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☞ **The Bulletins of this Station are mailed free to all residents of the State who make application for them.**

NOTE. On the 5th day of last October our station office building was destroyed by fire. The laboratory, a large part of the library, and all Reports and Bulletins from 1 to 12 inclusive, were burned. It will be impossible to supply copies of Bulletins issued earlier than No. 13.

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PIG FEEDING FOR PROFIT.

N. W. M'LAIN.

That there is to-day among those engaged in stock-raising a plentiful lack of practical information concerning breeding and feeding domestic animals is patent to any one conversant with the facts.

This is not alone true of one region or state. The fact is quite general in its application. That the cost of production and the value of the product determines the percentage of profit or loss is self-evident.

Why, among those actually engaged in raising cattle, swine and sheep, so very little is commonly known about what it actually cost them to produce a pound of beef, pork or mutton is not so plain.

Why it is, when competition is so sharp and agricultural depression so wide-spread, that farmers and stock.raisers go on year after year, growing hay, corn, oats, barley, etc., and producing more and more beef, pork and mutton without certainly knowing whether they can successfuily meet competition or not, without actually knowing whether the cost of production is more or less than the value of their product, can only be explained by saying that in farming and stock-raising there is a lack of practical application of practical, common-sense, business methods.

Too many farmers and stock-growers forget that the profit in production must be found between the cost price and market value, and none know better than they that too little attention is given to economy in production as the best means for meeting competition. Only bankruptcy, speedy and inevitable, would await the manufacturer who fails to recognize this fact. The animal industry, the manufacture of food products, furnishes no exception to this rule. Every undertaking in breeding and feeding must, to the extent of knowing approximately the cost of production, recognize and be governed by it.

Many years' practical experience in breeding and feeding from 200 to 600 head of pigs per annum, keeping account of cost and value of product, has taught me the nature and extent of the difficulties attending experimental feeding, and the variety of conditions to be met. To each of these, intelligent consideration must be given, if the results obtained prove anything of practical value.

In an experiment in feeding, a considerable number of individuals should be included in the test, otherwise the factor of individuality would become a possibly fatal source of error. If but few individuals, possibly widely varying in individuality, were included in the test, the conclusions reached would be from experience too narrow and limited, and, in the nature of things, would be incomplete and misleading.

I submit that it is hardly possible that any two or three individuals, of any one breed, can be selected that singly or collectively would represent that type of individual which would be, by any three thoroughly experienced breeders, conceded to be an exponent of the distinguishing characteristics and qualities of the breed in question, age, size, form, vigor, disposi-

tion, tendency and adaptability to early maturity, etc., all taken into account. Therefore, in a feeding experiment in which but two or three animals are used, the conclusions arrived at would ordinarily signify but little more than what had been found true in the case of the two or three individuals subjected to the test from which the conclusions were drawn. Hence, the value of any experiment in furnishing anything significant concerning the excellence or inferiority of any breed, or the effect of different kinds, quality and quantity of food upon that breed, would be determined by the completeness or incompleteness with which the type of that breed had been represented in the test.

I further submit, however, that if fifteen or twenty individuals, of one breed, be selected with skill and care, by one thoroughly familiar with the distinguishing characteristics and qualities of that breed, it will be easily possible to secure in these twenty a composite unit, which any thoroughly qualified and experienced breeder would recognize and acknowledge as a type of that breed. If, now, these individuals be subjected to well planned and thoroughly executed trials and the results carefully tabulated, from these data, taken together and in their relation to each other, we may draw valuable and approximately true conclusions.

For the purpose of demonstrating something of practical value to the farmers and swine-growers of the State, I determined to raise and fatten a car-load of hogs for profit. No special advantages attended the undertaking, and a detailed statement of the means employed, the method practiced and the results obtained is as follows:

Seven coarse Duroc Jersey sows, in pig by a Duroc Jersey boar, were listed in the inventory of Experiment Station property April 1st, 1889, at fifteen dollars per head. I found these in stock when I took charge of the Station. These seven sows farrowed fifty-five pigs. The average date of farrowing was April 15th. Fifty-four of the fifty-five pigs were raised, fed and marketed. It is characteristic of the Duroc Jersey breed that the females have the milk-giving function and the maternal instinct strongly developed. They are prolific, and, as a rule, take excellent [illegible] of their young.

The pigs were farrowed in ordinary styes, with separate out-lots adjoining. As soon as the pigs were of suitable age and size, the sows and pigs were turned in an eight-acre lot, which is a dry, gravelly knoll, covered with small oaks and undergrowth of brush. Very little vegetation suitable for pig food could be found in the lot. Temporary shelter was provided for protection during rain storms. The water supply was furnished in troughs from the farm tank. From April to October the food supply consisted of screenings meal. When the steam engine was in use, for pumping water or for other purposes, the waste steam was used for cooking the pig food. At other times the meal was mixed with water and soaked and fed sweet. The quantity fed was as much as the pigs and their mothers would eat, leaving the troughs clean, three times daily. An account was kept of the quantity consumed each month. During September a small supply of green corn was fed and allowance for the same made in the quantity of meal used during a like period.

The average weight of the pigs when weaned, at two and one-half months old, was forty-one pounds. The cost of ground screenings, at the mill, in Minneapolis, through May and June, '89, was thirty cents per hundred. The cost of the feed consumed by the sows and pigs in producing fifty-four pigs of forty-one pounds average weight was fifty cents per head, or, approximately, one dollar and twenty-five cents per hundred pounds. The feed used from October to January 25th was Dent corn, fed on the cob. The slops, made from screenings meal, were fed in connection with ear corn through October, but after that the drink furnished was simply cold water.

From Jan. 25th, 1890, to March 14th, the food consisted of whole corn, shelled, and either boiled or soaked. Pigs fed and watered three times daily.

Total cost of feed for 54 pigs, Dec. 24	$147.68
" " " " " Jan. 18	204.00
" " " " " March 14, '90	280.40
The weight of 54 pigs, Dec. 24	11,360 lbs
" " " " Jan. 18	13,360 "
" " " " March 14, '90	15,820 "
March 14th, 1890, pigs sold at	4 cts. per lb

I estimate the time required daily for caring for seven sows and their pigs at one hour per day for 12 months, which, at the rate of one dollar per day, would amount to, say, $36.00 per year.

STATEMENT.

Total cost of screenings meal fed	$ 58.26	
Market value of corn raised and fed	154.00	
Market value of small potatoes raised and fed	6.25	
Market value of corn purchased and fed	61.89	
		$280.40
Wages of one man, at $30 per month, one hour each day for 12 months, caring for sows and pigs		36.00
Total expense		$316.40
Fifty-four hogs weighing, March 14th (eleven months old), 15,820 povnds, sold at 4 cents per pound		632.80
Net profit on the seven sows, above the cost of labor and the market value of the food bought and raised on the farm		316.40
This is an average net profit from each sow of		45.20

In this statement no allowance has been made for depreciation in the value of the breeding stock, or for interest on the capital invested. It may be further stated, however, that I fatted five of the seven sows with the fifty-four pigs, and the cost of their feed and care is also included in the gross amount charged to the pigs, and I sold the five sows, which were too coarse to keep for breeding, for $77.02, or $2.02 more than the original inventory price. The other two of the seven I bred to a registered Poland China boar, and Dec. 1st, '89, they farrowed fifteen pigs, and I raised fourteen of them, which, April 15th, 1890, at four and one-half months old, weighed 1,840 pounds, which at four cents per pound, the price realized for the older pigs, were well worth $73.60. These two sows have each, between April 15th, 1889, and Dec. 12th, 1890, farrowed four litters. Out

of these I have sold or have on hand 51 head, and the sows are in excellent condition, probably serviceable as breeders for four or five years more, so that the depreciation in value, or interest on the money invested in breeding stock are not items of much value.

It will be seen that if all of the seven sows had been suitable to keep for breeding purposes the profit realized from the original stock would have been correspondingly larger.

The price received for the product, after a term of eleven months' feeding, was, at four dollars per hundred, just double the sum expended for feed and labor.

But the pigs could have been sold Dec. 24th, weighing 11,360 pounds, at three dollars and fifty cents per hundred, saving eighty days of winter feeding, and the percentage of net profit would have been greater by $30.24, as seen by the following statement:

54 pigs, Dec. 24th, '89, 11,360 pounds, at 3½c	$397.60
Cost of feed to Dec. 24, $14768; plus $36.00 for labor	183.68
Net profit, above cost of feed and labor	$213.92

Or the 54 pigs could have been sold Jan. 18th, 1890, weighing 13,360 pounds, at 3¾ cents per pound, saving 55 days of winter feeding, and the percentage of net profit would have been greater by $20.00, as seen by the following statement:

54 pigs, Jan. 18th, 1890, 13,360 pounds, at 3¾c	$500.00
Cost of feed to Jan. 18th, '90, $204.00: plus $36.00 for labor	240.00
Net profit above cost of feed and labor	$260.00

It is shown by the above figures:

1st. That with ground screenings of fair quality, costing six dollars per ton, and sound shelled corn, at thirty cents per bushel, and with comfortable pens, with board floors, and good feed troughs, with good, thrifty pigs, with the temperature such as prevailed during the winter of 1889-90, an average gross weight of 293 pounds was reached in 11 months, at a cost of two dollars per hundred, without the advantage of clover or blue grass pasture in summer. It is safe to conclude that if the pigs had had the adadvantage of good clover pasture, an average gross weight of 325, or perhaps 335, pounds would have been reached in less time and at less cost.

2d. That under like conditions, an average gross weight of 210 pounds was reached in eight months and eight days, without the advantage of summer pasturage, at a cost for feed and labor of one dollar and sixty-two cents per hundred.

3d. That the same pigs, under the same conditions, at the age of nine months and three days, reached an average gross weight of 247½ pounds, at a cost of one dollar and eighty cents per hundred.

4th. That nothing pays better, in any department of animal industry, than judgment and skill in selecting breeding stock. Nothing but pure bred sires should ever be used, and that both sires and dams should be the best obtainable, both as regards their breeding and their individuality.

I am now carrying on a line of pig feeding experiments, using seven

groups, with six pigs in each group. Pure bred pigs, of three different breeds, and two kinds of cross-bred pigs are included in the test. The nature of the experiment and the results obtained will be given later.

SWINE BREEDING.

N. W. M'LAIN.

A careful study of the characteristics of the different breeds of domestic animals and their adaptation to the conditions to be met in producing meat products for profit in this state is experimental work full of significance to those engaged in animal industry.

In swine breeding I have begun several lines of experiment, which are now progressing satisfactorily and give promise of results of great value.

I have secured for the station a valuable stock of hogs suitable for breeding and feeding, at very small cost, the individual merit, the breeding and number of animals taken into account.

These animals are of six different breeds, and I now have five different crosses of these breeds, and five other first and second crosses have been made.

In the nature of things an experiment in breeding requires much time and patience. However, the results being cumulative, if success comes there is encouragement, if failure, new hope comes with new effort.

In beginning it is essential that we take cognizance of all that is known concerning the distinguishing characterisrics of the different breeds, and with a definite purpose in view and a complete knowledge of the conditions to be met, choose those for foundation stock which most nearly possess the qualities desired, bearing in mind that skillful practice in selection and cross-breeding commonly manifest themselves in increased vigor.

In practical experience we find some breeds more prolific than others, some have greater vigor, and some produce a greater quantity and a better quality of pork from a given quantity of food in a given time than others. Some breeds are provided by nature with heavy coats of hair, and are hardier than others; some are distinguiched for rapid growth and early muturity, producing ripe pork from a carcass of medium weight, with light shrinkage from gross to net weight.

Some breeds have the maternal instinct and the milk-giving function singularly well developed. These traits in connection with prolificness are secondary to none, and add much to the value of any breed of which they are recognized characteristics, for all practical breeders know that very much of the usefulness of a pig as a source of profit, depends upon the start in life. Some breeds are of quiet disposition, some breeds are quite the opposite. Not a little significance attaches to this, and for very excellent reasons.

By selection, by line breeding, and sometimes by close breeding valuable qualities may be intensified and fixed. By cross-breeding race characteristics may be transmitted and modified and practically eliminated.

Certain qualites and race characteristics inhere potentially in the males of a species, and other distinguished traits inhere potentially in the females.

The prepotency of male or female commonly manifests itself along these lines.

I have fond however that it is a curious fact that some race characteristics whith commonly inhere in sires, are found to inhere potentially in the dam, even though seemingly more important structural modifications in favor of the sire have been secured in the same cross. But these same dams being bred to a sire of still another breed, the common result was obtained.

THE POLAND CHINA-DUROC-JERSEY.

For example take the characteristic of color. I bred a three-year old registered Poland China sire to two three-year old thoroughbred Duroc-Jersey dams. Both sire and dams were in color typical animals of their respective breeds. The sire carries both Tecumseh and Tom Corwin blood and shows but very little white. One of the dams was of the dark red Tamworth color, and the other of lighter (Jersey,) red color. The two sows farrowed fifteen pigs. The color of each litter was substantially like that of the dam, a few very black spots appearing on each pig. Both dams were again bred to the same sire and the result was as at first, each one of thirteen pigs resembling in color its own dam, and each carrying a few very black spots.

Again I bred the two sows to a thoroughbred Essex boar less than one year old, and the result was that commonly obtained. The two dams farrowed twenty-four coal black pigs, carrying scarcely a red hair. In this connection I would call attention to a Yorkshire boar bred to some Duroc-Jersey sows, and every pig farrowed was white, carrying scarcely a red hair; and a Chester White boar bred to a pen of Berkshire and Poland China sows produced seventy-four white pigs, carrying scarcely a black hair.

From the first cross of the Poland China upon the Duroc-Jersey I obtained most satisfactory results. In the first instance on the day when the pigs were 4½ months (135 days,) old, December 1st to March 14th, the 14 head averaged 131 pounds weight, and at the age of one year (365 days,) the average weight of 5 barrows was 400 pounds, which all will admit was a heavy agerage for winter pigs of that age. The pigs from the same sire and dams farrowed May 29th, 1890, weighed an average of 183 pounds at the age of 183 days. In neither case was there any effort made to hasten the maturity. The pigs were simply well cared for, well fed and kept in a thrifty growing condition.

In both instances the transmission of ancestral traits and qualities, and the modifications in form in the get in this first cross, were in favor of the male in a remarkable degree.

The size and shape of the head and face, the shape, size and position of the ear, the neck and jowl, the shape of ham and shoulder, the width of loin, girth around the heart, the fineness of bone, the top and side lines and length of body, together with docility; all these were distinctively characteristic of the Poland China; while in color, in maternal instinct, in development of the milk-giving function, in hardiness and general vigor and disposition to rustle for a living, their characteristics were distinctively those of the Duro-Jersey dams. These young Poland China-Duroc-Jersey

gilts proved to be excellent mothers, and when bred to a registered Poland China boar, and to a pure bred Berkshire boar, the get in both instances in the main possess the characteristics of the sires used in the second cross, but the hardiness the vigor and disposition to rustle for a living, and the ability to live upon anything a pig can eat, so characteristct of the grand dams, has been inherited.

THE ESSEX CROSS.

The result of the first cross of a registered Essex boar upon the pure bred Duroc-Jersey sows appears to be satisfactory. The pigs are yet young and small, but, from the feeder's standpoint, they promise to become nothing less than a revised, enlarged and improved edition of the Essex. Young pigs of the Essex breed are commonly small and more delicate than those of larger breeds, and they require good care when they are young, but the get of this cross were good size, vigorous, and immediately proved their ability to look out for themselves.

I have also crossed the Essex and the Berkshire, and the Essex and Chester White, and ths Essex upon half blood Poland China, Duroc-Jersey and also upon the Cheshire.

Youatt says: "The Essex are invaluable as a cross, being sure to give quality and early maturity to any breed." Mr. Wm. Smith, of Michigan, writes, that "this is a breed that will be appreciated in proportion as it becomes known. They mature early and attain good size. The meat is excellent and can be made fit for pork at any age from a month upwards.

In England they are marketed by thousands for light family pork, when from five to eight months old, and for that purpose there are none better. They command a higher price than coarser pork, and the market reports always make a distinction in quotations, and show a wide difference in the prices in favor of this breed. They are hardy, healthy and prolific."

Dr. Chase, of Kansas, says: "The Essex are quiet, docile animals, they fatten almost at the sight of corn, and weigh, under ordinary treatment, when grown from 250 to 275 pounds."

Mr. Cottrell, of Michigan, says: "During my experience of the past ten years in breeding and managing thoroughbred pigs I have some of the time exceeded a thousand choice animals of the imported breeds, including the Essex in considerable numbers, which has given me opportunity to compare and experiment upon their relative merits, under the same and different treatment, along side of each other.

As a result of this experiment I can say, that, in my estimation, they take rank among the best, they mature early and their meat is excellent. They possess powers of transmitting to their projeny an excess of their own good qualities, when crossed upon common or coarser swine will improve their qualities almost beyond recognition. Excepting the Suffolks, there is no breed that can compare with them for this purpose.

Coburn in Swine Husbandry, says: "We have never encountered a person who has once tried them, who did not place a high estimate on their value as a small breed, and especially on the boars to use for crossing on sows of larger breeds."

THE SPECIAL PURPOSE PIG.

Of late years we have heard a great deal about "the general purpose cow." Her advocates have proclaimed her merits with zeal and persistency worth of a better theme. While very much may be truthfully said of the value of "the special purpose dairy cow" as a Minnesota mortgage lifter, in my thinking there is an urgent demand for the general introduction of the special purpose pig, a pig of that breeding best adapted to the special purpose of producing the largest amount of choice pork product, with the best and quickest return for the food consumed, and best adapted to the local and commercial demands.

That which I have quoted above from some of the most skilled swine breeders of this country and Europe, concerning the valuable qualities of the Essex breed, and the power of the males to transmit these qualities when crossed upon other breeds, has special reference to what follows:

The competition to be met with in the production of any staple article —where the modern inventions of the pool and the trust have not been introduced—determines the measure of profit. If we are compelled to meet competition at a disadvantage, then we must either work for less profit, or employ greater skill and produce a superior article.

In the year 1889 the state of Minnesota produced 325,00 head of hogs. I have seen many thousands of these hogs in the sale pens in the principal live stock markets of the state. Any one will readily admit that in this state swine growing is attended with difficulties which are not found in states with which we have to compete, hence the necessity for greater skill.

One would suppose that self interest, the proper desire for the best rewards for skill as well as labor, would have manifested themselves in filling the sale pens in our markets with well finished specimens of the breeds best adapted to profitable pork production in this state, and best suited to the demands of the market.

It is true that "you may judge of a workman by his chips," then surely many of the farmers of the Northwest should serve an apprenticeship. I have had many years experience in the Chicago, St. Louis and Kansas City live stock markets, but I never saw so large a proportion of the gross receipts composed of ill-bred and unfinished hogs, alike unprofitable to producer and packer.

THE ESSENTIAL.

Professor Robertson says, that "the *sine qua non*, the essential in profitable darying is a good machine,"—a good cow. It is eqally true that the essential in profitable pork making is a good pig, and the skill required for the profitable management of the two machines may differ greatly in kind but not in degree.

The qualities which constitute the profitable dairy cow in Maine, Missouri or Minnesota are in the main identical, but the pig for profit in Minnesota, must in the nature of things, differ in some important particulars from that of Missouri.

These points of difference are necessitated by the difference in geograph-

ical position, the climate determining not only the kind of foods which may be cheaply and certainly produced, but also the length of season during which these may be profitably fed. In Missouri where corn and clover may be cheaply provided in great quantities, and uniformly of superior quality, where the climate is mild and the grazing season is long, the percentage of the grain ration reqdired for maintenance being small, the quality of early maturity is not so important a factor in the question of profit as in Minnesota, where the cost of feed is greater, the grazing season short, the climate more severe and the maintenance ration proportionately larger. In one case a pig with strong roomy frame and vigorous growth, may be the pig for profit, may be just the machine required for converting a large quantity of bulky cheap food into condensed and portable product.

I have found the pure bred Poland China and Berkshire and the crosses of the finer boned Poland China sires upon mature Berkshire sows most valuable for such uses where corn and clover were abundant and cheap, as in Missouri and Kansas.

But on the other hand the pig for profit in Minnesota is one with fine bone, strong, medium sized, well lined form, of vigorous growth and hardy, with thick covering of hair, with gentle disposition and the quality of early maturity well developed, producing a finished carcass yielding the highest per cent. of meat product to the gross weight, easily reaching an average of 240 to 250 pounds gross weight in from 220 to 230 days.

COST AND COMPENSATION.

Now these results can be realized only by observing a few common sense rules. Without the intention and desire to succeed there can be no success. There is an intimate relation between cost and compensation in raising pigs for profit, as well as in anything else, unless one is willing to meet the conditions, to pay the price of success, the undertaking should be abandoned.

First, the breeding stock must be selected on account of the known fitness and excellency of the breeds. The dominant characteristics must be those best suited to the conditions to be met in the locality where they are to be used and personality must correspond with pedigree. "Like begets like" is the axiom in breeding, and performance and not promises is what is wanted.

In this State the efforts so far made in the way of improvement have mainly consisted in introducing the Poland China and Berkshire sires. What I have quoted from the experience of some of these best qualified to speak of the qualities of the Essex boar, and the power which the sires of that breed have in impressing their qualities upon their projeny when bred to dams of other breeds, furnishes the reason for beginning certain lines in my experiments in breeding, and the desirability of introducing some of the qualities of early maturing breeds into the breedieg swine of this State, suggests the desirability of many progressive swine growers making similar trials, and failure in one direction should stimulate to further efforts.

I have mentioned the crossing of the Essex boar upon Poland China and Berkshire sows.

I have seen a pen of Essex-Poland China hogs, the get of an imported boar by just a medium lot of Poland China sows. They were a profitable lot both for the feeder and packer, with small head, trim jowl, thin ear, well set, small boned legs, well lined top and sides carrying the meat well on top, fine loin, large finely rounded ham, a carcass yielding a large per cent. of meat product to gross weight, even in light flesh.

The hog which won the prize in the grand sweepstakes ring, at the late American Fat Stock Show, in Chicago, was the Essex-Poland China cross.

HASTE MAKES WASTE.

2nd. The practice which has been very generally adopted among swine growers, of breeding from young and unmatured animals, cannot be too strongly condemned. The practice has become quite common among farmers to raise one or two litters from a gilt and then fatten and market her. About the time she has come to that degree of maturity when she should begin to be usefnl, and before there has been opportunity to estimate her value as a mother, she is retired from the herd, and the folly is repeated.

From all quarters I have heard complaints about the lack of thriftiness and vigor, and the susceptibility to disease. The expression is common and the feeling still more general, that "some strains of the different improved breeds have been bred so fine, that all the constitution has been bred out of them." The reason for this is not far to seek. The trouble is not so much that the constitution has been "bred out." The real fact is the constitution never has been bred in. A practical illustration of what is meant is seen by comparing the pigs from mature and immature parentage, raised side by side in the same pen. Not only will the litters from roomy well-developed sows, got by mature sires, be larger—nearly double the number of pigs—but frequently the pigs will be nearly double the size when three or four weeks old, and the advantage gained from qualities inherited from mature parents, and from liberal nourishment and vigorous growth when young, the animal will retain through life.

Not only are the evil effects of this practice manifest in the projeny, but by undue haste many animals of superior breeding and fine individuality are dwarfed and ruined, which, if they had been allowed time for developement, would have shown rare merit and usefulness as breeders.

Moreover the collection of a useful and satisfactory herd of breeders is an undertaking requiring skill and experience, and nothing short of a trial will entitle auy animal to a permanent place in the herd, and no animal is entitled to a trial unless their breeding is satisfactory, or the best obtainable, and the external form and appearance should furnish evidence of a vigo ous internal organization.

In selecting the members of a breeding herd it is not sufficient that each one accepted for trial shall be of the best breeding, best from an external appearance, but that the selection should be from families where excellence and superiority is the rule and not the exception. If but few superior animals are found in the family or families from whlch the selection is made,

even though the individual selected may possess great excellence, such animals cannot be depended on to transmit their excellency to their offspring. They are apt to get an uneven projeny, and prove very unsatisfactory as breeders. If on the contrary superiority is found to be the rule and inferiority the exception in the family, then the animal may be admitted to trial with confident expectation of satisfactory results. For example, I have just added to the station herd of breeding swine a "Mollie James" sow, which is one of a litter of 8 pigs, 1 male and 7 females, "as even as eggs," and prize winners wherever shown, the get of sire and dam of enviable record.

Everything being equal, prepotency is commonly manifested by the sire in many of the most essential qualities, and so the influence of the sire is co-extensive with the size of the herd upon which he is used, the question of success depends largely upon choice of a sire. A small percentage of the females in a breeding herd may prove worthless and the usefullness of the herd is not seriously impared, but if the head of the herd is inferior the get from the whole herd is inferior. There should be no lack of skill and care employed in selecting, and no false notion of economy in securing a male, for if "the best is the cheapest" the best is none to good. The same is true of the females. Success depends largely upon the selection of such animals as will prove able to produce and nourish a large number of pigs, in which the form, vigor and distinguishing excellencies of sire and dam re-appear. Only from the best animals best adapted to our needs can we hope to realize profit.

It will be seen that securing and testing a breeding herd is no little task, but when a useful herd of well bred animals has been secured there should be highly prized and carefully treated, and any animal having proved valuable and useful as a breeder, should not, except from necessity, be retired while that usefulness continues. It should be born in mind that the most useful half of the life of breeding swine is the last half, and care should be taken to make the best half as long and useful as possible.

Of the aggregate number of hogs raised last year in Minnesota, probably three-fourths were raised by farmers, who do not breed from more than 6 or 8 sows. To such as breed from a small number, the cost of securing a really valuable boar seems burdensome, and the temptation to use something inferior is strong. But because a man is able to raise only a few hogs each year, it by no means follows that those few may be inferior. On the contrary the opposite is true, for if there is but little profit in raising a few good ones, then the loss in raising poor ones bears some relation to the number raised. I have found the practice of a few neighboring farmers joining in the ownership and care of a first-class boar, bull or stallion, to be a practical and economical way of securing the service of such sires as are essential to success in stock raising.

FOOD AND SHELTER.

Among farmers of the nonprogressive sort the saying used to be current "that the best blood is a well-filled granary," and the poor quality of their stock furnished proof of their faith in that saying.

There is abundant proof that a majority of the farmers of this State believe that "anything is good enough for a hog," and that very little food and shelter is sufficient.

"Blood will tell" in a satisfactory manner only when the good blood is in an animal of good quality which has had proper food and shelter. The animals I use for breeding purposes are not permitted to grow fat. I feed mainly on nitrogenous food—muscle and bone producing food—such as ground screenings, ground oats, bran and shorts, and the stock runs in pasture at all times when the weather is suitable. The ground grain is either soaked or cooked and fed sweet. If the pasture is fresh and grass abundant they are fed twice daily, if pastures are dry and poor the slops are fed three times da ly. The quantity fed is just suffiient to keep the stock in a thrifty condition, so that the young animals will make rapid growth and the mature hogs keep in good flesh. They are given warm slops in winter and plenty of pure cold water in summer. Having no running water on the farm I made large, shallow water tight boxes for the hogs to wallow in, in hot weather. These are frequently cleaned out and supplied with fresh water. The cost of a rough box 8 feet by 10 feet is small, and if kept out of the sun when not in use, will last for years. Once in each week the hogs are given a supply of wood ashes, to which is added a trace of sulphur and salt.

Protection from the rays of the summer's sun, and from cold and heavy rains shonld always be provided. Any kind of protection which furnishes shade and a dry bed is sufficient for summer. Plenty of good pasture, —clover is best—plenty of pure water and protcetion from sun and rain are the essentials for health and growth. I shut the sows with young pigs in their pens when they are given their feed at evening, and keep them shut in until the due is dried from the grass the next morning. If the sows eat the grass wet with due the pigs are apt to scour, and every precaution should be taken least the pigs are stunted. If possible the hog house, or sheds, and yards used for winter, should adjoin the pasture, then these same fixtures furnish shelter from sun and storms in summer, as well as protection in winter. I have so arranged the hog houses here at the experimental station. These houses or sheds, and pens, should be kept very clean both summer and winter, and in winter the straw used for bedding should be frequently changed.

These houses or sheds need not be expensivve, but they should be dry, light, well ventilated, warm and as roomy as possible.

They should have tight strong floors near the ground, so arranged that the wind can not get under them. The sides and top may be made of boards with a sheet of building paper between, with board or shingle roof, or they may be made with sides and roof of straw or hay, or the sides may be made of sod, with straw or hay roof. The essential to be secured is comfort for the pigs; shelter, warmth, cleanliness. It is not easy to secure the cleanliness essential to comfort and health without a plank floor, and yet it can be done. Good feed troughs are quite indispensable. I use the V shaped trough, made of two-inch plank, and I like it much better than the

square, box trough. Nothing in swine growing pays better than cleanliness and regularity in feeding.

TWENTY POUNDS MORE OR LESS.

The number of hogs marketed in Chicago, St. Louis, Kansas City and other packing centres in the months of November and December, 1890, was 4,100,000. The average weight of those packed in Chicago was 232 pounds, twenty pounds lighter than that of the same two months in 1889. The reason for this was the scarcity and high price of feed. Twenty pounds reduction in the average weight of 4,100,000 head would be equivalent to a reduction in the total receipts for November and December of 350,000 head. The average price per head was about $8.50, equal to $2,975,000. Twenty pounds more or less on the average weight of 100 or 1000 head of hogs is not a matter of much significance, but when applied to the total number of hogs marked in the packing centres of the United States in the two months, or when applied to the total number of hogs marketed in the State of Minnesota in one year, its true significance appears. Suppose that twenty pounds had been added to the average weight of the 325,000 head of hogs produced in Minnesota in 1889, and suppose that this had been done with less feed, labor and time than was used in their production, the results would have been that more than a quarter of a million dollars would have been added to the profits of the farmers of the state during 1880 from swine growing alone.

No one conversant with the facts about swine growing in this state, about the quality and adaptability and individuality of the breeding stock commonly used, about the quantity and quality of the food, water, pasturage and shelter commonly furnished, about the very common lack of cleanliness and comfort provided for the animals, would hesitate to say that if the business had been done with that degree of skill and dilligent attention to details required of those who now-a-days compete in producing any staple article, if the methods given in this bulletin had been intelligently practiced the net profit from the industry would have been doubled.

SUGAR BEETS.*

D. N. HARPER AND W. M. HAYS.

For several years past sugar beets have been grown on the experimental farm, and during the past year at many other places in the State, with the view of determining how well our conditions of soil and climate are adapted to their profitable production. In general the results of these experiments have been quite satisfactory, and show that the conditions existing over a wide area of our State are favorable to the cultivation of the sugar beet. The results give promise that a sugar industry can be successfully established. But there are certain requirements which must be met by the farmer and by the manufacturer before success in this line can be obtained.

Good sugar beets must contain at least 12 per cent. of sugar, and the juice must be of high purity. They must grow regular in shape and of uniform size—to weigh about one pound. To be a good paying crop they should yield fifteen tons or more to the acre. To obtain these results the farmer must plant good seed of well established varieties, the soil must be naturally adapted to the crop, and careful cultivation must be given to it. Further on these agricultural features are more fully discussed.

To economically manufacture sugar the factory must be located within reasonable distance of the producers, the means of transportation being considered. It must be well equipped with all the necessary, well approved modern appliances, must have an abundant supply of good water, and good means of shipment. The cost of erecting a beet sugar factory, with capacity for working about 300 tons of beets every 24 hours, and located at Grevenbroich, Rhenish Prussia, is stated to be $76,746.00.†

Dr. Wiley‡ estimates that a plant in this country with capacity of 300 tons per 24 hours should cost between $150,000 and $200,000.

Three factories are now in successful operation in this country, two in California, using respectively 150 tons and 300 tons of beets per day, and one in Nebraska with a daily capacity of 350 tons. The cost of these is

*The historical, manufacturing, and cultural portions of this report are based upon reports made to the State Department by consular agents and others, reports of the Department of Agriculture, Stohmann's "Die Zuckerindustrie," Stammer's "Lehrbuch der Zuckerfabrikation," and articles in periodicals, particularly "The Louisiana Planter," "La Sucrerie Indigene," "Neue Zeitschrift für Rübenzucker-industrie," etc. The intention is to give a concise statement of the requirements for sugar production, based upon the experience of those places where the industry is now conducted. The agricultural features have been modified to best meet our conditions.

† Consular Reports, January, 1889. Consul Falkenbach.

‡ Sugar Beet Industry, Bulletin No. 27, Division of Chemistry, U. S. Department of Agriculure.

said to have been from $250,000 to $500,000 Other factories are being built, one with a reported capacity of 500 tons per day. Smaller factories are operated in Germany, and can be in this country, but the larger the factory, within reasonable limits, the more economically it can be operated.

The most successful factories abroad cultivate the beets as well as manufacture them, and at the start of this industry with us it will be advisable for any factory to do likewise. In this way the crop will be more uniform, can be handled better, and the farmer will sooner learn the requirements for successful production. Both farmer and manufacturer will be be better protected against loss at the outset. But no factory should be started without full knowledge that the agricultural conditions of the locality are favorable.

EXPERIMENTS FOR 1891.

To further investigate the agricultural features of this subject, the station will distribute seed to those making application for it where the soil is suitable. Requests for seed should state the kind of land, whether a heavy or light loam or clay or sandy soil, and the nature and depth of the subsoil. Certain varieties of beets are best adapted to certain kinds of soil, and it will assist in making distribution of the proper kind of seed to have this information.

Make preparations to seed only as much land as will be thoroughly well cared for, measure it accurately and state the amount. In making selection of land take that which is old but not weedy, and have the seed bed in fine condition as here described. Allow the plants to grow too close together rather than too far apart. When ripe send samples of the average sized beets for analysis, with the leaves on. But with regard to samples further information will be furnished later.

Boards of Trade and Farmers' Clubs. It is to be hoped that such organizations will be interested in keeping supervision over the cultivation of beets in any locality. Seed will be furnished through such bodies to farmers, and a frequent discussion of methods and results will do much to encourage the proper cultivation. It must not be forgotten that any results obtained which do not correctly represent the locality must be prejudicial to any subsequent attempts either to grow beets or to manufacture them. It is of the greatest importance, therefore, that our experiments this year shall be carried on intelligently and conscientiously. As the cultivation of sugar beets can not be successfully conducted without the expenditure of greater exertion and care than ordinarily given to grain crops, any enthusiasm which can be aroused regarding their cultivation will be beneficial.

The experience gained in cultivating beets properly will be of immense advantage should the results prove satisfactory, and the industry be started in any locality.

RESULTS OF 1890.

Following is a tabulated statement of the results of analysis of sugar beets raised during the past year:

Lab. No.	VARIETY	Solids	Sugar	P'rity
	On the Farm—	*Per ct*	*Per ct*	*Per ct*
1441	Fl. Desprez Richest	17.24	13.42	77.84
1444	Improved Imperial	14.48	11.45	79.07
1445	Excelsior	15.55	12.26	78.84
1450	Dippe's Kleinwanzleben	15.92	13.04	81.91
1451	Vilmorin White Improved	13.72	10.96	79.86
1458	Lane's Improved	15.86	11.15	73.45
1472	Gregory's White Sugar	15.90	12.55	78.93
1473	Vilmorin	15.95	12.42	77.87
1474	Vilmorin White Improved	15.00	12.17	81.13
1476	Simon Legrand's White Improved	17.60	14.83	84.26
1477	Bulteau Desprez Richest	16.02	14.07	87.89
1478	Dippe's Vilmorin	17.10	14.01	81.93
	Anoka—			
1457	Department seed, Varieties not given	18.14	13.95	76.90
1462	" " " "	17.92	14.09	78.63
1463	" " " "	18.40	14.99	81.47
1464	" " " "	17.16	14.00	81.58
1465	" " " "	18.50	14.84	80.21
1466	" " " "	17.92	14.42	80.47
1467	" " " "	18.14	14.35	79.11
1468	" " " "	17.24	14.61	84.74
1469	" " " "	17.24	13.39	77.66
	New Ulm—			
1447	Fl. Desprez Richest	16.20	12.53	77.34
1448	Dippe's Kleinwanzleben	15.50	12.42	80.12
	Hutchinson—			
1454	*	20.23	16.83	83.23
	Clara City—			
1459	German Imported	17.46	14.63	83.79
1460		19.36	15.69	81.04
1461		17.62	14.28	81.04
	Hampden—			
1475	German, Imported	17.94	14.15	78.87
	Red Wing—			
1455	Lemaire's Richest	19.62	15.16	77.26
1456	Fl. Desprez Richest	21 88	17.92	81.90
	Zumbrota—			
1488	*	22.00	16.98	77.14
1489	*	19.12	14.65	76.62
	Hastings—			
1446	Dippe's Kleinwanzleben	14.00	12.03	85.93
1449	Fl. Desprez Richest	12.72	10.23	80.42
	Freeborn—			
1440	*	19.00	15.71	82.70
	Luverne—			
1483	*	16.32	12.59	77.14
	LeSueur—			
1484		20.20	13.83	68.47
	Fond-du-Lac—			
1487	Dippe Kleinwanzleben	23.26	17.87	76.83
	Albert Lea—			
1502	*	17.20	1 157	67.25
	Hallock—			
1503	*	21.58	13.65	63.26
	Mankato—			
1479		11.84	8.00	67.56
1480	*	12.04	8.64	71.76
1481	LeMaire's Richest	14.24	10.79	76.26
1482	Fl. Desprez Richest	15.50	11.23	72.47
1490	Atlee Burpee & Co.'s	17.48	11.86	67.85
1491	*	17.98	12.14	67.54
	Glyndon—			
1492	S. LeGrand's White Improved	11.15	5.24	55.98
1494	Bul. Desprez Richest	13.82	8.98	65.00
1495	Lane's Improved	10.72	7.19	67.07
1496	Fl. Desprez Richest	12.10	7.77	64.3
1497	Will's Seed	13.82	8.83	63.8
1498	Dippe's Kleinwanzleben	16.52	12.4	73.91
1499	Dippe's Kleinwanzleben	17.38	12.96	74.56
1500	Dippe's Vilmorin	17.65	13.37	75.75
	Waterville—			
1501	Fl. Desprez' Richest	20.85	16.98	81.44

*Seed furnished by U. S. Dept. of Agl., but name not given with samples.

The beets from the farm were raised on old land of average fertility, which so far as known has never had an application of fertilizers. The soil is a clay loam, with gravelly sub-soil. The beets followed a crop of corn, which was the first crop after the land had lain as meadow for several years. The seed was planted May 28th, and the beets ripened about September 26th, but were not dug until October 10th. The seed did not germinate well, partly owing to the very cold moist weather, and no results as to the yield per acre were obtained.

The beets from Le Sueur and New Ulm were received in a much wilted condition, which will in part account for their low percentage of purity. Those from Albert Lea were not received until January 12th, '91, and had been frozen. Those from Glyndon were grown on rich loam soil, recently fertilized by barnyard manure and the beets did not ripen. The season at that locality is reported as exceptionally unfavorable. The beets from Mankato were grown on heavy, rich clay loam, and had grown largely above ground. In all these cases we should expect the degree of purity to be low.

The past season was more than usually unfavorable for the production of a sugar crop, and the requirements of cultivation were not well known. Another season, with more knowledge of these requirements and more care exercised, we may anticipate better results.

REQUIREMENTS FOR RAISING SUGAR BEETS.

We have prepared the following outline of the best methods of cultivation applied to our conditions.

The Seed. Of course the seed is of first importance. In 1747, Margraf, who first showed the presence of cane sugar in the beet, found it to contain only about 6 per cent. In 1799 Achard was the first to commence the manufacture of sugar, and from that time interest was aroused in the selection of good beets. And by this intelligent care in the selection of good beets the quality has been greatly improved, so that beets now containing less than 10 to 12 per cent. of sugar can not be economically worked, and it is not uncommon for them to mature with more than 20 per cent of sugar. But the common beet still contains only about 6 per cent. of sugar.

Selection of sugar beets for seed production has been made (1) to improve the physical character of the beet, (2) to increase the amount of sugar it contains, and (3) to increase the yield per acre. The beet of best form and size is one that matures with but a single tapering root, dense and brittle, and which weighs about one pound. It also contains the most sugar, and certain varieties are large yielders.

The Soil. The character of the soil has a further influence upon the shape, size, quality and yield of the beet. Very light sandy soils produce beets containing a fair amount of sugar, with juice of high purity, but deficient in yield per acre. In such soils the weight of leaves in proportion to the weight of roots is greatest. A clay soil produces a heavy, large beet containing a considerable quantity of sugar, but with low purity of the juice. Loamy lime soils produce beets having the most sugar,

with high purity of the juice, and the yield per acre is good. The beet takes most of its food from a depth of about 12 inches, so that a porous, easily cultivated and well drained soil is essential. A stiff, heavy soil forces the beet to grow above ground, and that part which grows above ground contains the least amount of sugar, and the greatest amount of other solids. Such beets are worthless for sugar making purposes.

According to Orth, a natural sugar beet soil is composed of a mild, moist loam to the depth of 20 inches, loam or marl 40 to 80 inches, and under this sand. The nearer any soil approaches to these conditions the better it is adapted to raising sugar beets. A soil in our State naturally adapted to the cultivation of sugar beets must have been for a sufficiently long time under cultivation; it must be fairly fertile; it must have a subsoil affording good natural drainage, or be well drained by artificial means. As it is necessary to have the roots develop below ground, deeper plowing than is practised for grains should be done in preparing the seed bed.

Moisture, Heat and Light. Any plant requires sunlight for the production of sugar, and according to the direct experiments of Peterman with beets where the minimum amount of moisture and heat are had, the increase in sugar is directly dependant upon the amount of light. The amount of heat best suited to the development of the sugar beet is found to be, according to Briem, during the period of germination, an average daily temperature of 41 ° F., during that of development, 66 ° F., during the time of ripening, 62 ° F. Briem found that during the three periods above mentioned the plant should receive the following amounts of moisture; 1st period, 3.78 inches; 2nd period, 4.45 inches; 3rd period, 3.94 inches; total during the entire life of the plant, 12.17 inches.

With our conditions, where the ground freezes to so great a depth during winter, and the spring comes suddenly with long sunshiny days, the requirements for moisture, light and heat are usually well filled. The amount of moisture, mentioned by Briem as necessary, can be reduced as the supply from beneath is exceptionally large with most of our soils. The great number of bright, sunny days commonly prevalent with us is also of most favorable importance.

Location. To secure the greatest possible amount of sunshine a location should be selected at sufficient elevation, and where there is no shade at any time during the day. A high elevation gives greater contact with the changing atmosphere, more sunlight and better drainage. But beets should be grown on nearly level or slightly sloping land, and not where they can be washed by rains, or where water can settle.

The Seed Bed. As the beet takes its food mostly from a depth of 10 or 12 inches and is not well adapted to reaching out for this, it is of great importance that the seed bed be well prepared. The ground must be in a fine condition of tilth to a good depth. The following is suggested as probably adapted to our conditions. Early in the fall after a crop of grain plow very shallow, or harrow, or cultivate thoroughly, to allow the weed seeds to germinate, and later plow to a depth of 6 to 8 inches, and with a subsoil plow loosen the ground still deeper without bringing up the subsoil,

Let the land lie as plowed through the winter. In the spring plow again and deeper. Cultivate until the seed bed is fine.

Planting. Plant when the soil is sufficiently warm for prompt germination. Drill the seed in with an ordinary grain drill, so arranged as to deliver the seed in an almost continuous stream, in rows 14 to 18 inches apart. A press drill which will cover the seed from half an inch to an inch would probably do well for this purpose. For experimental plots the small garden drills do well. Care must be taken to not sow the seed deeper than an inch. About 20 pounds of seed should be used to the acre. The time for planting is usually during May, in this section, the chief requirement being to get theplant started as early as possible after conditions are favorable for prompt germination. In Europe it is generally found that early planting, that during April, is the best, but with our quick seasons it will be wise to wait until conditions for germination are good.

Cultivation. As soon as leaves show above the ground cultivation should begin. This should be to kill weeds and loosen the surface soil, and can best be done by hand wheel hoes, though horse cultivation may be used in the middle of wide rows. In any case care must be taken that no dirt is thrown on the young plants, and the weeds must be kept out of the rows by hoeing and by hand weeding. Thorough cultivation should then be practised once a week, or as often as necessary to destroy weeds and keep a mellow surface, the oftener the better for the crop. This should continue until there is danger of injury to the young plants, which will be towards the end of July. When from 4 to 8 inches in height the plants should be thinned out so that they stand from 4 to 6 inches apart in the rows. For rich heavy soils allow them to grow close together, for lighter soils increase the distance. At the last cultivation the beets should be "hilled up." On an experimental plot this can best be done by hand hoeing, but for large crops suitable machines are used.

Indications of Ripeness. The beet has matured when the outer leaves turn yellowish and fall on the ground, and the leaves from the centre of the head turn yellowish-green. At this time harvesting may commence but it is wasteful to begin too early, since it is during the last few weeks of development that the greatest increase in sugar occurs. On the other hand if the beets are allowed to remain until shoots start from the head, loss is caused by an "inversion" of the sugar already stored up. The time of ripening is from the middle of September until late in October.

Harvesting. As the richest part of the beet is that which is deepest in the ground, any economical method of harvesting should contemplate getting the greatest length of the beet possible. In Europe special machinery is used which loosens the earth around the beet, at the same time lifts it out of the grouud and lets it drop back again into the hole. Afterwards the beets are gathered and the leaves cut off close to the crown. In an experimental plot probably the best way to harvest them will be to loosen the soil with a plow or spade, and pull by hand. Great injury is done to the quality if the beet is cut or bruised in any way, and it slowly deteriorates on being exposed to the atmosphere.

Preservation. After the beets are harvested and the leaves cut off the roots are packed in ridges running north and south in the following way: A ditch is dug in the field about a foot deep and six feet wide. The beets are laid in this to the depth of one foot, with their small end to the centre of the ditch, and covered with six inches of earth. Other layers of beets and earth follow, gradually narrowing until a peak is reached. The sides are then covered with earth, which, if dry, is made moist. If harvested and immediately taken to the factory, about a half inch of the head is cut off along with the leaves.

Rotation. In Europe a crop of beets is raised on the same land only once in 4 or 5 years. It is found best to follow some grain crop with beets and these with barley. After we have found out what land on our farms is adapted to raising beets it will be well to adopt some such system of rotation.

Fertilizers. On the old lands in Europe used for cultivating beets a careful system of artificial fertilization is necessary. On the contrary, on our lands, where the only fertilizer used is barnyard manure, it is important that beets shall not be grown on land recently fertilized. The use of this fertilizer has been a fruitful source of the low percentge of purity in many beets received for analysis.

Cost of Production and Value of the Crop. It is estimated that a crop of beets costs about twenty-five dollars an acre. With rows 18 inches apart and beets six inches apart in the rows, Dr. Wiley estimates there are 49,000 plants in an acre, which, if weighing a pound each, makes a yield of 24½ tons. While this is not an extremely large yield it is above the average. With proper cultivation, unless seasonal conditions are unfavorable, the yield should not fall much below 15 tons to the acre. At $5.00 per ton this crop is worth $75.00 per acre, so that the gross profit is large. Much larger profits should be realized than grain crops now pay, but it requires greater expenditure to produce a crop of beets, and unless cultivation is good the loss from failure will be greater than with grain.

MANUFACTURING CONSIDERATIONS.

The small price per ton and the perishable nature of the crop require that the factory shall be located reasonably near to the producers. Other considerations are that there shall be good facilities for shipping the manufactured goods, that there shall be contiguous a sufficient acreage of suitable land to produce the required crop. For a factory using 300 tons of beets per day of 24 hours, the crop from at least 2,500 acres should be delivered. There must be a bountiful supply of good water. To each ton of beets there is required for all purposes from 12 to 15 tons of water, so that a 300 ton factory should use about 35,000 barrels a day. As explained further on water is liberally used to wash the beets, to extract the sugar and for power. For purposes of sugar extraction, the water must be of good quality containing the minimum amount of mineral salts. Fuel must be obtained at reasonable cost and there must be a supply of limestone convenient. The purification of the juice is brought about by

the use of lime and as both the gas from the kiln and the burnt lime are used, a kiln of sufficient capacity is a necessary part of the factory.

PROCESS OF MANUFACTURE.

Great care and the use of specially adapted apparatus are required in the manufacture of sugar. No attempt to give a full account of the processes of manufacture will be made, but simply a short outline of the salient features.

After the beets are harvested and the tops cut off they are delivered to the factory where analysis is made to determine their value and to fix a price. Emptied into troughs they are carried by the aid of running water into the wash house where various means are employed to free them of dirt, sand and gravel. They then go to the slicing machines where they are cut into small bits and sent to the diffusion cells. These are iron vessels having an average capacity of about 320 barrels. About two and a half tons of the small chips are run into each diffusion cell and this is then filled with warm water. There are from 8 to 16 of these cells, forming what is called a battery. These cells are placed either in a single or double line or in a circle—preferably the last. One cell is always being filled and another emptied, the hot water making a circuit through the cells until it has obtained a sufficient density when it is run off from the last cell to the clarifiers. Here under proper degrees of heat the impurities of the juice are separated by the use of milk of lime and carbonic acid from the kilns. The slimy juice then passes through filter presses where the impurities are caught. This washed and pressed slime is taken away by the farmers for fertilizing their lands. The purified juice is then passed through a series of chambers where the water is evaporated off, finally under low pressure and at a low temperature. The syrup runs off through a cooling chamber into moulds where loaf sugar is formed, or it is run directly into the centrifugal. This is a machine which revolves rapidly on a central axis and by a screen separates the sugar from the molasses. The molasses is then repeatedly evaporated as long as sugar can be economically separated from it. The final residue is sold to distillers for manufacture into spirits.

The chief danger to the industry in this state is that attempts may be made to erect factories and manufacture sugar before the agricultural conditions of the locality have been fully demonstrated as suitable, or else to operate on too small a scale and with too limited an amount of capital. From the process of manufacture outlined, and the expensive nature of the apparatus necessary, an idea may be had of the cost of a factory. Various considerations will cause this to vary, but the estimate of Dr. Wiley, that for a 300-ton factory an expenditure of $150,000 to $200,000 is necessary is seen to be quite moderate.

The United States consumes more sugar than any other country, and with the exception of England the per capita consumption is greatest. During the past year it is estimated that between 1,500,000 and 1,600,000 tons of sugar were consumed in the United States, the rate of increase during the past eight years having been 100,000 tons per annum. Last year less than 200,000 tons of sugar were produced at home, of

which about 10,000 tons were from beets. From the immense amount of sugar which must be produced before we can be self-supplying we see that it must be a matter of considerable time before enough factories for this vast production can be operated, and it will certainly pay to delay building factories until we can be assured of success.

Since 1830 in ten States there have been erected fifteen factories for the manufacture of beet sugar, but three of which are now in operation: It is worth while to note that the unsuccessful results have been caused chiefly by failure on the part of producers to supply the crop in proper condition. The hasty erection of factories before the agricultural conditions were fully demonstrated, insufficient capital, attempts to operate on too small a scale and without the necessary supply of good water are other causes.

LEGISLATION.

Experimental manufacture. The processes for the manufacture of sugar are all tried and approved and there is here no field for experimentation. From what has already been stated it is readily seen that any attempt to manufacture on an experimental basis must prove unsatisfactory and will be harmful to the industry. The only legitimate field for experimentation is in determining how well our conditions are adapted to successful production of beets, what localities are favorable and within what limits. In this field as already explained our experiments will be confined.

Bounties. If the agricultural conditions are suited to the production of good sugar beets—and our results so far indicate that they are—it is believed that their manufacture will be successfully accomplished without the granting of any other bounty than that provided for by the last Congress. However, those states producing sugar from beets and sorghum have previously to the passage of the McKinley bill granted a bounty for manufacture—in Kansas of 2 cents per pound and in Nebraska of 1 cent per pound. To induce capital other than that which is local, to engage in this manufacture here it may be proper to provide a bounty so long as other states continue theirs.

If such legislation is deemed advisable it is believed that a premium granted to the producers of beets of high purity, large amounts of sugar and large yields per acre will be of most benefit.

SUGAR BEETS IN NEBRASKA.

In 1888 and 1889 sugar beets were raised in various places in Nebraska, the results at Grand Island being particularly good. To show how improvement has progressed with more knowledge of the requirements of cultivation, and for comparison with our results I quote as follows:

GRAND ISLAND BEETS 1888.*

SOLIDS.	SUGAR.	PURITY.	SOLIDS.	SUGAR.	PURITY.
Per Cent.	*Per Cent.*	*Per Cent.*	*Per Cent.*	*Per Cent.*	*Per Cent.*
17.2	14.9	86.00	16.0	13.71	85.70
18.9	16.1	85.00	17.1	14.2	83.00
19.5	17.5	89.00	16.3	13.10	80.40
21.4	19.2	90.00	18.9	15.8	83.60
19.7	16.7	84.00	18.2	15.20	83.50
21.8	19.8	90.00	18.4	15.90	86.40
18.8	16.4	87.10			

GRAND ISLAND BEETS IN 1889.

SOLIDS.	SUGAR.	PURITY.	SOLIDS.	SUGAR.	PURITY.
Per Cent.	*Per Cent.*	*Per Cent.*	*Per Cent.*	*Per Cent.*	*Per Cent.*
23.7	14.14	59	23.7	20.28	86
23.7	16.90	71	23.7	20.29	86
23.7	20.27	86	23.7	21.41	90
23.7	19.10	80	23.7	18.25	77
17.10	13.52	80			

FROM OTHER LOCALITIES IN 1889.*

SOLIDS.	SUGAR.	PURITY.	SOLIDS.	SUGAR.	PURITY.
Per Cent.	*Per Cent.*	*Per Cent.*	*Per Cent.*	*Per Cent.*	*Per Cent.*
21.6	13.28	61	19.3	10.13	52
17	11.49	68	23.7	15.32	65
23.7	19.52	80	23.7	13.51	58
19.3	9.91	51	23.7	9.69	40
20.4	10.14	50			

CONTRACT FOR PRODUCTION OF SUGAR BEETS.†

This agreement, made between the Oxnard Beet Sugar Company, party of the first part, and John Jones (assumed), party of the second part, witnesseth; That for and in consideration of the covenants hereinafter contained it is mutually understood and agreed between the parties thereto that the said party of the second part shall and will, during the current planting and harvesting season of 1891, plant on the farm occupied by him in section 15, township 28, range 5, county of Union, in soil approved by party of the first part, the particular tract of land to be hereafter selected by party of the first part, to prepare the soil, sow the seed furnished by the party of the first part at 10 cents per pound (which is less than cost), in quantities designated by the party of the first part, say not less than twenty pounds to the acre, to cultivate, thin out, harvest, preserve from the sun, rain or frost, and deliver said beets free from dirt, clean and in good condition, with tops closely and squarely cut off at the base of the last or bottom leave. It is agreed that the delivery of these beets has to take place when notice is given by the party of the first part. And for all beets delivered at the factory in Norfolk according to the conditions made above, the party of the first part agrees to pay as follows: $3 per ton for beets containing an average of at least 12 per cent. of sugar to the weight of the beet, with a purity coefficient of 80, and an additional 25 cents per ton for each and every per cent. of sugar contained above 12, and determined by daily tests made in the laboratory of the party of the first, as follows: $3 per ton for beets containing 12 per cent. of sugar to weight of beet and coefficient purity of 80; $3.25 per ton for beets containing 13 per cent. sugar to weight of beet, coefficint purity of 80; $3.50 per ton for beets containg 14 per cent. to weight of beet sugar and coefficient purity of 80; $3.75 per ton for beets containing 15 per

*Dr. Wiley, loco citu.

†Louisiana Planter, January 17th, 1891, P. 47.

cent. sugar to weight of beet and coefficient purity of 80; $4 per ton for beets containing 16 per cent. of sugar to weight of beet and coefficient purity of 80; $4.25 per ton for beets containing 17 per cent. of sugar to weight of beet and coefficient purity of 80; $4.50 per ton for beets containing 18 per cent. of sugar to weight of beet and coefficient purity of 80; $4.75 per ton for beets containing 19 per cent. of sugar to weight of beet and coefficient purity of 80; $5 per ton for beets containing 20 per cent of sugar to weight of beet and coefficient purity of 80. An additional 50 cents per ton will be paid from the bounty received from the state of Nebraska on beets from which the sugar enjoys that bounty, the intention being to make the farmer participate in said bounty. Also 20 per cent. of the weight of his beets in the shape of pulp will be returned free to the signer of this contract, subject to his taking it away as called upon to do so. Lime cakes, making an excellent fertilizer, will be given free to the farmer as fast as produced.

Very large beets or those grown mostly above ground, frozen or diseased beets, unfit to be manufactured into sugar, will be refused. In case the building is damaged by fire or otherwise in such a way that it is impossible to use or replace it in time to work off the crop of 1891, this contract becomes null and void, and the party of the first part agrees to pay the party of the second part $15 per acre for every acre contracted for and actually planted with beet seed at the time of the disaster, allowing said party of the second part to retain the crop. In case damage occurs before seeds are planted, then this contract becomes void, and the party of the second part has no claim at all against the party of the first part. Credit will be given for seeds to responsible parties, if desired to be deducted from payments on first delivery of beets. The party of the second part agrees to plant all the seed furnished him by the party of the first part on the acreage contracted for and dispose of it in no other way; said party of the second part also agrees to use no manure or fertillizers on the acreage contracted for after the signing of this contract. Payment will be made on the first of every month for beets delivered during the previous month, and checks will be sent by mail to those not present to collect. Beets can be delivered on cars at any station along the line of railroad running into Norfolk, said cars to be loaded to their visible capacity, and a deduction of 30 cents per ton will be made by the factory for distances of 25 miles from Norfolk or under, and a deduction of 50 cents per ton will be made for distances exceeding 25 miles and not over 45 miles, and not exceeding 100 miles 80 cents per ton will be deducted. Beets not properly cut and trimmed, or with dirt clinging to them, will be cleaned and cut, and the tare deducted from the weight of the beets. Notice should be given at the factory at once if anything detrimental occurs to the crop after the seeds are in the ground.

RESULTS OF 1890 AT GRAND ISLAND.

Through the kindness of Mr. H. T. Oxnard I have received the following condensed statement of the results of 1890, at Grand Island.

GRAND ISLAND, NEBRASKA, January 13, 1891.

Mr. D. N. Harper, Minneapolis, Minn.

DEAR SIR: The highest per centage of sugar in the beets this year was a little over 21 per cent., and the average 16 per cent. The yield varies from 10 to 20 tons. We have bought all our beets from farmers during the past year. Owing to the excessive drouth in this section last year, the cultivation of beets has not been entirely satisfactory.

Yours, very truly,

HENRY T. OXNARD, President.

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