defect.

Potassium in Soils

Soils average a considerably larger proportion of potassium than of either nitrogen or of phosphorus in their composition. The amount per acre in the top eight inches runs from twenty thousand up to forty thousand pounds for loam and clay soils, from five thousand to about twenty thousand pounds for sandy soils, and from one hundred to twenty-five hundred pounds for muck and peat soils. This generous supply would seem not easily exhaustible except in soils of the muck or peat type.

Yet the situation is not so favorable as it would appear from these figures. For much of the potassium of the soil exists in minerals that are not soluble in water and hence the plant can not make use of them. The process by which this supply of potassium is finally made available to plants is a chemical decomposition which is so slow that plants may be starved for potassium in soil that contains an abundance. Such is likely to be the case on sandy soils, when the chemical change is even slower than on moist finer soils. The remedy is the application of a potassium fertilizer.

Keeping up supply of potassium.—The problem of maintaining a potassium supply on the farm is somewhat simpler than in the case of phosphorus, for the reason that while phosphorus enters more largely into the grain than into the stems of plants, potassium is expended largely in the stalks and stems. Even if grain is sold from the farm, therefore, the supply of potassium can be kept up reasonably well by returning to the soil as much of the straw, stubble, corn stalks and hay as is possible. It will, nevertheless, often pay to apply some form of commercial potassium fertilizer to soils that are lacking in this element.

Supply of food taken by crops.—The following table gives the amount of each of the three elements, nitrogen, phosphorus and potassium removed from an acre by some of the common farm crops:

Crop.	Nitrogen Pounds	Phosphorus Pounds	Potassium Pounds
Wheat—			
Grain, 30 bu.	33	6.2	7.7
Straw	15	3.0	16.2
Oats—			
Grain, 50 bu.	35	5.2	8.3
Straw	15	2.6	29.1
Corn—			
Grain, 65 bu.	40	7.9	12.5
Stalks	45	6.1	66.4

Potatoes—			
224 bu.	47	9.4	63.5
Potato vines	20	1.2	0.9
Sugar Beets—			
(Roots only)			
15 tons	48	10.5	82.2
Red Clover—			
Hay, 2.42 tons	102	10.9	69.2
Alfalfa—			
Hay, 4 tons	200	17.9	95.5
Timothy hay—			
3000 lbs.	16.2	3.5	17.6

Crop Rotation and Fertility

The rotation of crops can not properly be said to increase the fertility of the soil. For every crop removes from the soil some quantity of each of the elements required for plant growth. Certain very definite advantages come from rotation, however, which at least save the rapid soil exhaustion resulting from growing one crop continuously. Rotation also brings increased yields. In this sense a proper rotation may have the same effect as the application of a fertilizer, though it can never serve as a substitute.

What is meant by rotation of crops.—By rotation of crops is meant a *regular order followed for a period of years, and alternating on different fields.* If this order is hit-and-miss, or the result of whim or chance, it can not be called a rotation. Rotations may be planned on a two-year, three-year, four-year, or any other time cycle.

What is accomplished by rotation.—Rotation of crops improves the physical condition of the soil. Grasses and legumes have a larger supply of roots than most cereals, and so increase the organic matter. Different crops send their roots to different depths, and so use new portions of the soil. The cultivation of inter-tilled crops clears the soil of weeds, and opens it up to air and moisture.

Rotation also aids in destroying insects and other enemies of plants, as we have already seen. The pests that attack one kind of crop die out when another crop is raised on the field. The growing of the nitrogen-gathering legumes on every part of the farm in succession is made possible by rotation, thus saving the necessity of buying commercial nitrogen fertilizers.

The crops to use in a rotation.—It is evident that no universal standard rotation can be prescribed. Both the particular crops and the order must be decided by local conditions and requirements. The rotation is usually based on some one principal crop, such as corn, cotton, potatoes or wheat, the other crops being arranged to favor these. Where cotton or tobacco is the main crop, the following five-year rotation is considered a good one: first year, cotton or tobacco; second year, corn and crimson clover; third year, crimson clover; fourth year, small grains; fifth year, cow-peas or soy-beans.

A good five-year rotation for the South to include trucking and fruit growing may be as follows: first year, cotton or wheat and cow-peas; second year, early potatoes and beans; third year, early potatoes and beans or other vegetables; and strawberries for the two succeeding years.

The table for the five-year rotation, showing distribution by fields, may be as follows:

Year	Field A	Field B	Field C	Field D	Field E
First	Crimson Clover	Small Grains	Cow-peas or Soy-beans	Cotton or Tobacco	Cow-peas or Soy-beans
Second	Small Grains	Cow-peas or Soy-beans	Cotton or Tobacco	Corn and Crimson Clover	Crimson Clover
Third	Cow-peas or Soy-beans	Cotton or Tobacco	Corn and Crimson Clover	Crimson Clover	Corn and Crimson Clover
Fourth	Cotton or Tobacco	Corn and Crimson Clover	Crimson Clover	Small Grains	Cotton or Tobacco
Fifth	Corn and Crimson Clover	Crimson Clover	Small Grains	Cow-peas or Soy-beans	Small Grains

Note that the above system of rotation provides for both corn and cotton each year, but never in the same field for two or more successive years. It also provides for forage and cover crops and small grains for necessary feed for farm animals.

Year	Field A	Field B	Field C	Field D	Field E
First	Corn	Corn	Oats	Clover	Pasture
Second	Corn	Oats	Clover	Pasture	Corn
Third	Oats	Clover	Pasture	Corn	Corn
Fourth	Clover	Pasture	Corn	Corn	Oats
Fifth	Pasture	Corn	Corn	Oats	Clover
First	Corn	Corn	Oats	Clover	Pasture

Principles of rotation.—In the southern states as a rule it will be found much more profitable to grow a crop of cotton or tobacco once every three, four or five years on the same field than every year. There are four kinds of crops that should be considered in every rotation. First, a *ready-money crop,* and upon this crop the rotation should be based. In the South these crops are usually cotton or tobacco, sometimes wheat. Corn is also fast becoming a good basic money crop for the South. Second, there should always be a *fodder crop* available for necessary feeding of farm animals. Third, there should be at least *one legume* in the rotation in order to furnish humus for plant growth. Fourth, in every rotation there should be a plan for the growing of a *winter cover crop* to prevent the erosion and leaching of the soils. The latter is especially important in the southern states.

In working out a system of rotation no plan will be safe to follow for all states or all districts. It is therefore quite important that the farmer should consult the local experiment station and college of agriculture with reference to a suitable system of rotation. In general, the following principles of rotation should be carefully considered:

Rotation Rules.—1. Rotate the crop so as to give not less than one money market crop every year. When plenty of land is available, two or more money crops should be grown.

2. Rotate crops so as to have as much green feed as possible for the entire year.

3. Rotate the crop so as to make use for each succeeding year of the remains or residue of former crops, such as manures and other fertilizers.

4. Rotate the crops so as to secure as much nitrogen

as possible from the air. Clover, alfalfa, cow-peas and other legumes will do this.

5. Rotate the crops so as to defeat or check the development of insect pests and plant diseases. Lack of this has been the chief cause of the rapid advance of the Mexican boll weevil in cotton territory.

6. Rotate the crops so as to make use of all tillable land every season.

7. Rotate the crops so as to secure an even distribution of labor for both man and beast during the entire year.

8. In southern territory rotate crops so as to provide for winter forage for live stock and cover crops to prevent leaching and erosion.

Improvement of Sandy Soils

The following rules for the improvement of sandy soils of northern states are given by the Experiment Station of the University of Wisconsin:

1. BY ADDING LIME.

What Kinds.—Ground limestone, quicklime, air slaked lime or marl.

When.—In spring or fall on plowed land.

How Much.—From one to two tons per acre depending upon acidity.

How Applied.—With manure spreader or fertilizer spreader.

2. BY GROWING LEGUMES.

Why.—1. To add nitrogen.
2. To furnish humus.

How.—1. By use of lime.
2. By use of plant food.
3. By inoculation.

4. By compacting soil.

The corrugated roller is very useful in bringing moisture to germinating seed.

Which.—Red or mammoth clover, soy-beans and alfalfa.

3. BY ADDING PLANT FOOD.

In stable manure which contains all the elements needed by sandy soils or in commercial fertilizers containing phosphorus and potassium. Nitrogen may be supplied by raising clover or some other legume.

4. BY ROTATING CROPS.

You will maintain nitrogen by use of legumes.
You will maintain humus by green manuring crops.
You will prevent growth of weeds.
You will prevent insects and diseases.

5. CONSERVING MOISTURE.

How.—By the use of the harrow or cultivator to keep ground covered with a fine dust mulch.

When.—As soon after rain as possible to keep soil water from evaporating. The plants will need it.

CHAPTER XXIX

SOIL MOISTURE

WATER is as necessary to the growth of plants as fertile soil. All the food taken by plants from the soil must first be dissolved in water. The tiny root-tips suck in this food-laden water which circulates to every part of the plant, producing its growth.

The amount of water required by a growing crop is enormous. For every pound of dry matter made by the plant, from three hundred to eight hundred pounds of water must be drawn in by its roots and circulate through it. To produce a ton of dry hay on an acre of ground demands that approximately five hundred tons of water be pumped by the grass stalks from the soil. When the soil lacks water, plants are cut off from both necessary food and drink.

Forms of Soil Water

Gravitational water.—Soil that is thoroughly saturated contains a certain amount of free water that will drain off if there is some outlet. That is, the force of gravity pulls it down through the soil; hence its name, free, or *gravitational water*.

To watch how this works, place some soil in a funnel closed with a stopper. Pour water over the soil until it is completely soaked. Then remove the stopper and allow what will of the water to drain off. All the water that thus escapes is free, or gravitational water.

Plants can not use gravitational water for their supply. This is to say that they can not grow in a soaked soil. "Water-logged" soil excludes air from the roots, and the plants soon suffer for want of oxygen. Standing water also keeps the roots of most plants too cold for good growth. Hence the necessity of conditions that will allow the soil to drain readily after rains, so that the free water may escape.

Capillary water.—Soils will not drain entirely dry. After your funnel of earth has lost all the water that will run from it, it is still wet. This wetness is caused by what is called *capillary* water.

Capillary water exists in the form of thin films around the soil particles and in the spaces between them, as described in an earlier chapter. Each separate particle is surrounded by its own film, while larger films bind the separate particles together in granules. Since the particles of a given weight of soil of fine texture present a larger surface area than the particles of a soil of coarse texture, it is evident that the finer the soil the greater the amount of capillary water required to make up the films.

Plant growth and capillary water.—It is the capillary water of the soil that plants use in their growth. Their root-tips come in contact with the water films surrounding the soil particles and drink this water in. One of the first requisites of soil to produce a good crop, therefore, is its ability to act as a reservoir for a large amount of capillary water.

Capacity of Soils of Capillary Water

Soils differ greatly in their capacity for capillary water. This can easily be shown by a simple experiment. Bake a pint of sand and a pint of clay until all the water is dried out; then place the samples in separate funnels over the lower ends of which are tied pieces of cheese cloth. Now slowly pour water from a graduate over each soil until the water begins to drip from the bottom of the funnel. Note carefully how much water was required in each case.

Soil texture and capillary water.—Because of the fineness of their texture, clay and silt soils have much greater capacity for capillary water than sandy or gravelly soils. Under average field conditions the difference in the amount of capillary water held in the *first two feet* of fully saturated soil is about as follows:

Sandy loam soil will hold	5	inches	of	water
Clay loam soil will hold	7½	"	"	"
Muck soil will hold	12½	"	"	"

This is to say that it would require a sheet of water five inches deep to supply the capillary water for the first two feet of saturated sandy soil; a sheet of water seven and one-half inches deep for the first two feet of saturated clay soil; and a sheet twelve and one-half inches deep for the first two feet of saturated muck soil.

Drawing ground water by capillarity.—A very simple experiment will test the capacity of different soils for drawing capillary water from below. Take four glass tubes at least one inch in diameter and from fifteen to twenty inches long, or four chimneys from student-lamps, and arrange them suspended in a rack. Tie over the lower end of each a piece of cheese-cloth. Fill the tubes with soils of different texture, from fine clay to coarse sand. Place a pan beneath the tubes, and pour water into it until the water stands half an inch above the bottom of the tubes. Now watch the water rise in the different soils. Keep accurate track of the time required, and of the height reached in each.

Humus and capillary water.—The capacity of any soil for holding capillary water is greatly increased by the presence of decaying organic matter. It has been carefully estimated that one ton of humus will absorb two tons of water and give it up as needed by growing plants.

Tillage and Soil Water

One of the chief problems of agriculture is to conserve the capillary water of the soil and make it available for plant growth. Capillary water is removed from the soil in two ways, (1) by evaporation, and (2) by being absorbed by the roots of growing plants. What is lost by evaporation is wasted as far as crops are concerned.

Tillage for conserving capillary moisture.—All loosening of the soil increases its absorbing power, and thus causes rain to soak into the ground instead of running off along the top. The deeper the plowing the greater this effect will be. Fall plowing, by opening the soil for the absorption of the winter snows, adds to the amount of soil water.

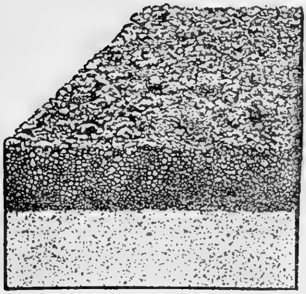
The most effective tillage for conserving capillary water, however, is the frequent cultivation during the growing season which results in a fine soil mulch over the surface. To see the truth of this, make the following experiment:

Effect of a soil mulch.—Fill two glasses nearly full of the same soil; if the soil is dry, add an equal amount of water to each, making the soil fairly damp, but not soaked; pack them equally by striking the glass gently down on the table. Now put a half inch of fine, dry road dust over the top of one, leaving the other without covering. Set the two glasses side by side, and note the time it requires for each to dry out by losing its capillary water through evaporation.

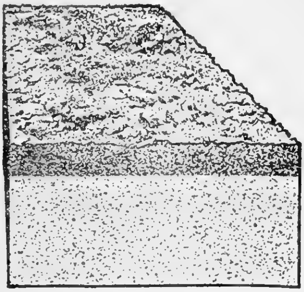
The fine mulch made by frequent harrowings and cultivations has precisely the same effect on our fields. In dry regions summer fallowing is used for the purpose of collecting a supply of capillary water. Whatever rain falls is saved by keeping the surface covered with a fine soil mulch, and what moisture is drawn up toward the surface from the ground water by capillary attraction is also conserved for the crop that is to follow.

Soil Drainage

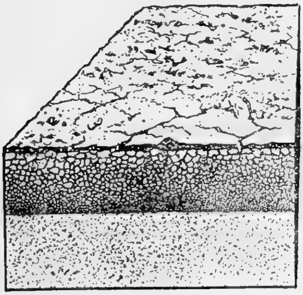
Necessary as water is to plants, however, much of our soil needs drainage to rid it of an oversupply of free or gravitational water. There are some eighty million acres of marsh lands in the United States. The greater part of this



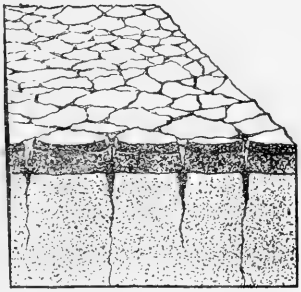
The right kind of mulch for moisture conservation is granular—that is, the dirt should not be pulverized too finely.



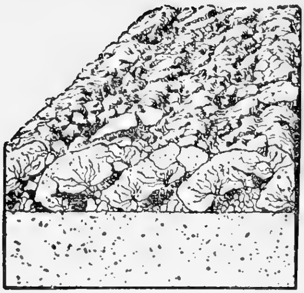
The wrong kind of mulch. The ground is almost dust. Such mulch blows away easily.



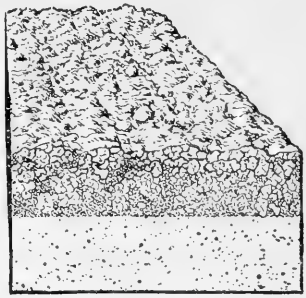
The granular mulch rained upon and left standing for a number of days. Observe that the ground is cracking and that moisture is escaping through these cracks. The crust can be easily broken.



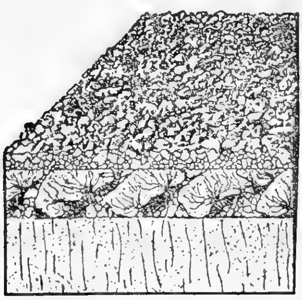
Dust mulch rained upon and left standing in the hot sun. Note that the crust has cracked, and that the moisture is escaping very rapidly. It is impossible to work up this seed bed properly.



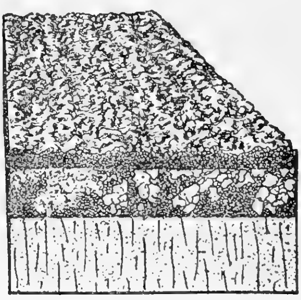
Undisked stubble plowed. Observe that the ground is turned up in lumps; that there are open spaces at the bottom of the furrow which prevent the close compactness of the lower portion of the turned furrow with the soil beneath.



Disked stubble plowed. The mulch formed by the disk harrow fills up the open spaces at the bottom of the furrow, thereby forming a close connection with the subsurface.



This illustration represents the field above treated with a pegtooth harrow after plowing. The surface is in comparatively good condition, but the bottom is not compact.



This illustration represents the field above harrowed with a pegtooth harrow. The air spaces are still at the bottom of the furrow.

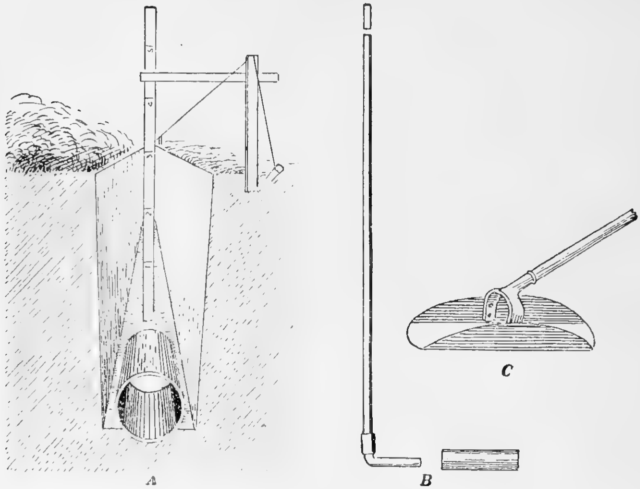
waste territory would make excellent farm land if properly drained.

But perhaps fully as important is the occasional small piece of wet ground on farms now under tillage. In certain regions there is hardly a farm that does not have its low marshy places where crops drown out in wet times, or which are allowed to lie without cultivation. In nearly all cases this land could be made the equal of the remainder of the farm by drainage and proper management.

Surface drainage.—Surface drainage is never so thorough and satisfactory as underdrainage, yet it will often improve conditions enough to pay. By surface drainage is meant the opening of runs or ditches to allow the escape of surface water that otherwise would stand on the soil, flood over lower ground, or percolate down to add to the gravitational water already in the subsoil.

Low ground is sometimes plowed in narrow strips, the frequent dead furrows allowing surface drainage. If there is a slight slope and the furrows can open freely at the end, this will prove of great benefit. Where such simple drainage will not serve, it is sometimes necessary to construct open ditches, though these should give way to underdrainage when this is possible. For underdrainage is under most conditions a more successful way of removing the water, and it saves much loss of ground and the cutting up of fields.

Making surface drains.—Surface runs which are only required to remove surplus water during flood seasons may be made one and one-half feet deep and ten feet wide at the top at a cost of about twenty-five cents a rod, using a road grader for the excavating. Such shallow runs are often seeded, and the edges leveled off and cultivated, thus avoiding waste of land. Open ditches of this kind are often desirable in connection with underdrainage. They also serve as eaves-troughs to prevent flood water of surrounding uplands from entering lower areas.



Section of common tile drain.
a. Ditch prepared for tile.
b. Tile hook and wooden rim for laying in.
c. Tile draining scoop.

Deeper ditches are required when the main drain is to receive the discharge of lateral drains. The size and depth will depend on the territory to be drained, and the fall of the ditch. In the Middle West, open ditches, many of them miles in length, are being constructed, each farm served paying its share of the expense. Open lateral ditches or underground tile then empty into this main drain. Under average conditions, the cost of opening a ditch seven feet deep and twenty feet wide at the top by means of a dredging machine has been about one thousand dollars a mile.

Underdrainage.—Underdrainage has the advantage of carrying off the ground water to any desired depth. This is an important matter in the growth of most crops. For where the level of ground water is near the surface, plants will not strike their roots deep in the soil, but spread them out near the top. This leaves the crop at the mercy of drought later in the season, when the upper layers of soil dry out. Deep rooting is also necessary to make full use of the plant food of the soil.

Tile underdrains.—Burnt clay and cement are the materials chiefly used for underdrains in most regions. These materials are made into cylinders from three to thirty-six inches in diameter, and from twelve to thirty inches in length. For lateral drains, tiles four or five inches in diameter are most used. The main outlet drain usually requires tiles from eight to twelve inches.

Moderately heavy clay soils require laterals about four rods apart to carry off the rainfall. If the subsoil is sandy, the laterals may be as much as eight rods apart. Sometimes the marshiness of a piece of ground is caused by seepage leading to it from some higher area. In this case, there should be a line of tile at the edge of the lower ground to receive the seepage.

Several lines of parallel drains are more economical than one central line into which diagonal laterals run. This is because with parallel drains there is less area receiving double drainage. Several parallel lines can often be carried into one line of larger tile, and all discharge through the same outlet, thus saving trouble and expense.

Depth of tile.—Tile should be placed deep enough that the level of ground water will not stand too near the surface, and yet not too deep to carry off the gravitational water without allowing it to stay too long in the soil. In clay subsoil the most common depth is about three feet. In partially sandy subsoils, the depth may be four feet. All tile meant to catch seepage should be as deep as four feet.

Gradient, or fall.—The larger tiles may be laid with a fall of an inch to one hundred feet. Laterals should have from two to three times this much fall. Lines for catching seepage should have still greater slope; as much as five inches to one hundred feet, if this is possible.

Cost of tiling.—The cost of tiling will, of course, vary with the size of tile used, the depth it is laid, and the character of the soil. The average cost under normal conditions is about as shown in the following table:

Size of tile	Depth tile is laid			
	3 feet	4 feet	5 feet	6 feet
4 inch	$ .30	$ .50	$ .80	$1.25
5 inch	.35	.55	.85	1.30
6 inch	.40	.60	.90	1.38
8 inch	.45	.65	.95	1.40
10 inch	.50	.70	1.00	1.45
12 inch	.55	.75	1.05	1.50

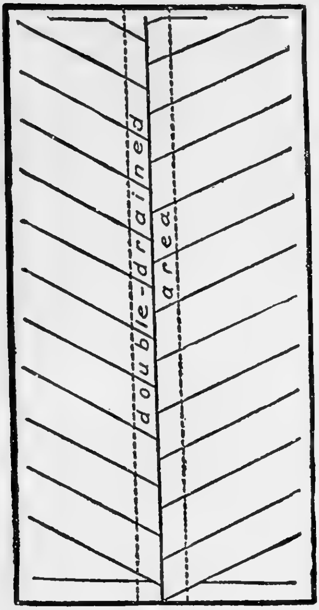


Fig. 1.
System of drainage with double-drained area.

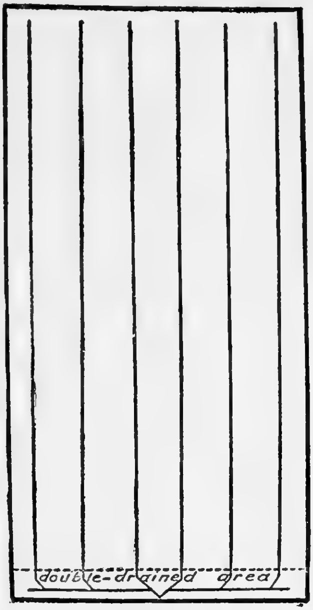


Fig. 2
Minimum area of double-drained land.

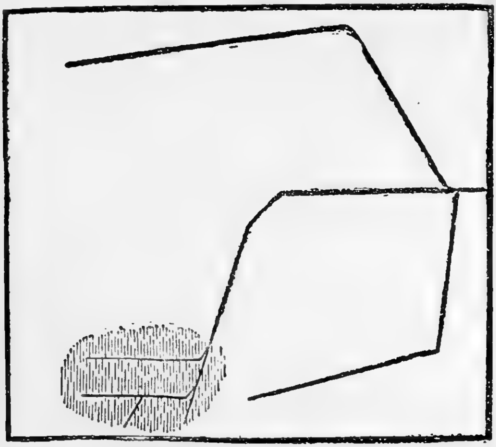


Fig. 3.
Random drainage system will not give the desired results.

The United States Department of Agriculture offers the following advice concerning drainage:

Placing the Tiling.—On rolling lands where only occasional wet spots are to be drained the random system (Fig. 3) is commonly used. On level lands needing artificial drainage a uniform system (Figs. 1 and 2) must be planned that will provide drains for the entire area. The most economical arrangement of such a system is one which permits the use of long laterals and requires the shortest total length of main drains. The advantage of this arrangement is shown graphically by Figures 1 and 2, in which the systems drain equal areas. The cost of purchasing and putting in the tile is, however, considerably greater for the system shown in Figure 2.

Size of the Tiles.—No hard and fast rule can be given for determining the sizes of tile to be used. Drains should be large enough to remove the surplus water before the crops are injured, even after a heavy rainfall in continued wet weather. It is better to use sizes too large than too small, and no tile less than four inches inside diameter should be used. In the Middle West the tendency is to use nothing smaller than five-inch tile.

The mains should be large enough to take the flow from the laterals. Actual practise has shown that for the dark silt loams of Illinois and Iowa, where the average annual rainfall is approximately thirty-six inches, eight-inch tile having a fall of two inches in one hundred feet will provide outlet drainage for forty acres, seven-inch tile for thirty acres, six-inch tile for nineteen acres, five-inch tile for ten acres, and four-inch tile for six acres. On stiff soil with equal rainfall the same-sized outlets will be adequate, but on the level soils of the South Atlantic and gulf states where the annual rainfall is approximately fifty inches, only about one-half the areas named above can be drained with tile of these sizes.

CHAPTER XXX

MANURES AS FERTILIZERS

THE term *manure* was originally used to include anything which, when applied to the soil, increased its productivity. Thus, George Washington "manured" his thin Mount Vernon acres with the rich muck from the overflow of the Potomac. The Romans and Greeks "manured" their land with chalk, marl and wood ashes. The word manure is now generally used in practical American agriculture to include (1) farm manure, such as comes from the barnyard; and (2) green manure or crops such as legumes plowed under to increase soil fertility.

Value of Farm Manure

The various classes of farm manures are described by Doctor H. J. Wheeler, of the Rhode Island State College, as follows: "The term 'farm manure' covers properly the dung of all the domestic animals kept on the farm, including the customary litter, night-soil, peat, muck, leaf mold, other vegetable refuse, and composts. *Barnyard manure,* as usually understood, relates to the 'dung' of *neat* cattle with the usual litter. *Stable manure* is a term at present more commonly applied to the 'dung' and 'litter' from horse stables."

Value of manure.—One of the best evidences of good farm management is a well-kept manure heap and its careful distribution to the fields. It has been estimated by experts that if animals are kept in stalls or pens throughout the year, given a reasonable amount of litter for bedding and all the manure saved, the annual value of the manure from each animal will be: horses or mules, twenty-seven dollars; cattle, twenty dollars; hogs, eight dollars; sheep, two dollars. Differently stated, the value of the manure produced during the seven winter months on a farm keeping four horses, twenty cows, fifty sheep and ten hogs would be at least two hundred and fifty dollars. These figures are based on the cost of an equal amount of commercial fertilizer.

The immense value of farm manure to our soils is not yet fully realized. Said Doctor C. G. Hopkins, "If corn were to sell at one dollar and five cents a bushel, the aggregate corn crop would then be worth approximately what the aggregate crop of manure is worth each year."

Manure and fertility.—Because manure is so valuable and the maintenance of fertility so difficult, every care should be taken to get the most possible out of the barnyard manures. Even the best that can be done with it, all the manure that can be produced on a farm will not wholly return to the land what the crops take from it.

While feeding farm crops to animals and returning the manure to the soil is far ahead of selling the crops off the farm, this process is also in a sense wasteful of fertility. It has been carefully estimated that domestic animals produce for our tables only about twenty per cent. of the food value they themselves eat, thus wasting four-fifths of what they consume from the soil. No wonder that meat is an expensive food, available to the common people only in favored countries like our own. Hundreds of millions of people, in many parts of the world, are compelled to live on a vegetable diet alone so as to save this wastage. Whether the American nation shall finally come to this condition will depend in no small degree on the faithfulness and skill with which the animal wastage is returned to the soil.

Manurial value of farm crops.—While it is true that not all the fertility taken from the soil by farm crops can be returned by using the manure from the feeding of crops, no small portion of it can. The manurial value of different farm products, based on the cost of commercial fertilizers, is shown in the following table: (*Farmers' Bulletin* 193, United States Department of Agriculture.)

Value as fertilizer in one ton of farm products.

Product	Nitrogen	Phosphoric acid	Potash	Total
Meadow hay	$ 3.47	$ 0.57	$ 1.06	$ 5.10
Clover hay	6.83	.78	1.46	9.07
Wheat bran	8.35	3.82	1.14	13.31
Linseed meal	17.87	2.25	.99	21.11
Cottonseed meal	23.06	3.96	1.17	28.16
Wheat	6.38	1.11	.42	7.91
Oats	6.21	.87	.35	7.43
Corn	5.62	.83	.30	6.75

We see from this table that the farmer who sells a ton of meadow hay loses from his farm fertilizer value that would cost about five dollars if purchased in commercial form. If he sells clover hay, he loses almost as much value in fertilizer as his hay brings him. If he pays twenty dollars a ton for wheat bran he gets over thirteen dollars' worth of fertilizer, leaving the feeding cost about seven dollars.

Bacterial value of manure.—Of course it is evident that these values will not be obtained from the feeding of farm crops unless the manure is carefully saved and properly used. Not only has manure great chemical value because of supplying the elements needed in plant growth, but it has *bacterial* value as well. For manure contains an enormous number of bacteria, many of which aid in plant growth. The excrement of all animals is swarming with micro-organisms, many kinds of which are necessary to plant growth. It is calculated that as many as one hundred millions of these may be found in a single grain of offal.

Certain conditions affect the value of manure. In general, the manure of mature animals has greater fertilizing value than that of young animals. The manure of animals that are fed chiefly on grains, milk or other rich foods is richer than that of animals living on grass or roughage containing but little nitrogen.

Preventing Loss from Manure

It is not to be forgotten that the liquid excretions of animals possess as high manurial value as the solid portions. Any plan for conserving the value of farm manure must therefore provide for saving the liquid as well as the solid part.

Although there is a steady and unavoidable loss from manure when it is exposed to the air, the greatest sources of loss under general farm conditions are two: (1) *fermentation,* or heating, which reduces the supply of nitrogen; and (2) *weathering,* or leaching from rains, in which all the valuable elements suffer great losses.

Controlling fermentation.—The *fermentation* of manure is caused by two different kinds of bacteria, one of which works near the outskirts of the heap where there is air, and one deeper down where the air is excluded. A certain degree of fermentation is necessary to the best rotting of the manure, yet overheating, or the "fire-fanging" so common in horse and sheep manure, greatly reduces its value.

The rapidity of fermentation can be controlled in part by packing. If the heap is too loosely built, the air-working bacteria become active, the heat grows intense and nitrogen and humus-making material are lost. On the other hand, if the heap is packed too closely, the decomposition is slow and the manure does not have the best effect when spread on the soil. Frequent sprinkling with water will aid in checking too rapid fermentation.

With some classes of farm stock, as beef cattle, or horses running in open sheds, the "deep-stall" method is a satisfactory way of collecting the manure. Under this plan the manure is simply allowed to accumulate in the sheds or stalls until it has reached one, two, or more feet in depth, when it is removed and spread at once upon the soil. The close trampling serves to reduce the amount of wastage. Of course the matter of cleanliness and hygiene is to be taken into account. For obvious reasons this method would not be suitable for dairy cows. During the warm season, such places are also a breeding place for flies.

Preventing leaching.—Great loss is suffered from *leaching* when manure is exposed to the weather. It has been found that six months' leaching of horse manure reduces its value fully one-half. The custom, once rather prevalent, of throwing the manure out under the eaves of the barn, where it would not only be exposed to the rains, but also to the water from the roof, is so wasteful as to have nothing to commend it.

The remedy lies in collecting manure under cover, so that it is not exposed to leaching. It should also be provided with a water-proof kit and floor for the heap, so that the liquid parts may not drain away into the soil. The profits from open-yard, badly leached manure are so small as hardly to pay for spreading it on the field. It is a careless, shiftless method of farming that allows this great waste, so easily prevented. Old piles of manure that have been lying for several years while the land has been suffering for want of its help are a poor advertisement for the farmer and surely an eyesore and a nuisance.

The Application of Manure

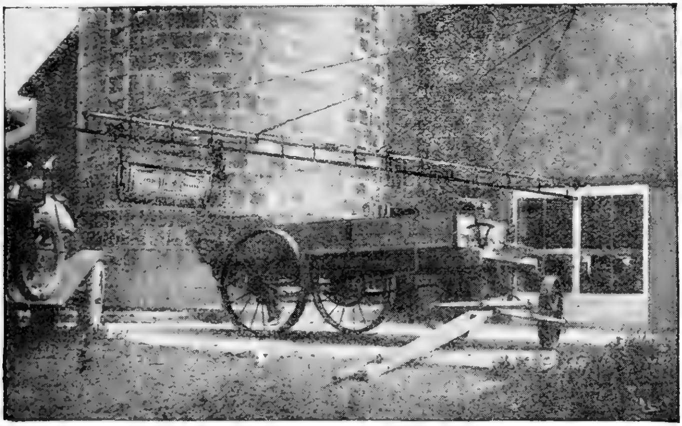
No general rule can be given for the application of manure to the soil. The most common European practise is to use it as a top-dressing. With thoroughly rotted manures, especially if the application can soon be followed by harrowing or disking, there is probably no better way. Where the manure must be applied without rotting, this will of course not work. Economical distribution of labor also demands that the manure be handled at some other time than when the soil is just ready for the crop. The custom

The wrong way to handle barnyard manures.

on most farms is therefore to distribute the manure in the fall or early spring and then plow it under.

Right and wrong methods.—For heavy soils, which need to be made porous by the addition of vegetable matter, it is well to spread manure on the field fresh from the stalls without waiting for it to rot. It should not, however, be allowed to lie long before being plowed under, as much of its strength is lost in this way. For all lighter soils, and especially such as have a tendency to dry out, the manure should be rotted before being applied.

Throwing the manure in heaps on the field and later spreading it is not good practise. For here also the leaching takes place. Some of the best elements of the manure



The better way. Manure carrier and spreader.

are drained into the ground immediately under the heap, and some are lost by passing off into the air. The most economical and satisfactory method of spreading manure is by use of the manure spreader. This machine saves labor, and distributes the manure more evenly than is possible by hand.

The amount of manure to be used will depend on the strength of the manure and the condition of the soil. Five tons to the acre is a light application, ten or twelve tons average, and twenty tons a heavy application.

Green Manuring

Meaning of green manuring.—By green manuring is meant plowing under any green crop for the purpose of improving the soil. Green manures improve the soil both by adding to its fertility and bettering its physical condition.

Hogs in clover. After pasturing, this clover will be turned under as green manure.

If the soil is light and sandy, green manure prevents it from drying out. On heavy clay soil green manure has quite the opposite effect, because of admitting the air, loosening the soil and improving its drainage.

Green manure crops.—For most purposes the best green manure crops are the nitrogen gatherers already discussed—the clovers, alfalfa, cow-peas, soy-beans, the vetches and other legumes. Rye, buckwheat, rape and turnips are among other crops used as green manures. This group, however, lacks the advantage of gathering nitrogen.

Green manuring must be practised if we are to maintain our soil fertility. Barnyard manure can not be excelled as far as it goes. But it does not go far enough. For example, they tell us that there are animals enough in the state of Illinois to produce but one and one-half tons of manure annually for each acre of farmed land in that state. This is, of course, much less than is required to compensate for the drain upon the soil from the growing of crops.

The great value of green crops turned under as manure is seen in the fact that one ton of clover plowed under will return as much organic matter to the soil as will be supplied from three tons of clover fed to animals, even if none of the manure were wasted. The same truth will hold in general for other green crops, such as cow-peas, alfalfa, or soybeans.

CHAPTER XXXI

THE USE OF COMMERCIAL FERTILIZERS

ALTHOUGH proper systems of manuring and rotation of crops will insure fertility on naturally good soil for many years, the land will finally become exhausted under normal treatment. This is for the simple reason that the crops remove from the soil each year more of the elements necessary to their growth than are returned to it. The deficiency must finally be made up if permanent fertility is to be maintained. This is accomplished by supplementing manuring and rotation with what are called the *commercial fertilizers.*

Importance of Commercial Fertilizers

The use of commercial fertilizers plays an important part in the production of crops in most European countries. Through their use farm crops in some countries are in general on the increase, while in large regions of our own country they have decreased. For example, the Director General of Agriculture for Holland gives the following table showing the increase of staple crops in that country during a period of sixty years:

AVERAGE YIELD PER HECTARE IN HECTOLITRES

	1851-1860	1891-1900	1906-1908
Wheat	19.3	24.9	32.4
Rye	18.0	21.0	23.0
Barley	32.8	41.8	46.5
Oats	32.4	42.8	50.0
Potatoes	120.0	181.0	211.0

The Director General attributes this increase to the *use of commercial fertilizers* combined with better selection of seed, manuring and improved tillage.

Increased yields in England.—England has during the last eighty years succeeded in increasing her yield of wheat in certain regions by about eighty per cent., the largest single factor, as judged by their agricultural experts, being the use of commercial fertilizers. England now secures an average of thirty-two bushels of wheat to the acre as against about fourteen bushels in the United States.

Increase in Germany.—Professor Von Seelhorst, of the Royal Agricultural Experiment Station of Gottinger, writing to Doctor C. G. Hopkins concerning the increase of crop yield in Germany, says: "I believe that the principal increase of the harvest is to be attributed in part to the application of artificial fertilizers themselves and in part to their combination with green manures. Through the application of the two the yield upon the average has been doubled on our common light soils. In some cases the yield has even been increased two and one-half to three fold. Clay soils become tillable to a greater degree when applications of artificial fertilizers are made. In general, I assume that of the one hundred per cent. increase in the yield, fifty per cent. can be attributed to the use of artificial fertilizers, twenty-five per cent. to better tillage, fifteen per cent. to the use of better seed, ten per cent. to better crop rotation."

Increase in France.—In France, where there has been a similar increase in yield, the Minister of Agriculture estimates that the effects of farm manures and artificial fertilizers together account for from fifty to seventy per cent. of the increase, better tillage from fifteen to thirty per cent., and seed selection from five to twenty per cent. Italy, following the example of England, Germany and France, uses large amounts of commercial fertilizers. In 1907 Italy, with an area only about twice the size of Illinois, used over one million tons of phosphorus, ninety thousand tons of nitrogen fertilizers, and nearly eight thousand tons of potassium salts. Germany did buy large quantities of phosphates from the United States and other countries.

We must use commercial fertilizers.—That the United States must follow the example of these older countries there can be no doubt. The pressing necessity is that we shall come to a realization of this fact before our soil is further depleted. Speaking on this point, Doctor Hopkins says:

"Do you ask how the smaller European countries, such as England and Germany, maintain their crop yields at a point about double the average of the United States? In large part by the application of American fertility which we export in foodstuffs and in phosphate rock. England raises 50,000,000 bushels of wheat and imports 200,000,000 of wheat, 100,000,000 of corn, 800,000,000 pounds of oil cake, and other foodstuffs, and great quantities of phosphate from the United States and other countries. Germany raises 125,000,000 bushels of wheat, but Germany consumes 200,-000,000 bushels of wheat, and imports, besides, 40,000,000 bushels of corn, more than 1,000,000,000 pounds of oil cake and some other foodstuffs, large amounts of phosphate, etc.; while her principal export is 2,000,000,000 pounds of sugar, which contains absolutely no plant food of value. Denmark produces 4,000,000 bushels of wheat and, in addition, imports 5,000,000 bushels of wheat, 15,000,000 bushels of corn, 800,000,000 pounds of oil cake, and large quantities of phosphate; while Denmark exports, principally, 175,000,000 pounds of butter, which contains practically no plant food of value. Belgium raises 12,000,000 bushels of wheat and imports 60,000,000 bushels."

Increased use of commercial fertilizers.—Commercial fertilizers have long been used in a small way, but it is only recently that they are coming to be employed on a large scale. The farmers of the United States are now paying out considerably more than $100,000,000 a year for such fertilizers. There are at present more than five hundred manufacturers selling the various fertilizing products.

Since, as we have seen, only three of the elements necessary to plant production are likely to run short, commercial fertilizers are commonly limited to these three—*nitrogen, phosphorus* and *potassium.* Lime, though not strictly a fertilizer, is often, because of its beneficial effects on the soil, treated as a fertilizer.

Commercial Phosphorus Fertilizers

Phosphorus has been called the "key to permanent agriculture in the United States." While there is probably no one "key," it is nevertheless true that phosphorus must finally be added in sufficient quantities to make up the difference between what phosphorus is removed from the soil by crops and what is returned in the form of farm manure. In regions where grain is sold from the farm the problem becomes all the more acute, since about three-fourths of the phosphorus used by the plant goes to the grain. And large quantities of grain must always, of course, be sold from the farms in order to feed the people and animals who live in towns and cities.

Forms of Commercial Phosphorus Fertilizers.—Phosphorus fertilizers are supplied commercially in the form (1) of the *bones of animals killed* at the slaughter-houses; (2) of *mineral deposits* in phosphate rock; immense beds of which are found in Tennessee, South Carolina, Florida, Wyoming, Utah, Idaho and Montana; and (3) of *slag* from the furnaces where certain ores containing phosphorus are smelted.

Bone phosphate is sold either as *ground* bone, which is raw bone ground up; or *bone meal,* which is made by grinding after the bones have been steamed under high pressure to remove the fats and oils.

Mineral phosphate is sold in two forms: (1) that first treated with sulphuric acid, and (2) the natural rock finely ground. The first form has the advantage of being more immediately available for plant use. The second form is considerably less expensive and, when mixed with organic matter like some form of manure, proves equally as valuable as the more expensive compound.

Native mineral phosphate.—The supply of high-grade phosphate has been thought by experts to be limited in this country. Discoveries of beds of high-grade phosphate in Idaho, Wyoming and Montana have been welcomed with great satisfaction, and serve to relieve the apprehension caused by the rapid exhaustion of the phosphate fields in eastern states. The discovery of great phosphate fields in northern Africa turns the European demand in that direction, thus serving further to conserve our supply for domestic use.

There is no doubt that some form of phosphorus fertilizer could be applied with profit to thousands of farms in nearly all parts of the United States. The intelligent farmer will, however, not *guess,* but will *find out,* either by his own investigation or by consulting with agricultural experts at experiment stations and colleges acquainted with local conditions, what the needs of the soil are and what form of phosphates is most economical and best adapted to the requirements.

Effects of phosphate fertilizers.—The effects of the application of phosphate to depleted soil is shown in an experiment on a run-down Wisconsin farm where a portion of a field was treated with three hundred pounds of acid phosphate to the acre and then planted to corn. The remainder of the field was planted to corn without the application of phosphate and both plats given the same tillage. The increase from the phosphate is shown in the fact that when cut, the corn and stover from the treated plat weighed two and three-fourths times as much per acre as from the untreated.

At the Ashland, Wisconsin, Experiment Station, a test was made to determine the effect of phosphorus fertilizers on heavy red clay as a supplement to manure. The crop raised was potatoes. With manure alone the yield was eighty-seven bushels per acre, and with rock phosphate added to the manure, one hundred twenty-eight bushels. In raising rutabagas the yield with manure was one hundred eight bushels, and with manure and phosphate one hundred thirty-seven bushels.

The following table shows the effect of phosphorus fertilizer in a three-year rotation of crops on average clay loam soil of Ohio, as determined by Director Thorne, of the Ohio Experiment Station:

Treatment	Yields per Acre Corn, 10 years Bus.	Wheat, 10 years Bus.	Hay, 6 years Lbs.
None	35	10	2,000
Manure	51	18	2,400
Manure and acid phosphate	60	25	3,500
Manure and rock phosphate	60	24	3,800

Cost of Phosphorus Fertilizers.—The determination of what form of phosphorus fertilizers to use rests on (1) availability of supply, (2) cost, and (3) adaptability to soil conditions.

Bone meal.—Ground steamed bone meal containing about twenty-eight per cent. of phosphoric acid costs from twenty-two to twenty-five dollars a ton at a central market like Chicago. This is the form usually best adapted for marsh soils or for upland clay loams that have become acid. It has the advantage that it becomes available to plant use more rapidly than the raw rock form. When used as a supplement to manure in a four-year crop rotation it should be applied at the rate of from two hundred to three hundred pounds to the acre every fourth year. A convenient way to apply it, especially if a manure spreader is used, is to spread a proportionate amount on top of each load of manure as it goes to the field.

Rock phosphate.—Raw rock phosphate contains from twenty-three to twenty-eight per cent. of phosphoric acid. It varies in cost from three to five dollars a ton, at the mines, to which freight charges must be added. The rock is finely ground so that about ninety per cent. of it will pass through a sixty-mesh screen. This is the cheapest form of phosphate on the market, at least for regions where distance from the mines does not make freight charges excessive. On clay soils that have become considerably exhausted the first application should be at the rate of about half a ton to the acre. After that, if manure is used, about one hundred pounds to the acre each year will maintain the soil phosphorus under average conditions.

An excellent way to apply rock phosphate is to mix it with the litter of the stable. It readily absorbs the elements of the manure and is distributed to the soil without extra labor. Care must of course be used to get the right amount for a given quantity of manure. A little experience will make this easily possible.

Acid phosphate.—This form of phosphate is prepared either from rock phosphate or steamed bone, by combining the raw phosphate with sulphuric acid. The acid changes the phosphorus into a form more easily absorbed by plants and the acid phosphate will show its effects more quickly than raw rock phosphate. Because of this fact it is often best to make the initial application in acid phosphate form, both to test the need of phosphate and to secure earlier returns from its use. From three hundred to three hundred and fifty pounds per acre is an average application of acid phosphate. It should be worked well into the soil before planting the crop.

The Use of Lime on Soils

Lime can hardly be called a fertilizer, since it does not contain any of the elements in which the soil is generally lacking. Yet because of its action on certain other elements of the soil it is necessary to plant production. When lime does not already exist in the soil it must be added in commercial form if the fertility of the soil is to be maintained. The purpose of lime is to cure the soil of its *acid* condition.

Acid soils.—All soils have a tendency to become sour, or acid. This acidity comes about in several different ways: in the decay of organic matter in the soil, certain acids are produced; hence the soils rich in humus are likely to be acid. Plant roots give off acid in the process of their growth, and this acid remains in the soil. The action of the nitrifying bacteria also adds to the acidity of the soil. Heavy non-porous clay soils which do not allow the entrance of fresh air are usually sour.

The degree of acidity of soils can be judged (1) by the *refusal of certain plants to grow* in them; for example, the legumes will not thrive in acid soils, and the failure of clover or alfalfa to do well should arouse a suspicion of too much acid. (2) The presence of such *weeds* as sheep-sorrel, horsetail rush, corn spurry and wood horsetail indicate acid. (3) Blue *litmus paper* turns red when placed in contact with a soil containing acid. (4) Other tests are used in various sections.

Liming acid soils.—Lime is a certain remedy for acid soils. In some regions, especially where limestone abounds, the natural supply of lime in the soil is sufficient to overcome the surplus acid. In other regions, lime needs to be applied in commercial form. This is the only cure for acid soil within reach of the farmer.

Nearly all prairie soil is in some degree acid, especially on slopes where leaching of the soil has carried away the original deposits of lime, and wherever large supplies of humus have formed from the decay of organic matter. Thousands of acres of acid land would well repay the cost of liming by increased yields. Many farmers now look on liming as a regular and necessary requirement. Of course lime should not be applied unless needed, but the tests are so simple that this is easily determined.

Forms of lime used.—Lime is available for application to the soil in several forms: (1) Quicklime, or lime ready for use in making plaster, when finely ground may be applied at the rate of about one ton to the acre. (2) Air-slacked lime, or ordinary lime that has been exposed to the air, is an excellent form, and may be applied at the rate of two or more tons to the acre. (3) Ground or finely crushed limestone direct from the quarries is widely used in regions where it is easily obtainable. From one to two tons to the acre will usually correct the acidity.

The form of lime to be used will depend chiefly on which is most easily available and cheapest. The amount required is determined by the degree of acidity in the soil.

Commercial Potassium Fertilizers

Potassium fertilizers are available in several commercial forms, none of which is produced in large quantity in this country. The potash mines of Germany have been the chief source of supply.

The crude potash may be used on the soil directly as mined, or it may be made into more concentrated form. It is usually sold commercially as a fertilizer (1) as *muriate of potash,* (2) as *saltpeter of potash,* and (3) as *kainit.*

German potash mines.—The German mines of potash salts are one of the most valuable natural resources possessed by any nation. They were discovered many years ago, and were at first considered merely an obstacle in the way of producing common salt. About half a century ago the value of potash salts began to be understood and many companies were formed to operate the German mines. The supply there seems practically inexhaustible.

It is evident, of course, that shipping so great a distance will make potassium much more expensive to the American farmers than if we had our own deposits. No investigations have as yet, however, located any important deposits of potassium salts except in Germany and a few in Austria.

The crude potassium salts may be used directly as mined, or they may undergo a process of concentration. The chief of the crude potassium fertilizers is *kainit,* which contains eleven to thirteen per cent. of potassium. The concentrated forms, such as *muriate* and *sulphate* contain from forty-five to fifty per cent. of potassium.

Kainit is used extensively in Europe, but less in this country, owing to freight charges. Its chief use here has been in making up compounds called "complete" commercial fertilizers. Because of its depressing effect on the production of starch and sugar in certain plants, kainit is to be avoided in the raising of sugar beets, tobacco and potatoes intended for the manufacture of starch.

The use of potassium.—A shortage of potassium in the soil affects some plants more than others. The size of the grain in wheat and other cereals is lessened by a lack of potassium. Clover and timothy will die out on soils very deficient in potassium, while red-top is less affected by the shortage. It is also thought that certain plant diseases, as in potatoes and other crops, are much more severe in the absence of sufficient potassium. On the other hand, there is strong evidence that the application of potassium where it is not needed may even result in positive injury to the crop. Both because of this fact and the high cost of potassium fertilizers it is best to secure expert advice before deciding on its application.

Potassium is not easily leached from the soil and may therefore be applied at any convenient time of the year. Enough may even be used at one application to serve for several crops. The quantity needed will, of course, depend on the amount already in the soil and on the crop to be raised. From one hundred to two hundred pounds to the acre is an average application for a crop of small grain, while a truck crop may require as much as three hundred pounds.

Other sources of potash production.—Aside from the potash mines of Germany the greatest known sources of potassium salts are various forms of sea-weeds found growing over great areas especially along the Pacific coast of the United States. Owing to troubles with the German potash producers, and the derangements growing out of the European war, extensive and promising experiments have been made in producing potassium from kelp and other forms of marine plants. This is not a new idea, as sea-weeds have been used for this purpose in Spain, Sicily and other countries of Europe for many years.

More common sources of supply for potassium are wood ashes, which may contain as much as ten or twelve per cent. of potash, and lime-kiln ashes, which contain much less potash than wood ashes. The ashes from cotton-seed hulls are relatively rich in potash and make a good fertilizer. Corn cobs are also rich in potash and have great fertilizing value, as do tobacco stems.

Commercial Nitrogen Fertilizers

Nitrogen is the most expensive of the three essential fertilizers. Commercial nitrogen fertilizer is sold chiefly in four different forms: (1) *nitrate of soda* (Chile saltpeter); (2) *sulphate of ammonia,* which is a by-product of the manufacture of coke and gas; (3) *dried blood,* ground or steamed *bone,* or other animal products from packing houses; (4) *calcium nitrate,* produced from the air by electricity.

The nitrogen fertilizers cost from fifteen to fifty cents a pound. Instead of depending on them the intelligent farmer will therefore use every effort to maintain the supply of nitrogen in his soil through the use of *farm manures* and the *nitrogen-fixing legumes,* occasionally *plowing under* a crop of clover, alfalfa, cow-peas, vetches or soy-beans. Where these can be grown successfully, there will be little need to buy nitrogen; it can be obtained from the seventy million pounds of free nitrogen in the atmosphere above each and every acre.

Use of commercial nitrogen.—Yet in many instances it will pay to add some form of commercial nitrogen fertilizer. This is especially true in the production of truck crops which will respond to a forcing process. The grass crops also respond well to the use of artificial nitrogen.

Nitrate of soda or sulphate of ammonia is usually applied at the rate of from one hundred pounds to two hundred pounds per acre, although certain truck crops may require more. To save leaching the fertilizer is often used in two or more applications during the growing season. Dried blood or steamed bone is commonly applied in quantities varying between two hundred and four hundred pounds to the acre.

In maintaining the nitrogen in soils it must not be forgotten that an acid condition is hostile to all nitrifying legumes, and that this condition is to be remedied by liming. The continued application of sulphate of ammonia tends to produce soil acidity. This form of fertilizer should therefore usually be accompanied by the use of lime.

The application of commercial fertilizers.—Because commercial fertilizers are expensive, and also for the reason that the application of a fertilizer when it is not needed may do positive harm, the advice of the county agricultural agent or some other agricultural leader of the state should be sought before purchasing. An agriculturist, after a survey of your soil, may be able not only to suggest the best kind for local needs, but also the amount that should be used.

CHAPTER XXXII

FARM ANIMALS AND AGRICULTURE

FARM animals form one of the most important sources of wealth in the nation. The five most important groups of animals, ranked according to their market value, are *horses, cattle, hogs, mules* and *sheep*. If these animals should all be sold, they would bring the enormous sum of nearly six billion dollars, or sixty dollars for every man, woman and child in the United States.

Work Animals

Farm animals serve several important uses: (1) they provide food for man, (2) they work for him, and (3) they supply various useful products. The total market value of the working animals, horses and mules, is slightly greater than that of the food producing group, cattle, sheep and hogs.

Using animals for work.—Centuries ago man had not yet domesticated the animals and trained them to work for him. Since the uses of steam and electricity had not been discovered, all labor had to be done by men themselves. The implements used for cultivating the soil were all crude and ineffective, and could only be operated by hand. It then required much more time and effort to secure a living by agriculture than it does now.

One of the greatest lines of progress in America has been the substitution of animal and machine power for man power in doing farm work. In this we are far ahead of

Colt judging contest at a Wright County community festival.

most other nations, even those of Europe. For example, we have in the United States almost twenty-five million horses, or approximately one to every four persons. In France, one horse has to serve ten people; in Germany, thirteen, and in Great Britain, twenty-six.

Saving in time by work of animals.—The use of work animals has resulted in great saving of time. It has been estimated that in 1830 each bushel of wheat grown in the United States required three hours of a man's time; it now requires less than ten minutes. In 1850 it took a man four and one-half hours on an average to grow, harvest and shell a bushel of corn; it now requires less than forty minutes. The greater part of this saving has come through the use of improved farm machinery drawn by horses or mules.

Where the peasants of European countries use shovels, hoes, scythes or other primitive implements, we employ gang-plows, disk harrows, auto trucks and self-binders. The great saving in human energy and time growing out of this difference is seen when it is remembered that one horse hitched to modern machinery can do the work of at least ten men with hand tools. Many an American boy with his four-horse team is therefore accomplishing the labor of forty European peasants with their hand work and poor implements.

The animals used for work.—Among the various animals that men have trained to work for them are horses, cattle, mules, buffalo, reindeer, camels, dogs, and even sheep, goats and elephants. No animals, except horses, mules and cattle, have ever been extensively used for farm work in this country. The use of oxen for work has now been almost wholly discontinued.

During recent years, horses and mules have found a competitor in the automobile and the traction-engine. Thousands of farmers now own their cars, and the gasoline tractor is a common sight on many of the larger western farms. In spite of these facts, however, the number of horses and mules on our farms is constantly increasing, and the market for them is growing better and more uniform. The price of work animals is considerably higher than it was when automobiles and traction-engines began to come into use. Horses will always have an important place in the economy of the farm.

Animals That Supply Food

Meat and other animal products form a very important part of our food supply. Even vegetarians, who are opposed to the eating of flesh, depend largely on such foods as butter, eggs and milk.

Meat as food.—A great proportion of all our farm crops goes to the feeding of meat producing animals. The most progressive nations of the world are those that in addition to fruit and vegetables for the diet make much use of their domestic animals in supplying food products. Meat is a more expensive food than grains, fruits and vegetables, and people of the poorer classes can not afford to eat it. Millions of those living in oriental countries seldom taste meat in any form. Lack of nutrition and a balanced ration is shown in absence of ambition and enterprise.

According to careful estimates the food supply in American homes is divided among the different foods in approximately the following proportions (*Farmers' Bulletin* 391):

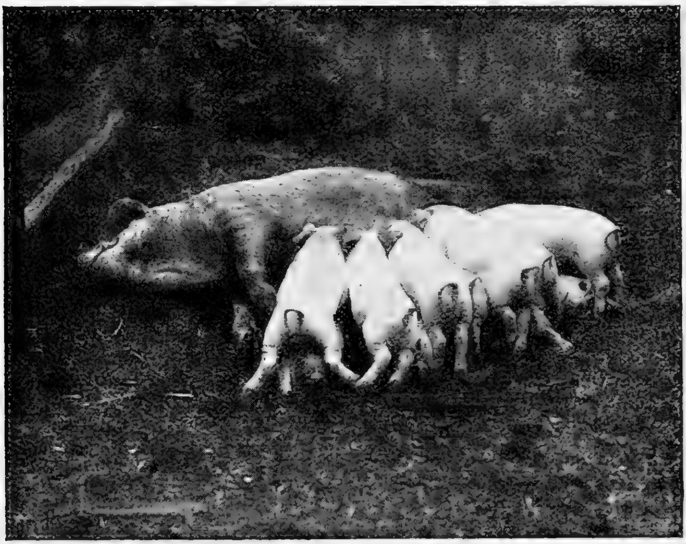
Meats and poultry	16%
Dairy products	18%
Cereals and their products	31%
Vegetables and fruits	25%
All other foods	10%

It is therefore seen that we derive more than one-third of all our food in this country from animals, either by consuming their flesh or other products from them, such as milk, butter, cheese, etc.

Animals used for meat.—The animals whose flesh is chiefly used for food are cattle, hogs, poultry and sheep. So great has the industry of preparing their flesh for food become, that many cities have great stock-yards and slaughter-houses, where hundreds of thousands of animals are killed every year. Cold storage vaults are provided in which meats can be kept at a temperature below freezing for months at a time. Much of the meat that is now used on the farms is first shipped to the city packing houses for slaughter, and then brought back by retail dealers as needed, in the form of bacon, ham, canned or dried beef, or as fresh meats shipped in refrigerator cars. Many small towns also have their local slaughter-houses, where animals purchased from the farms are killed for home consumption.

Other food products from animals.—The other food products from animal life, such as milk, butter, eggs and cheese, are even more important. Milk and eggs contain more of the different food elements needed by the human body than any other foods; and butter is as necessary as meat.

The dairy and poultry industries are therefore among the most important enterprises connected with agriculture. Milk and butter are shipped to the cities in refrigerator cars or special trains. Hundreds of creameries are operated to save time for the farmer and insure him greater profit. Many train loads of eggs and butter are collected during the summer



Making hogs of themselves.

months and put in cold storage and kept for the winter supply.

Other Animal Products

The farm animals are useful in other ways than doing work and providing food for man. Many practical necessities are supplied by them.

Leather.—The skins of all the common farm animals are saved for leather. Cattle, horses, sheep and even pigs, contribute to the making of our shoes, gloves, mittens, harnesses, saddles, cushions and many other articles in common use.

Wool.—Sheep furnish one of the most valuable clothing materials known. Many sheep ranches are maintained chiefly for the fleeces, mutton being of secondary consideration. More than thirty-eight million sheep annually give up their wool in the United States for the making of clothing and other articles for the household.

Other products.—We owe many other articles of common use to some form of animal product. Our brushes are made from bristles. Buttons are cut from bone. Gelatin and glue are both animal products. Many soaps are made from animal parts not suitable for meat. Blood and bone are used for fertilizers. So completely are all parts of slaughtered animals saved for some useful purpose that it is said nothing is lost of the pig when it is killed, except the "squeal."

It is estimated that the value for fertilizing purposes of the manure of all farm products in the United States, if properly saved and applied to the soil, would annually reach the stupendous amount of more than two billion dollars.

CHAPTER XXXIII

CATTLE

CATTLE range second only to horses in market value in the United States. Our farms support some twenty-two million dairy cows, or one to approximately every four people. In addition, there are about thirty-seven million other cattle, chiefly calves and beef stock. The value of each of these two great groups is about the same, nearly a billion dollars, or almost two billion dollars for the whole.

Dairy Cattle

Dairying is one of the leading American industries. Each of six states, Wisconsin, New York, Iowa, Minnesota, Illinois and Texas, has more than a million dairy cows, and four other states, Pennsylvania, Ohio, Michigan and Missouri, have more than three-quarters of a million each. These ten states supply fifty-three per cent. of all our dairy products.

In deciding whether dairying will pay as a principal farm project, each farmer must take a number of conditions into account. The labor required for handling dairy cows is considerably greater than that demanded for producing beef, mutton or pork. Milking when done by hand is hard work and requires time and patience as does the handling of the milk, cream and butter. The availability of markets for milk, cream or for butter and cheese products must also be taken into account. The same amount of feed will produce greater profits with a dairy herd than with beef stock. The farmer's problem is therefore to decide the proper balance between his labor, market conditions and the amount of feed available for his herd.

Profitable and unprofitable cows.—Whether a dairy herd yields a profit or a loss depends first of all on the milk and butter-fat producing capacities of the individual cows. A poor cow may require as much feed as a good one, and demands as much labor and attention.

All cows, whether good or poor, must of necessity require a certain proportion of a full ration for the up-keep of the bodily functions. A first-class dairy cow will demand approximately half of a full ration for bodily maintenance and will be able to put the remaining fifty per cent. into milk production. A poor dairy cow, after using the half of her ration for bodily maintenance, will have a tendency to put a part of the remaining half into body fat in place of into milk. Of course all surplus fat produced at the expense of milk is so much sheer waste in the dairy. The ideal arrangement would be to find dairy cows whose nutritive processes are so arranged that all food material above that required for good bodily up-keep should go to the production of milk. The best dairy cow, therefore, never fattens while milking, but she nevertheless utilizes a sufficient proportion of her food to keep the body organism strong, healthy and vigorous.

It has been estimated that one-third of the dairy cows in the United States are kept at an actual loss. Twice every day, therefore, there are milked some seven million cows, mere "boarders," that not only return no profit, but use up the profit from good cows.

Profit differences in herds.—It is estimated that the skim-milk, calf and manure from a dairy cow are worth the cost of caring for her. This leaves the milk to balance against the value of the feed. The difference between the best and the poorest cow in almost any herd is surprising. This difference is well shown in the following records of cows for one year in Illinois herds: (Bul. Ill. Agric. Exp. Sta.)

HERD NO. 1

No. cow	Lb. milk	Lb. fat	Per cent. fat	Profit	Loss
1	1204	49	4.07	----	$27.52
2	1236	50	4.05	----	27.20
3	2944	88	2.99	----	15.17
4	2597	91	3.50	----	15.38
5	2548	98	3.85	----	13.18
6	2475	99	4.00	----	13.18
7	2569	105	4.09	----	10.98
8	3164	117	3.70	----	8.37
9	2829	123	4.34	----	8.67
10	3380	149	4.41	----	1.58
11	4582	158	3.45	$1.41	----
12	4146	174	4.20	3.41	----
13	4103	177	4.31	5.41	----
14	4993	191	3.82	8.40	----
15	4435	200	4.51	10.21	----
				$28.84	$141.23
					28.84
Balance of loss					$112.39
Av.	3147	124	3.94		$ 7.49

Difference in profit between best and poorest cow, $37.73

This was an exceptionally poor herd, so poor that it lost the owner $112.39 for the year—an average loss of $7.49 per cow. Either of the two poorest cows lost almost as much as the best five made their owner. Even the best cow of this herd is poor enough, but there is a difference of $37.73 in the year's record between the best and the poorest.

HERD No. 2

No. cow	Lb. milk	Lb. fat	Per cent. fat	Profit	Loss
1	2496	102	4.09		$13.18
2	3158	107	3.39		10.57
3	3369	110	3.27		10.57
4	4178	121	2.90		7.59
5	3389	123	3.63		8.18
6	3349	124	3.70		8.37
7	3036	124	4.08		8.57
8	3415	125	3.66		5.98
9	3947	128	3.24		5.59
10	3438	132	3.84		5.98
11	3263	133	4.08		6.17
12	3435	134	3.90		5.98
13	3547	145	4.09		1.58
14	3686	149	4.04		1.38
15	2429	151	6.22		2.18
16	3922	157	4.00	$ 1.01	
17	3612	158	4.37	.62	
18	4185	158	3.78	1.21	
19	4296	161	3.75	1.21	
20	4328	168	3.88	3.41	
21	4131	170	4.12	3.41	
22	4290	175	4.08	5.61	
23	4528	181	4.00	5.81	
24	4458	182	4.08	5.81	
25	5014	184	3.67	6.20	

No. cow	Lb. milk	Lb. fat	Per cent. fat	Profit	Loss
26	5191	195	3.76	10.87	
27	5403	196	3.63	11.13	
28	5673	200	3.53	11.40	
29	5333	211	3.96	13.07	
30	5215	213	4.08	13.07	
31	5820	218	3.75	15.80	
32	5953	221	3.71	16.06	
33	5822	227	3.90	18.00	
34	6606	254	3.84	22.96	
				$166.66	$101.87
				101.87	
Balance of profit				$ 64.79	
Av.	4233	163	3.85	$ 1.91	

Difference in profit between best and poorest cow, $36.14.

Herd No. 2 was composed largely of grade cows but contained six animals which had a preponderance of dairy blood. Probably the most striking fact shown in the table is that the entire herd of thirty-four cows yielded an annual profit of only sixty-five dollars, or an average of less than two dollars per cow. It is also to be noted that the owner had fifteen cows which were losing him money and that his loss from this source was more than one hundred dollars. Had he disposed of these fifteen cows he would have made one hundred sixty-six dollars from the remaining nineteen in place of the sixty-five dollars which he made from the entire herd. This would have saved him the milking of fifteen cows which were kept at a burden and loss of both labor and feed. With another form of comparison, he would have made more from the best four cows than he made from the entire herd, so great was the difference in earning power of the different animals. It is the discovery of just such differences as these in a dairy herd and prompt action with reference to the disposal of poor stock that determines the profit the dairyman is to receive from his investment and labor.

HERD No. 3

No. cow	Lb. milk	Lb. fat	Per cent. fat	Profit	Loss
1	6921	220	3.18	$ 16.65	
2	5380	223	4.14	15.53	
3	5432	223	4.10	15.53	
4	6652	226	3.40	18.70	
5	7461	227	3.04	19.15	
6	7272	235	3.23	19.00	
7	6664	237	3.55	20.90	
8	7027	240	3.41	21.05	
9	6512	263	4.04	25.16	
10	8087	264	3.26	26.04	
11	7449	278	3.73	30.15	
12	7051	289	4.09	32.05	
Balance of profit				$259.91	
Av.	6826	244	3.57	$ 21.66	

Difference in profit between best and poorest cow, $16.52.

The difference between keeping herds all of which yield a fair profit, and herds a considerable portion of which are kept at a loss, is shown in the case of Herd No. 3. In this instance with a herd of twelve cows, the poorest of which made a profit of more than fifteen dollars, there is an aggregate profit of about two hundred and sixty dollars, as against the sixty-five dollars coming from thirty-four cows of Herd No. 2. Herd No. 3 contains no remarkably profitable cows, the best returning but thirty-two dollars. But the fact that no individuals were kept at a loss leaves the aggregate profit at a reasonable figure. With more herds like No. 3, even if these herds are relatively small, the dairy business will return considerably larger profits than are now received and dairy farmers will be much more contented with their reduced labor and larger income.

Selecting Dairy Cows According to Type

Dairy cows may be selected by two different methods: (1) keeping a record of the amount of milk produced, with the percentage of butter-fat it contains; and (2) judging whether the cow conforms to the physical type known as good dairy stock. The first of these is the only absolutely sure method. The second is also of great value, for cows are often bought without any possibility of learning their milk record. Every farmer should, therefore, know the points of a good dairy cow.

The dairy type of cow.—Dairy cattle and beef cattle present two rather distinct types as to form, or build, and appearance. In general, the frame of the beef animal is the shape capable of taking on the largest amount of flesh, while that of the dairy cow is adapted to the production of milk. Both types must be good eaters, for only the food above the amount required for maintaining the body can go to the production of either beef or milk.

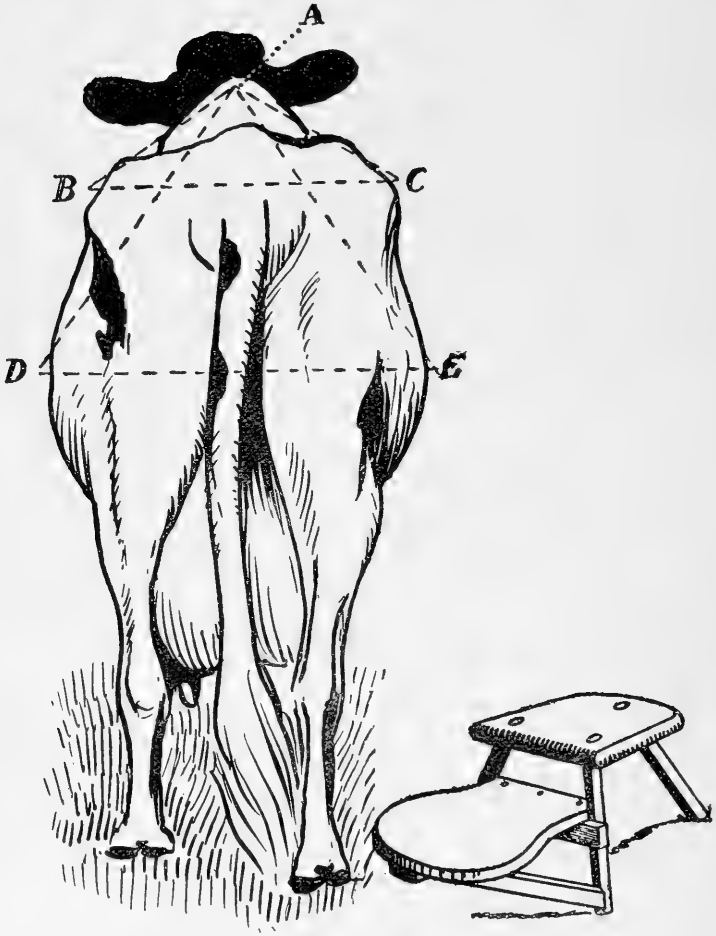
The good dairy cow is spare of flesh, for the surplus food must be turned into milk instead of fat. She appears somewhat loose-jointed, but the muscles are well developed. The coat is smooth and soft, the eyes are bright, and the disposition is wide-awake and active. The jaw is strong, the stomach and other organs of digestion are capacious. The circulatory system needs size and strength, as it must supply abundance of material for the production of milk. The udder is well shaped and large.

Shape of the dairy cow.—The typical dairy cow has what is called a *wedge* conformation, especially if viewed from front to rear; that is, the body outline as a whole, whether viewed from side, top, or front, roughly resembles a wedge.

The *side* wedge has its base in a line formed by the depth of the body through the hips to the lower extremity of the udder, with the point of the wedge at the head. The *top* wedge has its base in a line across the width of the hips, and its point at the withers. The *front* wedge has its base in a line across the floor of the chest, and its point at the top of the withers.

It is readily seen that the shape given the body by these three wedge conformations allows a generous amount of room for the digestive and circulatory systems and the udder. This form does not, however, give a frame capable of taking on a large amount of flesh, and is therefore not adapted to beef cattle.

Various score-cards are in use for the judging of dairy cows. Judging by use of the score-card trains one in accu-



Showing wedge formation of dairy cow.

A B C. Wedge shape looking along the back.
A D E. Rear view looking from main body to shoulder ridge.

rate observation and judgment, and shows the relative value of the different points.

The Score-Card for Judging Dairy Cows

	Scale of Points.	Standard
	HEAD—8 Points	
1.	Muzzle, broad	1
2.	Jaw, strong, firmly joined	1
3.	Face, medium length, clean	1
4.	Forehead, broad between eye dishing	1
5.	Eyes, large, full, mild and bright	2
6.	Ears, medium size, fine texture, secretions oily and abundant, yellow color	2
	FOREQUARTERS—10 Points	
7.	Throat, clean	1
8.	Neck, long, spare, smoothly joined to shoulders, free from dewlap	2
9.	Withers, narrow, sharp	3
10.	Shoulders, sloping, smooth; brisket, light	3
11.	Fore legs, straight, clean, well set under body	1
	BODY—25 Points	
12.	Crops, free from fleshiness	1
13.	Chest, deep, roomy; floor broad	6
14.	Back, straight, strong; vertebræ open	3
15.	Ribs, long, deep and well sprung	3
16.	Barrel, deep, long, capacious	10
17.	Loin, broad, strong	2
	HINDQUARTERS—12 Points	
18.	Hips, prominent, wide apart	1
19.	Rump, long, level, not sloping	4
20.	Pin bones, wide apart	1
21.	Tail, neatly set on, long, tapering	1
22.	Thighs, spare, not fleshy	3
23.	Hind legs, well apart, giving ample room for udder	2

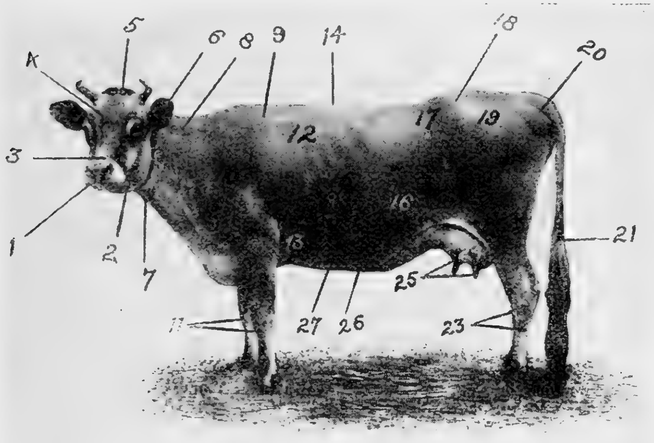
	MAMMARY DEVELOPMENT—30 Points	
24.	Udder, large, very flexible, attached high behind carrying well forward; quarters even	15
25.	Teats, wide apart, uniformly placed, convenient size	5
26.	Milk veins, large, tortuous, extending well forward	4
27.	Milk wells, large	6
	GENERAL APPEARANCE—15 Points	
28.	Disposition, quiet, gentle	2
29.	Health, thrifty, vigorous	3
30.	Quality, free from coarseness throughout; skin soft, pliable; secretions abundant; hair fine	4
31.	Temperament, inherent tendency to dairy performance	6
	Total	100

Selecting the Dairy Cow by Milk Tests

The profit from a dairy cow depends on two factors: (1) the amount of milk produced, and (2) the percentage of butter-fat in the milk. The first of these questions can be determined by weighing the milk; the second, by testing the milk with the Babcock milk test.

Testing the milk of different cows.—In order to determine the record of each cow of the herd, the milk must be weighed and tested regularly throughout the season. The testing and weighing may be done daily, though this frequent a test is hardly necessary for practical farm purposes. A plan followed by many farmers is *to weigh the milk daily, and test the butter-fat of both night's milk and morning's milk once a month.*

Making the Babcock test for butter-fat.—It is not the quantity of milk alone that determines the value of a cow. Practically all milk and cream now sold from the farm for butter-making purposes are paid for, not by weight or bulk, but by the amount of butter-fat they contain. The purpose of the Babcock test is to measure the percentage



1. Muzzle	8. Neck	15. Ribs	22. Thighs
2. Jaw	9. Withers	16. Barrel	23. Hind legs
3. Face	10. Shoulders	17. Loin	24. Udder
4. Forehead	11. Fore legs	18. Hips	25. Teats
5. Eyes	12. Crops	19. Rump	26. Milk veins
6. Ears	13. Chest	20. Pin bones	27. Milk wells
7. Throat	14. Back	21. Tail	

Parts of a dairy cow.

of butter-fat in milk. Every dairy farm should regularly use this test.

The *materials* for making the Babcock test are (1) a hand-power centrifugal tester; (2) two or more milk test-bottles; (3) a pipette to measure the milk; (4) a small glass measure for acid; (5) sulphuric acid with specific gravity of 1.82; (6) hot water. The necessary apparatus can be bought for about five dollars, though a fuller equipment may cost as much as twenty dollars. Full directions for making the test come with each set of apparatus.

Steps in the Babcock test.—The Babcock test is not difficult to make, nor does it require much time. Yet great care must be taken if the results are to be trustworthy. The following are the steps required in making the test:

1. Stir the milk thoroughly before taking the sample.
2. Fill the pipette to the height shown by the mark.
3. Empty the pipette into the test-bottle, blowing to drive all the milk out.
4. Fill the acid measure to the mark shown with sulphuric acid, and add to the test-bottle.
5. Shake the bottle to mix the milk and acid thoroughly.
6. Place the bottles in the machine, and whirl five minutes.
7. Add hot water to each bottle until filled to bottom of neck, and whirl one minute.
8. Add more hot water to bring the top of the fat nearly to the top of the marks on the neck of the bottle, and whirl one minute.
9. Read the per cent. of fat in the neck of the bottle; this indicates the quality of the milk.
10. Empty the test bottles and wash.

The percentage of butter-fat ought to be not less than three and five-tenths, and should range up to five or occasionally even six in the milk of the better cows.

Dairy Breeds

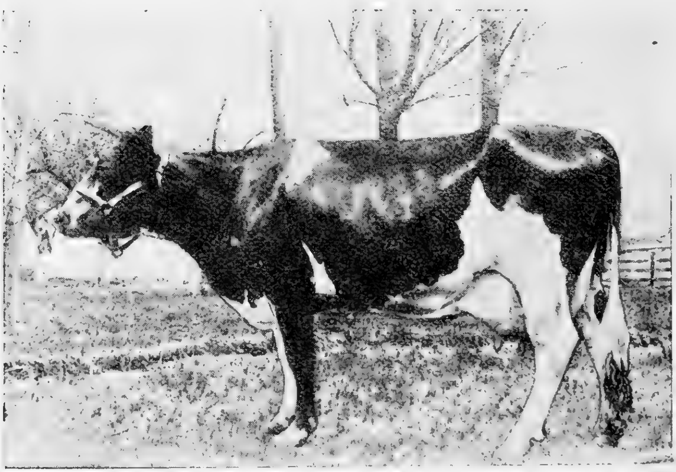
Dairymen are not agreed as to the type of cow that is most profitable. Some prefer what they call a "general-purpose cow," combining as far as possible the qualities of both dairy and beef breeds. Such animals are usually of large frame, take on flesh readily, and so are easily converted into beef when this is more profitable than milking. Other dairymen select the pure dairy breeds, preferring to get their profit out of the milk produced, rather than from the beef. Which is the better plan will depend on local conditions and demands.

Choosing the dairy breed.—It is impossible to select any one breed of dairy cattle as the best under all conditions. Some are noted for producing large quantities of milk, and others for producing milk rich in butter-fat. Some do best when allowed a wide range for foraging, and others when they are kept close and fed high. Some give a large flow of milk for a short season, and others a smaller flow for a longer time. The dairyman should decide what particular qualities are best adapted to his needs, and then select the breed that will meet these needs.

Leading dairy breeds.—Among the best-known breeds of dairy cattle are the Holstein, or Holstein-Friesian, as they are officially named; the Jersey; the Guernsey; and the Ayrshire. The Shorthorns are also a favorite class, combining in large degree both dairy and beef qualities. Records kept for one year in various experiment stations of the United States Department of Agriculture show the following average ratings as milk producers of the first four of these breeds in the station herds:

Breed	Pounds of milk	Per cent. of fat	Pounds of fat	Per cent. total solids
Holstein	8699	3.45	300	12.99
Jersey	5508	5.14	283	14.2
Guernsey	5509	4.98	274	14.2
Ayrshire	6533	3.85	252	12.98
Average	6562.25	4.355	277.25	13.5925

The *Holstein* cattle have been known as a dairy breed for more than two thousand years. Some three hundred years B. C. a people known as the Friesians, coming from somewhere on the shores of the Baltic, settled in the Rhine Valley in Germany, bringing with them their white coated cattle. Within the next century the Batavians entered this



"Banastine Belle de Kol," a champion Holstein cow with a record of 1,058.34 pounds of butter-fat in 365 days.

same territory bringing with them herds of black cattle. The combination of these two herds produced the black and white cattle now known as the Holstein-Friesian. They were first brought to the United States about the middle of the last century and have since that time become one of the foremost dairy breeds. The Holsteins are noted for their marvelous milk production, great food and digestive capacity and strong constitutions. Their milk, however, is not so rich in butter-fat as that of the Jersey or Guernsey. The Holsteins are larger than any of the other dairy breeds. In point of numbers they come next after the Jersey in the United States.

The *Jersey* cattle are famous the world over for their abundant and rich milk production. They were, in fact, the first of the dairy breeds to attract public attention for dairy efficiency in this country. Among the strongest points are the following: They convert a very large proportion of the food consumed into milk, using almost none for the production of unnecessary fat; they give milk of the richest quality, commonly showing an unusually high percentage of butter fat; they mature at an early age and hence can early be used for milk or breeding purposes, thus avoiding the necessity of long delays before they come into profitable usefulness. The Jerseys originated on the Island of Jersey, whose people are among the most prosperous and contented of the United Kingdom. The chief support of these Islanders is found in their herds of Jersey cows and the breed is kept pure by the strictest of laws against the importation of foreign animals.

The *Guernseys* are another of the dairy breeds originating among the islands of the English Channel. This famous breed of cattle came from the Guernsey Island where they probably had a common origin with the Jerseys. The two breeds are now entirely independent, however, although they resemble each other in general appearance and characteristics. The Guernseys are somewhat larger than Jerseys and carry more flesh. Next to the Jersey, the

Guernsey produces the richest milk known, and in quantity the Guernsey often excels even the Jersey. In early days the Jerseys and Guernseys were in this country classed together under the general name of Alderney, but were later recognized as separate breeds.

The 1914 dairy champion of the United States, "May Rilma," a Guernsey. Her record for 365 days was 19,639.5 pounds of milk and 1,059.59 pounds of butter-fat.

Not only are Guernseys prolific milk producers, but their gentle disposition makes them a favorite family cow. They are lighter feeders than the Holstein but devote a large proportion of their ration to the production of milk. The yielding of more than fifteen thousand pounds of milk in a year is not an unusual performance for many Guernsey cows.

The *Ayrshires* are a Scotch breed, originating in the mountainous parts of Scotland, later brought to the state of New York in the early part of the last century. Like other famous dairy breeds, the Ayrshires are noted for their economy in feeding and the large amount of milk produced in proportion to the feed consumed. Ayrshires are of a less quiet disposition than the other dairy breeds and somewhat inclined to be quarrelsome. Many stock raisers believe that the Ayrshire breed will thrive under less favorable conditions than either the Jerseys or Guernseys. This breed has become very popular in America within the last few years.

Feeding Dairy Cows

Just as the soil must contain the food elements needed in the growth of the plant, so the dairy cow's rations must contain the elements required to produce milk and upbuild the body. If proper food is not supplied, either the amount of milk or its quality will be sure to suffer. Only three different food elements, or *nutrients,* are likely to run short in the ordinary rations of the cow; these are (1) *protein,* (2) *carbohydrate,* and (3) *fat.*

Protein.—Protein is required in the animal body for the making of all muscular parts, blood and connective tissue. It supplies nearly one-third of the solid part of milk, going to form the curd and albumen.

It is fortunate that the nitrogenous plants so valuable in building up the soil are also rich in protein. Alfalfa, clover, cow-peas, soy-beans, the vetches and other legumes are therefore desirable as a part of the dairy ration. Bran, linseed meal, cottonseed-meal, gluten feed and oats are also rich in protein. Protein should make up approximately one-sixth of the cow's ration during the milking season; no other food can take its place. It is the most expensive part of the ration, and should be secured as far as possible from home-grown legumes.

Carbohydrates.—The carbohydrates are necessary to supply energy, heat and fat for the animal body, and sugar and fat in the milk. All the common grains are rich in carbohydrates, which are the cheapest nutrient of the cow's rations. Among the more common carbohydrate feeds are corn, corn silage, corn stover, oat straw, millet hay, sugar beets and dried beet pulp. In some cases sugar beet feeds have not proved satisfactory owing to their temporary effect upon quality of the milk. Timothy hay should not form a part of the dairy ration, as it has few of the elements required in producing milk.

Fat.—Fat is used for practically the same purposes as the carbohydrates in maintaining the body and producing milk. It is contained in some degree in all feeds, though in smaller quantities than carbohydrates, and in more concentrated form. It has been found that one pound of fat will serve the same purpose in the dairy ration as two and one-fourth pounds of carbohydrates.

The balanced ration.—By a *balanced ration* is meant a ration which contains the right digestible proportion of each kind of nutrient demanded by the animal. The term *nutritive ratio* is used when speaking of the relation of protein to carbohydrate and fat in the ration. The nutritive ratio of the dairy ration is 1 : 6; this is to say, one part of digestible protein to six parts of carbohydrates and fat combined. The following tables show several balanced and economical rations for dairy cows:*

Ration I

Corn silage	30	pounds
Cow-pea hay	10	"
Corn stover	2	"
Corn	6	"
Cottonseed-meal	1.5	"

Ration II

Sugar beets	25	pounds
Alfalfa hay	10	"
Corn stover	5	"
Corn	5	"
Dried brewers' grains	5	"

Ration III

Clover hay	18	pounds
Corn	5	"
Wheat bran or oats	6	"
Cottonseed-meal	1	"

Ration IV

Corn silage	30	pounds
Canadian pea and oat hay	10	"
Oats	5	"
Gluten feed	4	"

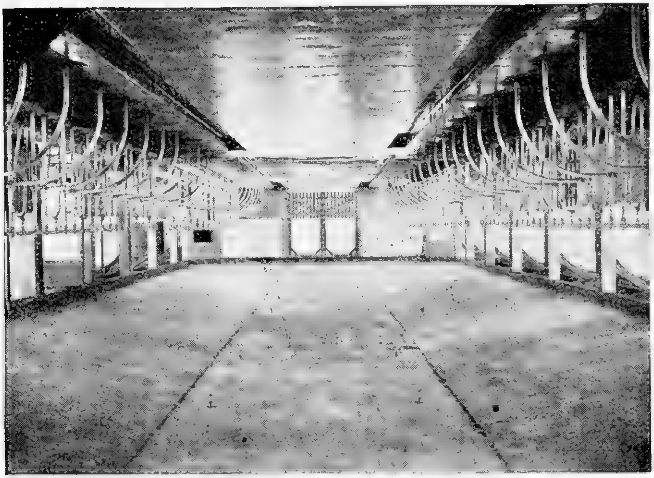
It must be remembered that, no matter what the feeds used to supply the protein, carbohydrate and fat, there must also be a certain amount of roughage in the ration. All browsing or grazing animals require bulky feed, and can not thrive on concentrated material alone.

Producing Clean Milk

Milk is perfectly clean as it comes from the cow. It is easily tainted, however, either by filth that may fall into the pail during the milking, or from dirty utensils. Dirty milk makes dissatisfied customers, endangers the health of users, especially children, hastens souring, makes a lower grade of butter, and indicates shiftlessness and low standards of dairying.

*(*Purdue Ext. Bul.* No. 21.)

The cow barn.—The cow barn should be constructed for the comfort, cleanliness and hygiene of its occupants. It should be well ventilated and have plenty of light. The floor should be of some hard material, preferably cement, and water-tight. The stalls should be the right length for the cows, and have a shallow gutter at the rear with slope enough toward one end to permit drainage. Instead of a



A clean dairy barn.

feed manger in front, there should be a liquid-tight trough, also with a slight slope, that it may be washed out. All floors should be kept thoroughly washed by means of a hose and stiff brushes.

Cleanliness in milking.—Before the milking is begun, both the cow and the milker should be clean. If the cow is dusty, the dust should be well brushed out. The udder should be wiped clean, washed, or sponged off, as may be required. The milker's hands should be freshly cleansed, as it is almost impossible to keep the milk from touching them.

Special suits should be kept for milking, and should be frequently washed. The practise of putting on old, greasy and unwashed clothes, simply to save soiling other garments while milking, is too filthy to be permitted in any dairy. All utensils should be kept in a perfectly clean place, and well *scalded* once each day.

A careful analysis of the dirt contained in milk shows about nine-tenths of it to be cow manure. The other tenth is hair from the cow, dirt from the cow or the milker, particles of the feed used, and disease germs from the cow or hands of the milker. No dairyman should ask a consumer to eat such an array of filth as this.

Milking machines.—Successful mechanical milkers of various types are now in common use. Each individual farmer must decide with reference to his entire set of farm enterprises, including the cost of labor, whether it will pay to install a mechanical milker for his herd. Where an electric current is available for power very excellent types of milkers can be obtained, each section of which will milk several cows at a time, one man being able to take care of the milking of four cows at once. Gasoline or other power will accomplish the same results if carefully adjusted to the work in hand.

Straining the milk.—Much of the dirt that gets into the milk can not be strained out, since it fully dissolves and will pass through the strainer as easily as the milk itself.

A good strainer will, however, if used while milking or immediately afterward, remove a considerable portion of the insoluble matter.

A wire mesh strainer should never be used. The strainer should be cone-shaped, with gauze and absorbent cotton forming the outlet. One thickness of the cotton is placed between four thicknesses of gauze, two on each side, and held in place by a ring which fits over the edges and attaches it to the bottom of the receptacle. The cotton should be destroyed after each straining, and never used a second time. The additional expense for this type of strainer is slight, and should keep no progressive dairyman from using it.

Cooling the milk.—After cleanliness, the next essential to good care of milk is quick cooling. So important is quick cooling to prevent souring of milk and keep it in good condition that a higher price is often paid for milk properly cooled than for uncooled milk.

For the best results some form of cooling apparatus is necessary. Various machines for this purpose can be had for from ten to twenty-five dollars. An average of about five cents' worth of ice is required for each hundred pounds of milk during the warm months. Milk should be cooled down to forty-five degrees in a few minutes of time.

Standard for Judging Butter

In judging butter, the different characteristics are given different values according to their relative importance. Following is given a standard used commercially and based upon one hundred per cent. grade as perfect:

	Score
Flavor	45
Body	25
Color	15
Salt	10
Style	5
Total, (perfect score)	100

Flavor.—As shown in the score above, flavor is the most important characteristic. Good butter should possess a clean, mild, rich, creamy flavor, and should have a delicate, mild, pleasant aroma. *Flat* flavor is noticeable in butter made from unripened cream. *Rancid* flavor is applied to butter which has a strong flavor, and develops in butter which has been standing a long time. *Cheesy* flavor is common to butter which has little or no salt. *Weedy* flavors are due to the condition of the milk before churned and are caused by the cows pasturing where weeds are growing, such as wild onions, garlic, etc. *Acid* flavor is due to improper ripening of the cream.

Body.—Next in importance to flavor is body. Butter that is greasy, tallowy, spongy, or sticky is undesirable. The body must be firm and uniform.

Color.—The color should be bright and even, not streaky or mottled. A light ripened out straw color is the one most desired.

Salt.—The amount of salt depends upon what the market wants. The principal thing is to have the salt thoroughly dissolved and evenly distributed. Medium salting is most desired.

Style.—By style is meant the appearance of the butter and package. It should be clean, neat and of pleasing form.

Beef Breeds

Larger profit can be secured from dairy than from beef cattle with the same amount of feed, but dairy animals require a much greater amount of labor and a more costly equipment. The work necessary to care for fifteen or twenty dairy cows will be sufficient to tend two hundred beef animals. Properly managed, the raising and feeding of cattle for beef from home-grown feed can be made highly profitable.

The beef-producing type.—Beef and dairy cattle differ widely in their type. For the production of beef, the animal must be able to use a large proportion of its food in the putting on of flesh; it must also have a form capable of holding a large amount of muscle and fat.

The beef animal should have a conformation that (1) favors the production and carrying of flesh; (2) supplies the best proportion of good cuts of meat on the block; (3) indicates good constitution and feeding capacity.

The form of beef animals.—Instead of the wedge conformation of the dairy cow, beef cattle should in their shape present a series of *rectangles;* that is, they should be "block." The body is reasonably long, and deep, with short sturdy legs. The whole form presents a plump full-shaped appearance. The back is broad and straight, with ribs well arched to give breadth to the body. The quarters are well filled and thick. The skin is pliable, rather thick, and the coat smooth and glossy.

In selecting feeders or judging beef stock, there is perhaps no point more important than the back of the animal. A wide, level, strong back with well arched ribs is essential. The girth should be large, for this means not only room for meat, but also space for vital organs to insure a better constitution.

A good beef animal usually carries a wide head and is a good feeder. The wide head commonly goes with width of body across the back, which gives room for a large quantity of high priced meat. The eye should be prominent, clear and quiet, showing the good disposition so necessary in animals that are required to take on flesh. The chest should be of great depth as well as girth, indicating large lung capacity and adding to the meat area of the animal. Reasonably broad shoulders are desirable but extreme width at this point is not to be sought as it usually stands for coarseness and unduly prominent hip points. The coupling or the distance between the last rib and the hip point should be short, as great distance in this measure indicates looseness of build with probable inability to take on flesh. The rump should be long, wide and level, the flank full and low. Shortness of legs is a prime point in the selection of beef stock for short legs decrease the amount of waste and increase the killing percentage of beef. Short legged animals also have less tendency unnecessarily to travel about and thus save their energy for the production of flesh and fat. The bones of a good beef animal are strong without coarseness.

Wholesale Cuts on the Beef Carcass

CUTS OF BEEF

	Name	Per cent. of carcass	Value per pound*	Per cent. of value of carcass
1.	Round	23	9.5 cts.	23.18
2.	Loin	17	14.5 cts.	26.15
3.	Flank	4	7 cts.	2.97
4.	Rib	9	12.5 cts.	11.93
5–6.	Plate	13	7 cts.	9.65
7.	Chuck	26	7.7 cts.	21.24
8.	Shank	4	5.5 cts.	2.33
9.	Suet	4	6 cts.	2.55

Judging beef cattle with the score-card.—Because of the difference in type between dairy and beef cattle, it is best to use separate score-cards in judging them.

Score-Card for Beef Cattle

STANDARD OF EXCELLENCE	Possible Score	Points Deficient
Weight, estimated ______ lb., according to age	10	______
Form, straight top line and underline; deep, broad, low-set; compact, symmetrical	10	______
Quality, fine hair; bone firm but strong; skin pliable, mellow, even covering of firm flesh; especially in region of valuable cuts; absence of ties and rolls	10	______
Condition, prime, flesh deep; evidence of finish especially marked in cod, at tail-head, flank, shoulder and throat; absence of ties or rolls	10	______

*Variable, of course, with market and location.

STANDARD OF EXCELLENCE	Possible Score	Points Deficient
Head, clean-cut; symmetrical; quiet expression; mouth and nostrils large, clear and placid; face short; forehead broad, full; ears medium size, fine texture, erect	8	------
Neck, thick, short, tapering neatly from shoulder to head; throat clean	2	------
Shoulder vein, full	2	------
Shoulder, well covered with flesh; compact	3	------
Brisket, full, broad but not too prominent; breast wide	1	------
Dewlap, skin not loose and drooping	1	------
Chest, deep, wide, full	1	------
Crops, full, thick, broad	3	------
Ribs, long, arched, thickly fleshed	8	------
Back, broad, straight, thickly and evenly fleshed	8	------
Loin, thick, broad; thickness extending well forward	8	------
Flank, low and full	2	------
Hooks, smoothly covered; width in proportion to other parts but not prominent	3	------
Rump, long, level, wide, and even; tail-head smooth, not patchy	2	------
Pin bones, not prominent, width in proportion with other parts	1	------
Thighs, full, fleshed well down to hock	1	------
Twist, deep, full; purse full	4	------
Legs, straight, short; arm full; shank fine, smooth	2	------
Total	100	------

(Courtesy Kansas Agriculture College)

Beef breeds.—Among the chief breeds of beef cattle in the United States are Shorthorns, or Durhams, Herefords, Aberdeen-Angus and Galloways. Several different breeds have also developed a polled, or hornless, type. Except for the lack of horns, the polled breeds closely resemble the parent breed from which they were derived.

The *Shorthorns* are the most popular breed of beef cattle in the United States as shown both by the fact that they outnumber any other breed and by their general distribution over all parts of the country. Besides their excellent beef qualities they produce a generous amount of milk. They have a gentle disposition and have come to be called the "farmer's cow." The Shorthorns have been found to cross well with other breeds and to be especially adapted to building up herds out of the common or scrub stock of the plains or western ranges. The Shorthorns mature early and fatten readily. The steers are in demand as profitable feeders, although they have not won prizes so readily as the Aberdeen-Angus at the Fat Stock Shows.

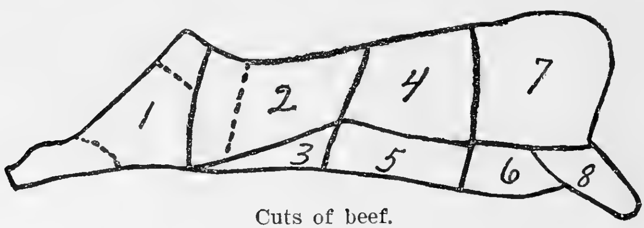
The *Herefords* rank next after the Shorthorns as a favorite beef breed and their number is constantly increasing, especially where cattle must be produced under adverse conditions, as on the western ranges. In ability to look out for themselves and prosper with rather a scant feed, the Herefords are not surpassed by any breed of beef cattle. The Hereford cow has been criticized somewhat because of scanty milk flow, but enough is usually produced for the raising of a good calf. The Herefords mature early and fatten readily under feeding conditions. The Hereford and Shorthorn breeds weigh practically the same, mature bulls ranging from eighteen hundred to twenty-two hundred pounds, and good cows from twelve hundred to sixteen hundred pounds. The Hereford is red with white markings, the white usually being found on the face and head from where it extends backward along the top of the neck and shoulders and downward over the throat to the bottom of the chest.

The *Aberdeen-Angus* breed are black in color and have no horns. While this is an old breed of cattle, it is only within recent years that it has come to be popular in the

A fine speciment of Angus bull.

United States. Although they stand next after the Herefords as grazers on scanty pastures, they have not become so popular on the western ranges as the former breed, nor indeed as the Shorthorns which they far surpass in their ability to thrive under adverse conditions. The Aberdeen-Angus cattle mature very early and can be readily fattened at any age. This latter quality makes them a favorite for baby beef production. Because of their excellent build for the block, their exceptional vigor and early maturity, they are the most popular of all breeds as feeders.

The *Galloways* are one of the oldest breeds of cattle. They are hornless and usually deep black in color, although some brown is occasionally shown in their long, curly, silky coat. The Galloway breed has unusual power to transmit the breed characteristics to offspring from cows of any breed. This is shown by the fact that as high as ninety per cent. of the calves from various colored cows are black, and more than ninety-five per cent. of the offspring from horned



Cuts of beef.

cows are polled. The Galloways are somewhat smaller than the other beef breeds and rather slower in maturing. They are exceedingly good feed rustlers and their heavy coat enables them to stand severe weather. For these reasons they have become popular on many of the ranges of the far Northwest and Canada. Because of their smaller size and their relative slowness in maturing, it is doubtful if this breed will become widely popular in the United States except where climatic conditions and the scarcity of range grasses require the Galloway characteristics.

Feeding beef cattle.—Feeding grain and roughage to beef cattle is a more profitable way to market crops than to sell them off the farm. In this way the fertility of the soil is also conserved, and better crops produced.

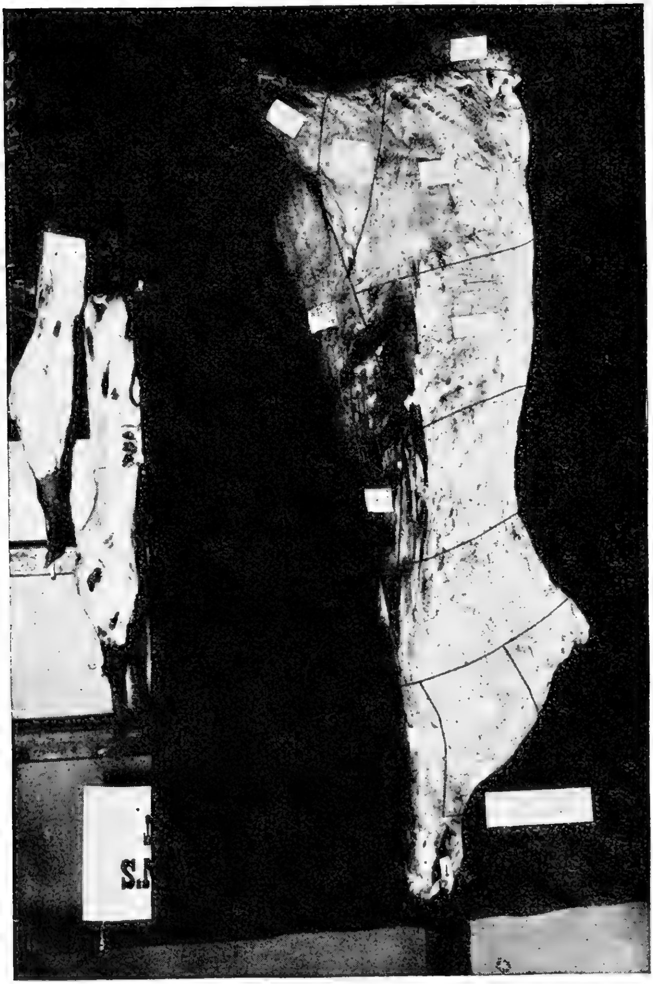
The fattening ration for cattle is slightly different from the dairy ration, the *nutrient ratio* for beef being 1:7 as against 1:6 for milk production. That is to say, that the fattening animal should have a balanced ration consisting of one part protein food for every seven parts of carbohydrates and fats.

Diseases of Cattle

Tuberculosis is a common disease among cattle. It is more common among dairy cattle than beef cattle. This is probably because dairy cows are kept to a greater age than beef cattle, and are more closely confined in barns. The effects of tuberculosis in a dairy herd are (1) lowered milk production and final loss of the tuberculous animal by death, and (2) danger of giving the disease to people, especially children who use the milk.

Prevalence of tuberculosis in herds.—There is no way of telling the exact number of cattle affected by tuberculosis, as comparatively few herds are examined for the disease. It is not uncommon to find as high as seventy to eighty per cent. of the cows in a herd diseased, some with the disease just starting, others with it well along and still others in the last stages. Since tuberculosis is contagious, it is evident that when it once gets started in a herd it is hard to stamp out.

The tuberculin test.—It is impossible to make certain of the presence or absence of tuberculosis in a herd by any



Showing beef cuts.

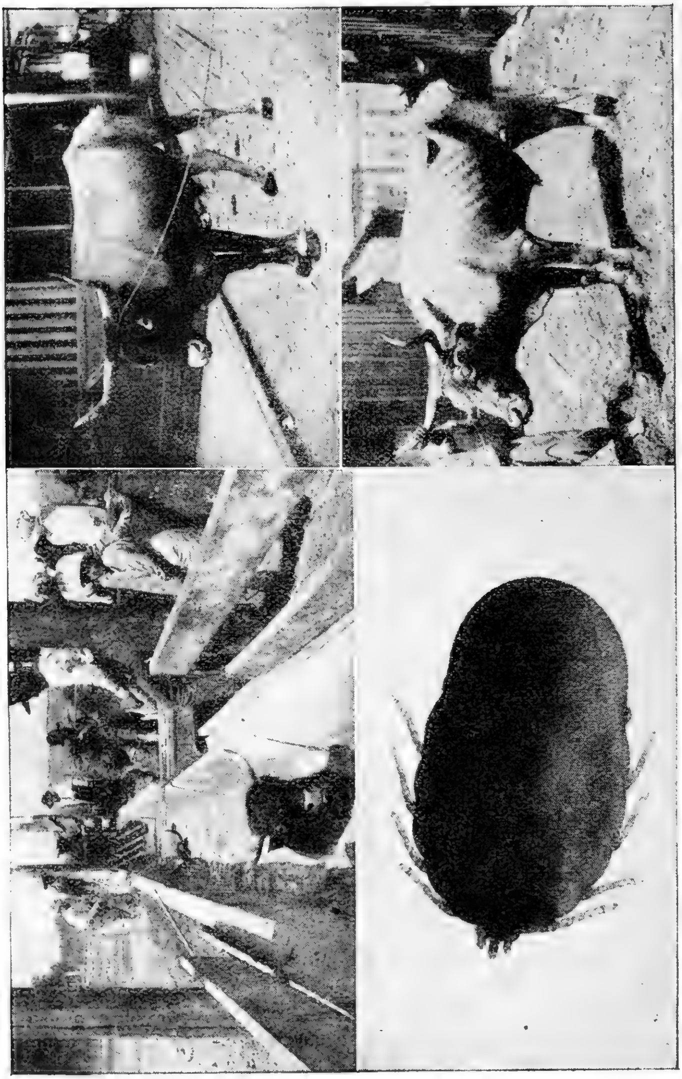
set of symptoms. The only sure way is by the *tuberculin test.* This test is required by law of all dairy herds in many of the states. Experts have shown that tuberculin, if properly used, will reveal the presence of tuberculosis in at least ninety-eight per cent. of the cases.

Tuberculin is a fluid in which tubercle germs have been grown, but from which they have all been removed. This fluid is injected with a hypodermic needle under the skin of all the animals of a herd which is being tested. It will not injure well animals nor give them the disease. Animals that have tuberculosis reveal this fact by a feverish condition which arises from eight to twelve hours after the tuberculin is administered. Well animals show no such reaction.

Suppressing tuberculosis in cattle.—Little can be done in the way of treatment to cure tuberculosis in cattle. Those that have contracted it in a mild form often recover. Animals found to be well advanced with the disease should at once be slaughtered. All diseased stock should be separated from well animals, and kept in different barns and pastures.

The milk from mildly diseased cows is sometimes used, but it should first be carefully *pasteurized.* To pasteurize milk, it is kept at a temperature of one hundred and forty-nine degrees for twenty minutes, or one hundred and seventy-six degrees for five minutes. This heating is sufficient to kill the germs of tuberculosis.

Texas, or tick, fever.—A troublesome cattle disease common throughout the southern states is *tick fever,* some-



Dipping cattle to eradicate tick.

Same steer free of ticks.

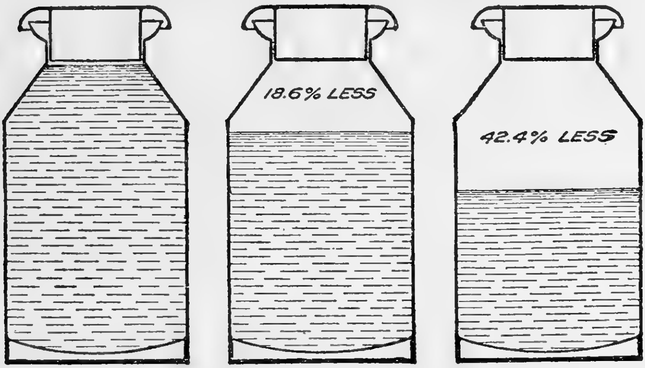
Cattle tick.

Tick infested steer.

times called Texas fever. The disease is caused by a small animal parasite carried to the affected animals by a small tick. The parasite works in the blood of the animal, causing a high fever.

Loss from the Texas fever ticks.—Not only does the tick carry to the animal on which it lives the parasite that causes serious disease, but it lives off the blood of its host, decreases its vitality, and reduces the amount of milk or

The Tick Takes Milk as Well as Blood.



Milk from Tick-Free Cows. From Cows with Few Ticks. From Cows with Many Ticks.

beef produced. It is estimated that the annual loss to the South from this one species alone has amounted to many millions of dollars.

Freeing cattle of ticks.—Treatment of animals sick with tick fever is usually not satisfactory. The remedy lies in prevention, which means getting rid of the ticks. Several methods are used for freeing cattle of ticks: (1) The ticks are picked off by hand, or scraped off several times until the animals are free from the pests. (2) The cattle are sprayed or rubbed with cottonseed oil, fish oil, or a mixture of kerosene and oil. (3) A dipping vat is used containing a carefully prepared disinfecting solution. Care must be exercised not to pasture cattle on land infested with ticks.

Foot-and-mouth disease.—This is a highly contagious disease greatly dreaded by farmers. It attacks not only cattle, but hogs, sheep, horses, dogs, cats and poultry. Human beings may also take the disease, especially children who drink the milk of diseased cows. Men who take care of diseased stock have occasionally become affected.

The first symptoms of the foot-and-mouth disease in animals are loss of appetite, and chills followed by fever. In a day or two eruptions the size of a pea make their appearance over the linings of the mouth and tongue; these small vesicles contain a yellowish watery liquid. The feet become swollen, sore and inflamed. Eruptions may then appear around the feet, and on other parts of the body.

Foot-and-mouth disease is not always fatal, but the effects in loss of milk, the stoppage of growth and interference with fattening for beef are so serious that the most stringent efforts are made to check the disease wherever it makes its appearance. Affected herds are often slaughtered under the direction of government officials, and the carcasses burned or buried. Rigid quarantines are established, and no live stock, meat, hides or other animal products capable of transmitting the disease are allowed to be shipped from the territory affected. In 1914 and 1915 fifteen states, including many dairy herds of large cities, were quarantined in whole or in part because of the foot-and-mouth disease.

To prevent contagion, there should be absolutely no passing between diseased herds and other territory. Visitors should stay away from affected farms; dogs and cats should not be allowed to roam about; even birds such as have the habit of alighting in barnyards may carry the germs. The pasteurizing of milk renders it less dangerous, and this precaution should never be neglected at times and places where the foot-and-mouth disease prevails.

Stern measures necessary.—So important is the prevention of foot-and-mouth disease that the United States Department of Agriculture has issued a poster of warning to farmers which contains the following words:

"Foot-and-mouth disease *is so contagious that one stricken animal invariably affects the entire herd.* The first symptoms are sores in the mouth, followed by similar ones around the hoofs. The milk may be contaminated and the supply is greatly diminished; the flesh is lost rapidly. Even if the animal recovers, its value is greatly decreased. In Europe, where the disease is firmly established, the plague costs farmers many more millions of dollars each year than it has cost the United States to eradicate any of the past scourges by killing. No price is too great to keep it from getting a firm foothold in this country.

"Foot-and-mouth disease can be spread in many ways—by horses, dogs, cats, poultry, pigeons, human beings, hay, straw, manure, etc. If there is infection in your neighborhood, keep your own animals *on* and other people's animals *off* your farm. If you are feeding skimmed milk, boil it.

"The slaughter and burial of all exposed herds and the thorough disinfection of premises are the only known measures that can stop the rapid spread of this disease. The government will do this work and pay its fair proportion for the slaughtered stock. Rigorous local quarantines are absolutely necessary until disinfection is completed. Township and county officials should cooperate actively with state and federal authorities."

Judging the Age of the Cow by the Teeth

The cow has a series of eight *incisors* in the lower jaw, but none in the upper. Like the horse the middle pair are known as the *middles,* the next as the *intermediates,* the third as the *second intermediates,* and the outer pair as *corners* or *laterals.*

At birth the calf usually is in full possession of the middles; if not, they will make their appearance in a very few days and within a month the remaining incisors appear. At the age of eighteen to twenty-six months, the middle pair of milk teeth is forced out and a permanent set takes their place. In like manner the intermediates are changed for a new and permanent set at the time the calf is from twenty-six to thirty-eight months old. The changes in the second intermediates are made when the animal is about thirty to forty-eight months old. The corners are changed at from forty-five to sixty months of age. Up to this time it will be comparatively easy to judge the age of an animal. After five years the age can only be approximately estimated from the actual wear shown by the teeth.

CHAPTER XXXIV

HORSES

MORE than twenty million horses are to be found on the farms of the United States. These horses of the farms alone are worth the enormous sum of two and a quarter billion dollars, or more than all our cattle, both dairy and beef. The raising of horses is therefore one of the leading industries connected with agriculture.

The Leading Horse Raising States

Slightly more than fifty-two per cent. of all the horses found on the farms of this country are raised in the following ten states: Iowa, Illinois, Texas, Kansas, Missouri, Nebraska, Ohio, Indiana, Minnesota and Oklahoma. The farms of Iowa and Illinois support approximately one and one-half million horses for each state; Texas, Kansas, Missouri and Nebraska have more than a million each, and Ohio, Indiana, Minnesota and Oklahoma, more than three-fourths of a million each.

Horses are adapted to a wide range of climates, and can be successfully produced in every state. The market for horses is good and, under skilful management, they can be raised with profit on almost all farms.

Classes of Horses

Class and grade.—Regardless of breed, horses are classed in the markets according to the uses to which they are suited. The different classes are: *draft* horses, *chunks, wagon* horses, *carriage* horses, *road* horses, *saddle* horses

A fine type of draft horse.

and *ponies.* Animals are graded within each class as *choice, good, medium, common* and *inferior.* The class to which a horse belongs depends on (1) weight, (2) height, (3) conformation, or build, and (4) quality.

Draft horses.—To be in the draft class a horse in good flesh must weigh from one thousand six hundred pounds to more than a ton. The height ranges from 15-2 to 17-3 hands. The form of draft horses is broad, compact and rugged, with legs short as compared with the depth of the body. This build brings the weight close to the ground, where it can exert the greatest power in drawing a load. Draft horses are used largely for city teaming, for logging and the like.

Chunks.—The form of this class of horses is indicated by their name. Chunks are heavy-set, short legged, compactly built horses, of lighter weight than draft horses. Their weight varies from eight hundred pounds among the lightest of the southern chunks to one thousand five hundred and fifty pounds in the North and East. The height is from 15 to 15-3 hands. The typical farm horse belongs to the chunk class.

Wagon horses.—Wagon horses are required to combine weight with action and endurance. City delivery and express, fire and artillery horses are selected from this class. They must have sound feet; strong clean legs; broad deep chests; and show good constitution and quality. Their weight is from one thousand and fifty pounds to one thousand seven hundred pounds; and their height from 15 to 17-2 hands.

Carriage horses.—The carriage, or heavy harness, class is required to have good action, a fair amount of speed, and to be of an elegant form and carriage. The head should be small, and well-set, on a long arching neck. The body should be smooth and rounded, the back short and well coupled, with a long level croup, and the hindquarters strong and well developed. The height ranges from 14-1 to 16-2 hands, and the weight from nine hundred pounds to one thousand two hundred and fifty pounds. The carriage class supplies the coach, park and cab horses.

Road horses.—Road or light harness horses are lighter in build, more angular in form, and possess better action than the carriage class. They must have good speed, life and quality. They are used for light and fancy driving, and for racing. Their weight is from nine hundred to one thousand one hundred and fifty pounds, and their height from 14-3 to 16 hands.

Saddle horses.—Saddle horses are built for ease of action, strength and sureness of foot. They are also required to have mettle, coupled with a good disposition and intelligence. The withers are high and thin, and the shoulders oblique. The back must be short, well muscled and strongly coupled, and the gait easy. The height runs from fourteen hands for polo ponies to sixteen hands for hunters or cavalry horses. The weight may vary from eight hundred and fifty to twelve hundred and fifty pounds.

Ponies.—Ponies are chiefly used for children, and must therefore first of all have good dispositions. To be in the pony class, the height must be under fourteen hands. The body is deep and well rounded, the legs and neck are short, the croup is level, and the quarters are strong and well developed.

These different classes of horses often merge into one another so that it is difficult to tell in which of two classes a certain animal belongs. For market purposes it pays to breed for well marked classes, as these always bring higher prices than mixed stock.

Breeds of Horses

While the breed to which a horse belongs has little bearing on its market value if the *class* marks are strong

A good pair of chunks, and their offspring by pure-bred sires.

and the *grade* high, yet the only way to secure class and grade is by pure breeding. Millions of dollars are being lost by American farmers every year through the breeding of grade or scrub horses.

The value of breeding.—An excellent illustration of the difference in market value between pure-bred and grade-bred horses is shown in the case of Wisconsin horses (Bul. 186, Wis. Ag. Exp. Sta.):

	Average value of horses by ages				
	4 to 6 months	1 year	2 years	3 years	4 years
From pure-bred sires	$78.77	$132.84	$196.84	$218.00	$303.00
From grade sires	51.25	85.00	127.50	156.45	200.20
Difference in favor of pure-bred sires	27.52	47.84	69.34	61.55	102.80

This table is very convincing when it is remembered that it costs no more in care and feed to raise a well-bred horse than a scrub. The farmer who uses only pure-bred sires for his breeding will get almost fifty dollars more for his colts as yearlings than if he uses grade sires, while if he does not sell until the colt has reached maturity he will receive at least one hundred dollars more. If pure-bred dams are also used, the difference will be greater still. Will it not pay well to "breed up" our horses?

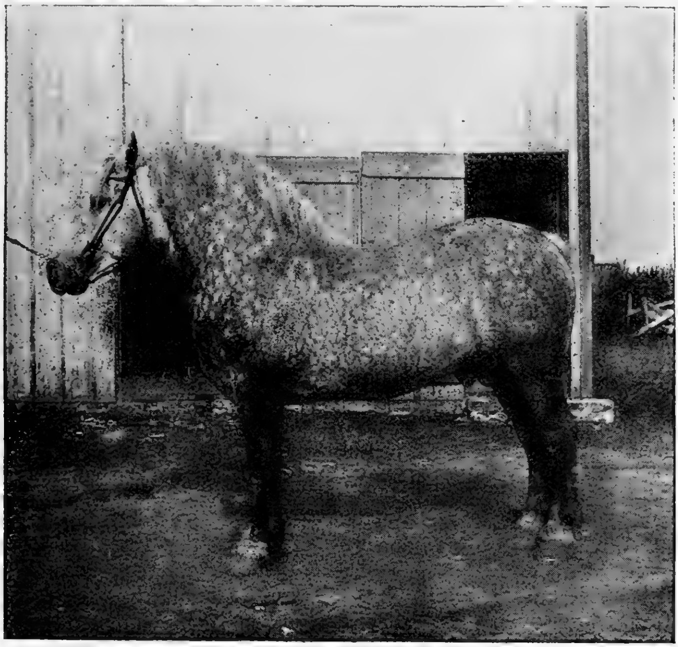
Draft breeds.—The chief breeds of draft horses in the United States have been imported from Europe. The favorite of these is the *Percheron,* which comes from France. The Percherons have good spirit, are strong-boned, and have sound feet. They show good action, have a high degree of intelligence, and respond well to training.

The *Clydesdales* come from Scotland. They are longer in build than Percherons, have smaller bodies, and less rugged constitutions. They are strongly marked by a heavy growth of hair on the lower part of the leg, especially at the fetlock. For use in wet and muddy times this excess of hair is a disadvantage, since it is hard to keep dry and clean.

The *Belgians* come to us from Belgium, and the *English*

Shires from England. Both are excellent breeds, though they have not yet come into the favor enjoyed by the Percherons, or even the Clydesdales.

It is chiefly from the heavier breeds that come all our draft horses, chunks, wagon horses, carriage, or heavy



A typical Percheron.

harness horses. A comparatively small proportion of horses in any of these classes is as yet pure bred, most of them being a cross with grade or common stock.

The lighter breeds.—Relatively few farmers have undertaken the raising of the lighter and speedier breeds of horses. This has been left to special breeders and stock farms that make a specialty of horses. The heavier breeds are better adapted to the farm, since the dams can then be used for general farm work, and thus serve a double purpose and thereby add to the profit.

Among the lighter breeds raised in this country, the English *Hackney,* the French *Coach* and the German *Coach* are the favorites for the carriage class. For lighter road use the breeds most favored are the *American Trotter,* the *American Saddle* horse and the *English Thoroughbred.*

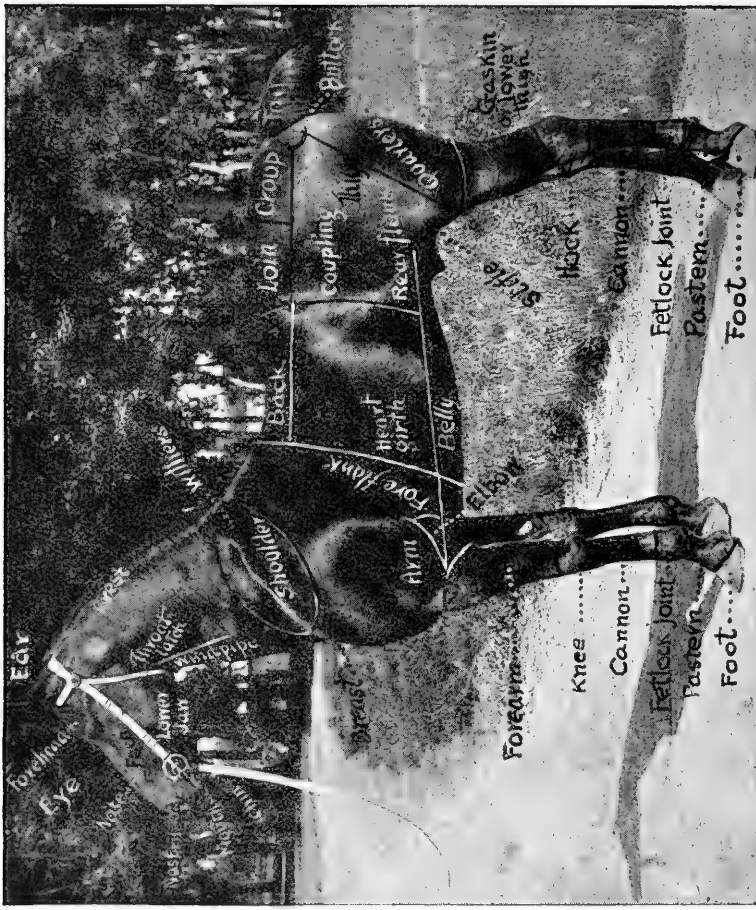
Judging Horses

The horse is to many people the most interesting animal on the farm. The satisfaction and profit from horse raising depend very largely on the breed, class and grade. For these reasons all who are interested in farm animals should learn to judge horses readily and accurately.

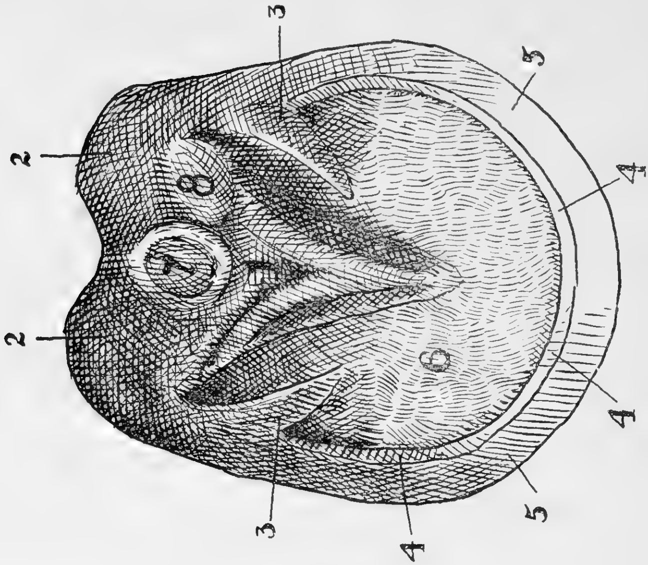
The score-card.—Before undertaking to use the score-card in actual judging, one must become thoroughly familiar with all its points, understanding as far as possible the requirements for a perfect score under any point. With this ideal in mind, the animal is to be examined, and the score put down on the card. Do not be afraid to mark off for all bad points. It takes a good animal to grade eighty per cent. when marked by a trained judge, and an exceptional one to grade ninety per cent. Judges do not usually mark closer than one-fourth per cent. on any point. The following is used by many authorities and we reproduce it here as one of practical value to both farmer and student.

SCORE-CARD—DRAFT HORSES

SCALE OF POINTS	Standard	Points Deficient
GENERAL APPEARANCE—19 per cent.		
1. Height, estimated______hands; actual_____ hands ______________________________		
2. Weight, over 1600 lbs., estimated____lbs. actual____lbs., according to age_______	6	______
3. Form, broad, massive, well proportioned, blocky, symmetrical ________________	4	______
4. Quality, refined; bone clean, hard, large, strong; tendons clean, defined; skin and hair fine; feather, if present, silky____	6	______
5. Temperament, energetic; disposition good_	3	______
HEAD AND NECK—9 per cent.		
6. Head, lean, proportionate size; profile straight ____________________________	1	______
7. Ears, medium size, well carried, alert_____	1	______
8. Forehead, broad, full ____________________	1	______
9. Eyes, full, bright, clear, same color______	2	______
10. Lower jaw, angles wide, clean____________	1	______
11. Muzzle, neat; nostrils, large, open, free from discharge; lips, thin, even, firm__	1	_____
12. Neck, well muscled, arched; throatlatch clean; windpipe large _______________	2	______
FOREQUARTERS—24 per cent.		
13. Shoulders, moderately sloping, smooth, snug, extending into back____________	3	______
14. Arm, short, strongly muscled, thrown back, well set ______________________	1	______
15. Forearm, strongly muscled, wide, clean__	2	______
16. Knees, deep, straight, wide, strongly supported ____________________________	2	______
17. Cannons, short, wide, clean; tendons defined, set back _____________________	2	______
18. Fetlocks, wide, straight, strong, clean_____	1	______


Ear
Forehead
Eye
Crest
Throat latch
Shoulder
Arm
Withers
Fore flank
Elbow
Heart girth
Belly
Back
Loin
Coupling
Rear flank
Croup
Hip
Quarters
Buttock
Gaskin or lower thigh
Stifle
Hock
Cannon
Fetlock Joint
Pastern
Foot
Breast
Forearm
Knee
Cannon
Fetlock Joint
Pastern
Foot

SCALE OF POINTS	Standard	Points Deficient
19. Pasterns, moderate length, sloping, strong, clean	2	------
20. Feet, large, even size, sound; horn dense, waxy; sole concave; bars strong; frog large, elastic; heel wide and one-fourth to one-half the lineal length of toe	8	------
21. Legs, viewed in front, a perpendicular line from the point of the shoulder should fall upon the center of the knee, cannon, pastern and foot. From the side, a perpendicular line dropping from the center of the elbow joint should fall upon the center of the knee and pastern joints and back of the hoof	3	------
BODY—9 per cent.		
22. Chest, deep, wide, large girth	2	------
23. Ribs, long, well sprung, close; coupling strong	2	------
24. Back, straight, broad, strongly muscled	2	------
25. Loins, wide, short, thickly muscled	2	------
26. Underline, low; flanks full	1	------
HINDQUARTERS—30 per cent.		
27. Hips, broad, smooth, level, well muscled	2	------
28. Croup, not markedly drooping, wide, heavily muscled	2	------
29. Tail, stylishly set and carried	1	------
30. Quarters, deep, broad, heavily muscled, thighs strong	3	------
31. Gaskins, long, wide, heavily muscled	2	------
32. Hocks, large, clean, wide, well set	6	------
33. Cannons, short, wide, clean; tendons defined	2	------
34. Fetlocks, wide, straight, strong, clean	1	------
35. Pasterns, moderately sloping, strong, clean	2	------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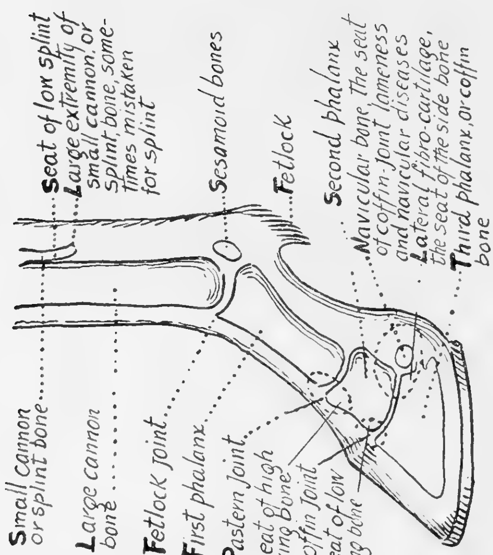

Small cannon or splint bone
Large cannon bone
Fetlock joint
First phalanx
Pastern joint
Seat of high ring bone
Coffin joint
Seat of low ring bone
Seat of low splint
Large extremity of small cannon, or splint bone, sometimes mistaken for splint
Sesamoid bones
Fetlock
Second phalanx
Navicular bone, the seat of coffin-joint lameness and navicular diseases
Lateral fibro-cartilage, the seat of the side bone
Third phalanx, or coffin bone

SCALE OF POINTS	Standard	Points Deficient
36. Feet, large, even size, sound; horn dense, waxy; sole concave; bars strong; frog large, elastic; heel wide, and one-fourth to one-half the lineal length of the toe	6	------
37. Legs, viewed from behind, a perpendicular line from the point of the buttock should fall upon the center of the hock, cannon, pastern and foot. From side, a perpendicular line from the hip joint should fall upon the center of the foot and divide the gaskin in the middle, and a perpendicular line from the point of the buttock should run parallel with the line of the cannon	3	------
ACTION—9 per cent.		
38. Walk, fast, elastic, regular, straight	6	------
39. Trot, free, springy, balanced, straight	3	------
Total	100	------

Common Defects and Unsoundness in Horses

Any defect or unsoundness lowers the value of a horse. All who have to do with horses should be able to identify the more common faults, and know their causes. (See *Purdue Circular,* No. 29.)

Defects of head, eyes and ears—

1. Poll evil; sore on top of head, caused by bruises.
2. Blindness; either with or without defects of eyeball.
3. "Blue-eyed"; a peculiar bluish color, may indicate blindness.
4. Over-mobile ears; showing viciousness or blindness.
5. Immobile ears; showing deafness or lockjaw.

Defects of the mouth—

1. Nose discharge; indicating catarrh, glanders, diseased molars.
2. Bit sores, showing tender mouth, or abuse.
3. Diseased molars; affect health and interfere with eating.
4. "Parrot" mouth; upper jaw too long, front teeth project over lower.
5. Undershot jaw; lower jaw short; front teeth do not meet.
6. Clipped tongue; tip cut off to prevent lolling.

Defects of neck, withers and shoulders—

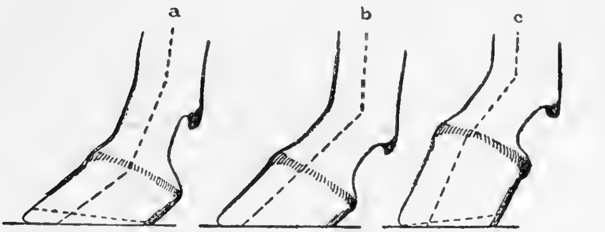
1. Neck sores; caused by collar wear on top of neck.
2. Fistula; running sore on withers or shoulders.
3. Collar sores and boils; dirty and ill-fitting collars.

Defects of feet and legs—

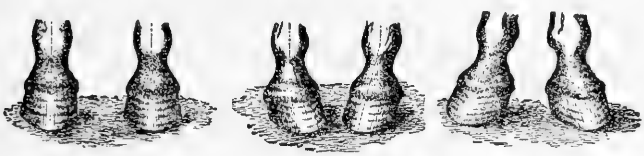
1. Shoe boil; sore at elbow from injury by shoe while lying down; also sore from harness band.
2. Splint; caused by overstrain and abuse of animal in driving or riding.
3. Broken knee; bent backward from injury.
4. Buck knee; bent forward from stiffening of tendons.
5. Capped knee; sore on knee—cap caused by injuries.
6. Greased heel; sores which refuse to heal.
7. Scratches; sores under fetlocks from filth or dampness.
8. Windgalls; puffs around fetlock joint from hard driving or standing on hard floors.
9. Cocked ankles; ankles bent forward from misuse.
10. Navicular disease; contracted foot, favored in action.
11. Toe cracks; transverse checks across the hoof.
12. Quarter racks; split in hoof extending up to heel.
13. Corns; caused by improper care of feet, neglect in shoeing or misfit shoes.
14. Thrush; usually caused from standing in damp, filthy stalls.
15. Knocked-down hip; one hip lower than the other from blow.
16. Spavin; either bog, or bone, indicating sprain or injury.
17. Thorough-pin.
18. Curb; enlargement at back of hock from sprain.

General defects—

1. St. Vitus's Dance; twitching of muscles.
2. Crampness; tendency for muscles to cramp.

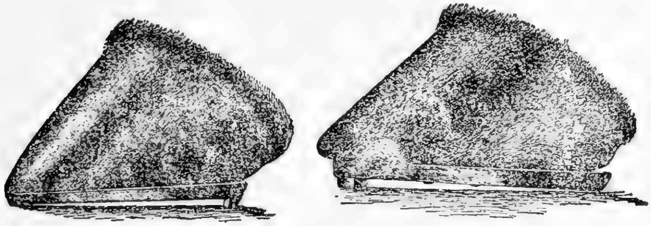


Limbs and hoofs in profile: *a*, Side view of foot with the foot-axis broken backward as a result of too long a toe. The amount of horn to be removed from the toe in order to straighten the foot-axis is denoted by a dotted line; *b*, side view of a properly balanced foot, with a straight foot-axis of desirable slant; *c*, side view of stumpy foot with foot-axis broken forward as a result of overgrowth of the quarters. The amount of horn to be removed in order to straighten the foot-axis is shown by a dotted line.



(a) (b) (c)

(a) Fore feet of regular form in regular standing position.
(b) Cocked ankles caused by misuse and overstrain.
(c) Fore feet of base-wide form in toe-wide standing position.



(a) (b)

(a) Fore hoof shod to quicken breaking-over.
(b) Hind hoof shod to slow the action.

3. Springhalt; one or both hind feet lifted too high.
4. Roaring; a wheezing, roaring sound in breathing; from bad wind.
5. Heaves; spasmodic breathing.

Vices—

1. Cribbing; habit of biting mangers, posts, etc., caused by teeth trouble.
2. Windsucking; habit of biting, and at the same time sucking in air.
3. Halter pulling; habit of pulling back when tied.
4. Biting; vicious tendency to bite people or other horses.
5. Balking; refusing to move when commanded.
6. Rolling in stall; likely to become "cast" and cause injury.
7. Kicking; showing vicious temper.
8. Striking; with front feet to injure attendant.

How to Determine Age by the Teeth of a Horse

The incisor teeth of the horse offer a convenient and comparatively true gage as to age. The horse has six incisors in each jaw, the middle pair commonly spoken of as the *middles,* the second pair as *intermediates,* and the outer pair as *corners* or *laterals.* Colts at birth are without incisors; the middle pair appears when the colt is from ten to fifteen days old and is followed by the intermediates when the colt is from fifteen to thirty days old. The corners or laterals appear when the colt is about four and one-half to five months old. These teeth are sometimes called the *milk* or *colt* teeth, and are gradually replaced by permanent teeth as the animal develops into maturity. The middle teeth usually drop out when the animal is from two to two and one-half years old and are replaced at three years by permanent teeth. At three and one-half the intermediates are forced out by the succession of permanent teeth. The corners or laterals are removed when the animal is four and one-half years old; in their stead five permanent corners are developed.

Relation of teeth cups to age.—This represents a series of changes from colt to horse teeth, and under normal conditions the animal at five years of age should possess what is known as a full mouth of teeth. All the incisors are permanent and should have in their bearing surface little black cups plainly noticeable in the early life of horses. When the horse is six years old, these black cups should disappear from the lower middle incisors. At seven they disappear from the lower intermediates; at eight from the lower corners; at nine they disappear from the upper middles; at ten from the upper intermediates, and at eleven from the upper corners. The changes in all of the upper teeth do not take place with quite so much uniformity as those of the lower, and therefore do not offer so reliable a guide in determining the age of a horse. Every student of horses should make a careful study of the teeth, be able to recognize the cups and determine the different ages.

In addition to the loss of the cups, the continued changing in the shape and position of the teeth from the maturity of the animal to death, offers an approximate guide to the determination of the age. When the animal is mature the incisors are short and wide, the thickness being about one-third of the width. The teeth of the upper and lower jaws should at this age meet squarely or nearly at right angles to the jaw. As the animal grows older these teeth lengthen


1 or 2 weeks
8 weeks
8 months
First Perma't Teeth 2 yrs
2nd Perma't Teeth 3 yrs
ALL Perma't Teeth 5 yrs.
6 yrs old
7 years old
8 years old
12 to 16 yrs old

out, become narrower and thicker, and at the same time gradually incline somewhat forward.

Care of the teeth.—The horse, like the human being, should have a perfect set of teeth in order that the food may be properly masticated and digestion aided in every possible way. The eyes, feet, stomach and teeth of every living animal constitute the machinery that should be properly cared for, and of these four, teeth are not the least important, as they bear very close relations to the entire working efficiency of animals. We would suggest, therefore, that careful study be made of the teeth and of their care, repair and treatment.

The Care of Horses

The horse is the most intelligent and companionable of the farm animals. It quickly shows the effects of ill treatment or lack of care and, on the other hand, easily responds to training and good usage.

Unsoundness due to ill usage.—Not a few of the defects common to horses should be blamed to their owners or users. For example, *poll evil* is frequently caused by striking the head against a door or stall beam that is too low. *Bit sores* indicate either a careless or a cruel driver, or a bit unsuited to the horse on which it is used. *Neck* and *shoulder* sores seldom occur if the collar is a good fit, and if kept clean. *Fistula* on withers on shoulders comes from collar bruises. *Sweeny* is the result of a wrench or strain, often due to ill-fitting collars.

In similar way, *splints, spavins, curbs, thorough-pins* and other injuries to the legs are often caused by excessive driving or pulling, especially of young horses. Misshapen knees and ankles are an evidence of hard usage. *Greased heel, thrush* and *scratches* come from damp and filthy stalls. *Roaring* is the result of driving until the wind is "broken"; *heaves* usually come from eating dusty feed; *cribbing* is a sign of the neglect of teeth that need attention.

The effect of training.—The vices which reduce the value of many horses and make them unpleasant to handle are usually due more to training than disposition. *Halter pulling* commonly begins in the colt being frightened and made to break loose when tied, or else being tied with an old and easily broken halter that encourages pulling on it. *Balking* often indicates lack of intelligence and patience on the part of the trainer fully as much as stubbornness on the part of the horse. *Biting* may be started by teasing; and *kicking* often has its beginning in fright from something loose about the harness or vehicle before the colt is well broken.

Treatment of horses.—The horse should be treated with kindness and firmness. The driver who strikes or jerks because of his anger or petulance deserves the contempt of all lovers of animal life, and should not be entrusted with horses. One who will work a team in the heat and dust and then allow them to stand overnight without cleaning shows either lack of intelligence about horses or cruelty. To drive a team until they are sweaty and then allow them to stand in a cold wind unblanketed reveals not only heartlessness but bad business management.

The horse can not be taught like a person. Therefore, only one single word of command should ever be used for the same act. *Whoa* should always mean an immediate and dead stop; *back* should mean to step backward, and not merely to stop. Some *one* signal alone should be used to start, and the horse never allowed to start without this signal. Care in such simple points as these would result in much better broken and safer horses.

Feeding Horses

The feeding of farm work horses is a different problem from the feeding of most other farm stock. This is because the horse is fed for *work,* while other animals are fed for meat, milk, eggs and so on.

The ration for horses.—The ordinary farm ration for working horses is some form of hay for roughage, and one or more cereals, such as oats or corn. The particular kind of hay fed is not important, so that it is in good condition and free from dust. If dusty hay must be used, it should be sprinkled with water as it is fed. Horses seem to find timothy hay more palatable than most other kinds, but red clover, alfalfa, meadow fescue and other grasses have been found satisfactory. It is thought that less grain is necessary to keep up the weight of horses at hard work when alfalfa is fed instead of some other hay.

Grain ration for farm horses.—Oats are the choice of the cereals for horses wherever they are obtainable. They are relished better than most grains, and seem especially suited to the horse as a nutrient. Horses fed on oats also seem to show better mettle than those fed on other grains.

In the corn producing region corn is usually a more economical feed for horses than oats, and has therefore come into quite general use as a part of the ration. Corn and alfalfa hay make a satisfactory ration, at least for a limited time, and are cheaper than oats and timothy hay. A very satisfactory and rather heavy daily ration for a horse weighing from one thousand two hundred to one thousand three hundred pounds, and employed at general farm labor is:

7½ pounds of whole corn.
7½ pounds of whole oats.
1 pound of oil meal.
3 pounds of wheat bran.
7½ pounds of timothy hay.
7½ pounds of clover hay.

Other rations that have been proved satisfactory by experiment are as follows:

1. Corn, 6 pounds; gluten feed, 6 pounds; bran, 2 pounds; timothy hay, 10 pounds.
2. Corn, 8 pounds; bran, 7 pounds; timothy hay, 10 pounds.
3. Oats, 6 pounds; corn, 4 pounds; bran, 2 pounds; hay, 12 pounds.

Larger horses should receive more, and smaller horses less, according to weight. It is also to be noted that some horses require more feed than others of the same weight.

How to feed.—For horses with good teeth it is not essential whether the grain is ground or fed whole, except that the same amount will yield somewhat more nourishment if ground. This difference may sometimes be as much as one per cent. in favor of ground feed. On days when work horses are allowed to stand idle the amount of grain should be reduced about one-half. If the idleness continues beyond three or four days, the amount of grain may gradually be increased, but should not reach the full work ration.

Most of the hay should be fed at night and in the morning, as there is not enough time at noon to secure the necessary nourishment from roughage. The noon feed of grain may be slightly heavier than that for night or morning. About twice as long is required for horses to eat ground grain fed dry as when it is dampened.

Watering horses.—Much difference of opinion exists concerning the best time for watering horses, some preferring to water before feeding, and others after. Careful experiments have shown that the time of watering is not highly important. If horses come from the field thirsty, it is reasonable to suppose that they will relish their meal better if they have had a drink. If the feed consists largely of dry roughage it also seems best to water before feeding. Whatever system is adopted should be followed *regularly,* as changing about often injures the appetite or produces some other derangement. Horses should never be given a large amount of water when highly heated from working or driving.

SCORE-CARD FOR MULES

SCALE OF POINTS.	Possible Score.	Points Deficient.
Age, estimated__________yr., actual__________		
GENERAL APPEARANCE—26 Points.		
Height, 16 hands or over; estimated_________ actual __________	3	______
Weight, 1,200 to 1,600 lbs. in good condition; estimated__________lbs., (score according to age) __________	3	______
Form, broad, massive, symmetrical, blocky___	4	______
Quality, bone, clean, large, strong; tendons defined, skin and hair fine __________	6	______
Action, energetic, straight, true, elastic; walk, stride long, quick, regular; trot free, balanced, rapid __________	8	______
Temperament, active good disposition; stylish carriage __________	2	______
HEAD AND NECK—9 Points.		
Head, proportionate size, clean-cut, well-carried, profile straight or slightly Roman-nosed__	1	______
Muzzle, neat; nostrils large, flexible; lips thin, even, firm __________	1	______
Eyes, full, bright, clear, large, same color______	1	______
Forehead, broad, full__________	1	______
Ears, large, tapering, fine texture, well-carried, alert __________	2	______
Lower jaw, angles wide, space clean__________	1	______
Neck, medium length, well-muscled, arched; throatlatch fine; windpipe large _________	2	______
FOREQUARTERS—22 Points.		
Shoulders, long, moderately sloping, heavily and smoothly muscled, extending into back_	2	______
Arms, short, heavily muscled, thrown back, well set __________	1	______
Forearm, long, wide, clean, heavily muscled__	2	______

SCALE OF POINTS.	Possible Score.	Points Deficient.
Knees, straight, wide, deep, strong, well-supported	2	------
Cannons, short, wide, clean; tendons large, clean and well-defined, set back	2	------
Fetlocks, wide, straight, strong, clean	1	------
Pasterns, moderate slope and length, strong, clean	3	------
Feet, large, even size, sound; horn dense, waxy; soles concave; bars strong, full; frog large, elastic; heels wide and strongly supported	6	------
Legs, viewed in front, a perpendicular line from the center point of the shoulder should fall upon the center of the knee, cannon, pastern and foot; from the side, a perpendicular line dropping from the center of the elbow joint should fall upon the center of the knee and pastern joints and the back of the hoof	3	------
BODY—10 Points.		
Withers, moderate height, smooth, extending well back	1	------
Chest, deep, wide; breastbone low; girth large	2	------
Ribs, deep, well-sprung, closely ribbed to hip	2	------
Back, broad, short, strong, muscular	2	------
Loin, broad, short, heavily muscled	2	------
Underline, long, low; flank well let down	1	------
HINDQUARTERS—33 Points.		
Hips, broad, smooth, level	2	------
Croup, long, wide, heavily muscled, not markedly drooping	2	------
Tail, attached high, well-carried	1	------
Thighs, deep, broad, strong, heavily muscled	2	------
Quarters, deep, heavily muscled	2	------
Stifles, strong, clean, muscular	2	------
Gaskins (lower thighs), long, wide, clean; tendons large, heavily muscled	2	------

SCALE OF POINTS.	Possible Score.	Points Deficient.
Hocks, large, strong, wide, deep, clean	7	------
Cannons, short, wide, clean; tendons large, clean and well-defined, set back	2	------
Fetlocks, wide, straight, strong, clean	1	------
Pasterns, moderate slope and length, strong, clean	2	------
Feet, large, even size, sound; horn dense, waxy; soles concave; bars strong, full; frog large, elastic, heels wide and strongly supported	5	------
Legs, viewed from behind, a perpendicular line from the point of the buttock should fall upon the center of the hock, cannon and foot; from the side, a perpendicular line from the hip joint should fall upon the center of the foot and divide the gaskin in the middle; and a perpendicular line from the point of the buttock should run parallel with the line of the cannon	3	------
Total	100	------

CHAPTER XXXV

SWINE

HOGS outrank every other farm animal in number in the United States, and are exceeded in value only by horses and cattle. There are more than sixty million hogs on our farms, or nearly two porkers for every three of the population. The aggregate market value of swine is about two-thirds that of dairy cattle, and not far from equal to the value of beef cattle. American farmers own more than six hundred million dollars' worth of hogs.

The Pork Producing Region

A large proportion of our hogs is produced in the states forming the corn belt. This is natural, since corn is one of the cheapest and best grains for raising pork. Many other regions can grow hogs as successfully as the corn states, however, and the industry is spreading, especially in the South and West.

The leading states in hog production.—Sixty per cent. of all our pork is raised in ten states. In the order of their importance in pork production these states are: Iowa, Illinois, Missouri, Nebraska, Indiana, Ohio, Kansas, Texas, Wisconsin, Georgia. The number of swine in these states runs from about two million in Georgia to nine million in Iowa.

Breeds of Hogs

Many of our important breeds of cattle and horses originated in Europe, but we have ourselves developed nearly all our chief breeds of hogs. The breeds most favored in the United States are Poland-China, Duroc-Jersey, Chester-White and Berkshire. The Berkshire, the only imported breed, came from England. Other less well-known breeds are the Yorkshire, Cheshire, Suffolk, Hampshire and Essex.

Poland-China.—Poland-China has long been a favorite breed of hogs, especially in the corn states. They are black in color, with irregular white markings on almost every part of the body. The ears are drooping. The Poland-Chinas make a rapid growth, and reach good size. They are rather small of bone, and not so good foragers as some other breeds. Some fault has been found with them for not producing larger litters.

Duroc-Jersey.—The Duroc-Jerseys are easily recognized by their reddish color. They are one of the most prolific and vigorous breeds, somewhat slow in developing, and strong of frame. Their bones are large, and they reach good size and weight. They have large drooping ears, are good foragers, and thrive well on pasturage, or when following a herd of fattening cattle.

Chester-White.—The Chester-White breed are of large frame, rather slow in maturing, and possess good constitutions. They are white without markings, and have drooping ears. They are raised more in New England than in the corn region.

Berkshire.—Berkshires resemble the Poland-China breed in color and markings, being black with white markings. They may be distinguished by their erect ears. They have a compact frame, are good feeders, and make a quicker growth than most other breeds. The Berkshire has long been a favorite breed, especially throughout the Middle West and is fast becoming the favorite in the southern states.

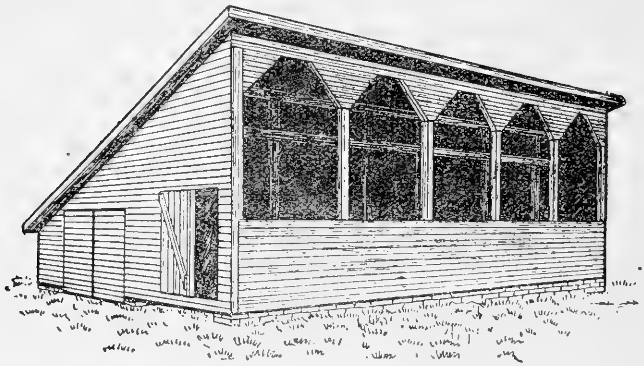
The Care of Hogs

Pigs are generally considered not so cleanly in their habits as some other farm animals. In so far as this is true it is often made possible because of neglect of owners. Many farmers seem to think that it does not matter how hogs are kept. Nothing could be a greater mistake. Hogs thrive only under hygienic conditions of feeding and housing. Millions of dollars are thrown away every year by failure to give hogs the care they require.

Need of good housing.—Hogs are the most poorly housed of our farm animals. Any kind of place is thought good enough for them on many farms. Yet hogs are far more sensitive to cold than horses or cattle, which have thick fur coats to protect them, while the hog has almost none. Hogs lie down more than most animals, and need a better bed. They live close to the ground, and easily breathe in dust and impurities. They need sunshine more than do horses and cattle, yet little is provided for them.

Hogs take cold very easily. Little pigs, especially, need to be kept warm, dry and away from drafts, if they are not to have their growth checked, or even lose their lives by catching cold. Neglect of these simple rules indicates shiftless farming, and causes great loss.

Hog-houses.—Every farm that makes a business of raising pigs will find a well-built hog-house a paying investment. The most economical and convenient hog-house has a row of pens along each side of a central alley which, in larger buildings, should be wide enough to drive through. This allows the hauling in of straw for bedding, and corn

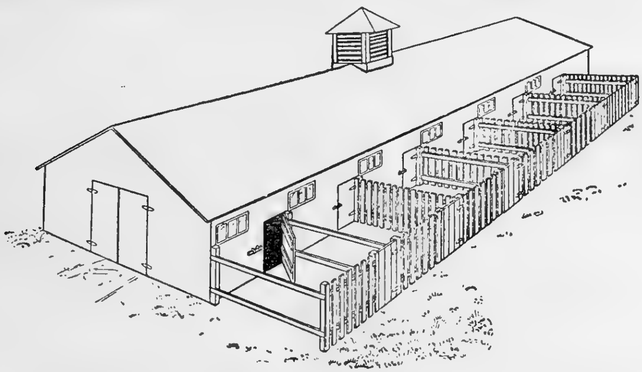


Hog-house for southern states.

or slops for feeding, thereby saving much labor. It also provides for the easy removing of manure.

The separate pens should be from five to eight feet wide, and from eight to twelve feet long, depending on the use to be made of them. Pens for brood sows need not be larger than eight by ten feet. If feeding is to be done in the pens they should be larger, or, better still, the partitions should be removable. The floor may be of cement, though for farrowing sows a temporary board floor should be laid over the cement, because of the coldness of a cement floor.

Woven wire stretched over the top of the ground to prevent rooting is sometimes used as a floor. Such a floor, however, is likely to be either dusty or wet. Board floors are expensive and drafty if built above ground. They also harbor rats, which not infrequently kill young pigs. A double trough may supply each pair of pens. Young pigs should have their own troughs outside the main pens.



Hog-house for northern states, side elevation; showing arrangement of outside feeding pens.

Lighting and ventilating hog-houses.—It is not uncommon to find hog-houses that cost several thousand dollars built almost without windows or other means of admitting light, air and sunshine. Other houses are built with windows in unfavorable positions, so that the sunlight can not fall on the floor of the pens where it is needed by the pigs.

The hog-house should run east and west, so that it may have one full side exposed to the sun. This arrangement will necessitate having one row of pens along the north side. In order to get sunlight into the north pens, the "broken roof" style of building is used. Care must be taken to place both upper and lower windows at such a height that the sunlight will reach the floor during the winter and early spring months, or during the farrowing season.

To do this, the angle of the sun, say in February and March, and the width of the building must be carefully computed. At the latitude of southern Iowa, or central Illinois, Indiana, Ohio and Nebraska, the tops of the upper windows of a hog-house twenty feet wide should be ten and one-half feet from the ground. The windows should be placed higher in southern and lower in northern states. If the north pens are eight feet long, and the alley is four feet wide, the sunshine will just reach the back line of the pens at ten o'clock and at two o'clock on the first of March. Care to such details will save the lives of many young pigs farrowed in the northern states during early spring.

Bill of Material

The following material is necessary for the construction of the portable house:

	Board feet.
Seven pieces, 2 by 4 inches, 16 feet long for the entire framework	75
One piece, 3 by 6 inches, 18 feet long, for two runners	27
Four pieces, 1 inch by 1 foot by 16 feet long, for the floor floor and two ventilators	64
One piece, 1 by 6 inches by 18 feet long, for braces on doors and ventilators	9
Fifty pieces ⅞ by 2 inches, 16 feet long, tongued and grooved, for entire covering of the house	133
Total	308

Two 4-inch barrel bolts, one for the door and one for the back ventilator, 4 button latches for the two end ventilators.

Six pairs of 12-inch strap hinges for the roof, doors and ventilators.

Six 5-inch hooks and eyes, No. 6 wire, to hold up ventilators when open.

Two pieces of No. 9 hog fence, 1 by 7 feet, for two end ventilators.

Two pieces of burlap, 1 foot square, for windows.

Fifteen feet No. 11 wire, to hold up ventilators when open.

Nails: 20-penny nails for the framework, 8-penny common-head nails for the lighter lumber, 8-penny coated nails preferred for the tongued-and-groved boards.

Individual hog cots.—Many hog raisers are now providing two types of hog-houses, the large permanent house for farrowing purposes, and the small individual cot for the sows and their litters as soon as the pigs are old enough

Individual hog cot, on runners, so that it can be drawn from place to place.

to be put out-of-doors. The individual cots may be scattered about the lot or pasture, and moved as often as necessary to keep the quarters clean. For winter service the cots can be collected side by side in a sheltered place, banked and used for sleeping quarters.

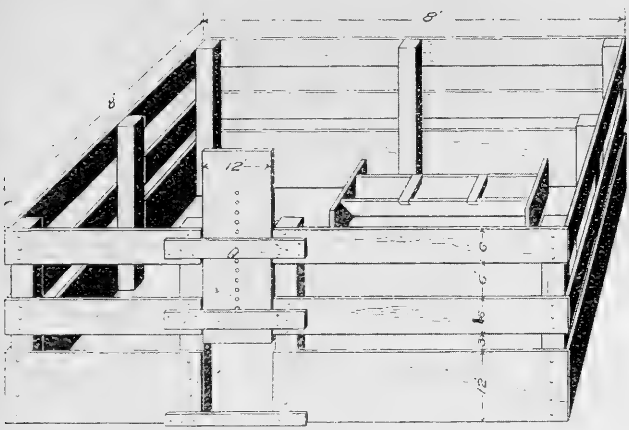
The feeding floor.—The use of a sanitary feeding floor should be much more common than it is. It is a great waste of grain to scatter it in the mud or dust of a dirt yard. This mode of feeding is also injurious to the health of the pigs, for it compels them to breathe in a great amount of dust and to eat impurities in order to get the grain. The effect is seen in such diseases as "thumps" and "wheezes," and in the greater liability to colds, tuberculosis and other troubles.

The best feeding floor is made of concrete, slightly raised above the level of the ground, if made outside the hog-house, and sloping slightly so that it can easily be washed off. Such a floor is not expensive, and will pay for itself many times over in the feeding of hogs.

Feeding Hogs

Hogs are probably the best money makers on the farm, if properly handled. The same amount of feed will produce a greater value of pork than any other meat. The returns also come in sooner than with most other farm animals. Money invested in hogs can be turned rapidly, as pigs are marketable when eight months old. The yearly sales from a herd of hogs should be from two to four times the original investment. Much of the profit depends on intelligent feeding.

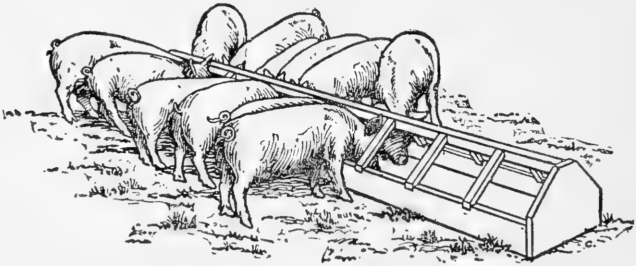
The feeding of pigs requires the consideration of three stages in their development: (1) from farrowing to weaning, (2) from weaning to fattening, and (3) fattening for market.



A good type of feeding pen for small pigs.

Feeding young pigs.—Little pigs do not need any food other than their mother's milk for the first two or three weeks of their life. When they have reached this age, they will begin to nibble on shelled corn. A little of this should be fed them in a place outside the pen. By the time they are from three to four weeks old, they may be fed a small amount of skim-milk, in which has been mixed a little ground feed, such as shorts. They should have a trough of their own where it can not be reached by the mother.

The amount of mixed feeds and shelled corn given small pigs may be increased till they are ten weeks old, when they should be weaned. When they are deprived of their mother's milk, which up to weaning time supplies the basis of

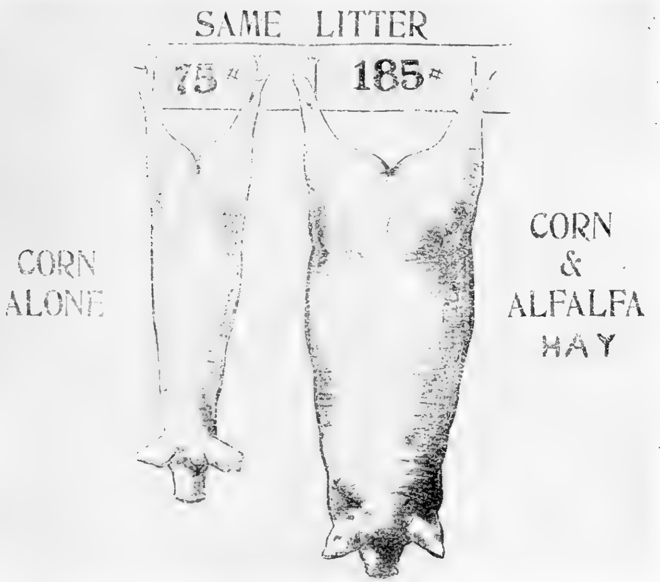


Weaning trough used on experimental farm, Beltsville, Md.

their nourishment, it is very important that they be fed a ration capable of producing the most rapid growth and best health.

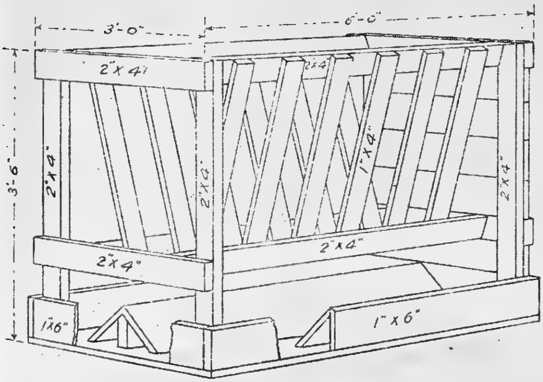
Feeding pigs after weaning.—At the time of weaning, the feed should not be greatly changed, except to increase the amount, until the pigs have become accustomed to the loss of the mother's milk. If pasture is available, the quantity of corn may be increased. If the pigs must be kept in a dry lot, a larger proportion of soft feeds should be used.

It is to be remembered that the leading purpose in feeding pigs from the age of two months up to the age of six or seven months is not to fatten them, but to cause them to grow large frames and develop good constitutions. If they are fattened too early, it stops their growth, and reduces their vitality, thereby making it unprofitable to continue feeding them up to full maturity.



Pasturage for growing pigs.—Growing hogs, therefore, require muscle and bone making food, instead of a ration that will fatten them. They need exercise to promote their growth, and give them strong vigorous frames for the taking on of fat. For these reasons, pasturage should supply the basis of the young hog's ration. Clover, alfalfa, peas, rape, vetch and other succulent plants are the cheapest and best feeds for the period between weaning and fattening time.

To this green feed will need to be added a certain pro-



Rack for Feeding Alfalfa Hay to Hogs.

portion of corn, or other grain, in order to make a balanced ration. But the poorest and most expensive way to grow pigs is to shut them in a dry lot and feed them a ration of corn alone, as is so often done. The farm lacking in well arranged hog pastures is not ready for the business of making money out of pork.

Balanced rations for young hogs.—No matter what other ration may be fed pigs, milk is always desirable. For milk is highly palatable to hogs, and it contains more of the necessary food elements than any other food. The following are suggested as rations suitable for growing hogs that have, in addition, access to good pasturage:

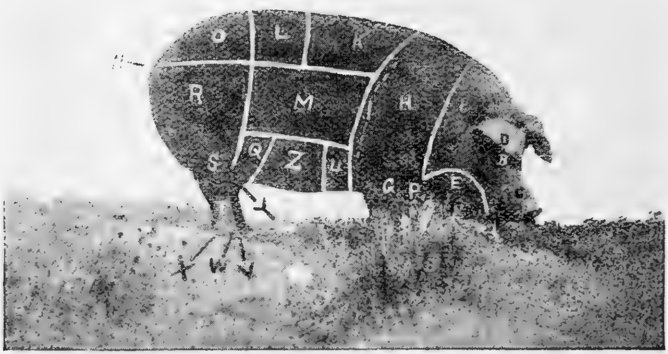
1. Corn, 60%; shorts, 30%; tankage, 10%; or
2. Corn, one-third; wheat, one-third; oats, one-third, ground; or
3. Corn, one-half; shorts, one-half; or
4. Corn, 60%; shorts, 20%; linseed-oil meal, 20%; or
5. Corn, one-third; milk, two-thirds.

It has been shown by careful tests that if pigs must be fed in dry lots, ration No. 1, consisting of corn sixty per cent., shorts thirty per cent. and tankage ten per cent., will produce double the gain that can be secured from corn alone.

Fattening hogs.—Pigs should be ready for fattening by the time they are from six to six and one-half months old. When fattening begins, the ration should have a much larger proportion of corn. In fact, hogs may be profitably fattened on corn by the addition of milk to the ration.

While being fed for fattening, the hog does not require the amount of exercise needed during the growing period. It is not best, however, to shut feeders up in a close pen, for a certain amount of exercise is necessary to keep the hog in a healthy condition and with good appetite.

Snapped corn is preferable to husked ears on account of the greater amount of work demanded of the hog, and the slower eating required. Where the fields can be properly fenced off, the best of all ways to feed corn to hogs is to allow them to do their own harvesting. This method of feeding, called "hogging down" corn, gives the hogs about the right amount of exercise, allows them to eat whenever they desire, and saves the farmer the labor of husking, hauling and feeding. The same amount of corn will also produce more pork.



Parts of a hog.

A. Snout
B. Eye
C. Face
D. Ear
E. Jowl
F. Neck
G. Fore leg
H. Shoulder
I. Chest line

K. Back
L. Loin
M. Side
N. Tail
O. Rump
P. Breast
Q. Hind flank
R. Ham

S. Hock
T. Hind leg
U. Fore flank
V. Foot
W. Pasterns
X. Dew claw
Y. Stifle
Z. Belly

Diseases Affecting Hogs

Young pigs are not particularly liable to any one disease, but easily fall prey to troubles arising from improper care. Cold, wet, dirty pens cause the death of many new-farrowed pigs. Dusty floors, filthy mud-holes and uncleaned troughs are always harmful. Exposure to extreme cold or to burning heat is sure to tell in loss of health or weight. It is safe to say that half the troubles attacking the younger pigs, at least, could be saved by providing them with more sanitary surroundings.

Thumps.—This is a disease that manifests itself in a spasmodic manner of breathing, which suggests the name. It is usually a digestive trouble caused by overfeeding and lack of exercise. Certain worms may also cause thumps. The best preventive for thumps, especially with young hogs, is plenty of pasture with green feed. The treatment for thumps is to reduce the amount of feed, give a laxative, and make sure that the pigs get exercise.

Scours.—Scours, or too great a laxness in the digestive tract, are caused in young pigs by overfeeding, a feverish condition of the mother sow, soured feeds, dirty troughs, or some other unsanitary condition connected with their feeding. The first step in applying a remedy is to find and remove the cause. If the trouble continues, each pig may be given a few drops of laudanum.

Worms.—Worms are a source of great trouble in raising pigs. Through rooting in the dirt, and being fed on dirt floors, young pigs pick up certain kinds of worms which continue to live in their digestive organs. Pigs never thrive when afflicted with worms. The coat shows rough, growth is hindered, the general health affected, and a large proportion of the feed wasted. A simple remedy is to give one teaspoonful of turpentine to sixty or eighty pounds of hog, and repeat the dose in three days. Another remedy is five grains of santonin combined with three grains of calomel for each sixty or eighty pounds of hog. This should be followed by an effective physic. Whatever the remedy employed, the pigs should be starved for twelve hours before being dosed.

Lice.—Many hogs are lousy. The lice can easily be detected by looking between the legs or behind the ears. Hogs suffering with lice will make a slower growth and fatten less easily than clean hogs. So important is this matter that many hog raisers provide as a part of their equipment a *dipping tank,* in which some form of crude oil or coal tar is used as a bath. Where the dipping tank is not available, or in the case of young pigs, the remedy should be sprayed or rubbed on.

Tuberculosis.—Hogs, like various other animals, are subject to tuberculosis. Many hogs have this disease in some form. Its effects are seen in a stoppage of growth, a general run-down appearance, loss of appetite, and in some cases, death. Because hogs are kept so short a time, and tuberculosis is so slow a disease, there is comparatively little loss owing to deaths from tuberculosis. But many animals when slaughtered are found to be unfit for food because of the disease.

Tuberculosis is caught either from diseased pigs, or from drinking the milk of tubercular cows. It is probable that most of the tuberculosis in swine comes from the latter cause. Many hog raisers now pasteurize the milk before feeding it to the pigs. This is the only sure preventive against tubercular milk.

Hog cholera.—By far the worse disease scourge affecting hogs is cholera. It not infrequently wipes out en-

Two hogs: one a pure bred, the other a "razor-back." The large one was owned and raised by the club boy, receiving good care and a balanced ration. The small one, owned by a farmer with old notions and habits, had poor care and a narrow ration.

tire herds within a few weeks. The average yearly loss from hog cholera for one year in a single state was estimated at three million dollars. In one single "cholera year" another state lost at least twenty million dollars from this cause. Other states suffer in like proportion. It is, therefore, of the highest importance that the causes of cholera, and the modes of prevention be well understood.

Hog cholera is a germ sickness caught by infection from hogs that have the disease. It is not necessary for well animals to come in direct contact with cholera hogs in order to catch the infection. The germs may be carried by dogs; by pigeons, crows, or other birds that alight in the hog lot to pick up grain; by men who have tramped through a lot where cholera hogs have been; by new stock brought into the herd; and by streams that have become infected. When hog cholera is in the region, therefore, it is necessary to observe every precaution to keep infection away from the herd.

Effects of cholera.—The disease is so marked in its symptoms that it is not hard to distinguish from most other hog sicknesses. In hog cholera, the lymphatic glands, lungs, intestines, kidneys and liver are highly inflamed. Red blotches appear on the skin. Appetite is lost, the gait becomes staggering, the eyes inflamed. Not infrequently bleeding at the nose and vomiting occur. The temperature is usually from one hundred and seven to one hundred and eight degrees Fahrenheit. The first ones of the herd to be stricken commonly die within a few days; those that take the disease later may live for several weeks, or even recover.

Treatment.—No absolute cure has been discovered for hog cholera. Nearly all animals that take the disease usually die. A method of preventing well herds from contracting cholera has, however, been discovered. This is to give well hogs anti-cholera serum; or, in effect, vaccinate them, as is done with people for smallpox and diphtheria.

The hog cholera serum is secured by drawing blood from a hog which has first been rendered immune to cholera, either by having had the disease or being given a special treatment for the purpose of immunizing, and then having had cholera germs injected into his veins. Each animal of the herd to be treated is given by hypodermic injection a certain quantity of this serum in proportion to its size.

I had serum.

I wish I had.

If the treatment is successful, it will immunize the herd against cholera for several weeks. When the serum is given to well herds, a cholera hog is sometimes brought among them, or its carcass even fed them, at the time the treatment is given. This method is thought to make the immunity more certain.

Success of the serum treatment.—The success of the serum treatment is still questioned by many. It seems reasonably certain, however, that where failure has followed its use, it was because the serum was improperly prepared or not skilfully administered. Various experiment stations have found that there is a loss of only about ten per cent. of the hogs treated in herds already infected, and of only one or two per cent. in well herds where the serum treatment has been carefully used. The manufacture of serum by the state, or official inspection of its manufacture by private plants, will make its use as a cholera preventive still more effective. No one is justified in neglecting to treat his herd with the serum when hog cholera threatens.

The following excellent advice is given on a poster issued by the University of Wisconsin Agricultural Experiment Station:

Symptoms of Acute Cholera

1. Failure to come up for feed, or refusal to eat.
2. Huddling together in pens or nests.
3. Stiffness, cough, discharge from eyes, and redness of skin.
4. Constipation followed by persistent diarrhoea.
5. Rise of body temperature (fever) above 104 F.
6. Death after being sick for a few days.

To Prevent the Introduction of Cholera

1. Quarantine for four weeks all hogs brought to the farm.
2. Keep away dogs and all other animals and persons coming from cholera-infected farms.
3. Pasture the hogs at some distance from main highways and away from contaminated streams.
4. Feed a laxative diet but avoid feeding very much new corn.
5. Disinfect the troughs daily and the pens and yards each week with quicklime.
6. Have an experienced person vaccinate, with serum, all hogs while healthy if the disease is in your locality.

To Insure Your Herd Against Cholera, Use Hog Cholera Serum

The state legislature has provided for the manufacture of hog cholera serum which is sold at one cent per c. c. (cubic centimeter). It costs about 25 cents each to protect pigs and 75 cents to $1.00 for mature hogs.

The serum treatment is recommended on the strength of the favorable results obtained from its general use during the past five years.

To Control Cholera If In Your Herd

1. Sell all well hogs which are ready for market.
2. Call a competent veterinarian immediately to give the serum treatment.
3. Burn carcasses of dead hogs promptly, also all rubbish.
4. Clean pens and apply quicklime liberally for disinfection.
5. Keep hogs from wallows and insanitary nesting places, and provide roomy, dry sleeping quarters.
6. Use every precaution to prevent spread of the disease to neighbors' herds.

Judging the Age of Hogs by the Teeth

In these days when a pure-bred pig is worth all the way from twenty-five to one thousand dollars, it is quite important to be sure about the age. It is therefore worth while to study the methods of judging the age of the pig. As in the case of other animals the age can be approximately told by the teeth.

The pig has six *incisors* in either jaw; the *corner* pairs appear at birth, the *middles* and *intermediates* come when the pig is from three to four months of age. When he is from six to ten months, the corners are replaced by the permanent teeth, all intermediates are replaced at from twenty to twenty-four months and the middles at from thirty to thirty-six months. It will be interesting to note that the order of changing for the permanent is the opposite or reverse of that of the horse, the cow and the sheep, commencing as you will note from the corners and working toward the center. In all the other farm animals they commence at the center and work toward the corners. The first teeth to appear with the pig are the corner teeth and the last the centers.

CHAPTER XXXVI

SHEEP

THE raising of sheep has never received the attention it deserves in most regions. There are at present only a little more than fifty million sheep on the farms of the United States. Almost sixty per cent. of our sheep are found in ten states, seven of which are in the far West, one in the South, and only two in the middle and eastern states. According to their importance in sheep raising, these states are: Montana, Wyoming, Ohio, New Mexico, Idaho, Oregon, California, Michigan, Texas and Utah. Other states having important sheep interests are: Missouri, Indiana, Kentucky, Iowa and Illinois.

Importance of Sheep on the Farm

Sheep could be raised with good profit on thousands of farms where they are now unknown. They are among the most hardy of the domestic animals, and will thrive in almost every part of the country.

Sheep as foragers.—Sheep have no equal among the farm animals as foragers. They will eat a wide range of roughage, much of which is not of value to other stock. Certain weeds not palatable to most animals are eaten by sheep, and they therefore aid in keeping pastures, meadows and fields clean. Sheep will graze steep hillsides not accessible to horses or cattle, and will feed from the foliage and twigs of brushland pastures. They find a good living on stubble-fields, and will clean up the waste leaves, husks

Sheep grazing in Washington.

and stalks of corn-fields, being able to thrive in fields where cattle and horses have gleaned all that they can well find. Sheep can therefore obtain a considerable part of their living from material that would otherwise be lost.

Sheep require little labor.—Comparatively little labor is required in caring for sheep. In order to maintain the fertility of the soil, we need to raise more stock on our farms. Half a dozen sheep will produce as much income as a dairy cow, and demand much less labor for their care. Their heavy coats enable sheep to live in relatively open sheds in the winter, providing they are kept dry. The cost of shelter is therefore low.

One of the chief practical difficulties in sheep raising is that the fences suitable for horses and cattle will not hold sheep. The present tendency, however, is to build closer fences, so that fields will be available for both hogs and sheep. In some regions serious loss of sheep occurs from vicious dogs, wolves and coyotes. Sheep-killing dogs should be relentlessly shot.

Sheep bring quick returns.—Sheep are almost as good as poultry for quick returns. For ordinary farm purposes dual purpose breeds are usually selected to produce both wool and mutton. In this way a double yield can be secured—fleeces from all the flock, and either lambs or mutton in addition.

It is estimated that the fleece from good sheep should pay for their feed, thereby leaving the lambs raised or the mutton produced as profit. Lambs are ready for market at from seven to twelve months of age, thus allowing the money invested in them to be turned quickly.

Breeds of Sheep

Sheep, like cattle, are kept for two purposes. Just as cattle include both the beef and the dairy breeds, so sheep comprise *mutton* breeds and *merino,* or *wool* breeds.

CLASSIFICATIONS OF BREEDS

According to Use

Mutton Breeds

Hampshire	Leicester	Shropshire
Oxford Down	Romney Marsh*	Wensleydale*
	Ryeland*	

General Purpose Breeds

Cheviot	Dorset	Suffolk
Cotswold	Southdown	Tunis*

Wool Breeds

Herdwick*	Lincoln	Merino
Highland		

SMALL

Herdwick*	Merino (American)	Tunis

According to Length of Staple

SHORT

Cheviot	Herdwick*	Merino
Dorset	Highland	Suffolk
Hampshire		

MEDIUM

Oxford	Shropshire	Southdown
Ryeland*		

LONG

Cotswold	Leicester	Wensleydale*
Highland	Lincoln	

According to Most Congenial Altitude

SEA LEVEL TO 1,000 FEET

Cotswold	Romney Marsh	Lincoln
Leicester	Wensleydale*	

1,000 TO 2,500 FEET

Dorset	Oxford Down	Southdown
Hampshire	Ryeland*	Suffolk
Merino	Shropshire	Tunis

2,500 TO 4,000 FEET

Cheviot	Highland	Welsh*
Herdwick*	Shetland*	

According to Horns

POLLED

Romney Marsh	Tunis	Hampshire
Shropshire	Wensleydale*	Leicester
Southdown	Cheviot	Lincoln
Suffolk	Cotswold	Oxford Down

HORNED

Dorset	Herdwick*	Females
Exmoor*	Welsh*	Polled
Merino	Highland	Lonk*

According to Quality of Wool

FINE

Merino

MEDIUM

Cheviot	Herdwick	Ryeland
Dorset	Suffolk	Shropshire
Hampshire	Oxford	Southdown

COARSE

Cotswold	Lincoln	Wensleydale*
Highland	Leicester	

According to Size

LARGE

Cotswold	Lincoln	Suffolk
Hampshire	Oxford Down	Wensleydale*
Leicester	Romney Marsh	

MEDIUM

Cheviot	Merino (French)	Shropshire
Dorset	Ryeland*	Southdown
Highland		

According to Color of Face

DARK

Hampshire	Ryeland*	Southdown
Highland	Shropshire	Tunis
Oxford		

LIGHT

Cheviot	Herdwick*	Romney Marsh
Cotswold	Leicester	Wensleydale*
Dorset	Lincoln	

*Too little known in America to be of importance.

Market classes of sheep.—Wholly regardless of breed, market demands divide sheep into three groups or classes. These are: (1) *fat,* or mutton sheep, or those ready for slaughter; if the animals are less than one year old, they are called lambs; (2) *feeders,* or animals ready to be fattened; and (3) *breeders.*

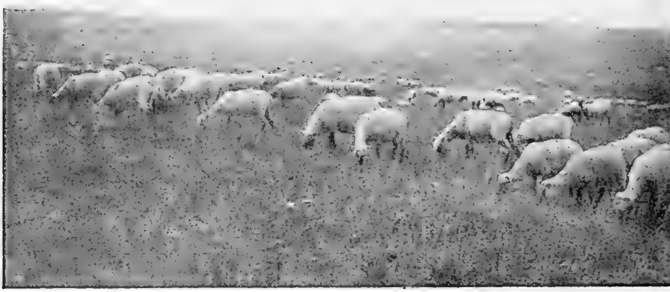
Score-Card

SCALE OF POINTS	Standard	Points Deficient
1. Age		
GENERAL APPEARANCE—38 per cent.		
2. Weight, score according to age	8	-------
3. Form, long level, deep, broad, low set, stylish	10	-------
4. Quality, clean bone; silky hair; fine, pink skin; light in offal, yielding high percentage of meat	10	-------
5. Condition, deep even covering of firm flesh, especially in regions of valuable cuts. Points indicating ripeness are, thick dock, back thickly covered with flesh, thick neck, full purse, full flank, plump breast	10	-------
HEAD AND NECK—7 per cent.		
6. Muzzle, fine; mouth large; lips thin; nostrils large and open	1	-------
7. Eyes, large, clear, placid	1	-------
8. Face, short; features clear-cut	1	-------
9. Forehead, broad, full	1	-------

SCALE OF POINTS	Standard	Points Deficient	
10. Ears, fine, alert	1		
11. Neck, thick, short, free from folds	2		
FOREQUARTERS—7 per cent.			
12. Shoulders, covered with flesh, compact on top, snug	5		
13. Brisket, neat, proportionate; breast wide	1		
14. Legs, straight, short, wide apart, strong; forearm full; shank smooth, fine	1		
BODY—20 per cent.			
15. Chest, wide, deep, full	4		
16. Ribs, well sprung, long, close	4		
17. Back, broad, straight, thickly fleshed	6		
18. Loin, thick, broad, long	6		
HINDQUARTERS—16 per cent.			
19. Hips, far apart, level, smooth	2		
20. Rump, long, level, wide to tail-head	4		
21. Thighs, full, deep, wide	4		
22. Twist, plump, deep	5		
23. Legs, straight, short, strong; shank fine, smooth	1		
WOOL—12 per cent.			
24. Quantity, long, dense, even	4		
25. Quality, fine, pure; crimp close, regular, even	4		
26. Condition, bright, sound, clean, soft, light	4		
Total	100		

Judging the Age By the Teeth

The sheep like the cow and the horse has a series of eight incisors in the lower jaw and none above. The new-born lamb as a rule has no incisors, but the entire set will develop during the first thirty days of life of the animal. These teeth are called the lamb's milk teeth and are soon



Sheep grazing, typical of western states.

replaced by permanent teeth. At the age of fifteen to eighteen months, the *middles* appear; about two years of age the *intermediates;* from three to three and one-half years the second *intermediates,* and from four to four and one-half years of age the *corners* are developed. Up to this time the determination of age of sheep may be quite definite; after this approximation only can be reached by a study of the general wear, appearances and condition of the teeth.

This test will of course depend in a large measure upon the physical condition of the animal and the care that has been given in both housing and feeding.

Feeding Sheep

What has been said about the ability of sheep to forage for a great part of their food must not be understood to mean that it does not matter what sheep are given to eat. For sheep are exactly like all other animals in requiring the right proportion of nutritive elements in their food. Lacking a proper ration, they will be checked in growth, delayed in fattening, or short on the quantity and quality of wool.

Feeding ewes kept for breeding.—Ewes that are to produce lambs in the spring may be fed through the winter on a cheaper ration than that required for the feeders. The ewes need more of the muscle-forming, and less of the fat-producing foods. Their rations may therefore consist more largely of roughage, and less of grains than for the fattening lambs.

For breeding ewes weighing from one hundred and twenty-five to one hundred and fifty pounds, the following daily rations have been tested by the Minnesota Experiment Station and have been found to be economical and satisfactory:

Ration No. 1.	Ration No. 2.
3.5 pounds of corn stover.	2.0 pounds of clover hay.
2.0 pounds of roots.	1.4 pounds of corn stover.
0.4 pounds of oats or shelled corn.	0.4 pounds of oats and corn mixed.

Feeding for market.—The ration for fattening requires a larger proportion of fats and carbohydrates than the ones just described. It has also been found that lambs fatten best with a mixture of succulent food along with the usual roughage and grain.

Montana sheep ready for shipment.

The Cornell University Experiment Station has tried extensive experiments in fattening different lots of lambs during a period of one hundred and ten days. Each of the following rations served fifty lambs for one day:

Ration No. 1.	Ration No. 2.
60 pounds of silage.	65 pounds of mixed hay.
50 pounds of mixed hay.	35 pounds of corn.
35 pounds of corn.	15 pounds of oats.
13 pounds of oats.	5 pounds of brewer's grains.
5 pounds of brewer's grain.	

Ration No. 3.	Ration No. 4.
65 pounds of mixed hay.	60 pounds of silage.
10 pounds of corn.	50 pounds of mixed hay.
20 pounds of brewer's grains.	10 pounds of corn.
20 pounds of gluten.	20 pounds of brewer's grains.
5 pounds of oats.	20 pounds of gluten.
	5 pounds of oats.

It should be understood in studying these rations that at the beginning of the feeding period a larger proportion of roughage and a smaller proportion of grain were fed. By the end of the one-hundred-and-ten-day period this proportion had been reversed. The rations as given are the daily average for the whole time.

The actual amount of nutrients is the same for each of these four rations, yet the results differ considerably both as to cost and the amount of fat produced, as is shown by the following comparisons:

Ration	Average gain per sheep in 110 days	Cost per pound of gain
1	22.7 pounds	10.6 cents
2	15.7 "	15.9 "
3	18.9 "	13.2 "
4	25.1 "	9.6 "

It will be noted that the most rapid gains, and at the lowest cost per pound were from the rations that contained silage. It is also seen that the lowest gain, and at the highest cost per pound, was from ration No. 2, where all succulent food was lacking, and most of the grain ration consisted of corn and oats.

Value of Mutton in the Diet

From the earliest times mutton has been a popular food both in eastern and western countries. The ease with which the sheep is raised has made it a favorite with all primitive peoples, as well as more advanced nations. The flesh of the sheep has approximately the same value for food as beef. The percentage of waste from the two animals is about the same, averaging a little less than twenty per cent. in each case. Mutton is also a favorite meat diet because of the ease with which it is digested and the fact that its use agrees with nearly every one. Many people who can not stand a diet of pork or even of beef find it possible to eat mutton.

CHAPTER XXXVII

POULTRY

THE raising of poultry is considered of rather incidental importance on most farms. A few chickens are kept for supplying the table with fresh eggs and an occasional fowl. Perhaps a flock of turkeys, ducks or geese are added for the sake of variety. Little attention is usually given to the possibility of large profits from the sale of eggs and poultry.

Yet, in spite of this somewhat haphazard method of treating the poultry industry, its aggregate returns are very large. For more than five and one-half million farms have a flock of chickens or other fowl. In addition, not a few people in villages and towns keep enough fowl for home use.

Distribution of Poultry Production

Nearly five hundred million fowls are kept on the farms for our population. Considerably more than one and one-half billion dozen eggs are produced annually. This is enough to supply every man, woman and child with fifteen dozen eggs per year. The value of the eggs is in excess of three hundred million dollars a year, or sufficient to pay nearly three-fourths of the running expenses of all our public schools. The fowls themselves are worth above two hundred million dollars.

The ten leading poultry states.—Ten states supply about fifty-four per cent. of all the eggs we produce. These states are Missouri, Iowa, Ohio, Illinois, Kansas, Indiana, Texas, Pennsylvania, New York and Michigan.

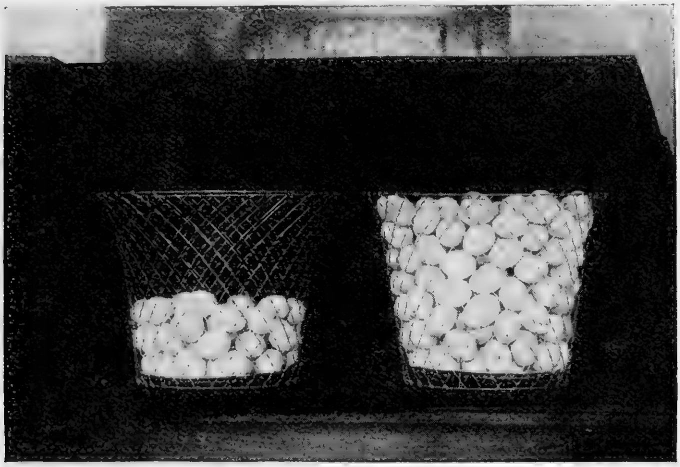
Poultry Raising as a Farm Industry

There are several good reasons why the raising of poultry should occupy a more important place than it now does on most of our farms all over the United States.

Increasing demands for eggs and poultry.—Eggs form one of the most necessary and palatable articles of food. With improved methods of shipping, parcel-post service and cold storage they have increasingly become a staple on almost every table, city as well as country. The prices are high, a dozen eggs bringing the farmer about as much as a pound of butter. The demand for fowl as a supplement to other kinds of meat has also greatly increased, and there is now a ready market throughout the year for all kinds of poultry suitable for the table.

Low cost of feeding poultry.—A fair-sized flock of poultry can be kept on the farm with but little expense for feed. This is because fowl will gather up the greater part of their living from material that would otherwise be wasted. Scattered grain from the feed lots; undigested grain from farm animals; weed and grass seeds; grass and various green plants about the barn lots, worms, bugs, grasshoppers and other insect pests form a large part of the diet of farm poultry during most of the year.

The labor of caring for poultry is light.—The labor connected with poultry raising is much lighter than with other farm animals. Much of the work is suited to the strength and interest of children, and gives the training in responsibility which every child needs. With a little over-



A year's product of an average hen and a good hen. The average hen laid 75 eggs, the good hen 223 eggs.

sight, children from ten to eighteen years can successfully take almost entire charge of poultry raising and make it highly profitable. This has been fully demonstrated in many boys' and girls' poultry clubs in every state.

Quick profits are realized.—The profits from a well managed flock of chickens are not only liberal and certain, but quick. Chickens are ready for market within a few months from the time they are hatched, and hens are at their best as layers during the first and second years of their life. And the eggs afford a continuous source of income to meet the expense of any feed or other supplies that are bought, or to add to the bank-account.

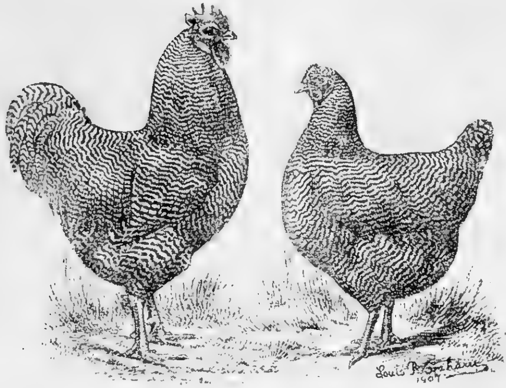
Almost all boys and girls could become expert chicken raisers and, by making arrangements with their parents to receive a share of the income from the flock, earn their own money for a farm, clothes, books, schooling, travel or whatever else they may desire.

Breeds of Chickens

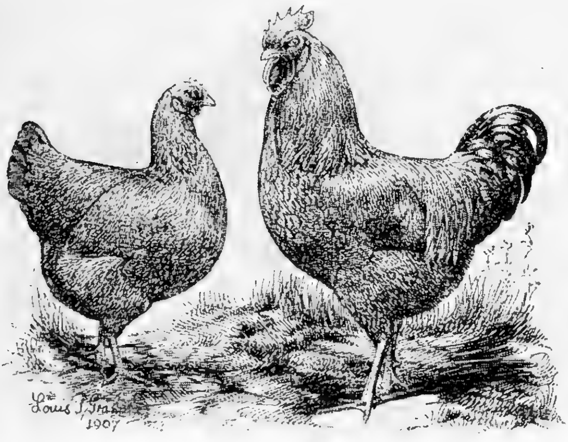
According to experts there are over one hundred standard varieties of chickens raised in the United States. There are many other varieties not sufficiently developed to be called standard. For practical purposes the standard varieties may all be grouped in four classes: (1) General purpose breeds; (2) meat or table breeds; (3) egg breeds; (4) ornamental breeds.

General purpose breeds.—The general purpose breeds are the result of an attempt to combine egg-laying with good table qualities. The favorites of these breeds are:

Plymouth Rocks, Barred, White and Buff.
Wyandottes, Silver, Golden, White, Buff, Black, etc.
Javas, Black and Mottled.
Dominiques, Rose-comb.
Rhode Island Reds, Single-comb and Rose-comb.
Buckeyes, Pea-comb.
Orpingtons, Buff, Black and White.
Houdans, Mottled.



Barred Plymouth Rocks.



Single-comb Rhode Island Reds.

Meat breeds.—The meat, or table, breeds are chiefly raised for the large markets. They must be of good shape and size, quick growers and ready fatteners. The principal breeds of this class are:

Brahmas, Light and Dark.
Cochins, Buff, Partridge, White and Black.
Langshans, Black and White.
Dorkings, White, Silver-gray and Colored.
Indians, White Game.

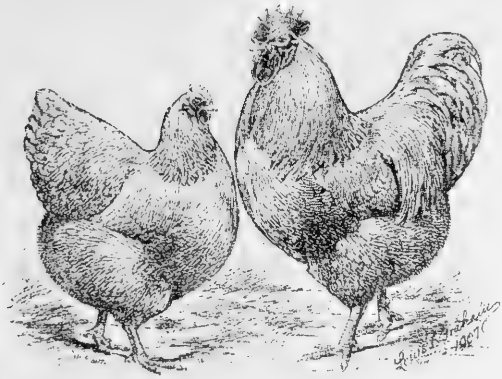
Egg breeds.—The prime consideration in the egg breeds is that they shall be good layers, begin laying young, and continue for a considerable period of time. The chief breeds are:

Leghorns, Brown, Buff, White, Black, etc.
Minorcas, Black and White.
Spanish, White-faced Black.
Andalusians, Blue.
Anconas, Mottled.
Hamburgs, Gold and Silver Spangled, White and Black.
Redcaps, Rose-comb.

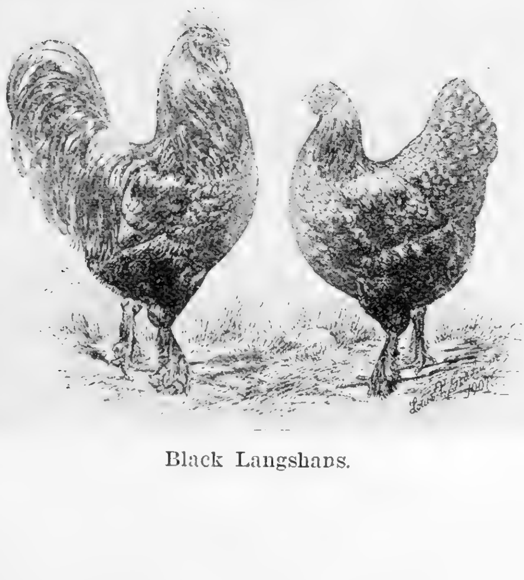
Ornamental breeds.—The ornamental breeds are not important for practical farm purposes. Some of the favorites of these breeds are:

Polish, White-crested Black, Golden, Silver, White, Golden.
Crevecoeurs, Black.
La Fleche, Black.
Bantams.
Games.

It is best not to mix breeds of chickens. First one should decide what class is desired, whether egg, meat, or general purpose. Then a pure breed of this class should be selected, and the strain kept free from mixture with other breeds.



Single-comb Buff Orpingtons.



Black Langshans.

Producing Chickens

A successful hatch depends (1) on securing fertile uninjured eggs, and (2) on proper incubation.

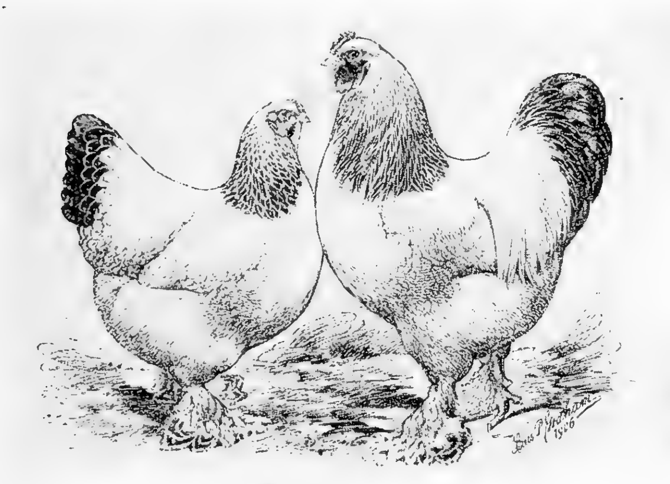
Eggs for hatching.—Heredity has its effect in fowl as well as other animals. The eggs for hatching should therefore come from the choicest and most vigorous members of the flock. The best plan is to separate from the main flock a sufficient number of desirable hens to produce the eggs required for setting. These can be kept by themselves until the hatching season is over.

In order that eggs may hatch at all they must be *fertile*. They are made fertile by the presence of a male bird in the flock during the laying season. One male should be supplied for every ten or twelve hens. Since one-half of the heredity of the entire flock is dependent on the male bird, he should be pure bred, the best of his kind, young and vigorous.

Care of eggs before setting.—Eggs should be fresh when they are set, never more than two weeks old, and better if not more than a few days from the nest. They should be kept rather cool, a suitable temperature being between fifty and sixty degrees Fahrenheit. Eggs that have been badly chilled will not hatch. It is necessary, therefore, that eggs intended for hatching shall be gathered at frequent intervals during cold weather. Many poultrymen think it is best to turn the eggs over every day or so during the time they are stored before setting. They should never be jarred or shaken.

Hatching with the hen.—Eggs may be successfully hatched either with a hen or an incubator. If the hatch is not to consist of more than from one hundred to two hundred chicks, and if the hens come of a breed of good setters, it is doubtful whether it pays to use an incubator.

Only quiet, motherly hens of good disposition should be used for setting. The nest should be made of a box from fourteen to sixteen inches square, and six inches deep. Four



Light Brahmas.

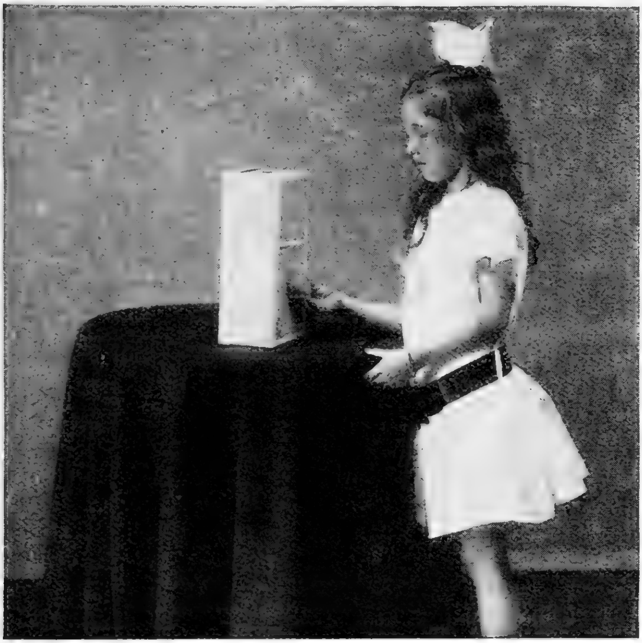
inches of earth should be placed in the box, hollowed slightly, and covered with chaff or straw. The broody hen should be removed to the nest at night and given a few china eggs for a day or two to make sure that she is in condition for sitting. From thirteen to fifteen eggs may then be given her for the hatch. It is well to dust both hen and nest with insect powder to destroy vermin. The sitting hen should be well fed on such grains as corn, wheat, or oats, have plenty of fresh water, and be let off the nest a short time each day for exercise and a dust bath.

Hatching with the incubator.—Although there are many different makes of incubators, they all supply the heat necessary for hatching by one of two methods, either *hot air*, or *hot water*. All of the standard makes will be found satisfactory, though the hot-air type seems less likely to get out of order.

Success with the incubator depends much more on the operator than the machine. For unless the temperature and ventilation are kept right, the eggs properly turned, and other necessary conditions met, the hatch is sure to fail. The directions supplied with the machine must be faithfully followed, else one need not hope for success.

Testing for infertile eggs.—About the sixth day after setting the eggs should be tested and the infertile ones removed. The testing may be done by placing a small lamp or a lantern in a box through one side of which just opposide the light a hole has been cut somewhat smaller than an egg. The testing should be done in the dark, preferably at night. The egg is held against the opening in front of the light. As the light shines through, the infertile eggs will appear clear, while the fertile egg will show a network of threads leading out from a center, and floating about as the egg is turned. If a number of hens were set at the same time, and many infertile eggs are found, one hen may be released, or given a new supply, and the fertile eggs distributed among the others.

Care of newly hatched chicks.—The chicks first hatched from a setting should be removed from the nest in about twenty-four hours. If they are not, they will begin to leave the nest themselves, and the hen is likely to desert the nest before all the eggs are hatched. The chicks must



Testing eggs with candle.

be kept warm and comfortable until the mother is ready for them.

When the hatching is done in an incubator, the chicks are left for twenty-four hours after hatching and then removed to the brooder, which must be at a temperature of from ninety to ninety-five degrees Fahrenheit. By the time the chicks are a month old the brooder may be brought gradually down to seventy degrees.

Feeding Chickens

Feeding young chickens.—For the first forty-eight hours after hatching the young chick needs no feed of any kind. Nature had provided for this period by having the yolk

Children and chicks take to each other.

of the egg absorbed into the abdomen of the chick just before it is hatched. This food must be used up before the chick is ready for more.

The first food given the chicks may be stale bread soaked in milk and squeezed dry; hard boiled eggs chopped fine, shell and all; or cracked corn, wheat or oats. A good grain ration for chicks is made of equal parts of cracked corn, cracked wheat and cut oats fed five times a day. An excellent supplementary ration to hasten growth is the following: bran, ten pounds; shorts, ten pounds; cornmeal, five pounds; meat scraps, five pounds; charcoal, two and one-half pounds; grit, one and one-half pounds. This mixture may either be fed wet or dry. Plenty of sour milk will add greatly to the effectiveness of the ration. Green foods should also be supplied from the first.

Feeding laying hens.—Hens, like other animals, do best on a ration balanced to meet their needs. There is no one best ration, since the necessary food elements can be obtained from many different sources. It is certain, however, that fowls require grain, meat, or milk, mill feeds such as shorts, or bran, green foods, sharp grit, shell and water.

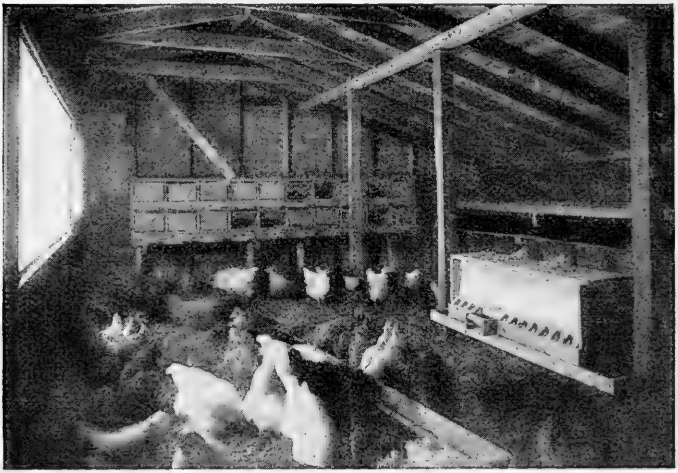
The following is recommended as a well balanced laying ration, though wheat may be left out and more corn and oats added, or milk supplied instead of the meat scraps. (*Purdue Extension Bulletin,* 10.)

Grain	Dry Mash
10 pounds of corn.	5 pounds of bran.
10 pounds of wheat.	5 pounds of shorts.
5 pounds of oats.	3½ pounds of meat scraps.

The grain is fed in a litter of straw night and morning, and the mash left before the fowls the greater part of the day. Green food is added to this ration. Grit, charcoal and oyster shells are to be fed in a hopper to which the fowls should have access all the time.

Feeding chickens for fattening.—Chickens should be specially fattened for market. Not only is weight added, but the quality of the meat greatly improved by fattening, and a higher price obtained. When unfattened chickens are selling at ten cents, the same fowls when fattened will bring fifteen cents in the city markets.

Both the *pen* and the *crate* method of fattening are used. Pen fattening requires less time and attention than crate fattening. The fattening pen should be kept darkened except at feeding time, in order that the chickens may remain



A well-arranged interior, showing nests and feeding equipment.

quiet. A suitable ration is fed at regular intervals, and in as large quantities as the fowls will eat in from twenty to thirty minutes.

Crate feeding.—More rapid fattening is possible by placing from six to nine chickens in a crate. The fowls are given a regular ration, and kept from all exercise. About two weeks is the average time required for fattening. An excellent fattening ration may be compounded as follows:

10 pounds of cornmeal.
5 pounds of shorts.
5 pounds of ground oats.
40 pounds of buttermilk.

Cramming.—Poultrymen who make a business of fattening for city markets often use the *cramming* system of feeding. This method is based on the fact that chickens will not eat so much as they can assimilate and use in making fat. The fowl is taken from the pen or crate and held while soft food is pressed down the throat into the crop, or passed into the crop by means of a tube attached to a cramming machine. This forcible feeding will considerably hasten the fattening process.

Producing and Marketing Eggs

Properly handled eggs are the most profitable part of the poultry business on the farm. It is therefore well to study the conditions necessary to the largest production of eggs. The number of eggs produced by a flock depends (1) on the breed, whether of the laying, or meat, type; (2) on the feed, whether it consists of a balanced ration containing the elements required by the egg; and (3) the housing and care.

Profitable layers.—There is a great difference in the laying qualities not only of different breeds, but also of individual hens. An average grade or scrub hen will lay about seventy-five eggs in a year; a high-class hen of a laying breed, more than two hundred. These two hens eat the same amount of food, take the same amount of room, and require the same amount of care. The one hardly pays for her keep, the other makes possible a substantial profit. It will pay every farmer to weed out the poor layers from his flock, and fill their places with productive hens.

Age and egg production.—Young hens are the best layers. Only in the case of exceptional layers should hens be kept after they are two years old. Hens that have passed their second year will continue laying and produce a fair number of eggs, but younger hens will produce *more* eggs, and should therefore take the place of the older ones.

Pullets should begin laying in the fall of their first year. In order that they may do this, it is necessary to have them hatched out early in the preceding spring, preferably not later than March or April, and about two months earlier in the South. They should then lay throughout the winter, and be at their best the following summer.

The quality of eggs.—Eggs are rated commercially according to size as *extras* when the weight is from twenty-six to twenty-eight ounces to the dozen; as *firsts* when they weigh from twenty-four to twenty-six ounces to the dozen; and as *seconds* when they weigh less than twenty-four ounces. In some places eggs are now sold by weight. For these reasons the size is of great importance.

To command the highest price, eggs should also be uniform in shape and color, the shell smooth and free from spots, and clean without having been washed. Tested with the candler the air cell should be no larger than a dime, thus indicating freshness; the contents must appear opaque, the yolks barely visible, and free from any discoloring; the white must show thick and compact, the yolk not floating about.

Effect of infertility on quality.—No eggs except those intended for hatching should be fertile. This is because infertile eggs keep much longer and in better flavor than fertile eggs. If a fertile egg is allowed to stand in a warm temperature for two or three days it begins to develop blood-rings; that is, it begins to develop the young. This process is sure to go on during the marketing and shipping, thus greatly reducing the value of the eggs. The infertile egg is free from all this difficulty, and will keep fresh much longer.

It is estimated that the loss from allowing eggs to become fertilized is more than fifteen million dollars annually in the United States. All male birds should therefore be kept away from laying hens when the eggs are to be used or sold. This will have no effect on the number of eggs produced.

Rules for egg production.—The following rules for egg production are given by the Poultry Division of the United States Department of Agriculture:

1. Keep the nests clean; provide one nest for each four hens.
2. Gather the eggs twice daily.
3. Keep the eggs in a cool dry room or cellar.
4. Market the eggs at least twice a week.
5. Market, kill or confine all male birds as soon as the hatching season is over.

Housing the Poultry

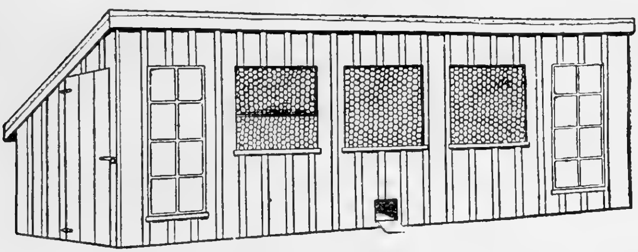
There are almost as many different styles of poultry houses as dwelling houses. The exact form of the poultry house is not important, though some types are more pleasing in appearance and less expensive than others. Every state agricultural college has plans for poultry houses adapted to the region and will be glad to supply these to citizens of the state. No matter what the style, however, certain fundamental requirements should be met by all poultry houses.

Drainage.—Poultry are especially sensitive to unhygienic surroundings. Impurities arising from ground saturated with unclean seepage, and dampness coming from undrained soil are sure to injure the fowls. The poultry house should be built on well drained ground. Drain tile should be used to carry the water away if necessary.

Room.—In many instances a flock of chickens are crowded into a space far too small for them, and the owner then wonders why they do not thrive well or lay eggs. The amount of floor space should be from four to five square feet for each bird. If there is free access to a sheltered yard, somewhat less than this may serve, but better sell part of the flock than overcrowd them in small pens.

Ventilation.—Chickens require far more air according to their weight than larger animals. Confinement in close, ill-smelling rooms is certain to lower their vitality, bring on diseases, and interfere with laying. In climates where the poultry house can not have an open front, two or more sashes should be covered with muslin instead of being glazed, and hung on hinges so that the window may be thrown open in good weather. In bad weather the sash may be closed and yet admit sufficient air. Drafts should never strike chickens either while they are on the roost or the floor.

Sunlight.—Sunlight is the best of disinfectants. The poultry house should front the south, and have a reasonable number of glazed windows besides the muslin sashes. Too much glass makes the house excessively hot in the summer and very cold in the winter; too little glass leaves



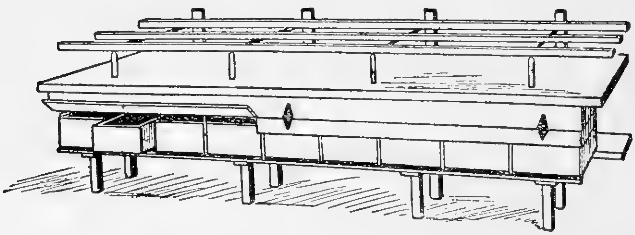
Inexpensive poultry house for small flock.

the quarters dark and gloomy, hinders the chickens in feeding, and encourages disease.

Freedom from dampness.—When frost gathers heavily inside the poultry house in cold weather it shows too great a degree of dampness. This may come from the ground floor, or lack of ventilation and sunlight. If a soil floor is used, there should first be filled in several inches of broken rock. On top of this may be placed a coating of cinders, and over the cinders a layer of soil. The soil floor at its best is hard to keep clean, dry and free from odors.

Cement makes an excellent floor, as it can easily be washed. Over the cement should be spread four inches of straw or hay.

Comfortable roosts.—Fowls spend much time on the roosts. It is therefore important that the roosts be comfortable. Roosts may be made from two-by-two-inch stuff, rounded on the upper edges; they should be placed about two and one-half feet from the floor. Eight inches below



This roosting-nesting outfit is easy to keep clean, and can be carried out-doors for treating with lice exterminators. Hens enter nests the back way.

the roosts should be a removable board or floor to catch the droppings.

Nests.—The nests may be built in a series of boxes along the side, or, better still, under the dropping board. Hens lay best in a secluded place. The nests should therefore be covered, and sufficiently enclosed to make them partially dark. Openings through the outer wall large enough to admit the hand into the nests will allow the gathering of the eggs without entering the building. Care must be taken, however, to provide a way to close these holes so that drafts may not strike the nests.

Colony houses.—Colony houses are small buildings intended for from fifteen to twenty-five fowls, and are movable. They may be constructed on the same plan as the larger building, and are placed on sills or runners so that they may be dragged from place to place with a team. Poultrymen who use colony houses move them frequently, thus securing better hygienic conditions. The colony house is especially desirable for hens with broods of chickens.

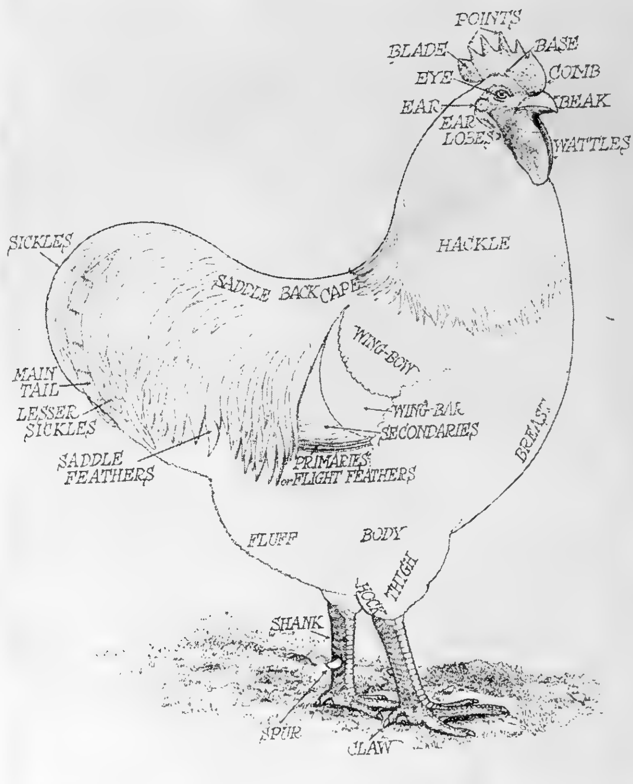
Colony houses and runs for ducks. Massachusetts.

Many large poultry raisers use both the permanent building and the colony house for their flocks.

Poultry Diseases

The poultryman's aim should be to prevent diseases rather than cure them in his flock. For a fowl sick with any serious disease is hard to treat, and the bird should usually be killed at once to save time in caring for it and the danger of infecting others.

Sanitation in the poultry yard.—Chickens are subject to a number of diseases that depend chiefly on lack of



The parts of a chicken.

cleanliness around the premises. Lice and various parasitic mites attack little chicks or older fowls alike. Frequent whitewashing of the poultry house, washing the roosts with kerosene, and spraying with kerosene emulsion such as is used for fruit trees, are some of the preventives for these pests.

A simple and effective lice powder is made of one pint of tobacco dust mixed with two quarts of fine road dust. Sulphur may be used in place of the tobacco dust, and finely sifted hard coal ashes in place of the road dust. The soil of a poultry yard should occasionally be sprayed with kerosene emulsion, or coated with whitewash after all refuse has been removed. If the ground is plowed or spaded late in the fall and allowed to freeze during the winter many parasites and disease germs will be destroyed.

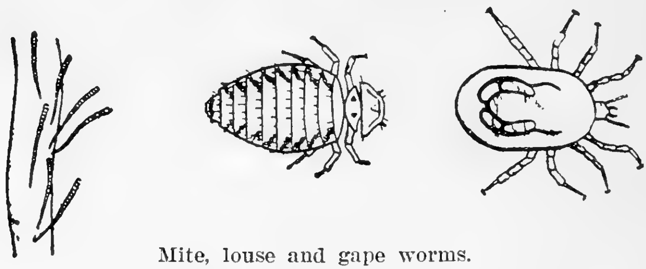
White diarrhea.—This is a disease affecting young chicks within the first four days of their life. They are most subject to attack the first twenty-four hours, and immune after ninety-six hours. The disease is caused by a bacterium found in the egg laid by a hen that carries the germs in her body. It may also be caught by contagion from chicks that have the disease, or from contact with incubators where the germs have lodged. There is at present no wholly successful remedy. A good measure of prevention is to keep incubators, brooders and all feeding utensils thoroughly disinfected.

Professor Knapp, of the North Carolina Experiment Station, recommends the following as a good remedy for the disease:

Zinc sulphocarbonate	15	grains
Calcium sulphocarbonate	7½	grains
Sodium sulphocarbonate	7½	grains
Bichloride of mercury	6	grains
Citric acid	3	grains

This amount should be mixed with one gallon of water and used for drinking purposes during the first month. After this the chicks should have it two times a week for two weeks.

Gapes.—Gapes is another disease attacking young chicks. It is caused by a small worm picked up from the soil. The worms attach themselves to the inner walls of the windpipe, where they draw their food from the blood of the chick, thereby weakening it, and also clogging the passage so that the chick gasps for breath.



Mite, louse and gape worms.

Here again prevention is mostly a question of sanitation. If the soil is free of the worms, there will be no gapes in the chickens. It is well, therefore, to keep the young chicks on clean new ground on which former broods have not been raised.

Cholera.—Several different kinds of germs commonly found in the intestines of chickens may, under certain conditions, cause a disease known as cholera. True chicken cholera is caused only by one particular germ, however. Cholera is contracted by contact with fowls sick with the disease, by germs carried by new birds brought into the flock, by germs brought by wild birds that alight in the poultry yard, or by dogs and other animals that roam from place to place.

It does not pay to try to cure fowls that have contracted the disease. It is best to kill them at once, burning or deeply burying the bodies. Care should mostly center on prevention. First of all, the flock must have sanitary surroundings—good air, sunshine, quarters that are dry and clean, and should have suitable food.

The poultry house and yard must be disinfected frequently. New fouls brought into the flock must be kept by themselves for a week to make sure they do not carry infection. Stray animals should be shut from the chicken yard. The careful following of these simple precautions will greatly lessen the danger from chicken cholera.

Roup.—This is but another name for a kind of contagious catarrh among poultry which closely resembles influenza, or grippe, in man. Roup is thought to be contracted only by contact with infected birds. It attacks the membranes of the eye, mouth and throat, causing inflammation and a sticky discharge. The disease is accompanied by high fever. Roup may be brought into the flock by newly purchased birds, by fowls that have been taken to poultry shows, or by pigeons and other birds.

Roup is one of few poultry diseases that may be successfully treated. The sick fowl should be separated from the flock and given a warm, dry, well-ventilated place. All the affected parts should be washed with some antiseptic mixture. This may be done with a spray, or by plunging the head into the liquid wash. The following are suitable washes:

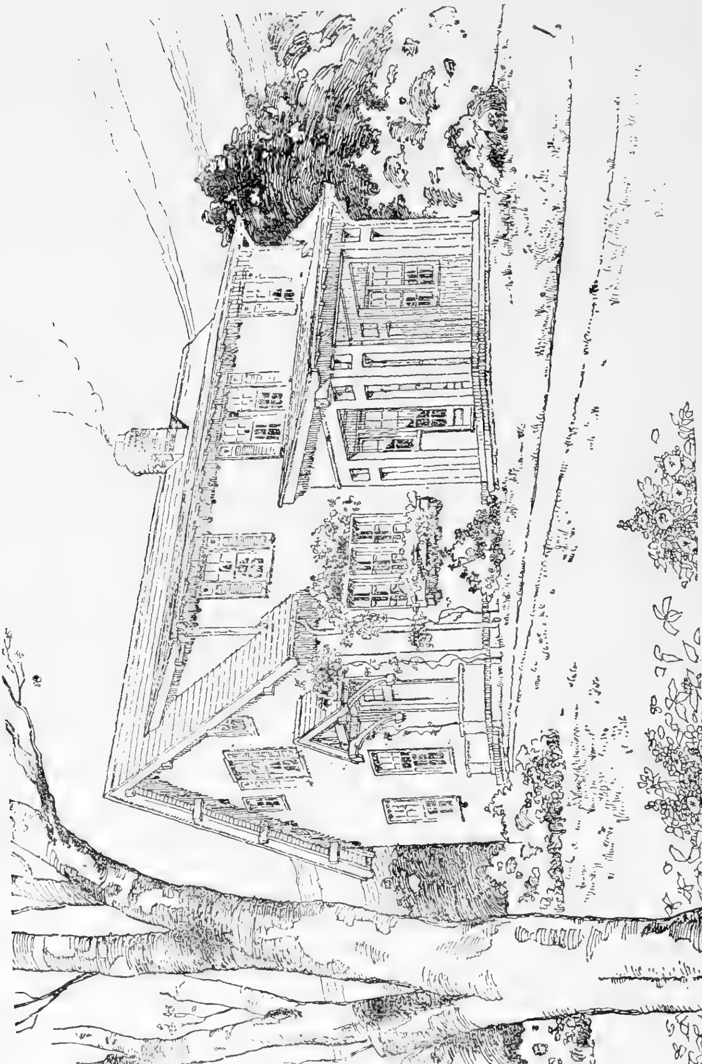
1. Boric acid, 1 ounce; water, 1 quart, or
2. Permanganate of potash, 1 dram; water, 1 quart, or
3. Peroxide of hydrogen, 1 ounce; water, 3 ounces.

CHAPTER XXXVIII

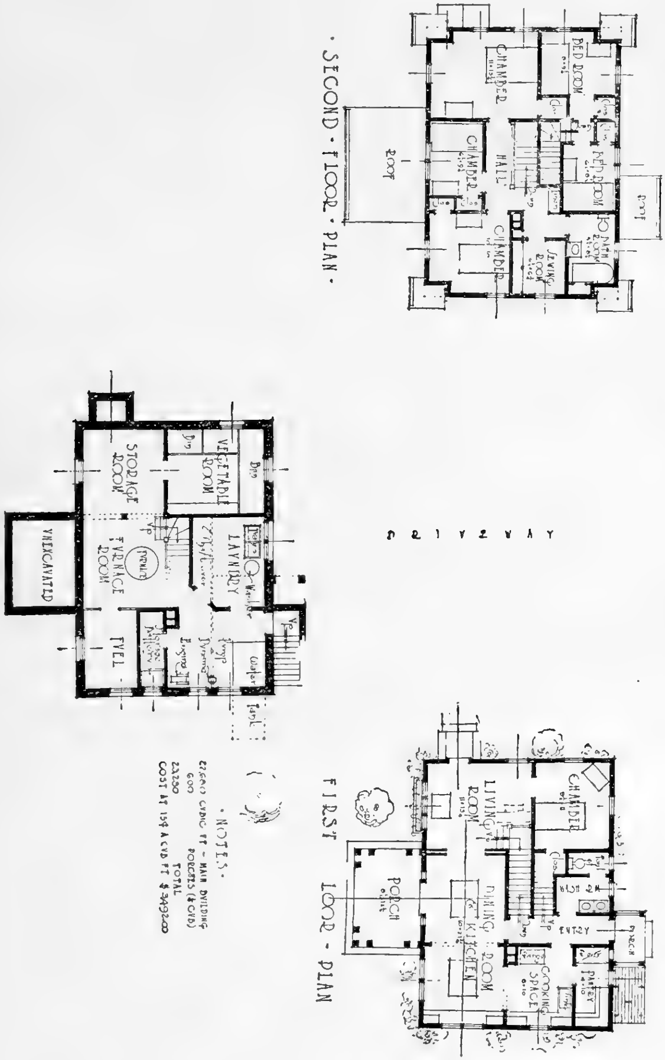
THE FARM HOME

ALL successful farming must make the farm home the center of interest and effort. It is the home and home life after all that set the final purpose for improving the fertility of the soil, raising good crops and producing fine herds and flocks. The end and aim of all one's work and planning is not merely to make more money in order to buy more land and therefore raise more stock. The home and its life must be made to share in the general prosperity.

The ideal for the home.—The home should be a place of which every member of the family is proud and in which all can be satisfied and happy. This does not require that the home shall be expensive and elaborate, but it must be home-like and its atmosphere must radiate the home spirit. A good home is an anchorage to the children which will hold them in times of temptation and moral stress as almost nothing else can do. Happy is the child whose home is such that the thought of bringing reproach or disgrace upon it is beyond the reach of his imagination or understanding. The true home is not only a place to rest from labor and to eat when hungry, but a spot in which to live the fullest, broadest and happiest life possible. It is a place to which fond memories cling and to which one's steps gladly return



Three-thousand-five-hundred-dollar Minnesota farm-house.



Plans of home.

after days, months or even many years of absence. Anything less than this in one's home leaves something more to be desired. To make the best possible home an ideal domestic unit is surely therefore the end and aim of our striving, no matter what be our occupation.

The Farm Home and Grounds

The farm usually offers the best opportunity anywhere to be found for a pleasing and attractive location for the house and grounds. There is no skimping of room as in the case of the thirty or fifty foot town lots. There is no shutting off the view with other buildings, skyscrapers or factories.

Choosing the location for the houses.—The placing of the farm-house offers an opportunity for the application of taste and good judgment. It should be so located with reference to the other buildings that it will not seem to be crowded out of the way by the larger barns, corn cribs and other buildings. It is not unusual to see a reasonably attractive farm-house so placed that it is so over-shadowed and elbowed as to appear out of harmony with its surroundings. It is more or less common even to locate barns so that they stand closer to the road than the house and partially obscure the house from view or cause it to look unimportant. Indeed in some arrangements of farm buildings one would almost think that the house was put in as an after-thought and allowed a position among the other buildings only as a favor and by sufferance.

In any well conceived plan for a set of farm buildings, the location of the house will be first decided upon and the other buildings will take their places with reference to this central position of the residence. Anything less than this preeminence given to one's home does not do justice to the home sentiment or its opportunities.

A fine homestead, but lacking in trees.

Lawn and trees.—The farm home is incomplete without a well kept lawn of fair size. True it requires some labor and a little time to keep up a lawn, but the added beauty and the satisfaction that attaches to a well kept homestead will more than compensate for this additional expense and trouble.

The farm home will of course be liberally supplied with shade and fruit trees. These will be so placed as not to obscure the view of the house nor over-shade it, thereby depriving it of sunshine and air. The position of the buildings and the slope of the ground will be considered in decorating the home place. All natural advantages will be made the most of to enhance the beauty and attractiveness. A reasonable amount of shrubbery will be placed in clumps here and there to give variety and thus relieve the monotony

Well-kept barns.

of an unbroken stretch. The house lot will be well fenced for the exclusion of farm animals and not to make a place for chickens, pigs or calves. The family on the farm should have one little patch of their own free from the trespassing of either crops or animals, where shade trees, arbors, swings, hammocks, seats and flower beds can be enjoyed without interference.

The back yard.—The standards of farm and home management may be pretty well judged by the condition of the back yard of the farm home. Upon the carelessly kept farms the back yard is found to be a litter place where are collected the remnants of broken down machines or outworn utensils, boards, barbed wire and the general miscellany that has a tendency to collect on every farm. Good management will see that the back yard of the farm home is clean, attractive and businesslike in appearance. Not only is this worth while from the point of view of the farm home itself, but it is an important part of the publicity and advertising which the condition of the homestead gives to its owner whether he will or no.

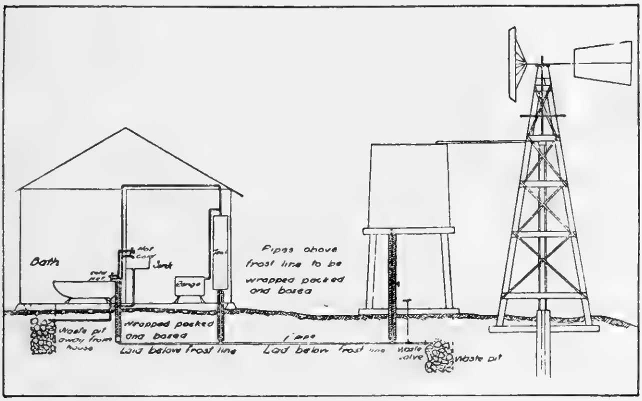
The Plan of the Farm-House

The farm-house should be adapted to the needs and the comfort of its owners. It should not be pretentious and expensive beyond the financial ability of the farm owner. Neither should it be diminutive, inconvenient and unsuited to the surroundings of a successful farm. The farm-house should first of all be comfortable and attractive. There is little excuse in this day for building houses that are ugly and repellent, for even moderate priced buildings can be planned to look well and at the same time be convenient and home-like. Nearly every magazine published to-day has its home page where plans and suggestions are freely given for houses of every type and suited to every need; all private and state art commissions, specialists and efficiency experts are lending valuable aid to home builders.

Planning the house.—The farm-house should be planned for convenience, for there is much hard work to be done by the housewife and every care should be taken to save her time and strength. A well ordered arrangement of rooms, stairs with easy treads, generous porches and windows and doors that easily open and shut may appear to be minor matters, but it is after all out of such little things that the convenience and attractiveness of a house must come.

The farm-house should have a well lighted basement with cement floor, a fully equipped laundry with water-pipes and stationary tubs connected with a drain, to save the lifting and carrying of water. Suitable vegetable bins should be provided and so arranged that they may be ventilated and cooled from the outside. A bathroom is a practical necessity on the farm as well as for the city house and can be supplied with water from an elevated windmill, silo, or cistern tank. A toilet and lavatory should also be a part of this equipment. The telephone now belongs to the farm as much as to the town, and electric lighting and power, even, are now being made available to many farms through the extension of trolley lines. All these things can be had without great cost. They require chiefly a spirit of enterprise and a little careful planning.

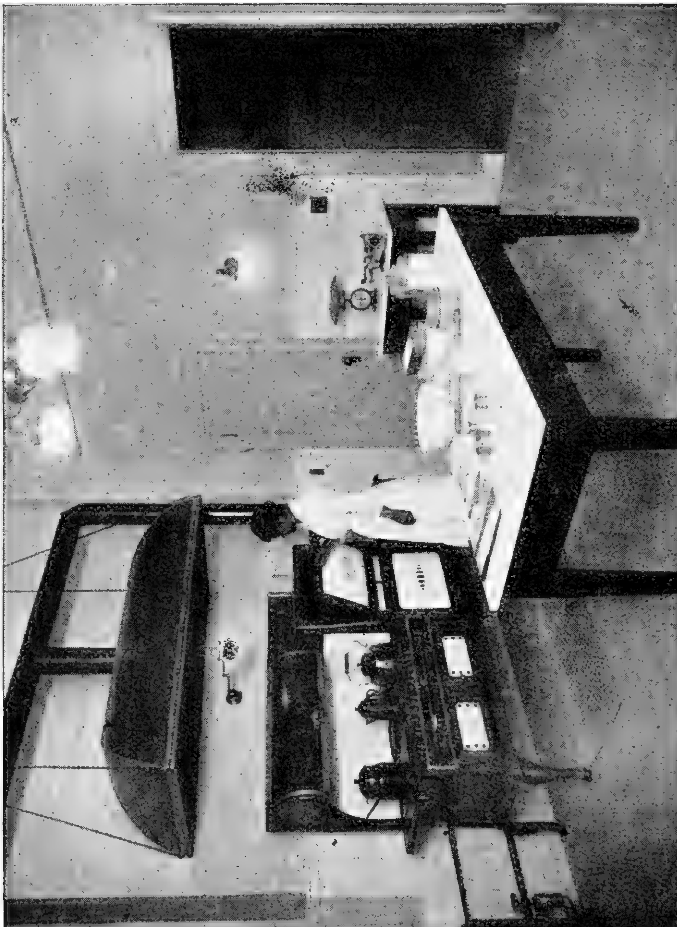
Modern equipment for the house.—The wise farmer buys good machinery to till his land and harvest his crops. His wife should also have the advantage of modern labor-saving devices in her work. The best of cooking utensils, fruit and vegetable canning outfits, automatically heated flat irons, cleaning devices, hardwood floors, rugs and other similar helps to good housekeeping should not be wanting. For such equipment now belongs to every modern home, and will save much time and drudgery.



Plan for water-pressure system.

The Farm Kitchen

A well organized kitchen is really the center of the farm home; for here is the workshop where is carried on the greater part of the work of the household. The kitchen should be conveniently located with reference to other rooms and should be so planned that the necessary equipment of stove, cupboards and sink may fit into their appointed places. The eight million women working in the farm kitchens of this country are among the hardest toilers to be found in any occupation. They spend long hours, seven days every week and fifty-two weeks every year in

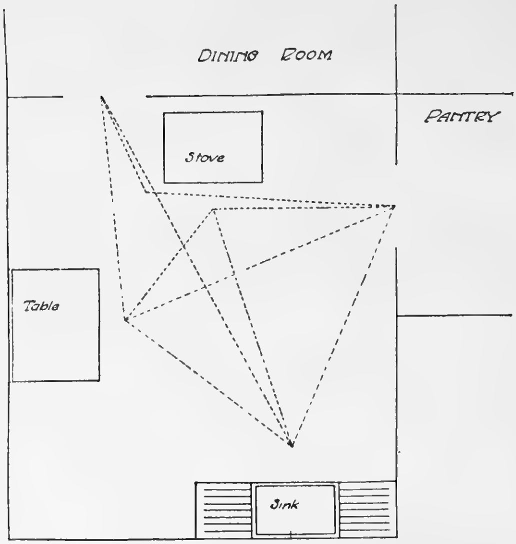


Model apartment-house kitchen.

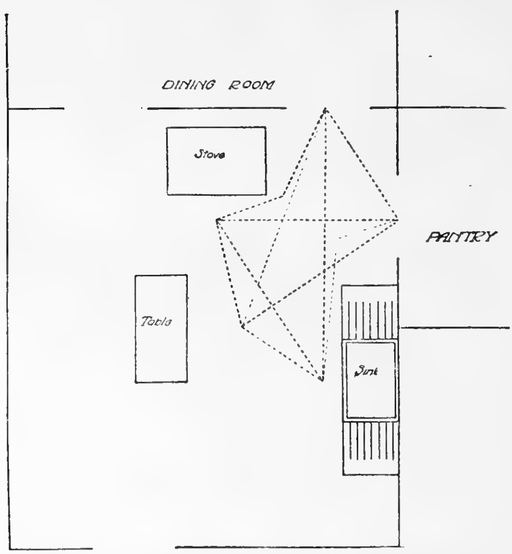
this home workshop. It is only right, therefore, that the kitchen should be made as convenient and attractive as possible.

The modern kitchen.—The farm kitchen, when well organized, is supplied with running water, a good sink with drainage, a movable kitchen cabinet and plenty of table space. It has whatever cupboards are necessary and provides an oil or gas heater for summer use with a fireless cooker to save fuel and the overheating of the room in the summer-time. With a windmill available or with a gasoline engine for pumping, an elevated tank may be made use of to supply a water system for the house and barns, equally serviceable for every practical purpose with the city water systems. By connecting the water pipes to the range or furnace, hot water may be made available and avoid hundreds of unnecessary steps in the doing of the household work. The kitchen should be so planned as to obtain light and ventilation from two directions. This cross ventilation is essential if the smoke and odors are to be carried away and if the room is to be relieved of excessive heat.

Small things of great import.—The kitchen floor, walls and ceiling should be as plain and free from cracks, ridges, moldings or any form or ornamentation as possible. The floor should be of hardwood, or better still, covered with linoleum, so that it is easily kept clean without much hard scrubbing. If tiled walls are too expensive the kitchen walls may be covered with oilcloth or the plaster painted with enamel paint which will stand washing and does not easily collect dust. The kitchen in common with

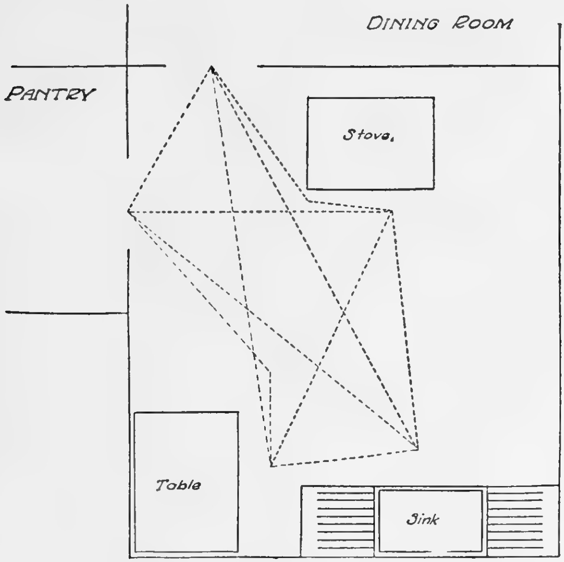


An inconvenient arrangement.



Here the distances have been reduced.

the rest of the farm-house should be thoroughly screened against flies. It should have all of the minor conveniences that will help in the rapid and effective doing of a day's



Another inconvenient arrangement.

work. The farmer who demands modern machines and implements for the carrying on of his work should not ask his wife to economize unnecessarily in these small matters that mean so much of time and strength.

CHAPTER XXXIX

THE HOME GROUNDS AND WOOD LOT

NO home place is complete without trees, plants, flowers and shrubs. Even with costly and pretentious buildings a homestead may look barren and inhospitable from lack of the decorative and comfortable effect of shade trees, groves, climbing vines and blossoming plants. One should learn not only *to make his farm pay but to make it interesting and attractive.*

Beautifying the Home Grounds

The house lot and lawn of the farm home can be made especially beautiful and interesting. For there is more room on the farm than in the town or city, and the trees and plants needed for its decoration will cost but little except a reasonable amount of care. Well kept grounds add a great deal to the market value of a farm, and contribute even more to the beauty and comfort of the home.

Plan for setting.—To produce the best results, the setting of trees and shrubbery should follow some complete and well devised plan. The effect of the most beautiful vegetation may be lost by careless or improper placing. When used for decoration or shade, trees should usually not be set in rows, unless along a driveway or boundary line; nor should they be so blocked together that they shut off the view of the house. They may stand as single isolated specimens, or in irregular groups. Trees often are placed too near the house, thus excluding the sun and causing dampness.

Shrubs, likewise, appear to best advantage when set in clumps, or irregularly to make a border for the lawn. Climbing vines can be used to screen porches, cover garden fences, hide unsightly sheds and outbuildings, or clamber over stumps, rocks or barren banks.

Selecting varieties.—One can select from an almost endless variety of trees, shrubs, flowers and vines. Each variety has its own peculiar individuality, which should be studied and known before the selection is made. A plant, once given a place on the grounds, becomes a permanent part of the home place, and should therefore be chosen with as much care as are our friends.

Shade trees should be hardy, well-shaped, broad leafed, grow to a good size, and attract no troublesome insects. Elms, maples, oaks, ash, basswood, catalpa, locusts, nut and fruit trees, and, in the South, magnolias, orange, pecan, sycamore, the redbud and live oak, are among the favorites.

Shrubs and flowers are to be selected both for their foliage and flowers. With care, provision should be made for the appearance of blossoms during each month of the summer, and for an attractive variety of foliage throughout the season.

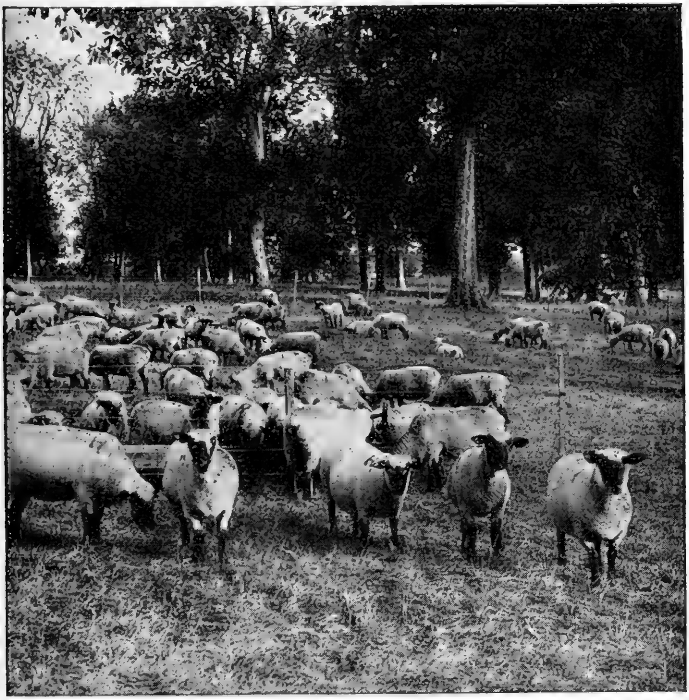
Flowering plants.—The plan for the home grounds should include a few beds of flowering plants. Most of these may be perennials, which will require but little care after the bed has become well established. With the addition of a few varieties of hardy bulbs for annual planting, beautiful effects can be produced with practically no cost and with the expenditure of very little time.

The lawn.—Nothing adds more to the appearance of a homestead than a well kept lawn. Lawns should sur-

The shrubs and trees add much to this old colonial farm home.

round the house, and as much care is needed in the planning of them on the sides and rear of the house as is required in what is commonly referred to as the "front yard."

The lawn must be close-mown during the early part of the summer if it is to produce a pleasing effect. If allowed to grow up, the grass becomes tufted and coarse, besides looking ragged and unkempt. Farm stock should not be pastured on the lawn. Their trampling will produce unevenness that interferes with the lawnmower, and the plants, shrubbery and young trees are sure to suffer from being browsed.



A good lot of Hampshire Downs and a fine wood lot.

The Farm Wood Lot

Every farm place should have its own wood lot. It costs little to start, requires but little care after the first year or two, and yields large returns.

Uses of the wood lot.—Poles, timbers and posts are constantly needed on every farm. When there is no wood lot to supply them, they must either be bought, or the farm suffer for their lack. Lumber, posts and timbers of every sort, as well as the nut and maple sugar products are becoming more expensive from year to year as our forests are being depleted. Fire-wood raised on the farm costs very much less than if bought in the market, and so scarce is it becoming in many regions that it can not be had at all unless produced at home.

The wood lot should be so placed as to serve for a windbreak for the farm buildings, and at the same time add to the beauty and value of the homestead. When the trees are grown they afford welcome shade for both man and beast, contributing both to their comfort and profit.

Birds are attracted to the wood lot, and from this shelter make sallies out upon the harmful insects that prey on crops or gardens. From the friendly tree-tops they also pour out their tribute of song to sweeten the life and activities of all in the neighborhood.

The location and size of the wood lot.—It may not always be desirable to plant a large wood lot near the buildings. When such is the case, low wet places, steep hillsides, or small irregular pieces of ground not suitable for cultivation may often be utilized.

From one-half an acre to several acres of ground can profitably be set to trees on a fair-sized farm. While the returns are not immediate as with other crops, yet the profit is reasonably sure in the end. Many far-sighted farmers are now providing for the fence posts and timbers they will need ten or twenty years hence by setting out and caring for trees in a wood lot. It is estimated that Minnesota farmers set out a million trees in a year and in many other regions the movement is quite as marked.

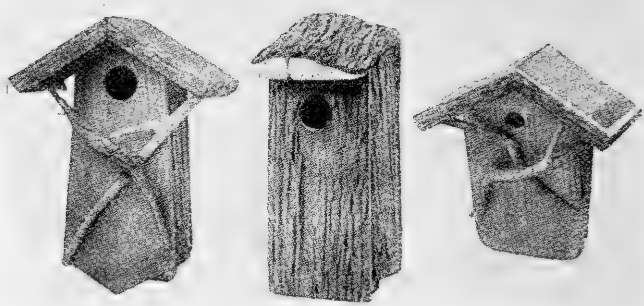
Varieties of trees for the wood lot.—It is impossible to recommend definite varieties of trees for the wood lot, since this depends on the region and the use to be made of

Using the wood lot for social center work, school picnics and club festivals, near Dows, Iowa.

the timber. Some prefer to plant the rapid-growing soft wood trees, while others are willing to wait longer for the harder woods to grow. An excellent plan is to plant a number of varieties. Not only will this allow a mixture of the slow and the fast growing trees, but provide a variety of timber suitable for different purposes of utility and comfort for the farm.

From the eastern to the middle western states the favorite trees seem to be the different varieties of maple, elm, oak, locust, ash, fir, basswood, hickory, walnut, box-elder, cottonwood, yellow poplar, catalpa, chestnut, sycamore, etc.

In the drier regions such as western Kansas and Nebraska, Oklahoma, Texas and Colorado, it is difficult to start successfully some of these varieties. Among the best drought resisting trees are the black locust, green ash, Osage orange and Russian mulberry. In the southern and far



Good homes for your bird friends.

western states practically all varieties suitable to the North and East can be grown and many others besides.

Starting the wood lot.—The wood lot may be started, in the case of most trees, either by planting the seed, or by setting out young trees. A common method of starting a grove of hardy catalpa, for example, is to prepare the seed bed as if for corn. Catalpa seed is then planted, and the field cultivated for several years. The young trees are sometimes cut back to the ground after two years of growth for the purpose of producing straighter and more sturdy trees. The growth of the tree is not retarded by this process.

A seed bed for trees can easily be started, and the trees transplanted to the desired positions when the seedlings are from one to three years old. A small seed bed will supply trees for a large wood lot.

Compact arrangement of barns, silos and cribs.

Tree Enemies

While most of the common trees are not subject to a large number of enemies, yet they must have reasonable care and protection if they are to thrive.

Farm animals.—One of the most common mistakes in starting young trees is to allow them to be exposed to stock. Cattle, sheep or hogs are sure to injure the trees by grazing upon the leaves and branches, by trampling them, or by rubbing against them. The wood lot should be fenced, and all stock excluded until the trees are well grown. Horses should never be tied to trees.

Weeds and sod.—Young trees are as easily injured as any other plant by weeds or grass. Many people seem to think that because large trees can take care of themselves against these enemies young trees can do the same. But trees once hindered in their growth by the choking of weeds or sod will never fully recover.

Insect and fungous enemies.—Shade and timber trees are, on the whole, less subject to insect and fungous attacks than fruit trees. Yet occasionally even the most hardy trees succumb to such enemies. The elm, one of the healthiest of our trees, has recently suffered greatly in certain regions. The chestnut has also been seriously afflicted with a bark disease. Whole forests of fir have died in southern localities. Even the catalpa is subject to a fungous trouble at certain stages of its growth. Whenever a considerable number of trees in a locality show signs of disease, an expert should be consulted and his directions followed.

CHAPTER XL

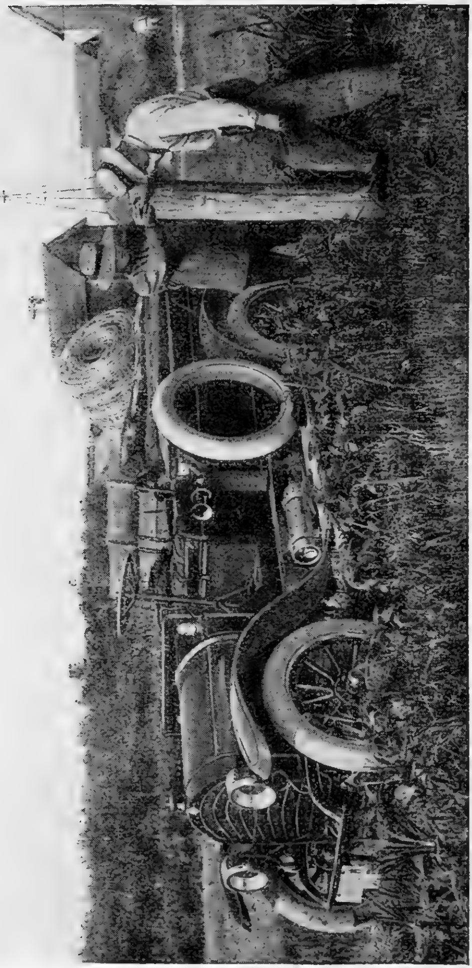
FARM IMPLEMENTS AND MECHANICS

Importance of Implements and Tools

ONE of the most important and interesting phases of agriculture is the study of farm implements, their origin, history, utility, proper care and up-keep.

Tillage and tools.—Good crops and large profits usually depend upon wise management and proper tillage; and good tillage requires the use of tools adapted to the soil, the particular crops, and the condition under which the farming is done. It is poor economy to farm with unfit tools, or implements in poor repair. On the other hand it is possible to have too large an amount of money invested in farm implements and machinery. A number of the larger farm machines, such as corn harvesters, threshing machines or shredders, can be owned cooperatively in a community and made to do the work of four to ten farmers instead of one. This will reduce both the first cost and the up-keep.

The care of machinery.—It is generally considered that a machine kept in good repair, and well housed when not in use, will last as long doing the work of five farmers as a machine owned by a single farmer and doing but one-fifth of the work, if neglected and allowed to stand out-



The auto truck saves energy of man and beast.

of-doors in rain, snow and all kinds of weather when idle. There is no better test of the progressiveness and good management of a farm than the way the farm tools and machinery are treated.

The Farmer as a Mechanic

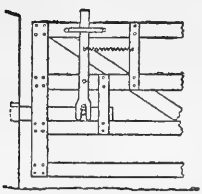
Every farmer should, at least to a degree, be a mechanic. This is not with a view to manufacturing imple-

The auto saves milk from souring and churning.

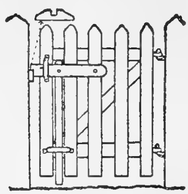
ments, or even to the building of his own barns and houses, but to enable him to keep the implements, barns and houses constantly in good repair.

The farm workshop.—A great many dollars can be saved on the average farm if the farmer has equipped his farm with a little workshop and a number of the necessary repair tools. A loose bolt, a broken rivet, a loosened board, or a brace out of position can easily be repaired by a practical farmer, while if it is neglected it may result in greater breakage, with the consequent loss of time and money. A large number of minor pieces of farm equipment, such as watering and feeding troughs, feed racks, seed trays, test boxes, fireless cookers, bins, shelving, wagon boxes and hog racks can profitably be made in the farm shop.

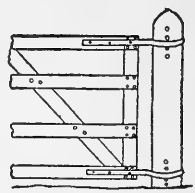
Gates That Will Save You Time



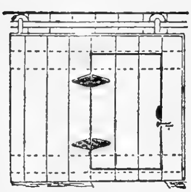
A latch for the horseman. The gate opens both ways, no need to dismount



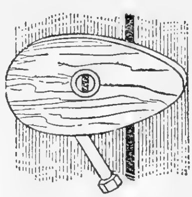
You can open this gate with your foot by raising upright stick with the toe



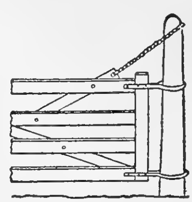
By putting pegs in the proper holes this gate is made adjustable to snow



A little door in the big one saves needless exertion. The women will like it



The heavy bolt ballasts the button so it's always horizontal and holds door shut

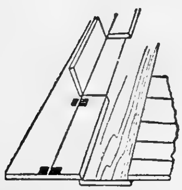


The chain wraps around the post and the weight of the gate then closes it

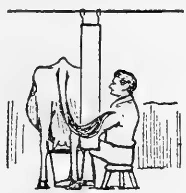
There are always plenty of rainy days and occasionally periods of time when the rush and heavy work of the fields have been completed and an opportunity given for repair work and the making of practical necessities belonging to the farm.

Manual training and the farm boy.—A farmer boy's education has no more important part than training in the use of farm tools and the application of his education to the ordinary mechanical work needed about barns, fences and machines. This phase of training should be correlated with the manual-training courses in the public school. The manual training learned by the farmer boy should relate to farm needs. Every farmer boy should master the practical principles of painting, the mixing and use of paint, and the

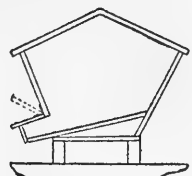
Excellent Stable and Feeding Devices



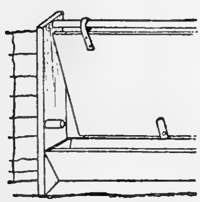
These trap-door gutter-boards let manure fall into spreader or carrier below



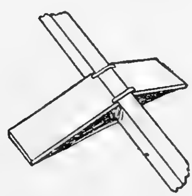
This dairy switchboard protects the milker from the restless cow's tail



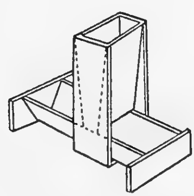
A crib that's easy to get corn from for feeding. It's really an immense hopper



The gate over this splash-proof hog trough swings forward and back



Door-sill wheelbarrow bridge made of two boards and two leather straps



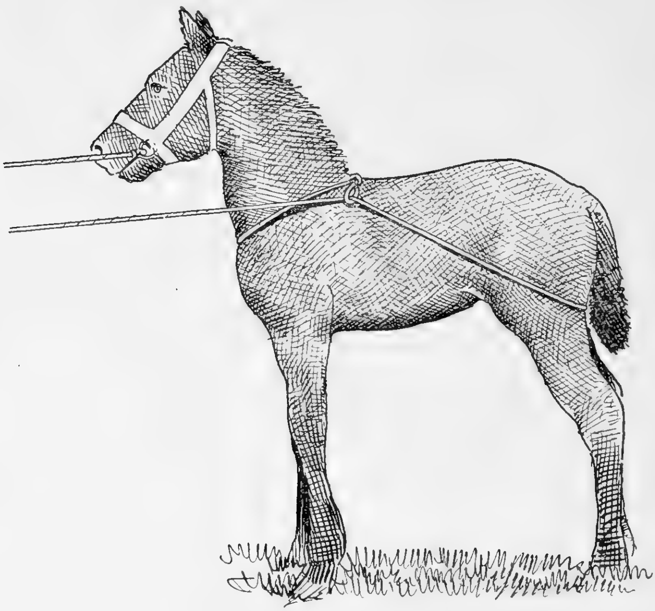
Pour swill down the hopper and greedy hogs will waste less. Stake it down

relation of color schemes. For the use of paint not only beautifies, but conserves buildings, fences and machinery.

The use of cement.—Cement has come to be one of the most important economies of a farm homestead. Every boy will want to know something about the making of concrete, and the proper methods of mixing and surfacing. He should understand the making of molds, the laying of foundation for a cement structure, and the application of cement to the construction of silos, water-tanks, fence posts, bridges, feeding floors, etc.

Rope Tying and Splicing

One of the elementary yet most interesting divisions of farm mechanics is rope tying and splicing. The place of



Teaching colt to lead by ropes. Note the three points of control —head, body and rear at the same time.

the rope in farm management is very much the same as the relation of the nail to the builder. Ropes are also widely used in other occupations, and the lives of many workmen often depend on the strength of a rope or the security of a knot.

The uses of ropes.—Long before farm machinery was invented or useful implements invented, rope tying and splicing held a very important relation to the work of agriculture. The first harness was made of rope. Joints and splicings were made with rope long before the day of bolts, rivets and other metal devices for the joining of parts in farm machinery. In spite of the fact that we have to-day all manner of improved farm machinery we still need the convenience and economy made possible by the use of the rope in knot tying and splicing.

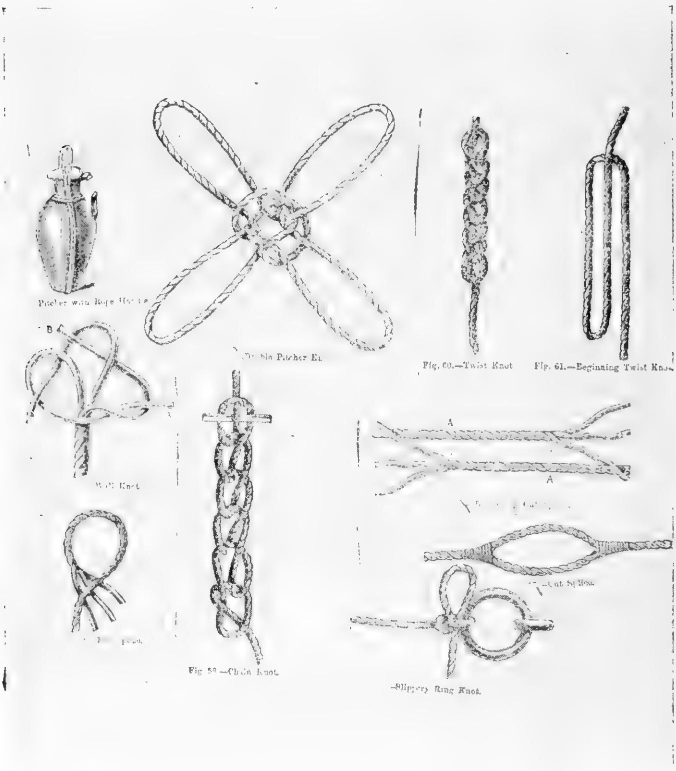
Some knots useful on the farm.—Some of the practical rope knots are as follows: the clove-hitch; bowline; never-slip noose; slipknot; Beckett hitch; reef-knot, or square knot, which never slips but is always easily untied; the two half-hitches often used for the halter-hitch; weaver's knot for the joining of small cords; fixed knot; anchor bend; timber-hitch, which can be easily untied but never slips; and the carrick-bend for joining ropes.

Making the right knot.—Different knots are required for different purposes. A simple knot that will serve in one use is not adapted to another; knots that will untie under certain conditions may be impossible to untie under other conditions.*

Principles of knot tying.—Certain principles apply to the tying of all knots. The efficiency of the knot does not depend on the number of turns or hitches, but on the

*A most interesting little book on rope knotting and splicing is one published by David McKay, Philadelphia, 50 cents. A number of the drawings here shown are taken by permission of the company from this set.

position of the "nip." The bend or hitch must be so formed that the part of the rope under strain *nips* securely some portion of the knot, either against itself or the object to



Learn to "do" these knots and rope splicings.

which it is attached. The nip of each different knot should be studied.

Rope materials.—While a large part of our rope and cordage is made of hemp, many other materials are now coming to enter into their manufacture. The coil rope is made from cocoanut fiber, which is used because it is so light and pliable. This rope is useful for warps, rocket lines, life-buoy lines, nets, etc. Manila grass is adapted to the construction of coarse ropes and hawsers requiring great strength and hard wear, and where tar can not be used on the rope.

Strips of hides are used for ropes where great strength and pliability with small diameter are needed. Cotton is employed for ropes and cordage used for fancy work of all kinds. Wire is used for rope making whenever very great strength is needed, as in connection with dredging machinery, suspension bridge cables and the like.

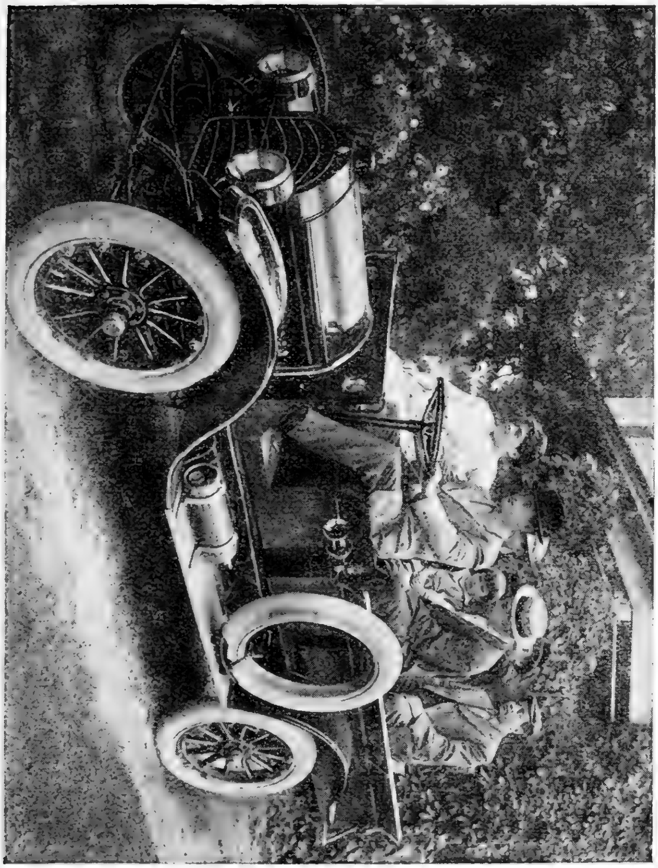
Rope-making.—*Yarns* are formed by twisting the hemp right-handed, while the *"strands"* are made by twisting or laying up the yarns left-handed, and the *rope* by laying it up in strands right-handed. Three small ropes laid up left-handed form a *cable-laid rope.* Four-stranded ropes are laid round a heart. In using hemp for rope making, great care should be exercised not to twist the hemp more than necessary, as this weakens the rope. A three-stranded rope will bear a greater strain in comparison to its size than any other rope of the same material. This accounts for the fact that most of our rope is made of three strands. Cable-laid and four-stranded ropes are as a rule about one-fifth weaker.

CHAPTER XLI

THE AUTOMOBILE AND THE FARMER

THE automobile is one of the most recent factors to be considered in the planning and administering of a farm. Not so many years ago the automobile was looked upon as a plaything of the rich, or at least as an extravagance and a luxury which the average man could not afford. It was also considered notoriously unreliable; engine or tire trouble was so common as to render trips very uncertain when dependent upon this means of transportation. Now, however, this is all changed about. The automobile has long since proved its practical usefulness, and far more machines are now in commercial use than are employed for pleasure alone.

Farmers buy the most cars.—The automobile has passed the experimental stage. It is a remarkable fact that the state of Iowa, which is almost entirely agricultural in its industries, and which has practically no large cities, leads in the number of automobiles in proportion to the population, having one automobile to each thirteen persons. Other agricultural regions of the country also own large numbers of automobiles. When it is thus seen that the farming regions lead the cities and the other industrial centers in the purchase and use of these machines, it is



Off to church and Sunday-school.

evidence that they possess solid utility and practical value to the farm.

Uses of the Automobile

The automobile is daily finding new uses. Its coming has, within reasonable limits, eliminated distance and isolation for the farmer. It is a great time saver. The five or ten mile drive to town for supplies or marketing is no longer dreaded, nor does it take half a day from the work of the farm as formerly. Not only will the automobile cover the road in one-fourth the time required for a team, but its easy and comfortable riding makes a trip to town or to the neighbors a rest and recreation rather than a wearisome task. Thus two birds can be killed with one stone by combining pleasure with business.

Saving on horses.—The automobile saves horses. The farm teams, heavily built and chunky as they are, are ill adapted to traveling on the road. Furthermore, their habits and training are only for the field, with slow gait and heavy load. Most farm horses when put under saddles or hitched to the light rig and put upon the road are out of their elements and easily tire. The automobile allows the entire energy of the horses to be devoted during the working season to the labor of the fields.

With the automobile at hand the farmer is relatively independent as to his trading and marketing. He does not have to buy at the nearest town nor sell such produce there as can be conveyed in his automobile. If he finds that he can secure a better deal at a more distant point, a difference

Auto truck at real farm work.

of ten miles in distance will not count, as this is a matter of but a half-hour's drive.

Driving farm machinery.—Various attachments are now being devised to use the automobile engine in driving machinery on the farm. Small electric motors can be driven by the engine and used to pump water, churn, grind feed, run the fanning mill, washing machines or do any other one of the light mechanical jobs demanded around the farm home. While it may not concern the farmer from the practical point of view, it is interesting to note that attachments are now in use even to run a moving-picture lantern by an automobile. The Louisiana State University uses such a machine in its extension service among farmers and rural schools, and in promoting the agricultural activities among the boys and girls of the state.

Adding to pleasure and recreation.—Not the least of the important functions of the automobile as a part of the farm equipment is in providing pleasure, recreation and change for the members of the family. Trips can be enjoyed in the evening after the farm work is done, on holidays or at slack times, which would be out of the question without this rapid means of travel. Young and old can broaden their experience as well as education and come into touch with many interests and activities which otherwise would be impossible. Lectures, entertainments, clubs and social functions in neighboring towns or communities are easily within the reach of all members of the family.

Possible Dangers from the Use of the Automobile

While the automobile has become a permanent institution and an important factor in agriculture, no small danger lurks in its use. The danger here referred to is not that which comes from accidents in the driving of the car. The mechanism of the automobile is now so thoroughly perfected that with careful driving and reasonable attention to the up-keep of a machine, there is less danger from its use than there is in driving horses.

Danger to home and community life.—The very fact that the automobile offers so many opportunities and makes possible so much broader a life on the farm carries with it an inherent possibility of danger. There is danger that the home life may be dissipated to no small degree. The fascination of the car and driving is likely to take the family much from home, or at least to break into the home circle so that evenings, Sundays and other leisure times find the members of the family widely scattered and in this way make it less possible for cultivating habits of home life and the consequent cementing of home ties, such as made the poet sing *Home, Sweet Home.*

There is also a possible danger to the local institutions, such as church and school. The farmer who owns a car no longer hesitates to drive to a neighboring town or city to church if he so desires. The country church to which he was, before the advent of the automobile, in a sense committed because of its nearness, is everywhere feeling the effects of the tendency to desert neighborhood interests.

Not only does the farmer pass his country church by in going to the town church, but there is often a temptation not to go to church at all on Sunday, the preference being to take the time in driving. The same danger may threaten the local school. Where roads are good it is not impossible, during a greater part of the year, to take the children to a school four or five miles away and go after them in the evening without any great loss of time. In not a few localities this tendency has greatly weakened the local or neighborhood school. In many instances this has prevented the consolidation of small schools in the open country, city schools have admitted the rural children and made in a measure unnecessary the new and better school at home.

There is also some danger that the automobile owner will neglect the general neighborhood interests in view of the wider range made possible through the use of his car. He can now drive to the county seat town, he can attend county or district fairs, the farmers' institutes in neighboring places, and go about within a radius of twenty-five or fifty miles as much as he will. All this is fine and in no sense to be condemned. On the other hand, there are certain local interests which should not suffer because of the use of the automobile. Neighborhood enterprises should not be neglected, even with all these wider opportunities. All the "dangers" suggested can easily be eliminated and there can be substituted in their stead only advantages at home and community welfare, if owners will invest the opportunities properly.

Deciding about Buying an Automobile

Shall the farmer buy an automobile? This is the question confronting thousands of farmers to-day. Of course no dogmatic answer can be given, any more than offhand advice as to whether a farmer shall buy a reaper or a hay-loader. These are questions which each farmer must decide with a view to the size of his farm, the number of farm enterprises, and various other questions entering into farm organization and administration.

Factors to be taken into account.—The wise farmer will, therefore, approach the automobile question as he will that of buying any other machine for his farm. He will not be influenced by the glamour and distinction of owning a car, but will calmly figure its cost, the interest on the money, the expense for repairs and up-keep and the probable depreciation. He will put against this the use that he can get out of the car, both from the point of view of business utility as well as pleasure and recreation. He can figure the practical utility phase more closely than the pleasure phase, and yet the latter must not be ignored; for the farmer as well as any other worker is justified in taking the point of view that life is more than making a living. And while making a living he will, if he has a true philosophy of life, try at the same time to secure all the reasonable pleasure and satisfaction that are available for himself and his family.

The type of car to buy.—The type of car best adapted to the farm will also depend upon individual needs and conditions. The farm car which is to be put into practical use will be exposed to the weather and hard road conditions more than the city car, and must therefore be of the rugged enduring type. The average farmer can hardly afford to invest a large sum of money in a car merely for the reputation or even the appearance of the machine. This does not mean that the farmer should buy a cheap or cheap-looking machine. In automobile buying as in other forms of purchasing, there is a happy medium between the bargain counter and extravagance. The Iowa farmers, already referred to as leading the country in ownership of automobiles, have shown by their purchases that they believe in the economy and efficiency of a relatively low priced car. Approximately seventy-five per cent. of the cars owned by Iowa farmers cost less than seven hundred and fifty dollars.

The Care of Automobiles

The automobile is one machine that it does not pay to neglect, and the farmer who is not able or willing to provide a good garage for his machine had better not buy one. Freedom from engine and tire trouble as well as various forms of breakage will depend in a large degree upon the intelligence and care with which the machine is kept. Few owners of automobiles are capable of adjusting, cleaning and caring for certain of the more complicated and delicate parts of the machine. On the other hand, any one who is sufficiently familiar with machinery to run the various implements of the farm can make sure that the general mechanism of his automobile is in good condition, with no nuts, screws or connections loose. He can see that the mechanism is sufficiently oiled and cleaned from mud. He can keep the car painted, worn parts replaced, and everything else done which is needed to make the car safe and save it from rapid deterioration.

The garage.—Wherever possible, the garage should be so constructed as to be free from freezing. This will save on the use of expensive anti-freezing mixtures in cold weather, and will prevent annoyance from frozen radiators and starting troubles that follow in the wake of freezing. The up-keep of tires will also be less if they are not allowed to stand frozen through the winter. The garage should be fire-proof, and no gasoline should be kept inside the building. For in spite of the highly developed mechanism of the modern automobile which makes it relatively safe to handle, there are possibilities of fire around a machine and no risks should be taken which may involve not only the car and garage, but also the barns and stock adjacent. It is better to have the garage separate from other buildings wherever possible.

It does not pay to run an automobile with heavy carbon deposits in the cylinders, with ill adjusted carbureter, with an oiling system that needs cleansing, or with bearings that need repacking with grease. Neither does it pay to drive tires without necessary repairs when the mileage could be greatly increased by a very small expenditure at the vulcanizing shop. With all its perfection the automobile is a very complex machine and must be handled with the highest intelligence and care if it is to maintain its efficiency and yield satisfaction in place of annoyance.

Anti-freezing mixtures.—In order to save freezing of the radiator in cold weather it is necessary to use an anti-freezing mixture. There are various mixtures available, a common one being the following:

For 5 degrees below zero use:

Wood alcohol	15 per cent.
Glycerine	15 per cent.
Water	70 per cent.

For 10 degrees below zero use:

Wood alcohol	18 per cent.
Glycerine	18 per cent.
Water	64 per cent.

Some manufacturers advise against the use of glycerine, employing only alcohol and water.

Driving the Car

Running an automobile is an art which is acquired without any great difficulty, but it must be acquired. It is not safe to assume that because one is familiar with farm machinery he can therefore manage a car without instruction or practise. Over-confidence has ruined many a machine and cost many lives. On the other hand, lack of confidence is as serious an error as over-confidence. For, while over-confidence may lead to carelessness and the taking of unnecessary risks, lack of confidence often causes one to "lose his head" in an emergency.

Mastering the car.—On purchasing a new car, the owner should deliberately set out to study it. He must learn it part by part until he is entirely at home with it. He should understand thoroughly such terms as *foot* and *emergency brakes, gear shift, clutch pedal, oil gage, accelerator, starter, spark lever, throttle, crank case, speedometer, magneto, carbureter,* and various others. He must know the relation of the various gears to different roads and grades, and learn to judge the working of the engine from its sound. He should master the lighting and ignition system, and be able to locate any of the minor troubles that occasionally arise. He should study the removal and replacing of tires, even going through the process in practise before actual need arises. Above all, he should read and reread the instruction book that comes with his car, and *follow* it until he becomes so familiar with the operating of the machine that he no longer requires instruction.

The care of tires.—The intelligent user of an automobile will remember that tires are the expensive part of the up-keep of a machine, usually costing from two to four times as much as the gasoline. Running tires with improper inflation is poor economy. A soft tire wears much more rapidly than a hard tire. The general rule that twenty pounds of pressure should be used for each inch of tire diameter should be rigidly followed under all ordinary conditions. An air-pressure gage should be a part of every driver's equipment. The life of tires is greatly shortened by allowing the machine to stand out in the hot sun. The freezing of tires, as already suggested, also tends to reduce their mileage.

Safety first.—No one who is not willing to put safety before speed or daring should be allowed to drive a car. For he endangers not only his own life, but the lives of all who are upon the highways or streets. Probably more than four accidents out of five could be prevented by the simple use of ordinary caution and common sense. Refusal to speed, slowing down at corners and on down grades, and stopping to look and listen at railway crossings would save most of the lives annually lost in automobile accidents.

Women and Automobiles

Most cars have now been made so simple and reliable that women may learn to drive and manage the automobile quite as easily as men. The managing device of the average automobile responds so easily that a woman soon learns to manage this machine with as much certainty as the sewing-machine, typewriter, or washing-machine. In fact it is, as a rule, safer and easier for women to drive the automobile than to drive a team of horses. It is a common sight on every country road as well as city street, to see large numbers of women driving all sizes and makes of automobiles. As the cars are now constructed the chauffeur is not a necessity and most people enjoy the "fine art" of driving their own car.

The demountable rim makes it possible for women to cope successfully with tire troubles on the road, which in former years was one of the discouraging factors in connection with women driving automobiles. The spark plug pump is also an essential thing in connection with the care of the tires on the road, and dispenses entirely with the old "strong-arm" hand pump. The woman's car should also be equipped with a self-starter to save the necessity of cranking.

The Automobile and Good Roads

While the automobile is hard on dirt roads, there can be no doubt that it has done more for the betterment of public highways in the United States than all other factors combined.

The automobile brings good roads.—Good roads are an essential to satisfactory use of automobiles. Because of this fact, the manufacturers and users of automobiles have been good roads promoters in every section of the country. They have not only given of their influence, but have contributed large sums of money for road building.

The farm secures advantage either directly or indirectly from every mile of roadway improved for the use of automobiles. The farmer can market his produce to better advantage and at less expense over the improved highway. He can save his time and that of his teams. He can drive his own car or his motor truck over the solid roads. And all this goes finally to increase the value of his land and buildings, and adds to the sum total of his family comforts.

Gasoline Farm Tractors

The automobile truck has for a number of years been a familiar sight in the cities. It has now displaced trucking by teams in the business of many of the largest concerns in all parts of the United States. Heavy tractor engines, both steam and gasoline, have also become more or less common on the larger farms of the West and Northwest. They are also to be found in smaller numbers in the richer farming regions of the Mississippi Valley. It is only recently, however, that the lighter farm tractors have been developed and they are by no means yet common, even in regions where the heavier tractors are well known.

Farm tractors have become practicable.—It is, nevertheless, probable that the next great step in advance in gasoline power for the farm lies in the direction of these lighter tractors. A number of manufacturers are now manufacturing farm tractors which are being sold at such a figure as to be practicable upon the moderate-sized farm. Recent demonstrations have shown such tractors having the necessary amount of horse-power, capable of drawing any ordinary farm machinery and costing from three to seven hundred dollars.

It is evident that if these machines can be made practicable for a wide range of farm work, they will have an important place upon thousands of farms throughout the country; for at the price now ruling for horses, a good farm team will cost approximately as much as the gasoline tractor. The team will depreciate in value as rapidly as the machine and horses go on eating whether they are at work or not. The gasoline tractor offers another advantage over horses in that during rush times the machine can be worked from earliest morning until late at night without weariness or exhaustion. In fact, by using two shifts of drivers and a headlight it is possible in emergencies to carry on most farm work at night or during any part of the twenty-four hours.

Not to displace the horse.—It is not to be thought, however, that the farm tractor will altogether displace horses. There are many farm uses which can not possibly be taken by the machine. On every farm of reasonable size it will certainly be necessary to have at least one team, no matter if the tractor is given the greater part of the work with the farm machinery. In the case of truck farming or with smaller farms, it is possible that several farm-

Popularity of the automobile.

ers could together own a tractor with which to do the major part of their farm work.

The best that can be said at the present time is that the tractor, so far as the average farmer is concerned, is already past the experimental stage, and promises great things for the future. While the cautious farmer will not rush into the market and buy a tractor because it is highly advertised and recommended by its makers, he will, on the other hand, keep an open mind and not be so conservative as to fail to take advantage of higher efficiency and cheaper labor for his farm if these can be secured through the gasoline tractor.

The Production of Automobiles.

Probably never before in the history of the world has so great an industry as that connected with the production, sale and repair of automobiles arisen in so short a time. A recent compilation of statistics suggests something of the magnitude of the business:

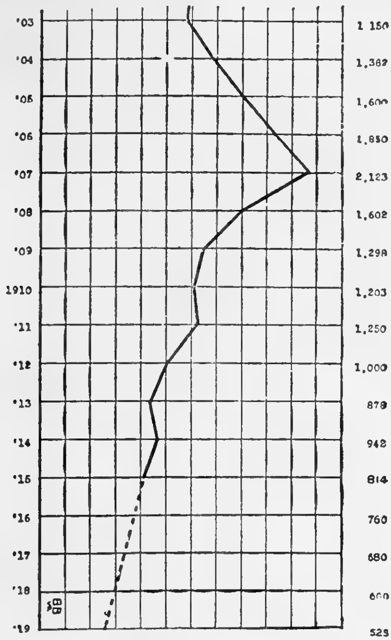
Motor-Car Production in the United States

(Passenger and Commercial)

Year	Number	Value
1899	3,700	$4,750,000
1903	11,000	12,650,000
1904	21,700	30,000,000
1905	25,000	40,000,000
1906	34,000	62,900,000
1907	44,000	93,400,000
1908	85,000	137,800,000
1909	126,500	164,200,000
1910	187,000	225,000,000
1911	210,000	262,500,000
1912	378,000	378,000,000
1913	485,000	425,000,000
1914	515,000	485,000,000
1915	703,527	573,000,000
Total for 14 years	2,125,900	$2,320,200,000

Changes in price.—It is interesting to compare the average cost of the automobile from year to year and note that the present tendency is toward the lower priced cars.

The following table gives the trend since 1903 with an estimate for the near future:



Preparation for a Drive

1. Investigate your gas and oil supply. Fill, if necessary.
2. Turn down all hard oil cups.
3. Fill radiator with clean water (rain water is the best).
4. Fill motor with oil until gage indicates "full."
5. Test lights.
6. Examine electrical connection.
7. Add distilled water to battery for every 100 miles traveled.
8. Pump up tires and test general pressure gage.

Starting Car

1. Place gear shift in neutral position before starting engine.
2. Adjust spark and gas levers.

3. Switch on electrical current.
4. Start motor either by hand or starter.
5. Adjust spark for running speed.
6. Accelerate motor with foot accelerator until it runs smoothly.
7. Press clutch pedal and shift gear to low.
8. Let in clutch pedal slowly and start car.
9. Press clutch pedal and shift to intermediate gear.
10. Press clutch and shift to high gear.

If You Would Have Your Car Wear Long and Last Well

1. Do not allow mud to dry on car.
2. Use a good grade of body polish instead of washing frequently.
3. Drain off lubricating oil from crank case every five hundred miles and wash out with kerosene. Fill with new oil.
4. Follow religiously lubricating chart furnished with the car.
5. Fill storage batteries with distilled water every two weeks.
6. Release power when turning corners.

CHAPTER XLII

ROAD BUILDING AND MAINTENANCE

GOOD public roads are a prime necessity to successful agriculture and rural development. They add to the pleasure, profit, appearance and convenience of the farm.

Importance of Public Roads

There are in the United States about two million two hundred thousand miles of roads. Of this immense stretch of public highway, two million miles are classed as *earth* roads. This is to say that we have enough earth roads to circle the globe eighty times at the equator.

Good roads and prosperity.—A study of history shows that every great and prosperous nation has built a good system of public roads, while primitive and unprogressive peoples are satisfied with poor roads. In our own country we find the most prosperous and progressive communities are those that are giving attention to the building and maintenance of good roads.

Need for good roads.—Because good roads allow the farmer to haul his produce to market at a minimum of expense in time and energy, he can make more profit out of his crops and stock. And the prosperity of the farmer is sure to increase the prosperity of all business and pro-

An earth road that needs improving.

The same road improved.

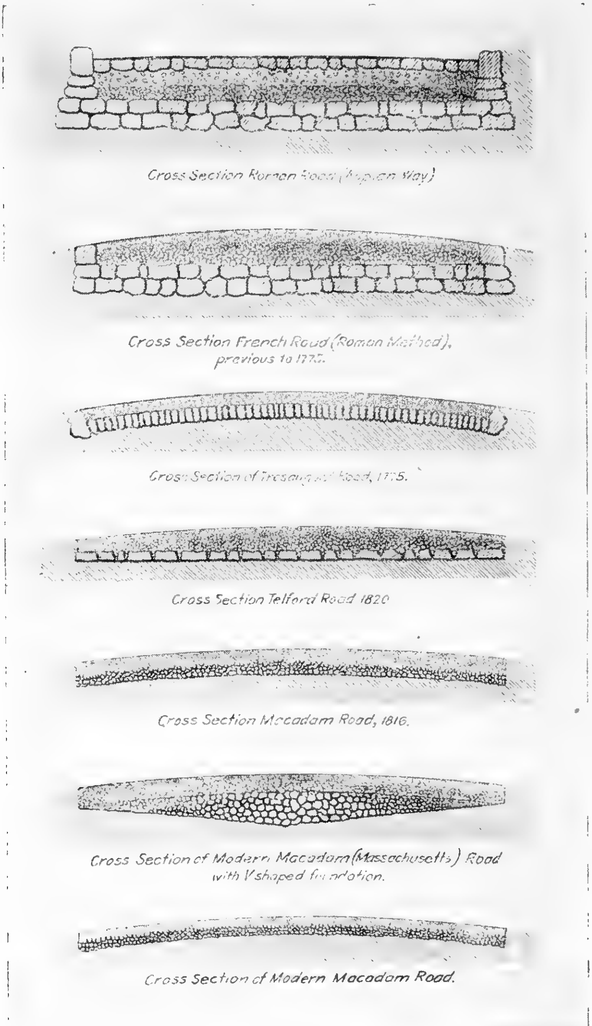
fessional men and lower the cost of living to consumers. The success of the rural schools also depends much on improved roads. Especially is this true where the schools are being consolidated and the pupils transported to the school by the district. Rural mail delivery and the extension of the parcel-post system further demand the improvement of the country roads. And, not least of importance, the making of country life interesting and attractive rests in no small degree on good roads, for they allow rural people easily to travel about the community for social as well as for business purposes.

Growing movement for good roads.—In nearly every part of the United States there is at present a growing interest in good roads. New laws have been passed and millions of money appropriated to improve our roads. Commercial clubs, business concerns and other organizations are working together to encourage road building. And farmers are coming to demand improved roads for both teaming and the use of automobiles.

Types of Roads

Roads are generally considered under the following types: (1) earth roads, (2) sand clay roads, (3) gravel roads, (4) macadam roads, (5) bituminous macadam roads, (6) brick roads, and (7) concrete roads. The discussion in this chapter will be confined chiefly to the earth roads.

Earth roads.—A chain is no stronger than its weakest link; so, also, a road is no better than its poorest part. This means that the heaviest load that can be drawn over



Cross-sections of different types of roads.

a public highway is the load that can be drawn up the steepest hill, through the worst ruts or mud-holes, or over the deepest stretch of sand. Hence the importance of lowering or going around the hill, and eliminating the mud-holes, ruts and stretches of sand.

The Location of a Road

Public roads should, as far as possible, be located in straight lines. In hilly or mountainous regions, however, this rule must often give way to avoid the climbing of too heavy grades.

Straightness and grade.—To lift a ton one foot high requires two thousand *foot-tons* of energy. On a road surface requiring one hundred pounds traction per ton, the same energy would roll the ton a horizontal distance of twenty feet. As far as the actual amount of energy used is concerned, therefore, to save one foot of grade, or up-hill climb, the road may be lengthened twenty feet. Public road grades should avoid a rise of more than six feet in a distance of one hundred feet. The hills should be cut down and the material used to fill in the hollows or else the road relocated to go around the hill and to avoid the steep grades.

The necessity of sunlight.—Every road bed should have at least six hours of sunlight each day. Brush, trees or hedges that interfere with this requirement should be cleared away or sufficiently thinned out. On the other hand, suitable trees, shrubbery, grass, vines and flowers should be encouraged along the roadway, as they add both to the beauty of the road and the value of the farm.

Drainage.—As a rule the only ditches needed for the proper drainage of the road can be made by the road grader. Deeper ditches are necessary where the adjoining land is low and level. In the building of culverts care should be taken to make them large enough to handle the overflow. They must also be sufficiently durable to resist the spring freshets and not be injured by the maximum flow caused by storm water. They should have sufficient slope so that the wash will keep them clean. All the spillways should be paved, if necessary, and the outlet and inlet protected by suitable head and wing walls.

The Construction of Earth Roads

Shaping the road bed.—Earth roads should not be made too wide. Twenty-four to thirty feet is sufficient unless that road is to be macadamized or otherwise permanently improved. All roads should be properly crowned or rounded in order to aid them in disposing quickly of surface water. An earth road twenty-four feet wide should not be less than six inches nor more than twelve inches higher at the center than at each of the borders. The total fall from center to side should be about an inch to the foot.

The work of construction.—The earth roads can best be crowned and ditched by a reversible road grader. The use of picks, shovels, scoops and plows should be avoided. One road machine with sufficient power and a good operator will do the work of a large number of men and do it much better. Graders as a rule should be used when the soil is damp. This will make the soil pack well while dry-

Earth road in Kansas.

Concrete road near Detroit.

ing. If it is worked when dry and hard it takes more power to draw the machine and in addition the dry earth and dust will absorb and retain moisture and soon develop ruts. All clods, sod, weeds and vegetable matter should be removed.

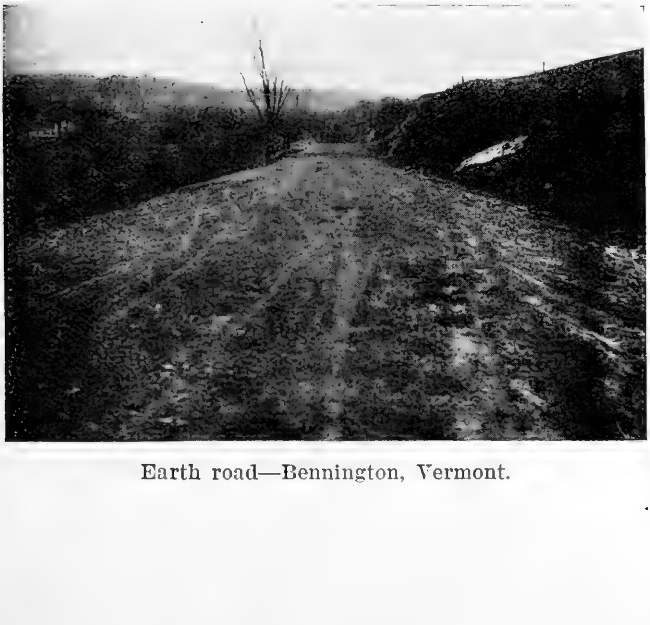
Maintenance of Earth Roads

Necessity of constant care.—The greatest problem of earth road building is that of maintenance, and any earth road which carries a great deal of traffic requires almost constant attention. Repairs should be made when needed. A few days spent upon the road at different times throughout the year will accomplish a great deal. It is a serious mistake to devote all of the time in road building to a particular season, leaving the road without care the remainder of the year. Most communities need a few men and teams or graders spending their entire time in keeping the roads in repair.

Dragging earth roads.—One of the most useful devices for the maintenance of public earth roads is the *split-log drag*. This works with great efficiency on both earth and gravel roads. To obtain the best results the roads should be dragged once each way after every heavy rain. This must be done while the soil is moist but not sticky.

It is not necessary to employ the direct supervision of skilled engineers for the maintenance and repair of earth and gravel roads, providing the rules and suggestions they lay down are carefully and intelligently followed. A difficult piece of construction or fixing of grades should, how-

Preparing foundation for macadam road.



Earth road—Bennington, Vermont.

ever, always be carried out under the supervision of an expert.

Use of the King Road Drag

D. W. King has the following to say about the use of the road drag:

The road drag is known to road makers throughout the civilized world. Road dragging is practiced in almost every

Maintained under patrol system.

county in the United States. The drag has made speedways of many stretches of hopeless highways; it has rescued scores of isolated neighborhoods; it has lifted the wagon-road reputation of entire states and changed that reputation from wretched to excellent.

All this and more, the simple, home-built, tool has accomplished, yet its work is scarcely well started, for the scope of the idea behind the tool is grasped by very few. The principle of proper drag construction is seldom understood. Errors are numerous both in the building of the drag and in its use. The most serious of these errors is in drag construction, because a poorly constructed drag, while it can be used so as to bring a measure of improvement to the road with quite ignorant handling, can not perform the best service or secure the most nearly perfect roads, even when manipulated by a skilled operator. Therefore a faulty drag means a faulty road.

Condition to Be Met.—For best results the drag must be made exactly according to specifications; the material on the road surface must be precisely in the right condition; the operator must be an expert in the management of the drag

The split-log drag at work on an Iowa road.

and also he must be an experienced and skilful teamster. Contrariwise, any kind of dragging with any kind of a drag is likely to leave the road far better than no dragging at all.

From ocean to ocean the same common mistakes prevail. Prominent among them is the habit of waiting until the road-bed becomes dry and hard. Dragging a dry, hard road does little good and usually leaves a feeling of disappointment in the mind of the operator. Another mistake is keeping the road too flat; not obtaining a sufficient crown.

In a large proportion of instances that have come under my observation, these faults in the road are due to the faulty construction of the drag. Almost universally drags are built too long or too heavy, or both.

Making the Drag.—For drag building select a light wood. Either red elm or red cedar is excellent. Cottonwood, box-elder, or even willow will last for several years if the timber is split and the bark is peeled the day the trees are felled. When peeled and split the slabs will season quickly. If they are not split and peeled they become doty or rotten before they dry. When they dry out and season thoroughly, they are quite light and are reasonably strong.

Road Club Projects

Permanent road building is not, as a rule, the work of boys and girls. But the building, maintenance and repair of common earth and gravel roads is quite within the reach of the boys ranging in age from twelve to nineteen. Two different projects are suited to club work.

One project is known as the "School Road Dragging Club," in which the pupils, under the leadership of the teacher and with the advice of the road officer, take charge of one mile of public highway near the schoolhouse, keeping it well dragged and in repair for the season. A second project permits individual pupils to take charge of one mile of road in front of the homestead, keeping it carefully dragged and in good repair during the summer.

Awards.—The basis of award in either of these club projects may be as follows:

1. General improvement in road during period of club project, based upon trueness, alignment, regularity and clearness of ditches, amount and shape of crown, betterment of surface and drainage 15

2. General condition of improved section at end of club project period with reference to clearness of ditches, waterways, trueness and shape of borders, freedom from ruts and depressions, smoothness, compactness, regularity of width ---------------------------------- 15
3. Economy of methods used, based on ten cents per hour for time of horse, and ten to twenty cents per hour for member -- 15
4. Complete records and story of "The Road Work of the Season" -- 15
5. Faithfulness of maintenance during club project period with reference to freedom of flow in ditches and waterway, repair of borders and washes, rapidity of drying out and hardening after rains, and the regularity and systematic use of the split-log drag------------------- 40

Total score --------------------------------------100

The authors are indebted to Mr. Maurice O. Eldridge, of the office of Good Roads, Washington, D. C., for able assistance in the preparation of this chapter, and to the office of Public Roads for photographs used.

CHAPTER XLIII

EXTENSION EDUCATION AND THE FARMER

DURING recent years there has been marked progress in the development of what is known as *extension* education in agriculture, home economics and other lines of practical affairs. The fundamental purpose of extension teaching is to give a larger proportion of our people more helpful and immediate benefit from our educational institutions. In this chapter we shall deal especially with institutions established for agricultural research and teaching in agriculture and household science, with particular reference to the farm and home interests.

The Aim of Extension Agencies

Farming is no longer a matter of mere planting and harvesting of crops and enjoying the fruits of one's labor. It is a skilled vocation and a highly complex business requiring brains and intelligence of well educated people. It is coming to be a fact to-day that educational institutions supported by public funds fail to fulfill their highest mission if they do not employ a force of extension teachers in addition to their corps of resident teachers.

Many helpful agencies, planned and directed by such institutions, are now at work seeking to extend to the farming population the advantages of colleges of agriculture with the results of research, the discoveries of the laboratories and the facts established by experiment station work. Such agencies have proved invaluable in carrying to the homes of the people the ever-growing fund of knowledge and scientific discovery and helping in its application to the common practise of the farm and the home.

Planning and working with the farmer located at an altitude of 9,500 feet above sea level.

Various extension agencies.—Extension work in agriculture and home economics is carried on in many different ways. First of all we have the *farmers' institutes,* one of the oldest institutions in extension education. Second, *short courses,* or what are sometimes called movable schools. Third, *agricultural trains.* Fourth, *county agent* work. Fifth, boys and girls' *club work,* or extension work in agriculture and home economics for young people.

All of these agencies have been rendering most excellent service. During recent years they have helped to raise the level of the entire field of rural life and connect it closely with the campus and the class room of the agricultural college and its experiment station. In like manner the whole country has become the campus and schoolroom of the United States Department of Agriculture with its many sources of instruction and helpfulness. It is possible through these various means for every person to receive

Conducting a field demonstration.

instruction and inspiration from the agricultural department of the federal government or from his own state college of agriculture, and thereby have the advantage of a course of study even though he can not take the time and expense to go to school. Every man, woman and child, through the work of extension teachers, state and national specialists, demonstrators, county agents, club leaders, and through the farmers' bulletins, circulars, news letters, farm journals and similar agencies, can receive help and instruction, which, except for the deep-seated interest of the government in agricultural interests, would cost many dollars or prove wholly beyond reach to many ambitious young farmers.

Practical help rendered.—The response to this effort on the part of state and national organizations has proved very encouraging. It is probably not too much to say that almost every progressive and enterprising farmer is to-day

Field demonstration in treating oat-field.

in touch with one or more of these extension agencies. Through them he is broadening his own outlook, increasing his education, extending the profits of his farm and placing his home and its life upon a higher and better plane. The busy housewife and her daughter are also being served through extension teaching and have made a notable beginning in the reorganization of the business of housekeeping and home-making. As in the case of the farmer, they can with a reasonable amount of ambition and very little expense, get a liberal education in the household arts and related subjects for home and community welfare through the opportunities offered through extension work.

Other extension fields.—While most of the extension work has heretofore been along agricultural and home economics lines, the present tendency is greatly to broaden the extension field. At the present time the universities, normal schools and even the public-school systems are all seeking to extend their schoolroom to patrons who are unable to come to the school itself. We may confidently look forward to the time when a very large proportion of our people will be continuing their education and increasing their efficiency while actually at work in their vocation and no longer in direct connection with the class rooms of the school. The community of to-morrow will have extension workers in music, art, literature, community hygiene recreation, and many other kindred subjects that have to do with man's economic, industrial and educational welfare. Through their help and guided by their own ambition the educational level of our people will be greatly elevated and their efficiency in every line of endeavor greatly increased and in this way we shall, in the language of Doctor P. P. Claxton, Commissioner of Education, help "bring about a real democracy in which all the people may be well educated."

Methods of Extension Work

The aim and method of extension teaching are much more direct and immediate than in the case of resident or regular college teaching. Agricultural extension teaching seeks to give help of a very concrete and direct kind. It tries to secure the immediate and practical application of the best principles and practise in farming, home-making and other subjects of interest. The instruction given may in a sense be brief and limited in its nature as compared with the well organized and sustained courses of study found in educational institutions, yet it is highly valuable.

Teaching business methods through children's market day.

The college or technical school seeks through a long period of study the completion of such lines of work as to produce a leader, a teacher or a farmer ready to put his education into common service, both for his own benefit and that of the public. The aim of the college is thus of a more remote type and plans for a broader culture and development than is possible through extension teaching. This, however, in no sense disparages the methods of extension teaching, which have their place and will aim at as definite and valuable results in making for efficiency of all the people as does regular class-room teaching.

Organization of extension teaching.—Because of its practical character and the lack of opportunity for long continued study, extension teaching needs to be even more carefully planned and carried out than does resident teaching. Sane as well as practical methods devoid of all scholastic cant and directly related to the immediate problems and needs at hand must be worked out. Otherwise results will fail to show the largest returns for the investment of time, energy and money, both on the part of the state and of the patrons receiving the benefit of the extension teaching. The subject matter taught in extension work, while of the same general character as that presented in the class room and approved by scientific research, must be freed from all technicalities, unexplained theories and fanciful applications. Its key-note must be its fruitfulness and immediacy of application to the interests and needs of the farm and home. A liberal use of common sense is most imperative in the difficult problem of keeping constantly before us the ideals of science while at the same time fitting scientific discoveries and principles into immediate concrete practise.

The organization of extension teaching is usually carried out through state and government agencies, but more directly through some local representative and community organization. The United States Department of Agriculture, every state college of agriculture and various other organizations are busily at work making plans and perfecting arrangements for administering their part of the great work of educating our people in their homes and at their occupations. Many highly trained and experienced leaders

A Lincoln, Nebraska, club girl who became extension helper to state extension service.

and practical men of affairs are giving their time, their thought and their energy to this great work. The day is not far distant when every farm and home in the nation may, if it chooses, be in touch with educational opportunities which a generation ago were available only to those most highly favored by fortune.

Farmers' Institutes

The farmers' institute is one of the oldest known agencies of extension work and as such is considered by many as the "forerunner of modern extension methods and agencies." For many years it has been in active operation in practically every state of the Union. The institute is not only held *for* the farmers and their families; but is organized and conducted almost entirely *by* them. At the institute meetings the farmers themselves discuss all kinds of problems relating to the home, the farm, the school and the common social life of the community. In many respects the farmers' institute is as democratic and broadly representative of the community needs and interests as are perhaps any other extension organizations.

Demands upon the farmers' institutes.—In order to be of real helpfulness and service the farmers' institute must keep fully abreast of the times. This must hold not only in the discussions and in the subject matter presented, but also with respect to the general organization and methods of conducting the institute and its meetings. Unless the institute is progressive and deals with live vital problems, it is not worthy the support of the people, much less worthy the encouragement and support of the state. This does not mean, however, that the farmers' institute must present a highly technical or theoretical program or that it must deal with speculative problems of doubtful interest and application. The best type of institutes keeps close to the real needs and definite problems of the farming community, and seeks to afford practical help upon the most puzzling and important problems confronting its members.

Institute program.—The institute program should be as carefully planned and carried out as the program of any scientific or professional organization. Exemplifying this principle, a recent farmers' institute held in one of the central states consisted of a three days' program. In it were given addresses of both practical and scientific value bearing upon farm and home management. There were large exhibits of products raised on the farm and produced in the home. The local rural schools had exhibits of their work. Stock and grain judging contests were held and instruction given in these subjects. All kinds of demonstrations, such as butter-making, baking, canning and the like were carried out. First aid to the injured was exemplified and the care of babies and young children demonstrated. Cooking contests were engaged in and a study of soils, grains and farm tools pursued. Different methods of spraying were demonstrated and practical work given in the setting, pruning and grafting of trees. Demonstrations were given in grading, picking, labeling and general marketing methods of important orchard and garden products. In addition to these activities special conferences were held on cooperative buying and selling. Moving pictures of various farm interests were shown. Recreation hours were enjoyed and luncheons and social gatherings abounded on all sides. In short, everything was up-to-date and every part of the program expressed the intelligence, the ambitions and the progressive ideals of the community.

As would be expected, agricultural trains, short courses, chautauquas, county agricultural agents, boys' and girls' club work, and other means of education were to be found and were well patronized in this county; yet none was more popular than the modern institute and probably none rendered more immediate inspiration and help.

The speakers.—At its best the farmers' institute has officers as well as program committees who are concerned first and foremost only for the efficiency and success of the institute. They aim at making it a force for the profit and enjoyment of all. Consequently, ambitious politicians, favorite friends of the officers and influential citizens or office holders are not permitted to monopolize program time unless they have something of true value to offer. Favoritism or weakness is never allowed to interfere with efficiency. Every person who speaks on the institute platform must have something of fundamental value to offer, preferably from his own experience. The program as well as the individual speeches must be timed just right and run according to schedule. Nothing must be overdone and everything must be well done. Everybody, young and old, is to be welcomed and especially provided for at the institutes. Farmers, teachers, preachers, lawyers, bankers and doctors will all find something of interest and value in a well balanced and well presented farmers' institute program. Special lectures and demonstrations must be planned and efficiently executed for the boys and girls. Every person who is interested in agriculture or in rural life should be able to find in the institute a source of inspiration and practical education.

Short Courses or Movable Schools

Another valuable opportunity open to farmers is found in the *short courses,* or "movable schools" conducted during the winter or slack season usually by the colleges of agriculture. In most states these short courses run from six days to two months. Generally they are held at the colleges, but in other instances they convene in various parts of the state as extension courses, or movable schools. Short courses definitely center on certain specified subjects, and involve class instruction and demonstration work, rather than free-for-all discussions and a general program of wide range. General discussions and practical questions are by no means barred, however, in short-course work.

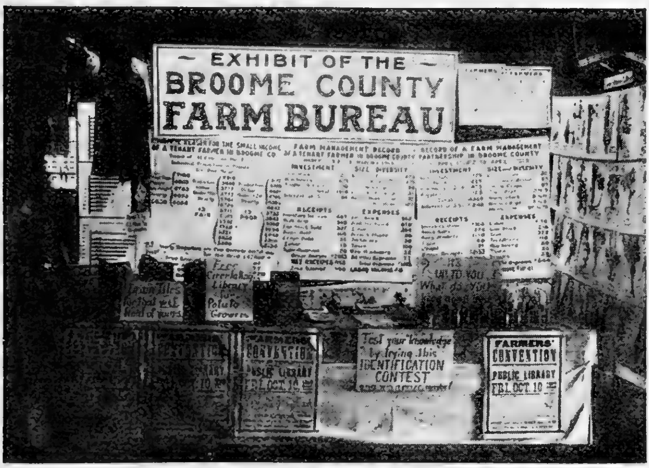
Work of the short courses.—In the short courses the special problems confronting the farmers of the region are brought forward, and the experimental results of much careful work and investigation are freely given to them. The best type of crops, the most favorable rotations, the most successful means of combatting insect and other plant enemies, instruction on breeds of live stock adapted to local conditions, protection against animal diseases, systems of marketing, and many other vital problems are discussed and taught in a helpful way. In addition, instruction is usually given in stock and grain judging and the farmers are so trained to efficiency in these lines that they can judge their own stock or crops with sufficient accuracy for all practical purposes.

Good returns.—Time and money spent in attending short courses, movable schools, or other types of educational meetings relating to farm interests are profitably invested. The progressive farmer who not only comprehends helpful scientific truths, but has the enterprise and ability to put them into practise upon his own farm will reap many-fold in returns for all he has expended. In addition, the pleasure and satisfaction that come from co-operating with the most progressive members of his county or neighborhood are in themselves sufficient compensation for all the sacrifice required.

The County Agricultural Agent's Work

One of the new agencies which has more recently entered the field of agricultural extension education in the interest of rural development is the *county agricultural agent.* The county agent is an agricultural or household science leader or extension representative whose business is to organize, lead, instruct and give agricultural direction and bring from every source helpful instruction and advice to the farmers and their families at home, in the field and in the schools of the county.

Purpose of the county agent.—The relation of the county agent's work to the agricultural interests of his county is suggested in the following words from Doctor B. T. Galloway, Dean of the College of Agriculture, Cornell University: "The successful county agent is one who can properly represent the whole community and the state and federal agencies aiding him, and who can use these agencies and all other agencies to the fullest advantage to the benefit of the community. The most successful work will be accomplished through the agent as an organizer and administrator. If he attempts to do much of the detailed work, he will so scatter his energies as to



County agent's exhibit at county fair.

accomplish little. It is not to be expected that the farm bureau agent can qualify as an expert upon all subjects that will have to be used in his county. He should depend largely upon specialists in subject-matter in departments of the college and in the United States Department of Agriculture to aid him in this work. His work can be made much more effective if he will so organize it as to utilize these subject-matter specialists in his county rather than to attempt to do all of the subject-matter work himself." In connection with the county agent, and back of his work, there is in many of the states an organization of farmers of the county, organized for the purpose of furnishing a sort of clearing house for agricultural and household in-

The country agricultural agent is discussing grain problems and smut explosions with the farmers at thrashing time.

formation and an organization through which the county agent may work. This organization is commonly known as the *Farm Bureau*.

The work of the county agent.—The advent of the Mexican boll-weevil in the cotton-fields of Texas was responsible for the beginning of this work. So great were its ravages that in 1904, 1905 and 1906 the United States Department of Agriculture employed Doctor Seaman A. Knapp to investigate what could be done to exterminate the boll-weevil and to demonstrate to the southern farmer that cotton could be grown in spite of the pest.

Doctor Knapp soon discovered that printed circulars of instruction, public lectures and other former means of agricultural instruction would not accomplish what was needed to be done. So he determined upon a plan of field and farm demonstration work for the purpose of showing upon a man's own farm not only how to exterminate the boll-weevil but how to grow an earlier variety of cotton, and if possible, a weevil-resistant strain. From this beginning there has been a very rapid growth of this type of extension work, until at the present time county agricultural agents are employed in every state in the Union.

The county workers.—Men employed as county agricultural agents are required to be possessed of scientific information as well as successful experience on the problems of agriculture. They are expected also to have had practical experience in the general management of a farm. Plans have already been made by which the county agent is assisted by a woman agent who will be thoroughly trained and fitted to advise and direct the girls and women in all matters relating to the making of better homes. Several hundred women agents are now at work in as many counties in all sections of the United States.

Organization of the county work.—The county agents live in the county and are supplied with an office where they may be consulted on special office days. They are furnished with some means of transportation so that they may travel about the county from farm to farm and from group to group. In this way the county agents carry to the very door of the farm home the services of specialists. They are able to bring to those who can not go to college the help, advice and leadership of the best scientific investigators, and really make the farms a part of the campus, class rooms and laboratories of the agricultural college and demonstra-

Teaching seed selection to farmers of to-morrow.

tion centers of the experiment stations and the United States Department of Agriculture.

Character of help rendered.—The work of the county agents is calculated to increase the profits of farming, and to make more possible the comforts and efficiency of the farm home; to aid in conserving and building up the soil; and to encourage the advancement of community education and social interests. Like the physician or surgeon, the county agents are to be called when advice, treatment or preventive measures are needed. They plan for a system of demonstrations to show the best methods of managing the soil, preparing the seed bed, selecting and caring for seed, management and care of farm animals, preparation of foods, home canning, organization and care of gardens and orchards, and the handling and conservation of farm buildings and machinery.

If a herd is stricken with tuberculosis, the hogs with the cholera, the cotton-field with the boll-weevil, or the corn-field with cutworms, or the members of the family with some disease caused by tubercular milk or foul water, the county agent should be notified and his help secured. If he is not able directly to give the information and aid he will know where to secure assistance on short notice. In like manner the county agent will be of special assistance in planning the proper management of soils and crops when the seasons are too dry or too wet; in the best organization of farm enterprises; and in the management of all the efficiency factors important to the success of American agriculture.

Financial support.—The county agent work was first supported by the United States Department of Agriculture by the use of funds directly appropriated by Congress to the department. This was liberally supplemented by a fund from the General Education Board. The work under Doctor Knapp's direction made definite progress toward the extermination of the boll-weevil and the development of resistant types of cotton. The best part of his work was the fact that through the county agent movement he succeeded in getting the southern farmers to appreciate that they needed to grow their own pork, beef, poultry and dairy products and that crop rotation was quite as possible in the South as in the central and western states. He also demonstrated through these men that growing cotton as a single crop enterprise from year to year meant certain destruction agriculturally to the South.

This work called for a more liberal appropriation of funds from year to year from four different sources: (1) the United States Department of Agriculture; (2) the state legislatures; (3) the General Education Board; (4) the local or county government.

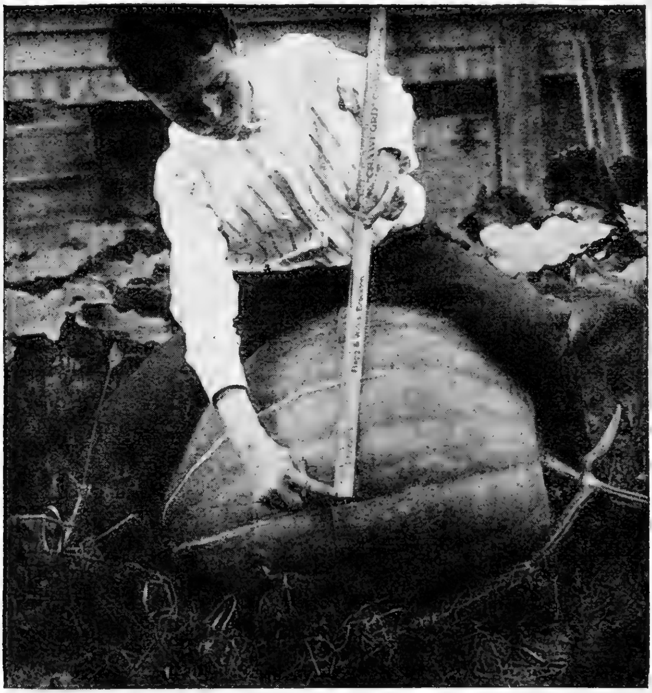
Congress in the year 1912 appropriated an additional amount of money to be expended for the development of farm demonstration and county agent work in the northern, central and western states for the first time. The fund was supplemented by one hundred thousand dollars donated by a Chicago business man. In 1914 the Smith-Lever Act was enacted and this made federal aid available for every state in the Union, beginning July 1, 1914. The entire amount appropriated for the first year was four hundred and eighty thousand dollars, to be divided equally among the forty-eight states. The appropriation is gradually to increase until the federal government is contributing some four and one-half million dollars annually for the encouragement of agriculture.

The Smith-Lever law contemplates that the greater part of this immense fund shall be spent in supporting county agricultural agents, state and district leaders in boys' and girls' club work, demonstration work in home economics, and other assistance in shaping and building up agricultural interests throughout the nation. The agricultural colleges and the United States Department of Agriculture are to cooperate in carrying out the provisions of the act.

Steps to be taken in securing a county agent.—The matter of securing an agent for a county should first be taken up with the state leader, whose headquarters are with the agricultural college of each state. He is in a position to assist in planning and conducting the campaign for an agent and can give information in regard to available sources of county, state and federal funds, and the amount of funds necessary properly to finance the movement. When the county is ready for the appointment of an agent the state leader will doubtless be able to recommend a man qualified for the work.

Agricultural Publications

Probably in no other occupation are there so many helpful publications available, with little or no cost to those who are interested and will use them, as in agriculture. The United States Department of Agriculture has printed and is distributing free of charge to all who desire them, many hundred different bulletins relating to the farm and its interests. In addition to this vast array of practical, scientific material, special bulletins for farmers, circulars and different series of follow-up instruction for boys' and girls' work are available; also various state agricultural colleges and experiment stations are annually publishing helpful material bearing upon the agricultural problems of their state. These publications are all free to the citizens of the state.

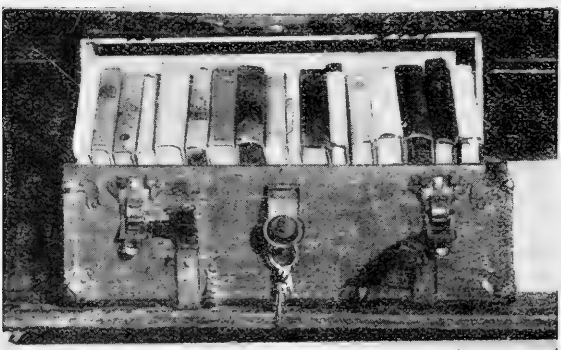


Use a real measure in agricultural achievement.

An abundance of valuable material.—Added to these lines are many circulars of information, agricultural reports and special bulletins upon definite farm problems, distributed either by federal, state or private organizations. Indeed the amount of this material is so plentiful that its very quantity is in danger of defeating its purpose. When a farmer has before him a list of several hundred state and federal bulletins on farm and home interests, and adds to this a list of a hundred or more from his own state agricultural institutions, it requires some care to make a wise selection, yet he may be sure of finding the very ones needed for the particular problems of his own farm or home.

Each region of the country or even each section of a state, indeed every individual farm, has its own particular problems. It is the business of the progressive farmer, therefore, not to try to read everything printed upon agriculture, but to select from the available material those particular helps which relate directly to his needs. In this way one can secure the assistance of scores or even hundreds of highly trained and thoroughly experienced agricultural scientists and practitioners, and, without expense to himself, add much of their knowledge to his own in the advancement of his economic interests.

Agriculture in the home library.—Every home library should therefore contain a general selection from among the agricultural bulletins, reports and circulars available for free distribution. In addition to these, the agricultural section of the home library should contain a few well selected reference books upon the subjects of cooking, housekeeping, home-making and agriculture. These are necessary in conjunction with bulletins for one who desires to get the general idea of the whole field of agriculture and home-making. For while each bulletin deals with its own specific problem, a book puts one in touch with the wider relations of his vocation. By such means as these the farmer who has not had the opportunity of technical schooling can, nevertheless, keep in touch with the best agricultural thought and practise of his day. And one who does this need have no fear of becoming an "old fogy" or "getting into the rut." Not only will he better his farming and thereby increase his financial success, but



Agricultural agent's portable rural library.

will keep an alert mind and grow mentally while improving his economic welfare, and will by their educational processes be able to remove the thorns and stingers from the so-called drudgery of farm life.

The home library.—But one should always be broader than his occupation. It is not enough for the farmer and his family to keep in touch with the best agricultural literature of the day. Our farming population probably averages higher in intelligence and natural capacity than any other great body of industrial workers. The interests of the farmer and his family will therefore naturally lead to reading matter covering a wide range of interests. The library of the home will need to have a well selected stock of books of literary, historic and practical scientific nature. On the library table will be found not only some farm journals, but the daily paper, a weekly magazine of national scope and one or more of the best monthly magazines. A fair proportion of one's income expended in this way will yield the highest returns in personal satisfaction, in broadened interests and intelligence and in all that goes to make life most worth while.

The progressive farmer is therefore, like his farm, improving daily. He is characteristic of the highest type of intelligent citizenship. He provides not only for the physical welfare of himself and his family, but also for intellectual needs. Not satisfied to follow blindly the methods learned when a boy upon his father's farm, he appropriates the lessons of modern science and profits by the results of experimental agriculture. He is too well balanced to be led off by mere fads, but at the same time he is sufficiently open minded so that the really valuable never passes him by. The progressive farmer, whether he is a graduate of an agricultural college or of a rural school of his native community, makes use of all educational agencies and adds to his storehouse every year, net earnings of health, wealth and increasing intelligence.

CHAPTER XLIV

EXTENSION EDUCATION BY MEANS OF BOYS' AND GIRLS' CLUB WORK

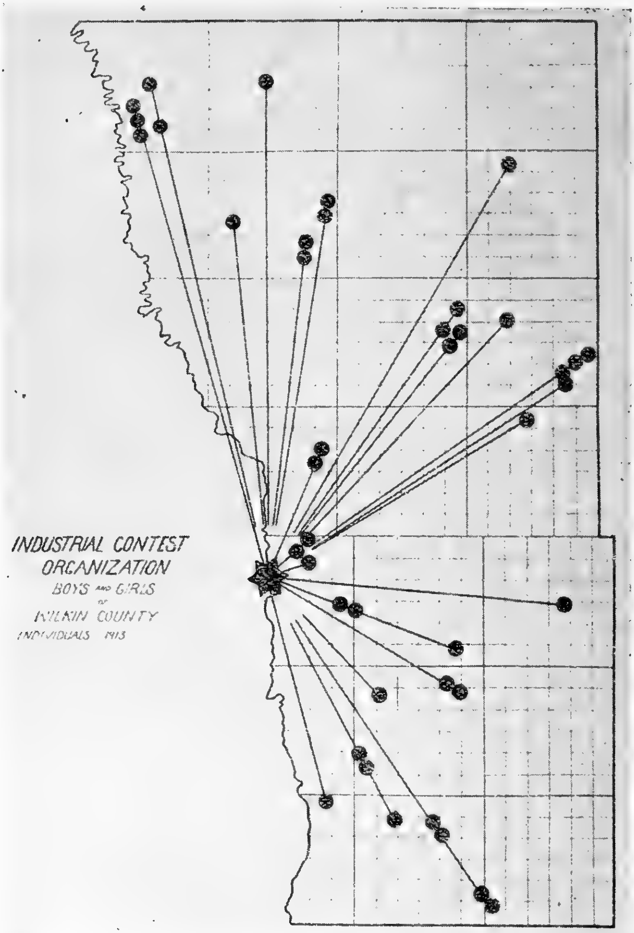
CLUB work is one of the several forms of extension teaching now being systematically conducted throughout the entire nation. In Canada, and in several of the foreign countries the work is also being introduced.

Purpose of Club Work

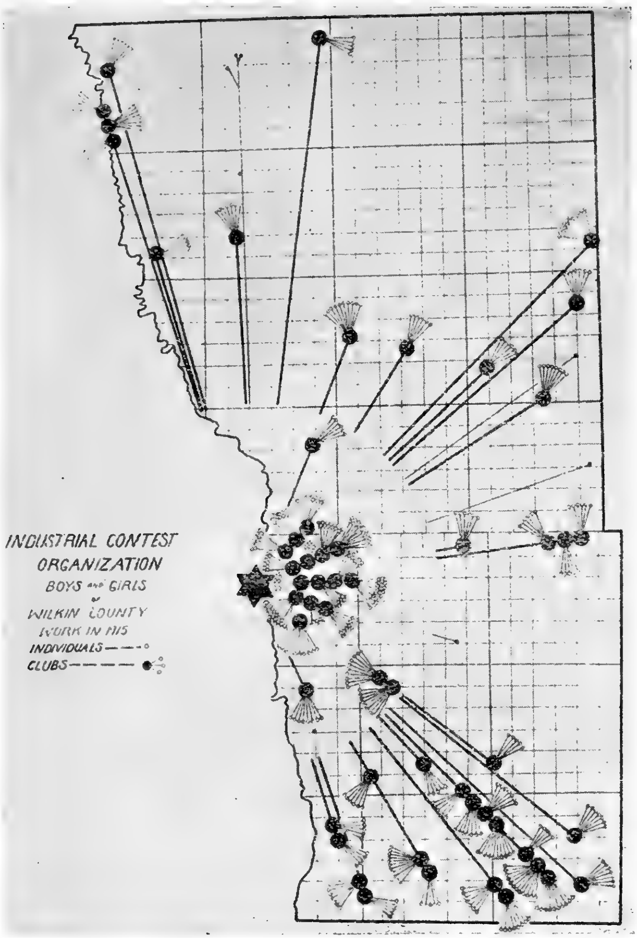
These clubs are an organized system of extension teaching for young people, and contemplate the carrying on of home, farm, orchard and garden projects throughout the growing season and in fact throughout the entire year. Boys and girls are organized into groups called clubs. All members of these groups carry on a uniform or definite line of work outlined by national, state and local leaders. Systematic instructions are given from time to time throughout the season, club meetings are held, programs are furnished for detailed guidance, field and demonstration meetings are conducted by state, district or local leaders. These club leaders attend meetings, conduct fairs, special club festivals, play tournaments, club fairs, pageants and banquets, some of which are held for the purpose of creating enthusiasm and interest, and to give the members of the group the encouragement and common motive needed for success in their work.

Correlation with home interests.—Club work is distinctly a back-to-the-home movement, and seeks to correlate and coordinate the activities of the school with those of the community and the home. The club organization through its group meetings aims to develop leadership, independence of initiative, cooperative strength, and an appreciation of what constitutes community welfare and efficiency.

Other of the leading objects in this type of extension work are to offer young people of rural and village life the careful guidance and direction in agricultural and home work and interests such as will retain for the farming business many of the best young people of every community. The purpose is also to demonstrate through these trained boys and girls the highest efficiency and best practise for the farm and the home. The boys and girls through this group organization are likewise afforded the training in industry and team work that will make for better community ideals. The club presents also a plan of systematic study that renders help to the rural and village schools which are endeavoring to teach agriculture and home economics. It gives to the isolated boy and girl of the country the educational advantages so essential to all-around development. It teaches habits of thrift, economy, industry, and a positive liking for the work of the farm. Finally, the boys' and girls' club inspires a greater interest in all the activities and enterprises of the farm through



The large star shows location of county leader, black dots location of boys' and girls' club groups in the country for the year, each group receiving help and inspiration from a local leader.



Large star represents the county leader, black dots show club groups and small circles represent the club membership of each group.

developing a broader culture and giving a knowledge of the plant and animal world with which the farmer and his family have to do.

Some of the Club Projects Given to Groups

Field, farm, fruit and garden projects.—In corn, potato, sugar beet or mangel, market-garden, alfalfa, apple, rotation, home garden and canning work.

A New England club exhibit.

Home demonstration projects.—In home canning and marketing, mother-daughter home canning, garment-making, home garden, boys' and girls' home canning, wheat and bread work.

Animal husbandry projects.—In pork and crop production, poultry project consisting of hatching and rearing and egg-laying and marketing, beef and crop production, and dairy work.

Special club projects.—In home management, farm management, farm and home handicraft work.

Requirements of members in all projects.—The requirements for all clubs are practically the same; namely, every member is required to make application for membership, agree to requirements, such as attend meetings, follow instructions, and faithfully manage at least his acreage or project unit. There is as a rule no limit to the size of the plot nor the amount of work which may be undertaken. The member must keep a record of observation, cost, receipts, and make an exhibit of his products at the time and place designated by state and local leaders.

Basis of award.—For basis of award, follow-up instruction, enrollment blanks and organization circulars, write to the state agent in charge of boys' and girls' extension work at the state college of agriculture of your own state. If possible arrange for the county club leader or county superintendent of schools to assist you in getting a club or group of boys and girls organized in one or two of the above projects. In some communities it is very important that one project be used for the boys and another of more definite application to the home used for the girls. No school community or district should undertake more than two club projects or groups. It is much better to be content with one or two club groups and make a definite success of them than to have many and practically fail in all.

Results from Club Work

The results of boys' and girls' club activities in agriculture and home economics are both immediate and remote. The more immediate result is the economic efficiency that it brings to the farm and the farming community by making of every boy and girl a demonstrator of the best known practises of agriculture and home economics. Boys and girls as a rule, with their open minds free from prej-

Parcel post and market exhibit.

udice, unpossessed of habits of bad practise, and in the formative period of life, are in position to take and put into immediate practise the instruction and directions of scientists and specialists. Indeed they are much more readily influenced than are their parents and adult neighbors who have been practising for so many years in other ways, and therefore have developed habits that are difficult to overcome. The demonstrations made possible through boys and girls render it a simple matter for the adults to secure through each object lesson the facts essential to their own advantage in conducting the farming business.

Results upon character.—A more remote but not less important result is that club work offers under skilful leadership and direction just the kind of out-of-door industrial life required for the conservation of the health, character and ideals of young life ranging from ten to twenty-one years of age. The club work also develops within the member a desire for ownership and possession of things worth while, and teaches the dignity of achievement through personal effort with soils, farm animals, crops and kitchen enterprizes. A very important result is that the work sets standards of achievement for young people in connection with the common duties of the farm and home life. To teach a child to earn a dollar through his own investment of time, money and energy is certainly one of the important things in connection with education. Such training will go a long way toward teaching to save or spend the money and may later prevent the common abuse or the misuse of wealth.

Club Leadership

In every state of the Union there are from four to forty people devoting all of their time to the leadership, organization and direction of the boys' and girls' agricultural and home project activities. In addition to these there are also a corps of specialists and national leaders who assist the state forces in the promotion and reinforcement of the work.

Economic support.—The state, district and county leaders are usually paid from funds obtained from a number of different sources—from the Smith-Lever Act, from the state colleges of agriculture, from the United States Department of Agriculture, from the local, county or city government, and sometimes from still other sources. Prizes, premiums and general awards used in connection with the work are not furnished by the state and federal govern-

Superintendent Sussen and Harold Stranderg—boy champion.

ments but are usually supplied by interested individuals, organizations, institutions and commercial concerns.

Relation to Schools

The relation of the boys' and girls' club work to the schools of the state and county should be similar to that of the general extension activities to the larger educational institutions. Surely the natural and legitimate extension work of the rural and village school lies in the boys' and girls' clubs. This agency is designed to translate the theories of text-book and class-room work into terms of life.

Opportunity of the school.—It is now generally conceded that it is impossible properly to teach the subjects of agriculture and home economics from text-book and class-

School corn club testing seed corn in sawdust germination boxes.

room work alone. Definite efforts therefore need to be made to help the young people put into immediate practise the truths, experiments and laboratory results, not at the end of the course, but at the end of each day's lesson. Surely then every farmer and farmer's wife will be interested in seeing that the local school makes an effort thus to correlate, through the force of club extension work, the book and class-room education with the life of the home and the farm.

Club Records

The table opposite will show something of the results that may be obtained from the boys' and girls' club work in any state. The greater the number of young people who enroll, stay in the work, and complete all of the work required by the leaders of the state, the greater the tangible results shown in this table will be.

Application of Terms Used in the Boys' and Girls' Extension Work

The federal government, together with all the state extension departments, is putting out a large amount of organization and follow-up instructions for this type of work. The following terms are used systematically in all of this printed material and it is important that the general public be familiar with the use of these terms as they are intended to be used by the leaders in charge of the work:

1. **Club Work**—Club work is an organized system of extension teaching for young people through demonstrations in the field and home. It contemplates the organization of young people into groups called clubs, for the purpose of definite work under carefully prepared projects and with adequate local leadership.

2. **An Experiment**—An experiment is an effort designed to discover principles or facts and the methods of their application.

3. **A Test**—A test is an effort to prove or disprove the

Records of Boys' and Girls' Club Work in Agriculture and Home Economics for the Year 1915, *Northern and Western States*

STATE	Total Enrollm't	Total Number Reporting to Date	Total Cost of all Club Work	Total Value of all Club Products	Leading Project	Highest Yield Per Acre	Average Yield Acre Basis	Average Net Profit Acre Basis
Connecticut	3,129	1,145	$ 4,691.43	$11,949.41	Corn	116 bu.	80 bu.	$ 57.90
					Potato	310 bu.	208.4 bu.	118.22
					Garden and Canning	4,831 lbs.*	3,231 lbs.*	51.41*
Kansas	2,045	805	3,567.08	14,228.50	Corn	98.20 bu.	58.41 bu.	23.60
					Sorghums	75.50 bu.	44.39 bu.	18.13
					Potato	432 bu.	320 bu.	160.00
Indiana	22,776	391	12,038.00	2,919.83	Potato	497 bu.	426 bu.	193.96
Idaho	7,840	184	5,780.00	49,330.50	Corn	127 bu.	62 bu.	36.65
					Potato	384 bu.	277 bu.	83.65
Vermont	1,389	607	3,000.00	4,790.97	Corn	77.72 bu.	64.74 bu.	12.61
					Potato	288 bu.	153 bu.	37.18
Arizona	440	43	2,357.00	1,322.95	Sorghum	5,049 lbs.	3,759 lbs.	106.13
Minnesota	8,110	2,902	5,305.00	97,260.00	Corn	101 bu.	30 bu.	18.00
					Potato	605 bu.	224 bu.	60.00
Wyoming	629	193	3,071.00	2,782.28	Potato	640 bu.	242 bu.	145.04
					Garden and Canning	3,320 lbs.*	576.6 lbs.*	27.27*
Montana	2,689	46	2,575.04	1,311.71	Corn	60 bu.	24 bu.	18.15
					Potato	520 bu.	254 bu.	115.04
					Garden and Canning	4,522 lbs.*	2,140 lbs.*	73.90*
South Dakota	2,486	891	2,420.24	2,280.25	Corn	81.75 bu.	38.5 bu.	8.11
					Potato	210 bu.	152.5 bu.	5.88
California	634	554	3,630.00	5,757.72	Corn	74 bu.	50 bu.	37.50
					Potato	592.5 bu.	142.6 bu.	60.00
					Alfalfa	10.3 tons	7.4 tons	24.65
Utah	24,468	1,888	3,358.68	66,942.45	Potato	646 bu.	440 bu.	132.00
					Sugar Beet	32 tons	18.5 tons	43.93
					Garden	3,030 lbs.*	1,965 lbs.*	24.00*
Massachusetts	69,306	51,295	8,791.99	--------	Poultry	822 eggs†	53.15 eggs†	.6235†
New Mexico	874	58	2,970.75	720.62	Corn	75 bu.	45 bu.	15.93
					Milo Maize	40 bu.	32 bu.	6.22
					Garden and Canning	430 lbs.*	340 lbs.*	15.75*

Total cost of all club work is the total cost to state and government from all sources.

Total value of all club products is based upon those making complete reports only.

In Illinois the Cook County Board of Education paid $8,300 of total cost for local leaders for Cook County only to supervise club work.

*Figures based on 1/10 acre plat instead of acre basis.

†Massachusetts Poultry Club work covers a period of 100 days. Figures show the rate per hen covering this period.

practical, local application of established principles and facts under a given set of conditions.

4. **A Demonstration**—A demonstration is an effort designed to show by example the practical application of an established fact. Demonstrations may be of methods or of results.

5. **Field Meeting**—A field meeting is a gathering of young

Boys and girls bringing corn to school for judging and testing in a Cook County rural school.

people for the purpose of observing, discussing, and studying the progress or results of a definite field demonstration.

6. **Club Visit.**—A club visit is a personal call by state, district, or local club leader to the club group or club meeting, which may be held in the home, school, club room, court-house or other convenient place.

7. **Club Project**—A club project is the particular home work of field, garden, etc., to be undertaken by the entire club group.

8. **Home Project**—A home project is the individual work

undertaken by each club member at home, as part of the club project or work of the group.

9. **Contest**—A contest is a competitive phase of the club work, in which club members measure themselves and their work by a common standard, called a basis of award.

10. **Club Festival**—A club festival is an organized part of the club work and has reference to the organized activities of a single day, on which members exhibit products, demonstrate

Apple Club boys pruning orchard under direction of county agent, Cortland County, New York.

methods, hold related plays and other program features, for the purpose of arousing interest and creating enthusiasm for the work.

11. **Basis of Award**—The basis of award is a standard of measurement, outlined for the convenience of leaders in determining the achievement, grade, or standing of a club member, and is used for both the awarding of school credits for club work and the awarding of prizes, medals, diplomas, etc.

12. **Score-Card**—A score-card is a standard of measurement employed for use in judging work to determine the quality

of products, animals, grains, and articles produced in connection with the boys' and girls' club work.

13. **Agricultural Club**—An agricultural club is a club of young people organized for systematic instruction, for the purpose of developing the efficiency of its members in all general agricultural subjects and country life interests.

14. **Follow-up Instructions**—Follow-up instruction is the especially prepared, typewritten, multigraphed, or printed directions, and subject-matter directions prepared for club members,

Selecting seed corn.

and may deal with both the club group work and the subject-matter instructions for the individual home projects.

15. **Follow-up Work**—Follow-up work is the term used to denominate the different efforts, activities, and organization which seeks to aid, from time to time, the club group or individual member upon the plot in connection with the work, for the purpose of showing definite and concrete results at the close of the year.

16. **Specialist in Club Work**—A specialist in club work is an individual who has been assigned to extension teaching in boys' and girls' club work on a particular subject, and who,

as a rule, deals with subject matter and not the general organization work.

17. **Local Leader**—The local leader in boys' and girls' club work is the one who has been selected by the State, district, or county leader for the purpose of looking after the local group of club members, meeting with them at their regular meetings, holding field meetings and demonstrations, visiting their club plots and home project work, and in other ways representing the state agent in the conduct of the work. This person may be a paid or volunteer leader.

18. **Club Program**—A club program is a definitely outlined series of activities required of club members, club groups and club leaders, for a given season or year.

19. **Club Plot**—A club plot is a piece of ground required as the unit or acreage upon which the home project and field work is to be performed.

20. **Club Unit**—The club unit is the outlined unit of work and refers to quantity or measurement of projects that can not be estimated in terms of acreage and yield.

21. **Completed Project**—A completed project is an expression used in boys' and girls' club extension work to indicate that a club leader, club group or club member has worked out the entire program and fulfilled all requirements of the leaders in charge of the work including attendance at meetings, growing of the crop, harvesting, marketing, making exhibits and submitting a properly filled out, signed, and attested crop report to the leader in charge at the end of season or year.

CHAPTER XLV

PHYSICAL HEALTH AND EFFICIENCY

NO question of farm administration is more important to the farmer than the health of himself and his family. Good health underlies all satisfaction, happiness and success. Sickness not only causes worry, but results in a more or less permanently lowered standard of efficiency. It shortens life and is expensive from every point of view. Every normal person wants to live long and be strong and vigorous while living. None would knowingly manage his life or work so as to shorten his years or produce invalidism as the result.

The cost of sickness.—A person who is ill on an average of one day a month and requires the attention of some member of the family to take care of him, with perhaps a call from the doctor can figure on at least five dollars outlay in loss of time and labor, doctor's bills and medicine. This for one year would aggregate sixty dollars, and for a family of five, three hundred dollars a year of actual outlay. While one may not realize this much loss because of our common habit of counting but our doctor's bills and the medicine when we are sick, yet time is money and a day spent in bed in place of the field is so much income lost. If, however, one is not ill to the extent of requiring medical attention or of being obliged to go to bed, but is only feeling out of sorts and incapable of doing his best work, he may not think to count the financial loss at all. But the fact, of course, is that one who is working up to but half of his physical efficiency is in fact losing half of his time and therefore half of the wage that he should earn.

No small part of the planning and the care of the home should, therefore, be given to matters of hygiene and physical health and its consequent efficiency. This will pay in dollars and cents, in happiness, satisfaction, long life and the ultimate success of every member of the family.

Rural Health and Hygiene

For many reasons the country should be more healthful than the city, yet our medical authorities and students of public health and efficiency are coming to doubt whether the greater part of our farm population live under as good hygienic conditions as the industrial workers of equal financial rating in towns and cities. There is more than a suspicion that farmers and their wives have a tendency to age earlier than is necessary, and in spite of the rush and tumult of the cities it is found that disease is as prevalent in rural as in urban districts. It is a notable fact that many of the preventable diseases year after year show a higher mortality rate in the country than in towns. With all of the country's natural advantages over the city, our health statistics while far from complete, reveal approximately as high a death rate for rural communities as for the cities, with all our bad housing conditions in certain sections of cities and with a greater danger of contagion because of multitudes living close together.

Death toll from preventable diseases.—The result of these easily remedied unhygienic conditions is measured in the annual loss of more than eighty thousand of our rural population through the ravages of tuberculosis; of nearly sixty thousand through intestinal troubles other than typhoid; of fifty-five thousand through various forms of colds; of fifty thousand through pneumonia; of sixteen thousand through typhoid; and so in less numbers through diphtheria, scarlet fever and other such diseases. Here, then, is one of the greatest lines open to good farm and home management—to provide and plan for better living that life may be longer, health and happiness greater, and physical efficiency more perfect.

Factors Bearing on the Health of the Farm

A few illustrations will show some of the practical directions that may be taken in securing for the farmer and his family better hygienic conditions.

Water.—Careful studies of the water supply in a large number of wells in various parts of the country have convinced experts in these matters that approximately sixty per cent. of the farm wells are polluted by house and barnyard drainage. Not only is the thought of drinking this seepage revolting, but it is a well-known fact that all such drainage contains bacteria, many species of which are detrimental to health and vitality even where they do not produce actual disease. A large proportion of cases of disentary, summer complaints and other forms of digestive derangements are directly traceable to the bacterial element in water, milk and other food. It hardly need be argued that intelligent farm management should relieve the family of all such danger to health and life. Any other point of view indicates a degree of carelessness inexcusable in the light of present-day knowledge on matters of hygiene and public health.

Milk.—It is natural and right that the farm family should use a greater proportion of milk in their diet than any other people. Farm children especially should be supplied with an abundance of fresh pure milk and use less of tea and coffee. Yet it is beyond question as proved by thousands of tests that milk is being constantly used without pasteurizing from tubercular cows, thus exposing the children of the farm family to the danger of this dread infection at an age when they are most susceptible to its ravages. A large proportion of the milk now sold in the cities has been pasteurized, or otherwise rendered sterile to the dangerous forms of bacteria so easily transmitted through milk. With the tuberculin tests easily available to every farmer, and with the possibility of simply and easily pasteurizing the milk at home for the table, it would seem that we should not endanger health and life for want of either *enterprise* or care to make certain of the purity of the milk supply.

Ventilation.—Not uncommonly the air breathed in our farm homes during the winter months is impure because of inadequate ventilation. Windows are sometimes stuck or nailed fast that should be opened and sleeping rooms that should be freely aired are left entirely closed to shut out the cold. Cold air is often thought to be pure air and the outer atmosphere is carefully shut from sleeping rooms when we should permit a free circulation of air within. It is undoubtedly the lack of ventilation in our homes that causes so large a crop of pneumonia cases late in the winter and during the early spring of each season. When we come to realize that one does not "catch cold," that he does not "take" pneumonia, but that the cold and pneumonia germs are always present in some degree in our system, only to get the better of us and give us colds or pneumonia when our vitality is exhausted and when we are run down from lack of pure air, sleep, rest and unhygienic conditions, then we shall seek the causes resulting in this lowered vitality and so escape the ravages of disease.

Drainage.—Farm cellars are not infrequently damp and improperly drained. The musty and "close" smell so often recognized as one comes into the house out of the open air indicates a condition that requires immediate remedy if we are to escape physical danger. Especially should the housewife, the greater part of whose work is in the house, not be subjected to the impurities always to be found in air of this sort. Cellar drains are inexpensive and concrete can easily be used to make the cellar walls and floor as clean and sweet as those of the upper stories. Windows can be put through the foundation walls admitting sunshine and fresh air to the basement, so that it may be as habitable as any room in the house. Such matters are only questions of enterprise and administrative ability and do not require any considerable outlay of money.

The Farm Table

The farm is the source of all food supply and furnishes town and city homes as well as farm homes with all that goes on the table. There is every reason, therefore, why the farmer's table should be the most bountiful and hygienic table to be found anywhere. American farmers particularly do not stint their table. They have enough to eat and may be said to live well.

Need of varied diet.—Yet many farm tables could be greatly improved by increasing the variety of the foods available. Especially does every person need an abundance of vegetables and fruits as a regular part of the dietary. Every day in the year should see the farm table supplied with an abundance of vegetables and fruits, whether in the winter months or during the growing season. Many of our tables, however richly supplied with "green stuff" during the summer months, are relatively destitute of any wide range or variety of these important foods during the winter and spring. And these are the times, because of the strain of the severe cold in the more northern regions and because of the more sedentary life lived by many families in the winter season, that we most need the effects of vegetables and fruit diet to maintain our health and vitality.

Contribution of garden and orchard.—Good farm management will, therefore, provide plenty of garden and orchard products for the home table. This will pay abundantly even when there is no attempt to market truck crops for profit. Equipment, and help when necessary, should be supplied in the home for the canning of an abundance of these foods to have throughout the entire year so that there may be no shortage or scrimping during the winter months. Attention given in these directions will not only render the diet more palatable, but will tend greatly to reduce doctor's bills and increase physical efficiency.

Farm Sanitation and Flies

The elimination of flies is one of the greatest of sanitation problems in the farm home, for wherever there is refuse left to decay, there flies will propagate and multiply. So rapidly is the process of generation with these pests that the progeny of a single pair by the end of a season results in millions of offspring.

Danger from flies.—Flies are a nuisance from every point of view. They are dirty. They are born and bred in filth and live chiefly on manure and other refuse. Many of them are domestic in their tastes and seek the house, helping themselves to the food which comes to our table, sipping from the cups of milk before the children get their drink, cleaning their filth-laden feet upon our bread or our pastry and finally drowning themselves if they are not watched, in our coffee or soup. Flies carry disease. The bacteria which transmit typhoid fever are so small that many thousands can be carried by a single fly, and enough distributed by one trip to a piece of food to give one or two members of the family the disease.

Flies are a source of no small loss in the production of meat, milk and butter. They torment animals and cause a large part of the energy and food supply that should go to the production of flesh or milk to be expended in fighting flies. Flies annoy horses, causing them to fret and adding greatly to the strain and burden of the day's work, thereby causing loss of flesh and reducing the working efficiency of the animals.

Getting rid of flies.—There are two remedies for flies, the first and most effective is not to raise them. This, the authors appreciate, is more easily prescribed than accomplished under practical farm conditions, and yet much can be done on any farm to eliminate the breeding places of flies. Since it takes from one to two weeks, depending on temperature and other conditions, for flies to hatch, it is evident that if all manure and filth which are the essentials of fly production should be removed every few days and not allowed to accumulate, flies would then cease to exist for the simple reason that they could not be hatched.

But when flies exist around the barns and house, recourse must be had to screens and traps. The farm-house should be thoroughly screened as a protection against flies and mosquitoes. Traps can easily be made or purchased very cheaply, which if properly used will practically eliminate the fly pest about the farm-house. Such small matters and foresight do not demand the outlay of money and therefore are to be solved upon the basis of administrative ability and enterprise.

Recreation and Health

Health and happiness on the farm as anywhere else demand opportunity for relaxation and recreation. The farmer must occasionally have something more recreative and restful than the alternation of the day's work with the nightly chores. The farm wife must now and then have an opportunity to meet other people than those for whom she cooks and sews. The young people of the farm have as strong a desire for recreation and amusement as their city cousins. The social impulse in farm boys and girls is natural and right, and must have opportunity for its proper expression, if development is to be normal and if the desires are not to be turned away from the farm and toward the city or town. All work and no play will result in dulness on the farm as anywhere else. The farm can never hope to hold its boys and girls permanently to rural life unless it recognizes the necessity for a reasonable amount of freedom from labor and of opportunity for social mingling and the fun and frolic that belongs to youth and in this way lightens many heavy burdens of farm and home life.

Need of the holiday.—There are busy times on the farm, to be sure, when "a day off" is not to be thought of. Every member of the family loyal to the farm interests will be found in his or her place doing the utmost to finish planting the crop or to gather the harvest on time. But when the rush is past and the press of the season is over, relaxation must come. The home games, neighborhood parties, lectures, chautauquas, entertainments, short courses, club meetings, and athletic events are as much a part of good farm management in a community as the selecting of the breeds of live stock, the planning of rotation of crops, or the administration of the activities of the farm.

Planning for efficiency.—In order to live a life of high physical efficiency, therefore, certain social and recreational laws must be followed; the farm home must be carefully organized with all these values in view. Its food supply must be abundant and well selected to provide a nutritious and balanced ration for each member of the family. The air breathed must be pure and free from taint at all times during the day and night and during every season, winter as well as summer. The water and milk supply must be carefully guarded that no danger can come from these sources. Flies and other insect pests must be reduced to the lowest possible minimum. The labor of the farm, intense and exhausting as it often is, must find relief in the relaxation of social mingling, athletic games and harmless amusements of every good sort. The supplying of these conditions is an important part of good farm management.

CHAPTER XLVI

MISCELLANEOUS INFORMATION

How to Remove Stains

Iron rust.—Apply salt and lemon juice to the dampened spots. Place in the sun or near the fire. Then rinse or wash thoroughly.

Burned cooking utensils.—To clean granite wares where mixtures have been burned on the surface, fill container half full of water, add good soap, washing powder, or baking soda. Bring water to a boiling point and scrub with a small brush.

Tea, coffee or cocoa.—Wash with cold water, pour glycerine over spots and let stand for a few hours. Then wash with cold water and hard soap. If stains are fresh, pour over the stains boiling water from a height of four or five feet, after soaking.

Blood.—Wash in warm water until stain disappears. Use ammonia to assist in dissolving the blood. Rub with naptha soap and soak in warm water.

If heavy or new goods, as a new blanket, make a paste of raw starch and warm water. Spread on stain, and as fast as starch is discolored, make a new application.

Bluing.—1. Wash in boiling water. Boiling will draw out the spots of blue formed from imperfect bluing. Vinegar or dilute acid will assist, if necessary. This is effective for pale and black blues.

2. Apply Javelle, and follow immediately with boiling water. Thorough rinsing will prevent Javelle from affecting fiber. A yellow cast may remain if the bluing has been an iron compound. This yellow cast or these spots may be taken out as iron rust. (See iron rust.)

Chocolate.—Cover with borax, wash with cold water. Boiling water will remove trace of stain.

Coffee.—Spread stained part over a bowl, pour boiling water on it from a height so as to strike the stain with force. Covering the spot with glycerine or borax will often assist in removing a stubborn stain.

As a last resort, Javelle water may be used.

Cream.—Wash in cold water, then in warm water and soap. Remove as grease.

Ink.—1. Moisten with salt and lemon juice, lay in the sun.

2. Apply a few drops of oxalic or hydrochloric acid, follow with a few drops of Javelle, and rinse quickly with boiling water.

3. Apply ammonium sulphide, wash with water, then wash with very dilute hydrochloric acid. Can be successfully used on colors.

Printers' ink.—1. Spread stained portion over a bowl containing one quart of water and one teaspoon of borax. Apply acid, drop by drop until stain brightens, then dip stain at once into water. If not removed use same method until stain disappears. Care should be taken to use either borax or ammonia in rinsing water.

2. Sprinkle stain with salt and moisten with lemon juice; lay in the sun. This method is slower and less likely to affect material. Either method will extract color.

Milk.—Wash in cold water, then follow with soap.

Mucus.—Mucus as found on handkerchiefs may be soaked in salt and water, then wash in warm water with ammonia or with soap.

Paint.—1. If paint is fresh, use at once soap and water if goods are washable.

2. Wash the spot in gasoline, turpentine or benzine, remembering that they are inflammable and should not be near fire or lamplight.*

Varnish.—Wet the stain with alcohol or turpentine and allow it to stand a few minutes, then wet again and sponge off with a clean cloth. Continue this until stain is removed. In case the color is affected by alcohol, sponge with chloroform; but for blue material use diluted vinegar.

Vaseline.—Wash a fresh vaseline stain with turpentine. Soaking may aid the removal. Stain can not be removed after it has been boiled.

Wagon grease.—Rub either oil or lard on stain, then wash with warm water and soap. It will be found of help to keep a cloth or blotter under stain while rubbing on the oil.

Wax.—Scrape off all that is possible, then place blot-

*Old stains may be softened first with lard, oil, kerosene, before using any of the remedies.

ting paper over spot and press with warm iron. This will soften wax and cause it to be absorbed by the paper. If there is color, as from colored candle wax, use alcohol to extract color after removing wax. Javelle may be needed to bleach the color.

Fruit.—1. Spread stained part over a bowl, pour boiling water on it from several feet above so as to strike the stain with force. Borax will assist in removing stubborn stains.

2. Use Javelle solution and boiling water in equal quantities and immerse stained portion, allowing it to soak a few minutes, then rinse thoroughly with boiling water. This is best for peach stains, if alcohol fails.

3. Borax and ammonia may be used instead of Javelle which destroys woolen, silks and colors.

4. Apply a few drops of oxalic acid. Rinse well with hot water.

Grass.—1. Wash a fresh stain with cold water without soap, rub with molasses, let stand a few minutes. Wash out in warm water.

2. Alcohol or ether will dissolve the green coloring matter when material can not be washed.

Grease (oil).—1. Wash in warm water and soap. Remove traces of grease stains by bleaching with Javelle, (For white cottons and linens.)

2. For delicate fabrics, apply ether, alcohol or benzine with a cloth, preferably of the same material, rubbing the stain lightly until all the reagent has evaporated. (These reagents are inflammable.)

3. A mixture of equal quantities of acetone and benzote with Fuller's earth may be used without fear of water rings appearing or of changing color. Apply the powder to the stain and let stand several hours, then brush off lightly.

Machine oil.—1. Wash in soap and cold water.

2. Rub stain with turpentine.

Mildew.—1. If the mildew is very fresh, and has not attacked the fiber, it will wash out in cold water.

2. Apply potassium permanganate, then wash with warm water, use oxalic acid and then wash.

3. Apply Javelle, then wash with hot water.

Perspiration.—1. Wash in warm water and soap, and if cotton or linen, place in sun to dry. (For white washables.)

2. Javelle water may be used for cottons and linens according to directions for white goods given above.

3. Apply a dilute solution of sodium hydrosulphite and wash in water. To remove perspiration stains from colored goods with anything other than soap and water, means in most cases, removing color. Redyeing is the final remedy. The odor may be removed by chloroform.

Scorch.—1. For cottons and linens, hang in sunlight, and slight scorch will be removed.

2. Wash in soap and water and place in sun. Scorch on woolens and silks means that the fiber is destroyed.

Shoe polish.—1. Use lard or grease, rubbing in well, then wash in warm water with soap. (For black paste.)

2. Use hydrochloric acid and ammonia alternately. Wash with soap and warm water. (For bronze.)

3. Use oxalic acid and ammonia alternately. Then wash with soap and warm water. (For tan.)

Quantity of Seed to Sow Per Acre

Alfalfa (broadcast)	15	to	20	lb.
Alfalfa (drilled)	12	to	16	lb.
Artichoke, Jerusalem	6	to	8	bu.
Barley	8	to	10	pk.
Bean, field, small varieties	2	to	3	pk.
Bean, field, large variety	5	to	6	pk.
Beet	4	to	6	lb.
Brome grass	12	to	15	lb.
Broom corn			3	pk.
Buckwheat	3	to	5	pk.
Bur Clover			12	lb.
Carrots (for stock)	4	to	6	lb.
Clover, alsike	8	to	15	lb.
Clover, Japan			12	lb.
Clover, mammoth	12	to	15	lb.
Clover, red (on small grain in spring)	8	to	10	lb.
Clover, sweet	8	to	10	lb.
Clover, white	4	to	6	lb.
Clover, crimson	10	to	12	lb.
Corn	5	to	9	lb.
Cotton	1	to	3	bu.
Cow-pea	1	to	1½	bu.
Cow-pea (drilled with corn)	½	to	1	bu.
Cow-pea (for seed)			3	pk.
Field pea, small varieties			2½	bu.
Field pea, large varieties	3	to	3½	bu.
Flax (for seed)	2	to	3	pk.
Flax (for fiber)	1½	to	2	bu.
Hemp (broadcast)	3½	to	4	pk.
Hungarian grass (for hay)			2	pk.
Johnson grass	1	to	1½	bu.
Kafir (drilled for grain)	5	to	8	lb.

Kafir (for fodder)	50	to	70	lb.
Kale	2	to	4	lb.
Lupine	1½	to	2	bu.
Mangel	5	to	8	lb.
Millet, barnyard (drilled)	1	to	2	pk.
Millet, German (for seed)	2	to	3	pk.
Millet, pearl (for hay)	8	to	10	lb.
Milo	4	to	6	lb.
Oat grass, tall			30	lb.
Oats	2	to	3	bu.
Orchard grass	12	to	15	lb.
Parsnips	4	to	8	lb.
Pop corn			3	lb.
Potato, Irish	10	to	14	bu.
Potato, Irish (cut to one or two eyes)	6	to	9	bu.
Rape (drilled)	2	to	4	lb.
Rape (broadcast)	4	to	8	lb.
Redtop, recleaned	12	to	15	lb.
Rice	1	to	3	bu.
Rutabaga	3	to	5	lb.
Rye	3	to	4	pk.
Rye grass	2	to	3	bu.
Sorghum (forage, broadcast)	1½	to	2	bu.
Sorghum (for seed or sirup)	2	to	5	lb.
Sorghum, saccharine (for silage or soiling, drilled)	6	to	½	bu.
Soy-bean (drilled)	2	to	3	pk.
Soy-bean (broadcast)	1	to	1½	bu.
Sugar beets	15	to	20	lb.
Sugar cane	4 tons of cane			
Sunflower	10	to	15	lb.
Timothy	15	to	25	lb.
Timothy and clover (timothy)			10	lb.
(clover)			4	lb.
Turnip (broadcast)	2	to	4	lb.
Turnip (drilled)			1	lb.
Velvet bean	1	to	4	pk.
Vetch, hairy (drilled)			1	bu.
Vetch, hairy (broadcast)	1	to	1½	bu.
Wheat	3	to	9	pk.

Commodities for Which Bushel Weights Have Been Widely Adopted.

	Alfalfa seed	Apples	Barley	Beans	Beets	Blue-grass seed	Bran	Buckwheat	Shelled corn	Corn meal	Corn in ear, husked	Clover seed	Oats	Onions	Wheat
U. S.	...	...	48	...	...	...	...	42	...	48	...	...	32	...	60
Ala.	...	...	47	60	...	...	...	...	56	...	70	...	32	...	60
Ariz.	...	...	45	55	...	...	...	...	...	...	...	...	32	...	60
Ark.	...	50	48	60	...	14	20	52	56	48	70	60	32	57	60
Cal.	...	...	50	...	...	...	...	40	...	...	...	...	32	...	60
Colo.	...	...	48	60	...	14	...	52	...	50	70	60	32	57	60
Conn.	...	48	48	60	60	...	20	48	...	50	...	60	32	52	60
Del.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	60
D. C.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Fla.	...	48	48	60	...	...	20	...	56	48	...	...	32	56	60
Ga.	...	...	47	60	...	14	20	52	56	48	70	60	32	57	60
Hawaii	...	...	48	...	...	...	...	...	...	...	...	...	32	...	60
Idaho	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ill.	...	...	48	60	...	14	20	52	56	48	70	60	32	57	60
Ind.	...	...	48	60	...	14	...	50	56	50	...	60	32	48	60
Iowa	60	48	48	60	56	14	20	52	56	50	70	60	32	57	60
Kans.	60	48	48	60	56	14	20	50	56	...	70	60	32	57	60
Ky.	...	...	47	60	...	14	20	56	56	50	...	60	32	57	60
La.	...	...	48	...	...	...	...	...	...	...	...	...	...	...	60
Me.	...	44	48	60	60	...	...	48	...	50	...	...	32	52	60
Md.	60	...	48	60	...	14	20	...	56	48	70	60	32	57	60
Mass.	...	48	48	60	60	...	20	48	50	50	...	60	32	52	60
Mich.	...	48	48	60	...	14	...	48	56	50	70	60	32	54	60
Minn.	...	50	48	60	50	14	...	50	56	...	70	60	32	52	60
Miss.	...	..	48	60	...	14	20	48	56	48	72	60	32	57	60
Mo.	...	48	48	60	...	14	20	52	56	50	...	60	32	57	60
Mont.	...	45	48	60	50	14	20	52	56	50	70	60	32	57	60
Nebr.	60	48	48	60	...	14	20	52	56	50	70	60	32	57	60
Nev.	60	48	48	60	56	...	20	50	56	48	...	60	32	57	60
N. H.	...	48	48	...	60	...	20	48	...	50	...	60	32	52	60
N. J.	...	50	48	60	60	...	...	50	...	...	...	64	30	57	60
N. Mex.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
N. Y.	...	48	48	60	...	...	20	48	...	50	...	60	32	57	60
N. C.	60	48	48	60	...	14	...	50	...	48	70	60	32	57	60
N. Dak.	...	50	48	60	60	...	20	42	56	...	70	60	32	52	60
Ohio	...	50	48	60	56	...	...	50	56	...	68	60	32	55	60
Okla.	60	48	48	60	60	14	20	52	56	50	70	60	32	57	60
Oreg.	...	45	46	...	...	...	...	42	...	...	...	60	32	...	60
Pa.	...	...	47	...	...	...	...	48	...	...	...	60	32	50	60
R. I.	...	48	48	60	50	...	20	48	56	50	70	60	32	50	60
S. C.	...	...	...	...	...	...	...	...	...	48	...	...	...	...	...
S. Dak.	...	...	48	60	60	...	20	42	56	...	70	60	32	52	60
Tenn.	...	50	48	60	50	14	20	50	56	...	70	60	32	56	60
Tex.	...	45	48	60	...	...	20	42	56	...	70	60	32	57	60
Utah	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Vt.	...	46	48	62	60	...	...	48	...	...	...	60	30	52	60
Va.	...	...	48	60	...	14	...	52	56	50	70	60	32	57	60
Wash.	...	45	48	...	...	...	...	42	...	...	...	60	32	...	60
W. Va.	...	...	48	60	...	...	...	52	...	...	...	60	32	...	60
Wis.	...	50	48	60	50	...	20	50	...	50	...	60	32	57	60
Wyo.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Gardener's Planting Table

Brackets indicate that a late or second crop may be planted the same season.

Kind of vegetable.	Seeds or plants required for 100 feet of row.	Distance for plants to stand— Rows apart. Horse cultivation.	Rows apart. Hand cultivation.	Plants apart in rows.	Depth of planting.	Time of planting in open ground. South.	Time of planting in open ground. North.	Ready for use after planting.
Artichoke, Globe	½ ounce	3 to 4 ft.	2 to 3 ft.	2 to 3 ft.	1 to 2 in.	Spring	Early spring	15 months.
Artichoke, Jerusalem	2 qts. tubers	3 to 4 ft.	1 to 2 ft.	1 to 2 ft.	2 to 3 in.	Spring	Early spring	6 to 8 months.
Asparagus, seed	1 ounce	30 to 36 in	1 to 2 ft.	3 to 5 in.	1 to 2 in.	Autumn or early spring	Early spring	3 to 4 years.
Asparagus, plants	60 to 80 plants	3 to 5 ft.	12 to 24 in.	15 to 20 in.	3 to 5 in.	Autumn or early spring	Early spring	1 to 3 years.
Beans, bush	1 pint	30 to 36 in.	18 to 24 in.	5 or 8 to ft.	½ to 2 in.	February to April. [August to September.]	April to July	40 to 65 days.
Beans, pole	½ pint	3 to 4 ft.	3 to 4 ft.	3 to 4 ft.	1 to 2 in.	Late spring	May and June	50 to 80 days.
Beets	2 ounces	24 to 36 in.	12 to 18 in.	5 or 6 to ft.	1 to 2 in.	February to April. [August to September.]	April and August	60 to 80 days.
Brussels sprouts	¼ ounce	30 to 36 in.	24 to 30 in.	16 to 24 in.	½ in.	January to July	May and June	90 to 120 days.
Cabbage, early	¼ ounce	30 to 36 in.	24 to 30 in.	12 to 18 in.	½ in.	October to December	March and April. (Start in hotbed during February.)	90 to 130 days.
Cabbage, late	¼ ounce	30 to 40 in.	24 to 36 in.	16 to 24 in.	½ in.	June and July	May and June	90 to 130 days.
Cardoon	½ ounce	3 ft.	2 ft.	12 to 18 in.	1 to 2 in.	Early spring	April and May	5 to 6 months.
Carrot	1 ounce	30 to 36 in.	18 to 24 in.	6 or 7 to ft.	½ in.	March and April. [September.]	April to June	75 to 110 days.
Cauliflower	¼ ounce	30 to 36 in.	24 to 30 in.	14 to 18 in.	½ in.	January and February. [June.]	April to June. (Start in hot bed during February or March.)	100 to 130 days.
Celeriac	¼ ounce	30 to 36 in.	18 to 24 in.	4 or 5 to ft.	⅛ in.	Late spring	May and June. (Start in cold-frame during April.)	100 to 150 days.
Celery	¼ ounce	3 to 6 ft.	18 to 36 in.	4 to 8 in.	⅛ in.	August to October	May and June. (Start in hot-bed or cold-frame during March or April.)	120 to 150 days.
Chervil	1 ounce	30 to 36 in.	18 to 24 in.	3 or 4 to ft.	1 in.	Autumn	Autumn	1 year.
Chicory	¼ ounce	30 to 36 in.	18 to 24 in.	4 or 5 to ft.	½ in.	March and April	May and June	5 to 6 months.
Citron	1 ounce	8 to 10 ft.	8 to 10 ft.	8 to 10 ft.	1 to 2 in.	March and April	May and June	100 to 130 days.
Collards	¼ ounce	30 to 36 in.	24 to 30 in.	14 to 18 in.	½ in.	May and June	Late spring	100 to 120 days.
Corn salad	2 ounces	30 in.	12 to 18 in.	5 or 6 to ft.	½ to 1 in.	January and February. [September and October.]	March to September	60 days.
Corn, sweet	¼ pint	36 to 42 in.	30 to 36 in.	30 to 36 in.	1 to 2 in.	February to April	May to July	60 to 100 days.
Cress, upland	½ ounce	30 in.	12 to 18 in.	4 or 5 to ft.	½ to 1 in.	January and February. [Autumn.]	March to May. [September.]	30 to 40 days.
Cress, water	½ ounce	Broadcast			On surface.	Early spring	April to September	60 to 70 days.
Cucumber	½ ounce	4 to 6 ft.	4 to 6 ft.	4 to 6 ft.	1 to 2 in.	February and March. [September.]	April to July	60 to 80 days.
Dandelion	¼ ounce	30 in.	18 to 24 in.	8 to 12 ft.	½ in.	Early spring or autumn	Early spring	6 to 12 months.

Eggplant	1/3 ounce	30 to 36 in.	24 to 30 in.	18 to 24 ft.	½ to 1 in.	February to April	April and May. (Start in hotbed during March.)	100 to 140 days.
Endive	1 ounce	30 in.	18 in.	8 to 12 in.	½ to 1 in.	February to April	April. [July.]	90 to 180 days.
Horse-radish	70 roots	30 to 40 in.	24 to 30 in.	14 to 20 in.	3 to 4 in.	Early spring	Early spring	1 to 2 years.
Kale, or borecole	¼ ounce	30 to 36 in.	18 to 24 in.	18 to 24 in.	½ in.	October to February	August and September. [March and April.]	90 to 120 days.
Kohl-rabi	¼ ounce	30 to 36 in.	18 to 24 in.	4 to 8 in.	½ in.	September to March	March to May	60 to 80 days.
Leek	½ ounce	30 to 36 in.	14 to 20 in.	4 to 8 in.	1 in.	May to September	March to May	120 to 180 days.
Lettuce	½ ounce	30 in.	12 to 18 in.	4 to 6 in.	½ in.	September to March	March to September	60 to 90 days.
Melon, muskmelon	½ ounce	6 to 8 ft.	6 to 8 ft.	Hills 6 ft.	1 to 2 in.	February to April	April to June. (Start early plants in hotbed during March.)	100 to 150 days.
Melon, watermelon	1 ounce	8 to 12 ft.	8 to 12 ft.	Hills 10 ft.	1 to 2 in.	March to May	May and June	100 to 120 days.
Mustard	¼ ounce	30 to 36 in.	12 to 18 in.	4 or 5 to ft.	¼ in.	Autumn or early spring	March to May. [September.]	60 to 90 days.
New Zealand spinach	1 ounce	36 in.	24 to 36 in.	12 to 18 in.	1 to 2 in.	Early spring	Early spring	60 to 100 days.
Okra, or gumbo	2 ounces	4 to 5 ft.	3 to 4 ft.	24 to 30 in.	1 to 2 in.	February to April	May and June	90 to 140 days.
Onion, seed	1 ounce	24 to 36 in.	12 to 18 in.	4 or 5 to ft.	½ to 1 in.	October to March	April and May	130 to 150 days.
Onion, sets	1 quart of sets	24 to 36 in.	12 to 18 in.	4 or 5 to ft.	1 to 2 in.	Early spring	Autumn and February to May.	90 to 120 days.
Parsley	¼ ounce	24 to 36 in.	12 to 18 in.	3 to 6 in.	⅛ in.	September to May	September and early spring.	90 to 120 days.
Parsnip	½ ounce	30 to 36 in.	18 to 24 in.	5 or 6 to ft.	½ to 1 in.		April and May	125 to 160 days.
Peas	1 to 2 pints	3 to 4 ft.	30 to 36 in.	15 to ft.	2 to 3 in.	September to April	March to June	40 to 80 days.
Pepper	⅛ ounce	30 to 36 in.	18 to 24 in.	15 to 18 in.	½ in.	Early spring	May and June. (Start early plants in hotbed during March.)	100 to 140 days.
Physalis	⅛ ounce	30 to 36 in.	18 to 24 in.	18 to 24 in.	½ in.	March to May	May to June	130 to 160 days.
Potato, Irish	5 lbs. (or 9 bu. per acre).	30 to 36 in.	24 to 36 in.	14 to 18 in.	4 in.	January to April	March to June	80 to 140 days.
Potato, sweet	3 lbs. (or 75 slips).	3 to 5 ft.	3 to 5 ft.	14 in.	3 in.	April to May	May and June. (Start plants in hotbed during April.)	140 to 160 days.
Pumpkin	½ ounce	8 to 12 ft.	8 to 12 ft.	Hills 8 to 12 ft.	1 to 2 in.	April and May	May to July	100 to 140 days.
Radish	1 ounce	24 to 36 in.	12 to 18 in.	8 to 12 to ft.	½ to 1 in.	September to April	March to September	20 to 40 days.
Rhubarb, seed	½ ounce	36 in.	30 to 36 in.	6 to 8 in.	½ to 1 in.		Early spring	2 to 4 years.
Rhubarb, plants	33 plants	3 to 5 ft.	3 to 5 ft.	3 ft.	2 to 3 in.		Autumn or early spring	1 to 3 years.
Ruta-baga	¼ ounce	30 to 36 in.	18 to 24 in.	6 to 8 in.	½ to 1 in.	August and September	May and June	60 to 80 days.
Salsify	1 ounce	30 to 36 in.	18 to 24 in.	2 to 4 in.	½ to 1 in.		Early spring	120 to 180 days.
Spinach	1 ounce	30 to 36 in.	12 to 18 in.	7 or 8 to ft.	1 to 2 in.	September to February	September or very early spring	30 to 60 days.
Squash, bush	½ ounce	3 to 4 ft.	3 to 4 ft.	Hills 3 to 4 ft.	1 to 2 in.	Spring	April to June	60 to 80 days.
Squash, late	½ ounce	7 to 10 ft.	7 to 10 ft.	Hills 7 to 9 ft.	1 to 2 in.	Spring	April to June	120 to 160 days.
Tomato	⅛ ounce	3 to 5 ft.	3 to 4 ft.	3 ft.	½ to 1 in.	December to March	May and June. (Start early plants in hotbed during February and March.)	100 to 140 days.
Turnip	½ ounce	24 to 36 in.	18 to 24 in.	6 or 7 to ft.	¼ to ½ in.	August to October	April [July]	60 to 80 days.
Vegetable marrow	½ ounce	8 to 12 ft.	8 to 12 ft.	Hills 8 to 9 ft.	1 to 2 in.	Spring	April to June	110 to 140 days.

Location of Colleges of Agriculture, Extension Departments and Experiment Stations

Letters addressed to any of these institutions, requesting information on agriculture or home economics subjects will be answered with courtesy. Help will be rendered or farm bulletins supplied when possible.

STATE	College of Agriculture	Extension Department	Experiment Station
Alabama	Auburn	Auburn	Auburn Uniontown (Sub.) Tuskegee (negro)
Arizona	Tucson	Tucson	Tucson
Arkansas	Fayetteville	Fayetteville	Fayetteville
California	Berkeley	Berkeley	Berkeley
Colorado	Fort Collins	Fort Collins	Fort Collins
Connecticut	Storrs	Storrs	Storrs New Haven
Delaware	Newark	Newark	Newark
Florida	Gainesville	Gainesville	Gainesville
Georgia	Athens	Athens	Experiment
Hawaii	Honolulu	Honolulu	Honolulu
Idaho	Moscow	Boise	Moscow
Illinois	Urbana	Urbana	Urbana
Indiana	Lafayette	Lafayette	Lafayette
Iowa	Ames	Ames	Ames
Kansas	Manhattan	Manhattan	Manhattan
Kentucky	Lexington	Lexington	Lexington
Louisiana	Baton Rouge New Orleans	Baton Rouge New Orleans	Baton Rouge Auburn Park (brch.) Calhoun (branch) Crowley (branch)
Maine	Orono	Orono	Orono
Maryland	College Park	College Park	College Park
Massachusetts	Amherst	Amherst	Amherst
Michigan	East Lansing	East Lansing	East Lansing
Minnesota	St. Paul, Care W. Farm	St. Paul	St. Paul
Mississippi	Agric. College	Agric. College	Agric. College
Missouri	Columbia	Columbia	Columbia
Montana	Bozeman	Bozeman	Bozeman
Nebraska	Lincoln	Lincoln	Lincoln
Nevada	Reno	Reno	Reno
New Hampshire	Durham	Durham	Durham
New Jersey	New Brunswick	New Brunswick	New Brunswick
New Mexico	State College	State College	State College
New York	Ithaca	Ithaca	Ithaca Geneva
North Carolina	West Raleigh	West Raleigh	West Raleigh
North Dakota	Agric. College	Agric. College	Agric. College
Ohio	Columbus	Columbus	Wooster
Oklahoma	Stillwater	Stillwater	Stillwater
Oregon	Corvallis	Corvallis	Corvallis
Pennsylvania	State College	State College	State College
Porto Rico	Mayaguez	Mayaguez	Mayaguez Rio Piedras (Sub.)

STATE	College of Agriculture	Extension Department	Experiment Station
South Carolina	Clemson College	Clemson College	Clemson College
South Dakota	Brookings	Brookings	Brookings
Tennessee	Knoxville	Knoxville	Knoxville
Texas	College Station	College Station	College Station
Utah	Logan	Logan	Logan
Vermont	Burlington	Burlington	Burlington
Virginia	Blacksburg	Blacksburg	Blacksburg
	Hampton	Hampton (negro)	Norfolk (branch)
Washington	Pullman	Pullman	Pullman
West Virginia	Morgantown	Morgantown	Morgantown
Wisconsin	Madison	Madison	Madison
Wyoming	Laramie	Laramie	Laramie

THE END

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