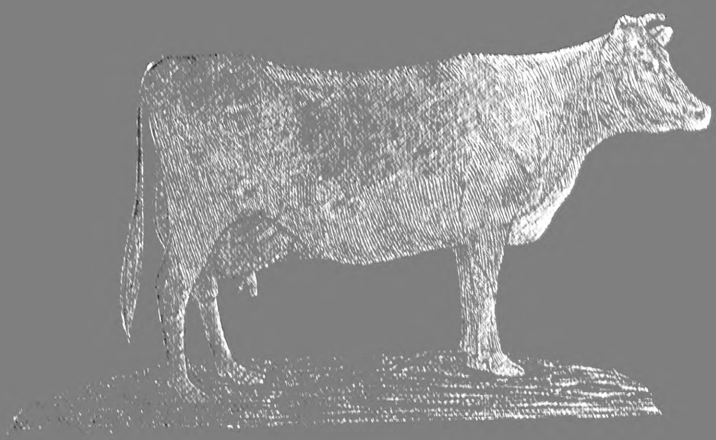
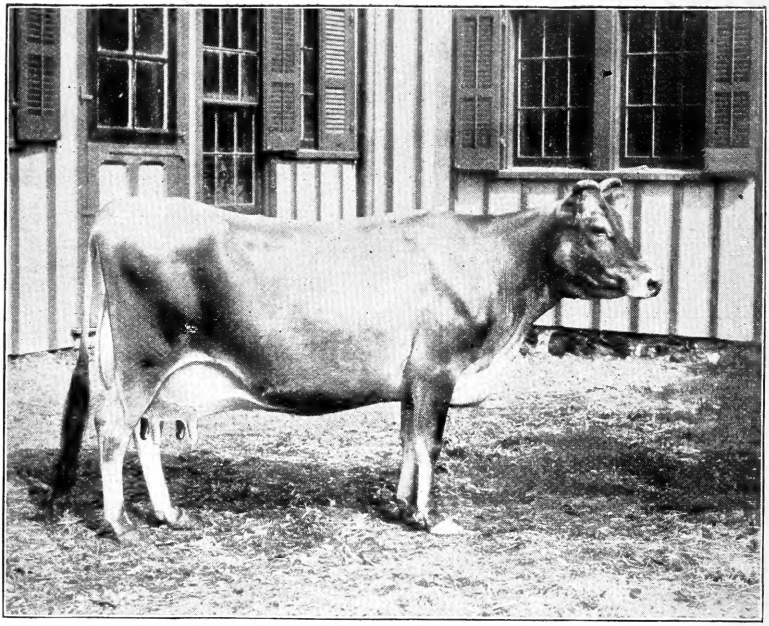
THE CREAMERY PATRON'S HANDBOOK



A BOOK OF INFORMATION

FOR THE

KEEPERS OF DAIRY COWS



THE DAIRY QUEEN:—

E'en though thou art of man the servant; the taker from him of such treatment as in wisdom or lack of it, he may accord thee; the yielder to him in thy maternity of that mystic life fluid that sustains him, gives to him his power, and makes for his profit and pleasure; the glad recipient of his kindness, or the meek object of his untaught abuse. All these art thou, yet, to the end of time, thou shalt still rule thy kingdom, and that of man's need, a Queen.

THE

CREAMERY PATRON'S HANDBOOK.

BEING A COMPILATION OF THOSE THINGS THE DAIRY FARMER SHOULD KNOW AND PRACTICE, TO THE SPEEDIER ATTAINMENT OF A SATISFACTORY INCOME FROM HIS DAIRY, AND THE PLEASURE AND PROFIT THAT COMES OF DAIRY WORK WELL AND SKILLFULLY DONE.

ILLUSTRATED.

A book to be studied rather than read; to have its application in daily practice rather than lose itself in the mere knowing; to lead on to achievement rather than idly to entertain.

PUBLISHED BY
THE NATIONAL DAIRY UNION,
154 LAKE ST., CHICAGO.
OCTOBER, 1902.

INTRODUCTORY.

But words are things, and a small drop of ink, falling like dew upon a thought, produces that which makes thousands, perhaps millions, think.—BYRON.

The world is too large to bring all individuals into that contact with their fellow workers whereby each will learn of the other's needs, and each contribute something helpful to the other, except by means of their printed words—books. "But words are things," and in the reading—diligently, understandingly—we may apply the world's best thoughts as we will to our own profit.

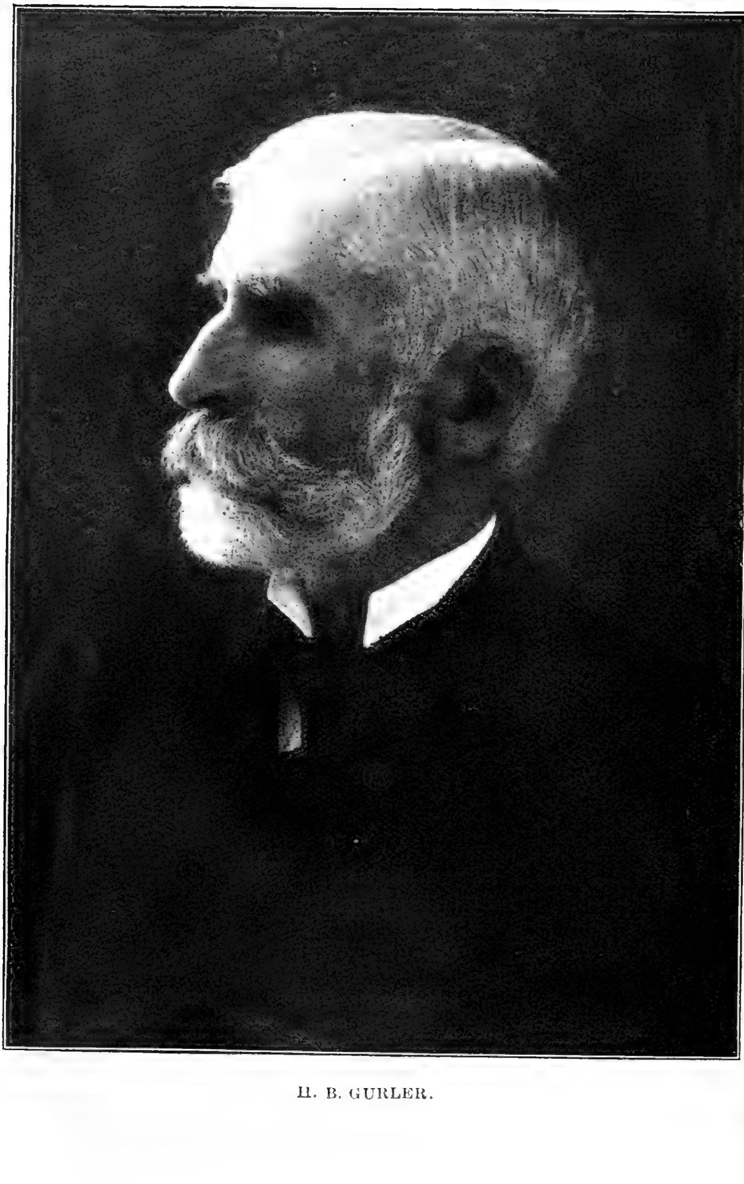
In this book are the best thoughts of well known and prominent investigators and workers in the dairy field. Practical men, every one of them, and who speak from the experience that comes of the doing of things with their own hands, assisted by habits of study—the scientific spirit that prompts the observer to seek into the how and the why of things that the world may the better understand, and, understanding, go on to still greater achievement. Words are the things that lead to action and actions are the expressions of knowledge. Those who put off the acquirement of the full knowledge of their industry, will ever be surpassed in their endeavors by those who seek the truth that they may know, for with truth abundant this is not a time for guessing.

In this book are expounded no theories. Every author deals with facts and takes them first hand. The non-essential things are left out and the essential ones simmered down for easy, every day, practical use. It is a book of the cow, first, last and in the middle. A book of the cow, the calf, the feed, the stable, the pasture, the milking, the care and sale of the milk. Much of it is a record of what has been done with cows, how it was done and who did it. Much more of the book tells what can be done by you, the reader—the best way to go about it, and what you may expect in return for the practical application of that better knowledge in your dairy work.

There is need of better dairying methods. There is need of a general awakening to the demands on the dairy and its wonderful possibilities. The dairy farmer will find a big profit when he dairies right—when he applies true dairy principles as they are here demonstrated in superabundance of example.

Applying the right methods doesn't mean more work for the same gain. No one ever lost anything by doing things right—by doing the right things at the right time and in the right way. And those things, and that way, is every bit the whole story of what this book endeavors to impress and help you to accomplish.

CHICAGO, ILL., October 1, 1902.



H. B. GURLER.

CONTENTS.

CONTENTS.

OFFICERS OF THE NATIONAL DAIRY UNION.

ILLUSTRATIONS.

CHARLES Y. KNIGHT.

THE NATIONAL DAIRY UNION AND ITS WORK FOR THE PROTECTION OF PURE BUTTER AGAINST OLEOMARGARINE IMITATION.

BY CHARLES Y. KNIGHT, SECRETARY OF THE NATIONAL DAIRY UNION, EDITOR AND MANAGER OF CHICAGO DAIRY PRODUCE.

Chicago.

Farmers who sell milk to the creamery and receive pay therefor upon basis of the market price of butter little realize the losses which they have incurred as a result of the manufacture and sale of a mixture of lard, tallow and cottonseed oil, known as oleomargarine, but until July 1 of this year almost universally sold or served as butter because of the fact that it was colored in exact imitation thereof.

In 1886 this traffic amounted to 21,513,537 lbs.; in 1894 it had grown to 69,622,246 lbs.; in 1900 to 107,045,028 lbs., and during the last fiscal year of the existence of oleomargarine artificially colored, the make in this country was 123,180,075 lbs., equal to 2,463,615 fifty-pound tubs, over six thousand car loads, or as much oleomargarine as one thousand large creameries turn out butter. *In other words, twenty-seven oleomargarine factories turned out oleomargarine equal in quantity to 25 per cent. of the butter product of all the creameries in the United States!*

The National Dairy Union was organized for the purpose of fighting this fraud. Its officers for the past five years have been:

PRESIDENT—Ex-Gov. W. D. Hoard, of Wisconsin, editor of Hoard's Dairyman.

TREASURER—Hon. H. B. Gurler, DeKalb, Ill., owner of "Clover Farm," author of "American Dairying," and whose entire interests are in dairying.

SECRETARY—Chas. Y. Knight, of Chicago, editor and manager of *Chicago Dairy Produce*, a weekly newspaper devoted to buttermaking.

In December, 1898, the proposition to ask Congress to place a tax of 10 cents per pound upon oleomargarine, colored in imitation of butter, was laid before the dairymen of the country by this organization. The work was immediately taken up, and, after more than three years of constant effort, the measure was finally passed. Every buttermaker or creamery manager knows what the results have been.

Those most benefited by the work of the National Dairy Union are the milkers of cows. Every cent added to the value of butter is a cent directly into their pockets. The merchant makes as much on butter sold at 15 cents as he does on that sold at 25 cents, and the former price requires less of his capital to handle; the creamery company is benefited only to the extent of its increased output of butter, which results from driving a fraudulent competitor out of the market. It is the farmer who gets nine-tenths of any advance in price of butter.

The object of the publication of this book is two-fold: First, to convey to the producer of milk information which will aid him to secure quality and quantity for his own financial gain; second, to provide means through its sale with which to sustain this organization in its work of protecting the dairy interests of this country against competition with fraudulent substitutes,

The principal provisions of the new oleomargarine law, which passed Congress finally April 29, and was signed by President Roosevelt May 9, 1902, are that all oleomargarine artificially colored shall pay an internal revenue tax of 10 cents per pound, the tax to be paid by the manufacturer, and any person who takes uncolored oleomargarine and colors it for the use and consumption of others, except his own family, shall be classed as a manufacturer and be subject to the 10 cent tax and $600 per year manufacturer's license.

In 1886 Congress passed a law placing a tax of 2 cents per pound upon all oleomargarine, and making provisions for marking, branding, inspection, etc. The act of 1902 raised the tax to 10 cents per pound upon all oleomargarine that is colored to resemble butter, and reduced to ¼-cent per pound the tax on that made in the color of the natural fats of which it is composed. The law of 1902, therefore, is really an amendment to the law of 1886. As amended by the recent act, the full oleomargarine law is as follows:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That for the purpose of this act the word "butter" shall be understood to mean the food product usually known as butter, and which is made exclusively from milk or cream, or both, with or without common salt, and with or without additional coloring matter.

SEC. 2. That for the purposes of this act certain manufactured substances, certain extracts, and certain mixtures and compounds, including such mixtures and compounds with butter, shall be known and designated as "oleomargarine," namely: All substances heretofore known as oleomargarine, oleo, oleomargarine oil, butterine, lardine, suine, and neutral; all mixtures and compounds of oleomargarine, oleo, oleomargarine-oil, butterine, lardine, suine, and neutral; all lard extracts and tallow extracts; and all mixtures and compounds of tallow, beef-fat, suet, lard, lard-oil, vegetable-oil, annatto, and other coloring matter, intestinal fat, and offal fat made in imitation or semblance of butter, or when so made, calculated or intended to be sold as butter or for butter.

SEC. 3. That special taxes are imposed as follows:

Manufacturers of oleomargarine shall pay six hundred dollars. Every person who manufactures oleomargarine for sale shall be deemed a manufacturer of oleomargarine.

And any person that sells, vends or furnishes oleomargarine for the use and consumption of others, except to his own family table without compensation, who shall add to or mix with such oleomargarine any artificial coloration that causes it to look like butter of any shade of yellow shall also be held to be a manufacturer of oleomargarine within the meaning of said Act, and subject to the provisions thereof.

Wholesale dealers in oleomargarine shall pay four hundred and eighty dollars. Every person who sells or offers for sale oleomargarine in the original manufacturer's packages shall be deemed a wholesale dealer in oleomargarine. But any manufacturer of oleomargarine who has given the required bond and paid the required special tax, and who sells only oleomargarine of his own production, at the place of manufacture, in the original packages to which the tax-paid stamps are affixed, shall not be required to pay the special tax of a wholesale dealer in oleomargarine on account of such sales.

Retail dealers in oleomargarine shall pay forty-eight dollars. Every person who sells oleomargarine in less quantities than ten pounds at one time shall be regarded as a retail dealer in oleomargarine. And sections thirty-two hundred and thirty-two, thirty-two hundred and thirty-three, thirty-two hundred and thirty-four, thirty-two hundred and thirty-five, thirty-two hundred and thirty-six, thirty-two hundred and thirty-seven, thirty-two hundred and thirty-eight, thirty-two hundred and thirty-nine, thirty-two hundred and forty, thirty-two hundred and forty-one, and thirty-two hundred and forty-three of the Revised Statutes of the United States are, so far as applicable, made to extend to and include and apply to the special taxes imposed by this section, and to the persons upon whom they are imposed; Provided, That in case any manufacturer of oleomargarine commences business subsequent to the thirtieth day of June of any year, the special tax shall be reckoned from the first day of July in that year, and shall be five hundred dollars.

Provided, further, That wholesale dealers who vend no other oleomargarine or butterine except that upon which a tax of one-fourth of one cent per pound is imposed by this Act, as amended, shall pay two hundred dollars; and such retail dealers as vend no other oleomargarine or butterine except that upon which is imposed by this Act, as amended, a tax of one-fourth of one cent per pound shall pay six dollars.

SEC. 4. That every person who carries on the business of a manufacturer of oleomargarine without having paid the special tax therefor, as required by law, shall, besides being liable to the payment of the tax, be fined not less than one thousand nor more than five thousand dollars; and every person who carries on the business of a wholesale dealer in oleomargarine without having paid the special tax therefor, as required by law, shall, besides being liable to the payment of the tax, be fined not less than five hundred nor more than two thousand dollars; and every person who carries on the business of a retail dealer in oleomargarine without having paid the special tax therefor, as required by law, shall, besides being liable to the payment of the tax, be fined not less than fifty nor more than five hundred dollars for each and every offense.

SEC. 5. That every manufacturer of oleomargarine shall file with the collector of internal revenue of the district in which his manufactory is located such notices, inventories, and bonds, shall keep such books and render such returns of material and products, shall put up such signs and affix such number to his factory, and conduct his business under such surveillance of officers and agents as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, may, by regulation, require. But the bond required of such manufacturer shall be with sureties satisfactory to the collector of internal revenue, and in a penal sum of not less than five thousand dollars; and the sum of said bond may be increased from time to time and additional sureties required at the discretion of the collector or under instructions of the Commissioner of Internal Revenue.

SEC. 6. That all oleomargarine shall be packed by the manufacturer thereof in firkins, tubs, or other wooden packages not before used for that purpose, each containing not less than ten pounds and marked, stamped, and branded as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, shall prescribe; and all sales made by manufacturers of oleomargarine and wholesale dealers in oleomargarine shall be in original stamped packages. Retail dealers in oleomargarine must sell only from original stamped packages in quantities not exceeding ten pounds, and shall pack the oleomargarine sold by them in suitable wooden or paper packages, which shall be marked and branded as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, shall prescribe. Every person who knowingly sells or offers for sale, or delivers or offers to deliver, any oleomargarine in any other form than in new wooden or paper packages as above described, or who packs in any package any oleomargarine in any manner contrary to law, or who falsely brands any package or affixes a stamp on any package denoting a less amount of tax than required by law, shall be fined for each offense not more than one thousand dollars and be imprisoned not more than two years.

SEC. 7. That every manufacturer of oleomargarine shall securely affix, by pasting, on each package containing oleomargarine manufactured by him, a label on which shall be printed, besides the number of the manufactory and the district and State in which it is situated, these words: "Notice—The manufacturer of the oleomargarine herein contained has complied with all the requirements of law. Every person is cautioned not to use either this package again or the stamp thereon again, nor to remove the contents of this package without destroying said stamp, under the penalty provided by law in such cases." Every manufacturer of oleomargarine who neglects to affix such label to any package containing oleomargarine made by him, or sold or offered for sale by or for him, and every person who removes any such label so affixed from any such package, shall be fined fifty dollars for each package in respect to which such offense is committed.

SEC. 8. *That upon oleomargarine which shall be manufactured and sold, or removed for consumption or use, there shall be assessed and collected a tax of ten cents per pound, to be paid by the manufacturer thereof; and any fractional part of a pound in a package shall be taxed as a pound; Provided, When oleomargarine is free from artificial coloration that causes it to look like butter of any shade of yellow said tax shall be one-fourth of one cent per pound. The tax levied by this section shall be represented by coupon stamps: and the provisions of existing laws governing the engraving, issue, sale, accountability, effacement and destruction of stamps relating to tobacco and snuff, as far as applicable, are hereby made to apply to stamps provided for by this section.*

SEC. 9. That whenever any manufacturer of oleomargarine sells, or removes for sale or consumption, any oleomargarine upon which the tax is required to be paid by stamps, without the use of the proper stamps, it shall be the duty of the Commissioner of Internal Revenue, within a period of not more than two years after such sale or removal, upon satisfactory proof, to estimate the amount of tax which has been omitted to be paid, and to make an assessment therefor and certify the same to the collector. The tax so assessed shall be in addition to the penalties imposed by law for such sale or removal.

SEC. 10. That oleomargarine imported from foreign countries shall, in addition to any import duty imposed on the same, pay an internal revenue tax of fifteen cents per pound, such tax to be represented by coupon stamps, as in the case of oleomargarine manufactured in the United States. The stamps shall be affixed and canceled by the owner or importer of the oleomargarine while it is in the custody of the proper custom-house officers; and the oleomargarine shall not pass out of the custody of said officers until the stamps have been so affixed and canceled, but shall be put up in wooden packages, each containing not less than ten pounds, as prescribed in this Act for oleomargarine manufactured in the United States, before the stamps are affixed; and the owner or importer of such oleomargarine shall be liable to all the penal provisions of this Act prescribed for manufacturers of oleomargarine manufactured in the United States. Whenever it is necessary to take any oleomargarine so imported to any place other than the public stores of the United States for the purpose of affixing and canceling such stamps, the collector of customs of the port where such oleomargarine is entered shall designate a bonded warehouse to which it shall be taken, under the control of such custom officer as such collector may direct; and every officer of customs who permits any such oleomargarine to pass out of his custody or control without compliance by the owner or importer thereof with the provisions of this section relating thereto shall be guilty of a misdemeanor, and shall be fined not less than one thousand dollars nor more than five thousand dollars, and imprisoned not less than six months nor more than three years. Every person who sells or offers for sale any imported oleomargarine or oleomargarine purporting or claimed to have been imported, not put up in packages and stamped as provided by this Act, shall be fined not less than five hundred dollars nor more than five thousand dollars, and be imprisoned not less than six months nor more than two years.

SEC. 11. That every person who knowingly purchases or receives for sale any oleomargarine which has not been branded or stamped according to law, shall be liable to a penalty of fifty dollars for each such offense.

SEC. 12. That every person who knowingly purchases or receives for sale any oleomargarine from any manufacturer who has not paid the special tax shall be liable for each offense to a penalty of one hundred dollars, and to a forfeiture of all articles so purchased or received, or of the full value thereof.

SEC. 13. That whenever any stamped package containing oleomargarine is emptied, it shall be the duty of the person in whose hands the same is, to destroy utterly the stamps thereon; and any person who wilfully neglects or refuses so to do shall for each such offense be fined not exceeding fifty dollars, and imprisoned not less than ten days nor more than six months. And any person who fraudulently gives away or accepts from another, or who sells, buys, or uses for packing oleomargarine, any such stamped package, shall for each such offense be fined not exceeding one hundred dollars, and be imprisoned not more than one year. Any revenue officer may destroy any emptied oleomargarine package upon which the tax-paid stamp is found.

SEC. 14. That there shall be in the office of the Commissioner of Internal Revenue an analytical chemist and a microscopist who shall each be appointed by the Secretary of the Treasury, and shall each receive a salary of two thousand five hundred dollars per annum, and the Commissioner of Internal Revenue may, whenever in his judgment the necessities of the service so require, employ chemists and microscopists, to be paid such compensation as he may deem proper, not exceeding in the aggregate any appropriation made for that purpose. And such Commissioner is authorized to decide what substances, extracts, mixtures, or compounds which may be submitted for his inspection in contested cases are to be taxed under this Act; and his decision in matters of taxation under this Act shall be final. The Commissioner may also decide whether any substance made in imitation or semblance of butter, and intended for human consumption, contains ingredients deleterious to the public health; but in case of doubt or contest his decision in this class of cases may be appealed from to a board hereby constituted for the purpose, and composed of the Surgeon-General of the Army, the Surgeon-General of the Navy, and the Commissioner of Agriculture; and the decisions of this board shall be final in the premises.

SEC. 15. That all packages of oleomargarine subject to tax under this Act that shall be found without stamps or marks as herein provided, and all oleomargarine intended for human consumption which contains ingredients adjudged, as hereinbefore provided, to be deleterious to the public health, shall be forfeited to the United States. Any person who shall wilfully remove or deface the stamps, marks or brands on packages containing oleomargarine taxed as provided herein shall be guilty of a misdemeanor, and shall be punished by a fine of not less than one hundred dollars nor more than two thousand dollars, and by imprisonment for not less than thirty days nor more than six months.

SEC. 16. That oleomargarine may be removed from the place of manufacture for export to a foreign country without payment of tax or affixing stamps thereto, under such regulations and the filing of such bonds and other security as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury may prescribe. Every person who shall export oleomargarine shall brand upon every tub, firkin, or other package containing such article the word "oleomargarine," in plain Roman letters not less than one-half inch square.

SEC. 17. That whenever any person engaged in carrying on the business of manufacturing oleomargarine defrauds, or attempts to defraud, the United States of the tax on the oleomargarine produced by him, or any part thereof, he shall forfeit the factory and manufacturing apparatus used by him, and all oleomargarine and all raw material for the production of oleomargarine found in the factory and on the factory premises, and shall be fined not less than five hundred dollars nor more than five thousand dollars, and be imprisoned not less than six months nor more than three years.

SEC. 18. That if any manufacturer of oleomargarine, any dealer therein or any importer or exporter thereof shall knowingly or wilfully omit, neglect, or refuse to do, or cause to be done, any of the things required by law in the carrying on or conducting of his business, or shall do anything by this Act prohibited, if there be no specific penalty or punishment imposed by any other section of this Act for the neglecting, omitting, or refusing to do, or for the doing or causing to be done, the thing required or prohibited, he shall pay a penalty of one thousand dollars; and if the person so offending be the manufacturer of or a wholesale dealer in oleomargarine, all the oleomargarine owned by him, or in which he has any interest as owner, shall be forfeited to the United States.

SEC. 19. That all fines, penalties, and forfeitures imposed by this Act may be recovered in any court of competent jurisdiction.

SEC. 20. That the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, may make all needful regulations for the carrying into effect of this Act.

SEC. 21. That this Act shall go into effect on the ninetieth day after its passage; and all wooden packages containing ten or more pounds of oleomargarine found on the premises of any dealer on or after the ninetieth day succeeding the date of the passage of this Act shall be deemed to be taxable under section eight of this Act, and shall be taxed, and shall have affixed thereto the stamps, marks, and brands required by this Act or by regulations made pursuant to this Act; and for the purposes of securing the affixing of the stamps, marks, and brands required by this Act, the oleomargarine shall be regarded as having been manufactured and sold, or removed from the manufactory for consumption or use, on or after the day this Act takes effect; and such stock on hand at the time of the taking effect of this Act may be stamped, marked, and branded under special regulations of the Commissioner of Internal Revenue, approved by the Secretary of the Treasury; and the Commissioner of Internal Revenue may authorize the holder of such package to mark and brand the same and to affix thereto the proper tax-paid stamps.

AN ACT to reduce the revenue and equalize the duties on imports, and for other purposes.

* * * * * * * *

SEC. 41. That wholesale dealers in oleomargarine shall keep such books and render such returns in relation thereto as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, may, by regulation, require, and such books shall be open at all times to the inspection of any internal revenue officer or agent.

* * * * * * * *

SEC. 53. That all special taxes shall become due on the first day of July, eighteen hundred and ninety-one, and on the first day of July in each year thereafter, or on commencing any trade or business on which such tax is imposed. In the former case the tax shall be reckoned for one year; and in the latter case it shall be reckoned proportionately, from the first day of the month in which the liability to a special tax commenced to the first day of July following. Special tax stamps may be issued for the months of May and June, eighteen hundred and ninety one, upon payment of the amount of tax reckoned proportionately under the laws now in force, and such stamps which have been or may be issued for the period ending April thirtieth, eighteen hundred and ninety-one, may, upon payment of one-sixth of the amount required to be paid for such stamps for one year, be extended until July 1st, eighteen hundred and ninety-one, under such regulations as may be prescribed by the Commissioner of Internal Revenue. And it shall be the duty of special tax-payers to render their returns to the deputy collector at such times within the calendar month in which the special tax liability commenced as shall enable him to receive such returns, duly signed and verified, not later than the last day of the month, except in cases of sickness or absence, as provided for in section three thousand one hundred and seventy-six of the Revised Statutes.

That all articles known as oleomargarine, butterine, imitation process, renovated or adulterated butter, or imitation cheese, or any substance in the semblance of butter or cheese not the usual product of the dairy and not made exclusively of pure and unadulterated milk or cream, transported into any State or Territory or the District of Columbia, and remaining therein for use, consumption, sale or storage therein, shall, upon the arrival within the limits of such State or Territory or the District of Columbia, be subject to the operation and effect of the laws of such State or Territory or the District of Columbia, enacted in the exercise of its police powers, to the same extent and in the same manner as though such articles or substances had been produced in such State or Territory or the District of Columbia, and shall not be exempt therefrom by reason of being introduced therein in original packages or otherwise.

RENOVATED AND ADULTERATED BUTTER AMENDMENT.

SEC. 4. That for the purpose of this Act "butter" is hereby defined to mean an article of food as defined in "An Act defining butter, also imposing a tax upon and regulating the manufacture, sale, importation and exportation of oleomargarine," approved August second, eighteen hundred and eighty-six; that "adulterated butter" is hereby defined to mean a grade of butter produced by mixing, re-working, re-churning in milk or cream, refining or in any way producing a uniform, purified, or improved product from different lots or parcels of melted or unmelted butter or butterfat, in which any acid, alkali, chemical or any substance whatever is introduced or used for the purpose or with the effect of deodorizing or removing therefrom rancidity, or any butter or butterfat with which there is mixed any substance foreign to butter as herein defined, with intent or effect of cheapening in cost the product, or any butter in the manufacture or manipulation of which any process or material is used with intent or effect of causing the absorption of abnormal quantities of water, milk or cream; that "process butter" or "renovated butter" is hereby defined to mean butter which has been subjected to any process by which it is melted, clarified or refined and made to resemble genuine butter, always excepting "adulterated butter" as defined by this Act.

That special taxes are imposed as follows:

Manufacturers of process or renovated butter shall pay fifty dollars per year and manufacturers of adulterated butter shall pay six hundred dollars per year. Every person who engages in the production of process or renovated butter or adulterated butter as a business shall be considered to be a manufacturer thereof.

Wholesale dealers in adulterated butter shall pay a tax of four hundred and eighty dollars per annum, and retail dealers in adulterated butter shall pay a tax of forty-eight dollars per annum. Every person who sells adulterated butter in less quantities than ten pounds at one time shall be regarded as a retail dealer in adulterated butter.

Every person who sells adulterated butter shall be regarded as a dealer in adulterated butter. And sections thirty-two hundred and thirty-two, thirty-two hundred and thirty-three, thirty-two hundred and thirty-four, thirty-two hundred and thirty-five, thirty-two hundred and thirty-six, thirty-two hundred and thirty-seven, thirty-two hundred and thirty-eight, thirty-two hundred and thirty-nine, thirty-two hundred and forty, thirty-two hundred and forty-one, and thirty-two hundred and forty-three of the Revised Statutes of the United States are, so far as applicable, made to extend to and include and apply to the special taxes imposed by this section and to the persons upon whom they are imposed.

That every person who carries on the business of a manufacturer of process or renovated butter or adulterated butter without having paid the special tax therefor, as required by law, shall, besides being liable to the payment of the tax, be fined not less than one thousand and not more than five thousand dollars; and every person who carries on the business of a dealer in adulterated butter without having paid the special tax therefor. as required by law, shall, besides being liable to the payment of the tax, be fined not less than fifty, nor more than five hundred dollars for each offense.

That every manufacturer of process or renovated butter or adulterated butter shall file with the collector of internal revenue of the district in which his manufactory is located such notices, inventories, and bonds, shall keep such books and render such returns of material and products, shall put up such signs and affix such number of his factory, and conduct his business under such surveillance of officers and agents as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, may by regulation require. But the bond required of such a manufacturer shall be with sureties satisfactory to the collector of internal revenue, and in a penal sum of not less than five hundred dollars ; and the sum of said bond may be increased from time to time and additional sureties required at the discretion of the collector or under instructions of the Commissioner of Internal Revenue.

That all adulterated butter shall be packed by the manufacturer thereof in firkins, tubs, or other wooden packages not before used for that purpose, each containing not less than 10 lbs. and marked, stamped, and branded as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, shall prescribe; and all sales made by manufacturers of adulterated butter shall be in original stamped packages.

Dealers in adulterated butter must sell only original or from original stamped packages, and when such original stamped packages are broken the adulterated butter sold from same shall be placed in suitable wooden or paper packages, which shall be marked and branded as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, shall prescribe. Every person who knowingly sells or offers for sale, or delivers or offers to deliver, any adulterated butter in any other form than in new wooden or paper packages as above described, or who packs in any package any adulterated butter in any manner contrary to law, or who falsely brands any package or affixes a stamp on any package denoting a less amount of tax than that required by law, shall be fined for each offense not more than $1,000 and be imprisoned not more than two years.

That every manufacturer of adulterated butter shall securely affix, by pasting, on each package containing adulterated butter manufactured by him a label on which shall be printed, besides the number of the manufactory and the district and State in which it is situated, these words: "Notice.--That the manufacturer of the adulterated butter herein contained has complied with all the requirements of law. Every person is cautioned not to use either this package again or the stamp thereon, nor to remove the contents of this package without destroying said stamp, under the penalty provided by law in such cases." Every manufacturer of adulterated butter who neglects to affix such label to any package containing adulterated butter made by him, or sold or offered for sale for or by him, and every person who removes any such label so affixed from any such package shall be fined $50 for each package in respect to which such offense is committed.

That upon adulterated butter, when manufactured or sold or removed for consumption or use, there shall be assessed and collected a tax of 10 cents per pound to be paid by the manufacturer thereof, and any fractional part of a pound shall be taxed as a pound, and that upon process or renovated butter, when manufactured or sold or removed for consumption or use, there shall be assessed and collected a tax of one-fourth of one cent per pound, to be paid by the manufacturer thereof, and any fractional part of a pound shall be taxed as a pound. The tax to be levied by this section shall be represented by coupon stamps, and the provisions of existing laws governing engraving, issuing, sale, accountability, effacement, and destruction of stamps relating to tobacco and snuff, as far as applicable are hereby made to apply to the stamps provided by this section.

That the provisions of sections nine, ten, eleven, twelve, thirteen. fourteen, fifteen, sixteen, seventeen, eighteen, nineteen, twenty, and twenty-one of "An Act defining butter, also imposing a tax upon and regulating the manufacture, sale, importation, and exportation of oleomargarine," approved August second, eighteen hundred and eighty-six, shall apply to manufaturers of "adulterated butter" to an extent necessary to enforce the marking, branding, identification and regulation of the exportation and importation of adulterated butter.

SEC. 5. All parts of an Act providing for an inspection of meats for exportation, approved August thirtieth, eighteen hundred and ninety, and of an Act to provide for the inspection of live cattle, hogs, and the carcasses and products thereof which are the subjects of interstate commerce approved March third, eighteen hundred and ninety-one, and of amendment thereto approved March second, eighteen hundred and ninety-five, which are applicable to the subjects and purposes described in this section shall apply to process or renovated butter. And the Secretary of Agriculture is hereby authorized and required to cause a rigid sanitary inspection to be made, at such times as he may deem proper or necessary, of all factories and storehouses where process or renovated butter is manufactured, packed or prepared for market, and of the products thereof and materials going into the manufacture of same. All process or renovated butter and the packages containing the same shall be marked with the words "Renovated Butter" or "Process Butter" and by such other marks, labels or brands and in such manner as may be prescribed by the Secretary of Agriculture, and no process or renovated butter shall be shipped or transported from its place of manufacture into any other State or Territory or the District of Columbia, or to any foreign country, until it has been marked as provided in this section. The Secretary of Agriculture shall make all needful regulations for carrying this section into effect, and shall cause to be ascertained and reported from time to time the quantity and quality of process or renovated butter manufnctured, and the character and the condition of the material from which it is made. And he shall also have power to ascertain whether or not materials used in the manufacture of said process or renovated butter are deleterious to health or unwholesome in the finished product, and in case such deleterious or unwholesome materials are found to be used in product intended for exportation or shipment, into other States, or in course of exportation or shipment, he shall have power to confiscate the same. Any person, firm, or corporation violating any of the provisions of this section shall be deemed guilty of a misdemeanor and on conviction thereof shall be punished by a fine of not less than fifty dollars nor more than five hundred dollars or by imprisonment not less than one month nor more than six months, or by both said puuishments, in the discretion of the court.

SEC. 6. That wholesale dealers in oleomargarine, process, renovated, or adulterated butter shall keep such books and render such returns in relation thereto as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, may, by regulation, require ; and such books shall be open at all times to the inspection of any internal revenue officer or agent. And any person who wilfully violates any of the provisions of this section shall for each such offense be fined not less than fifty dollars, and not exceeding five hundred dollars, and imprisoned not less than thirty days nor more than six months.

SEC. 7. This Act shall take effect on the first day of July, nineteen hundred and two.

The following members of the House of Representatives voted for the passage of this measure in the 57th Congress, and are therefore entitled to the friendship and support of farmers in general:

CALIFORNIA.

Frank L. Coombs..........Napa
Samuel D. Woods..........Stockton
Victor H. Metcalf..........Oakland
James McLachlan..........Pasadena
James C. Needham..........Modesto

COLORADO.

John F. Shafroth..........Denver
John C. Bell..........Montrose

CONNECTICUT.

E. Stevens Henry..........Rockville
Nehemiah D. Sperry..........New Haven
Charles A. Russell..........Killingly
Ebenezer J. Hill..........Norwalk

DELAWARE.

L. Heister Ball..........Faulkland

ILLINOIS.

George E. Foss..........Chicago
Albert J. Hopkins..........Aurora
Robert R. Hitt..........Mount Morris
George W. Prince..........Galesburg
Walter Reeves..........Streator
Joseph G. Cannon..........Danville
Vespasian Warner..........Clinton
Joseph V. Graff..........Pekin
J. Ross Mickey..........Macomb
Thomas J. Selby..........Hardin
Ben F. Caldwell..........Chatham
Thomas M. Jett..........Hillsboro
Joseph B Crowley..........Robinson
James R. Williams..........Carmi
Frederick J. Kern..........Belleville
George W. Smith..........Murphysboro

INDIANA.

James A. Hemenway..........Boonville
Robert W. Miers..........Bloomington
William T. Zenor..........Corydon
Francis M. Griffith..........Vevay
Elias S. Holliday..........Brazil
James E. Watson..........Rushville
George W Cromer..........Muncie
Charles B. Landis..........Delphi
James M. Robinson..........Fort Wayne
Abraham L. Brick..........South Bend

IOWA.

John N. W. Rumple..........Marengo
David B. Henderson..........Dubuque
Gilbert N. Haugen..........Northwood
Robert G. Cousins..........Tipton
John F. Lacey..........Oskaloosa
John A. T. Hull..........Des Moines
William P. Hepburn..........Clarinda
Walter I. Smith..........Council Bluffs
James P. Conner..........Dennison
Lot Thomas..........Storm Lake

KANSAS.

Charles Curtis..........Topeka
Alfred M. Jackson..........Winfield
James M. Miller..........Council Grove
Wm. A. Calderhead..........Marysville
William A. Reeder..........Logan

KENTUCKY.

D. Linn Gooch..........Covington
George G. Gilbert..........Shelbyville

LOUISIANA.

Phanor Breazeale..........Natchitoches

MAINE.

Amos L. Allen..........Alfred
Charles E. Littlefield..........Rockland
Edwin C. Burleigh..........Augusta
Llewellyn Powers..........Houlton

MARYLAND.

William H. Jackson..........Salisbury
Albert A. Blakeney..........Franklinville
Sydney E. Mudd..........La Plata
George A. Pearre..........Cumberland

MASSACHUSETTS.

George P. Lawrence..........North Adams
Frederick H. Gillett..........Springfield
John R. Thayer..........Worcester
Charles Q. Tirrell..........Natick
William S. Knox..........Lawrence
William H. Moody..........Haverhill
Joseph A. Conry..........Boston
Samuel L. Powers..........Newton
William C. Lovering..........Taunton
William S. Greene..........Fall River

MICHIGAN.

Henry C. Smith..........Adrian
Washington Gardner..........Albion
Edward L. Hamilton..........Niles
William Alden Smith..........Grand Rapids
Samuel W. Smith..........Pontiac
Edgar Weeks..........Mount Clemens
Joseph W. Fordney..........Saginaw
Roswell P. Bishop..........Ludington
Henry H. Aplin..........West Bay City
Archibald B. Darragh..........St. Louis

MINNESOTA.

James A. Tawney..........Winona
James T. McCleary..........Mankato
Joel P. Heatwole..........Northfield
Fred C. Stevens..........St. Paul
Loren Fletcher..........Minneapolis
Page Morris..........Duluth
Frank M. Eddy..........Glenwood

MISSOURI.

James T. Lloyd..........Shelbyville
John Dougherty..........Liberty
Charles F. Cochran..........St. Joseph
David A. De Armond..........Butler
James Cooney..........Marshall
Champ Clark..........Bowling Green
Richard Bartholdt..........St. Louis
Edward Robb..........Perryville
Willard D. Vandiver..........Cape Girardeau
Mœcenas E. Benton..........Neosho

NEBRASKA.

Elmer J. Burkett..........Lincoln
David H. Mercer..........Omaha
John S. Robinson..........Madison
William L. Stark..........Aurora
Ashton C. Shallenberger..........Alma
William Neville..........North Platte

NEVADA.

Francis G. Newlands..........Reno

NEW HAMHSHIRE.

Cyrus A. Sulloway..........Manchester
Frank D. Currier..........Canaan

NEW JERSEY.

John J. Gardner..........Atlantic City
Benjamin F. Howell..........New Brunswick

Joshua S. Salmon........................Boonton
James F. Stewart........................Paterson
Richard Wayne Parker..................Newark
Charles N. Fowler.....................Elizabeth

NEW YORK.

Frederic Storm....................Bay Side, L. I.
Henry Bristow.........................Brooklyn
George H. Lindsay.....................Brooklyn
Nicholas Muller.... ....New York
Arthur S. Tompkins......... .... Nyack
John H. Ketcham..................Dover Plains
William M. Draper.................Lansingburg
John K. Stewart..... ....Amsterdam
Lucius N. Littauer........ . ...New York
Louis W. Emerson.................Warrensburg
Charles L. Knapp......................Lowville
James S. Sherman..........................Utica
George W. Ray................... ......Norwich
Michael E. Driscoll...................Syracuse
Sereno E. Payne........... ....Auburn
Charles W. Gillet. ....Addison
James Breck Perkins..................Rochester
De Alva S. Alexander...................Buffalo
Edward B. Vreeland.................Salamanca

NORTH CAROLINA.

Edward W. Pou.......................Smithfield
John D. Bellamy....................Wilmington
Theodore F. Kluttz......................Salisbury
Spencer Blackburn......................Winston
James M. Moody...................Waynesville

NORTH DAKOTA.

Thomas F. Marshall.......................Oakes

OHIO.

Robert M. Nevin..........................Dayton
Robert B. Gordon...................... St. Marys
John S. Snook............................Paulding
Charles Q. Hildebrant..............Wilmington
Thomas B. Kyle................ ....Troy
William R. Warnock....................Urbana
Stephen Morgan........................Oak Hill
Emmett Tompkins....................Columbus
James A. Norton.......................... Tiffin
William W. Skiles... ....Shelby
Henry C. Van Voorhis................Zanesville
Joseph J. Gill.......................Steubenville
John W. Cassingham.................Coshocton
Robert W. Tayler..........................Lisbon
Charles Dick...............................Akron

PENNSYLVANIA.

Galusha A. Grow.......................Glenwood
Robert H. Foerderer...............Philadelphia
Henry H. Bingham................Philadelphia
Edward Morrell....................Philadelphia
Thomas S. Butler...................West Chester
Irving P. Wanger.....................Norristown
Howard Mutchler..........................Easton
Henry D. Green..........................Reading
H. Burd Cassel...... ....Lancaster
Henry W. Palmer...................Wilkesbarre
George R. Patterson....................Ashland
Marlin E. Olmsted....................Harrisburg
Charles Fred. Wright..............Susquehanna
Elias Deemer......................Williamsport
Rufus K. Polk............. ....Danville
Thaddeus M. Mahon.............Chambersburg
Robert J. Lewis..............................York
Alvin Evans................... .....Ebensburg
Summers M. Jack.........................Indiana
Ernest F. Acheson..................Washington
Joseph B. Showalter......................Chicora
Arthur L. Bates..... ....Meadville
Joseph C. Sibley........................Franklin
James K. P. Hall........................Ridgway

OREGON.

Malcom A. Moody................... The Dalles
Thomas H. Tongue....................Hillsboro

SOUTH DAKOTA.

Eben W. Martin........................Deadwood
Charles H. Burke...........................Pierre

TENNESSEE.

Walter P. Brownlow..................Jonesboro
Henry R. Gibson......................Knoxville

UTAH.

George Sutherland...............Salt Lake City

VERMONT.

David J. Foster........................Burlington
Kittredge Haskins...................Brattleboro

VIRGINIA.

William A. Jones........................Warsaw
John Lamb............................Richmond
Peter J. Otey..........................Lynchburg
James Hay...............................Madison
John F. Rixey............................Brandy
William F. Rhea...........................Bristol

WASHINGTON.

Wesley L. Jones. .... Yakima
Francis W. Cushman...................Tacoma

WEST VIRGINIA.

Blackburn B. Dovener.................Wheeling
Alston G. Dayton.........................Philippi

WISCONSIN.

Henry A. Cooper...........................Racine
Herman B. Dahle..................Mount Horeb
Joseph W. Babcock.......................Necedah
Theobold Otjen.......................Milwaukee
Samuel S. Barney....................West Bend
James H. Davidson.......................Oshkosh
John J. Esch..... ....La Crosse
Edward Minor......................Sturgeon Bay
Webster E. Brown....................Rhineland
John J. Jenkins.................Chippewa Falls

The vote in favor of the bill in the Senate was as follows:

CALIFORNIA.

Thomas R. Bard, Rep...................Ventura
George C. Perkins, Rep...........San Francisco

CONNECTICUT.

Joseph R. Hawley, Rep................Hartford
Orville H. Platt, Rep........ ....Meriden

ILLINOIS.

Shelby M. Cullom, Rep...........Springfield
William E. Mason, Rep.. ... .Chicago

INDIANA.

Albert J. Beveridge, Rep..........Indianapolis
Charles W. Fairbanks, Rep.. .... Indianapolis

IOWA.

Jonathan P. Dolliver, Rep...........Fort Dodge
William B. Allison, Rep................Dubuque

KANSAS.

Joseph R. Burton, Rep...................Abilene
William A. Harris, Pop..... ....Linwood

KENTUCKY.

William J. Deboe, Rep......... ....Marion

MAINE.

William P. Frye, Rep..................Lewiston
Eugene Hale, Rep......................Ellsworth

MARYLAND.

Louis E. McComas, Rep.............Hagerstown

MASSACHUSETTS.

George F. Hoar, Rep..................Worcester
Henry Cabot Lodge, Rep........... .....Nahant

MICHIGAN.

James McMillan, Rep.....................Detroit
Julius C. Burrows, Rep..............Kalamazoo

MINNESOTA.

Knute Nelson, Rep....................Alexandria
Moses E. Clapp, Rep......................St. Paul

MISSOURI.

Francis M. Cockrell, Dem..........Warrensburg

NEBRASKA.

Joseph H. Millard, Rep...................Omaha
Charles H. Dietrich, Rep...............Hastings

NEW HAMPSHIRE.

Henry E. Burnham, Rep............Manchester
Jacob H. Gallinger, Rep.. ....Concord

NEW JERSEY.

John Kean, Rep.........................Elizabeth

NEW YORK.

Chauncey M. Depew, Rep.............New York
Thomas C. Platt, Rep......................Owego

NORTH CAROLINA.

Jeter C. Pritchard, Rep.................Marshall

NORTH DAKOTA.

Porter McCumber, Jr.. Rep...........Wahpeton
Henry C. Hansbrough, Rep.........Devils Lake

OHIO.

Marcus A. Hanna, Rep................Cleveland
Joseph B. Foraker, Rep...............Cincinnati

OREGON.

John H. Mitchell, Rep..................Portland
Joseph Simon, Rep,......................Portland

PENNSYLVANIA.

Matthew S. Quay, Rep....................Beaver
Boies Penrose, Rep.....................Philadelphia

SOUTH DAKOTA.

Robert J. Gamble, Rep..................Yankton
Alfred B. Kittredge, Rep............Sioux Falls

UTAH.

Thomas Kearns, Rep............. Salt Lake City

VERMONT.

Redfield Proctor, Rep............ ....Proctor
William P. Dillingham, Rep.. ......Montpelier

WASHINGTON.

Addison G. Foster, Rep..................Tacoma

WISCONSIN.

Joseph V. Quarles, Rep..............Milwaukee
John C. Spooner, Rep....................Hudson

The following United States Senators voted against the passage of the bill :

ALABAMA.

John T. Morgan, Dem.......................Selma
Edmund W. Pettus, Dem..................Selma

ARKANSAS.

James H. Berry, Dem...............Bentonville
James K. Jones, Dem...............Washington

COLORADO.

Thomas M. Patterson, Dem......... ....Denver
Henry M. Teller, Dem.......... ...Central City

FLORIDA.

James P. Taliaferro, Dem..........Jacksonville
Stephen R. Mallory, Dem.............Pensacola

GEORGIA.

Augustus O. Bacon, Dem.... ....Macon
Alexander S. Clay, Dem................Marietta

IDAHO.

Frederick T. Dubois, Fus..............Blackfoot
Henry Heitfeld, Pop...................Lewiston

KENTUCKY.

Joseph C. S. Blackburn, Dem.........Versailles

LOUISIANA.

Murphy J. Foster, Dem.................Franklin
Samuel D. McEnery, Dem..........New Orleans

MARYLAND.

George L. Wellington, Rep. ....Cumberland

MISSISSIPPI.

Anselm J. McLaurin, Dem.............Brandon
Hernando DeSoto Money, Dem..... . Carrollton

MISSOURI.

George G, Vest, Dem................Kansas City

MONTANA.

William A. Clark, Dem................. ..Butte
Paris Gibson, Dem...................Great Falls

NEVADA.

William M. Stewart, Sil.............Carson City
John P. Jones, Sil.......................Gold Hill

NORTH CAROLINA.

F. McL. Simmons, Dem. ....Raleigh

RHODE ISLAND.

George P. Wetmore, Rep..............Newport
Nelson W. Aldrich, Rep..............Providence

SOUTH CAROLINA.

Benjamin R. Tillman, Dem.............Trenton
John L. McLaurin, Dem...........Bennettsville

TENNESSEE.

Edward W. Carmack, Dem..............Memphis
William B. Bate, Dem..................Nashville

TEXAS.

Joseph W. Bailey, Dem.... ....Gainsville
Charles A. Culberson, Dem...............Dallas

UTAH.

Joseph L. Rawlins, Dem.........Salt Lake City

VIRGINIA.

Thomas S. Martin, Dem..............Scottsville
John W. Daniel, Dem.... ....Lynchburg

WASHINGTON.

George Turner, Sil........................Spokane

WEST VIRGINIA.

Stephen B. Elkins, Rep....................Elkins
Nathan B. Scott, Rep............ .....Wheeling

WYOMING.

Francis E. Warren, Rep...............Cheyenne
Clarence D. Clark, Rep................Evanston

HON. W. D. HOARD.

THE PATRON AND THE CREAMERY.

BY HON. W. D. HOARD, EX-GOVERNOR OF WISCONSIN, PRESIDENT OF THE NATIONAL DAIRY UNION AND EDITOR OF "HOARD'S DAIRYMAN."

Fort Atkinson, Wis.

The real foundation of the creamery business is the patron. The first chief care should be to so equip the patron with knowledge and understanding concerning his share of the work that he may make the largest profit possible. A very large proportion of the creamery patrons make the serious mistake of supposing that their profits must somehow come from the creamery end rather than the farm end. They are all the time looking at the price paid for making the butter, thinking the great expense lies there. This is not true. The real and most serious expense lies at the farm end in producing the milk, and getting it to the creamery. There seems to be a most serious lack of knowledge and study concerning the best economy and methods of producing milk; concerning the right kind of cows that shall produce milk in sufficient abundance to make the cost low per cow; concerning the right methods of field and stable management so that the cow can do her best; concerning farm management in producing the right crops and so handling them that they shall stimulate milk secretion to the largest advantage; concerning the science of feeding, how to compound a ration that is adapted to milk production. All these points require reading and study, and every creamery should be a dairy school where the patrons may take advantage of their co-operation together to increase their knowledge.

How many creameries are there of that sort in the country? But very few. A prominent creamery company, comprising over one hundred creameries, keeps an expert dairy farmer to travel from one creamery to another instructing the farmers on all these points to the best of his ability. Some of the patrons are quick and anxious to learn. They realize the necessity of such training and education. They purchase books and papers that treat of these questions, and it is a fact that their profits per cow are many times greater than those of their neighbors, in the same creamery, who place no value on such knowledge and study. But few, comparatively, realize the tremendous difference and increase in profits which such intelligence brings.

I will give one illustration taken from the Hoard Creameries at Fort Atkinson, Wis. To one patron, who has a herd of nineteen cows, was paid

$65 per cow for the year, for the cream in his milk, the skim-milk being returned to him. The cost of keeping was $35 per cow. This left him a profit of $30 per cow. To another patron in the same creamery, was paid $35 per cow. The cost of keeping his cows was $30 per cow. He received $5 per cow profit. The first patron received *six hundred* per cent. more of net profit than the second man. The milk of both was taken by the Babcock test, and the butter of both sold at the same price. This tremendous difference in profits lay at the farm end of the business, and not at the creamery. The first patron was a reading, thinking man who kept his mind at constant study on all the points we have mentioned. The second patron did not believe in such things, and he lost $25 per cow for his way of thinking. When he came to compare his ideas and methods with the first patron, he made up his mind that it did not pay to despise dairy knowledge and a better education in the things that so closely belonged to his business.

This leads us to suggest that every creamery should prepare a yearly report setting forth the name of each patron; the number of cows in his herd, and the cost of their yearly keeping; whether a silo was used or not; the pounds of milk and the butter yield per cow; the average price at which the butter sold for the year, and the amount received in cash per cow for each dollar spent in feed. Such a report would show each patron at once just what his neighbor's cows were earning, by which he could compare his own work and see whether his ideas were as profitable as they should be, or not. Such a system of reporting would act as a great stimulus to thousands of dairy farmers, and result, we believe, in great benefit to the creamery. What every man needs is a comparative knowledge of the dairy facts about him, and such a report would yield that knowledge. Shut up within our own line fences, we "measure ourselves by ourselves," and so continue to confirm ourselves in mistaken ideas and methods.

As useful as is the creamery, it is productive of some bad effects on the minds of certain farmers who patronize it. To illustrate: In 1885, there were over one thousand dairy farmers in Jefferson County, Wis., who were making butter and selling it on commission in Chicago and other cities. They were thus brought sharply in contact with the demands of the market, and the market was forcing them every day up to a higher and more profitable plane of dairy management. These men were consequently anxious to learn all that was necessary to know about cows and their proper handling. Their minds were constantly being broadened and brightened by their immediate relation to a very exacting market.

Now, the creamery has come and, to a certain extent, has stepped in between them and the market, so that they do not as clearly see their own responsibility to the quality and price of the butter as they did before. The consequence is that many of these men have grown careless and indifferent to their own improvement. Their standard of dairy farming has been lowered and they are not as successful handlers of cows as they were in 1885.

This is a most serious mistake, for every man is in reality just as much responsible for the final result, as he was twenty years ago. This shows that the creamery proprietors and managers should make especial effort to promote dairy education and knowledge of best methods, in order to counteract this tendency to lax effort. Every patron should look upon his relation to the creamery in the light that he is a partner. What is needed in every creamery is a strong central tone of public sentiment that shall tend to the promotion of intelligence and improvement along dairy lines.

We believe most thoroughly in the creamery, but we want it to act as a stimulant to dairy improvement and progress. There are dangers, as well as blessings, in its path. We have seen old dairy districts in the State of New York decline in fertility of the soil, and a true spirit of progress among its farmers, to the extent that farms that sold for $100 an acre, thirty years ago, can be bought to-day for $25 to $30. This fearful loss came because the farmers gave themselves up to indifference as to their own dairy knowledge and improvement. A bright, intelligent set of patrons in any creamery always insures honesty and good management. Such men will be satisfied with nothing less. Dairy education has benefited the creamery operator more than the patrons. Consequently the creamery end is kept up square with the best modern judgment, to a larger degree than is the farm end. As a rule, the buttermaker does his share of the work better than the milk producer. This is because he has put himself in contact with the best modern thought on dairy matters to a much larger degree than has the patron. It is the patron who really makes the butter; the creamery only separates it, and puts it on the market. Certainly there is as great need for sound knowledge, intelligent, up-to-date methods and the spirit of true American progress among the patrons, as with the buttermakers.

A broader, more just view of the true relations of the patron to the creamery has always resulted in greatly increasing the profits, as well as the harmony and success of both patron and the creamery operator.

"Let me be no assistant for a state,
But keep a farm."—Shakespeare.

"And joy to him, who o'er his task,
Remembers toil is nature's plan;
Who, working, thinks—and never sinks
His independence as a man."

—*Mackay.*

BUILDING UP A DAIRY HERD, WITH SUGGESTIONS ON MIDSUMMER FORAGE CROPS.

BY PROF. F. C. CURTISS, DIRECTOR AND AGRICULTURIST, IOWA AGRICULTURAL EXPERIMENT STATION.

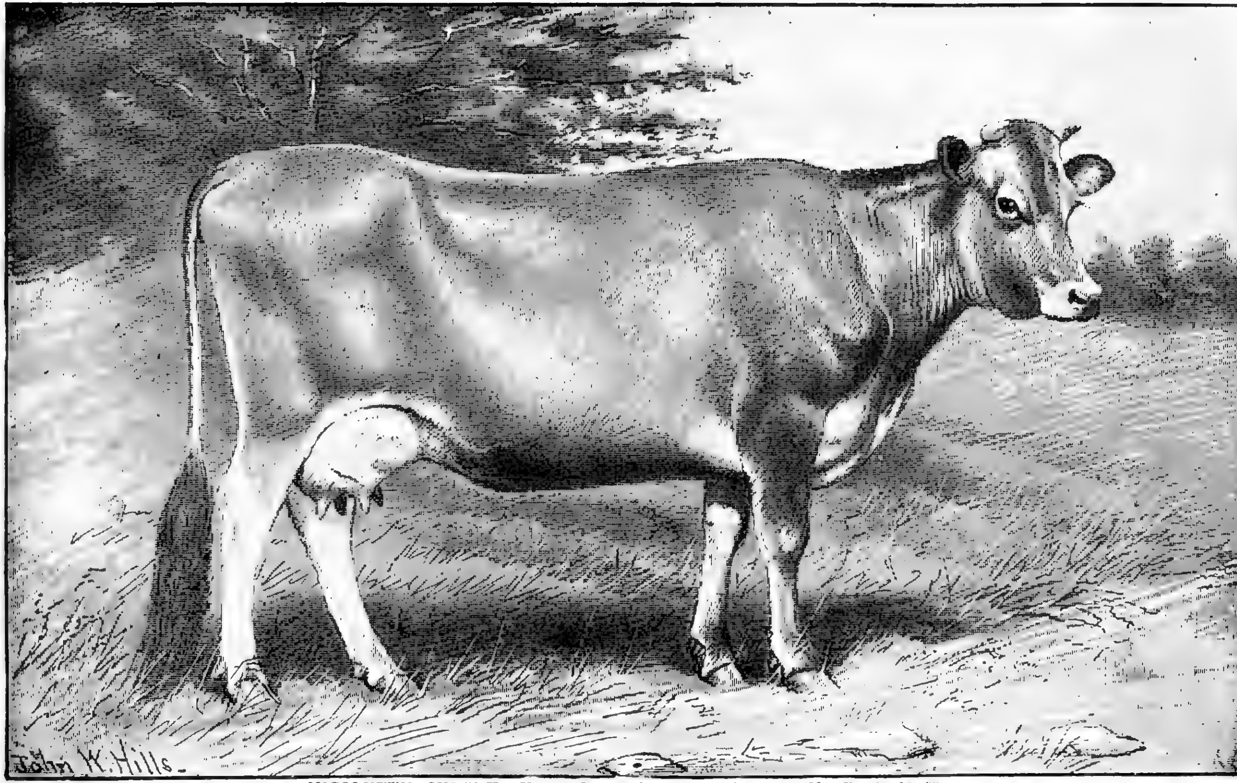
Ames, Iowa.

The primary problem in dairy progress is the cow. The success of the dairy industry in any locality must depend primarily on the dairy cow and her management. Marked advance has been made in recent years in the improvement of facilities and methods for perfecting our dairy products, but the cow is still the source of supply of the raw material. It is the function of the creamery and dairy to convert the raw material into finished products of the highest degree of excellence; but the cow precedes the factory. The process of butter production supplements milk production. Inferior cows mean loss to the owner and failure to the factory.

GOLDIE'S TORMENT.
Champion Aged Bull at the Iowa and Minnesota State Fairs, 1900, When 12 Years Old; Also First Prize on Get of Sire at Both Fairs.

By reason of the improvements made in creamery methods and appliances, the cow is a much less important factor than formerly in determining the quality of the product, provided the milk is obtained in wholesome condition. The buttermaker is now conceded to have more to do with this than the cow. In computing the profit and loss, however, we are compelled to reckon with the cow first, last and all the time. In this feature the cow is a greater factor than ever before.

Two years ago I spent a couple of days attending the annual exhibition of the Royal Agricultural Society of Jersey Island. This exhibition is a Jersey cattle show. All the cattle on the island are Jerseys. As I studied my catalogue, I noted the frequency of the occurrence of a particular sire



NICOLETTE—JERSEY.—Yearly Butter Record, 513 Pounds; Net Profit, $49.00.

in the pedigrees of the prize winners. I was struck with the uniformity and excellency of this bull's progeny. After the judging was completed, I said to one of the judges: "Where is this bull, Golden Fern's Lad?" "That bull," said Mr. Nicole, "was sold for export to England last year, and the cattle interests of the island lost fully £10,000 ($50,000) when he left."

I there saw one of the most striking demonstrations of the potency and value of a superior sire that it has ever been my privilege to witness. This strain of blood has since been in universal demand among the best breeders of both continents.

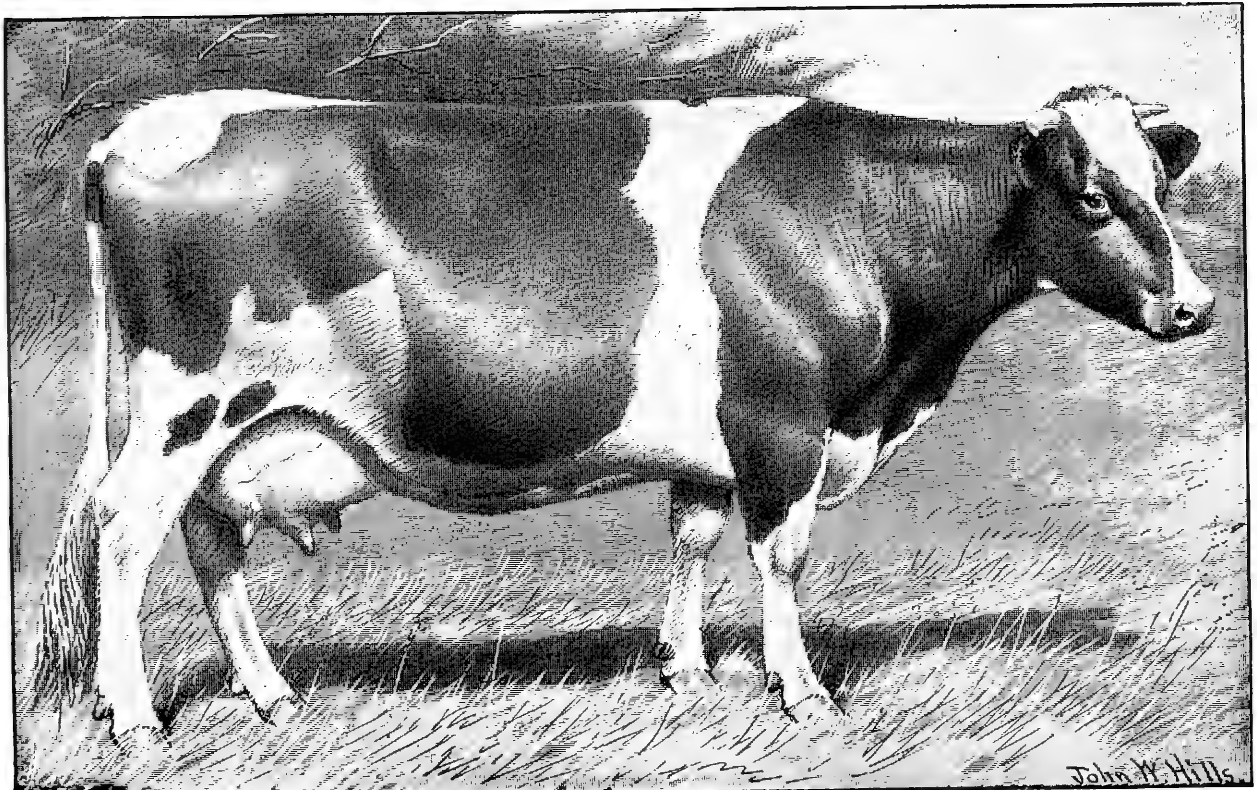
The task of building up a dairy herd whether pure bred or for practical production, must begin with the sire. This is the fundamental problem of the breeder. The development of superior herds is generally a record of the strength and potency of good sires. Without this all other efforts will fail. There are but few dairy sires of outstanding excellence, and comparatively few among domestic animals of any kind.

The primary problem and the life long study of the great breeders of all times has been a study of sires. Successful sires are more rare among dairy cattle than among any other kind of stock, unless it be high speed horses. Both are highly artificial creations. Nature's laws operate with less certainty in the more delicately organized animals of nervous temperament, where excellence depends on performance, than where heredity is more a matter of form and substance, as in meat producing animals and draft horses.

There are many qualities to be considered in the dairy sire. These qualities are never fully apparent in the animal itself, but must be sought and studied in the ancestry. One of the first essentials is a good mother. This alone is by no means conclusive evidence of inherited excellence, but a sire should never be without a strong line of maternal ancestry. Concentration of good blood and individual excellence is the surest means of its perpetuation. First among the characteristics sought in a good sire ,I would look to the head. I presume many will take exception to this and place constitution first, but the head reveals constitution, almost as accurately as do depth and width of thorax and fullness of heart girth. Next to the udder I regard the head as the most expressive character of the dairy cow, as well as the chief significance in the dairy bull.

The more we study the best types of domestic animals and the more we study the work and the products of the great breeders, the more we are forced to recognize the head as of chief significance in revealing the inherent quality and practical value of animal excellence. The head is, in a sense, a mirror reflecting all that goes to make up the animal. The successful sire must have a bull's head. It must be strong, masculine, full of character and vigor. It must be broad between the eyes and clean cut and well defined. The eyes must stand out full and prominent.

The head is sometimes classed among the points of fancy, but it is more than this. It indicates vitality, strength, breed type, and nerve force; all



PRINCESS OF BLACKHAWK—HOLSTEIN.—Yearly Butter Record, 538 Pounds; Net Profit, $59.54.

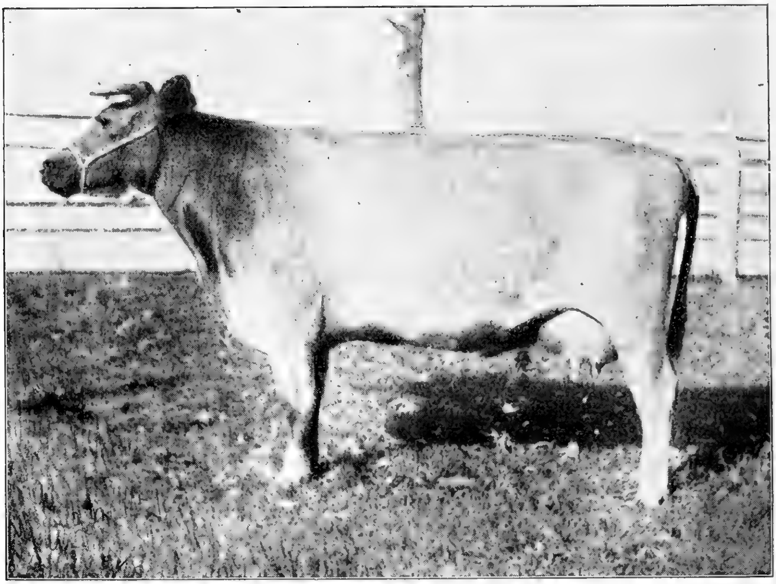
of which are essential to a prepotent sire. A sire must descend from a strong line of good ancestors, but he must have more than this, he must present unmistakable evidence in his make up of having inherited from these ancestors in a marked degree the qualities and characteristics that are sought for reproduction.

Depth and spring of rib, indicating feeding capacity, necessarily rank among the characteristics of prime importance in either the sire or the dam. There should be no bad udders in the ancestry back of the bull. This is one of the first requisites of a good dairy sire. There is now and then a good dairy cow with a defective udder; but they are rare and a strictly good, well balanced udder is almost aways a certain indication of good performance at the pail, no matter what breed or type it accompanies. The men who have bred dairy cattle longest and most successfully, are the most exacting about the udder.

The dairy sire should always be selected from a cow of outstanding excellence and from a long line of such ancestry on both sides. No inherent weakness should be tolerated in the ancestors that enter into the pedigree. Under no circumstances should a sire be used from a cow having a defective udder, or a weak constitution, or a lack of feeding capacity. Among the points of excellence sought in the cow, I should place constitution first, dairy quality or function, as indicated by the head, udder and form, second; breed type and character, third. It is not well to depart too much in either direction from the established standard of size or from the prevailing or most popular type. Animals of extreme variation are not likely to reproduce desirable characteristics. An unusual degree of coarseness can better be tolerated in the cow than in the sire. Attractiveness is desirable, but style, finish and beauty must not be sought at the expense of utility. The tendency to recognize one type for the show ring and another for type utility and profitable production, cannot but result injuriously to any breed. It is difficult enough to breed domestic animals successfully to one type or standard of excellence, instead of striving for two distinct standards. Qualities that make a cow a profitable producer, should have first consideration in building up a dairy herd. These qualities should be carefully and persistently sought and every possible effort exerted to perpetuate and intensify them. There are always radical departures from the highest type of animals in all classes. This is particularly true in the dairy breeds.

One of the common and most serious mistakes is made in the supposition that animals have excellence because they belong to a particular breed or family. There are no dairy herds in existence, no matter how carefully or intelligently bred, that do not need to be rigidly selected, and all the culls and inferior animals rejected. There is such a small percentage of the males of the dairy breeds used for sires that there is no occasion for using any but the best; yet there are many animals used of ordinary individual merit and very inferior ancestry. It is better in most cases to use an aged sire that has been tried and proven his merit than an untried sire of doubtful prepotency. The greatest problem in breeding is the selection of the sire, whether it be for the improvement of a grade herd, or the upbuilding of a registered herd of the pure breeds.

As a rule it is better to breed the cows that make up the dairy herd than to depend upon buying them. There are comparatively few good dairy cows for sale, and except in case of dispersion sales, the best cows of a herd can seldom be bought at a reasonable price. The policy in breeding should be to test regularly and reject all that do not measure up to a high standard after they have been given a thorough trial. The selection should



COLLEGE MOORE—SHORTHORN.
Yearly Butter Record, 474 Pounds; Net Profit, $81.60.

be based upon actual results at the pail, rather than points of fancy or form. It is a pretty safe policy to select cows upon performance. There are some exceptions to this rule, but in general the cow that is a good producer will conform closely to the accepted dairy type and form.

The ideal dairy type and form also admits of considerable flexibility and it is not advisable to adhere too rigidly to established types, provided better results could be obtained by a slight departure in some instances. The best dairy heifers will almost invariably come from the very best cows of the herd; but it is seldom that all of the heifers from any cow will be good enough to be retained in the herd. The offspring of even the very best bred ancestry needs to be subjected to rigid selection. The only way to do this intelligently is to actually know what every cow in the herd is capable of producing, and to apply the same test to the heifers as soon as they come into milk. It is not always advisable to reject a heifer from the results of the test made during her first period of lactation. The inferior animals of defective udder, or seriously defective form, can easily be culled out by the first test; but those of less prominent defects sometimes need to be retained longer, and in some instances heifers that promise well during the first period of lactation do not fulfill this promise by subsequent development.

COLLEGE LILY—ABERDEEN-ANGUS.
Yearly Butter Record, 387 Pounds; Net Profit, $46.16.

The feeding and general management of a dairy herd are an important factor in the results attained by the dairy herd. Excellence of breeding and inherited dairy function, may be set at naught by improper methods. Many cows never milk well because they never have a chance, and are never properly fed for milk production. If the same kindly treatment and constant attention bestowed upon the dairy cattle of the Channel Islands and Holland and Denmark, could be given to the dairy herds of our country, it would, in a great majority of cases, lead to double the present production. The modern dairy cow is a highly organized, sensitive, and artificial creation. To subject her to lack of feed, exposure and neglect, common in so many herds, means a loss of practically all that has been gained by good breeding. Feed, comfort, care and breeding combined are the only means of bringing our dairy herds to the standard of excellence that must be maintained to make them profitable on the high-priced land of the Mississippi valley.

MIDSUMMER FORAGE CROPS

FOR THE DAIRY HERD.

The impression exists in the minds of some that as farm lands advance in value, the pasture and grass lands must largely diminish.

SYLVIA—RED POLL.
Yearly Butter Record, 361 Pounds; Net Profit, $34.13.

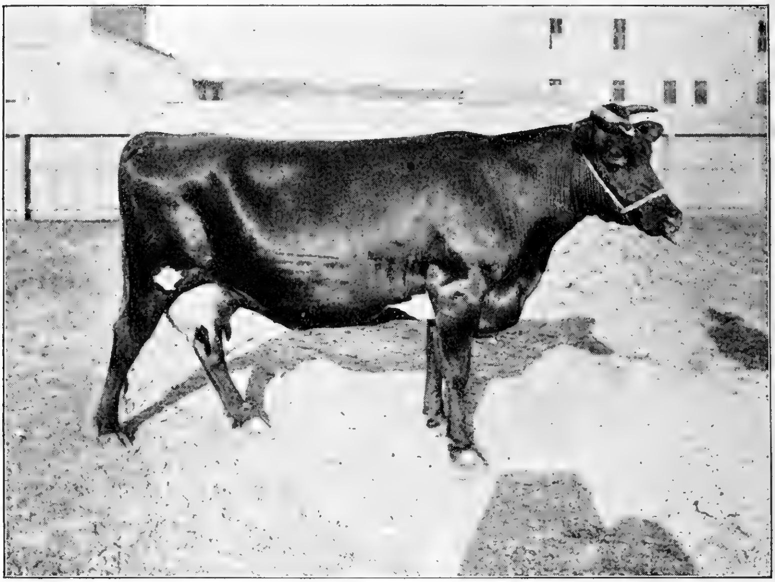
The idea that lands become too high priced to grow grass and forage products profitably is erroneous. Relief must be sought in better grass and more of it, rather than in diminished grazing areas. Grass lands are often unprofitable, not because they are high priced but because they are neglected. The intensive system of agriculture can nowhere be applied with better returns than to the grass lands. The matter of securing a uniform supply of good feed for the dairy herd throughout the year is of prime importance. Careful breeding and inherited excellence may be set at naught by insufficient or unsuitable feed, even for a brief period.

The successful dairyman will carefully provide in advance for the feed supply during every month of the year. Too frequently provision is made only for the winter months. The severest test sometimes comes in midsummer rather than in midwinter, when the tendency appears to be to trust to chance and let the dairy cow take the season's feed supply as it comes. The milk supply of the average creamery falls off more rapidly on pasture in "dog days" than in midwinter. Milk yield lost by the herd at any season of the year can never be fully regained. The entire subsequent yield during any period of lactation will be mainly governed by the extent of the decline during an unfavorable period. The dairy cow and likewise the dairy herd that makes the best yield must have no adverse periods at any time. It is the evenly sustained yield rather than the sudden spurt that determines the year's total. The best record made by any cow in the college dairy herd last year, age and all things considered, was that of a four year old. Her yield of butter during the first three months, beginning April 1st, was 146 pounds, during the second three months 109 pounds, during the third, 101 pounds, and during the last three months, 93 pounds, making a total of 448 pounds in twelve months. To have allowed this cow through neglect or insufficient feed to decline 30 or 40 pounds during July and August, would have caused irreparable loss and probably cut the year's record short 100 pounds. Instead of that, she was provided with green forage crops and given a moderate grain ration and made a net profit of $77.41.

The first step in providing the summer's feed supply should be to strengthen the pasture. The way to have grass is to let it grow. The pasture should never be bare. A rich carpeting of grass conserves moisture in mid-summer and protects vitality of the plant in winter. It insures a constant and economical feed supply. It furnishes the basis of the best and most economical ration obtainable. Properly supplemented with green forage crops fed in a cool dark stable during the day from July 15th to September 15th, giving the cows the run of the pasture only at night, pasture grass furnishes the cheapest and best dairy ration the farm affords.

The problem, as our lands become more valuable, will be not how to do with less grass, but how to get more of it. Pasture lands may become worn out or more properly what is termed "run out," quite as readily and completely as tillable lands. No part of the farm will yield better returns for careful attention and good treatment than the pasture. Some simple experiments conducted in the Iowa College farm pastures have furnished striking results in favor of pasture culture. The application of ten quarts of clover seed per acre, disced and harrowed into blue grass pasture in the early spring increased the yield 65 per cent. over pastures immediately adjoining that receiving no treatment. Pasture land thus treated produces a heavier, denser growth, and better variety of grasses, and stands drouth better and the improvement extends over several seasons. This treatment should be alternated with top dressing, applied preferably during the fall or winter, followed with the harrow in the spring. The best pastures are those that are never disturbed by the plow. The English gardener's directions for making a lawn apply to pasture. His instructions were to prepare the ground very carefully, sow the seed, and then water and mow it, and water and mow it, for 400 years.

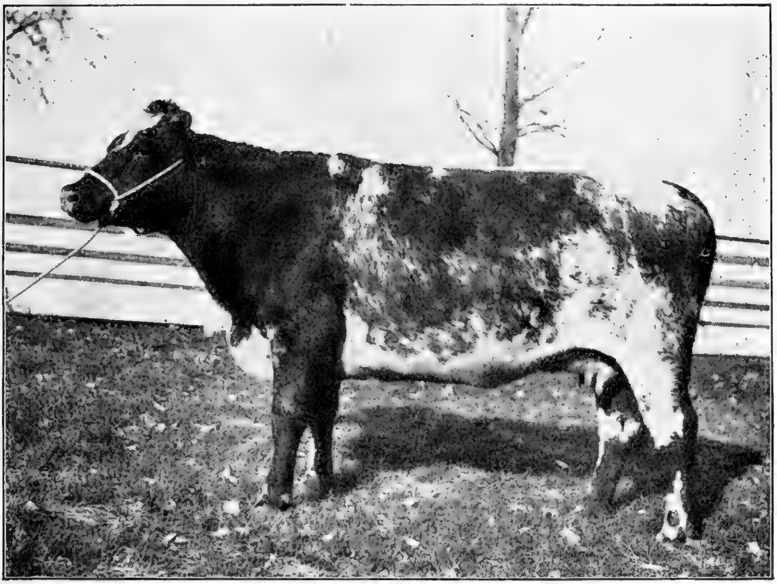
However good the pastures may be, there are times when they must be supplemented with forage crops and grain rations to maintain the dairy herd in good flow of milk, and the poorer the pastures the greater the necessity. The earliest of the green forage crops is rye and it affords a generous supply of good feed although it comes at a time when the feed



BELLE—GRADE SHORTHORN.
Ten Month's Record, 339 Pounds Butter; Net Profit, $35.40.

supply is usually quite sufficient for the time being. The use of rye in the early spring makes it possible to hold in reserve a larger surplus of grass for midsummer. It can be sown in the corn fields after the last plowing and in most seasons it will afford a good supply of green feed after the corn crop has been secured in the fall. This practice tends to eradicate weeds and renovate the soil.

First among the soiling crops for midsummer and early autumn, I would place sorghum. Its hardiness, vigor of growth, abundant yield and adaptation to our soil place it among the most reliable and profitable crops of the farm, regardless of drouth or other abnormal climatic conditions. Any part of the crop not needed for summer feeding in the green state can be cured in the form of excellent winter fodder. It may be sown any time after the season opens until as late as August 1st. The latter date is rather late, but it may often be sown after a crop of wheat, barley or early oats have been taken from the field. The yield from the Iowa Experiment Station fields has been as high as 29 tons per acre of green fodder and ten tons of fairly well cured fodder. About 100 pounds of seed per acre should be sown to give the best quality of fodder. The yield is practically the same regardless of the quantity of seed sown within the limit of 40 to 120 pounds.



IDEAL'S PRIDE—AN UNPROFITABLE DAIRY COW.
Yearly Butter Record, 128 Pounds; Net Loss, $1.07.

Next to sorghum, as a forage crop for midsummer feeding in Iowa, I should place the soy bean. This plant does not yield as heavily as sorghum, yet it is a hardy, vigorous grower and has better drouth resisting qualities. During the intense heat and drouth of the past summer, both of these crops stood the conditions perfectly and yielded well. The soy bean produces a crop of grain as well as forage. It may be used for green feed during the summer months to good advantage, or it may be allowed to ripen beans and be thrashed for winter feeding. A good crop yields from 25 to 30 bushels of beans per acre. It is a rich, highly concentrated feed, and constitutes an excellent adjunct to the ordinary grain ration. One of the chief advantages of the soy bean in addition to its drouth resisting qualities is that it constitutes a feed very rich in protein. On this account it is well adapted to combining with sorghum and our ordinary farm feeds. Protein can be produced much more economically by growing soy beans than by buying oil meal, bran or cottonseed meal at prevailing prices. Soy beans constitutes an excellent feed for the dairy cow or for young and growing stock of all kinds. It is also a good fattening ration. On account of its high percentage of protein, it is likely to become quite extensively grown in the corn belt states, to furnish nutrients required to balance the corn crop.

In considering forage crops either for green or dry feeding, sweet corn should have a prominent place. It constitutes one of our best yielding and most nutritious feeds for midsummer and early autumn. Sweet corn fodder does not keep as well as field corn, but it furnishes an excellent substitute for failing pastures after the middle of August until the close of the season. The larger growing varieties, such as Stowell's Evergreen are preferable on account of the abundant feed produced.

A combination of green sorghum, soy beans and sweet corn furnishes an ideal soiling crop ration. Add to this from two to four pounds of bran or meal per head daily and the milk yield may be well maintained during a period when it ordinarily falls off very heavily. Among the general forage crops of the farm, rape is entitled to take rank as one of the best. Its utility, however, is principally as a feed for sheep and hogs. Cattle do not take to it readily and if dairy cows were forced to use too much of it, it would unfavorably affect the quality of the dairy products.

In order to get the best results from any system of feeding or grazing, it is necessary to give attention to the comfort as well as the feeding of the cow. Protection from flies and the intense heat is of the utmost importance. During the severest heat period, the cows should graze only at night and be kept in a cool, darkened stable during the day. This plan has been practiced for a number of years with the college dairy herd and there is a marked difference between the regularity of the milk yield of the college herd and the herds of the patrons of the college creamery. At the approach of cool weather, about the middle of September, the herd may be again turned out during the day and should be stabled at night as soon as frosty nights appear. Next to scant supply of feed, nothing contracts the milk of the dairy herd like cold. The cows should be housed in dry, comfortable, well bedded quarters in all raw and chilly weather as well as in severe winter.

SELECTION OF COWS.

BY C. P. GOODRICH, DAIRYMAN.

Fort Atkinson, Wis.

The men who attain the highest success in any business always use the implements or machines that are best adapted to their business.

The farmer who makes milk production his business is a dairyman, and he needs the best of dairy cows. The best dairy cows are those that will return the most value of milk for the food consumed. The dairy cow is a machine for converting the forage raised on the farm and perhaps other foods into money by producing milk, butter and cheese.

For the patron of a creamery or maker of dairy butter the best cow is the one that will produce the most butterfat in a year for a given amount of feed. It is the same with the patron of a cheese factory.

SELECTING FROM ONE'S OWN HERD.

For the farmer who has a herd of cows, perhaps a sufficient number to stock his farm, his "selection" should commence with his own herd by weeding out and disposing of his poorest ones.

Many farmers, and, in fact most of them, who are keeping cows have some individuals in their herds that do not pay for their feed, and the owner does not know it. He has not taken the means to select out those of his herd that do pay a profit from those that do not.

A cow has to be fed a year for which she returns us what milk she gives in a year. The only way to tell how well she pays us is to weigh her milk every milking, or, at least, at frequent intervals, and test it with the Babcock test and find out how much butterfat she produces in a year.

Some may think this involves a great deal of labor, but, with things properly arranged, it requires but very little time. With a milk-sheet properly ruled, and with the names or numbers of the cows, together with the days of the month, placed on it, and a pencil hanging to a string, and a spring balance, all conveniently located in the stable where the milking is done, the milkers will be able to record the amount of milk each cow gives at every milking with the expenditure of but a few seconds of time at each milking. Each sheet can be made out for one month. At the end of the month the figures can be footed up, and at the end of the year one can tell the exact amount of milk each cow has produced.

The testing should be done once or twice a month by testing one day's milk—both morning's and evening's milk—because the test of the milk is liable to vary from time to time, but a test at stated intervals—say the middle of each month—and, taking that for the average of the month, will approximate, at the end of the year, very closely indeed to the actual amount of butterfat a cow produces during the year.

Now when the farmer knows—as he ought to know very closely—as any good business man would know—the value of the feed his cows consume and the value of the butterfat he furnishes to the creamery he can readily know which cows are returning him a profit and which ones he is keeping at a loss.

It would seem that it ought not to require any argument to convince any man of the folly of keeping cows that did not pay in milk for the food they consumed, yet some men are constantly doing it and refuse to enlighten themselves as to which cows are boarding on them without paying for it.

I have in mind now a man whom I had been urging to take this means of finding out which cows in his herd were not paying for their keep, and he answered me by saying: "I won't do it. I'm afraid I should find too many poor cows, and if I should dispose of all that did not pay, then what should I do for cows?" Of course, argument is wasted on such a man and I said no more.

Some men think they know without weighing and testing the milk of the individual cows of the herd which are the best ones, but they can only guess at it, and are frequently grievously mistaken. I know this was the case with me. Before the Babcock test was invented, the best I could do was to weigh the milk, which I did once in a while, and thought I knew something of the value of the different cows.

As soon as Mr. Babcock brought out his milk test I bought one, and it revealed to me some startling facts. Some cows, which I had supposed were my best ones, I was glad to dispose of, while some that I had barely tolerated on my farm were really the most profitable ones.

One instance I will relate: I had a large cow that was a hearty feeder, we called Whitie, which my hired man milked; and another medium size, called "Beauty," which I milked. The hired man used to say, when milking "Whitie," when fresh and getting a large pail brimming full at a milking: "If you only had a whole herd of cows like 'Whitie,' you would make lots of money." Then, as he looked at the scant half pailful that I got from my cow, he would say: "I don't see why you keep such a cow as 'Beauty' is. It must be to look at; she don't give enough milk to pay."

But the Babcock test came, and I got some milk scales and went to work to weigh and test the milk for a year. "Whitie" started with 50 pounds a day, but it soon began to drop off, and, after a while, she began to fatten up and finally went dry some three months; and, notwithstanding her great pretensions to begin with, she gave but 6,000 pounds during the year. Still, the amount of milk was very good, but the Babcock test revealed a very disappointing fact. The test averaged but 3%, which made 180 pounds of butterfat, which would make 210 pounds of butter.

"Beauty" never gave over 25 pounds a day but kept up her flow well so that, at the end of the year, it footed up a little over 5,000 pounds with an average test of 6.5%, which made 325 pounds of butterfat or 380 pounds of butter. She made 170 pounds more than "Whitie" on less feed.

Of course, "Whitie" had to go when she came fresh again. The man who looked at nothing, when buying cows, but a large frame and an immense udder, that denoted a large quantity of milk at the time of purchase, bought her. But "Beauty" stayed on my farm for ten years after that, giving me net profit, above the cost of feed, of from 35 to 50 dollars a year, besides leaving with me many of her descendants which were excellent cows. When I sold her on account of age, she did not bring much, but, after all, I thought I had good reason to be satisfied with her.

Had I kept "Whitie" a like number of years, her butter would probably, judging from that one year's record, have just about paid for her feed; and her female descendants would have stood a great chance of being inferior, as dairy cows, to "Beauty's" descendants. There is no question in my mind that "Beauty," in that ten years, paid me at least $400 more than "Whitie" or a cow like her could have done.

SELECTING COWS TO BUY.

When one wishes to buy cows to take the place of some weeded out, or to increase his herd, or to start a new herd, a different problem presents itself. He cannot have the year's record for the reason that those who have cows to sell have not kept a record of individual cows; or, if they have, they have too much business sense to sell off their best cows. It is of no use to ask the seller which are his good cows, for he will tell you they are all good, and, besides, he does not know himself, because he has never made a yearly test. It is of but little use to see the cow milked and take a sample and test it. One can learn but very little from one milking what a cow will do for a year.

Therefore there remains but one thing to do, and that is for the buyer to use his own judgment, being governed entirely by the form of the cow. There is a dairy type—a form which indicates dairy ability, which the close student of the dairy cow is able to recognize.

There are cows of dairy type and of good dairy performance in nearly all breeds, but they are found more nearly universal among the recognized dairy breeds such as Guernsey, Jersey and Holsteins, than among other breeds. There is occasionally one of dairy type and a splendid performer found among some of the beef breeds; but they are exceptions to the general rule; though good performers themselves, would not be very likely to transmit first class dairy qualities to their offspring. So it is best to hunt among the dairy breeds, or grades of dairy breeds—those which have been bred and used through many generations solely for dairy purposes—when wishing to select dairy cows.

THE DAIRY FORM.

A good, competent judge, when he goes out to buy a cow, does not ask the owner, "Is she a good cow?" "How much milk will she give?" or "How much butter will she make?" but he looks her over carefully and makes up his mind whether or not she has the right form to be a good producer.

As far as the dairy form is concerned there is not, in my opinion, a different standard for different breeds. Not that the great producers of all breeds, or, even of the same breed, are all shaped exactly alike, but all great performers, of all breeds, have certain characteristics alike which distinguish them as dairy animals.

Now I do not claim that a man, even though he may be the very best judge, can, with unerring certainty, select a good dairy cow every time, for there may be some defect, in the internal milk machinery, of which there is no outward evidence. But, after all, the form is the best guide that an expert judge can have.

It is a very difficult thing to describe on paper the dairy form, but I will try as best I can to give my ideas about it.

The first thing to be looked at is the cow's head. She should have a broad forehead with large, full, mild, intelligent looking eyes, and have every indication of a strong brain with strong nervous force. Milk production, with the cow, is the result of nervous force, and this nervous force starts from the brain and runs along the spinal cord. A strong, rugged backbone indicates that it encloses a large, strong spinal cord. Nerves branch off from this cord between each of the sections of the backbone. And the larger these nerves the more open are these sections, and farther apart the ribs. This makes the dairy cow long bodied and having a rather loose and relaxed appearance.

The mouth should be large and the jaws strong and muscular, which indicates that she is a good feeder. She should have great depth of body showing that she has large capacity for handling and digesting the large amount of food that her strong jaws are able to eat. She should have a broad chest and large girth around the heart and plenty of lung capacity. She should have a broad, strong loin with hips quite wide apart, with the backbone rising quite high between them. This indicates large room for the organs of maternity.

The thighs should be thin and incurved on the back side, with great room between them, and the flank arched up high just in front of them. All this to give room for the large fine udder which she must have to be a great producer. The udder should extend well forward and well back, making a long connection with the body, and having four fairly good-sized teats set on well apart. Large, full milk veins that carry the blood from the udder to the heart through large "milk-wells" or openings through the walls of the chest are indications of a large flow of milk.

Some other points which good cows usually have, but not always, might be mentioned. These are the thin, slim neck, the clean, well cut up throat, the thin withers and the long tail.

A great many men when judging of a cow's dairy ability are guided almost entirely by the udder. If that is large and fine they think she must be a good cow, no matter what the form otherwise is. Of course, a good udder usually goes with a good dairy form, but not always, and when it does not the cow is either a partial or total failure as a dairy cow. A cow may have a large udder and give a good quantity of milk for a short time, but, if she has not a good dairy form, she has not the machinery to keep on filling her udder long enough to make her a profitable cow. More men have been deceived by a large udder than by anything else about a cow, because that was almost the only feature they looked at.

The buyer should never fail to examine carefully the udder of every cow he thinks of selecting to see that it is sound; has no paralyzed quarters and gives milk easily and freely from all four of her teats.

SOME FAULTS OF COWS.

Sometimes an otherwise excellent cow is rendered partially or totally worthless for the dairy because of a habit of leaking milk. This fault cannot always be detected unless the milk is seen to be leaking. It does not follow that because a cow milks easily that she will leak her milk; far from it. Still those that do leak usually milk rather easy. Sometimes the milk seems to drip away from the teats nearly as fast as it is made and the udder is always nearly empty. This makes a cow worthless as a milker but can be detected at any time except when she is dry. Other cows do not leak until the udder is well distended and she lies down, forcing the milk out in a stream and making quite a puddle of milk on the ground or floor. Sometimes the close observer will detect this.

Another fault that some cows have is the habit of sucking other cows, or, worse still, of sucking themselves. My advice is never to buy such a cow under any circumstances if one can detect the fault. Such a cow may possibly be prevented from sucking, but she can never be cured of the inclination to do so and will surely be a source of vexation.

If the cow you are looking at has a ring in her nose, or has her nose pierced for a ring, don't buy her. That was done for something, and probably in a vain attempt to prevent her from sucking. If she has her tongue slit it is for the same reason. But, no matter, she can suck just the same. If the hair is worn off about her head or neck, be sure that it is not caused by some toggery put there to prevent her sucking.

FURTHER TESTS OF COWS.

When one has selected and bought his cows in the manner I have described, if he is going to get as profitable a herd as possible, he must test them with the scales and Babcock test for a year. He will perhaps find that, although he may be one of the best of judges of cows, he has got some unprofitable ones that will have to be discarded.

CONCLUSION.

By this it will be seen that a dairyman, if he obtains the greatest possible profit out of his business, must be constantly "selecting cows" and it will pay him immensely to study carefully and minutely the peculiarities of form of all his best producers and he will be convinced that there is a best dairy form, as well as a best beef form, and that they never go together in the same animal.

"The object we have or should have in teaching science is not to fill the mind with a vast number of facts that may or may not prove useful hereafter, but to draw out and exercise the powers of observation."—*Dr. Morris.*

STABLE LOCATION, CONSTRUCTION AND SANITATION.

BY H. B. GURLER, TREASURER NATIONAL DAIRY UNION, PROPRIETOR CLOVER DAIRY FARM—AUTHOR OF "AMERICAN DAIRYING."

De Kalb, Ill.

I believe we are at the beginning of a revolution in the construction of sanitary cow stables. And it is time we realized that the cow stable is a place where human food is prepared.

It is a burning shame on we dairymen that so much time and money has to be spent by experimenters and manufacturers to devise methods and machinery to cover up or bridge over our faulty work. For it is our faulty work that has made it necessary to pasteurize milk and cream. How many of us could eat a breakfast prepared in the cow stable where the milking is done? There certainly is no article of human food that will absorb more from the surrounding atmosphere than milk, and the other breakfast foods would be much less contaminated than is the milk. Perhaps we might offer the excuse that we were raised in that way and thought it all right; I certainly can think of no other excuse to offer, and that one will not be accepted longer by the intelligent public. I have met persons that were so accustomed to the cowy odor and flavor that they were suspicious of milk that did not contain it. This is a little rough on humanity and perhaps should not have been told here. I know of a Chicago doctor telling a lady that he could blindfold her and lead her through a certain cow stable and she would have no suspicion that she was in a cow stable. This shows what it is possible to accomplish. And it is entirely practicable to have our stables in such sanitary condition that the expert will not detect the odor of the stable in the milk.

To show the susceptibility of milk to contracting odors I will give a little incident in my dairy school work. I was training the class in detecting bad flavors in the milk by warming samples to a temperature that would cause a little vapor to rise from it, and passed the warm samples around the class. One of the students detected the flavor of the hog-pen one day, and I also did. This matter was followed to the farm where the milk was produced and we learned that the patron practiced putting his night's milk in an open vat in a room where there was nothing else, thinking he was doing the very best that he could. This room was about 50 feet from

INTERIOR VIEW OF COW STABLES AT H. B. GURLER'S "CLOVER FARM," DE KALB, ILL.
Showing How Cows are Fastened in Their Ironwork Stalls, the Cement Floored Alleyways, Gutters, etc.

his hog-pen, and to cool the room he opened a window on the side toward the hog-pen; the milk absorbed the hog-pen odor and brought it to the dairy school and we were able to detect it in the milk.

I once made the statement at a farmer's convention, when talking on dairy matters, that the public consumed more filth in their milk than in any other *one* article of food. At the close of the session the dean of an agricultural college said to me that I might safely have said that we were consuming more than in *all* other articles of food.

We deserve to be indicted by the public for such careless work, and we will be, too, in the near future, if we do not mend our ways.

The healthy cow will produce us a perfect food if we will do our part well. Then the up-to-date buttermaker will be happy producing butter that will delight all customers and compel the judges to devise a new score card. There is more profit to high grade work than there is in low grade work. A man has more respect for his business and for himself, and everybody thinks better of him unless it be some jealous competitor who cannot or will not keep up in the race.

The cow stable should be located where good drainage can be secured, and the drainage should not flow toward the dwelling house, as there are times when the ground is frozen that surface water cannot reach the tile, to be carried off, and must run off on the surface. And where stock are gathered for a short time even they pack the soil by their tramping so that it is impervious to water, compelling the water to get away on the surface.

The distance of a *sanitary* cow stable from the dwelling house is a matter of choice, as it will not be objectionable to the family from any odors coming from it. The *unsanitary* cow stable should be located at a distance from the dwelling house to compare with its condition.

I am not a believer in the underground nor even in a partial underground cow stable. If the situation is such that a natural approach to the second story can be secured and is desired, utilize it by all means; it is not necessary to put the building against the ground, but it can be moved or located a few feet away and the space bridged, which will give us one more side to receive light from and it will add very little to the expense of building.

In constructing the cow stable, having first decided whether it is to be one or more stories high, the first to be built is the foundation, which may be of stone or concrete depending largely upon the comparative cost of the two, though the opinion is growing with me that a good job of concrete is more durable than stone, and in many locations it costs less by quite a percentage. Outside this foundation wall, and a little below it, should be put a row of tile to take all the surface water that would penetrate under the foundation, and also receive the water from the down spouts of the building and conduct it to a proper distance from the building. A person's choice and local conditions must decide what material shall be used in the construction of the building, and the man that is to pay the bills is the one

THE IMPROVED "DROWN" STALL—M. J. DROWN, MADISON, WIS., MAKER.

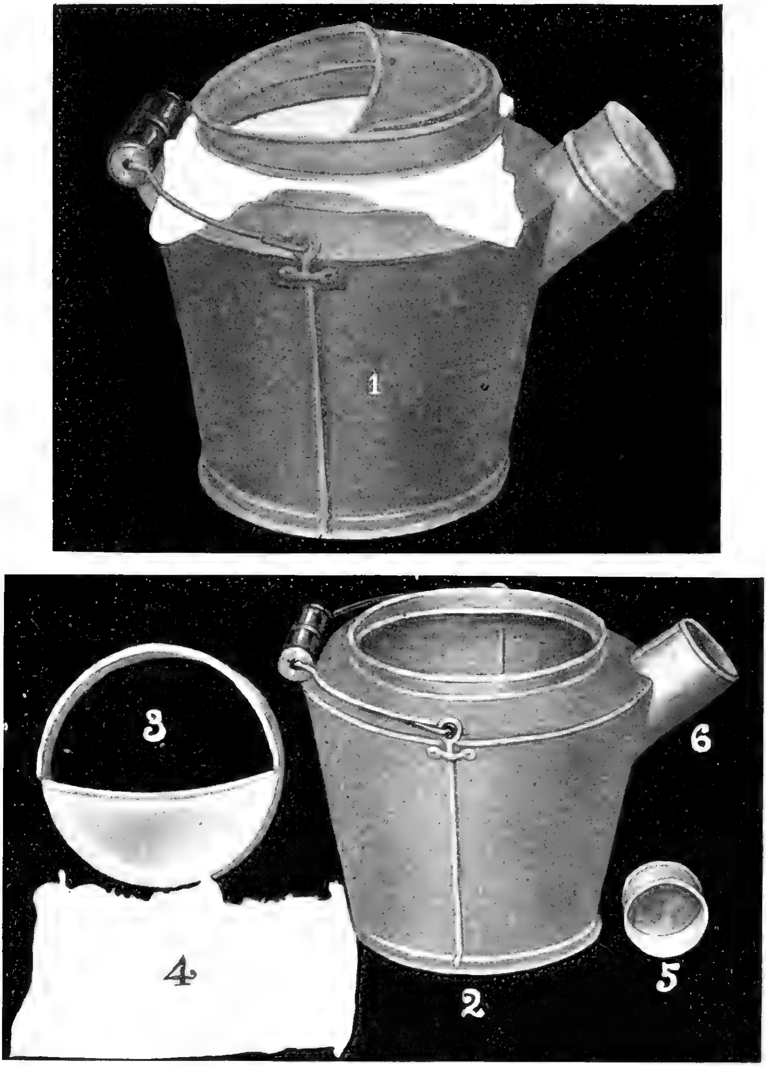
One Design of this Stall is Used in the Gurler Stables. View Shows Cement Mangers and Floors Fitted with Iron Stalls Having Two-Way Movable Partitions to know about these points and decide. Before the foundation is built, it of course has been decided whether the building is to be one or more stories high, and the foundation planned for the load that is to be carried. Make the foundation ample, as it does not cost much more; piers can be built very cheaply. In 1876 I built a barn 50x60 feet and put under it, beside the outside wall, over 40 stone piers, those under the posts being thirty inches square. This barn was built with a basement story for stock, and twenty feet above for hay and grain, and it has stood up to its load so well that I put a cement floor on the second story after the barn was twenty-five years old, and it is carrying the load all right. This was done to utilize room for cows that was made for hay, and was not needed for hay after the silo had taken the place of the haymow.

There is a barn in my neighborhood that is about the age of the one that I have described that is nearly ruined from not having had a good foundation under it. Nothing will stand without a good foundation, it does not matter whether it is a barn or a man's character.

I ceil the outer walls inside the stable with matched lumber so as to give a dead air space as a protection against cold, and to give a surface to whitewash, which is the best way I know of to keep the stable sweet and light. The cow stable should have sufficient windows to make it as light as a dwelling house; there is just as much need of light in one as the other.

I use cement floors in all stables where we milk, and should make nothing else if I were to build more stables. I use the individual stalls in all my milking stables. These stalls are so built that the cow has all the freedom possible, with cleanliness, as she is not tied by the neck, but is held in the stall by a rope or chain across the rear, and an adjustable front by which means she can be held lined on the gutter, as it is necessary for her to be if she is to be kept clean without an attendant. I use a continuous cement manger which is very readily cleaned. I do not like an individual manger for the reason that it is very hard to keep clean. But a continous cement manger, with sewer connections, is very easily kept clean, and this is a necessity if high grade work is to be done. A dirty manger is not a sanitary manger.

My cows go outside for their water most of the time, though I can water in the cement mangers when it is desirable. I once came near putting in the individual water trough, and have been pleased that I did not do it, for several reasons; the main one of which is that they are not kept in a sanitary condition. Standing water in the stable is an excellent purifier of the atmosphere, but is not fit for a cow to drink after it has purified the stable. The cows will drink while eating and drop food into the water buckets where it will soon ferment. A professor of dairy husbandry who had visited many modern cow stables looking for ideas to incorporate in a new barn to be built, told me that he had not found a case where the individual water bucket was in a good sanitary condition.

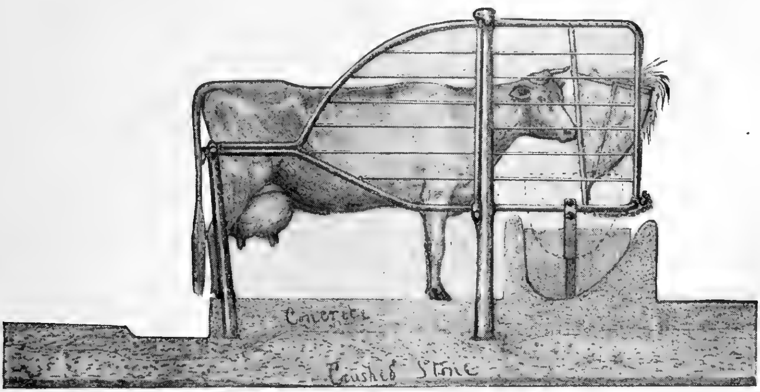


THE H. B. GURLER SANITARY MILK PAIL.

Devised by Mr. Gurler and used on his farm at De Kalb, Ill., where about 200 cows are milked daily. No. 1 is the pail complete as ready for milking—the streams strike the cloth at a slant, the cover checking any spatter. No. 2 is the pail as ready for washing. No. 3, the tin ring and part cover that holds cloth in place. No. 4, sheet of fine cheese cloth doubled over a layer of absorbent cotton. No. 5, cap for closing the spout (No. 6) while milking. The cloths are washed, sterilized, and used several times over. The cotton is thrown away at the finish of each milking. One pound of the cotton is sufficient to make 50 strainers.

The length of the platform on which the cows stand should be four and a half to five feet, according to the length of the cows, and the width needs to be three feet for medium sized cows, and more for large ones; very large cows needing, in some cases, as much as four feet, but the stall must not be so wide that the cow can turn around in it. These stalls may be built of wood or iron. Wood is all right and much less expensive than iron. The barn may be so arranged that a wagon can be driven through onto which the manure can be thrown and drawn immediately to the field; it may be wheeled out or it may be carried out in a conveyance running on a suspended track, and it may also be dropped into a basement and drawn out when we get ready. This plan is all right for the manure, but I do not like it for the cows to live over.

I cannot recommend any kind of a stall for cows that will permit one cow to step on its neighbor's teats. When I used the stanchion as a cow



SIDE VIEW OF "DROWN" STALL.

Showing Method of Construction of Cement Manger and Floor and Setting of the Iron Partition and Feed Rack.

tie I lost more teats from this than any other cause, the bruise causing inflammation which could not be reduced in time to save that quarter of the udder. I can recommend no stall in which it is possible for such an accident to occur.

When finishing a cement floor for a cow stable, do not smooth the surface with the trowel, as it will be so smooth that the cow will slip on it, but leave it as it is from the wooden float and she will not slip on it.

I cannot decide whether a person shall build a one story cow stable or whether he shall make it two or three stories; that depends on what he is going to do. If storage room is needed for hay, grain or other purposes, put the barn up and get this needed room under the same roof with the cows.

It is an advantage to the cow stable in some ways to have a story above it; one reason is that it makes the ceiling warmer and there is less danger of frost on it in cold weather. Ten feet is a good height for the cow stable; eight feet will answer, but I would not build with less than ten-foot ceilings. I have one stable with twelve-foot ceilings, but that is higher than is necessary. The old idea that we should build a cow stable with a certain number of cubic feet per cow for air space ought to be exploded, as it is not up to date. Arrange the floor space to make it convenient for the cows and yourself, and provide fresh air by a system of ventilation. I have the King system of ventilation in four cow stables and it works very satisfactorily. This has been described so frequently in the dairy papers that it seems almost unnecessary to describe it here. It consists of air flues in the outer walls of the building, opening near the floor, or at the sills on the outside, and extending upward as high as the stable ceiling, and there opening into the stable. These flues should have a sliding or some other controllable kind of a door by which the amount of air can be controlled, as in case of a strong wind there may be at times too much cold air received into the stable. The impure air is taken out by flues opening near the floor of the stables and extending to the highest point of the barn or stable. I find this principle to work very nicely, having used it for at least fifteen years as near as I can remember. I once had visitors test the ventilation of an empty stable by closing all the doors and windows, when a test showed a circulation of air was going on all the time, coming in the fresh air flues and going out the foul air flues.

"Whatever is worth doing at all is worth doing well."—Earl of Chesterfield.

THE COMPARATIVE VALUE OF FEEDS, WITH TABLES GIVING THEIR PERCENTAGE OF DIGESTIBLE NUTRIENTS.

BY W. A. HENRY, DEAN, COLLEGE OF AGRICULTURE, UNIVERSITY OF WISCONSIN; AUTHOR OF "FEEDS AND FEEDING"—A HAND-BOOK FOR THE STUDENT AND STOCKMAN.

Madison, Wis.

Every dairyman should possess a clear knowledge of the chemical composition of feeding stuffs and know something of the laws of animal nutrition. In this chapter we will consider the common constituents of the various feeding stuffs generally available on American farms. I ask the reader not to skip this chapter, declaring it too scientific for his understanding, but to study it in order to know more concerning his business. The really practical man needs every help he can get and will utilize everything available. Science is simply well arranged knowledge and science is needed in every operation on the well managed dairy farm.

There are technical terms to be learned, but fortunately they are few and not particularly difficult to understand. The first of these is "protein" which embraces a group of nutrients in feeding stuffs of the highest importance. Protein means first or principal, and the protein compounds in our feeds should always be first considered when we talk about feeding stuffs. The white of egg is almost pure protein with water additional. If we chew a few kernels of wheat for a time, there remains a sticky mass which as boys we called "gum." This gummy substance is the protein part of the wheat grain commonly called gluten. Gluten helps make the dough elastic in bread-making and adds greatly to the nutritive value of bread in furnishing protein. Nitrogen is the characteristic chemical element in all protein substances and hence feeding stuffs rich in protein are often called nitrogenous feeds. The muscles as well as the nerves of animals are composed mainly of protein; the hide, hair, hoofs, horns and a part of the bones likewise consist largely of protein. Leguminous plants such as clover, alfalfa, cow peas, field peas, etc., are all rich in protein. The protein in the wheat grain and the corn grain is located near the outside of the kernel, and in milling it passes away with the bran and middlings to a considerable extent, so that bran and middlings are both comparatively rich in protein. When animals consume feeding stuffs containing protein the digested portion leaves the intestines and passes into the blood circulation, going ultimately to build up the protein parts of the body, as already explained. From all this we will readily understand that the dairy cow must have a goodly supply of protein in her feed in order to maintain her own muscular system, to build up the muscles of the fœtal calf, and to form the casein and albumen (protein) portion of the milk.

The next group of substances which we shall consider is characterized by the term "carbohydrates." Sugar and starch are pure carbohydrates. The woody fiber of plants is likewise a carbohydrate having practically the same chemical composition as sugar and starch, though less digestible than these. The carbohydrates dissolve in the digestive tract and when absorbed into the blood serve the animal for the production of fat, for warming the body and for the production of energy. They may be converted into the sugar part of milk. The carbohydrates constitute a larger proportion of feeding stuffs percentagely than does protein; the animal likewise needs more pounds of carbohydrates for its nourishment than it needs pounds of protein. Corn, wheat, and the other grains are all rich in carbohydrates since they are composed largely of starch. Timothy hay, corn stover, and the straws are relatively rich in carbohydrates, containing as they do considerable starch, some sugar, and much woody fiber.

The fatty substances in feeding stuffs possess the same chemical elements as the carbohydrates and in general they serve the same purpose—the formation of fat and keeping the body warm. The fatty substance in feeding stuffs is generally termed "ether extract" by the chemist because he uses ether in his laboratory to extract the fat from the different feeding stuffs. When a pound of fat or oil is burned it gives off from 2¼ to 2½ times as much heat as does a pound of woody fiber, sugar, or starch when burned. By multiplying the fat found in a feed by 2.4 we are able to measure its fuel value in terms of carbohydrates. Flaxseed and cottonseed are both rich in oil; linseed oil meal and cotton-seed meal obtained from these seeds will carry considerable oil. Indian corn is quite rich in oil. Root crops are poor in oil or ether extract.

A protein substance taken into the body proper can be used for all of the purposes that protein is required for and also do the work generally imposed upon the carbohydrates; that is, protein can build muscle or it can be converted into heat or fat or energy. On the other hand the carbohydrates and fat cannot of themselves build up muscle. They contain no nitrogen and cannot form red meat in the body (muscle) nor can they be elaborated into the cheese part of the milk. The protein part of feeds is always expensive so that while protein can serve all body wants we should not attempt to use it further than is absolutely necessary, making the cheap carbohydrates serve so far as they possibly can. We all know that oil meal and cotton-seed meal are high priced—they are so because the buyers are seeking protein and to some extent fat. The carbohydrates in the form of hay, straw and the starchy matter of corn, wheat, etc., are much cheaper per pound than protein.

The animal needs mineral matter, especially for the building up of bones, and there is some mineral matter in the muscles and all other portions of the body. When animals are properly nurtured otherwise, the stockman need not consider the question of mineral matter in feeding stuffs because there will always be enough of these substances in the feeds he supplies. Neither in this connection need we consider water, which is the great vehicle of nutrition.

When a cow consumes any given feed—hay, for example, the process of reducing it to infinitely fine particles begins with mastication; the hay, moistened by saliva, is softened and passes into the paunch where it is still further softened by moisture and heat. Re-chewed during rumination it is swallowed again and finally passes into the true stomach. Here it is attacked by fluids which tend to dissolve all of the softer and more useful portions. Leaving the stomach, any undissolved portions of the food are further attacked by the bile, the pancreatic fluid, and the intestinal juices. These solvents reduce most of the feed to a condition where it can be utilized. The dissolved parts are absorbed and enter the blood. The portion so absorbed is considered the digestible part of the feed. The undigested part passes along the alimentary tract and is finally ejected. It has never been properly within the body but only inside of the long convoluted tube (stomach and intestines) passing through the body. The digestible portion of the food taken up by the blood is the only part which is really useful to the animal. Since all the food constituents are not digestible and only the digested parts are useful, we have come to speak of "digestible protein," "digestible carbohydrates," and "digestible ether extract" (or fat) of feeding stuffs. The chemist in his laboratory can find out how much total protein, total carbohydrates and total fat any given feeding stuff contains; he cannot tell us, however, by laboratory methods how much of each of these is really available to the animal. To determine the digestible portion he must conduct feeding tests directly with the animal itself. This is done in the following manner: He first analyzes the feed and determines the total quantity of each constituent in a given allowance of feed. This feed is then fed to the animal under experiment and all of the solid excrement resulting from it is saved and likewise analyzed. The sum of the constituents appearing in the solid excrement is subtracted from the sum of the constituents given in the feed supplied and the difference is called the digestible portion. Thus, if a hundred pounds of protein are fed to an animal and thirty pounds appear in the solid excrement, then seventy pounds must have passed from the intestines into the blood, and in this case we would say that seventy per cent. of the protein in this feed is digestible.

Digestion and utilization of feed are different things. Two animals may digest a given feed equally well and yet give quite different returns from such feed. One cow may convert a large part of all she digests into milk, while another may turn it into body fat, and a third may waste it in worry or in some other way we hardly know how. Still it is of prime importance to know how much of each and all feeding stuffs is actually digestible for we then know what portion is available. A vast deal of work has been done by the chemist in analyzing feeding stuffs and conducting digestion trials. The following table taken from *Feeds and Feeding* shows the total dry matter and the digestible portion of all of our common feeding stuffs:

Table showing the total dry matter and the digestible nutrients in 100 *pounds of American feeding stuffs.*

CONCENTRATES. NAME OF FEED.	Dry matter. Lbs.	Protein. Lbs.	Carbo-hydrates Lbs.	Ether extract. Lbs.
Corn, all analyses	89.1	7.9	66.7	4.3
Dent corn	89.4	7.8	66.7	4.3
Flint corn	88.7	8.0	66.2	4.3
Sweet corn	91.2	8.8	63.7	7.0
Corn cob	89.3	0.4	52.5	0.3
Corn and cob meal	84.9	4.4	60.0	2.9
Corn bran	90.9	7.4	59.8	4.6
Gluten meal	91.8	25.8	43.3	11.0
Germ meal	89.6	9.0	61.2	6.2
Starch refuse	91.8	11.4	58.4	6.5
Grano-gluten	94.3	26.7	38.8	12.4
Hominy chops	88.9	7.5	55.2	6.8
Glucose meal	91.9	30.3	35.3	14.5
Sugar meal	93.2	18.7	51.7	8.7
Gluten feed	92.2	20.4	48.4	8.8
Wheat	89.5	10.2	69.2	1.7
High-grade flour	87.6	8.9	62.4	0.9
Low-grade flour	87.6	8.2	62.7	0.9
Dark feeding flour	90.3	13.5	61.3	2.0
Wheat bran	88.1	12.2	39.2	2.7
Wheat bran, spring wheat	88.5	12.9	40.1	3.4
Wheat bran, winter wheat	87.7	12.3	37.1	2.6
Wheat shorts	88.2	12.2	50.0	3.6
Wheat middlings	87.9	12.8	53.0	3.4
Wheat screenings	88.4	9.8	51.0	2.2
Rye	88.4	9.9	67.6	1.1
Rye bran	88.4	11.5	50.3	2.0
Rye shorts	90.7	11.9	45.1	1.6
Barley	89.1	8.7	65.6	1.6
Malt sprouts	89.8	18.6	37.1	1.7
Brewers' grains, wet	24.3	3.9	9.3	1.4
Brewers' grains, dried	91.8	15.7	36.3	5.1
Oats	89.0	9.2	47.3	4.2
Oat meal	92.1	11.5	52.1	5.9
Oat feed or shorts	92.3	12.5	46.9	2.8
Oat dust	93.5	8.9	38.4	5.1
Oat hulls	90.6	1.3	40.1	0.6

CONCENTRATES. NAME OF FEED.	Dry matter Lbs.	Protein. Lbs.	Carbo-hydrates Lbs.	Ether extract Lbs.
Rice	87.6	4.8	72.2	0.3
Rice hulls	91.8	1.6	44.5	0.6
Rice bran	90.3	5.3	45.1	7.3
Rice polish	90.0	9.0	56.4	6.5
Buckwheat	87.4	7.7	49.2	1.8
Buckwheat hulls	86.8	2.1	27.9	0.6
Buckwheat bran	89.5	7.4	30.4	1.9
Buckwheat shorts	88.9	21.1	33.5	5.5
Buckwheat middlings	87.3	22.0	33.4	5.4
Sorghum seed	87.2	7.0	52.1	3.1
Broom-corn seed	85.9	7.4	48.3	2.9
Kaffir corn	84.8	7.8	57.1	2.7
Millet	86.0	8.9	45.0	3.2
Flax seed	90.8	20.6	17.1	29.0
Linseed meal, old process	90.8	29.3	32.7	7.0
Linseed meal, new process	89.9	28.2	40.1	2.8
Cotton seed	89.7	12.5	30.0	17.3
Cotton-seed meal	91.8	37.2	16.9	12.2
Cotton-seed hulls	88.9	0.3	33.1	1.7
Cocoanut meal	89.7	15.6	38.3	10.5
Palm-nut meal	89.6	16.0	52.6	9.0
Sunflower seed	92.5	12.1	20.8	29.0
Sunflower-seed cake	91.8	31.2	19.6	12.8
Peanut meal	89.3	42.9	22.8	6.9
Rape-seed meal	90.0	25.2	23.7	7.5
Peas	89.5	16.8	51.8	0.7
Soja (soy) bean	89.2	29.6	22.3	14.4
Cowpea	85.2	18.3	54.2	1.1
Horse bean	85.7	22.4	49.3	1.2
ROUGHAGE.				
Fodder corn.				
Fodder corn, green	20.7	1.0	11.6	0.4
Fodder corn, field-cured	57.8	2.5	34.6	1.2
Corn stover (husked shock corn), field-cured	59.5	1.7	32.4	0.7
Fresh grass.				
Pasture grasses (mixed)	20.0	2.5	10.2	0.5
Kentucky blue grass	34.9	3.0	19.8	0.8
Timothy, different stages	38.4	1.2	19.1	0.6
Orchard grass, in bloom	27.0	1.5	11.4	0.5
Redtop, in bloom	34.7	2.1	21.2	0.6
Oat fodder	37.8	2.6	18.9	1.0
Rye fodder	23.4	2.1	14.1	0.4
Sorghum	20.6	0.6	12.2	0.4
Meadow fescue, in bloom	30.1	1.5	16.8	0.4
Hungarian grass	28.9	2.0	16.0	0.4
Green barley	21.0	1.9	10.2	0.4
Peas and oats	16.0	1.8	7.1	0.2
Peas and barley	16.0	1.7	.2	0.2

ROUGHAGE. NAME OF FEED.	Dry matter Lbs.	Protein. Lbs.	Carbohydrates Lbs.	Ether extract Lbs.
Hay.				
Timothy	86.8	2.8	43.4	1.4
Orchard grass	90.1	4.9	42.3	1.4
Redtop	91.1	4.8	46.9	1.0
Kentucky blue grass	78.8	4.8	37.3	2.0
Hungarian grasses	92.3	4.5	51.7	1.3
Mixed grass	87.1	5.9	40.9	1 2
Rowen (mixed)	83.4	7.9	40.1	1.5
Meadow fescue	80.0	4.2	43.3	1.7
Soja-bean hay	88.7	10.8	38.7	1.5
Oat hay	91.1	4.3	46.4	1.5
Marsh or swamp hay	88.4	2.4	29.9	0.9
Marsh or swamp hay	92.1	3.5	44.7	0.7
White daisy	85.0	3.8	40.7	1.2
Straw.				
Wheat	90.4	0.4	36.3	0.4
Rye	92.9	0.6	40.6	0.4
Oat	90.8	1.2	38.6	0.8
Barley	85.8	0.7	41.2	0.6
Wheat chaff	85.7	0.3	23.3	0.5
Oat chaff	85.7	1.5	33.0	0.7
Fresh legumes.				
Red clover, different stages	29.2	2.9	14.8	0.7
Alsike, bloom	25.2	2.7	13.1	0.6
Crimson clover	19.1	2.4	9.1	0.5
Alfalfa	28.2	3.9	12.7	0.5
Cowpea	16.4	1.8	8.7	0.2
Soja bean	24.9	3.2	11.0	0.5
Legume hay and straw.				
Red clover, medium	84.7	6.8	35.8	1.7
Red clover, mammoth	78.8	5.7	32.0	1.9
Alsike clover	90.3	8.4	42.5	1.5
White clover	90.3	11.5	42.2	1.5
Crimson clover	90.4	10.5	34.9	1.2
Alfalfa	91.6	11.0	39.6	1.2
Cowpea	89.3	10.8	38.6	1.1
Soja-bean straw	89.9	2.3	40.0	1.0
Pea-vine straw	86.4	4.3	32.3	0.8
Silage.				
Corn	20.9	0.9	11.3	0.7
Clover	28.0	2.0	13.5	1.0
Sorghum	23.9	0.6	14.9	0.2
Alfalfa	27.5	3.0	8.5	1.9
Grass	32.0	1.9	13.4	1.6
Cowpea vine	20.7	1.5	8.6	0.9
Soja bean	25.8	2.7	8.7	1.3
Barn-yard millet and soja bean	21.0	1.6	9.2	0.7
Corn and soja bean	24.0	1.6	13.0	0.7

NAME OF FEED. ROUGHAGE.	Dry matter. Lbs.	Protein. Lbs.	Carbohydrates Lbs.	Ether extract Lbs.
Roots and tubers.				
Potato	21.1	0.9	16.3	0.1
Beet, common	13.0	1.2	8.8	0.1
Beet, sugar	13.5	1.1	10.2	0.1
Beet, mangel	9.1	1.1	5.4	0.1
Flat turnip	9.5	1.0	7.2	0.2
Ruta-baga	11.4	1.0	8.1	0.2
Carrot	11.4	0.8	7.8	0.2
Parsnip	11.7	1.6	11.2	0.2
Artichoke	20.0	2.0	16.8	0.2
MISCELLANEOUS.				
Cabbage	15.3	1.8	8.2	0.4
Spurry	20.0	1.5	9.8	0.3
Sugar-beet leaves	12.0	1.7	4.6	0.2
Pumpkin, field	9.1	1.0	5.8	0.3
Pumpkin, garden	19.2	1.4	8.3	0.8
Prickly comfrey	11.6	1.4	4.6	0.2
Rape	14.0	1.5	8.1	0.2
Acorns, fresh	44.7	2.1	34.4	1.7
Dried blood	91.5	52.3	.0	2.5
Meat scrap	89.3	66.2	.3	13.7
Dried fish	89.2	44.1	.0	10.3
Beet pulp	10.2	0.6	7.3	.0
Beet molasses	79.2	9.1	59.5	.0
Cow's milk	12.8	3.6	4.9	3.7
Cow's milk, colostrum	25.4	17.6	2.7	3.6
Skim milk, gravity	9.6	3.1	4.7	0.8
Skim milk, centrifugal	9.4	3.9	5.2	0.3
Buttermilk	9.9	3.9	4.0	1.3
Whey	6.6	0.8	4.7	0.1

This long table shows how much dry matter there is in 100 pounds of each of the feeding stuffs named. Following this we learn the pounds of digestible protein, carbohydrates and ether extract in 100 pounds of each and all of the feeds. One hundred pounds of corn, for example, the first article in the table, contains an average of 7.9 pounds of digestible protein. The digestible carbohydrates, mostly starch, reach the large aggregate of 66.7 pounds, while the digestible corn oil or ether extract amounts to 4.3 pounds. These three sums added together do not make 100. A part of the difference is water, and the remainder is made up of the indigestible portion and the ash. The reader is urged to study the data of the table in order to familiarize himself with the characteristics of the different feeding materials available in this country. He will see that such feeds as bran, gluten meal, linseed oil meal, cottonseed oil meal, buckwheat middlings, etc., are all rich in protein but carry no large percentage of carbohydrates. On the other hand, corn and wheat are very rich in carbohydrates and comparatively low in protein content. Forage from the legumes such as clover hay and alfalfa hay is comparatively rich in protein while wheat straw and timothy hay are poor in protein. The faithful dairy student will refer often to such tables and will find the information most helpful.

We should next learn what is meant by the "nutritive ratio." As before stated, the fat or ether extract of feeding stuffs serves the same purpose as the carbohydrates but has a higher fuel value. To measure these fatty substances in terms of carbohydrates, we multiply the quantity of digestible fat contained in any feed as stated in the table by 2.4. The nutritive ratio is the ratio existing between the digestible protein in any feed and the digestible carbohydrates plus the digestible fat reduced to carbohydrate equivalent. To find the nutritive ratio we multiply the digestible ether extract by 2.4 (its heat equivalent) and add the result to the total digestible carbohydrates. The sum obtained is next divided by the total digestible protein. In the table which Professor Haecker gives, Wolff tells us that the nutritive ratio for the dairy cow should be 1:5.4. By this he means that the ratio of the protein to the carbohydrates and ether extract equivalent should be that expressed by the figures. In other words, the scientific ration for the dairy cow should have 5.4 pounds of carbohydrates or their equivalent for each pound of protein it contains.

In availing himself of feeding stuffs for the use of his herd the dairyman should have certain fixed facts well in mind. Let us first consider some of these in relation to the concentrates. Of all the various feeding stuffs generally available, Indian corn is the richest in carbohydrates and fat. Indian corn may be regarded as a fuel and fat forming food, much as anthracite coal is a heat furnisher. Corn is generally the cheapest source of concentrated carbohydrates available to the stockman, and consequently will be extensively used by the American dairyman. Supplied in reasonable quantity, there is no better feed than corn; fed in excess, it tends to cause the cow to fatten and consequently to dry up in her milk.

In recent times there has been a wonderful increase in the manufacture of various articles like starch, glucose, dextrine, etc., from the corn grain. As a consequence vast quantities of by-products termed corn bran, gluten meal, gluten feed, corn germ, corn-oil cake, etc., are being offered to stockmen as feeding substances. These materials, if pure, are of high feeding value, and the dairyman should thoroughly familiarize himself with their properties and uses. Gluten meal is the protein part of the corn grain aside from the germ. It is of a heavy concentrated character. Corn bran is the skin or outside covering of the corn grain. These two feeds mixed constitute gluten feed. The germs of the corn grain freed by the manufacturer from most of the oil they contain constitute germ-oil cake or meal. It is a rich, useful feed.

Next to corn comes wheat, which has about the same feeding value as corn, so far as carbohydrates are concerned, and is a little higher in protein. Wheat is a splendid cow feed and only its high price prevents its wide use. Barley may be used with advantage when not too high priced.

The by-products from the barley grain known as malt sprouts, wet brewers' grains, and dried brewers' grains are most helpful feeds with the dairyman. As the table shows, malt sprouts are very rich in digestible protein. Unfortunately cows do not usually like malt sprouts very well and so they cannot be heavily fed. At the prices for which they are usually sold they are very cheap and dairymen should use them to the extent of two or three pounds per cow per day. Malt sprouts should either be soaked before feeding or they may be mixed directly with silage or other wet feed. Wet brewers' grains are a nutritious, milk-producing food greatly relished by cows. They are a dangerous feed in the hands of ignorant or vicious dairymen. They should always be fed before they have been fermented, and only a reasonable allowance should be given. Fed after they have fermented and given in dirty feeding boxes and in dark, foul stables, as is too often the case near cities, it is no wonder that many people object to the milk from cows fed wet brewers' grains. All such troubles lie in the abuse and not in the legitimate use of such materials. Dried brewers' grains are a very rich, nutritious food for dairy cows. They are now mostly shipped across the ocean to be fed on the Continent. They should be fed nearer where they are produced. Oats in and of themselves practically form a balanced ration. Bran falls on the protein side of our list since it is relatively low in carbohydrates and quite high in protein. Then follows middlings, likewise from the wheat grain. The enormous milling interests in the northwestern states give to the farmers of that region a vast output of bran and middlings. The use of these feeds is now universal, and they are properly appreciated. Bran is healthful as well as nutritious, and with oats forms one of the safest feeds at the dairyman's hands. Milk requires much mineral matter in the foods producing it, and bran is rich in both phosphoric acid and potash. Middlings furnish more carbohydrates than bran. Generally the farmer would better mix bran and corn rather than feed bran and middlings. In many cases the latter may best be used as a pig feed.

Buckwheat middlings are a very rich protein feed and of high feeding value with cows. The miller mixes as much of the black, almost worthless buckwheat hulls with the rich middlings as possible, and then sells the combination for bran. The dairyman would better buy the higher priced middlings and then use corn stalks, straw from his own farm, etc., in place of the low value hulls.

There are a number of by-products from the oat-meal mills. Oat hulls are sometimes sold to feed dealers, who mix them with corn meal and sell the mixture for ground oats and corn, which mixture is valuable just in the proportion that it contains the real grain substance. Oat dust is of low value, and in other ways not desirable. Linseed oil meal is a useful food for farm stock generally. This substance is not only rich in protein but it has mucilaginous properties which seem particularly helpful to the digestive tract.

Cows do not respond, however, to the heavy feeding of linseed meal, and its high price often limits its general use. The dairyman can usually profitably feed a pound or two per cow daily, which small allowance will have a beneficial effect on the digestive tract, showing that fact in the smooth, glossy coat of hair and the general thrift of the animal.

Cotton-seed meal is richer than linseed meal in protein, but it does not have the general beneficial effect found in linseed meal. Throughout the South cotton seed and cotton-seed meal should be extensively fed. In the northern dairy districts cotton-seed meal will often be extensively used because it is a cheap source of protein, and manure resulting from its use is extremely rich in fertility. The dairyman can often advantageously feed two or three pounds of cotton-seed meal daily per cow. As with linseed meal, such an allowance will help bring the protein up to the required standard.

In regard to the roughage, we must place first reliance on the Indian corn plant since it supplies us with the cheapest possible carbohydrates. Every American dairyman should be an extensive corn raiser not only because of the grain furnished but for the roughage it supplies. Dry fodder corn can be used with all forms of dairy stock from calves to milk cows, with success and economy. Planted thickly, there is a fair yield of grain and a large production of coarse corn-hay or fodder. Planted less thickly, there is a large yield of grain, and the corn stover or straw is still valuable—much more so than wheat or oat straw. Many dairymen are not satisfied with good corn fodder or corn stover for their cows, but push their progress further and utilize the silo as a means of storing fresh succulent corn forage.

Experiments at the Wisconsin, Vermont and New Jersey Experiment Stations show that an acre of corn in the silo is somewhat superior in feeding value to an acre of dried shock corn. There is another effect of silage not measured in short experiments. This succulent feeding material tends to keep the animal in a healthy, thrifty condition, something which is not attained during our long winters by using dry feeds only. All talk about silage destroying the teeth of cows, eating up the digestive tract or inducing or favoring tuberculosis, is idle talk and should not be listened to by intelligent dairymen. Silage has proved its usefulness and helpfulness over and over again on the American dairy farm.

Oat straw is the best kind of straw for dairy cows, a few pounds a day being helpful in making up a ration. Next comes barley straw, then wheat straw, and finally rye straw, which last two had better be used for bedding purposes rather than placed in the feed manger.

Of the hays, timothy is the least valuable, being comparatively rich in carbohydrates but quite poor in protein, and always more expensive for the nutriment furnished than is corn forage. The dairy farmer cannot afford to raise timothy hay for his cows so long as he can grow a corn crop. Clover hay is comparatively rich in protein, and when well cured is one of the most useful of all feeds in the dairy barn. First of all the dairyman should be a corn grower and next a clover grower. By using clover, the protein of the ration is materially increased at low cost for the same, and this means a cutting off of expense for concentrated feeds purchased. The large protein requirements of the dairy cow explains why she takes so kindly to red clover hay. Better still than red clover hay is that from the alfalfa plant. Good alfalfa hay is almost as rich in protein as wheat bran, and carries about the same amount of carbohydrates as the feeding table in this chapter shows. It is not surprising then that we find dairymen who have alfalfa hay, claiming that in many cases such hay takes the place of wheat bran in the ration. Dairy farmers should carefully test the alfalfa plant and grow it if that can possibly be done.

In considering the question of preparing feed for the dairy cow we should understand her needs and the composition of the feeding stuffs available. Where the ears of corn are small and where labor is high, it will often be best to feed shock corn directly to the cattle without husking. It is best to run the forage through the feed cutter, but if one can put up with the long waste stalks, he need not even give that preparation. The dairy cow can do her own husking of corn, and thanks no one to do it for her. Like the hickory-nut meat, the ear of corn is fresher when left in the husk until used. The cow is happy when crunching small ears of corn. Partially dry cows; dry cows, heifers and other young stock may well get their small corn allowance in the unhusked form. Oats may also be fed whole. Where animals are hard worked as is the dairy cow when giving a full flow of milk, it is generally best to prepare feed by chaffing or shredding the corn forage, cutting the hay and grinding the grain.

The paunch of the dairy cow holds two or three hundred pounds of food and water. In the paunch the food does not lie quiet but is being constantly moved about and mixed by the muscular contractions of that organ; this true, there is very little use of the farmer mixing up feeds in advance for his cows. Farmers sometimes think that if they moisten the forage and then sprinkle meal over it, that they have greatly helped the cow. All the feed a cow eats is intimately mixed in the paunch within fifteen minutes after it is swallowed. This true, one should feed cows in that manner which is the most satisfactory to them so far as palatability goes and the most convenient to himself. In regard to the order of administering feed, habit and comfort should rule again. Some cows grow restless if they do not receive their concentrates first, and after eating these they quietly munch the roughage for two or three hours later. The same rule should govern in regard to the frequency of feeding. Habit is the strongest factor. In general, the writer believes that twice a day is often enough for feeding the dairy cow concentrates, and roughage too for the most part. Let the morning and night feeds be heavy. At mid-day let the cows have some roughage to chew when they would otherwise be idle. It is not necessary to feed a cow four or five times a day to get the best results. Nature provides the paunch as a storage place for food, and it is a good deal better to let this be well filled and then well emptied twice a day than to be constantly adding a little from time to time.

There seems no valid reason for wetting forage and then placing meal thereon unless the cattle like such feed a great deal better than in the dry form. Carefully conducted tests show that forage and grain are often actually injured for stock-feeding by being cooked. The dairyman should usually not cook any feed for his cattle. Roots are a good feed for cattle, but it costs too much to produce them in this country. The farmer who is inclined to grow roots for his cattle because he feels their need of succulent feed in the winter time should build a silo and use that instead of the root cellar. A good crop of corn silage costs only about half as much as roots for the nutriment furnished.

The silo as an adjunct to dairying, calls for special treatment. The silo is simply a large tub or vat in which green forage, usually the corn plant, is preserved until required for feeding cows. Whoever uses the silo should see that it is air-tight and well made. "Cheap" silos are a delusion. Even though the cattle will eat silage from a poorly made silo, it has usually lost much of its value through slow fermentation and waste. With a good silo one can store a large amount of green corn in most palatable form to be used when required. Corn is the best silage crop. It should be cut into half-inch to inch and half lengths and placed in the silo when the grains of corn on the ears are dented and while the leaves of the plant are still green. The silo should be slowly and steadily filled. Great care should be taken in packing the material about the walls, and if the silo is not deep, the material should be weighted. In corn silage no part of the corn plant is wasted by the animal, the coarser parts being readily consumed. By preserving the corn in the silo there is no husking or otherwise caring for the grain, every part of the work being performed in the single operation of silo filling. Dairy cows are universally fond of corn silage when they have once learned to know it. At the University farm when feeding cows liberally on corn silage we have had them refuse to eat so much as five pounds of hay per day, though the latter was of good quality. The dairyman because of the large amount of manure produced on the farm can grow large crops of corn, and this can be preserved in the silo. Silage is useful not only for winter feeding but for summer feeding, when a shortage of pasture is apt to occur. Some dairymen think even more of the silo for summer use than for winter feeding. Twenty years ago the silo was advocated by a few enthusiasts who claimed unreasonable things for it. These claims did much harm and prejudiced many dairymen. Strangely this prejudice yet exists in many places. All dairymen do not need a silo. Some of them keep only a few cows on a given area of land and have plenty of roughage; such do not need a silo. The dairyman who needs a silo is the one who keeps a large number of cows relatively on a given area of land, and is always short of coarse feed and corn. The silo in and of itself will not help the dairyman any more than will a wagon, a horse or anything else—all depends upon whether it is needed or not. The use of the silo is steadily growing with intelligent, pushing dairymen. Where dairying is the most extensively followed there the silo has the most friends. Half-hearted dairymen or those who follow dairying as a secondary business would better let the silo alone.

"He that gives a portion of his time and talent to the investigation of mathematical truth, will come to all other questions with a decided advantage over his opponents."—Colton.

"Seldom ever was any knowledge given to keep, but to impart; the grace of this rich jewel is lost in concealment."—Bishop Hall.

MANAGEMENT OF YOUNG DAIRY STOCK, WITH A REVIEW OF SOME INTERESTING CALF EXPERIMENTS.

BY D. H. OTIS, PROFESSOR OF DAIRY HUSBANDRY, KANSAS AGRICULTURAL COLLEGE AND EXPERIMENT STATION.

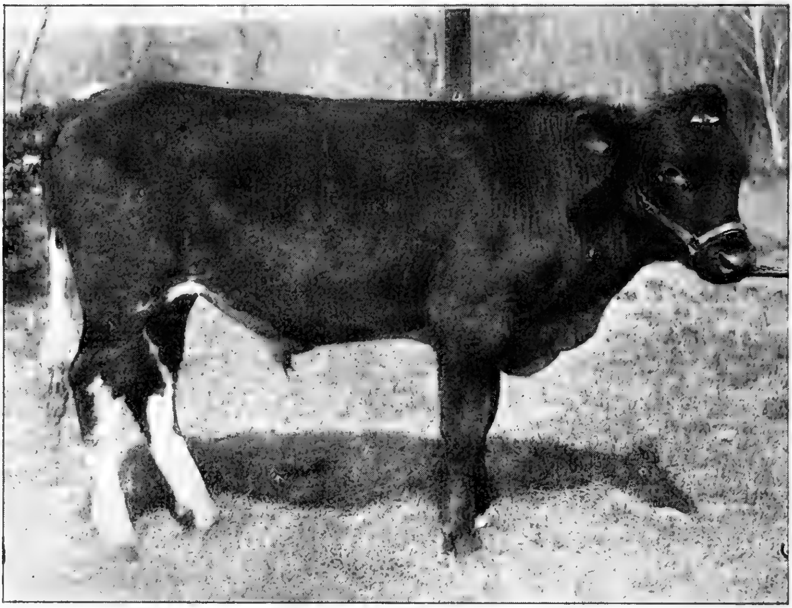
Manhattan, Kan.

THE REARING OF CALVES.

PRENATAL INFLUENCES: To get best results in rearing calves attention must be given to the mothers of the calves previous to birth. A good dairyman will supply his cows with wholesome and nutritious feeds in abundance. This is necessary for best results at the pail as well as for the best development of the calf. Highest yields of milk and butterfat and the best calves are usually obtained from cows that go dry from six to eight weeks prior to calving. If it is impossible to dry the cow without injuring the udder, continuous milking should be practiced.

A dry cow on good pasture with plenty of shade and water will need very little attention, except to see that she is not annoyed or injured by other cattle. Sometimes heavy milkers on luxuriant pastures will be stimulated to produce too much milk prior to calving, in which case the supply of feed should be reduced. On dry feed the cows should be kept in good condition though not too fat. Where alfalfa or clover hay is available, little or no grain is necessary. Ensilage and roots are especially desirable for cows at this time. When grain is used a mixture of two-thirds bran and one-third oil meal is excellent. Soy beans make a good substitute for oil meal. The object is to keep the bowels loose. All these points have an important bearing on the health of the cow and consequently on the condition and health of the calf, before and after birth. If the cow is sick when the calf is born the milk is liable to be affected in a way to seriously injure the calf.

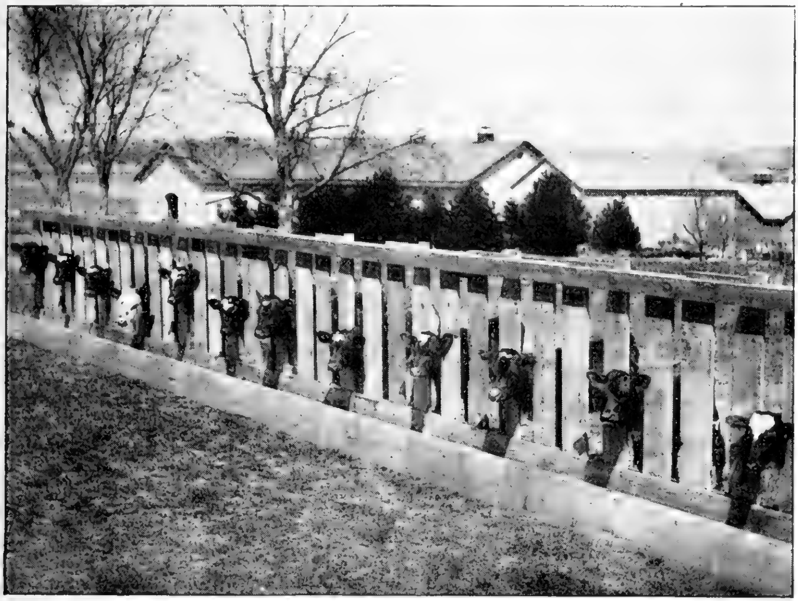
AT CALVING TIME: If the weather is chilly put the cow in a box stall well bedded and free from draught. When the calf is born blanket the cow until she gains her normal condition. If nothing better is available gunny sacks, sewed together, will answer. Give light, loosening feeds and water from which the chill has been removed. Cold water is likely to cause a contraction of the womb and retention of the afterbirth. If the latter is not discharged in twenty-four to forty-eight hours it should be removed. If the udder is hot and caked it is better to milk the cow frequently (at least once in two or three hours) but not dry, as a fresh flow would be stimulated which would increase the inflammation and might lead to milk fever. Steaming the udder with a flannel cloth dipped in as hot water as the hands will bear is very desirable after which the udder should be rubbed dry and treated with camphorated vaseline. Keep the bowels loose. If any signs of constipation appear, give one and one-half to two pounds of Epsom salts dissolved in warm water. Adhering to these points means much in giving the calf a good, vigorous start.



STEER RAISED ON SKIM MILK.

The New Born Calf: After the calf is licked dry by its mother it usually has strength enough to rise and suck. If it does not it should be assisted in securing its first meal. The calf may then be taken away, in which case it should be fed the colostrum milk from its mother, or it may be left until the milk is fit for use. Where the cow's udder is in good shape it is easier to teach the calf to drink when it is taken away before sucking at all. The records at the Kansas Experiment Station show that when a calf is weaned from its mother at once or when four or five days old, it will make good gains the first week, but when left two or three weeks, the first seven days after weaning is a losing period. If the cow's udder is caked, however, it is well to leave the calf with her, as the rubbing of the calf tends to reduce inflammation and soften the udder. Where the calf is several days old before weaning, the moral atmosphere around the calf pen will usually be better if the calf be allowed to go without eating for twenty-four hours. By that time is it hungry enough to eat without a great deal of coaxing.

FEEDING THE MILK: In nature, the calf gets its milk often but in small quantities, and always at blood temperature. In this respect we should imitate nature as far as possible. At first the calf should not be fed over ten pounds daily (one quart equals about two pounds), divided



READY FOR BREAKFAST.

into three messes; four pounds in the morning, two pounds at noon, and four pounds at night. This quantity may be increased gradually to twelve pounds per day. After two weeks the milk may be fed only twice daily. Since the calf is a very greedy animal, there is often a great temptation to give it more milk than it can properly handle, thus causing scours. Over feeding is undoubtedly one of the main reasons why so many farmers fail in raising good calves on skim milk. The quantity of milk should be weighed or measured at each feed. Calves from three to five weeks of age will consume from ten to twelve pounds daily; when from seven to eight weeks old fourteen to sixteen pounds daily; and when three or four months old from eighteen to twenty pounds. Calf milk should always be fed warm and sweet. If impossible to have the milk sweet all the time, then it should be fed sour every meal. It is possible to raise good calves on sour milk, but it is impossible to raise good calves and have sweet milk one meal and sour the next.

IMPORTANCE OF SKIM MILK: Since the advent of creameries the raising of calves on skim milk has been a subject of vital importance to every creamery patron and one of growing importance to every private dairyman. When calves six months old are worth from eighteen to twenty dollars a head, and when the profits from a good milk cow are so greatly enhanced by raising the calf on skim milk, it is vastly important that we know how, first, to raise a No. 1 calf, and second (especially to the man with limited capital on high priced land), how to accomplish this result through the medium of skim milk.

CHANGING FROM WHOLE TO SKIM MILK: When two or three weeks old we may begin to feed skim milk. The stomach of a calf is delicate and sensitive, and any change of feed should be made gradually. Do not change from whole milk to skim milk faster than a pound or a pound and one-half per day; *i. e.*, if the calf is getting twelve pounds of whole milk per day, the first day of the change feed eleven pounds of whole milk and one pound of skim milk; the second day ten pounds of whole milk and two pounds of skim milk; and so on, until the change is complete.

FEEDING GRAIN: It has been found by experience that the starch and fat contained in corn or Kafir-corn can be made to take the place of fat removed from the milk. Calves will begin to eat grain when ten days to two weeks old. At first put a little meal in their mouths after drinking their milk, and in a short time they will go to their feed boxes and eat with a relish. We find that calves four weeks old will eat from one-half to three-fourths of a pound per day; when eight weeks old, from one and one-fourth to one and one-half pounds per day.

Never mix corn, Kafir-corn or any other grain in the milk. The starch of corn must be changed to sugar before it is digestible. This change takes place only in the presence of an alkali, and, hence, chiefly by the saliva of the mouth. When the corn is gulped down with the milk the starch is not acted upon by the saliva, and cannot be acted upon by the gastric juice of the stomach, since that is acid instead of alkaline. It will then remain unchanged until it reaches the alkaline secretions of the intestines. Since the intestines of the calf are comparatively short, complete digestion is impossible. In this respect the calf differs from the hog, which has a comparatively small stomach and long intestines. For this reason he may gulp down his feed, and what is not digested in the mouth will have plenty of time to be digested in the intestines.

Kafir-corn meal has proven to be a superior feed for calves. It seems to be constipating, and materially assists in checking the tendency to scours, so common with calves. Experiments at the Kansas Station show that calves will begin eating shelled corn when three to four weeks old and will do as well and even better than when fed corn chop. When possible it is desirable to feed a mixture of shelled corn and ground Kafir-corn.

Soy beans have been tested at the Kansas Experiment Station as a calf feed, and all results indicate that they are not adapted to young calves in any quantity whatever. They are very loosening and cause scours.

Where calves are intended for dairy cows, the grain ration of corn or corn meal should be changed to include oats and bran or oil meal whenever they begin to appear fleshy.

FEEDING ROUGHNESS: Calves will begin to nibble at hay about the

SKIM MILK STEERS.
Average Weight, 724 Pounds at One Year Old.

same time that they commence to eat grain. When from six to eight weeks old, the calves under experiment at the Kansas Agricultural College consumed from one-half to one pound daily per head. Mixed orchard grass and prairie hay are best. Alfalfa hay proves to be too loosening for young calves, though it may be gradually introduced into the rations after three to four months. Nothing but clean, bright hay should be offered to calves.

At times considerable difficulty is experienced from scours when calves are suddenly turned on pastures. This can be overcome by feeding a little green feed before making the change. Give a forkful the first feed, two forksful the second feed, and so on until the calves get all the green feed they want, when they can be turned on pasture without injury.

WATER: Calves like fresh, clean water. In a trial at the Kansas Station with thirteen calves, ranging from two to three months of age, it was found that 868 pounds of water was drunk in seven days, or nearly ten pounds per day per head. It was noticed that these calves drank several times a day, but sipped only a little at a time. Even after their ration of milk they would take a few swallows of water. An automatic waterer situated a little above the surface of the ground is the best arrangement for supplying this need.

CALF TIES: The Kansas Experiment Station has tried both ropes and stanchions, and find that using the latter is the simplest and best means

SKIM MILK CALVES.
Average Daily Gain Per Head, 1.51 Pounds. Feed Cost Per 100 Pounds of Gain, $2.26.

of holding calves while they are being fed. Calves will also learn to eat grain much quicker than when fed in an open pen. With stanchions each calf finds its place, and the feeder can set the milk pail in the feed trough, which prevents it from being tipped over, and while the calf is drinking can measure out the milk for the next calf. In this way it is possible for a man to keep three or four pails going, until all the calves are fed. If grain is put into the feed trough at once the calf will go to eating, and forget about its friendly but impolite and unsanitary affection for its neighbors ears or mouth. Calves fed in this way can be let loose again fifteen minutes after entering the stanchions. The Agricultural College has found that excellent stanchions for calves can be made out of plain fencing for the upright pieces, with 2x4's for the horizontal pieces at the top, with fencing boards at the bottom. The stanchions are forty-two inches high, twenty-eight inches apart from center to center, and allow for four and one-half inches space for the neck. The feed trough is twelve inches wide, four inches deep, and runs the full length of the stanchion. If calves are fastened by rope ties, they should be far enough apart to prevent them from sucking each other.

SCOURS: The greatest difficulty in raising calves is undoubtedly scours. Here, as elsewhere, "An ounce of prevention is worth a pound of cure." The principle causes are overfeeding, feeding sour milk, feeding cold milk, feeding grain with the milk, dirty milk pails, unwholesome feed boxes, and irregularity of feeding. An intelligent and observing feeder will notice the symptoms of this disease as soon as it appears, in which case the ration of milk should be cut down one-half or more and gradually increased again as the calf is able to stand it. A successful feeder will do his best to keep the milk sweet. When sterilized skim milk is brought back from the creamery, the portion intended for that night's feed will usually keep in good condition without any treatment. The portion intended for the next morning's feed or the following feeds (where milk is kept over Sunday or hauled to the creamery every other day) needs to be cooled down to 60 degrees F. or less as soon as it arrives from the creamery. Complaints are sometimes received about sterilized skim milk souring when placed in tubs of cold water as soon as received from the creamery. Sterilized skim milk will not sour until it is cooled to about blood temperature. A can of hot milk will warm a tub of water to about this temperature, and as the milk is cooled at the same time the best conditions are offered for the development of lactic-acid germs. In this case a tub of water only helps to keep the can of milk at blood temperature. Under such circumstances the water is worse than nothing. If hot skim milk is cooled in the tub, it should be done by running water. A better plan is to use a cooler, and place the can of cooled milk in a tub of cold water in order to keep it cool.

Skim milk treated in this way at the Kansas Agricultural College has been kept sweet from Saturday forenoon until Monday morning, during the hottest months of the summer, without the use of a particle of ice, the cooling being done with well water. Where trouble is experienced when skim milk is cooled and kept below 60 degrees, the fault probably lies in using unclean utensils, or by the creamery receiving tainted or sour milk, or by the skim milk being improperly sterilized.

The heating of the milk tends to produce chemical changes that help to prevent scours. There is probably no more effective way of upsetting the system of the young calf than by feeding it cold milk. So important is it always to feed the milk at blood temperature (95 to 100 degrees F.) that a careful feeder will occasionally test the temperature with a thermometer. No one can expect to successfully raise skim milk calves without giving close attention to the temperature of the milk when fed.

The feeding of the grain with the milk has already been mentioned in detail. Calf buckets may be kept clean by rinsing and scalding after each feed. No more grain or hay should be fed than the calves will eat up clean. Should any remain uneaten it should be removed before giving any fresh feed. Calves like salt the same as other animals.

Dried blood has been found to be an effective remedy for scours. Mix a teaspoonful with the milk while the calf is drinking. In case of a weak calf the allowance may be increased gradually to a tablespoonful at each feed.

To summarize, warm, sweet milk, fed in clean buckets, with access to corn meal, shelled corn or Kafir-corn meal, bright hay, fresh, clean water,

WHOLE MILK CALVES.
Average Daily Gain Per Head, 1.86 Pounds. Feed Cost Per 100 Pounds of Gain, $5.46.

salt, plenty of sunlight, shelter and bedding in cold weather, shade in summer and regularity and kindness in treatment will usually insure good, thrifty calves that will gain from a pound and one-half to two pounds daily.

SOME INTERESTING CALF EXPERIMENTS.

CREAMERY COMPARED WITH HAND SEPARATOR SKIM MILK: Thirteen calves at the Kansas Experiment Station were divided into two lots of six and seven respectively. During the feeding period of 142 days the six calves, fed on sterilized creamery skim milk made a gain of 250 pounds per head, while the seven calves fed on hand separator skim milk gained during the same time 251 pounds per head. At first the calves showed a dislike for sterilized skim milk but as soon as they became accustomed to the odor they drank it with a relish. It will thus be seen that the two kinds of skim milk are practically equal in feeding value. Too much emphasis however cannot be placed upon having the skim milk from the creamery thoroughly sterilized, preferably by live, dry steam so as to add as little water as possible. The temperature should go above 200 degrees F. Where the skim milk is sterilized at the creamery and well cared for after reaching the farm the calves are sure of getting good sweet milk of uniform quality at each meal. Sterilized milk helps to prevent scours. Without these precautions it is impossible to raise good, thrifty calves on skim milk. Sterilization is not necessary where the milk is separated on the farm and fed immediately after each milking.

CALVES RAISED WITH DAMS.
Average Daily Gain Per Head, 1.77 Pounds. Cost Per 100 Pounds of Gain, $4.41.

FEEDING OIL MEAL, FLAXSEED MEAL OR BLACHFORD'S MEAL WITH MILK: The Iowa Experiment Station compared the relative value of oil meal and corn meal in supplementing skim milk. In commenting on the results Professor Curtiss says. "The results of all the investigations made at this station strongly indicate that it is not only unnecessary but poor economy and poor practice in feeding to use a highly nitrogenous product like oil meal in combination with separator skim milk. The practice has neither logical reason nor scientific theory for its support; and in the corn belt states with their surplus of corn and oats, there is no necessity for the purchase of a high-priced nitrogenous product to be used in supplementing the skim milk ration."

Flaxseed meal is recommended by dairy writers as a suitable feed to take the place of the butterfat removed from the milk. Blachford's calf meal is advertised and sold for the same purpose. The Kansas Experiment Station fed four calves on flaxseed meal. The meal was placed in a pail and enough boiling water poured over it to make a jelly, which was fed with the skim milk at feeding time. At first each calf received a tablespoonful of flaxseed at each meal; this allowance was gradually increased to one-half pound per head per day by the time the calves were three to four months old. Four calves were fed Blachford's calf meal. The latter was mixed with warm water according to directions to form a gruel. This gruel was mixed with the skim milk and the same amount fed as with the flaxseed meal. Both lots received all the mixed hay and Kafir-corn meal they would eat. A third lot of five calves received skim milk, Kafir-corn meal and mixed hay. The calves receiving the Blachford's calf meal gained 1.9 pounds daily per head, the flaxseed lot 1.55 pounds daily per head, and the lot with nothing mixed with their skim milk 1.82 pounds daily per head. Both the flaxseed meal and the Blachford's calf meal are very expensive, and unless better gains than the above are secured their use is not only expensive but of practically no value.

Shelled Corn Compared with Corn Chop for Young Calves: In the fall of 1900, the Kansas Experiment Station purchased twenty head of young calves, composed mostly of Shorthorn and Hereford grades. On November 28, these calves were divided into two lots as nearly equal as possible, the average weight being 127 pounds. Both lots were fed and treated alike, with the exception that one received its grain as shelled corn and the other as corn chop. All the calves were fed mixed hay (red clover, orchard grass and English blue grass) for the first nine weeks, prairie hay for the next four weeks and a mixture of prairie and alfalfa for the last six weeks. Each lot was given all the milk, grain and hay the calves would eat without scouring. Salt was accessible at all times. For nine days previous to the division into lots the grain for all the calves consisted of a mixture of shelled corn and corn chop. It was noticed that the calves would begin to eat the shelled corn when three to four weeks old, and in a few cases when two to three weeks old. At the commencement of the experiment each lot was consuming ten pounds of grain daily. As the experiment advanced it was found that the corn chop calves could not eat as much grain as the shelled corn calves without causing considerable trouble from scours. This accounts for the difference of 325 pounds in the grain consumed by the two lots.

Shelled Corn Lot: For nineteen weeks under experiment these ten calves consumed 18,561 pounds of skim milk, 2,611 pounds of shelled corn, and 7,088 pounds of hay. The total gain during the experiment was 2,322 pounds, or 1.74 pounds daily per head. Valuing skim milk at fifteen cents per hundred pounds, grain at fifty cents per hundred pounds and hay at $4.00 per ton, the feed cost of raising these calves amounts to $55.06, or $5.50 per head. The cost for each 100 pounds of gain is as follows: Skim milk $1.20, grain $0.56, roughness $0.61, total $2.37.

CORN CHOP LOT: The ten calves consumed 18,666 pounds of skim-milk, 2,286 pounds of corn chop, 7,088 pounds of hay. The gain of this lot was 2,123 pounds, or 1.59 pounds daily per head. At prices given above the feed cost amounts to $53.60, or $5.36 per head. The cost of each 100 pounds of gain is as follows: Skim-milk $1.31, grain $0.54, roughness $0.67, total $2.52. If we raise the cost of grain five cents per 100 pounds (about three cents per bushel) to pay for the grinding, the grain cost per 100 pounds of gain would be increased to $0.59 and the total to $2.57.

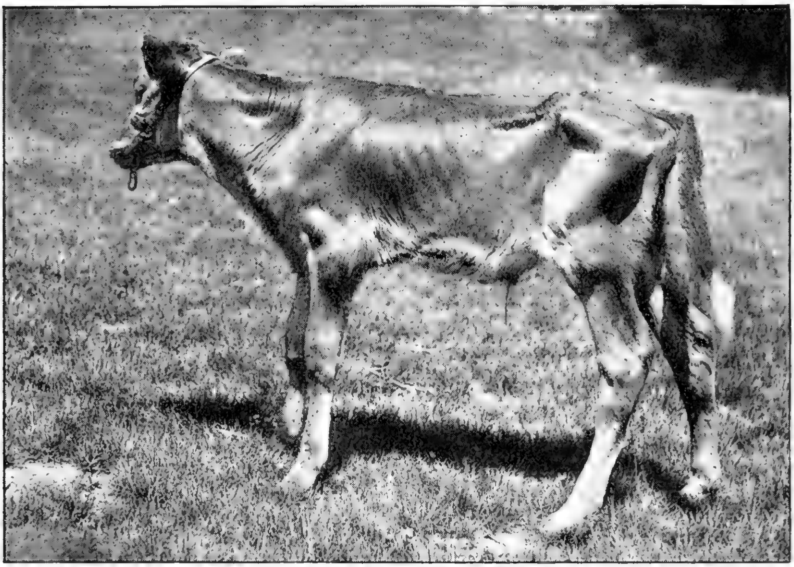
Comparing the two lots, we find those on shelled corn made the best gains by 199 pounds and at a cost of $0.20 less per 100 pounds of gain. Since calves relish shelled corn and will begin eating it when three or four weeks old, and make better and cheaper gains on it, and are less subject to scours than on corn chop, there is certainly no object in going to the expense of grinding corn. This experiment shows that it is possible to raise good, thrifty calves that will gain 1.75 pounds daily per head on feeds produced entirely from the farm and in a form that requires no preparation of the feed, outside of harvesting, except the shelling of the corn.

THREE WAYS OF FEEDING MILK TO CALVES: Twenty head of grade Shorthorn and Hereford calves were purchased by the Kansas Experiment Station in the spring of 1900 and divided into two lots. One lot was fed on sterilized creamery skim milk with a grain ration composed of equal parts of corn and Kafir-corn meal, with all the alfalfa hay they would eat. The second lot was fed the same as the first, except that fresh whole milk was used instead of skim milk. In addition to these two lots, the Station secured the privilege of weighing twenty-two head of high grade Hereford calves which were running with their dams in a pasture near the Experiment Station.

RESULTS WITH SKIM MILK: For the twenty-two weeks under experiment the ten calves consumed 24,736 pounds of skim milk, 1,430 pounds of corn chop, 1,430 pounds of Kafir-corn meal and 641 pounds of alfalfa hay. The total gain was 2,331 pounds, or a daily average of 1.51 pounds per head. Figuring skim milk at 15 cents per 100, grain at 50 cents per 100 pounds and hay at $4 per ton, the total feed cost of raising these calves was $52.68, or $5.27 per head. The feed cost for each 100 pounds of gain was $2.26.

Cows that are milked will produce larger yields than when suckling calves. According to the average yield at this Station, ten cows (one for each calf) produced 55,540 pounds of milk testing 3.93 per cent. butterfat. With butterfat at 15½ cents per pound, this would amount to $338.52. The value of the skim milk not needed by the calves would raise this to $374.24. Deduct from this the value of the feed consumed by the calves and there remains $321.56, or $32.15 per calf to pay for the expense of milking, feeding the calves and hauling the milk to the creamery. At 12½ cents per hour, this expense need not be one-half of the above sum, leaving $15 to $16 clear profit for each calf raised on skim milk.

RESULTS WITH WHOLE MILK: During twenty-two weeks these ten calves consumed 23,287 pounds of fresh milk, 835 pounds of corn chop, 835 pounds of Kafir-corn meal, and 835 pounds of alfalfa hay. The total gain was 2,878 pounds, or a daily average of 1.86 pounds per head. Charging butterfat at creamery prices, the feed cost of raising these calves amounted to $157.19 or $15.72 per head. The feed cost for each 100 pounds of gain amounts to $5.46.



YPSEY'S START IN LIFE.
(Before Taking Dried Blood.)

RESULT WITH CALVES NURSED BY THE COWS: On May 28, 1900, twenty-two calves that were running with their dams averaged 174 pounds. On October 15, these same calves averaged 422 pounds, or an average daily gain per head of 1.77 pounds. The only expense attached to raising these calves was the keep of the cows, which was estimated by the owner to be $12 per head. Multiplying the average daily gain of these calves by 154, the number of days in previous experiment, gives a total gain of 272 pounds per head. With $12 as the cost of raising the calf, each 100 pounds of gain cost $4.41.

RESULTS IN FEED LOT AFTER WEANING: In the fall all these calves were placed in the feed lot, where they were pushed for baby beef. During the seven months under experiment, the skim milk calves gained 440 pounds per head, the whole milk calves 405 pounds per head, and the calves nursed by the cows, 422 pounds per head.

This experiment shows that the feed cost of raising a good skim milk calf need not exceed $5.25 in contrast to $15.75 for a whole milk calf and $8 for one nursed by the dam. The skim milk calf becomes accustomed to eating both grain and roughness early in life, is handled enough to be gentle, and when transferred to a feed lot is ready to make rapid and economical gains.

Dried Blood as a Tonic for Young Calves: For over two years the

YPSEY AS A YEARLING.
(After Taking Dried Blood.)

Kansas Experiment Station has used dried blood in connection with its experiments in feeding calves. In March, 1899, one of our cows gave birth to a calf weighing 86 pounds. This calf was allowed to suck for several weeks, to assist in reducing the inflammation in the dam's udder. On account of poor quality and quantity of milk, the calf did very poorly, and to save its life it became necessary to remove it from the dam. With the ordinary treatment accorded our calves he grew worse and worse, and when 79 days old weighed only ninety pounds, or four pounds heavier than at birth. Although no one would have given ten cents for the calf at this time, an effort was made to bring him out. He was given castor oil, laudanum, fresh eggs, calf meal, and, as a last resort, dried blood. With the blood the calf commenced to improve, and in a short time was gaining at the rate of nearly fourteen pounds per week, and not infrequently as high as seventeen to eighteen pounds per week. When a year old he weighed 578 pounds—a pretty good record for a calf that gained only four pounds for the first seventy-nine days of its existence. The dried blood consumed during parts of three months amounted to seven and one-half pounds. At two cents per pound, the cost was fifteen cents.

In October, 1900, a heifer belonging to the Agricultural College dropped her first calf. The calf was small and sickly, and for the first few weeks did very poorly, as is shown by the fact that on December 1 it weighed two pounds less than on November 1. For a few weeks its life was in a very critical condition, but when induced to eat a little dried blood with its milk it began to improve and has been making fair gains ever since.

Dried blood is not only good for a weak calf, but is an excellent remedy for any calf subject to scours. The Kansas Experiment Station purchases many young calves. Frequently these calves arrive at the Station badly affected with the scours; a little dried blood always brings about a cure. Recently a test was made with five calves that happened to be scouring at the same time. With two of these calves dried blood was fed after reducing the regular feed of milk. With the other three the dried blood was fed without changing the supply of milk. In the former case the calves recovered from the scours after two feeds; in the latter after three feeds. With seventy head of young calves under experiment at the Kansas Station during the past year, there has not been a single case of scours that dried blood has failed to check.

In feeding dried blood, a teaspoonful at a feed is a great plenty. This should be continued until the scours disappear. In case of a weak calf, the allowance may be gradually increased to a tablespoonful at a feed. To prevent the dried blood from settling to the bottom of the pail, where the calf will be unable to get it, it may be stirred in the milk while the calf is drinking, or the milk and blood may be fed immediately after being thoroughly mixed. Since dried blood is such a cheap and effective remedy, it will pay any one who raises young calves by hand to have a little available whenever a calf shows signs of disorders in its digestive tract. It can be obtained from any of the large packers. When ordering, state that the blood is wanted for feeding purposes.

Dehorning Young Calves: With the possible exception of pure bloods it is well to dehorn the calves while young, preferably when three or four days old. As soon as the button can be felt beneath the skin clip off the surrounding hair; then take a stick of caustic potash, wrap all but one end with paper, to protect the hand, moisten the exposed end in water and rub gently over the button, until the skin becomes slightly raw and the calf smarts a little under the operation. In a few days a scab will form, soon to disappear, leaving the animal without horns. Usually one application is ample, but, should the horns start to grow, the operation can be repeated. This is by far the easiest and most humane way of dehorning cattle. Care should be exercised not to allow any of the dissolved caustic potash to run down over the hair and injure the eyes or skin.

RELIEVING CALVES FROM FLIES: During the hot summer months flies are a constant torment to young calves. For two seasons the Entomological Department of the Kansas Agricultural College has been experimenting and compounding various substances, in order to produce an effective and economical mixture which, when applied to the surface of an animal, would ward off the flies. As a result of these experiments, they

SKIM MILK HEIFERS RAISED FOR THE DAIRY.
Average Weight, 564 Pounds at One Year Old.

have succeeded in producing the following formula, which seems to answer the purpose reasonably well: Resin, 1½ pounds; laundry soap, 2 cakes; fish oil, ½ pint; enough water to make three gallons. Dissolve the resin in a solution of soap and water; add the fish oil and the rest of the water. Apply with a brush. This mixture will cost from seven to eight cents per gallon, and may be used for either calves or cows. One-half pint of this mixture is considered enough for one application for a cow; a calf, of course, would require considerably less. It will be more economical to apply this only to the parts of the animal not reached by the tail. At first it will probably be necessary to give two or three applications per week, until the outer ends of the hair become coated with the resin. After that retouch those parts where the resin is rubbed off.

MANAGEMENT AFTER WEANING.

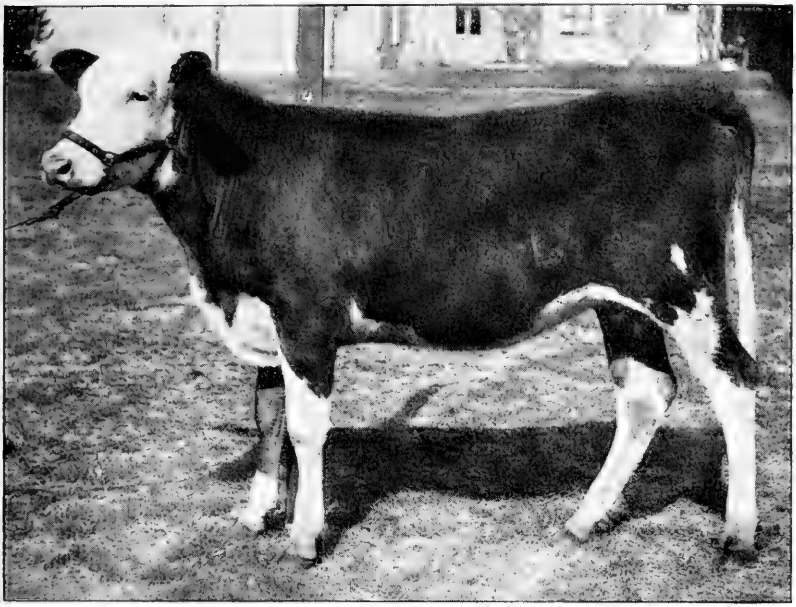
FEEDING: Skim milk can be profitably fed to calves until they are five or six months old, and when milk is plenty even longer. Weaning from milk should be done by gradually reducing the allowance; at least one week should be consumed in the change. If pastures containing plenty of feed and water are available young dairy stock could ask for no better quarters. If weaning occurs in winter they should be supplied with plenty of nutritious rough feed, such as alfalfa, red clover, cow-pea hay or soy bean hay. These can be supplemented to advantage with sorghum hay, corn stover, Kafir-corn stover, millet, timothy, orchard grass or prairie hay. It is very desirable to have plenty of leguminous crops, like the first four mentioned, to furnish plenty of protein to develop bone and muscle. Heifers intended for future usefulness in the dairy need very little or no grain after weaning until they drop their first calves. The object is to develop large frames and large paunches. This can be better and more economically done with roughness than with grain. In the winter of 1900–01 a small herd of grade Guernsey heifers were wintered in excellent shape on alfalfa and sorghum without grain.

SHELTER: Under conditions existing in Kansas a shed open to the south is ample protection for young dairy stock. Hardiness is one of the very essential points to develop in dairy cattle. This cannot be done where the young stock are kept in as warm and close quarters as is usually necessary for the milch cow. In northern climes the open shed may not be sufficient but the object should be to come as close to it as the climate will permit.

INOCULATING FOR BLACK LEG: A large number of calves are lost every year from black leg. Protective inoculation is the only successful way of combating this disease. Experiments at the Kansas Station show that the death rate is more than seven times as great before as after inoculation. A man is running too much risk in allowing his heifers to go uninoculated. If the reader cannot procure vaccine for inoculation from his own Experiment Station he can probably get it of the United States Department of Agriculture or from some commercial manufacturers advertised in the stock and dairy papers.

BREEDING: Dairy heifers are nearly always stunted and frequently injured more or less for life if they are bred to calve before they are two years old. If the heifer was a spring calf it would be better to breed her to calve in the fall following her second birthday. Fall calving is profitable in more ways than one. When fresh, a cow will give a good flow of milk even on dry feed. In the spring the stimulating effect of the green grass will keep up and even increase the flow. A cow calving in the spring will usually shrink very materially in her milk flow when changed from pasture to dry feed in the fall. Again the cow calving in the fall produces the largest amount of butterfat when prices are the highest. A fall calf will usually fare better than his spring sister. The farmer has more time to give it the attention that it needs, flies are not so bad and in the spring it is ready to go to pasture. Much depends in getting the dairy heifers in the habit of calving at the time of year when they will bring in the most profit.

General Care: The yards, sheds and barns in which the young dairy stock are kept should be so situated that water will readily drain away, that



HALF GUERNSEY HEIFER.
Raised on Skim Milk.

sunlight will find an abundant entrance, and if possible so that cold winds of the north and northwest will not reach them. The shed or barn should be well bedded. While it is not desirable to have the main racks for hay under the shed they should be located in as well protected spot as possible. Where racks are constructed to prevent the cattle from wasting it, enough hay may be hauled in at one time to last several days. When ice forms on the drinking water, tank heaters are very desirable. They cost but little, require only a small amount of fuel and are easily cared for. These heaters will keep ice from forming in the severest weather, and the stock will drink much more water with evident satisfaction.

"The great high-road of human welfare lies along the old highway of steadfast well-doing; and they who are the most persistent, and work in the true spirit, will invariably be the most successful. Success treads on the heels of every right effort."—Samuel Smiles.

ECONOMIC FEEDING AND CARE OF DAIRY COWS, WITH INSTRUCTIONS AND EXAMPLES OF HOW TO FORMULATE DAIRY RATIONS.

BY T. L. HAECKER, PROFESSOR OF DAIRY HUSBANDRY, UNIVERSITY OF MINNESOTA.

St. Anthony Park, Minn.

American literature dealing with the feeding of domestic animals is largely based upon the teachings of Dr. Emil V. Wolff, a German Scientist, who nearly half a century ago, published the results of his investigations as to the kind and amount of nutrients needed by domestic animals in making growth, maintaining the body and returning animal products. In his feeding standards the amount of organic matter and disgestible nutrients needed by various animals is given in great detail, and the standard daily ration for an average cow in milk, basing the weight at 1,000 pounds, was fixed at 24 pounds of organic matter and of digestible nutrients, 2.5 pounds of protein, 12.5 pounds of carbohydrates, and .4 of a pound of ether extract or what is commonly termed fat.

In the application of this standard to feeding practice it has gradually become apparent that the amount of protein stated in the formula or standard, for a dairy cow, was often more than was really needed by one weighing 1,000 pounds.

A formal deviation from Wolff's standard appeared in bulletin 38, of the Wisconsin Experiment Station, by Woll, who collected data from over 100 dairymen and submitted a proposed American standard ration for dairy cows based upon the average obtained from the rations fed. Atwater and Phelps of the Connecticut Station made a special study of this subject during several winters and submitted a standard which seemed to give best results in their investigation. Dr. C. Lehmann, of the Berlin (Germany) Agricultural College, modified the Wolff standard according to the quantity of milk the cow gives. The wisdom of such a standard is obvious, for a cow giving a large flow of milk requires more nutriment, other things being equal, than one giving a smaller flow.

AMERICAN AND GERMAN FEEDING STANDARDS FOR DAIRY COWS.

DIGESTIBLE NUTRIENTS PER DAY PER 1,000 POUNDS LIVE WEIGHT.

RATION.	Dry matter.	Digestible nutrients			Nutritive Ratio.
		Protein.	Carbohydrates.	Ether extract.	
	Lbs.	Lbs.	Lbs.	Lbs.	
Wolff original (German) feeding ration	24.0*	2.5	12.5	.4	1:5.4
Woll proposed American ration	24.5	2.15	13.27	.74	1:6.9
Atwater and Phelps proposed standard	25.0*	2.5	12 to 13	5 to 8	1:5.6
Wolff-Lehmann modified standard:—					
I. When giving 11 lbs. of milk daily	25.0	1.6	10.0	.3	1:6.7
II. When giving 16½ lbs. of milk daily	27.0	2.0	11.0	.4	1:6.0
III. When giving 22 lbs. of milk daily	29.0	2.5	13.0	.5	1:5.7
IV. When giving 27½ lbs. of milk daily	32.0	3.3	13.0	.8	1:4.5
Standard maintenance ration	18.0	.7	8.0	.1	1:11.8

*Organic matter.

Upon examining the table, it will be observed that there is a general agreement in the standards submitted except that Woll's proposed standard contains .35 of a pound less protein, and .34 of a pound more fat or ether extract than the original Wolff standard. The Atwater–Phelps proposed standard varies the ether extract from .5 to .8 of a pound. The excess of ether extract in these two proposed standards is doubtless due to the fact that American feed stuffs contain a larger supply of this nutrient. The standard proposed by Dr. Lehmann appears to have been merely a mathematical deduction based upon the assumption that, for example, a cow weighing 1,000 pounds requires .7 of a pound of digestible protein daily for maintenance of the body and .081+ of a pound of protein for each pound of milk yielded; for 1.60 pounds protein prescribed for a cow giving 11 pounds of milk daily, less .7, the amount needed for maintaining the body, leaves .9 of a pound of protein available for the production of 11 pounds of milk, and $.9 \div 11 = .081+$. Again, if a cow yielding 22 pounds of milk requires 2.5 pounds of digestible protein daily and she requires .7 of a pound for maintenance there is left 1.8 pounds of protein available for milk production, and 1.8÷22=.081+, the amount of protein required for one pound of milk according to Dr. Lehmann.

During the winter of 1894–5, at the Minnesota Station, an experiment was made with dairy cows, comparing various feeding stuffs, during which less protein was fed than is prescribed in the various feeding standards, and it was therefore a practical test as to whether cows required as much protein as the standards call for. All feed stuffs used were subjected to chemical analysis, every ration was weighed out daily to each cow, and each milking was weighed and tested with the Babcock milk test. It may therefore be assumed that the data obtained are fairly accurate.

The following table gives the daily average of dry matter and digestible nutrients consumed and milk yielded and average per cent. butterfat in each cow's milk from November 19, 1894, to February 10, 1895—84 days.

COW.	Dry matter.	Digestible.			Milk daily Lbs.	Per cent. fat.	Protein to 1 lb milk
		Protein.	Carbohydrates.	Fat.			
Betty	20.53	1.70	10.98	.45	10.03	6.7	.109
Dora	22.53	1.87	12.08	.49	15.02	6.3	.083
Beckley	20.08	1.63	10.72	.43	13.44	5.6	.077
Tricksey	20.53	1.70	10.98	.45	16.78	4.9	.071
Houston	23.23	1.98	12.44	.51	25.00	5.6	.053
Sweet Briar	26.91	2.25	14.50	.58	30.81	4.8	.049
Olive	20.08	1.63	10.72	.43	27.26	3.8	.039
Topsy	31.49	2.64	16.92	.69	44.39	3.7	.041
Lou	26.22	2.14	14.10	.55	38.01	3.7	.035
Quidee	23.29	1.90	12.42	.50	25.55	3.5	.045
Lydia	28.34	2.38	15.22	.61	32.02	3.4	.052
Countess	28.37	2.39	15.28	.62	45.27	2.4	.034
Average	24.30	2.01	12.03	.53	26.96	4.1	.05

The daily consumption of dry matter ranged from 20.08 pounds to 31.49, and averaged 24.30, being very near the amount fixed in the standards. The amount of digestible protein provided ranged from 1.63 pounds to 2.64 pounds, and averaged practically 2 pounds, while the carbohydrates and ether extract varied but little from the standard. Since the flow of milk was large and remarkably uniform, and the cows were apparently well nourished, it may be assumed that the nutrients provided were ample. It will be observed that none of the cows had as much protein in proportion to milk yielded as is prescribed in Dr. Lehmann's modification of the Wolff standard, except Betty and Dora, that were near the close of their period of lactation, and gave milk containing over 6 per cent. of butterfat. It is probable that these cows and some others received more protein than they needed for the work they were doing, but of this there is no evidence. The average amount of protein consumed, after deducting .7 of a pound for maintenance of body, for each pound of milk produced, is .05 of a pound. This offers strong evidence that cows do not need as much protein as is prescribed in the feeding standards. Since this experiment ended the 10th of February, there may be still a doubt as to whether the cows could maintain a normal flow of milk during the remainder of the winter on such a light supply of protein. Fortunately the cows were started on another experiment the 11th of February, comparing timothy with prairie hay, which covered a period of 70 days ending the 21st of April, which was only about two weeks before they were turned to pasture. The following table gives the daily consumption of nutrients and yield of milk of each cow:

COW.	Dry matter.	Digestible.			Milk daily Lbs.	Per cent. fat	Protein to 1 lb. milk.
		Protein.	Carbohydrates.	Fat.			
Beckley	21.19	1.68	11.10	.51	13.17	5.59	.082
Houston	25.24	2.14	13.35	.64	24.88	4.38	.061
Tricksey	19.61	1.56	10.33	.47	15.73	5.34	.066
Sweet Briar	27.00	2.21	14.21	.67	26.09	2.28	.056
Reddy	20.94	1.69	11.01	.51	14.49	5.21	.075
Belle	20.56	1.76	10.89	.50	19.38	4.14	.056
Olive	21.15	1.67	11.12	.51	21.20	4.12	.053
Topsy	31.93	2.59	16.79	.78	40.82	3.69	.043
Lou	27.00	2.21	14.10	.67	31.46	3.67	.045
Lydia	27.57	2.26	14.49	.68	27.93	3.57	.054
Quidee	22.73	1.85	11.94	.55	25.81	3.49	.048
Countess	29.22	2.40	15.50	.72	41.80	2.53	.040
Average	24.51	2.00	12.90	.60	25.23	4.07	.048

There are features in this experiment which have a direct bearing on the feeding standards. One is the small amount of protein fed, the other is the large and uniform flow of milk during the winter. There was only one cow that received as much protein as is given in the original Wolff standard, and she gave during the second period, which covered 70 days, an average daily yield of 40.82 pounds of milk with 2.59 pounds of protein, while the Wolff–Lehmann standard prescribed 3.3 pounds of protein for a daily yield of 27.5 pounds of milk. Countess consumed 2.40 pounds of protein and gave 41.80 pounds of milk daily and after deducting the amount of protein calculated for maintenance of the body, she used at the rate of only .04 of a pound of protein to a pound of milk, being less than half the amount prescribed in the above standard, and the whole herd required only at the rate of .048 of a pound.

Making a summary of the results of the two periods cited we have the following:

	Dry matter.	Digestible nutrients daily.			Milk. daily Lbs.
		Protein.	Carbohydrates.	Ether extract.	
Daily average of nutrients consumed					
Period I.	24.30	2.01	12.03	.53	26.96
" II.	24.51	2.00	12.90	.60	25.23
Total.	48.81	4.01	24.93	1.13	52.19
Average	24.40	2.00	12.46	.56	26.09
Needed daily for body maintenance	13.00	.67	6.69	.10	......
Available daily for milk production	11.40	1.33	5.77	.46	26.09
Nutrients to 1 lb. of milk	.44	.05	.22	.017	......

From this we learn that in a herd where the daily average yield of milk ranges from 10 to 43 pounds, and the quality of the milk from that containing 2.45 per cent. of butterfat to 6.7 per cent. after making allowance for food of maintenance, at the rate of .7 of a pound of digestible protein, 7 pounds of digestible carbohydrates and .1 of a pound of ether extract, per 1,000 pounds of live weight, the nutrients used to a pound of milk testing 4 per cent. fat, was .05 of a pound of protein, .22 of a pound of carbohydrates and .017 of a pound of ether extract or fat. With this definite information at hand it becomes an easy matter for the feeder to calculate about how much of each kind of nutrients is required to provide for a given flow of milk of fairly average quality.

Food of Support. The nutrients an animal uses in rebuilding the tissues of the body as they wear out day by day, in generating heat and providing energy to carry on all involuntary movements of the internal organs, is termed the food of support or maintenance. The amount of food an animal needs for this purpose depends upon its size, disposition and environment.

The larger the animal, other things being equal, the more food is needed for maintenance, though not quite in proportion to the increase in weight. That is, a small animal requires relatively more food for this purpose than does a large one. An animal being constitutionally timid, irritable, or discontented will need more than one having a docile, contented disposition.

One in uncomfortable quarters will use more than one that is made comfortable.

The factors generally used to express the daily needs of a cow weighing 1,000 pounds, for food of support, is of protein .7 of a pound, carbohydrates 8 pounds, and of ether extract or fat .1 of a pound. These are used by the author with the exception that, of carbohydrates, only 7 pounds are allowed because there is ample proof that it is sufficient and more than enough for this purpose. Especially is this the case with American food stuffs that contain fatty matters in excess.

PRACTICAL FEEDING SUGGESTIONS.

Compounding Rations. The object in formulating a ration is to provide sufficient bulk to satisfy the appetite and feeding capacity and furnish the amount of each nutrient needed for the work a cow is doing. If the ration lacks in bulk she will be discontented; if it contains an excess of nutriment needed for the maintenance of the body and milk yielded, a gradual gain in weight will follow, and if it is short of the required amount of nutriment there will be a decrease in the flow of milk.

Proportion of Roughage to Concentrates. Since it is highly important that a cow should, at all times, have enough food to satisfy the appetite, the proportion of coarse feed to grain must be adjusted to her actual needs. When she is dry or yielding a small mess of milk, but little grain will be needed, say from 2 to 4 pounds daily with enough coarse feed to satisfy her. If she is doing just medium work, one-third of the nutrients should be provided by the concentrates and two-thirds by the roughage; when in full flow and giving a large yield, about half the nutrients in the ration should be provided by the concentrates. If it is the aim to retain a cow in the dairy during her natural life, this proportion should be maintained; but if a maximum yield for only a few years is desired, two-thirds of the nutrients may be provided by the concentrates. Such methods of feeding may be practiced with advantage where cows are purchased for the purpose of using them one or two years in a dairy and then replacing them with others fresh in milk.

Palatability. In formulating a ration due regard should be had to its palatability. A cow will give better return if she relishes her food. It stimulates the appetite and aids digestion. To this end forage should be cut early and not exposed to sunshine any longer than is absolutely necessary. Dews and sunlight in alternation will bleach forage, reduce its palatability and digestibility. The ration should be composed of a reasonable number of feed stuffs, since a mixture is relished better than only one kind of grain or roughage, though frequent changes in a ration should be avoided since this causes imperfect digestion and assimilation. So adjust the supply of food that the ration can be made from two kinds of roughage and several varieties of grain and then make no more changes during the the winter than is necessary. If an appetizing, well balanced, fixed ration can be fed all winter, better results will be obtained than by frequent changes in the composition of the ration. Succulent feed such as roots and silage is greatly relished and stimulates the appetite and the flow of milk. It also aids digestion by keeping the cow in better physical tone.

ORDER OF FEEDING. It is of great importance that strict regularity should be observed both in feeding and in milking, in order to secure the greatest degree of contentment in the herd. If cows are fed at stated intervals they will not be worrying for food until the time for feeding arrives, and if it is then given to them in proper quantity they will eat it and then lie down, chew the cud, and sleep or rest contentedly until the time for another meal. First give the grain mixture, and milk while they are eating it. This routine is recommended because with some cows the milk comes more freely while they are eating that portion of their ration which has the most relish. Cured roughage should be fed after milking because it fills the air in the barn or stable with dust. Succulent food, like silage and roots, should also be fed after milking because of the odor that it gives out. Feeding twice a day will bring better returns than more frequent and wasteful feeding. Give half the concentrates and half the roughage in the morning and half in the evening. Cows will soon become accustomed to this routine. In the winter they should be allowed to spend the day in the stall, and for two or three hours during mid-day they should not be disturbed. Turning them out into a yard or giving them access to a straw stack or field of corn stalks will cause them to shrink in milk no matter how much or how well they may be fed in the morning and evening. No more food should be given than they will eat up clean. The mangers should be absolutely clean and free from any food during the day and night.

FORMULATING RATIONS.

Having the table showing the dry matter and the digestible nutrients in 100 pounds of American feed stuffs given by Professor Henry in a preceding chapter, the feeding standards and the modifications suggested in the feeding experiment reviewed, and the general suggestions offered in regard to feeding practice, we are prepared to take up the details in formulating rations adapted to the work a cow is expected to do.

As an example, let us assume that we are to prepare a ration for a cow weighing 1,000 pounds and giving 10 pounds of milk daily, and that we have on hand clover hay, fodder corn, corn and barley. The first question that presents itself is how much of each of the three nutrients must be provided for the production of the milk and maintenance of the body. It has been shown that cows use .05 of a pound of protein to a pound of average milk.

	Digestible		
	Protein	Carbohydrates	Fat
For 1 pound of milk	.05	.22	.017
For 10 pounds of milk	.50	2.20	.17
For food of maintenance	.70	7.00	.10
Nutrients needed in the ration	1.20	9.20	.27

Thus we find that the ration should contain of digestible nutrients, 1.20 of protein, 9.20 pounds of carbohydrates and .27 of a pound of ether extract or fat. Since the cow is doing light work the larger portion of the nutrients should be provided in the roughage. We therefore use 10 pounds of red clover hay. The table given by Prof. Henry tells us that in 100 pounds of hay, there are 6.8 pounds of digestible protein. Dividing this by 100 we find .068 of a pound of protein in 1 pound of hay, and multiplying this by 10, the number of pounds to be fed daily, we have .68 of a pound protein. In 100 pounds of the hay there are 35.8 pounds of carbohydrates, in 1 pound .358, and in the 10 pounds 3.58 pounds. Making similar calculations with the ether extract in 100 pounds of the hay, we find that in the 10 pounds there is .17 of a pound. We next take the 10 pounds of fodder corn. We see by the table that a hundred pounds contains, of protein 2.5; of carbohydrates 34.6, and of fat 1.2; and by a similar calculation we find that in the 10 pounds of fodder corn there are nutrients as follows: protein .25, carbohydrates 3.46, ether extract .12. In making these calculations we have also discovered that in dividing the number giving the nutrients in a hundred pounds of any feed by 100, is simply removing the decimal two points to the left, and that it can then be multiplied by the number of pounds to be used in the ration. As an illustration: we choose to use 2 pounds of ground corn meal in the ration. From the table we find that in 100 pounds of corn there are 7.9 pounds of protein or .079 in 1 pound, and .158 in the 2 pounds, and in the same way the other nutrients are found. Not desiring to buy any mill feed unless it is necessary, 2 pounds of barley meal are added to the ration. No attention has been paid to the dry matter in the ration because this point is always adjusted if the suggestions in regard to methods of feeding are observed. At first it seems as though formulating rations were a complicated matter, but such is really not the case. By a little practice one soon finds it simple and becomes familiar with the composition of all ordinary feed stuffs. Tabulating the data obtained we have the following formula:

		Digestible		
	Lbs.	Pro.	C.-H.	Fat
Clover hay	10	.68	3.58	.17
Fodder Corn	10	.25	3.46	.12
Corn	2	.16	1.33	.08
Barley	2	.17	1.31	.04
		1.26	9.68	.41

This ration provides all the nutrients a little in excess of the cow's needs for a daily yield of 10 pounds of milk, if she is kept quiet, and in comfortable quarters; but if she were allowed to roam over fields, exposed to extreme cold or raw strong wind or cold rains, she might need nearly all the nutrients in the ration for food of support.

Now let us suppose that there are a number of cows to be fed and that some are giving 15 pounds of milk daily, others 20 or possibly as high as

40 pounds. To adjust the ration to the varying needs of cows is where we encounter difficulties under the feeding standards. One tells us that we should feed 2.5 pounds of protein daily, another proposes 2.15, another tells us to feed 1.6 of a pound of protein when a cow yields 11 pounds of milk, 2 pounds when yielding 16.5 pounds of milk; but what should be fed for intermediate yields is not stated. Just at the critical point where a feeder needs some definite guide he is left to shift for himself. If it is permissible to state that a cow requires 1.6 pounds of protein when yielding 11 pounds of milk daily, the license will apply to factors applicable to any yield of fairly similar milk. Having found the nutrients required for a pound of milk and the maintenance of the body, rations can readily be adjusted, approximately to the needs of each animal.

Having found a ration adapted to a cow yielding 10 pounds of milk, let us adjust it to a cow yielding 15 pounds. Taking the footings of the first ration we must select some food stuff or some mixture that will provide five times the nutrients required for one pound of milk, or, pro. .25, C. H. 1.10, fat .09. By trial it is found that 1 pound each of bran and shorts or bran and middlings will answer. Turning again to the table giving the composition of feeding stuffs, we find that a pound of bran contains .129 of a pound of protein, .40 of carbohydrates and .03 of fat, and that 1 pound of shorts contains .122 of protein, .50 of carbohydrates and .04 of fat. Adding this to the ration we have the following:

		Digestible		
	Lbs.	Pro.	C.-H.	Fat
Ration for 10 pounds of milk		1.26	9.68	.41
Bran	1	.129	.40	.03
Shorts	1	.122	.50	.04
Ration for 15 pounds of milk		1.51	10.58	.48

In like manner the ration can be adjusted to any yield of milk by adding at the rate of two pounds of the mixture to each additional 5 pounds of milk yielded. In general feeding practice, one and a quarter pounds of the grain mixture to three pounds of milk yielded will bring satisfactory results.

If the roughage in the ration will approximately provide the nutrients needed for food of maintenance, then the grain mixture may be so proportioned that 2 pounds of it will contain the nutriment needed for 5 pounds of milk.

		Digestible		
Food.	Lbs.	Pro.	C.-H.	Fat
Corn Stover	12	.20	3.89	.08
Clover Hay	8	.54	2.86	.14
Roughage	20	.74	6.75	.22
Grain Mixture	8	1.03	4.48	.34
		1.77	11.23	.56

The roughage and 8 pounds of the grain mixture will answer for a cow giving 20 pounds of milk daily. For a daily yield of 30 pounds of milk 12 pounds of meal would be required.

Cows giving a large yield of milk should always be provided with roots of some kind, or silage, since it aids digestion and keeps them in good physical tone. Fresh cows should always receive a liberal supply of protein to afford them an opportunity to increase in the flow of milk. When more protein is fed than is actually needed, it may stimulate the lacteal functions to a larger flow at each successive lactation, so while no direct benefit may be noticed during the first lactation, beneficial results may become manifest in succeeding lactations. The young cow also needs a surplus of protein with which to mature the body and give nourishment to the calf she carries. So in compounding a ration, due consideration should be given to these requirements.

It is not considered necessary to formulate a large number of rations, for the aim of this portion of the manual is simply to show how much nutriment is required for milk production, in what proportion nutrients should be combined, how to make the proper balance between concentrates and roughage for the work a cow is doing, and how to feed and care for the cow to secure the maximum yield at a minimum cost.

In our first example, which was given to show the methods of calculating rations, we incidentally found that with clover hay as a roughage it was not necessary to resort to mill products containing a high per cent. of protein to maintain the proper balance between protein and carbohydrates.

As an illustration of this, a ration will be made with alfalfa hay and farm grains.

		Digestible		
Food.	Lbs.	Pro.	C.-H.	Fat
Alfalfa	10	1.10	3.96	.12
Stover	10	.17	3.24	.07
Corn	4	.32	2.67	.17
Barley	4	.35	2.62	.06
		1.94	12.49	.42

In the ration preceding this it required 8 pounds of the mixed meal for a daily yield of 20 pounds of milk and in this ration with 8 pounds of corn and barley sufficient nutrients are found for a cow giving 25 pounds of milk daily. If wheat is fed in place of corn and barley the ration will contain 2.11 pounds of protein and 12.73 pounds of carbohydrates, being almost an ideal ration so far as composition is concerned; but only one kind of grain in a ration is not relished as well as when a variety is fed. There are many localities in our country where corn does not do well but where barley is a good crop. In such localities a ration composed of alfalfa and ground barley will be found quite satisfactory. A little bran and shorts might be added if available.

Farmers in northern latitudes are beginning to learn that by raising more protein, feed bills are reduced. In localities where there is much moisture in the air, as is the case near the great lakes and sea coast, peas can be grown to good advantage, both for roughage and for pea meal, which is a most excellent milk feed. But it must be admitted that the average market price of peas makes it expensive feed, and that as a rule if they are sold the money will buy more protein in bran, gluten meal and oil meal, than there is in the peas. In the interior, where the atmosphere is comparatively dry and the temperature is high, the cow pea and soy bean are rapidly coming into favor. The hay from these plants is fairly relished by cattle and the bean and pea meal are excellent concentrates for dairy cows. With cow pea or soy bean hay, farm grains can also be used as concentrates.

		Digestible		
Food.	Lbs.	Pro.	C.-H.	Fat
Cow pea hay	10	1.08	3.82	11
Corn Stover	10	.17	3.24	07
Corn and Barley	8	.67	5.29	23
		1.92	12.35	.41

This ration is about equal to the preceding in which alfalfa was used. Soy bean in composition is similar to the cow pea except that it contains a trifle less protein and considerable more fat.

Having briefly considered rations containing a legume for roughage let us now substitute the most common hay—timothy. We will use the same amount of roughage so their comparative merits will be more apparent.

		Digestible		
Food.	Lbs.	Pro.	C.-H.	Fat
Timothy	10	.28	4.34	.14
Stover	10	.17	3.24	.07
		.45	7.58	.21

In the alfalfa and stover there were 1.27 pounds of protein, while the timothy and stover contain only .45 of a pound and 7.58 of carbohydrates. From this we learn that the 8 pounds of meal that are to be fed in this ration must contain about 1.5 pounds of protein or nearly 20 per cent. of that important nutrient. We also notice that only about 4.75 pounds of carbohydrates are to be added. That the 8 pounds of meal is to contain about 6.50 pounds of nutrients. If we use corn and barley the ration will fall far short of protein and have an excess of carbohydrates. If bran and oats are used the ration will be short both in protein and carbohydrates, because both of these feed stuffs contain a small percentage of disgestible nutrients. In order to meet the proper balance between the protein and carbohydrates, we must use concentrates containing a large percentage of digestible matter, and one must contain a large percentage of protein and the other a high percentage of carbohydrates. The person experienced in formulating rations at once looks to corn and its by-products to meet this requirement, for he knows that corn meal contains a high per cent. of carbohydrates and that gluten meal and gluten feed, a by-product of corn, contain a very high per cent. of protein, and that both contain a high per cent. of digestible matter. If we add 2 pounds of corn and 6 pounds of gluten feed we find that the ration will contain more protein and less carbohydrates than is needed for a daily yield of 25 pounds of milk; and if 3 pounds of corn and 5 of gluten feed are fed there will be a shortage in protein and an excess of carbohydrates. So the proper balance is between these two. We conclude, therefore, to try 2.5 of corn and 5.5 of gluten meal. Now this presents a new phase of our work, and we therefore go into the details in making the calculations. One pound of corn meal contains .079 of protein, .667 of carbohydrates and .043 of fat, and multiplying these several numbers by 2.5 we get as a product .1975 of protein, 1.667 of carbohydrates and .1075 of fat. In one pound of gluten feed there are of protein .233, of carbohydrates .507, and of fat .027, and multiplying these numbers by 5.5 we get as a product 1.2815 protein, 2.788 of carbohydrates and .1488 of fat. By adding the two products to the nutrients in the timothy and stover we have the following ration:

		Digestible		
Food.	Lbs.	Pro.	C.-H.	Fat
Roughage	20.	.45	7.58	.21
Corn	2.5	.20	1.67	.11
Gluten Feed	5.5	1.28	2.79	.15
		1.93	12.04	.47

While the ration is a trifle short in carbohydrates for a daily yield of 25 pounds of milk, this can easily be made good by bedding with bright straw. Even well fed cows will eat some of the litter, especially if they can reach over into an adjoining stall for it.

With prairie hay, marsh hay and the corn plant as roughage, it is necessary to make up the concentrates from half to two-thirds of such mill products as gluten feed, oil meal, gluten meal and cotton seed meal, if a large flow of milk is to be maintained. For a medium flow, bran, shorts, middlings, dry brewers' grains, oat feed and cotton seed will answer. Farmers, as a rule, do not take kindly to buying mill feed, and prefer to feed such hay as timothy, prairie or marsh with corn and oats, or corn and bran for the concentrates. Let us see what these feeds will provide for. An average cow can take about 18 pounds of hay and 8 pounds of grain.

		Digestible		
Food.	Lbs.	Pro.	C.-H.	Fat
Timothy	18	.50	7.81	.25
Corn	3	.24	2.00	.13
Oats	5	.46	2.37	.21
		1.20	12.18	.59

This ration will be good for about ten pounds of milk. This method of feeding largely accounts for the fact that the average cow yields only from 125 to 150 pounds of butter a year. There is much said about farmers getting better cows. What benefit would the milk producer get by investing in better cows when such feeding methods are almost universal. Farmers should first learn how to get all that a common cow is capable of producing before employing the dairy bred cow. As a matter of fact, the average cow is a better dairy animal than the average man is a dairyman. At any time 5 pounds of oats can be exchanged for as many pounds of bran, let us substitute bran for oats.

Food.	Lbs.	Digestible Pro.	Digestible C.-H.	Digestible Fat
Hay	18	.50	7.81	.25
Corn	3	.24	2.00	.13
Bran	5	.65	2.00	.17
		1.39	11.81	.55

By making this change we have a ration that is good for about 40 per cent. more milk, and by adding one pound of such feeds as oil meal, gluten meal or cotton seed meal the milk value of the ration would be about doubled. It is not claimed that if a cow has been giving only ten pounds of milk with the former ration she will give twice as much by feeding the latter; cows do not respond to feed in that way. But the information we give is that 1.20 pounds of protein daily will maintain a flow of ten pounds of milk, while 1.69 pounds of protein is good for 19 pounds. Comparisons have been made with bran and oats where both rations contained more protein than was actually needed for the milk yielded, and in such trials there was a slight yield in favor of the oats, probably due to the stimulating property in oats and its larger per cent. of digestible matter.

When cows are doing full work in the dairy, more grain is needed than has been given in the rations. A cow yielding about 24 pounds of 5 per cent. milk would need one containing nutrients as follows:

Food.	Lbs.	Digestible Pro.	Digestible C.-H.	Digestible Fat
Prairie Hay	12	.35	4.98	.14
Corn	6	.47	4.00	.26
Bran	5	.65	2.00	.17
Oil Meal	1	.29	.33	.07
Mangels	24	.26	1.29	.02
		2.02	12.60	.66

We have received the best results from rations made in about the proportions given. Dairy bred cows coming fresh in the fall, comfortably housed, a little daily outing, regularly fed and milked, should average 360 pounds of butter for the year.

For a little heavier work, it would be better to reduce the corn and feed proportionally more bran.

Food.	Lbs.	Digestible Pro.	C.-H.	Fat
Wild Hay	14	.40	5.81	.17
Corn	2	.16	1.33	.09
Barley	2	.17	1.31	.03
Bran	10	1.29	4.01	.34
Roots	28	.31	1.51	.03
		2.33	13.97	.66

This ration is especially adapted for steady, heavy work. A cow can take such a ration all winter without any material shrinkage in milk or gain in weight, if she is properly cared for in other respects. A cow receiving such a ration and doing corresponding work when fresh, may be so mismanaged that she will be a stripper by spring and have added 200 pounds to her weight. It is good for an average daily yield of 40 pounds 2.5 per cent. milk, 37 pounds 3.5 per cent. milk or 30 pounds of 4.5 per cent. milk.

Another ration that has given very good and steady yield is the following:

Food.	Lbs.	Digestible Pro.	C.-H.	Fat
Wild hay	8	.23	3.32	.10
Corn Silage	20	.18	2.26	.14
Bran	6	.77	2.41	.20
Barley	4	.35	2.62	.06
Oats	3	.28	1.42	.13
Oil Meal	1	.29	.33	.07
		2.10	12.36	.70

During the winter 1895–6, the Minnesota Station herd received this ration, and during that year the cows that were also in the feeding experiment reviewed in this article, yielded 363 pounds of butter during that lactation year, while the year following they gave 360.44 pounds of butter, on the average, with a daily supply of 2.59 pounds of protein.

Since gluten feed and gluten meal are rapidly coming into favor among our most progressive dairymen, 4 pounds of gluten feed will be substituted for the 6 pounds of bran and the 1 pound of oil meal in the following ration:

Food.	Lbs.	Digestible Pro.	C.-H.	Fat
Wild hay	10	.35	4.98	.14
Corn Silage	30	.27	3.39	.21
Barley	4	.35	2.62	.06
Oats	3	.28	1.42	.13
Gluten Feed	4	.93	2.03	.11
		2.18	14.44	.65

By making this change and increasing the roughage, we get a ration that will answer for a larger flow of milk and make a material reduction in cost. In feeding this ration we should consider it advisable to change the proportion of grain to roughage, because with it cows would be apt to convert feed into gain in body weight, if 14 pounds of grain were fed. The gluten meal and gluten feed should always be fed with either barley, oats or bran, because the former are short in ash. The ration will answer for a daily yield of 30 pounds of milk. The oats may be eliminated because it is about the most expensive feed, and the gluten feed increased to 6 pounds.

Food.	Lbs.	Digestible Pro.	C.-H.	Fat
Wild hay	10	.35	4.98	.14
Corn Silage	30	.27	3.39	.21
Barley	4	.35	2.62	.06
Gluten feed	6	1.40	3.04	.16
		2.37	14.03	.57

By making the change we get a ration adapted to a daily yield of 33 pounds of milk and at a reduction in cost. Barley is also generally dearer than bran, and most dairymen can get bran, so we will give a formula with bran and gluten feed.

Food.	Lbs.	Digestible Pro.	C.-H.	Fat
Wild hay	10	.35	4.98	.14
Corn Silage	10	.27	3.39	.21
Bran	5	.65	2.00	.17
Gluten feed	5	1.17	2.54	.14
		2.44	12.91	.66

This is an ideal ration since it is composed of feed stuffs that can be secured by nearly every dairyman in the land, is cheap, contains all the nutrients in about the right proportion both for milk giving and growing the foetus. Cows can be fed all winter and all their lifetime to their full limit without danger of fattening, contracting garget, getting foundered or shortening their time of usefulness. It is good for a daily yield of milk from 25 to 50 pounds, according to quality of milk and size of cow. The hay may be any kind of prairie, or marsh, timothy, red top, barley, oats, millet or sorghum. The silage may be either corn, kaffir corn or sorghum. In place of the wild hay, fodder corn may be used, by increasing it to 15 pounds. The different feed stuffs should, however, be given very nearly in the proportions stated. When hay is fed give one part hay, one part grain and three parts silage. One cow may need hay, 8 pounds, silage 24, grain 8. Another may require 16 pounds hay, 48 pounds of silage and 16 pounds of grain. It is by such methodical feeding that cows return in dairy products from two to three times the cost of the feed.

If it is desired to furnish a ration which will contain more farm grains and at the same time be adapted for a still larger yield of milk, the ration may be formed as follows:

Food.	Lbs.	Digestible Pro.	Digestible C.-H	Digestible Fat
Roughage	40	.62	8.37	.35
Corn	3	.24	2.00	.13
Barley	3	.17	1.31	.03
Gluten meal	5	1.61	2.06	.13
		2.64	13.74	.64

This ration furnishes ample nutriment for from 35 to 45 pounds of milk daily, and it can be readily adjusted to any yield, since one pound of the grain mixture contains enough protein for 4 pounds of milk, but it should be observed that of carbohydrates it has only enough for two pounds of milk.

It is not considered necessary to further illustrate how rations may be made from the many feed stuffs that have not been used in the formulae submitted, since the chief object was to show the nutrients required for milk production and how to combine food stuffs so the ration will furnish the cow the material she needs in milk making and not lumber up the digestive tract with things she has no use for.

For the convenience of feeders in determining the nutrients needed for the production of a given daily yield of milk testing about 4 per cent. butter fat, the following table is submitted:

FEEDER'S GUIDE FOR RATIONS.

Co-efficients for food of maintenance per hundredweight of cow and for one pound of milk of average quality; also digestible nutrients required for a given number of pounds of milk.

	Digestible Pro.	Digestible C.-H.	Digestible Fat
For food of maintenance per cwt. of cow	.07	.7	.01
Nutrients for one pound of milk	.05	.22	.017
For 10 pounds of milk	.50	2.20	.17
For 15 pounds of milk	.75	3.30	.26
For 20 pounds of milk	1.00	4.40	.34
For 25 pounds of milk	1.25	5.50	.43
For 30 pounds of milk	1.50	6.60	.51
For 35 pounds of milk	1.75	7.70	.56
For 40 pounds of milk	2.00	8.80	.69
For 45 pounds of milk	2.25	9.90	.78
For 50 pounds of milk	2.50	11.00	.85
For 55 pounds of milk	2.75	12.10	.93
For 60 pounds of milk	3.00	13.20	1.00
For 65 pounds of milk	3.25	14.30	1.12

THE CARE OF THE COW.

In order to secure a large yield of milk it is quite as important that the cow or herd is handled properly as that proper feeding should be practiced. We know of many instances where the best of dairy cows were used and where good methods of feeding were practiced, and still results fell far short of what might reasonably have been expected, simply because the animals did not receive that kindly treatment which is so essential to a cow giving lots of milk for a long time. The herd as a whole should always be moved slowly. Never hurry a cow, or strike her or speak loud or harshly. A gentle voice and a caressing touch is quite as potent as is digestible protein. If you so handle the cows that they are fond of you, you have learned one of the most important lessons that lead to profitable dairying. The most successful milk producers are in close touch with every cow in the herd. The milk producer has to do with motherhood, in which affection always plays an important part. A cow's affection for the calf prompts the desire to give milk; if you gain her affection she will desire to give you milk. If you have not been in the habit of caressing the cows the time to inaugurate the practice is when they approach the time of calving, as it is at that particular time that they take kindly to grooming and gentle rubbing of the udder.

Each cow should have a name which should always be spoken when approaching her. This one point counts for much in the successful handling of a herd. Suppose the cows are slowly filing into the barn and you see that Rose is about to go into the wrong stall, a quick call of "Rose" will attract her attention and she will forget that she was about to go into her neighbor's stall to steal a mouthful of her feed. If Rose, when in the yard, is about to hook another member of the herd, and just at that moment hears her name called, she will forget what she was about to do. Again suppose the herd is slowly wending its way down the lane to the pasture, and someone has thoughtlessly left a side gate open leading into a grain field. If Rose is in the lead, and as you see her turning toward the open gate a quick, sharp call of "Rose!" will exert a wonderful influence in bringing her back into line. It is by such methods that a herd can be gradually taught to do the right thing, save you many steps and at the same time bring a larger return.

During the eight or ten weeks that cows go dry their food should be chiefly roughage. A daily allowance of two pounds of bran or oats or a mixture of 2 parts each of bran and oats and one part linseed meal or corn oil meal makes a proper feed for a cow near calving. Some roots, cabbage, pumpkins or squashes are also very good. Highly carbonaceous roughage—such as straw and corn stalks are not good at this particular time. These with cold water, cold drafts or laying out at night on damp or frozen ground, are the chief causes of caked udder or garget.

For ten days preceding the time of calving the cow should be kept in a comfortable, well littered box stall or pen, in which there is no manger. The feed should be given in a box or basket which should be removed after the feed is taken. The coarse feed may be put in the corner and no more should be given than she will eat. This rule should, however, be observed at all times. Throwing large quantities of roughage before a cow, gets her into the bad habit of eating only the most appetizing parts and wasting much feed. It is a good practice to take a lantern and go the rounds of the barn before retiring for the night to see that everything is as it should be.

When the calf is dropped leave it with the dam a few hours to afford her an opportunity to lick it.

If the cow gives milk containing only an ordinary amount of solids and butterfat, the calf may be permitted to take what nourishment it wants the first time; but if the cow gives very rich milk, only a little should be allowed, otherwise there is danger of having a bad case of indigestion on your hands the second day. Just at this time much attention should be be given the cow by way of grooming, not with a currycomb, but with a brush, and frequent rubbing of the udder. This will prove beneficial to the cow and profitable to you. After the calf has taken nourishment once it should be removed, preferably when the dam is not in the stall or pen, for it is better that she does not associate you with the loss of her calf, and that she may more readily transfer her affection to you. By removing the calf at once, it is soon forgotten and thus disturbance is minimized. The first mess for the cow should be about half a pail of whole or preferably ground oats, which has been allowed to stand covered for half an hour after pouring hot water over it. There are stimulating properties in the oats which will aid her in passing the afterbirth. If oats is not to be had give her a warm bran mash containing a pint of oil meal or corn oil meal or a handful of ground flax or a pint of boiled flax. The degree of her usefulness during this period of her lactation depends largely on your skill in bringing her to a full feed and full flow of milk. It takes a cow about three weeks to reach her full flow and the same time should be taken in getting her to full feed. If nature takes its proper course the afterbirth will pass the first day, though this may not take place until the second day, and in the meantime the oats or bran mash should be fed twice a day for two days, when a gradual change may be made to the regular ration. The amount that should be given at first depends, of course, upon the cow. But in a general way a half of a ration of the concentrates will answer, permitting her to satisfy her appetite on clover or pea hay. She has, if properly fed, stored up in her body a surplus of carbonaceous nutriment upon which nature intended that she should draw and thus make it unnecessary for her to eat heating carbohydrates to add more heat to an already feverish condition of the system. So if the carbonaceous nourishment is scant the system will the more quickly be reduced to normal temperature and the liability to caked bag or milk fever will be lessened. The linseed meal or flax was recommended with a view of keeping the bowels in a laxative condition. Special care should be exercised in not exposing the cow to cold drafts at this critical period. If it seems necessary to leave the barn or stable door open for a while the cow should be blanketed, but this should be removed soon after the door is closed, for if she becomes accustomed to a blanket she will be more liable to take cold. During the period when the cow is being brought to full feed she should be encouraged to consume a large quantity of roughage, and to this end a variety of tempting morsels may be given her.

While the routine of the barn work may be adjusted to your convenience, strict regularity should be observed in all things to maintain as much as possible the pace of the cow's system, secured when she is in full flow. If feeding or milking is delayed, the elaboration of milk is interrupted and the flow lessened. So in order to get a full yield for a long time everything should be done with strictest regularity. The milking should be done in such a way that a cow will receive the largest possible satisfaction from this semi-daily event.

Since many of our readers may be out of practice in figures and find it irksome to calculate the nutrients in a given quantity of food stuff and the cost of a ration, the following tables are submitted giving the digestible nutrients in a given number of pounds of the various common standard feed stuffs, the cost of a pound of feed at a given price per bushel, and the cost of one pound at a given price per ton:

TABLE GIVING COST OF ONE POUND AT A GIVEN PRICE PER TON.

Price of 1 Ton	Cost of 1 Lb.	Price of 1 Ton	Cost of 1 Lb.	Price of 1 Ton	Cost of 1 Lb.	Price of 1 Ton	Cost of 1 Lb.	Price of 1 Ton	Cost of 1 Lb.	Price of 1 Ton	Cost of 1 Lb.
$	Cents	$	Cents	$	Cents	$	Cents	$	Cents	$	Cents
.25	.0125	.57	.0285	.89	.0445	6.25	.3125	14.25	.712	22.25	1.112
.26	.0130	.58	.0290	.90	.0450	6.50	.3250	14.50	.725	22.50	1.125
.27	.0135	.59	.0295	.91	.0455	6.75	.3375	14.75	.737	22.75	1.137
.28	.0140	.60	.0300	.92	.0460	7.00	.3500	15.00	.750	23.00	1.150
.29	.0145	.61	.0305	.93	.0465	7.25	.3625	15.25	.762	23.25	1.162
.30	.0150	.62	.0310	.94	.0470	7.50	.3750	15.50	.775	23.50	1.175
.31	.0155	.63	.0315	.95	.0475	7.75	.3875	15.75	.787	23.75	1.187
.32	.0160	.64	.0320	.96	.0480	8.00	.4000	16.00	.800	24.00	1.200
.33	.0165	.65	.0325	.97	.0485	8.25	.4125	16.25	.812	24.25	1.212
.34	.0170	.66	.0330	.98	.0490	8.50	.4250	16.50	.825	24.50	1.225
.35	.0175	.67	.0335	.99	.0495	8.75	.4375	16.75	.837	24.75	1.237
.36	.0180	.68	.0340	1.00	.0500	9.00	.4500	17.00	.850	25.00	1.250
.37	.0185	.69	.0345	1.25	.0625	9.25	.4625	17.25	.862	25.25	1.262
.38	.0190	.70	.0350	1.50	.0750	9.50	.4750	17.50	.875	25.50	1.275
.39	.0195	.71	.0355	1.75	.0825	9.75	.4875	17.75	.887	25.75	1.287
.40	.0200	.72	.0360	2.00	.1000	10.00	.5000	18.00	.900	26.00	1.300
.41	.0205	.73	.0365	2.25	.1125	10.25	.5125	18.25	.912	26.25	1.312
.42	.0210	.74	.0370	2.50	.1250	10.50	.5250	18.50	.925	26.50	1.325
.43	.0215	.75	.0375	2.75	.1375	10.75	.5375	18.75	.937	26.75	1.337
.44	.0220	.76	.0380	3.00	.1500	11.00	.5500	19.00	.950	27.00	1.350
.45	.0225	.77	.0385	3.25	.1625	11.25	.5625	19.25	.962	27.25	1.362
.46	.0230	.78	.0390	3.50	.1750	11.50	.5750	19.50	.975	27.50	1.375
.47	.0235	.79	.0395	3.75	.1875	11.75	.5875	19.75	.987	27.75	1.387
.48	.0240	.80	.0400	4.00	.2000	12.00	.6000	20.00	1.000	28.00	1.400
.49	.0245	.81	.0405	4.25	.2125	12.25	6125	20.25	1.012	28.25	1.412
.50	.0250	.82	.0410	4.50	.2250	12.50	.6250	20.50	1.025	28.50	1.425
.51	.0255	.83	.0415	4.75	.2375	12.75	.6375	20.75	1.037	28.75	1.437
.52	.0260	.84	.0420	5.00	.2500	13.00	.6500	21.00	1.050	29.00	1.450
.53	.0265	.85	.0425	5.25	.2625	13.25	.6625	21.25	1.062	29.25	1.462
.54	.0270	.86	.0430	5.50	.2750	13.50	.6750	21.50	1.075	29.50	1.475
.55	.0275	.87	.0435	5.75	.2875	13.75	.6875	21.75	1.087	29.75	1.487
.56	.0280	.88	.0440	6.00	.3000	14.00	.7000	22.00	1.100	30.00	1.500

TABLE GIVING COST OF ONE POUND AT A GIVEN PRICE AND WEIGHT PER BUSHEL.

When a Bushel Costs	When a Bushel Weighs									
	32 Lbs. 1 Lb. Costs	42 Lbs. 1 Lb. Costs	46 Lbs. 1 Lb. Costs	48 Lbs. 1 Lb. Costs	50 Lbs. 1 Lb. Costs	52 Lbs. 1 Lb. Costs	56 Lbs. 1 Lb. Costs	58 Lbs. 1 Lb. Costs	60 Lbs. 1 Lb. Costs	70 Lbs. 1 Lb. Costs
Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents
10	.312	.237	.217	.208	.20	.192	178	.172	.167	.143
11	.344	.262	.239	.229	.22	.212	.196	.189	.183	.157
12	.375	.286	.261	.250	.24	.231	.214	.207	.200	.171
13	.406	.309	.283	.271	.26	.250	.232	.224	.217	.186
14	.437	.333	.304	.292	.28	.269	.250	.241	.233	.200
15	.469	.357	.326	.312	.30	.288	.268	.259	.250	.214
16	.500	.381	.348	.333	.32	.308	.286	.276	.267	.228
17	.531	.405	.369	.354	.34	.327	.304	.393	.283	.243
18	.562	.428	.391	.375	.36	.346	.321	.310	.300	.257
19	.594	.452	.413	.396	.38	.365	.339	.327	.317	.271
20	.625	.476	.435	.417	.40	.385	.357	.345	.333	.286
21	.656	.500	.456	.437	.42	.404	.375	.362	.350	.300
22	.687	.524	.478	.458	.44	.423	.393	.379	.367	.314
23	.719	.547	.500	.479	.46	.442	.411	.396	.383	.328
24	.750	.571	.522	.500	.48	.461	.428	.414	.400	.343
25	.781	.595	.544	.521	.50	.481	.446	.431	.417	.357
26	.812	.619	.565	.542	.52	.500	.464	.448	.433	.371
27	.844	.643	.587	.563	.54	.519	.482	.465	.450	.386
28	.875	.667	.609	.583	.56	.538	.500	.483	.467	.400
29	.906	.690	.630	.604	.58	.558	.518	.500	.483	.414
30	.937	.714	.652	.625	.60	.577	.536	.517	.500	.428
31	.969	.738	.674	.646	.62	.596	.554	.534	.517	.443
32	1.000	.762	.696	.667	.64	.615	.571	.552	.533	.457
33	1.031	.787	.717	.687	.66	.635	.589	.569	.550	.471
34	1.062	.809	.739	.708	.68	.654	.607	.586	.567	.486
35	1.094	.833	.761	.729	.70	.673	.625	.603	.583	.500
36	1.125	.857	.783	.750	.72	.692	.543	.620	.600	.514
37	1.156	.881	.804	.771	74	.711	.661	.638	.617	.528
38	1.187	.905	.826	.792	.76	.731	.678	.655	.633	.543
39	1.219	.928	.848	.812	78	.750	.696	.672	.650	.557
40	1.250	.952	.869	.833	.80	.769	.714	.689	.667	.571
41	1.281	.976	.891	.854	.82	.788	.732	.707	.683	.586
42	1.312	1.000	.913	.875	.84	.808	.750	.724	.700	.600
43	1.344	1.024	.935	.896	.86	.827	.768	.741	.717	.614
44	1.375	1.048	.956	.917	.88	.846	.786	.759	.733	.628
45	1.406	1.071	.978	.937	.90	.865	.804	.776	.750	.643
46	1.437	1.095	1.000	.958	.92	.884	.821	.793	.767	.657
47	1.469	1.119	1.022	.979	.94	.904	.839	.810	.783	.671
48	1.500	1.143	1.043	1.000	.96	.923	.857	.827	.800	.686
49	1.531	1.167	1.065	1.021	.98	.942	.875	.845	.817	.700
50	1.562	1.190	1.087	1.042	1.00	.961	.893	.862	.833	.714
51	1.594	1.214	1.109	1.062	1.02	.981	.911	.879	.850	.728
52	1.625	1.238	1.130	1.083	1.04	1.000	.928	.896	.867	.743
53	1.656	1.262	1.152	1.104	1.06	1.019	.946	.913	.883	.757
54	1.687	1.286	1.174	1.125	1.08	1.038	.964	.931	.900	.771
55	1.719	1.309	1.196	1.146	1.10	1.058	.982	.948	.917	.786
56	1.750	1.333	1.217	1.167	1.12	1.077	1.000	.965	.933	.800
57	1.781	1.357	1.239	1.187	1.14	1.096	1.018	.983	.950	.814
58	1.812	1.381	1.261	1.208	1.16	1.115	1.036	1.000	.967	.828
59	1.844	1.405	1.283	1.229	1.18	1.134	1.054	1.017	.983	.843
60	1.875	1.428	1.304	1.250	1.20	1.154	1.071	1.034	1.000	.857

NOTE.—The above table is made to aid in determining the cost of a ration. If it is desired to ascertain the cost of a pound of oats when it sells for 23 cents per bushel, follow down the column under the heading, "When a Bushel Costs," until the number 23 is reached; then to the right to the column headed "32," because there are 32 pounds in a bushel, where .719 is given as the price of 1 pound of oats. Multiplying this factor by the number of pounds of oats to be used in the ration gives 2.157 cents, the cost of 3 pounds of oats. If barley is fed, follow the line to the right until the column headed "48" is reached, which gives .479 as the cost of 1 pound of barley when a bushel costs 23 cents. If 4 pounds of barley are fed the cost is 1.916 cents.

TABLE GIVING POUNDS OF DRY MATTER AND DIGESTIBLE NUTRIENTS CONTAINED IN A GIVEN NUMBER OF POUNDS OF FOOD STUFF

LBS.	CORN FODDER				CORN STOVER				SORGHUM FODDER			
	Composition				Composition				Composition			
	Dry Matter	Digestible			Dry Matter	Digestible			Dry Matter	Digestible		
		Pro	C. H.	Fat		Pro	C. H.	Fat		Pro	C. H.	Fat
5	2.89	.125	1.730	.060	2.97	.085	1.620	.035	2.51	.120	1.605	.080
6	3.47	.150	2.076	.072	3.57	.102	1.944	.042	3.02	.144	1.926	.096
7	4.05	.175	2.422	.084	4.16	.119	2.268	.049	3.52	.168	2.247	.112
8	4.62	.200	2.768	.096	4.76	.136	2.592	.056	4.02	.192	2.568	.128
9	5.20	.225	3.114	.108	5.35	.153	2.916	.063	4.53	.216	2.889	.144
10	5.78	.250	3.460	.120	5.95	.170	3.240	.070	5.03	.240	3.210	.160
11	6.36	.275	3.806	.132	6.54	.187	3.564	.077	5.53	.264	3.531	.176
12	6.94	.300	4.152	.144	7.14	.204	3.888	.084	6.04	.288	3.852	.192
13	7.51	.325	4.498	.156	7.73	.221	4.212	.091	6.54	.312	4.173	.208
14	8.09	.350	4.844	.168	8.33	.238	4.536	.098	7.04	.336	4.494	.224
15	8.67	.375	5.190	.180	8.92	.255	4.860	.105	7.54	.360	4.815	.240
16	9.25	.400	5.536	.192	9.52	.272	5.184	.112	8.05	.384	5.136	.256
17	9.83	.425	5.882	.204	10.11	.289	5.508	.119	8.55	.408	5.457	.272
18	10.40	.450	6.228	.216	10.71	.306	5.832	.126	9.05	.432	5.778	.288
19	10.98	.475	6.574	.228	11.30	.323	6.156	.133	9.56	.456	6.099	.304
20	11.56	.500	6.920	.240	11.90	.340	6.480	.140	10.06	.480	6.420	.320

LBS.	TIMOTHY				RED TOP				MILLET			
5	4.34	.140	2.170	.070	4.55	.240	2.345	.05	4.40	.160	2.425	.05
6	5.21	.168	2.604	.084	5.47	.288	2.814	.06	5.28	.192	2.910	.06
7	6.08	.196	3.038	.098	6.38	.336	3.283	.07	6.16	.224	3.395	.07
8	6.94	.224	3.472	.112	7.29	.384	3.752	.08	7.04	.256	3.880	.08
9	7.81	.252	3.906	.126	8.20	.432	4.221	.09	7.92	.288	4.365	.09
10	8.68	.280	4.340	.140	9.11	.480	4.690	.10	8.80	.320	4.850	.10
11	9.55	.308	4.774	.154	10.02	.528	5.159	.11	9.68	.352	5.335	.11
12	10.42	.336	5.208	.168	10.93	.576	5.628	.12	10.56	.384	5.820	.12
13	11.28	.364	5.642	.182	11.84	.624	6.097	.13	11.44	.416	6.305	.13
14	12.15	.392	6.076	.196	12.75	.672	6.566	.14	12.32	.448	6.790	.14
15	13.02	.420	6.510	.210	13.66	.720	7.035	.15	13.20	.480	7.275	.15
16	13.89	.448	6.904	.224	14.58	.768	7.504	.16	14.08	.512	7.760	.16
17	14.76	.476	7.378	.238	15.49	.816	7.973	.17	14.96	.544	8.245	.17
18	15.62	.504	7.812	.252	16.40	.864	8.442	.18	15.84	.576	8.730	.18
19	16.42	.532	8.246	.266	17.31	.912	8.911	.19	16.72	.608	9.215	.19
20	17.28	.560	8.680	.280	18.22	.960	9.380	.20	17.60	.640	9.700	.20

LBS.	PRAIRIE HAY Upland				PRAIRIE HAY Mixed				PRAIRIE HAY Swale			
5	4.37	.15	2.090	.070	4.20	.145	2.075	.060	4.31	.130	2.095	.055
6	5.25	.18	2.508	.084	5.05	.174	2.490	.072	5.18	.156	2.514	.066
7	6.12	.21	2.926	.098	5.89	.203	2.905	.084	6.04	.182	2.933	.077
8	7.00	.24	3.344	.112	6.73	.232	3.320	.096	6.90	.208	3.352	.088
9	7.87	.27	3.762	.126	7.57	.261	3.735	.108	7.77	.234	3.771	.099
10	8.75	.30	4.180	.140	8.41	.290	4.150	.120	8.63	.260	4.190	.110
11	9.62	.33	4.598	.154	9.25	.319	4.565	.132	9.49	.286	4.609	.121
12	10.50	.36	5.018	.168	10.09	.348	4.980	.144	10.36	.312	5.028	.132
13	11.37	.39	5.434	.182	10.93	.377	5.395	.156	11.22	.338	5.447	.143
14	12.25	.42	5.852	.196	11.77	.406	5.810	.168	12.08	.364	5.866	.154
15	13.12	.45	6.270	.210	12.61	.435	6.225	.180	12.94	.390	6.285	.165
16	14.00	.48	6.688	.224	13.52	.464	6.640	.192	13.81	.416	6.704	.176
17	14.87	.51	7.106	.238	14.36	.493	7.055	.204	14.67	.442	7.123	.187
18	15.75	.54	7.524	.252	15.21	.522	7.470	.216	15.53	.468	7.542	.198
19	16.62	.57	7.942	.266	16.05	.551	7.885	.228	16.40	.494	7.951	.209
20	17.50	.60	8.360	.280	16.90	.580	9.300	.240	17.26	.520	8.380	.220

TABLE GIVING POUNDS OF DRY MATTER AND DIGESTIBLE NUTRIENTS CONTAINED IN A GIVEN NUMBER OF POUNDS OF FOOD STUFF—Continued.

LBS.	SEDGE HAY				OAT HAY				SOJA BEAN HAY			
	Composition				Composition				Composition			
	Dry Matter	Digestible			Dry Matter	Digestible			Dry Matter	Digestible		
		Pro	C. H.	Fat		Pro	C. H.	Fat		Pro	C. H.	Fat
5	4.49	.135	2.265	.055	4.55	.215	2.320	.075	4.43	.540	1.935	.075
6	5.39	.162	2.718	.066	5.47	.258	2.784	.090	5.32	.648	2.322	.090
7	6.29	.189	3.171	.077	6.38	.301	3.248	.105	6.21	.756	2.709	.105
8	7.19	.216	3.624	.088	7.29	.344	3.712	.120	7.10	.864	3.096	.120
9	8.09	.243	4.077	.099	8.20	.387	4.176	.135	7.98	.972	3.483	.135
10	8.98	.270	4.530	.110	9.11	.430	4.640	.150	8.87	1.080	3.870	.150
11	9.88	.297	4.983	.121	10.02	.473	5.104	.165	9.76	1.188	4.257	.165
12	10.78	.324	5.436	.132	10.93	.516	5.568	.180	10.64	1.296	4.644	.180
13	11.68	.351	5.889	.143	11.84	.559	6.032	.195	11.53	1.404	5.031	.195
14	12.58	.378	6.342	.154	12.75	.602	6.496	.210	12.42	1.512	5.418	.210
15	13.48	.405	6.785	.165	13.66	.645	6.960	.225	13.30	1.620	5.805	.225
16	14.38	.432	7.248	.176	14.58	.688	7.424	.240	14.19	1.728	6.192	.240
17	15.28	.459	7.701	.187	15.49	.731	7.888	.255	15.08	1.836	6.579	.255
18	16.17	.486	8.154	.198	16.40	.774	8.352	.270	15.97	1.944	6.966	.270
19	17.07	.513	8.607	.209	17.31	.817	8.816	.285	16.85	2.052	7.353	.285
20	17.97	.540	9.060	.220	18.22	.860	9.280	.300	17.74	2.160	7.740	.300

LBS.	ALFALFA HAY				ALSIKE HAY				RED CLOVER HAY			
5	4.58	.55	1.980	.060	4.51	.420	2.125	.075	4.23	.340	1.790	.085
6	5.50	.66	2.376	.072	5.42	.504	2.550	.090	5.08	.408	2.148	.102
7	6.41	.77	2.772	.084	6.32	.588	2.975	.105	5.93	.476	2.506	.119
8	7.33	.88	3.168	.096	7.22	.672	3.400	.120	6.78	.544	2.864	.136
9	8.24	.99	3.564	.108	8.13	.756	3.825	.135	7.62	.612	3.222	.153
10	9.16	1.10	3.960	.120	9.03	.840	4.250	.150	8.47	.680	3.580	.170
11	10.08	1.21	4.356	.132	9.93	.924	4.675	.165	9.32	.748	3.938	.187
12	10.99	1.32	4.752	.144	10.84	1.008	5.100	.180	10.16	.816	4.296	.204
13	11.91	1.43	5.148	.156	11.74	1.092	5.525	.195	11.01	.884	4.654	.221
14	12.82	1.54	5.544	.168	12.64	1.176	5.950	.210	11.86	.952	5.012	.238
15	13.74	1.65	5.940	.180	13.54	1.260	6.375	.225	12.70	1.020	5.370	.255
16	14.66	1.76	6.336	.192	14.45	1.344	6.800	.240	13.55	1.088	5.728	.272
17	15.57	1.87	6.732	.204	15.35	1.428	7.225	.255	14.40	1.156	6.086	.289
18	16.49	1.98	7.128	.216	16.25	1.512	7.650	.270	15.25	1.224	6.444	.306
19	17.40	2.09	7.524	.228	17.16	1.596	8.075	.285	16.09	1.292	6.802	.323
20	18.32	2.20	7.920	.240	18.06	1.680	8.500	.300	16.94	1.360	7.160	.340

LBS.	WHEAT STRAW				OAT STRAW				RYE STRAW			
1	.904	.004	.363	.004	.908	.012	.386	.008	.929	.006	.406	.004
2	1.808	.008	.726	.008	1.816	.024	.772	.016	1.858	.012	.812	.008
3	2.712	.012	1.089	.012	2.724	.036	1.158	.024	2.787	.018	1.218	.012
4	3.616	.016	1.452	.016	3.632	.048	1.544	.032	3.716	.024	1.624	.016
5	4.520	.020	1.815	.020	4.540	.060	1.930	.040	4.645	.030	2.030	.020

TABLE GIVING POUNDS OF DRY MATTER AND DIGESTIBLE NUTRIENTS CONTAINED IN A GIVEN NUMBER OF POUNDS OF FOOD STUFF—Continued.

LBS.	CORN SILAGE				SORGHUM SILAGE				CLOVER SILAGE			
	Composition				Composition				Composition			
	Dry Matter	Digestible			Dry Matter	Digestible			Dry Matter	Digestible		
		Pro	C. H.	Fat		Pro	C. H.	Fat		Pro	C. H.	Fat
10	2.09	.090	1.130	.070	2.39	.060	1.490	.020	2.80	.200	1.350	.100
11	2.30	.099	1.243	.077	2.63	.066	1.639	.022	3.08	.220	1.485	.110
12	2.51	.108	1.356	.084	2.87	.072	1.788	.024	3.36	.240	1.520	.120
13	2.72	.117	1.469	.091	3.11	.078	1.937	.026	3.64	.260	1.755	.130
14	2.93	.126	1.582	.098	3.35	.084	2.086	.028	3.92	.280	1.890	.140
15	3.13	.135	1.695	.105	3.58	.090	2.235	.030	4.20	.300	2.025	.150
16	3.34	.144	1.808	.112	3.82	.096	2.384	.032	4.48	.320	2.160	.160
17	3.55	.153	1.921	.119	4.06	.102	2.533	.034	4.76	.340	2.295	.170
18	3.76	.162	2.034	.126	4.30	.108	2.682	.036	5.04	.360	2.430	.180
19	3.97	.171	2.147	.133	4.54	.114	2.831	.038	5.32	.380	2.565	.190
20	4.18	.180	2.260	.140	4.78	.120	2.980	.040	5.60	.400	2.700	.200
21	4.39	.189	2.373	.147	5.02	.126	3.129	.042	5.88	.420	2.835	.210
22	4.60	.198	2.486	.154	5.26	.132	3.278	.044	6.16	.440	2.970	.220
23	4.81	.207	2.589	.161	5.50	.138	3.427	.046	6.44	.460	3.105	.230
24	5.02	.216	2.712	.168	5.74	.144	3.576	.048	6.72	.480	3.240	.240
25	5.22	.225	2.825	.175	5.97	.150	3.725	.050	7.00	.500	3.375	.250
26	5.43	.234	2.938	.182	6.21	.156	3.874	.052	7.28	.520	3.510	.260
27	5.64	.243	3.051	.189	6.45	.162	4.023	.054	7.56	.540	3.645	.270
28	5.85	.252	3.164	.196	6.69	.168	4.172	.056	7.84	.560	3.780	.280
29	6.06	.261	3.277	.203	6.93	.174	4.321	.058	8.12	.580	3.915	.290
30	6.27	.270	3.390	.210	7.17	.180	4.470	.060	8.40	.600	4.050	.300
31	6.48	.279	3.503	.217	7.41	.186	4.619	.062	8.68	.620	4.185	.310
32	6.69	.288	3.616	.224	7.65	.192	4.768	.064	8.96	.640	4.320	.320
33	6.90	.297	3.729	.231	7.89	.198	4.917	.066	9.24	.660	4.455	.330
34	7.11	.306	3.842	.238	8.13	.204	5.066	.068	9.52	.680	4.590	.340
35	7.31	.315	3.955	.245	8.36	.210	5.215	.070	9.80	.700	4.725	.350
36	7.52	.324	4.068	.252	8.60	.216	5.364	.072	10.08	.720	4.860	.360
37	7.73	.333	4.181	.259	8.84	.222	5.513	.074	10.36	.740	4.995	.370
38	7.94	.342	4.294	.266	9.08	.228	5.662	.076	10.64	.760	5.130	.380
39	8.15	.351	4.407	.273	9.32	.234	5.811	.078	10.92	.780	5.265	.390
40	8.36	.360	4.520	.280	9.56	.240	5.960	.080	11.20	.800	5.400	.400

LBS.	SUGAR BEETS				MANGELS				RUTA-BAGAS			
5	.675	.055	.510	.005	.455	.055	.270	.005	.570	.050	.405	.010
6	.810	.066	.612	.006	.546	.066	.324	.006	.684	.060	.486	.012
7	.945	.077	.714	.007	.637	.077	.378	.007	.798	.070	.567	.014
8	1.080	.088	.816	.008	.728	.088	.432	.008	.912	.080	.648	.016
9	1.215	.099	.918	.009	.819	.099	.486	.009	1.026	.090	.729	.018
10	1.350	.110	1.020	.010	.910	.110	.540	.010	1.140	.100	.810	.020
11	1.485	.121	1.122	.011	1.001	.121	.594	.011	1.254	.110	.891	.022
12	1.620	.132	1.224	.012	1.092	.132	.648	.012	1.368	.120	.972	.024
13	1.755	.143	1.326	.013	1.183	.143	.702	.013	1.482	.130	1.053	.026
14	1.890	.154	1.428	.014	1.274	.154	.756	.014	1.596	.140	1.134	.028
15	2.025	.165	1.530	.015	1.365	.165	.810	.015	1.710	.150	1.215	.030
16	2.160	.176	1.632	.016	1.456	.176	.864	.016	1.824	.160	1.296	.032
17	2.295	.187	1.734	.017	1.547	.187	.918	.017	1.938	.170	1.377	.034
18	2.430	.198	1.836	.018	1.638	.198	.972	.018	2.052	.180	1.458	.036
19	2.565	.209	1.938	.019	1.729	.209	1.026	.019	2.166	.190	1.539	.038
20	2.700	.220	2.040	.020	1.820	.220	1.080	.020	2.280	.200	1.620	.040

TABLE GIVING POUNDS OF DRY MATTER AND DIGESTIBLE NUTRIENTS CONTAINED IN A GIVEN NUMBER OF POUNDS OF FOOD STUFF—Continued.

LBS.	BARLEY				CORN				OATS			
	Composition				Composition				Composition			
	Dry Matter	Digestible			Dry Matter	Digestible			Dry Matter	Digestible		
		Pro	C. H.	Fat		Pro	C. H.	Fat		Pro	C. H.	Fat
1	.89	.087	.656	.016	.89	.079	.667	.043	.89	.092	.473	.042
2	1.78	.174	1.312	.032	1.78	.158	1.334	.086	1.78	.184	.946	.084
3	2.67	.261	1.968	.048	2.67	.237	2.001	.129	2.67	.276	1.419	.126
4	3.56	.348	2.624	.064	3.56	.316	2.668	.172	3.56	.368	1.892	.168
5	4.45	.435	3.280	.080	4.45	.395	3.335	.215	4.45	.460	2.365	.210
6	5.35	.522	3.936	.096	5.35	.474	4.002	.258	5.34	.552	2.838	.252
7	6.24	.609	4.592	.112	6.24	.553	4.669	.301	6.23	.644	3.311	.294
8	7.13	.696	5.248	.128	7.13	.632	5.336	.344	7.13	.736	3.784	.336
9	8.02	.783	5.904	.144	8.02	.711	6.003	.387	8.01	.828	4.257	.378
10	8.91	.870	6.560	.160	8.91	.790	6.670	.430	8.90	.920	4.730	.420

LBS.	CORN and COB MEAL				RYE				BREWERS' GRAINS, DRIED			
1	.85	.044	.60	.029	.88	.099	.676	.011	.92	.157	.363	.051
2	1.70	.088	1.20	.058	1.77	.198	1.352	.022	1.84	.314	.726	.102
3	2.55	.132	1.80	.087	2.65	.297	2.028	.033	2.75	.471	1.089	.153
4	3.40	.176	2.40	.116	3.54	.396	2.704	.044	3.67	.628	1.452	.204
5	4.24	.220	3.00	.145	4.42	.495	3.380	.055	4.59	.785	1.815	.255
6	5.09	.264	3.60	.174	5.30	.594	4.056	.066	5.51	.942	2.178	.306
7	5.94	.308	4.20	.203	6.19	.693	4.732	.077	6.43	1.099	2.541	.357
8	6.79	.352	4.80	.232	7.07	.792	5.408	.088	7.34	1.256	2.904	.408
9	7.64	.396	5.40	.261	7.96	.891	6.084	.099	8.26	1.413	3.267	.459
10	8.49	.440	6.00	.290	8.84	.990	6.760	.110	9.18	1.570	3.630	.510

LBS.	WHEAT				BRAN				SHORTS			
1	.89	.105	.692	.017	.88	.129	.401	.034	.88	.122	.50	.038
2	1.79	.210	1.384	.034	1.77	.258	.802	.068	1.76	.244	1.00	.076
3	2.68	.315	2.076	.051	2.65	.387	1.203	.102	2.65	.366	1.50	.114
4	3.58	.420	2.768	.068	3.54	.516	1.604	.136	3.53	.488	2.00	.152
5	4.47	.525	3.460	.085	4.42	.645	2.005	.170	4.41	.610	2.50	.190
6	5.37	.630	4.152	.102	5.31	.774	2.406	.204	5.29	.732	3.00	.228
7	6.26	.735	4.844	.119	6.19	.903	2.807	.238	6.17	.854	3.50	.266
8	7.16	.840	5.536	.136	7.08	1.032	3.208	.272	7.05	.976	4.00	.304
9	8.05	.945	6.228	.153	7.96	1.161	3.609	.306	7.94	1.098	4.50	.342
10	8.95	1.050	6.920	.170	8.85	1.290	4.010	.340	8.82	1.220	5.00	.380

LBS.	COTTON SEED MEAL				OIL MEAL				GLUTEN MEAL			
1	.92	.372	.169	.122	.91	.293	.327	.078	.88	.321	.412	.025
2	1.84	.744	.338	.244	1.82	.586	.654	.146	1.76	.642	.824	.050
3	2.76	1.116	.507	.366	2.72	.879	.981	.214	2.64	.963	1.236	.075
4	3.67	1.488	.676	.488	3.63	1.172	1.308	.282	3.52	1.284	1.648	.100
5	4.59	1.860	.845	.610	4.54	1.465	1.635	.350	4.40	1.605	2.060	.125

LBS.	GLUTEN FEED				GERM OIL MEAL				PEAS			
1	.90	.233	.507	.027	.90	.202	.445	.088	.89	.168	.518	.007
2	1.80	.466	1.014	.054	1.80	.404	.890	.176	1.79	.336	1.036	.014
3	2.70	.699	1.521	.081	2.70	.606	1.335	.264	2.68	.504	1.554	.021
4	3.60	.932	2.028	.108	3.60	.808	1.780	.352	3.58	.672	2.072	.028
5	4.50	1.165	2.535	.135	4.50	1.010	2.225	.440	4.47	.840	2.590	.035

COMMERCIAL FEEDING STUFFS.

BY DR. W. H. JORDAN, DIRECTOR NEW YORK AGRICULTURAL EXPERIMENT STATION.

Geneva, N. Y.

(An address given before the New York State Dairymen's Association.)

The trade in commercial feeding stuffs is largely of recent development. It is a trade complex in its features, and requires for the proper understanding of it a great variety of information. In earlier times, only the cereal grains in their entire condition were found in commerce; now, by-products from a number of manufacturing operations, which consist of parts of various seeds, including oil seeds and farm grains, are found in the markets. For instance, we have refuses from the manufacture of oil, the manufacture of starch and glucose, the manufacture of spirituous liquors, the manufacture of breakfast foods, and so on. Many of these materials have an undoubted value for feeders of all classes of farm animals. Indeed, some of the by-product commercial feeding stuffs have equal or greater value than the original seeds from which they were produced. At the same time these by-products have a greatly unequal value, some of them being almost worthless and others possessing the highest quality. Until one of these feeds is investigated as to its composition and utility for various kinds of feeding, it is an uncertain quantity. It requires, therefore, on the part of the consumer, a constant watchfulness and search for information concerning the newer products which are offered in the markets. One fact which renders watchfulness and an intelligent understanding of the feeding stuff market so essential, is the numerous mixtures of the various by-product materials which manufacturers are constantly compounding as a means either of disposing of their manufacturing by-products or of making a low cost feed which can be sold at a larger profit than the standard article.

These numerous feeding stuffs will be found to differ in two ways: (1) in composition and (2) in digestibility. To illustrate, linseed meal contains a large proportion of protein and a minor proportion of the non-nitrogenous compounds, while hominy feed contains practically no more protein than corn meal and a very large percentage of the carbohydrates. Between these extremes there are all gradations in the relative proportions of the several ingredients. It is not difficult to learn what these differences are and how they range when we are dealing with standard articles. When dealing with mixtures which pass under the general name of mixed feeds or under proprietary names, we have nothing to guide us other than the assertions of manufacturers, sometimes of doubtful accuracy, or the safeguards provided by law.

Important differences are also found in the digestibility of these materials, and this is a matter of great moment, because the only portion of a feeding stuff which is useful to the animal is that which is dissolved by the digestive juices and absorbed by the blood.

Feeding stuff adulteration is widely practiced at the present time. By adulteration I mean the introduction into a material of a certain grade of something inferior either in nutritive value or in cost. There are those who deplore any reference to dishonest practices in trade, such as adulteration, because they say it will hurt business. I would very much regret injuring the business of any honest manufacturer by anything I might say here. I wish to bear testimony to the uprightness and straightforward business methods of a large proportion of the feeding stuff manufacturers and dealers with whom I come in contact, either directly or by correspondence. Many of them, yes, the most of them, have as great a desire to maintain their goods up to the standard which they set for them as any class of business men have to deal fairly. If adulterations are practiced, it is necessary to make plain what they are, and if trade is thereby injured, the responsibility does not lie with the men who search out such dishonest methods, or with the consuming public that is made the victim of dishonesty, but it lies with the disreputable manufacturers themselves. I, for one, shall not hesitate to speak plainly concerning those devices of commercial greed by means of which one man defrauds another. The ethics of trade in this country need reforming in certain quarters. There is altogether too lenient a spirit toward the man who declares that he must practice this or that deception in order to maintain himself against the competition of the market, or who excuses his unwholesome methods by declaring that others do the same. We should not cry peace when there is no peace. To-day, therefore, I shall first describe briefly the principal feeding stuffs which are now found in our markets, indicate the standards by which we should measure these materials, point out some of the ways in which they are adulterated, and refer to certain precautions and preventions which must be utilized by the farmer in order to protect himself in so complex a trade.

CLASSES OF FEEDING STUFFS.

1. Natural Grains. When the cereal grains and other seeds are sold in their unground natural condition, they are easily recognized by all who have any familiarity whatever with agricultural matters, and they need no comment or description from me. When sold in the ground condition, they are at present adulterated to some extent, a matter to which I shall refer later.

2. Oil Meals. Several seeds, such as cottonseed, flaxseed, rapeseed, etc., contain very large percentages of oil, which, either by pressure or by the use of a solvent, it is possible to remove. These oils have their important uses in the arts. It is the residues from their extraction in which we are interested

as farmers. Cottonseed meal, as well as all other meals from the oil seeds, contains practically all the compounds of the seed except the oil. In other words the protein compounds and carbohydrates, together with a small proportion of the oil, are left behind when the crushed seed is submitted to pressure or leached with a light benzol. There is then a concentration of certain parts of the seed in the waste, and for this reason we see the protein in pure cottonseed meal always ranging above 42 per cent. and sometimes reaching nearly 50 per cent. The same facts are in general true of linseed meal, where the proportion of protein reaches 35 or 36 per cent. There is no reason to suppose that the compounds which are left in the by-products from the oil seeds are injured for nutrition purposes by the pressure, heat or other influences to which they are subjected.

3. Starch and Glucose Wastes. The seed of Indian corn, or, more properly, maize seed, contains a very large proportion of starch. Inventive ingenuity has discovered mechanical methods for separating this starch from other parts of the kernel, which may be sold as such or subjected to the action of acids and converted into glucose. As in the case with the oil meals, the starch wastes are not injured by the process of manufacture, as the maize kernel is only subjected to crushing and to the action of water. There is a variety of these wastes from starch manufacture, and concerning them there has been much confusion of understanding by people at large. Farmers are quite accustomed to simply designate these materials as gluten.

Starch wastes include three kinds or grades of material. The most valuable part is what is properly known as gluten meal, and it consists of the flinty portion of the maize kernel which lies directly under the hull and outside of the central portion of the seed, which is more purely starch. Gluten meal contains practically as much protein as linseed meal, or from 35 to 37 per cent.

Another starch waste is the hull of the maize kernel itself, and it is undoubtedly of less value than the same weight of the entire kernel. This hull is sometimes spoken of as sugar corn waste and corn feed, but is more properly designated as corn bran.

Gluten feed, the third form of waste from starch manufacture, is simply the mixture of the gluten meal and the corn bran. This material contains approximately 25 per cent. of protein. It is important, therefore, for the dairyman to clearly understand whether he is buying gluten meal, gluten feed or corn bran. There is a great difference in the proportions of the constituents of these several materials and an important difference in their digestibility.

4. Brewers' and Distillery Wastes. Sugar is required for the manufacture of alcohol, whether it is found in old fashioned New England rum or in lager beer. At the present time, this sugar is obtained from our cereal grains, chiefly corn, rye and barley. The first thing which is necessary is the conversion of the starch of these grains into maltose, a form of sugar. For instance, the maltster submits moistened barley grains to a

certain temperature for a certain length of time, until these grains have sprouted and the ferment action in their interior has converted a large part of their starch into a soluble sugar. The sprouts which appear on these grains are rubbed off, and are known in our markets as malt sprouts. They make a useful feeding stuff, carrying about 25 per cent. of protein. The grains, minus the sprouts, are crushed and the sugar is extracted, this extract afterwards being submitted to a fermentation for the production of alcohol. The extracted grains, after drying, are sold under the name brewers' grain, and contain about the same proportion of protein as malt sprouts. There are also found for sale distillery wastes, which are produced by the manufacturers of whisky and other liquids of a like character. Here we have the characteristic high proportion of protein.

5. Wheat Offals. No feeding stuffs are more widely or favorably known than wheat bran and wheat middlings. These have come to be regarded as standard materials. Formerly they were sold in separate form, but now it is the custom in many mills to run the offals from the milling of wheat together into one mixture to be sold under the general term mixed feed. If the screenings and other inferior mill wastes are not run into this mixed feed, the mixing is not disadvantageous to the farmer, perhaps. Many mixed feeds, of this class, however, appear to contain a good deal of inferior material.

6. Breakfast Food Wastes. Within the past twenty-five years there has been a remarkable increase in the variety and quantity of prepared breakfast foods, such as oatmeal, rolled oats and others bearing proprietary names. From the manufacture of all of these, there are derived by-products which find their way into the market mostly as cattle foods. The by-products most important in this connection are those coming from oats. In the first place, the manufacturer uses only the largest and heaviest grains, and rejects the smaller and lighter grains. The latter are sold back to the farmers. From the heavy, larger grains, the hull is removed, the kernel itself being all that is used in preparing foods for human consumption. These oat hulls should either be burned or sold for some inferior purpose, but so far as I can judge, they are finding their way into the market to be used, either honestly or dishonestly, in the manufacture of mixed feeding stuffs. This will be referred to in discussing adulterations.

Two by-products from the manufacture of buckwheat flour are buckwheat hulls and buckwheat middlings. The latter of these is a valuable feeding stuff, the proportion of protein being practically the same as that in gluten feed or the brewers' residues. The hulls are comparatively worthless for feeding purposes. Often the middlings and hulls are sold in the mixed condition, and in such cases the value of the mixture depends upon the proportion of the hulls.

7. Beet Sugar Wastes. Two new by-product feeding stuffs have appeared among us since the introduction of the manufacture of beet sugar in this country, viz.: sugar beet pulp and sugar beet molasses. The former

in a fresh condition carries approximately 90 per cent. of water and can scarcely be a profitable feed at any great distance from the factories, owing to the great cost of transporting so much useless material. This pulp is inferior to the same weight of beets before extracting the sugar, and does not differ essentially in its general character from roots and other succulent carbohydrate feeding stuffs. It appears that this sugar beet pulp is now offered in a dried condition, and if the price is sufficiently low it may doubtless be purchased to advantage by those farmers who have an insufficient supply of coarse foods. The only ingredient of value in beet sugar molasses is the sugar which has not crystallized. This molasses contains from 50 to 60 per cent. of sugar, and may be combined advantageously with coarse fodders and nitrogenous feeding stuffs in making up a ration for various classes of animals.

8. Hominy Wastes. In the manufacture of hominy quite a portion of the maize kernel is rejected, and is known in the market as hominy feed. The composition of this by-product is not essentially unlike that of the whole maize kernel, and it is very nearly equal to corn meal in feeding value. At the present time the price of this feeding stuff as compared with corn meal is such that it may be purchased with advantage.

The above is a brief reference to the principal feeding stuffs found in the markets. A determination of the ones which a farmer can most advantageously purchase depends upon the ruling prices. There are no hard and fast relative values which can be applied to a determination of the materials which it is wisest to purchase. It is possible to base a rational decision upon a comparison of the proportions of digestible material in feeding stuffs of the same class. This does not apply, however, when comparing feeding stuffs of unlike classes. To illustrate, it would not be possible to compare the value of corn meal and cottonseed meal on the basis of the proportions of digestible matter in the two materials, because the digestible matter in the one is so greatly unlike that in the other.

MIXTURES AND ADULTERATIONS.

No more important topic in connection with this general subject can be brought to your attention than the present quite prevalent practice of compounding mixed feeds which contain an inferior ingredient, and of adulterating many of the valuable feeding stuffs which now appear in the markets. Let us consider some of the facts which are well known to those who are investigating the feeding stuffs trade.

Let me say, first of all, that I have known of very few instances of the adulteration of linseed meal. Up to the present time no feeding stuff has been more uniform in its quality than has this one. Inferior cottonseed meals appear in the market quite frequently, however. Here the degradation of quality is accomplished by grinding hulls with the pure meal. Some so-called cottonseed meals have been found on sale carrying less than 30 per cent. of protein, whereas the proportion should be above 42 per cent a least. When such mixtures are sold for what they are, as for instance in the case of cottonseed feed, no fraud is perpetrated, and the consumer is left to make a free choice.

So far as I have observed, the only danger of unfair dealing in the sale of the wastes from the manufacture of starch from the maize kernel lies in a failure to understand clearly the differences in these articles, and consequently of buying corn bran instead of the more valuable gluten feed or gluten meal. I suspect that in some instances finely ground corn bran has been sold under the name light gluten, or special gluten, and it would be very easy to mix such finely ground corn bran with the gluten meal or gluten feed to the advantage of the dealer, because of the lower price of the bran.

One of the most notorious adulterations now practiced is the mixing of ground corn cobs or ground broom corn waste with wheat bran. A sample of this character came into my hands the other day. One of the feeds licensed in the State of New York is such a mixture, and is guaranteed to contain only 11 per cent. of protein, whereas pure bran contains from 15 to 16 per cent. This adulteration may easily be detected by any one who will give a careful study to the general appearance of pure bran, and who has had an opportunity to inspect the mixture. A deterioration of wheat offals is also brought about by introducing into them various inferior mill wastes. The presence of this inferior material is generally made evident by the hulls and parts of weed seeds that may easily be seen.

Taken as a class, various mixed feeds known under a great number of names are probably the worst imposition now being practiced upon the farmers in this country. In these the inferior ingredient is oat hulls. Oat hulls are probably worth less than good cut oat straw. In fact, I consider them inferior to any straw whatever. Two years ago we took a large number of samples of so-called corn and oat feeds sold in the State of New York, and we found very few that were not compounded by the use of a certain proportion of oat hulls. The immediate responsibility here lies to quite an extent with the local millers that are found scattered all over this and other states. They can purchase these oat hulls, sometimes unground and sometimes ground into a very fine condition so that they are not so easily detected, at a very low price, and by introducing 25 per cent. by weight of these hulls into corn or hominy, can produce a feed which closely resembles genuine corn and oat chop, and which is sold at the price of genuine goods. It is not difficult for one who will give the matter a little attention to detect the differences between these inferior mixtures and genuine corn and oats. The oat hulls present have a different appearance, and none of the crushed oat kernels can be seen in the oat hull mixture. There are sold very generally throughout the country certain proprietary feeds which in many cases are a mixture of several materials. In many instances, these feeds are mixed by the manufacturers for the sole purpose of disposing of their waste products, one of which, oat hulls, could not find a sale in the market if not disguised by the presence of more valuable ingredients. I have lately learned that a New Jersey firm is making a mixed feed into which coffee hulls, rice polish and other inferior materials enter. This fraudulent stuff has been sold in part through a New York firm. Is there not good reason for advising consumers to avoid all unknown mixtures and buy only standard goods?

Even the ground cereal grains, such as corn meal, are adulterated. Two materials are at present used for adulterating corn meal, one of which is hominy feed and the other is corn bran. It may be claimed that the mixture of hominy feed with corn meal does not constitute an adulteration, because the former is nearly equal in feeding value to the latter. It is an adulteration, however, when the hominy feed can be purchased at a considerably less price than the corn meal, because by selling the former at the price of the latter an imposition is practiced upon the consumer. He buys at the higher price a material of lower commercial value.

I have in my possession a circular letter addressed by a prominent jobber in the State of New York to millers, explaining to them how, by the introduction of ground corn bran into corn meal, they can make corn meal at a price which will enable them to compete successfully in the market against other millers or dealers. This is also an adulteration which is an imposition upon the consumers. Corn bran is sold for much less than corn meal at the present time, and has undoubtedly a lower feeding value. It is easy to see that the kind of adulteration practiced will be determined by the relative prices of feeding stuffs. When two materials similar in appearance have quite different selling prices, there is always temptation for dishonest dealers or millers to mix the one with the other.

PRECAUTIONS AND PREVENTIONS.

At the present time the people of this country are much inclined to resort to legislation as a means of curing various evils. Such legislation is generally wise. As applied to feeding stuff control, it is of undoubted value. First of all, feeding stuff inspection laws have an educational value. When the terms of such a law become known, buyers are inclined to give a great deal more attention to the composition of feeding stuffs than before. This is true, because laws of this nature now on our statute books in several states require that manufacturers or dealers shall file with some state department the guaranteed composition of their goods, and that the goods when sold shall be properly marked with the name of the manufacturer and the guaranteed composition of the goods. Through these means, and the publications which are occasionally issued as a result of the inspection, consumers become more familiar with the composition of the various feeding stuffs than would otherwise be the case.

Moreover, through the guarantees and the proper marking of the various brands of feeding stuffs, the purchaser is protected against buying inferior materials. To illustrate, cottonseed meal should carry no less than 42 per cent. of protein, linseed meal should carry at least 35 per cent., gluten meal about the same, gluten feed from 23 per cent. upwards, malt sprouts and brewers' grains about 25 per cent., wheat bran and wheat middlings over 15 per cent., pure mixed corn and oats over 10 per cent., and so on. Unless the protein is kept to approximately these figures, the material is not pure. Hulls cannot be introduced into cottonseed meal without lowering the percentage of protein, and the same thing is true of the admixture of ground corn cobs with wheat bran or any other material. Oat hull mixtures, especially those where their components are corn meal or hominy feed and oat hulls, necessarily carry less than 10 per cent. of protein. When therefore the guarantee of a proprietary feed, whatever may be its name, ranges from 6 to 8 per cent. of protein, the purchaser may be pretty sure that he has under observation an oat hull mixture, and the purchaser should always remember that an oat hull mixture is only worth what it contains outside of the oat hulls. The oat hulls are not worth purchasing.

It is probable, too, that the penal force of a feeding stuff counts for something. Some men are honest because they like to be, some men are honest because they are afraid to be otherwise, and some have courage enough to be dishonest until they are caught. With the second class and perhaps the third, such a law has some influence.

It must be remembered that after all no law can take the place of intelligence on the part of those whom it is supposed to protect. If the farmers of this country would inform themselves thoroughly in regard to various commercial feeding stuffs on the market, and learn to distinguish the various kinds by mere physical inspection; there would be much less need for legislation than is at present the case. The buyer who is awake to the situation will not purchase oat hull mixtures with the understanding that he is getting pure corn and oats, neither will he long be deceived by bran and corncobs.

One fact which promotes the sale of inferior feeding stuffs is the foolish desire of so many to purchase something cheap. If one dealer has a mixture which he is offering at a dollar per ton less than some other dealer, the former gets the trade of a certain class of people, who consider only price, and have no intelligent understanding of quality. It should be understood that even when a feeding stuff inspection law exists it will be largely inoperative unless it has the co-operation of the constituency which it is supposed to benefit. No farmer should allow himself to purchase a feeding stuff which is not sold under the proper guarantee and marks. He should refuse to listen to the smooth statements of some dealer or agent who fails to comply with the requirements of the law, and who assures him that he has some remarkably valuable mixture to offer him. The days of magic are past. There are no nutrients of greater value than those which are found in the grains which are raised upon your farms, and when any manufacturer claims to have discovered some remarkable material or process, by means of which he can furnish you a cattle food of previously unheard of merit, you should turn a deaf ear.

TAINTED OR DEFECTIVE MILKS, THEIR CAUSES AND METHODS OF PREVENTION.

BY DR. H. L. RUSSELL, BACTERIOLOGIST, WISCONSIN LXPERIMENT STATION—AUTHOR OF "DAIRY BACTERIOLOGY."

Madison, Wis.

The peculiar constitution of milk renders it especially liable to defects that seriously impair its value for dairy products. Particularly is this so where made up into cheese, as tainted milk exerts a more pronounced and harmful effect when made into this product than into butter. Thousands of dollars are yearly lost to the cheese industry because of the imperfections that occur in the condition of the milk. Much of this could be saved if a more thorough knowledge concerning the causes of these troubles could be disseminated.

Considering the question of milk defects from the standpoint of the milk producer—the factory patron—the subject may be treated under the following heads

1. Taints or defects produced by the presence of living micro-organisms.

2. Taints or defects due to the absorption of pre-existing odors from the air or food, or to the derangement of the normal functions of the animal.

In the first instance we have to deal with biological problems, with milk as affected by living germs; in the second, the defective or improper condition is caused mainly by the absorption of odors in a purely physical way, or is due to some unusual condition of the system of the animal.

Before taking up the taints in milk due to germ life, it may be helpful to premise this with a brief discussion of how living organisms gain access to milk and the conditions that favor their development.

MILK AS A BACTERIAL FOOD MEDIUM. The physical constitution of milk is well adapted to promote the active growth of many living organisms if they are once introduced. The nutritive elements in it are either in a soluble state or are readily converted into a condition that permits of their absorption by the lower forms of plant life. The degree of concentration is also favorable to most forms. Condensed milk keeps because the soluble solids are so concentrated that living germs cannot well develop in it; in ordinary milk the more dilute condition permits development.

The chemical composition of milk is also favorable to germ activity. In reaction it is nearly neutral, or if acid, the acidity is not usually sufficient to inhibit the development of life that is otherwise capable of growth in such a fluid. Not all of the milk constituents are of equal value as food for micro-oganisms. The fat is not readily affected, hence butter is less susceptible to biogenic defects than cheese. Both the sugar and the nitrogenous elements are readily decomposed by a large number of micro-organisms.

The lower forms of plant life such as the bacteria, yeasts and moulds are the common organisms which are capable of existing in milk that deleteriously affect it. The first group is by far the most important; indeed, the great majority of abnormal milks that may be ascribed to germ origin are due to this type of organic life. In some instances, yeasts and moulds have some effect, but their influence is usually more potent in the manufactured product than in fresh milk.

Healthy milk sterile in udder. While milk is so constituted chemically and physically as to make an excellent food for these lower forms of vegetable life, it is free from all traces of germ life in the milk glands of a healthy animal. In a diseased animal the case may be different, especially if the trouble exists in connection with the udder. An animal may be suffering from some physiological trouble such as indigestion, stomach or intestinal derangement, and yet the milk might retain its sterile properties. Indeed, the disturbed condition of the animal due to the disease might be so grave as to seriously alter the chemical or even the physical condition of the milk, and still the milk remain germ free. It is a very prevalent notion that the ingestion of living germs with the food is the way in which the milk becomes infected, but such is not the case. The healthy animal, or even vegetable tissue for that matter, is free from foreign forms of life. Normal blood is perfectly sterile. In the functional activity of organs, the secretions as secreted are likewise free from micro-organisms.

HOW MILK BECOMES INFECTED WITH GERM LIFE.

While the milk is sterile when elaborated in the udder, it invariably becomes contaminated with living germs during the process of milking. This need cause but little wonder when we consider the conditions under which the milk is drawn. All of the surroundings of the animal are teeming with innumerable microbes. From the time of milking until it is removed from the barn, it is continually exposed to conditions that permit of its being infected with bacteria. Even before it flows from the udder, it is exposed to contamination, for the opening of the teat is always covered with a film of dirt and from this is derived a sufficient quota of bacteria to infect the same. To such an extent is this true, that the first few streams from each teat contain a much larger number of organisms than any subsequent part of the milking.

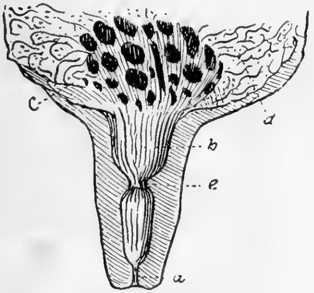


Fig. 1.—Sectional view of udder; *a*, exterior opening of milk duct showing opportunity of infection by bacteria from without; *b*, milk cistern; *c*, milk sinus; *d*, glandular secreting tissues; *e*, sphincter muscle of teat. The bacteria are unable under ordinary conditions to work their way up into milk cistern but the lower portion of milk duct in teat almost invariably contains them.

In attempting to prolong the keeping quality of milk as is done in the milk business, the presence of these organisms is a drawback, for the bacteria in the fore milk are in a rapid state of growth, owing to the environment in which they have been kept. Warmth, food and moisture are present in the milk duct to a favorable degree, and a rapid growth cannot but take place.

Dairy utensils. Dirty vessels are a most prolific source of trouble. Old rusty cans that are difficult to cleanse, and therefore are not well cleaned,

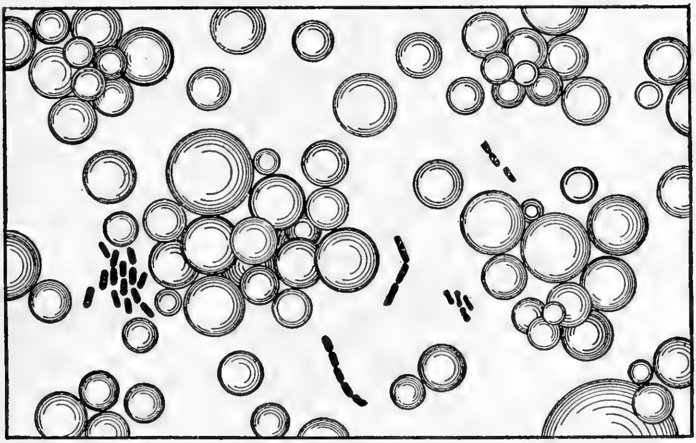


Fig. 2.—Microscopic appearance of ordinary milk showing fat globules and bacteria in the milk serum. The cluster of bacteria on left side are lactic acid forming germs.

are a standing menace to the purity of a milk supply. Too much attention cannot be paid to the condition of these milk receptacles. Not only should great care be given the milk pails and cans, but all utensils that come in contact with the milk should be subject to the same close scrutiny. The custom of returning the by-products of the factory (skim milk, whey and buttermilk) to the farm in the same set of cans that are used for the fresh milk is a source of much trouble. Many factories insist that separate receptacles shall be used for these products that are always in an advanced stage of fermentation. With intelligent effort the danger from this source could be much minimized, but the difficulty lies in the fact that one careless patron often defeats the labors of those who are more careful

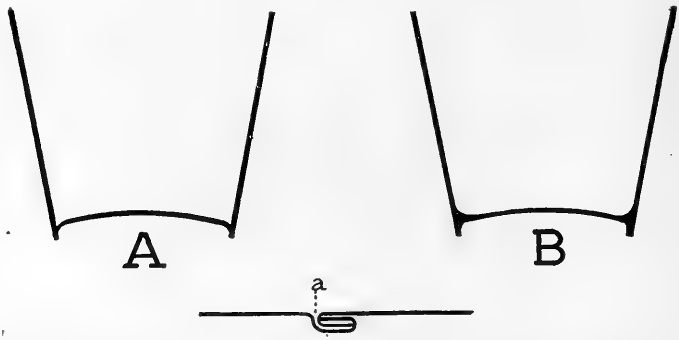


FIG. 3.—The wrong and right kind of a milk pail. A, the ordinary type of pail showing sharp angle between sides and bottom; B, the same properly flushed with solder so as to facilitate thorough cleaning. The lower figure represents a joint as ordinarily made in tinware. The depression *a* affords a place of refuge for bacteria, from which they are not readily dislodged. This opening joint should be filled completely with solder.

in this regard. Greater care on the part of the cheesemaker in keeping the whey vat sweet and clean would be an object-lesson to patrons that would be of more value than abundance of precept.

It must be remembered in cleaning milk vessels that the spores of these "infinitely little" germs are often endowed with powers of resistance that far exceed the ordinary standard. In a practical way, on the farm, unless one has steam at his command, it is impossible to actually destroy all these latent forms of life that may happen to adhere to a pail or can. Tepid, or even hot water momentarily applied has but little effect, but thorough scalding will do much toward removing the larger amount of germ life. Joints and seams should receive especial attention. These should be well flushed with solder so as to make a round surface that can easily be cleaned.

INFECTION FROM BODY OF ANIMAL. A serious source of contamination of milk always comes from the animal herself. Drawn, as the milk usually is, in an open pail, the opportunity for entrance of loose hairs, particles of excreta, fine dust, epithelial scales and fodder particles could not well be improved. Every hair of the animal's coat is laden with dormant germ life. Fig. 4 shows a culture made of several hairs that were allowed to fall on a sterile gelatine surface. When the animal is shedding her hair, there is nothing to prevent the falling of these germ-laden particles directly into the milk. Even where the hair is not rubbed off, the movements of the animal and milker are constantly dislodging particles of fine dust that settle in a continuous shower into the warm nutrient fluid below. It may be thought that straining the milk removes this source of filth. So it does the visible filth, but not until the invisible living germ life has been washed off into the fluid, there to set up the various fermentations that it is capable of producing. The kind of organisms that gain access to the milk from this source is, generally speaking, thoroughly undesirable. They are largely fecal bacteria, derived from decomposing animal excreta. In a large number of instances they are spore-bearing

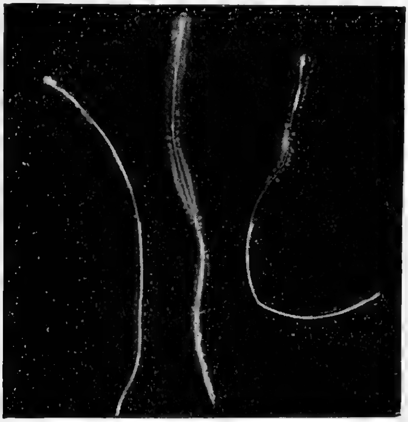


FIG. 4.—Showing the bacterial contamination arising from hair. These three hairs were allowed to fall on a sterile gelatine surface. The adherent bacteria developed readily in this medium and the number of bacteria thus introduced into the milk from these hairs can be estimated by the developing colonies that show as irregular protuberances along the line of the hair.

bacteria that are very resistant, and the type of fermentative activity that they are capable of producing in milk is undesirable in cheese making.

Besides the dirt and filth that is derived directly from the animal, matter from other sources may gain access to the milk by being carried in the hairy coat of the animal.

Cows wading in stagnant water in midsummer often cover their bag and flanks with slimy deposits that dry on and in this condition particles of dust are readily dislodged.

The custom of leaving the milk in the barn even during the milking is a practice that should be thoroughly condemned. Not only can it absorb, to a certain extent, the odors peculiar to the place—a point which will be taken up more in detail later—but the milk may be filled to a greater or less extent with the fine dust that is floating in the barn air. If dry feed has been fed immediately before or during milking, the air of the barn will be filled with dust particles that contribute their quota of bacterial life.

In a general way, this gives a brief summary of how the milk becomes infected with bacterial life. Some of these species are not especially undesirable as to their effect on manufactured products; but very often serious trouble does arise at the factory, owing to the introduction of troublesome bacteria that gain access through the improper care of milk. To the extent that is consistent with practical manipulation, the attempt should be made to so handle milk as to keep all kinds of bacterial life out of it. There is no danger of milk being so sweet and pure as to injure it for commercial

FIG. 5.—Showing germ content of barn air. A sterile gelatine plate was exposed for 30 seconds in the barn during the milking. The bacteria from the air have settled on the moist surface and developed into colonies. Each spot on the circle represents a colony that grew from a single germ.

purposes. If a large percentage of its bacterial content was excluded, even to such an extent as to materially retard the normal development of the acid, still such a condition is to be preferred to that of continually overripe or tainted milk. It is far better for the maker to use a starter and control the course of the fermentation than it is "to let the acid boss him."

EFFECT OF TEMPERATURE ON QUALITY.

The proper treatment of milk does not stop with the securing of it in as near its original purity as possible, but it must be handled in such a way as to retard the development of bacteria that find their way into it. As it comes from the animal, it has a high temperature, approximating blood heat. At this elevated temperature bacterial growth takes place with surprising rapidity, and unless the animal heat is artificially lowered and the milk kept chilled, various fermentations are set up in it as a result of the growth of different bacterial forms. Common experience is so uniformly in accord with this that no further statement is necessary to emphasize its importance. (Figure 6.)

FERMENTATIONS OF MILK.

So far we have considered the *manner* of infection of milk by bacteria rather than the *kind* of infection. As the biological defects in milk possess more or less well defined characteristics that enable the experienced person to recognize them, it is necessary that the leading troubles with which

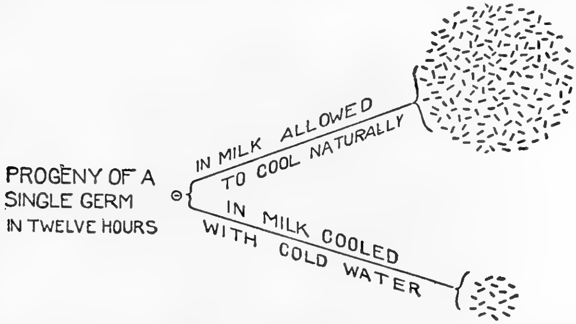


FIG. 6.—Showing the effect of cooling milk on the growth of bacteria. The beneficial results of early chilling are readily apparent.

the factory patron may be brought in contact should be so described as to enable him to recognize their presence and intelligently determine the cause of the same. A great deal of misconception exists among dairymen as to the causes of these troubles. We shall attempt, however, to outline briefly the causes of these various defects in milk with sufficient clearness so that they may be recognized. This will enable the patron to intelligently search for the same and apply an efficient remedy directly to the seat of the trouble rather than to expend so much well intended but misdirected energy in other directions.

SOUR MILK OR LACTIC ACID FERMENTATION.

Milk, if left to itself invariably undergoes a fermentative change, generally known as souring. The acidity of the same gradually increases until finally the amount of acid developed causes a coagulation or precipitation of the casein, and milk is said to curdle. This change is brought about mainly by a fermentation of the milk sugar, lactic acid being the chief product formed. The primary cause of this change is not to be found in any atmospheric condition, such as damp or hot weather, or sudden changes in temperature, but is dependent upon the growth of certain species of bacteria that get into the milk. Notwithstanding the popular notion, thunder storms in and of themselves do not sour milk. If milk is free from bacterial or other living organisms, thunder or electric discharges are unable to affect its acidity. It is the conditions that usually accompany the thunder storms, such as damp, heavy, muggy weather—conditions that favor rapid bacterial growth that are the real cause of the more rapid changes. The lactic acid bacteria are so widely distributed that their presence in milk is always assured, and the fermentative change that they cause may be considered as normal.

In general their presence is advantageous in milk intended for cheese making, as the whole process of manufacture favors the development of this class to the exclusion of other kinds. Their enormous development in green cheese cannot be without significance, and undoubtedly the rapidity and character of the ripening process is largely determined by the development of this group.

GASSY MILK.

The most dreaded fermentations with which the cheesemaker has to contend are those in which gaseous by-products are formed. In the great

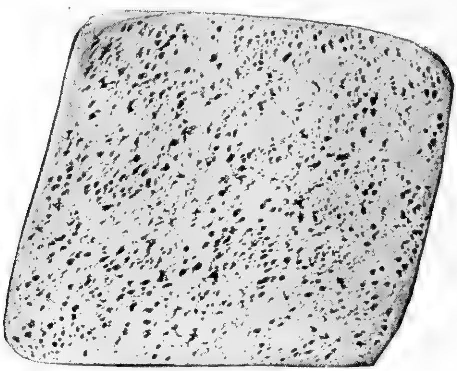


FIG. 7.—A "gassy" cheese made from tainted milk. Note not only its porous texture but the distorted shape of the cheese.

majority of instances, the organisms causing these changes belong to the sour milk class, but in addition to the lactic acid that they form, they also give off other decomposition products, among which are gases such as carbon dioxide and hydrogen, and various volatile ill-smelling compounds. Fermentations of this character are almost sure to produce undesirable taints that pass over into the cheese, materially injuring its quality.

The appearance of "gassy" milk is due entirely to the presence of gas producing bacteria. All of the phenomena in cheese making associated with the development of gas are likewise attributable to the same cause.

If the difficulty appears before the milk is set, the milk is said to be "gassy." Often it is delayed until the cooking process, when the curds rise to the surface of the whey and float on account of the development of the imprisoned gas. Such curds are known as "floaters" or "bloaters." A less pronounced fermentation results in the production of "pinholes" in the curd. The appearance of gas may even be delayed until the cheese is taken from the press. If it occurs at this stage, the cheese is said to "huff" or swell and the texture in severe cases is practically destroyed. All of these appearances whether they occur in the milk, in the curd, or in the green cheese are to be traced back to a faulty condition in the milk. In the majority of instances this originates on the farm

FIG. 8.—A block (Swiss) cheese made from "gassy" milk. This is the most common trouble noted in the Swiss cheese industry.

through careless methods of handling. The rapidity of its development in the factory can be controlled in part by the cheesemaker, but it is difficult, if not impossible, to make a superior article out of inferior raw materials. Unless the factoryman is furnished with a clean, pure, wholesome milk free from noxious germs that are able to cause these abnormal fermentations, he cannot be expected to make a superior product.

SWEET CURDLING AND DIGESTING FERMENTATIONS IN MILK.

Quite often the milk producer finds that his milk lobbers or curdles quickly without the production of appreciable amounts of acid. This premature curdling is an abnormal fermentation in which the following series of changes occur in the character of the milk. The casein is not precipitated on account of the development of lactic acid but by the action of certain unorganized ferments (enzymes) that are secreted by various species of bacteria. The action of these non-vital ferments is quite similar to that of ordinary rennet; in fact, rennet as well as pepsin, are examples of these proteid-converting enzymes, that are extracted from the stomachs of animals. Under proper conditions, certain bacteria have the power of producing various enzymes in a manner similar to the cells of the stomach or intestine. This bacterial rennet does not differ materially from rennet of animal origin. Curds precipitated by the action of rennet may be readily distinguished from those produced by acid. As a rule, they are softer, and more gelatinous than acid curds.

This abnormal milk is produced by a large variety of bacteria which as a class can be characterized as follows: As a rule they are spore bearing organisms; therefore, they possess high powers of resistance. It is for this reason that boiled or heated milks almost always undergo this type of fermentation. If such milk is allowed to stand after it has curdled, another abnormal change usually sets in which is marked by the gradual digestion of the curd and the appearance of a cloudy whey. Such "wheyed off" milks have had the insoluble casein, the leading cheese constituent of the milk, transformed into soluble peptone-like substances. This part of the cheese solids is therefore dissolved or "digested" as it is said. When such a change has occurred, recovery of the casein in the milk is impossible. It is for this reason that the cheese yield from tainted milks of this class is lower than from pure sweet milk. The unfairness of the "pound for ten" plan of manufacturing cheese is evident under such circumstances. With such defective milk, it is a physical impossibility for the cheese maker to retain the entire casein in the cheese.

The organisms producing these quick curdling and digestive fermentations are, as a rule, bacteria that are associated with fecal matter which finds its way into the milk in a variety of ways.

SLIMY FERMENTATIONS.

Not infrequently milk undergoes a marked change in its consistency, becoming so viscous as to even string out in threads to some distance. All gradations of this increased viscosity may be noted, from where the milk is slightly thickened or sticky, through a slimy or slippery stage, to that where it can be pulled out into long strings. A variety of terms have been applied to the different phases of this series of changes to represent the varying conditions that are to be noted. Thus, slimy or viscous milk refers to an increased viscosity; ropy, stringy or thready milk, to where the milk adheres to anything it touches, stringing out in threads often several feet long.

The causes of these various abnormal fermentations are due to the presence of certain species of bacteria that for the time being gain the ascendency over the normal milk bacteria. Several different species have been separated from samples of slimy or ropy milk.

In some instances the sugar constituent of the milk is changed into a viscous substance by the action of these organisms; in other cases the proteid elements suffer. Ropy or stringy milk besides being unsightly and thus injuring the product for direct consumption, is undesirable for dairy products. The viscosity of such milk is increased so much that it cannot be thoroughly creamed for butter making, and the fermentation changes that go in the curd also injure it in some cases for cheese making. The slimy fermentations are more apt to occur during summer weather, but epidemics of this kind have been reported under winter conditions. Defective milks of this type are quite frequent, as several epidemics come to our notice almost every year. A careful bacteriological study of apparently normal milk often reveals the presence of slime-forming bacteria in limited numbers that are kept under subjection by some more dominant ferment change such as the sour milk fermentation.

FIG. 9.—A "slimy" milk. This milk strung out in fine threads several feet in length.

BITTER FERMENTATIONS.

A bitter condition in milk may be induced by a variety of causes, but true fermentations that produce bitter products are the result mainly of bacterial action. This type of fermentation is caused by widely different bacteria. The writer has isolated a pure acid organism, one that soured milk without the production of any gaseous product, and yet milk impregnated with this organism developed a taste as bitter as gall. Many of the digestive or peptonizing fermentations develop bitter flavors. Where butyric acid is formed in milk, a bitter taste is often noted. In heated milks especially, bitter flavors frequently occur. This condition arises from the fact that the heating process destroys the normal lactic acid bacteria and as these bitter ferment germs are usually spore-bearing organisms, they are able to resist the heating process.

Bitter milk or cream is occasionally noted in the winter. Some of the bacteria that are able to form bitter substance can grow at considerably lower temperatures than the ordinary sour milk forms; and so, if milk is kept where it is near the freezing point, these bitter-forming species develop more rapidly than the lactic species, thus giving the peculiar flavor to the milk. In some cases the bitter flavor in milk, unless it is too pronounced, disappears when the product is made up into butter or cheese.

VARIOUS OTHER FERMENTATIONS.

The above fermentative changes include the more important ones that are liable to appear in milk as a result of bacterial infection. In addition to these there are numerous other changes that occur from time to time.

Among such may be mentioned the formation of alcohol, due mainly to yeasts, pigment fermentations such as blue, red or bloody, yellow and green milks; but these do not occur frequently enough to merit a further consideration in this connection.

The fermentations so far referred to are the result of bacterial action. They are not diseases in the strict sense of the word, but they affect materially the commercial value of milk.

DISEASE BACTERIA IN MILK.

Besides these bacterial defects or troubles, there are certain bovine diseases of a contagious character in which the milk of the diseased ani-

FIG. 10.—Bacterial content of milk handled in ordinary way. Each spot represents a colony growing on gelatine plate. Compare with Fig. 11 (opposite page) where same quantity of milk is used in making culture. Over 15,000 bacteria per cc. in this milk.

mal may be infected with bacteria dangerous to health. In some instances the milk secretion is so changed by the disease, as in anthrax fever, that its abnormal appearance in connection with the condition of the animal would lead to its rejection. In other animal diseases, the milk may show no physical peculiarity that would enable one to recognize its true state. As for instance, in tuberculosis, the milk secretions remain apparently unimpaired for a considerable period, and it is only where the disease becomes aggravated, especially in the mammary glands, that the appearance of the milk is markedly changed.

The majority of the bacteria that are capable of causing contagious diseases gain access to milk after it is drawn. Persons convalescing from fevers may infect the milk, or individuals who care for the sick may inadvertently be the means of transmitting contagion. Typhoid fever is quite often disseminated in this way.

The greatest danger that arises from a diseased milk supply comes from the poison-forming bacteria that get into it through improper handling. The cases of ice cream, cheese and milk poisoning, and the high mortality of bottle-fed infants are in large part due to the poison formed from the putrefactive changes that take place in milks that are produced by careless and filthy methods of handling. The presence of such disease bacteria cannot be recognized by a simple test. The greatest care should be taken by all dairymen in regard to the milk of animals suffering from any disease;

FIG. 11.--Bacterial content of milk drawn with care. Diminished germ content is shown by smaller number of colonies (330 bacteria per cc.). Compare this culture with that shown in Fig. 10 on opposite page.

also in allowing persons to handle the milk supply who are convalescing from or who have been exposed to contagious diseases of any sort.

DIRECT ABSORPTION OF TAINTS.

In a great many cases where milk becomes tainted so as to impair its value for cheese making, the trouble is due to the operation of another set of causes than those that have just been considered. It is a well known fact that milk readily absorbs many volatile substances with which it may come in contact, and it is generally believed that the taints and defects that are from time to time observed in milk are due to this absorptive property rather than to the growth and development of various fermentative organisms that form undesirable flavors and odors by breaking down certain substances in the milk. While in the popular mind greater importance is attached to this physical absorption than the actual facts will warrant, still it should be thoroughly understood that this principle does operate to a considerable extent and that undesirable or defective milk is often produced entirely through the operation of these physical processes.

Many liquids have a great affinity for matter in a gaseous form and will absorb varying amounts of such substances. These can be readily recognized if the absorbed substance contains an odoriferous principle. A fluid like milk possesses this property to an unusual degree, for not only does the liquid serum absorb volatile odors, but the fat also has a great affinity for many of these substances.

ABSORPTION AFTER MILKING.

As milk is exposed during the milking process and very often after its withdrawal to an atmosphere that is liable to contain odors of an undesirable character, it is not surprising to note that it may thus contract flavors by direct absorption. The peculiar stable odor is due to the volatile products that are escaping from the decomposing masses of manure or fermenting foods and the exhalations from the bodies of animals in the barn. Under ordinary circumstances the barn air is saturated with these products, and even in a well ventilated barn, where considerable care is taken to purify the air, they persist to a greater or less degree in spite of all efforts.

It is a popular belief that milk will not absorb any of these odors if it is warmer than the surrounding air; that it exhales odors when warmer and absorbs odors only when colder than the atmosphere. For this reason it is said that there is no danger of milk absorbing any taints in the barn so long as it is removed from such an atmosphere before it is cool. Scarcely any one will uphold the method of leaving milk in the barn over night as a process that is consistent with a pure sweet product; yet, owing to this popular notion concerning the absorptive properties of milk, a large majority of dairymen believe that the exposure in the barn air is fraught with no particular danger so long as the milk is removed before it loses its natural heat.

While the popular belief expressed above is throughly entrenched in the minds of many dairymen, still, it is contradicted by the every-day experience of the housewife. The careful housekeeper has learned by experience that milk or even meat should not be put into a refrigerator in a warm condition. It should first be allowed to cool before being placed in such a confined atmosphere, for, when warm, it absorbs more readily any odors that may come from other foods, and is thus tainted much sooner than would be the case if it were chilled before being placed in the refrigerator.

Experiments made by the author where milk was exposed to air saturated with various volatile odors showed that both warm and cold milk absorbed these odors in less than an hour to such an extent that they could be detected in the milk by the sense of smell or taste. Where the odor was marked it was almost without exception greater in the warm milk than in the cold.

While it is entirely possible that warm milk may exhale odors in cooling, it is also true that it is capable of absorbing other odors at the same time and that an exposure, even for a short time, to an air that is befouled or tainted with any obnoxious gases may be sufficient to impregnate the milk so that the odor can be recognized hours afterwards.

ABSORPTION OF ODORS PREVIOUS TO MILKING.

Besides the odors that are absorbed subsequent to milking, milk invariably has a more or less pronounced odor that is derived directly from the animal herself that is usually referred to as the "cowy" or "animal odor." While very little is known concerning the nature of these peculiar odors, it is not at all surprising that they exist and that they are imparted to the milk. When we understand how different volatile odors are diffused by means of the circulation throughout the body tissues, it might be expected that a fluid having great absorptive properties as milk would be saturated with these peculiar substances. Not only the milk but other secretions and even gaseous emanations from the body are often charged with volatile products that are consumed in the feed. While this is true to a certain extent, even where the animal receives ordinary food, it is materially intensified when the animal is given any food that is rich in these peculiar substances. Thus the volatile principle in onions and some other garden vegetables can be recognized in the expired breath and within a short time.

The peculiar property of rapid diffusion throughout the system by means of the circulation and the subsequent absorption by the milk makes it necessary to use considerable care in the feeding of certain food stuffs to animals whose milk is to be used for direct consumption or made into the usual dairy products. In the majority of cases where such foods are not fed to excess and are given to the animal immediately *after* milking the peculiar odors will be thrown off so that at the succeeding milking they will not be markedly apparent. Considerable difference in different animals is, however, noted in this regard. There can be no doubt, however, but that milk is saturated with certain odors derived from the food, if such food is fed a few hours before milking. The question under discussion is mainly whether such a condition will persist from one milking to another.

An abnormal condition of the animal incident to the disturbance of some physiological function may also affect the milk. When cows are in heat, their milk sometimes assumes an abnormal character and the marked variation, chemically and physically between colostrum and normal milk justifies its rejection for the usual domestic purposes. Animals fed largely and exclusively on a single food are apt to have peculiar milk. This is not always noticeable on account of any marked odor but the chemical characteristics of the liquid are sometimes changed. The milk of swill-fed cows, according to Kober and Busey, often has a peculiar taste and odor and is said to produce a hyperacidity of the urine and consequent eczema. Brewer's grains and distillery slops when fed in large quantities frequently induce an abnormal chemical reaction.

DISCRIMINATION BETWEEN DIRECTLY ABSORBED AND BIOGENIC TAINTS.

The cause of a tainted condition of milk is not always an easy matter to determine. Much confusion exists in the minds of many in regard to these various phenomena, and the many inquiries received show the importance of the subject. In case trouble of any sort arises in connection with the milk supply, it is highly important that intelligent steps should be taken to locate the exact cause of the difficulty. The manner of dealing with a taint due to bacterial infection is so radically different from the treatment of a taint absorbed directly by the milk that the distinction between these two different types of milk faults or defects should be made evident.

The conditions under which the taint appears in the milk throw much light on its probable cause. If it is pronounced immediately after milking there is but little probability of its being due to any other cause than direct absorption. A bacterial taint can only be formed in the milk when opportunity is had for infection and subsequent development of the bacteria. This requires several hours, so that a taint produced by decomposition changes that are caused by the action of micro-organisms, does not appear until the milk is usually from twelve to twenty-four hours old or even older. The length of time necessary to produce this change is determined mainly by the temperature at which the milk is kept. The appearance of that taint some hours subsequent to milking does not necessarily indicate a bacterial cause. It is entirely possible that the milk may not have been subjected to conditions that favored direct absorption for some hours, and also where the odors were not very pronounced, it might take several hours before they would be absorbed with sufficient intensity to be readily detected. Odors due to bacterial development usually become more pronounced with the increasing age of the milk.

Another simple rule that will aid in the detection of bacterial defects is to inoculate or add to a quantity of milk that has just previously been boiled, a small portion of the suspected milk. If in the course of twelve to twenty-four hours, a similar trouble is noted in the inoculated milk, it indicates that the defect is a progressive one and that it is due to the action of living ferments. Taints directly absorbed by milk are incapable of generating themselves in this way. Only living matter possesses this characteristic. Boiled milk is preferable to raw milk, because if ordinary milk is used, the lactic acid forms that are invariably present may repress or overcome the taint organism that is inoculated. If boiled milk is used this disturbing factor is for the most part eliminated.

TREATMENT OF MILK CONTAMINATED WITH BACTERIAL TAINTS.

Having described in a general way the origin of the various taints that are to be noted from time to time in imperfect milk, the practical questions that arise in the minds of milk producers are how can these difficulties be overcome if they have already occurred. Often little or no special attention is paid to the conditions that may result in defective milk so long as the milk supply is normal. Only when trouble has already arisen do we awake to the necessity of taking steps to overcome the present difficulty and avoid a repetition in the future. If we would once realize that prevention is very much easier than cure, we would see the necessity for a more thorough understanding of the conditions that surround these defects.

Inasmuch as the attention of the factory patron is more prominently directed toward these difficulties when once he is troubled with them, it will be better to consider the different ways in treating a defective milk supply. The first step is to determine accurately the cause of the difficulty. Successful measures cannot be intelligently directed against unknown causes. From the rule given above the milk producer can easily determine whether the given defect is due to a living germ or whether it is the result of some physiological disturbance of the animal, or possibly due to direct absorption.

In doing this it is necessary to locate the difficulty. It may be due to a single animal or to a general condition of the herd. Sampling the milk of the herd separately will enable one to determine more easily the cause of the difficulty.

Supposing the taint to be due to some abnormal fermentation, how should it be treated? There are two general methods of treatment that can be followed:

(1) Eradication, by eliminating the inciting cause.

(2) Overcoming the difficulty by an antagonistic fermentation.

Let us assume that the defect is a ropy condition that appears in the night's milk, or milk that is held over Sunday. This difficulty is due entirely to the presence in an unusual degree of certain kinds of bacteria that have gained access to the milk in large numbers. From ordinary milks these slime forming organisms can often be isolated. In three separate instances, during the past season, in the writer's laboratory, micro-organisms of this class have been found in normal milk. It is only because this particular kind was not in the ascendancy that the milk did not undergo slimy degeneration under ordinary conditions. Such forms exist in water, soil and filth of various kinds, but few of this type get into the milk compared with the total number there present. If ,however, a mass of them should be accidentally introduced and they should gain the mastery over the more common bacteria, the milk would soon assume a slimy or stringy condition. The various fermentations that are continually going on in milk represent, in a limited compass, the perpetual struggle that is seen everywhere in nature. In some cases, different forms of life live together in the same fluid in seeming harmony, but only so because both of them are indifferent to each other. Sooner or later a struggle ensues as to which will gain the mastery, and just as the weaker plant or tree is choked out in the field or forest, so the course of fermentative changes is determined by the predominance of certain ferment germs and the conditions that affect their environment.

Having determined that the abnormal condition is a slimy fermentation, that is general to the whole herd, the question is to locate its origin. Under ordinary conditions, it must gain a foothold in the milk subsequent to its withdrawal.

In some instances where inflammation of the udder (mammitis) occurs, the milk is slimy when it is drawn, but such instances would be readily recognized from the condition of the udder. The most likely sources of infection of this character are those that are due to the contamination from the barn air or the animal herself. Brushing and carding the under parts of the animal to remove loose hairs and then thoroughly moistening the same to prevent the dislodgment of fine dust-like particles will materially diminish the danger arising from the coat of the animal. Cows wading in stagnant pools often become coated with slime and in some cases slime forming bacteria have been found in the surface water.

The fault may be with imperfectly cleaned utensils, such as rusty cans or pails. Such a source of infection may be positively excluded by giving all utensils, strainers and dippers, as well as cans and pails, a thorough scalding and steaming. Epidemics of these milk troubles have been in several instances traced to contamination of barn air from foul feed or litter. The dust rising from such stuff remains suspended in the air for some little time, and under such conditions exposure of the milk may result in infecting it with the obnoxious form.

Exclusion of bacteria by clean milking and handling. By taking greater care in securing the milk to see that no foreign matter is allowed to fall into the same, and continuing this care during the entire handling, it is usually possible to overcome the peculiar defect by exclusion. If a dairy once becomes infected in this way, it must be remembered that the the dairy utensils and the whole surroundings of the place are likely to contain the specific ferment germs. just as under ordinary conditions they invariably contain the peculiar forms capable of souring the milk. By eliminating one source after another the milk producer can usually find the direct cause and then by instituting more rigorous measures in regard to this, he can in the future avoid a repetition of the difficulty.

If the milk is received in thoroughly cleaned pails, if loose hairs, dust and dirt are prevented from falling into the pail during milking, if the barn air is pure and free from dust, and if the fore milk from each teat is rejected, the bacterial content of the milk will be greatly reduced. In a series of experiments of this sort, carried out by the author, the following results were obtained.

Milk received under ordinary conditions contained 15,500 bacteria per c. c.

Milk received with above precautions contained 380 per c. c.

A repetition of the experiment under winter conditions showed 7,600 bacteria per c. c. in milk as ordinarily milked, and only 210 for same volume where the above precautions were observed in milking. Milk taken from the cow with this degree of care remained sweet over twenty-four hours longer than did that which was drawn in the usual manner.

This diminution in germ life means not only a lengthening of the time during which the milk will remain sweet, but it also favors the exclusion of those bacteria that are especially undesirable. The typical lactic acid bacteria cannot be entirely excluded, but among those that are kept out by this careful milking are the deleterious forms, those that are able to cause abnormal changes in the liquid.

Antagonistic fermentations. It sometimes happens that the exclusion methods fail to eradicate the persistent organism. With certain abnormal fermentations, another course is still open that very often will succeed where the first fails.

Take, for instance, a milk defect where the fluid curdles in a sweet condition without the production of the usual amount of acid. Such a condition is not at all unusual and where present is often accompanied by a taint that renders the milk undesirable for factory purposes. The bacteria that are able to produce the enzymes causing the curdling of the casein are unable to develop in fluids containing much acid. The lactic bacteria, therefore, antagonize this sweet curdling class, and if a starter of pure sour milk from some neighboring dairy is added to the freshly drawn milk, the lactic acid fermentation will gain the upper hand, the rennet forming bacteria being thus suppressed by the antagonistic fermentation. Such a method would not be feasible where the milk was sold for direct consumption, as the addition of the lactic acid starter would hasten the souring of the whole product, but where made into cheese or butter the objection would not be so great, as these organisms are a necessary factor in the manufacture of these dairy products. Such a method is somewhat objectionable on general principles and should only be used where one has failed to eradicate the difficulty by thorough cleanliness.

CHEMICAL DISINFECTION.

Only rarely will it be necessary to resort to more heroic measures to overcome the various abnormal fermentations to which milk may be subject. Thorough cleanliness, intelligently applied, will usually restore conditions to their normal state. In cases of contagious disease, more severe measures are necessary, as the specific disease organism is so well adapted that it can usually grow with rapidity if it once establishes itself in the animal body. Various disinfectants, such as freshly prepared milk of lime, sulphur, formaldehyde, corrosive sublimate, etc., can be used where complete disinfection is necessary.

TREATMENT OF MILK TAINTED BY DIRECT ABSORPTION.

In case the defective milk is caused by the direct absorption of some pre-existing odor, the method of treatment as to cure or prevention should be radically different from that employed when the difficulty is of biogenic origin. These absorbed taints have their source either in the animal herself or are taken up by the milk subsequent to its withdrawal.

As with abnormal fermentations produced by living organisms, it is much easier to prevent than to overcome an imperfect condition in milk. If the difficulty is due to absorption after milking, it can easily be prevented by removing the milk from the odoriferous source. Milk houses—and every well regulated dairy should have a room or building set apart specifically for the purpose of storing the milk—should be entirely free from any objectionable odor. The room should be thoroughly ventilated so as to remove all dank odors that are apt to arise from places that are subject to much moisture.

If the defect is most pronounced at time of milking, undoubtedly it can be traced directly to the animal. It may be due either to the normal odor, popularly called animal or cowy odor, that is usually present in milk to a greater or less degree, or the difficulty may be caused by the animal eating certain weeds or plants in her feed.

The so-called animal odor is more or less constant in its appearance, independent of the character of the feed, although it varies in intensity in different animals. Just how this odor is produced is not thoroughly known, but it is probably carried by the blood to the various tissues of the body and absorbed from the circulation directly by the milk. Cabbages, turnips, rape and silage when fed to cows likewise produce a peculiar flavor in the milk. These foods contain various volatile substances that are absorbed from the alimentary canal by the blood and are subsequently eliminated through the various excretory channels (lungs, skin and kidneys). If the milk is drawn a few hours after the animal has partaken of such foods the particular odor will often be quite marked. To a considerable extent, the intensity of this odor can be diminished by regulating the time of feeding. Where such crops are fed they should be given the animal immediately after milking so as to give the longest possible time for their elimination before the succeeding milking. The amount fed also has a considerable effect on the intensity of the odor. The animal herself, likewise exerts an individual peculiarity, the taint being more pronounced under similar conditions with some cows than with others. Where such feeds are given to cows it is important that no more should be fed than will be consumed in a relatively short time. If the animal has access to such feeds in her manger for a considerable number of hours, a tainted condition in the milk is sometimes observed that would not have been present if the food had been eaten immediately.

Cows on pasture often eat weeds or plants that impart peculiar and ofttimes obnoxious flavors to the milk. The onion family, represented by the leeks, garlic and wild onions, are notorious in this regard. Cows running in the woods, especially in spring, are liable to have their milk affected from such a source. In some parts of the United States, particularly along portions of the Atlantic seaboard, these wild plants infest the pasture lands to such an extent as to almost ruin the milk supply. Chicory, rag weed and numerous other wayside weeds bother later in the season. Where it is possible to control the access of cows to such places trouble may be easily prevented.

METHODS OF ELIMINATING TAINTS.

Aeration. Various methods have been suggested to aid in the elimination or destruction of these obnoxious odors after they have been absorbed by the milk. The most widely discussed of these methods is aeration, i. e., bringing the milk more or less completely in contact with air, thereby allowing, it is claimed, an opportunity for the escape of these volatile substances. This method has been most strongly recommended for milk used in cheese making, it being a well established belief that airing the milk improves it for this purpose.

Aeration as ordinarily practiced has a double effect. Besides airing the milk, it usually lowers the temperature so that the effect of cooling is likewise secured in a partial degree. Whether the reported benefits of aeration are not in part due to the cooling effect is not well known. Experiments made under the auspices of different experiment stations are contradictory in their results and a satisfactory explanation of the reported benefits of aeration is yet to be made.

The results of the system as determined by practical experience should have great weight, and notwithstanding the failure to satisfactorily explain the apparent discrepancies between practice and carefully controlled experiments, the method certainly has no disadvantage. Care should be taken to aerate in a thoroughly pure atmosphere, that is, free from dust and taints of all sorts; otherwise more harm than good may come from the process.

Pasteurization. Driving off the odors by heating the milk has also been highly recommended. In fact, this claim is often made as one of the advantages accruing from the pasteurizing process. In heating milk the various gases, as carbon dioxide, oxygen, etc., that are dissolved in the serum are driven off, and it is undoubtedly true that other substances of a gaseous nature would be eliminated, at least, in part by this treatment. Even an odor as persistent as that of garlic, it is claimed, may be greatly diminished in this way.

The addition of chemicals, such as potassium nitrate (saltpeter) has also been recommended, but in our limited experience with this agent, we have always found that the milk made into cheese had a peculiar odor.

Undoubtedly the use of heat and pure air will be of some help under certain conditions, but with the great majority of cases it will be easier and far more effectual to remedy the difficulty by prevention rather than by treatment.

In the larger number of instances where milk is tainted, the producer expects to find that the difficulty is due to the absorption of some pre-existing taint. Generally he is wrong in this conclusion, for in a dairy that is kept reasonably free from putrefactive odors, the tainted condition of milk is more often due to the action of microbes than to direct absorption. In general, dairymen do not fully appreciate the influence of these microscopic forms of life. Until we recognize how potent they are in their effect on milk and how necessary it is to take every precaution to prevent their entrance and growth in this field, we shall fail, as a rule, to apprehend the real source of trouble.

Under natural conditions dirt and bacteria are invariably associated so that the entrance of even microscopic dust is really sufficient to seed the milk with organisms that are capable under ordinary conditions of greatly changing the chemical and even the physical constitution of milk, thereby converting what should be a highly nutritious fluid into much less valuable and often positively injurious products.

In the preceding pages the attempt has been made to explain the cause of the various abnormal conditions that occur in milk, but these defects can be prevented in the great majority of cases if the proper care is given to the milk in the first place. To give definite expression as to what is meant by proper care, the following rules are appended. Even a rigid observance of these regulations will not in all cases insure success, but they will be helpful to those that are in doubt in regard to the best method of treatment. These rules simply put into concise language the spirit of the foregoing pages.

SUGGESTIONS TO MILK PRODUCERS IN REGARD TO THE CARE OF MILK.

CARE OF ANIMALS.

1. The milk of any animal suffering from disease should not be used for food in any form.

2. The milk from fresh animals should be rejected until after the ninth milking.

3. Ensilage, turnips, etc., should only be fed immediately after milking, so as to allow time for the elimination of the volatile products of these feeds from the system of the animal.

4. The quantity of above feeds should be limited so that the animals will consume the entire ration at once.

5. The milking stable should be as free from dust as possible at time of milking. Feed dry fodders after milk is removed from stable.

6. Brush udder and flanks with a stiff brush to remove dirt and loose hairs. Sponge off udder thoroughly with clean water, leaving it moist but not dripping wet.

7. Use only clean tin milk pails. Reject all rusty or patched tinware in the milk business. Unless seams and joints are extra well soldered, it will pay to have an extra coating over all seams and the joints well flushed.

8. Just before milking, the milker should wash his hands thoroughly with soap and water. Under no conditions should the hands be wet during the milking.

MILKING.

1. Milk should not be left in barn during the milking as it can absorb odors even when hot and become contaminated with bacteria from the air.

2. Milk, even when warm, should be strained through several layers of cheese cloth. This strainer should be first washed in tepid water and boiled after every milking and then dried.

3. Milk should be aerated immediately after being milked. Aerators are best suited for this purpose, but stirring, dipping and pouring the milk will reduce in part the peculiar odors present in fresh milk.

4. Milk should be immediately cooled after being drawn from the cow. Where possible, use ice or cold running water. A quick reduction in temperature checks the development of any bacteria that may have fallen into the milk during milking.

STORAGE AND TRANSPORTATION.

1. Milk should not be kept in barn over night. The dairy store room or building should be free from all foul smells. Stable and hog pen odors can be easily absorbed by the milk.

2. The milk should be kept cold until it is delivered. An initial cooling is useless unless it is continued.

3. In hauling milk to factory, cans should be full or covers pushed down to prevent churning.

4. Cans should be protected by a covering, as a tarpaulin, to prevent dust from settling on cans and to protect the milk from the sun.

CARE OF UTENSILS.

1. Factory products such as whey or sour skim milk should be returned in other receptacles than the cans used for bringing milk to factory. This custom of returning waste products to the farm in the cans

used for milk is the cause of more trouble in the cheese industry than any other one factor.

2. Milk cans should be cared for as soon as returned to the farm. They should be rinsed in warm water, then thoroughly cleaned and left in the sun to dry, inverting in such a manner as to permit circulation of air.

3. All dairy utensils, such as pails, strainers, dippers, etc., should receive as stringent treatment as the cans.

In caring for milk it should be remembered that two things are necessary;

1. To prevent the absorption of any foul odors.

2. To prevent the development of living organisms in the milk that are able to form foul substances that taint the same.

The first can be accomplished by keeping taint-producing feeds from the cow and by keeping the milk in a place that is free from all undesirable odors. The second result can be attained by thorough cleanliness combined with a low temperature. Dirt and filth are so intimately connected with bacteria in nature that germ life can be largely excluded by keeping out the dirt. The efficiency of this method, however, does not depend upon a removal by straining out the visible dirt, for under such conditions, the bacteria adherent to these particles are washed off and cannot be removed by filtering or straining. If the milk is kept at a low temperature, the development of the bacteria in the same is greatly retarded. These organisms obey the laws that govern the growth of all plant life, and just as our cereal grains will not grow in early spring or winter, so the bacteria present in the milk are greatly checked in their development or even prevented from growth by lowering the temperature of the milk.

"It is the glorious prerogative of the empire of knowledge that what it gains it never loses. On the contrary, it increases by the multiple of its own power. All its ends become means; all its attainments help to new conquests."

—Webster.

MILK AND ITS PRODUCTION FOR CITIES AND TOWNS.

BY A. W. BITTING, M. D., INSPECTOR, CITY BOARD OF HEALTH, LABORATORY OF COMPARATIVE PATHOLOGY, INDIANA AGRICULTURAL EXPERIMENT STATION.

Lafayette, Ind.

There is no food product in general use that is more wholesome than milk. It is palatable, easily digestible, and highly nutritious. Its nutritive qualities are recognized by physicians in that they recommend it as the principal article of diet for weak or sick patients suffering from almost all forms of disease. Milk cannot be made the exclusive diet for the adult as it is for the child but it can be made to have a much larger part in the daily diet than is now given to it. By analysis it has been found that a quart of milk contains essentially the same nutritive value as three-fourths of a pound of steak. Upon this basis a quart of milk would have a real value of from nine to twelve cents when steak has a value of from twelve to sixteen cents. The price of milk, however, usually ranges from five to eight cents and the greater proportion is sold for less than six and one-quarter cents. The milk has an advantage over steak in that its nutrients are practically all digestible while some of the nutritive qualities of the steak are lost as a result of cooking. Records upon the cost of diets in which milk was a large factor as compared with diets in which this article was practically absent, confirm the results of the laboratory analysis. When the persons were using large quantities of milk they used less of other and more costly materials so that the result was a distinct saving. In cities milk is used more in the nature of a condiment rather than as a food. It is used to season coffee and tea, upon fruits, and as an adjunct to the cooking rather than as a staple article of diet. A quart of milk per day is made to serve for all purposes for a family of four or more persons and when the milk bill exceeds six or seven cents per day they consider themselves extravagant. This feeling is so deeply seated that it will be a long time before the woman who orders the kitchen supplies will see the economy of ordering two quarts of milk at six cents each instead of one and a half pounds of steak at sixteen cents although the saving would be twelve cents.

The very qualities which make milk such a desirable food also render it undesirable from another standpoint. It is an ideal medium for the growth of almost all forms of bacteria and from the very nature of things cannot be produced or handled in a commercial way without becoming more or less contaminated. Some germs even invade the udder; hair, scales, particles of manure, dirt and dust fall into the bucket during the milking, bacteria float in the air of the stable and add a greater or less number, depending upon the length of time the milk is allowed to stand after being drawn; the buckets are two often unclean or rinsed with water that is germ laden and thus adds to the quota already present. From all these sources and other exposures necessary in the handling of milk it is not surprising that there may be several thousand germs in each cubic centimeter (small thimble full) before it even starts on its way to the customer. If the milk be permitted to stand without cooling and be delivered from large milk cans by dipping as is the usual custom, it gives additional exposure to street dust, to the questionably clean receptacle, to the air of the dwelling room or kitchen, and tests made upon such milk may show from one hundred thousand to more than a million germs per cubic centimeter at or within a short time after delivery. The rate with which germs multiply at ninety degrees, the temperature at which much milk is delivered during the summer, is so rapid that we can easily see the necessity for dairymen making two deliveries per day during the summer months.

Fortunately most of the forms which find their way into the milk are comparatively harmless or only produce a souring. The most common danger is from forms that will produce poisons that may cause diarrhoea or intestinal disturbances. These products affect children more than the adult and are responsible for many deaths under the more familiar names of cholera infantum and summer complaint. A number of out breaks of infectious disease, especially typhoid fever, have been traced to the milk supply; not from the cattle but from the water or affected patients handling the milk. Scarlet fever is another disease that seems to be carried in the same way occasionally. It is not often that disease is carried directly from the animals. Tuberculosis is the disease that is most common to people and cattle but the number of cases contracted from the use of milk is not now considered to be so large as it formerly was. All diseases whether constitutional or local to the mammary gland may exert an unwholesome influence.

The city dairyman is interested in the changes which milk undergoes largely from the standpoint of souring. It is imperative that he should deliver milk that is sweet and that will remain in that condition until it can be used. Rapid souring of milk makes it necessary for him to deliver his product twice a day during the heated term or nearly five months of the year. In a city of only 25,000 population it means the driving of twenty or more wagons, as many drivers, and about thirty horses an extra half day on the road. It means an extra traveling of from 150 to 200 miles each day or a total of 30,000 miles during the season without additional compensation for the trouble. It means very early rising and a very long day's work that makes the business distasteful. Whatever methods that are practicable that will lessen this cost of delivery should not only be welcomed but sought after. It has been demonstrated by experience that milk may be so handled that one delivery per day will suffice and that the methods necessary to secure this result will also make a better product for consumption. It works to the advantage of the producer and consumer. The essentials are cleanliness and a fairly low temperature. The former is hard to secure, the latter may be obtained cheaply.

Milk of good quality can only be obtained from cattle capable of producing a good quality. A dairyman with nondescript cattle can not hope to compete with his neighbor having high grade or pure bred Jerseys. Neither feed nor surroundings can compensate for breed characteristics in the per cent. of fat present. A high grade milk should contain five per cent. or more of butterfat, a good milk four per cent. or more, while a milk containing only three per cent. must be considered low. Probably 80 per cent. of the milk delivered in cities will contain from three to four per cent. of fat, 15 per cent. will contain between four and five per cent., and five per cent. will contain more than five per cent. of fat. Dairies in which the cattle are common stock selected upon the basis of the amount of milk produced, and kept only for a short time and then turned over to the butcher as fatted stock, are never high grade. In fact they are not high grade in quantity as an exact record is not kept, and when such is made for a comparison it is disappointingly low. A dairy in which there is frequent change can not have a uniform set of milkers; cows are less docile and are more predisposed to disease and to injuries from each other. As long as milk is sold by the quart volume and not upon its quality, the dairyman delivering three per cent. milk receiving the same as the one delivering five per cent. milk, so long will there be a preponderance of poor dairies.

It is almost unnecessary to say that the herd must be healthy. Only the most unscrupulous will willingly or knowingly milk a cow that is diseased. Some will milk a cow having garget in one quarter and some will milk a tuberculous animal not realizing the danger that may come from it. In all herds there should be ample provision of separation of animals at breeding periods.

The stable arrangement and conditions are very important factors in the preservation of the health of the herd and in the ease with which cleanliness may be secured. From a hygienic standpoint some of the newest and most expensive dairies are most at fault. It is the proper plan and not the amount of expense that is put into a stable that determines its fitness. In the recently constructed dairies tight siding to secure warmth has taken the place of the loosely constructed stables, but no adequate means for ventilation has been given to compensate for this lessened circulation of air. The cubic air space allotted to animals in a number of barns was found to be from 250 to 300 cubic feet or from one-fourth to one-third the amount that should be allotted. The object has been to secure warmth by retaining the heat radiated from the animal body, little realizing that it means the repeated inhalation of poisoned air that in the long run must have a prejudicial effect upon the animal, weakening the body and predisposing to disease. In dairy barns there are two types with reference to the arrangement of the cattle in stalls; one with the heads facing a common feed floor, and one in which the heads are toward the wall with an alley separating the rows for removing manure, etc. The former has an advantage in feeding, but it brings the heads of so many cows together that the breath from one is thrown into the face of the one directly across, and frequently into that of each of those standing on either side of the one facing as well as those at her own side. Crowded into three and one-half foot stalls, or four foot stalls and a feed way of four feet, it virtually causes six animals to rebreathe the air exhaled from each other. This arrangement can not be too quickly abandoned as a proper dairy arrangement. The type of arrangement in which the cattle face the wall obviates the objection to the former arrangement in part. If the partitions separating the animals are high enough so that each is practically separated from the neighbor on either side it is probably the best arrangement that can be given. It does offer an advantage in the cleaning of the stable that compensates for the lesser advantage in feeding. It is a custom, too, to place two cows in one seven and one-half foot stall. The writer has never seen the special reason for it. If two animals can stand in a stall, why not more? why have partitions at all? Each animal should have an individual stall and the partition between of sufficient height and length to prevent injury from one animal stepping on another, and to prevent befouling. In the double stall arrangement, or no stall arrangement, the animals are frequently injured, and in every stable there will be plenty of examples of uncleanliness. The fixed stanchion too is a cruelty. It puts the animal's neck in the same relation as would a man's body if stretched in bed and not permitted to turn. The moveable stanchion or tie is much to be preferred. The stable should have plenty of windows. Light is the cheapest disinfectant, and with plenty of windows it can act all the time and not being dependent upon the memory of an employe, or the feeling that it is costing something without giving adequate returns. It does possess an advantage that some either fail to appreciate or must feel that it costs too much, that it does make it easier for both the stock and the helpers to find their way.

All stables should be disinfected regularly whether disease has occurred or not. It is a precaution that should be followed as regularly and for the same reasons as the careful housekeeper cleans house. For disinfection there is probably nothing better than good whitewash. It will destroy the germs with which it comes in contact, makes the place whiter and therefore lighter for the constant destruction of germs. After once being applied it is necessary to re-apply in order to keep the place clean and the necessity for cleanliness in this respect will have its influence upon other phases of the dairy work. It is cheap and can be most economically applied by means of the spray pump, such as is used in spraying potatoes or other garden crops. It should be used on sides and ceiling twice a year and on the stalls oftener. The disinfection by formaldehyde or sulphurous acid gas is not practicable in barns.

The newer idea of having a large enclosed shed or yard has much to commend it. The cattle are given their liberty at all times except while being milked and fed. They may move about from place to place to feed and may drink whenever they so desire. They have light exercise, are assured protection from the storms of winter, and the extremes of summer, have plenty of light and ventilation and are more easily kept clean than under any other condition. The milking stable can be kept cleaner, and free from odor, a marked advantage in the handling of the milk. There is no full gutter or breath-fouled air to give up its objectionable properties. The shed scheme is the sanitary idea and rapidly growing in favor where understood. It is economical in construction but much more so in the cattle management. A large number of tests of the air in such a shed and milking room have been compared with the conditions found in all sorts of dairies with the advantage decidedly in favor of the shed. The barn idea with all its ancient history will not be soon displaced by such a scientific improvement.

The teaching at the present time is to the effect that food has but little influence upon the quality of milk, that quality is dependent upon breed characters. Food may temporarily change the quality as in the better feeding of an animal that is in a very poor condition will increase the per cent. of fat, but not beyond the normal, and it will remain there after the animal body has attained its equilibrium. Some foods exercise a prejudicial effect as onions, cabbage, turnips, etc., decayed foods, and milk from animals fed upon such food is considered adulterated. Ensilage, especially if quite sour, and brewers' grains will give an unusual flavor that will almost wholly or completely pass away after continuous use of the feed.

The effect of food upon the quantity of milk is very much greater than upon the quality.

There has never been any question as to the use of hay, fodder, straw, and the grains and mill by-products as feed for dairy cattle. There has been objection to the use of brewers' grains, distillery slops, the swill from starch factories and other fermented foods. In a few instances ensilage has come under the ban as objectionable. The feeders have maintained that these were proper food stuffs and have been supported in their contention by chemists and experimenters. Boards of Health have often maintained that the milk exercised some injurious effects. In our investigations we found it to be an almost invariable rule that the milk from dairies in which such feeds were used, that there would be a more rapid souring of the milk than from the dairies in which sweet feed alone was used. Whether this change was due to the greatly increased number of fermentive bacteria present in such stables, or to some less stable compounds in the milk, was not determined. The belief is that it is more probably due to the former cause. It was further found that taking the feeders of malted or fermented food as a class and comparing the per cent. of butterfat present with the per cent. of fat present in the milk supplied by those using only sweet feed, that there was a difference in favor of the latter. The average tests from twenty-five herds using malt grains was 3.5 per cent. of fat. The average of thirty-four herds using sweet feed was 3.95 per cent. of fat. The effect of ensilage could not be determined in this test as no dairyman in this vicinity uses it. It was also observed that the dairies supplying the creamery also had a higher per cent. of fat than those using the malt feed. The difference in the cattle and surroundings would hardly account for this condition. The creamery does not buy on the basis of a butterfat test, and never makes a test, so that could not be a stimulant to a higher grade of milk or protect against a water adulteration.

The water supply is of even greater importance than the food. The water supplies a double purpose, that for the animals, and cleansing and rinsing the vessels and cooling the milk. The food can affect the milk only as it may influence the animal and as particles may accidentally gain entrance during the milking process. The water is used directly upon the buckets, cans, and other appliances, and if it be contaminated it adds its infection instead of taking away. It is not contended that impure water may pass through the cows and affect the milk, but that the great danger is from its use upon the vessels. It should be that a water unfit for domestic use should never be used for cattle to drink or in any dairy operation. A dairy cow demands a very large amount of water daily, from 12 to 16 gallons, and safety demands that the water be of known purity. The water from a tubular well is a much safer water from a hygienic standpoint than that from any other source. The water from a twenty-foot driven well must come from the bottom, and little contamination need be expected, while that from a dug well of any depth will receive more or less drainage from the surface. The location of a well at or near the stockyard, especially if it be an open well, is wrong because it will receive drainage. Such wells have been responsible for many of the most alarming outbreaks of typhoid fever and unaccountable sickness. The contamination of course coming from a patient in the house of the dairyman or from a helper.

It is not an easy matter to obtain water at all places, and when such must be gotten from dug wells, they should be located some distance from the yard and the water piped to the point at which it is wanted. All dairies in cities should be compelled to use water from the city service or from tested wells.

Much has been published during the past few years upon the number of bacteria that gain access to the milk during the operation of milking. A large number of tests were made to determine this matter at the Purdue Experiment Station during the years 1895 and 1896. The tests were made under as large variety of conditions as possible, commercial dairies of all descriptions, and in private dairies that were kept in an exceptional manner. The average number of germs falling upon a surface the size of the usual milking pail, in four minutes, the average time for milking one cow, was 17,680 in the average dairy; in a good dairy it was 8,080, and in a dairy having a separate milking room and taking the precaution to wipe off the sides of the animal and udder, 720 germs. In some of the very poor and unclean places the total number ran up into the hundred thousands. The advantage coming from carefully cleaning and wiping the animal with a damp cloth was so great that the precaution can not be omitted in any high class dairy. It is not possible for all dairymen to have separate milking rooms, roomy stables, or as much light and ventilation as science demands, but they can all use this simple precaution. Another precaution of no small meaning is that of emptying the first milk from each quarter on the floor. The first milk drawn contains an immense number of germs as compared with that drawn later. In our own experiments it was found that in eleven successive milkings the first milk showed the following number of bacteria to be present per cubic centimeter: 122,400; 1,353,600; 15,400; 12,800; 32,000; 8,000; 14,400; 8,200; 5,000; 22,000 and 6,000. The following is the average number found in the whole milk as taken from six cows, the first milk not being saved; 10,600, 2,000, 2,000, 2,000, 2,200, 2,400 and 1,800, while the average for whole milk and the first milk not drawn will be from 8,000 to 15,000 for the year.

The milk should be removed from the stable as soon as drawn to avoid contamination from the air and to prevent the absorption of odors. The milk should not be strained in the stable, but this is preferable if done directly into the large can than to allow it to stand. It is not an uncommon practice to find the milkmen feed the cattle on sour slop immediately before milking, and without washing the hands go through the milking operation, and as soon as through strain the milk into the ten or fifteen gallon route can at a point within a few feet of the sour slop trough. Under such conditions it is impossible to produce a milk that will keep, and makes the second delivery a necessity.

When milk is first drawn it has a temperature of about 100 degrees Fahrenheit. It will lose a part of this heat and come to the same temperature as its surroundings in a greater or less length of time, depending upon the bulk and the surface exposed to radiation. If left in the large bulk of the eight or fifteen gallon can, the cooling process is slow, as there is little surface from which to lose the animal heat, and nothing to force the rapid circulation of all parts of the milk in the can to the surface. In order to more effectively accomplish the cooling of milk, special apparatus has been designed to reduce the milk to a very thin layer and to bring a lower temperature into immediate proximity for the rapid absorption of the heat. This is so effectively done that on even small coolers a pound of milk will be spread over a surface of 8,000 square inches and from ten to thirty degrees of heat removed in five seconds. An eight gallon can of milk will flow over the cooler in about twelve or fifteen minutes and lose from twenty to twenty-five degrees of heat by simply using the ordinary well water. The same can if set into a tub of water at the same temperature would require from one hour to one hour and a half to accomplish the same result.

The effectiveness of a cooler depends upon the area of exposure and the degree of coldness that may be maintained within itself to abstract the heat. No cooler will abstract more heat than it gives off. If one hundred pounds of freshly drawn milk passes over it and gives off twenty-five degrees of heat, it will necessitate that one hundred pounds of water be used at a temperature of fifty degrees. If it is desired to cool the milk more than twenty-five degrees it will require a greater proportion of water. To cool one hundred pounds of milk on a cooler will require as much water to cool it standing in a tub, less the amount of loss from radiation due to the longer exposure. The surface exposure of the ordinary shotgun can is 440 square inches, and eight gallon milk can is 872 inches, but the layer of milk in contact with the surface is not changed rapidly.

A series of tests were made of the cooling of milk as set in the ordinary can and set in the tub, by suspending thermometers at distances of one inch from the surface to the center. The milk was not agitated and the cooling was more uniform than was anticipated. Milk seems to be a better conductor of heat than water, and while the difference in temperature of the water on the outside and the milk on the inside was quite marked, currents were set up that made the cooling quite uniform. When this difference in temperature became less pronounced the currents almost ceased and further reduction was very slow.

The special advantage to be derived from the use of the cooler is not so much in the economy of ice or water used, as is so often claimed by the manufacturers, but in the sudden chilling of the milk and thus arresting bacterial growth. The sudden reduction of temperature seems to have the effect of shock and checks the power to multiply. The reduction of temperature to the same degree, but by slow means, is not so effective. The same principle is recognized in pasteurizing; it does not depend simply upon the raising the temperature to a high degree, but almost to the same extent upon its sudden lowering. In the ordinary method of cooling milk by setting the cans in tubs of water, the time of cooling is nearly two hours, sufficient time for considerable multiplication. A second advantage in the use of special coolers is in the aeration, the getting rid of much animal odor and absorption of oxygen that has a detrimental effect upon some forms. A study was made upon the number of bacteria present in milk at every hour during forty-eight hours, using milk that had not been cooled, milk that had been cooled and left at room temperature, and milk that had been cooled and kept cool. The room temperature was ninety-three degrees and the cooling was done to fifty-four degrees, as that was the water temperature without the use of ice. The results often showed as much change in the uncooled milk in six hours as in the cooled that was kept cool in twenty-four or thirty hours. Tests upon acidulation fully agree with the bacterial tests.

Milk is delivered in four ways; by dipping from large cans, by drawing from the bottom of the can, by carrying it in small cans sufficient for only a few customers, and in glass jars of standard quantity, as quarts and pints. Fully nine-tenths of the milk sold in cities is delivered by the first method. Each method has its advantages and disadvantages. The delivery by dipping from the large can is the most objectionable from a sanitary standpoint. To empty a fifteen gallon can will necessitate the removal of the lid on an average of 62 times. From our observations there will be four half gallon customers, forty-six quart customers, and twelve pint customers. This means that in the time required to empty one can of milk the top is removed and there is exposure for from thirty to forty minutes, sufficient time for the entrance of from one hundred to one hundred and fifty thousand germs on a dry summer day, and four hundred thousand on a very dusty day. If the lid be made to fit into the top of the can instead of fitting over it, it is an easy matter to allow as many more to be deposited in removing and putting on the top. In the delivery of the product of one day, some of the larger dairymen have the milk exposed to street contamination for a period of fully two hours. The catching of 100,000 or 400,000 germs in fifteen gallons of milk is not such a large number when we consider that bad milk may contain as many as 3,000,000 germs in fifteen drops. It is the very rapid multiplication of these germs that causes the unwholesome changes.

In the delivery of milk by either the dipping process or by drawing from the bottom, the infection does not end with the delivery to the customer. The milk is nearly always received in an open vessel and carried into the house, another period of exposure; sometimes not placed in a proper storage place as soon as received, another exposure; and not infrequently received in vessels used for the same purpose on the previous day, and having only been rinsed they act as a starter for new growth, another exposure. The dairyman may plead that he is not responsible for what happens to the milk after it leaves his hands, but if the delivery can be made to avoid all these injurious influences, it is so much to his credit. The delivery of milk by drawing has an advantage over dipping just so far as it prevents street infection. The small pail is used only to a very limited extent but has the advantage of little exposure. The glass jar is decidedly preferable to any of these methods. It obviates all exposure on the street and in delivery, the milk is kept in its package until ready for use, and only such forms are present as gained entrance at the time of bottling, and the number depends upon their multiplication. The most serious objection that can be urged against the use of the bottle is that it may be used in the home where there may be sickness on one day and in another family on the succeeding day. This demands that the bottles be thoroughly cleaned and sterilized; otherwise they might become a serious menace to health. No bottle should ever be accepted from a customer as being clean, but be subjected to a thorough cleaning process, and steam sterilization. The bottle insures uniform quality to all customers, a lessened churning effect, and the maximum of cleanliness. The objection from the standpoint of the producer is the expense and loss from breakage. In the examination of city milk it has been found that the bottled milk was delivered at a uniformly lower temperature, kept longer, and one delivery each day sufficed even in the hottest weather. If by the extra care in milking, cooling and bottling, one delivery may be made to suffice, the cost may be reduced below that of two deliveries under old methods.

A test was made of the quality of milk from the top to the bottom of cans by both the dipping and drawing process. A sample was taken after the delivery of each gallon. The record is as follows:

	Per cent. of fat in the milk.	
Sample.	Dipped.	Drawn.
1	3.6	1.0
2	3.6	3.9
3	3.6	4.1
4	3.6	4.1
5	3.6	4.3
6	3.6	4.2
7	3.6	4.2
8	3.6	4.3
9	3.6	4.3
10	3.6	4.3
11	3.6	4.4
12	3.6	4.2

There can be no greater uniformity in bottled milk than is shown in these samples.

Milk can be produced and delivered under such conditions that one delivery a day will suffice. The requirments are not theoretical but practical and are in operation. Clean cattle, clean stables, clean milking, separating for purifying purposes, cooling, and delivering in cans will secure the end. The separator and cooler must some time become as much the equipment of the dairyman as the ice-chest is of that of the butcher. The cost of these things is not great. It does not mean cement floors and tiled milk rooms, but the application of a few scientific principles under conditions that are attainable when the knowing how is present.

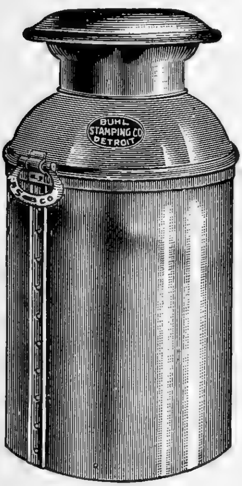
Nearly every phase of dairying from a study of breeds, feeds, barns, handling of milk, butter and cheese making have been the subject of many experiments. The question of city supply is as yet almost untouched. How much labor might be saved by improved methods of handling, by a common separating, cooling and bottling plant, and by a more modern system of delivery and other questions of equal importance, is yet unknown.

MILKING, COOLING AND GENERAL CARE OF MILK FOR DELIVERY TO CREAMERY.

BY PROF. E. H. FARRINGTON, OF THE WISCONSIN DAIRY SCHOOL.

Madison, Wis.

Nearly every farmer has probably either heard or read about the man being a public benefactor who makes two blades of grass grow where formerly there was but one. The statement is often quoted and the truth of it is acknowledged by all in theory at least. It is easy to comprehend the meaning of two hay crops in one year, but some of us fail to realize that the second one may be the reward of extra care and attention. The accomplishment of great things by watchfulness over small things is as possible on the farm as it is in any other line of business, and in no branch of agriculture is there a better profit paid for constant attention to details than there is in the dairy. Very few, if any, food products are so susceptible to defects or so easily contaminated as is milk, and still the protection of its purity until it reaches the consumer is largely a matter of common cleanliness,—a very simple duty, but one which, when faithfully performed, will more than pay for the effort made.

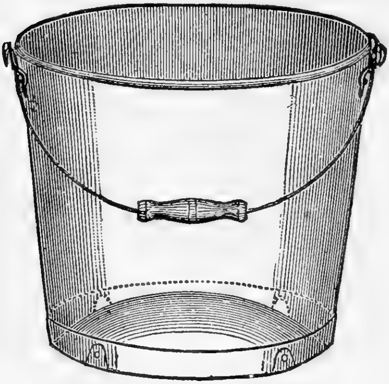


RAILROAD MILK CAN.
"New York" Factory Can.

Directions for the proper handling of milk have been printed over and over again. The rules given generally include an old story, familiar to many a milk producer, which I am repeating in order, first, to refresh the memory of some who may need to be reminded of things forgotten, second, to induce others to do as well as they know how to do, and third, to overcome any tendency all may have to slight the little things that are known to be important for preserving the natural purity of milk.

In taking up the discussion of this subject it is hoped that some of this old story may make a new impression on those who have heard it many times before and that it may possibly furnish a new idea or two to those who are less familiar with the subject.

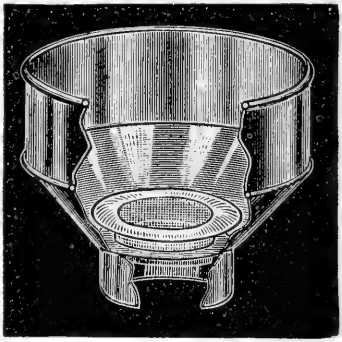
THE MILKER'S RESPONSIBILITY. When a man is milking, he should bear in mind that he is handling a food product which will undoubtedly be placed on the tables of many people in essentially the same condition that it is obtained from him. He should be just as particular and as careful when milking to supply his customers or a factory as he is when filling the glass pitcher which his wife or child brings him when milking and asks to have it filled for his own supper table.



IRON-CLAD TIN MILK PAIL.

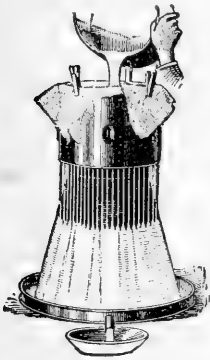
Many of our food products are "purified by fire," or cooked before they appear on the table, but milk and its products are, as a rule, used raw with all the impurities that may have gotten into them on the way from the cow to the table. The consumer does not like to be reminded of these possibilities of contamination and he will therefore gladly pay an extra price for milk which is known to be clean and wholesome.

Milk is sometimes a source of positive danger to a community as it has been demonstrated that diseases may be spread by the milk supply from one farm to many households. When such contagious diseases as typhoid fever, diphtheria, scarlet fever, etc,. occur in a family selling milk, the fact should at once be made known to the proper authorities and the milk produced on that farm should be disposed of as directed by them. A sick person or one convalescing from any contagious disease, or any one acting as a nurse for the sick, should not be allowed in the cow stable or permitted to take care of the cows. He also should neither be allowed to handle nor deliver the milk, as it is one of the best food materials for disease germs. They thrive and multiply with alarming rapidity in milk. It is therefore necessary to use every precaution possible to prevent the spreading of diseases by criminal carelessness in handling milk from an infected locality.



ELGIN MILK STRAINER.

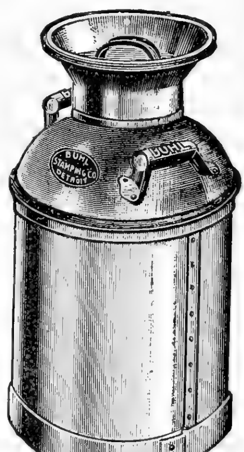
The Milker's Preparation. The milker should wash his hands with soap and water just before milking and wipe them dry with a clean towel. His finger nails should be cut close so as not to injure or irritate the cow. No loud talking should be permitted during milking. Go about this work promptly and quietly, with as much regularity in the time of milking as is possible. Some successful dairymen milk their cows "by the watch" and are very particular about the exact time each cow is milked. They are also careful to have the same cows milked by the same men in the same order. Experience has taught them that regularity in milking aids in developing a tendency to prolong the period of lactation.



MILK COOLER AND AERATOR.

Always milk with *dry hands*; moistening the hands with milk or water during milking is one of the most filthy practices imaginable.

The Milk Pail. One of the best modern milk pails is covered with a double strainer cloth between which there is a thick layer of absorbent cotton. This pail is provided with a spout through which the milk is poured out; while milking, this spout is covered with a tin cap. A covered milk pail that protects the milk from falling dust and dirt during milking is much to be preferred to the open pail. A wire gauze placed over the opening in a milk pail cover is better than no cover, but a strainer cloth placed over the wire gauze is still better, and absorbent cotton in addition to the cloth and gauze is the best protection. If covered milk pails were more generally used there would be less complaint about sour or tainted milk. Anyone thinking of using absorbent cotton must remember, however, that it should be used but once and then burned; the accumulation of dirt, loose hair, etc., on the cotton furnishes sufficient evidence of the necessity of using it as a protection against impurities in milk.



"IOWA" OR "DUBUQUE" FACTORY CAN

Wooden Pails should not be used, as they easily get sour and can only be kept thoroughly clean when new. Tin pails ought to have all seams and cracks flushed smooth with solder in order to make them easy to clean. This soldering should be done when the pails are bought and before they are taken home.

The Cow Stable and Yard. Cows ought to be milked in a comfortable, clean, thoroughly drained and well lighted place. Ventilation is best secured by some well constructed and easily operated device rather than by loose boards or accidental holes in a window. The walls and ceiling of the stable may be purified by a coat of whitewash which can be effectually applied with a spray pump; this ought to be done several times in a year. Some cow stalls are covered with straw or old hay placed on boards with large cracks between them. No amount of whitewash will keep such a ceiling in a sanitary condition. Chaff and loose straw dropping through the cracks are a constant source of dust and dirt during milking; the floor above the cows ought to be as tight as the walls of the stable.

The gutters and the mangers of the cow stable should be cleaned out daily and plaster or clean bedding spread over the floor.

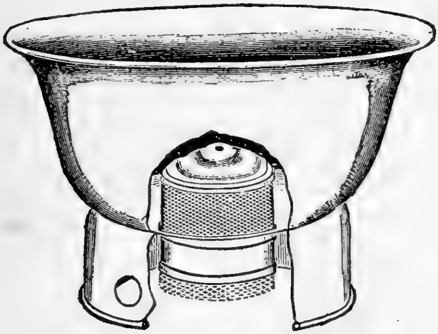
Cows should be tied or stalled in a humane way, made contented in every particular and liberally fed. No loud talking should be permitted during milking and anything that will excite the cows must be avoided. Driving them from pasture in a hurry or chasing the cows with dogs will diminish both the quantity and the quality of the milk.

Cleaning the Cows. A gentle brushing or carding of the cows every day will be found to be very beneficial to them; if this is not done regularly, the flanks and udder of a cow should be brushed just before milking in order to remove all loose hair and dirt that might fall into the pail during milking. The mud which cows have gotten on their legs and udders should be brushed off before milking is begun, and before the pails are brought to the stable so that the dust will not settle on the tinware and thus get into the milk.

Washing the udder is to be recommended if it is wiped dry before milking begins. The foremilk or the first few streams drawn from the teats may be kept separate from the rest as it contains many bacterial impurities. The difference between the first milk drawn and that obtained after the ducts and passages of the udder are rinsed by milking a short time may be shown by keeping some of both in separate clean bottles and noticing how much more quickly the foremilk sours than that obtained later.

Milk the Cows Dry. A great many milkers are in too much of a hurry to get through milking to milk the cows dry. This loss may amount to one-half a pound of milk from each cow at every milking, as was found to be the case by a farmer who followed his hired man and milked all the cows after him. By this second milking he got over a pound from some cows and less than one-half a pound from others, but from ten cows he got five pounds of strippings at one milking. This to some does not seem to be a very large amount of milk to bother with, but if milking in general was done so carelessly, the total loss of milk in the United States from lazy milking would amount to sixteen million pounds per day. This startling figure is undoubtedly as correct as the statistical reports which give the number of milch cows in the United States as 16,292,360, and it shows that a great saving may be made by milking the cows dry. The last milk or strippings is also much richer than the first milk so that it is worth an extra effort to obtain it. Another point which should be considered in milking cows is the quickness with which the milking is done. Fast milking has been found to give better results than slow milking.

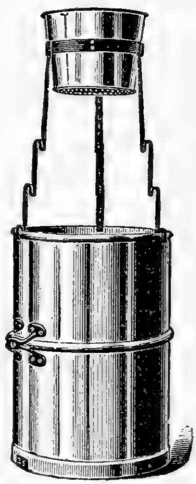
THE MILK CANS into which the milk is strained must not be left standing in the stable where the cows are being milked. The stable odor or dust may contaminate the milk unless it is at once taken to another room or into the pure outside air where the straining into cans may be done.



CURTIS WIRE-CLOTH MILK STRAINER.

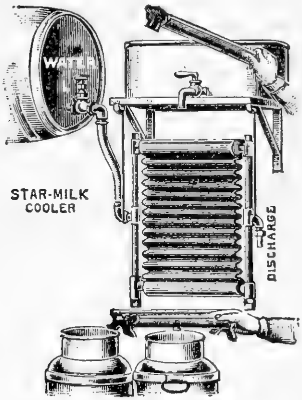
HEALTH OF THE COWS. Milk from a cow having any kind of disease should not be used for human food. Sore teats, a caked udder or anything that causes bloody milk must be cured before the milk is usable. milk from healthy cows ought not to be used until six days after calving; some authorities also refuse to accept milk for thirty days before calving or when a cow gives less than six pounds per day.

INJURIOUS FOOD. Decayed or musty grain or feed is unfit food for milch cows as it has an injurious effect on the products made from it as in fact on the cow herself. Musty hay and decayed silage are as bad as musty grain; certain kinds of roots, rape, etc., should only be fed in such a way as to leave the milk free from taint or odor, which can be done by feeding these foods directly after milking; wet brewers' grains must be fed with caution; on account of the strong odor from this by-product and similar feeds, the milk will be contaminated unless removed at once from the stables after milking. Musty litter or bedding should be avoided as the dust from it will get into the milk in spite of all care.



MILK AERATOR
Mounted on Factory Can.

PURE WATER. This is as essential for cows as it is for humanity, and nothing but deep well—spring—or pure running water is fit for cows. Pond holes or stagnant water must be fenced in so that the cows will not drink from them; serious defects in milk, butter and cheese have been traced to a pond hole or to swampy land through which cows had walked. The mud and dirt from such places clings to the legs, body and udder of the cow and if these are not groomed the dirt gets into the milk and contaminates both it and the products made therefrom. Watering troughs must be cleaned regularly and one found to contain rusty iron or decayed wood ought to be repaired or replaced. Fresh water should be pumped daily if the cows are watered at the stable. Two water tanks are sometimes provided at dairy farms and a milk-house built over one of them. The water is pumped by a wind-mill through the milk-house tank containing the cans of milk and then passes on to the stock watering tank, This makes a very satisfactory arrangement for keeping the milk cool when the wind blows, but when there is no wind the water must be pumped some other way. Such a milk-house should be well ventilated and kept clean. The water tanks ought to be regularly scrubbed so that the cows may always be supplied with an abundance of pure, clean water.



STAR MILK COOLING SYSTEM.

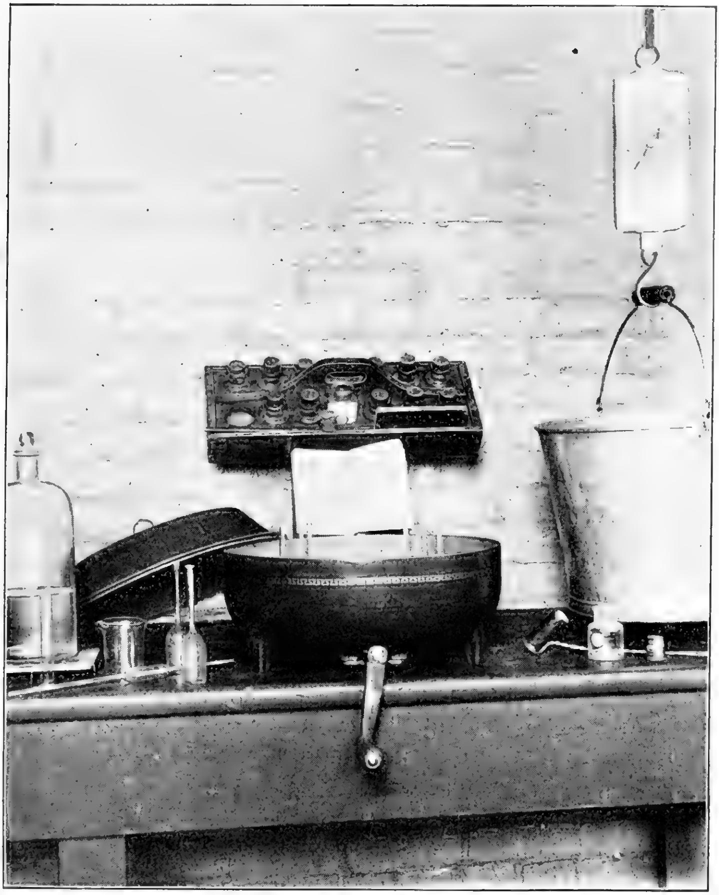
Straining Milk. If a covered milking pail has not been used, the milk must be poured through a cloth strainer made of cotton flannel or of four thicknesses of cheese cloth. A wire gauze strainer is not sufficient, and when the milk is dirty or a large amount of it is strained, the cloth should be changed as soon as any accumulation of dirt from the milk is noticed on the strainer. Milk should never be strained in the stable.


CHEESE FACTORY CAN.

Aeration of Milk. Milk is benefited more from mixing pure air with it as soon as possible after milking than from almost any other method of handling. The flavor is especially improved by aeration, and when the milk is also suddenly cooled at this time it will keep sweet much longer than milk which has not received this treatment.

A great many good milk aerators are on the market. A certain amount of aeration may be obtained by dipping the milk with a long-handled dipper, lifting it high in the air and pouring it into the can again. This dipping should be repeated occasionally for an hour or more after milking, but as it is not so thorough and takes more time than pouring the milk over an aerator and cooler as soon as each cow is milked, an aerator should be bought and used.

Cooling Milk. Immediately after milking the temperature of milk ought to be reduced to forty or fifty degrees either by pouring it in a thin



MILK TESTING OUTFIT.
Milk Tester, Weighing Scales, Sample Bottles and Supplies Needed for Testing Cows.

layer over a smooth, metal surface which is kept cold with water, ice or brine, or by setting the cans of milk into cold water and stirring frequently to hasten the cooling. The quicker this is done the better, as the sudden chilling of milk is very beneficial; it improves the flavor and hastens the separation of cream.

There are many good milk coolers on the market and in making a selection the purchaser should be sure to get one that has capacity enough to thoroughly and quickly chill all the milk run over it. The cooler should never be crowded with too much milk.

Keep Night and Morning's Milk Separate. Never mix warm milk with cold milk as this will spoil both. The morning and night's milk should be kept in separate cans until thoroughly cold. The cans of milk must be loosely covered and kept in a perfectly clean place protected from dirt and bad odors. In winter the milk should not be allowed to freeze and in summer it must be kept sweet without the use of any kind of preservative. In some states there are strict laws against the use of preservatives in milk.

Delivering the Milk. During transportation the cans of milk must be filled to prevent churning and must be closed with tightly fitting covers and jackets or a canvas placed over them as a protection from dust, mud or rain. These coverings will aid in keeping the milk cool in extremely hot weather and in winter they may prevent the milk from freezing.

Milk ought to be below sixty degrees Fahenheit when delivered to a factory or to any other buyer, and the nearer fifty degrees, the better for the milk, as this indicates that it has been thoroughly cooled at the farm.

Buttermilk should not be returned in the sweet milk cans as the sour taint is very hard to remove from them.

Washing Cans, Pails, Strainer Cloths and Tinware. All efforts to produce clean milk that will keep sweet for a reasonable length of time are useless if the pails, cans, etc., are not faithfully washed and scalded every day. After emptying the milk the cans should be rinsed with cold water, then scrubbed with frequent changes of warm water, using a brush to clean all the seams and cracks inside and outside the cans; they should then be rinsed with scalding hot water and set to dry in the sun, if possible, but protected from dust. Tinware should not be wiped dry with a cloth, but scalded with boiling hot water. All the joints and corners in pails and cans should be filled smooth with solder, as before stated, and those having rusty iron spots ought not to be used as these places may cause taints in the milk. One of the hardest taints to remove from cans is that caused by allowing milk to sour therein. The cans should be emptied and cleaned as soon as they are returned to the farm, and left to dry and air in some clean place.

Inspection. When a can of milk is emptied the last quart should be as free from sediment as the first. There will be no dirt in the bottom of cans if the milking has been cleanly and the cans have been protected from dust.

Both the odor and taste of milk should be pure and sweet when the can cover is first removed; perfectly sweet milk will have an acidity of less than two-tenths of one per cent. as is shown by the alkaline-tablet test.

Samples of milk for inspection or for testing should be taken immediately after it has been thoroughly mixed by pouring. A certain amount of cream will soon rise on milk, and a fair sample cannot be secured by dipping a small quantity from the top of a lot of milk after it has stood even for a few minutes.

If the test of one cow's milk is desired, samples of several milkings should be taken; there is often such a variation in richness between two

CREAMERY PATRON'S COW.

Gave 3,303 Pounds of Milk in a Year, Worth $26.86. Milk Tested 4.2 Per Cent Fat, Making 163 Pounds of Butter.

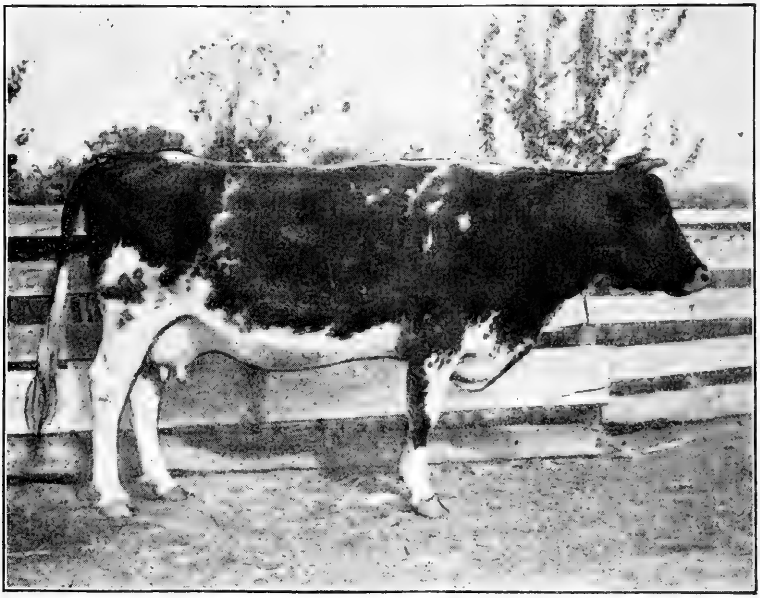
milkings of the same cow in one day that a very erroneous impression may be obtained from the test of one milking only. A fair sample cannot be taken by milking directly into a small bottle, because the milk of the same milking is not of uniform richness.

In taking samples of a cow's milk, she should be milked dry and all her milk thoroughly mixed by pouring from one pail to another before a sample for testing is taken from it. If the sample is to be sent to some place for testing, a little preservative should be added to the bottle and this filled with milk to the cork in order to prevent partial churning of the milk by the agitation during transportation.

THE PURITY OF MILK is entirely within the control of the milker. If the cows are healthy there is no excuse for dirty, tainted or sour milk. The defects most commonly met with in milk may be avoided by following the directions given in this brief outline.

TESTING COWS.

THE VALUE OF RECORDS obtained by weighing and testing the milk of each cow once a week for a year has been demonstrated many times.



CREAMERY PATRON'S COW.
Gave 6,938 Pounds of Milk in One Year, for Which the Creamery Paid $67.47. The Milk Tested 5.2 Per Cent Fat, Making 426 Pounds of Butter.

Such records have been made for over two hundred cows in some of the ninety-five patrons' herds supplying milk to the Wisconsin Dairy School. The farmers weighed the milk of each cow at the two milkings of one day, in some cases every week during a year, and sent small samples of each cow's milk to the creamery to be tested. From these tests and weights the total milk production of each cow was calculated. The results obtained showed that many cows were not giving anywhere near enough milk in a year to pay for the care and feed the farmers gave them. The cows were supported by the sweat of their owner's brow and paid him less than nothing for his labor.

Some idea of the difference in the value of patron's cows may be formed from the records of the two cows shown in the cuts. The feed and the labor of milking and caring for these two cows were about the same, but one cow produced over forty dollars worth more milk in a year than the other and the milk of the poorer cow did not amount to enough to pay for her feed.

In a herd of twelve cows tested for three years the milk of one cow was worth $110.00 more than the feed she ate, while that of five other cows added together only amounted to $114.00 more than their feed. One cow produced nearly as much profit as five cows in the same herd.

Farmers will shoot crows, woodchucks and other animals that eat their crops without paying for them and why should not the unprofitable cows be disposed of? A pair of scales with a Babcock test will show that some cows are more wasteful of a farmer's labor and crops than any other animal on the place.

Many farmers supply a creamery or a cheese factory with at least 100 pounds of milk per day and receive for their milk in the neighborhood of four hundred dollars a year. This sum surely warrants an investment of ten to fifteen dollars in a milk-tester and the time to use it not only on the cows but to detect any errors in testing that may be made at the factory.

"Every addition to true knowledge is an addition to human power."

Horace Mann.

"In every rank, or great or small,
'Tis industry supports us all."

—*Gay.*

NECESSITY OF MAKING GOOD BUTTER AND THE FARMER'S PART IN ITS PRODUCTION AND SALE.

BY JOSEPH KOLARIK, ASSOCIATE EDITOR CHICAGO DAIRY PRODUCE.

Chicago.

To the farmer who has had the opportunity of coming into direct contact with the consumer of butter, as one who is selling butter to such consumer, little need be said on the first half of this subject—the necessity of making that butter GOOD.

On the making of good butter, good all over, good all through, and good all around, depends the prosperity, the very income, of the farmer who keeps cows for the production of milk. The consumer of butter, who is the man out of whose pocket comes the price that means the milk producer's profit, has the right to dictate to the maker of butter what kind of butter he shall make for him. The farmer has been too slow to realize this. The farmer has gone right ahead and made butter—good butter, indifferent butter, and poor butter—as if on the assumption that the consumer had no choice in the matter and would have to take what there was to be had. But as population has grown and consumers of butter multiplied, the demand for good butter became more and more insistent, and to-day is so markedly earnest that the effort of every farmer, of every creameryman, and every buttermaker, must be strongly enlisted in producing the only grade of creamery butter now wanted—the premium-taking Fancy Extra.

It is this insistent demand for a uniform quality of fine butter that is the foundation of our present day creamery system, as it is only through the creameries that sufficient butter of desired flavor and uniformity and quantity can be produced. There is, to be sure, a great quantity of good butter churned in the farm dairies—millions of pounds of it—that finds a more or less satisfactory market and a more or less satisfied consumer. But wherever there is a good creamery wherein is employed a good buttermaker, the producer of milk will without the least question of doubt serve his own interests in the highest and fullest degree only when he becomes a regular patron of that creamery.

"Good butter—send us good butter," is the demand from the market to the butter producer. The necessity of making good butter is seen in the satisfaction good butter gives the guest at the table; it is seen in that relishable wholesomeness of cooked food that only good butter can impart to it; it is noted again in the request of the housewife shopping at the store and invariably asking for "the best" quality. It is manifest again in the very critical examination the grocer gives the butter when buying it in the store of the commission merchant; from the merchant the call goes to the buttermaker—"good butter," "good butter."

No greater necessity in the dairy world to-day than that of making GOOD BUTTER!

So great is the necessity for good butter that the national government has established colleges where students may be taught those things that are needful to its production. So great is the necessity for good butter that no one is now considered competent to make butter in a creamery until he has mastered the teachings at a dairy school and served an apprenticeship of one to two years in a creamery under the daily tutoring of an expert buttermaker, himself a trained and experienced operator. So great is the necessity of making only good butter that out of the need of the hour has sprung the organization of dairymen's and buttermakers' associations in every state where butter is considerably produced—their object being to improve that knowledge among their members that will enable them to make this good butter so greatly demanded.

Creamery buttermakers have ever been sensitive to the pulse of the market and strenuously responsive to its every demand for improvement. Creamerymen have installed new apparatus for the improvement of their product and again and again replaced this after a time with later designs of apparatus that gave promise of further improvement. New ways of creaming have superseded the old, new ways of cream handling have displaced old methods, new ways of churning and working butter are now standard—all, every bit of it, the result of the imperative necessity of making good butter.

What more can the creameryman or the creamery buttermaker do?

Let us ask—has the farmer, the creamery patron, advanced in his calling to the same extent as has the creamery buttermaker?

We have the word of no less an authority than Hon. W. D. Hoard, of Wisconsin, on this question, who, after the most careful canvass made from farm to farm by trusted correspondents in creamery districts in several states in the summer of 1901, spoke at a state dairymen's convention as follows:

"I here venture the assertion, and it is founded on evidence of the most convincing kind, that the average patron of the creamery is but little, if any, better educated as a dairyman than he was twenty-five years ago, and that he is producing milk today from as poor cows, and just as expensively, as was the case twenty-five years ago. To me it is astonishing that the influences of progress and intelligence should affect all other branches of this great industry to their manifest improvement, and still the farmer remains, with but few exceptions, right where he was a quarter of a century ago."

What is it has caused this severe criticism of "the average" creamery patron? In what way has the creamery patron been remiss in his calling?

The inquiry had developed the fact that hardly any out of a hundred patrons knew what their cows were returning in product above the cost of their keep until the correspondent got what facts he could from the patron and from the creamery books and figured it out. Very few knew except in the most general way which cows were yielding a profit and which were not. A very few fed a balanced ration suited to the purpose of milk production, and most were keeping cows of a kind that even good feeding and care would not make profitable milk producers. The general average production of the dairy cows of these one hundred patrons was under 140 pounds butter per cow per year, while in dairy districts, such as in Jefferson County, Wisconsin, and elsewhere, where dairying is a leading feature of farm work, the butter product averages 240 pounds per cow per year—a clear gain of 100 pounds and more of butter through the exercise of thought in both selection of cows and the special purpose of milk production in view in their care and feed.

This then, is the farmer's part in the production of good butter: First, the having on his farm a sufficient number of cows to make it well worth while to provide for them the kind of feeds and give them the care they should have.

Second, the cows must be of a recognized milk producing type—a cow that does not yield 200 pounds butterfat during one year's period of lactation can seldom be kept at a profit. The best dairy herds now produce over 300 pounds per cow per year, and already some have set even a much higher mark.

Third, the cows must have an ample supply of nourishing and palatable food, summer and winter, and of course plenty of pure water. For a palatable and nourishing food for winter use there is nothing better than corn ensilage.

Fourth, and fully as important as any other of the many requirements in profitable dairy farming, is the care given the milk.

Good milk—good buttermaker—good butter. Here is a trinity that stands all powerful between the dairy farmer and his profit—the willing dollars of the butter consumer. Good butter—good buttermaker—good milk—a trinity one and inseparable, and the farmer is the beginning and the ending. His part it is to furnish the good milk—the alpha and omega of getting a fancy butter product, which again means a good market demand and price and a goodly share of honest profit dollars in the pockets of the owners of the cows.

The necessity for producing good milk cannot too strongly be impressed on all who have the handling of it. Though many suggestions may be found of great practical utility by the patron, such as prompt removal from the milking stalls, rapid cooling in tanks of water, to drive out quickly the animal heat, clean washing of cans followed by exposure of them to sun and air, etc., one general law, well observed, will suffice.

Aim to deliver the milk at the weigh-room of the creamery as clean, as pure and as sweet as though every drop of it was to be used on your own table!

Can dirty milk, unstrained, turning sour, smothered, tainted from stable exposure or otherwise, or carried in anything but sweet smelling cans ever reach the weighcan of the creamery under that rule?

Whether operated by an association of farmer shareholders, by a stock company, by a corporation located in a distant city or by a locally resident owner, the creamery is ever a co-operative institution. No one patron can deliver milk below grade and flatter himself that because it passed the receiver, he is thereby the gainer. 'Tis true he has gained temporarily what is lost by his more careful neighbors, for he has lowered the quality of their product to his own level, but it is not written that a man shall continue to prosper at the expense of others indefinitely.

Let every milk can stand on its own bottom. Let every patron feel that in the chain of association for the production of good butter, he forms no weak link, but equally with his neighbors stands steadfast and true, giving of his best and asking equal worth of every other. The organization is not perfect if any part is weak or wanting, and thus the milk producer must do his full share toward the attainment of that perfect result—a market for the highest grade butter through a well managed creamery well patronized by well satisfied intelligent patrons.

Do what the buttermaker may, the purity of the butter will never rise above the purity of its source, therefore the better the milk the better the butter. Every hour every minute, the milk is exposed in stables, barns or other surroundings laden with flavor destroying taints, or exposed at temperatures above sixty degrees, its quality is impaired for the making of the best grade of butter. Every time it is closed tightly into the creamery can while warm, or the warm morning's milking is poured into the cold milk of the evening before, it means a loss in butter quality because of "smothered" milk. Every exposure of the cans to the hot sun of summer while the milk is on the way to the creamery means a lessening of that fine delicate taste that is to butter what the fine edge produced only by honing is to the axe or other sharp cutting tool. It is not in nature that the stream shall rise above its source—neither may it be that butter shall be better than the milk it is made from.

Something can be done, it is true, in the creamery to overcome previous neglect of the milk, through the cleaning process of centrifugal cream separation and through the use of heat to stop further deterioration, as cooking will check for a time the spoiling of food. But neither of these processes will restore a tenth part of that fine flavor the milk has lost through neglect of the simplest precautions against absorption of taints and the keeping of it at a properly low temperature.

There can be no good butter if the farmer has not done his part to produce good milk, and if the buttermaker has not done his part to handle that milk in a skillful manner to concentrate its good qualities into the finished product.

What is the farmer's part in the sale of good butter, now that he has done his part in its production?

The sale of good butter would be a simple matter if there was not a counterfeit of butter which is cheaply made and which is sold by hundreds of so called "butter" dealers as and in place of pure butter. This thing of selling this counterfeit of butter—oleomargarine—is easily done by those who prefer the ten cents to fifteen cents a pound profit on each pound to their business honor, because in the great majority of cases the purchaser is not well qualified to discriminate between what is pure butter and what is the counterfeit, and so gives his full confidence to the dealer—who thinks little or nothing of so grossly abusing this confidence to serve his own base purpose.

It is difficult, indeed, for the farmer, accustomed as he is to trading mostly with life time friends and neighbors, to realize how a dealer can so grossly abuse his customers' confidences and so guiltily take from them the value of a good article while giving to them a grossly cheap counterfeit which they would promptly refuse to buy did they but know how they were being cheated. To the honest minded person this is a thing quite inexplicable; and it only can be explained on the ground that substitution, of whatever nature, usually means the replacing a good article with an inferior one, and where the inferior one is difficult of detection—well, the morals of some will not stand against it;—and this is most painfully the case with the sale of oleomargarine,—about nine-tenths of all that is produced being sold to consumers as pure butter or used by them as pure butter at hotels and restaurants.

The production of oleomargarine has in the past two years reached an amount equal to the amount of creamery butter made in both Iowa and Minnesota, or almost any two of the great butter producing states in the Union. If made and sold as oleomargarine, if offered to the butter buyer as a cheap SUBSTITUTE for butter, no man could or would object, for that would be a legitimate business—the buyer and user having the choice of "taking or leaving" it. But when oleomargarine is made a COUNTERFEIT of butter, and is given to buyers and users who ask for butter and think they are getting butter, paying therefor the price of good butter and NOT the price of a CHEAP SUBSTITUTE, then the industry is an illegitimate, a fraudulent one, and the people, through their voice in the national government, have the right not simply to ASK—but to DEMAND—that the making of oleomargarine yellow, AS A COUNTERFEIT OF PURE BUTTER, shall be stopped.

What is the farmer's part in the sale of good butter?

His part is to use his vote and personal influence in the legislation of this country as to forever make impossible the counterfeiting of pure butter made from pure milk either on the farm or in the creamery.

Products made in a manner that will proclaim their identity everywhere are legitimate articles of commerce, but products that are made to COUNTERFEIT others have no right to exist, and oleomargarine colored a butter yellow is such a product. It is a counterfeit just as much as money not made in a government mint is counterfeit, and farmers have the right to demand its proper suppression—leaving the way open for it to be made a product distinctive in itself so all may easily know which they are offered—oleomargarine or pure butter—either at the store or wherever a meal may be served.

The farmer, whether private dairyman or creamery patron, thus is the central figure in the production of good butter, and his influence extends through to its final sale. He is but one of the many engaged in the work of making and selling butter, but his influence, his work, his personality, dominates all, and the work is not well done or complete without his best efforts have helped to make it so.

It is not an easy task—this thing of dairying. It is not an easy thing to handle a herd of cows to get the right amount of milk from each, and it is not an easy thing to care for this milk as it should be cared for—as it must be cared for—if good butter is to be made. But the farmer-dairyman has not all the hard work to do, as the writer has fully realized by actual work on the farm, by work as a buttermaker in the creamery, and by active association with the commission dealer and the butter retailer.

Each in his occupation must use brains, employ well his time, direct his business intelligently, and work with energy and persistence if he shall gain success.

If the farmer shall do this same way, who is there to say that his will not be the greater share in so much of that material wealth, peace, prosperity, and that homely happiness in life and contentment in occupation as those may expect who are earnestly associated in the making and marketing of GOOD BUTTER?

MILK.

What a wonderful thing is milk! Born of the mother-love, it nourishes the young of all warm blooded creatures whose term of life would quickly end were it wanting. From the lowliest mammal to noble man, made in Godlike image, milk is the flesh builder, the nervepower, the very essence of life. It is the one product all indispensable, universal. The cow, man's queenly servant, sacred in history, ever needful, deserving of the most kindly regard of man for animal—because giver of that most intricate of life's mysteries, that greatest of life's necessities—MILK!

Symbol of purity—milk. Its whiteness the mirror of all that is good and pure and true. Its composition the illustration of the complexity of life governed by One, Ruler of all destiny. Its universality the illustration of that God spirit who has made a world-wide brotherhood of mankind and given man dominion of all animals, and of these none greater in her use to man than the cow.

Comprising all the elements of life, as does no other food, no other food deserves man's attention as does milk.

In its natural state it goes to the tables of the rich as of the poor. Itself the most perfect and wholesome drink, it combines to improve others; it is used as a relish with some foods; it is combined with other foods in cooking. As butter it serves a multitude of purposes none other product will do. The most delicate are better for its use—the strongest grow in strength because of its power. No corner of the world where a dairy product has not penetrated—no nook in the vast universe where dairy products as foods for man have not been appreciated. In the frozen north, the torrid equatorial clime, the rugged mountain regions, the sunburned deserts—in all climes, in all countries, the worth and need of milk and its products as foods has been acknowledged by man.

Nor does the usefulness of milk end here. Milk is a most potent medicine. As an antidote for poisons its use is well recognized. Milk makes a most powerful poultice. Pure milk gives health and life to the consumptive; it brings the glow of health to the invalid. In the mechanic arts milk is again indispensable. A glaze made of milk is used to coat the finest book paper. A most durable and fire-proof paint is made from milk. Sugar from milk has many medicinal uses. The very buttons on one's coat can be made from the casein of milk. Almost limitless in its uses, and constantly furnishing new surprises as advance is made by scientists in its study, is milk.

To the true dairyman the worth of milk as a human food in its several forms will ever be a silent, resistless appeal to treat his cows kindly, keep them comfortable and contented, and especially to let no untidiness in the handling of milk rob it of its fresh purity and wholesomeness.

The heart-throb of past ages, the animate life of the present, the dependence of the future—Milk. In its production and in the making from it those articles of food so necessary to the welfare of man, there is not possible to hold too high an ideal, or make unworthy use of one's best talents, or labor to a more noble purpose.

"Let us have faith that right makes might; and in that faith let us dare to do our duty as we understand it."—Abraham Lincoln.

VARIATION IN TESTS; COMPOSITION OF MILK AS OBSERVED AT THE MODEL DAIRY AT THE PAN-AMERICAN EXPOSITION AT BUFFALO, N. Y.

BY DE WITT GOODRICH, BUTTERMAKER AND DAIRY INSTRUCTOR; OFFICIAL MILK TESTER AT PAN-AMERICAN MODEL DAIRY.

Belvidere, Ill.

As one branch of the Dairy and Live Stock department of the Pan-American Exposition, a so-called "model dairy" was planned by Superintendent Converse to be installed and operated at an estimated cost of $6,000.00.

The impression in some way gained pretty wide circulation, in the United States at least, that the model dairy at Buffalo was to be conducted on broad educational lines, demonstrating to the visiting public the most modern and approved methods of handling and feeding dairy cows as well as handling the product; in fact, that it was to be a show dairy more than a contest of the several breeds of cattle invited to participate. However, when it came time to make the final arrangements and rules for the feeding and crediting of products of the several breeds, the show dairy was given secondary consideration in the all-absorbing question of how to properly and fairly handle the feed and product of ten separate breeds of cows in a six months' contest.

Considering the small sum set aside for constructing, equipping and maintaining such a dairy, it goes without saying that a model dairy which would meet the approval of the advocate of certified milk dairies and admirer of porcelain lined and nickle-plated dairy-rooms would have been an impossibility. If funds *had* been provided for such a demonstration alone, it would have been of infinitely less value to the thousands of practical dairy farmers who had put before them for study every week (in some one of the several hundred papers publishing them) the weekly records of the fifty cows in the Pan-American dairy test. In addition to the practical results attained through the agricultural press, the dairy barn was every day thronged with curious and interested visitors studying the animals themselves in connection with their records, weekly renewed and hung above them. New York City and Buffalo people who scarcely knew how milk is obtained saw cows milked, fed and groomed for the first time, and learned to distinguish Jerseys, Guernseys, Brown Swiss and the other breeds represented.

The expense of conducting this test was as follows: Salaries, $7,321.25; feed, $3,177.77; shavings (for bedding), $772.85; ice, $338.69; chemical analysis, $226.00; supplies, etc., $182.17; total, $12,018.73. Receipts for products $8,175.64. Net expense to exposition, exclusive of building, $3,843.11.

Ten breeds entered the test with five cows each as follows: Shorthorn, Holstein, Ayrshire, Jersey, French Canadian, Guernsey, Brown Swiss, Red-Polled, Polled-Jersey and Dutch Belted; the first five breeds named being furnished by Canada and the last five by the United States.

The breeds were represented by A. W. Smith, G. W. Clemons, Robt. Robertson, Prof. Day, Dr. Couture, W. H. Caldwell, Mr. Inman, V. T. Hills, A. T. Mohr and J. McInnes, the representatives coming in same order as breeds named above.

These gentlemen, together with an advisory committee, composed of Maj. Henry E. Alvord (Dairy Division U. S. Dept. Agl.), Hon. E. W. Hobson, of Canada, and Dr. W. H. Jordan and J. H. Grisdall, representing Association of American and Dominion Experiment Stations respectively, met and formulated the rules which governed the test.

Four prizes were to be awarded to herds excelling in the four following points:

1st. Greatest net profit on estimated butter at 25c. per lb., 85 lbs. butterfat in milk to represent 100 lbs. of butter (equal to 17½ per cent. overrun).

2nd. Greatest net profit on churned butter at 25c. per lb.

3rd. Greatest net profit on total milk solids at 9c. per lb.

4th. Greatest net profit on total milk solids at 9c. per lb. plus gain in live weight at 3c. per lb.

After considering the average prices of feed throughout the United States and Canada for the last five years, the committee arrived at the following schedule of prices to be charged in the test:

Clover hay, $7.00; ensilage, $2.00; green feed, $1.75; bran, $15.00; corn meal and gluten meal, $16.00; ground oats, $19.00; oil meal, cotton-seed meal and pea-meal, $25.00 per ton.

Each herd of five cows was fed, milked and cared for by a man chosen and employed by the association representing the breed, but the exposition paid these men additional salaries and they were in a measure under control of the superintendent.

Each herdsman (sometimes with advice or suggestions from owners of the cows) made daily requisitions for the ration for each of his five cows, choosing such feeds, within the above list, and in such quantity as he deemed best, the feed for all being weighed and charged by careful and responsible men employed by the exposition.

The milk from each cow was brought to the dairy room as soon as drawn and here weighed and recorded and two samples taken for testing. One taken with a milk-thief (a copper tube of about ⅜-inch bore) was added to a composite jar provided for each cow, and the other, taken with a small dipper, was put in another set of pint jars for testing with the lactometer.

Each mess of milk was poured, after weighing, into a common shotgun or setting can and at once sampled; the milk-thief thus taking a proportional amount of each mess to be added to the composite sample.

The composite samples, provided with a little corrosive sublimate, were tested with the Babcock test each week on the same day, and from these tests and total milk yield for the week, the pounds of butter fat and value of same for each cow was computed and value of feed consumed by each deducted. Thus the profit on butterfat or "estimated butter" for each cow and herd was determined for each week separately.

The samples taken for lactometer testing were tested daily and the readings for the week for each cow averaged. To the average lactometer reading and composite Babcock test of each cow a formula was applied which gave the per cent. of total solids in her milk for the week. Thus the data for the third award (profit on total solids) was supplied from week to week and a separate record made for each animal in total solids as well as in butterfat.

Total solids include all constituents of the milk excepting water and represent its full food value. In average milk the solids are divided about as follows: Fat 3.5, casein and albumen 3.4, milk sugar 5.0 and ash .7 per cent., total. 12.6 per cent.

The committee who fixed the price of 9c. per lb. for total solids, evidently assumed each element of solids to be of equal nutritive value for human food and based their calculation on the average price and approximate composition of milk sold in New York City.

The award of greatest profit on "churned butter" was a sort of conciliatory measure, probably intended to satisfy that faction of the Jersey breeders who contend that no records excepting those of actually churned butter signify anything.

Owing to the impracticability of churning all the milk from each of the ten breeds separately, the rules were so modified as to provide for the separating and churning of one day's milk from each breed each week. The yield of butter per 100 pounds for the single day's milk churned to be applied to the total yield of milk for the week and this estimate called "churned butter."

The test of a herd's milk on the day it was churned frequently varied .2 to .3 per cent. from the average per cent. of fat in the herds' milk for the entire week, so that with perfect work in separating and churning, the so-called churned butter for the week would fall short or over-run the estimated butter, which here represented the *true* butter producing value of the herd.

With this way of *calculating* instead of *churning* churned butter there is but little satisfaction in trying to compare the yield of churned butter with butterfat; but considering that in a series of twenty-six weeks and as many churnings of each breed, the law of averages should pretty nearly balance up the errors of such a method, when we find that for the whole period the churned butter has fallen short of the estimated butter (in every breed but one) from 19 to 71 lbs., or from 1.3 to 4.7 per cent., the inference is that 85 lbs. of fat will not make 100 lbs. of butter under these conditions.

Taking the whole amount of churned butter, arrived at as above described, we find that it took very close to 87 lbs. of fat in milk to make 100 lbs. of butter, or that it gave a trifle over 15 per cent. over-run.

The butter was made by an expert dairy buttermaker from New York State, and I think worked a little dryer than most western creameries work it.

The weighing and testing of all milk which formed the basis of production for each cow and herd, was done by two experienced and responsible men. One from Canada, Mr. James Stonehouse, Agricultural College Guelph, Ont., and the other from the United States (the writer).

The Composite method of Testing.

As a check on any possible tampering with composite samples, and in order to obtain further data on the question of composite vs. daily test, these men in charge of the testing, as opportunity afforded, tested samples of each milking for an entire week corresponding with the composite test week.

One breed was run at a time in this way, but in all, seven breeds were tested, through a period covering all kinds of weather, and together furnish a vast amount of evidence in favor of the composite method of testing individual cows and herds. In addition to this, it serves to demonstrate how widely many cows milk will vary in richness from one milking and one day to another. It served to demonstrate in what way sexual heat, sickness, excessively hot weather and other temporary disturbances affect the test.

In no instance did the composite test vary more than .1 per cent. from the per cent. fat as determined from the pounds of fat yielded at each milking separately. Where the cows were milked three times a day, as most of them were throughout the test, 21 separate samples were tested and the fat figured out to compare with the composite test for the week.

A comparison of average per cent. of fat in the week's milk of the herds of five cows, with the test of the same herd for one full day of the same week, shows that it is often misleading to take a single day's sample as an indication of the test of the herd for a week. See following examples taken from Pan-American records. For the week ending October 1st the per cent. of fat in the French-Canadian herd was 4.16 but the mixed milk of the herd tested 5.1 for one day of the same week.

In like manner the difference in the Polled-Jersey herd for the week ending June 11 was .48 per cent. and for another week .41 per cent. In June the Ayrshires had a difference in one week of .45 per cent. and in September and October .37 and .39 per cent. Other breeds varied about the same.

I include herewith some tables of the separate milkings and tests of same in comparison with composite tests for same period.

The Brown Swiss and Dutch Belted cows which were tested in like manner showed less variation than the breeds given here in detail.

A summary only of the Holstein tests for one week is given first:

HOLSTEIN

	Range in per cent. fat.	Average.	Composite test.	Total difference in butterfat for 7 days.
Cow No. 1	2.6—3.6	3.01	3.10	.266
" " 2	2.2—4.0	3.026	3.10	.211
" " 3	2.6—3.2	2.95	3.05	.250
" " 4	2.1—3.8	3.26	3.25	.033
" " 5	2.9—4.5	3.31	3.30	.044

TESTS OF EACH MILKING FOR THE JERSEY COWS FOR ONE WEEK COMPARED WITH COMPOSITE FOR SAME PERIOD.

GIPSY, OF SPRUCE GROVE.

Date.	Lbs. milk.	Test.	Lbs. fat.
Aug. 7—noon	9.1	5.2	.4732
" —night	9.6	5.1	.4896
" 8—morning	10.4	4.1	.4264
—noon	10.4	5.1	.5304
—night	9.1	4.8	.4368
" 9—morning	10.8	3.8	.4104
—noon	10.	4.8	.4800
—night	9.	4.	.3600
" 10—morning	11.2	4.	.4480
—noon	9.4	4.6	.4324
—night	8.6	4.3	.3698
" 11—morning	9.6	3.7	.3552
—noon	9.9	5.6	.5544
—night	8.2	5.3	.4346
" 12—morning	10.3	3.6	.3708
—noon	10.3	5.9	.6077
—night	8.4	5.2	.4368
" 13—morning	10.8	4.1	.4428
—noon	9.	4.8	.4320
—night	8.1	3.9	.3159
" 14—morning	10.7	3.9	.4173
Totals	202.9		9.2245
Composite test and fat from same		4.5	9.1305
Test computed from daily weight and tests		4.541	

PRIMROSE.

Date.	Lbs. milk.	Test.	Lbs. fat.
Aug. 7—noon	8.1	6.9	.5589
—night	7.3	6.	.4380
" 8—morning	9.9	5.8	.5742
—noon	8.8	6.5	.5720
—night	7.3	5.4	.3942
" 9—morning	10.1	5.3	.5353
—noon	8.4	6.5	.5460
—night	6.7	5.	.3350
" 10—morning	10.	5.4	.5400
—noon	8.3	7.	.5810
—night	8.1	6.3	.5103
" 11—morning	8.8	5.6	.4928
—noon	8.	6.2	.4960
—night	6.	4.6	.2760
" 12—morning	10.8	6.5	.7020
—noon	7.4	6.9	.5106
—night	7.6	6.4	.4864
" 13—morning	9.	6.2	.5580
—noon	4.8	4.1	.1968
—night	7.	4.	.2800
" 14—morning	12.3	7.4	.9102
Totals	174.7		10.4937
Test computed from daily weight and tests		6.061	
Composite test and fat from same		6.1	10.656

QUEEN MAY.

Date.	Lbs. milk.	Test.	Lbs. fat.
Aug. 7—noon	9.4	6.	.5640
—night	8.7	4.7	.4089
" 8—morning	10.9	4.5	.4905
—noon	9.5	5.6	.5320
—night	8.4	4.7	.3948
" 9—morning	11.1	4.2	.4662
—noon	8.8	4.7	.4136
—night	9.3	4.8	.4464
" 10—morning	10.5	4.3	.4515
—noon	9.	4.6	.4140
—night	9.4	4.8	.4512
" 11—morning	11.1	4.5	.4995
—noon	9.	5.4	.4860
—night	9.1	5.2	.4732
" 12—morning	11.3	4.6	.5198
—noon	9.6	5.4	.5184
—night	8.6	4.8	.4128
" 13—morning	10.8	4.5	.4860
—noon	9.3	5.3	.4929
—night	9.	4.8	.4320
" 14—morning	10.9	4.4	.4796
Totals	203.7		9.8333
Test computed from daily weight and tests		4.822	
Composite test and fat from same		4.85	9.8794

REXINA.

Date.		Lbs. milk.	Test.	Lbs. fat.
Aug.	7—noon	10.6	5.6	.5936
	—night	10.	4.9	.4900
"	8—morning	11.4	3.7	.4218
	—noon	10.	5.6	.5600
	—night	10.3	5.2	.5356
"	9—morning	8.	2.5	.2000
	—noon	9.5	4.7	.4465
	—night	8.4	3.8	.3192
"	10—morning	11.4	2.9	.3306
	—noon	8.9	3.5	.3115
	—night	9.1	3.5	.3185
"	11—morning	10.9	2.9	.3161
	—noon	10.6	5.9	.6254
	—night	8.7	5.2	.4524
"	12—morning	11.4	3.7	.4218
	—noon	9.7	4.6	.4462
	—night	2.6	2.8	.0728
"	13—morning	16.6	3.8	.6308
	—noon	10.7	7.5	.8025
	—night	9.3	4.8	.4464
"	14—morning	10.9	3.	.3270
Totals		209.0		9.0687
Test computed from daily weight and tests			4.32	
Composite test and fat from same			4.4—9.196	

MOSSY, OF H.

Date.		Lbs. milk.	Test.	Lbs. fat.
Aug.	7—noon	10.1	5.2	.5252
	—night	9.4	4.2	.3948
"	8—morning	11.7	3.8	.4446
	—noon	10.2	4.9	.4998
	—night	9.9	5.	.4950
"	9—morning	10.9	2.6	.2834
	—noon	11.1	5.	.5550
	—night	9.1	4.1	.3731
"	10—morning	10.8	3.1	.3348
	—noon	10.6	5.4	.5724
	—night	8.6	4.2	.3612
"	11—morning	10.5	2.8	.2940
	—noon	9.2	4.2	.3864
	—night	9.4	5.	.4700
"	12—morning	10.2	3.4	.3468
	—noon	9.4	5.2	.4888
	—night	8.7	4.1	.3567
"	13—morning	11.1	4.1	.4551
	—noon	10.6	7.3	.7738
	—night	9.4	4.8	.4512
"	14—morning	10.6	3.8	.4028
Totals		211.5		9.2649
Test computed from daily weight and tests			4.38	
Composite test and fat from same			4.4—9.306	

TEST OF EACH MILKING OF AYRSHIRE COWS COMPARED WITH COMPOSITE METHOD FOR SAME PERIOD.

Date.	KIRSTY WALLACE.	Lbs. milk.	Test.	Lbs. fat.
July	31—noon	9.2	3.9	.3588
	—night	9.9	3.5	.3465
Aug.	1—morning	12.9	3.6	.4644
	—noon	10.6	4.	.4240
	—night	10.	3.9	.3900
"	2—morning	12.4	3.7	.4588
	—noon	11.1	4.	.4440
	—night	10.7	3.8	.4066
"	3—morning	14.	3.6	.5040
	—noon	11.1	4.4	.4884
	—night	10.7	3.7	.3959
"	4—morning	14.	3.4	.4760
	—noon	11.1	4.	.4440
	—night	10.7	3.8	.4066
"	5—morning	13.4	3.3	.4422
	—noon	12.4	4.1	.5084
	—night	11.1	4.	.4440
"	6—morning	13.3	3.8	.5054
	—noon	11.	3.9	.4290
	—night	10.3	3.2	.3296
"	7—morning	13.6	3.2	.4352
	Totals	243.5		9.1018
	Test computed from daily weight and tests		3.73	
	Composite test and fat from same		3.7	—9.0095

Date.	LADY FLORA.	Lbs. milk.	Test.	Lbs. fat.
July	31—noon	8.6	3.7	.3182
	—night	8.4	3.6	.3024
Aug.	1—morning	9.6	3.4	.3264
	—noon	7.3	4.3	.3139
	—night	8.1	3.6	.2916
"	2—morning	10.9	3.3	.3597
	—noon	8.9	3.4	.3026
	—night	9.6	3.4	.3264
"	3—morning	12.5	3.5	.4375
	—noon	9.7	3.7	.3589
	—night	10.2	3.1	.3162
"	4—morning	13.	3.2	.4160
	—noon	10.	3.5	.3500
	—night	10.6	3.2	.3392
"	5—morning	12.8	3.4	.4352
	—noon	10.7	3.3	.3531
	—night	11.1	3.3	.3663
"	6—morning	13.4	3.5	.4690
	—noon	10.7	3.2	.3424
	—night	10.6	2.9	.3074
"	7—morning	15.	3.4	.5100
	Totals	221.7		7.5424
	Test computed from daily weight and tests		3.4	
	Composite test and fat from same		3.4	—7.537

BETSY 1ST.

Date.	Lbs. milk.	Test.	Lbs. fat.
July 31—noon	10.2	4.4	.4488
—night	11.	3.6	.3960
Aug. 1—morning	13.7	3.4	.4658
—noon	11.1	3.7	.4107
—night	11.3	3.2	.3616
" 2—morning	14.8	3.4	.5032
—noon	11.	3.8	.4180
—night	11.7	3.6	.4212
" 3—morning	14.9	3.5	.5215
—noon	10.7	4.	.4280
—night	11.1	4.	.4440
" 4—morning	13.7	3.	.4110
—noon	10.6	3.7	.3922
—night	11.8	4.	.4720
" 5—morning	13.9	3.4	.4726
—noon	10.7	3.6	.3852
—night	11.7	3.8	.4446
" 6—morning	14.2	3.6	.5112
—noon	11.5	4.	.4600
—night	11.	3.2	.3520
" 7—morning	15.5	3.8	.5890
Totals	256.1		9.3086
Test computed from daily weight and tests		3.63	
Composite test and fat from same		3.65—9.34	

ALICE 2ND.

Date.	Lbs. milk.	Test.	Lbs. fat.
July 31—noon	8.3	5.1	.4233
—night	8.5	4.6	.3910
Aug. 1—morning	10.4	3.6	.3744
—noon	9.8	4.8	.4704
—night	8.7	4.	.3480
" 2—morning	11.4	3.6	.4104
—noon	10.3	5.1	.5253
—night	9.3	4.2	.3906
" 3—morning	12.2	3.8	.4636
—noon	9.4	4.5	.4230
—night	9.3	4.4	.4092
" 4—morning	11.8	3.5	.4130
—noon	9.8	4.5	.4410
—night	9.5	4.3	.4085
" 5—morning	11.7	3.7	.4329
—noon	9.9	3.8	.3762
—night	9.9	3.5	.3465
" 6—morning	13.1	3.9	.5109
—noon	10.8	4.6	.4968
—night	9.7	3.9	.3783
" 7—morning	13.	3.5	.4550
Totals	216.8		8.8883
Test computed from daily weight and tests		4.1	
Composite test and fat from same		4.05—8.78	

Date.	PEARL OF WOODSIDE.	Lbs. milk.	Test.	Lbs. fat.
July	31—noon	9.3	5.1	.4743
	—night	9.5	4.	.3800
Aug.	1—morning	12.1	3.4	.4114
	—noon	10.5	4.6	.4830
	—night	10.3	3.8	.3914
"	2—morning	13.4	3.3	.4422
	—noon	10.8	4.3	.4644
	—night	11.8	4.3	.5074
"	3—morning	13.5	3.3	.4455
	—noon	11.	4.5	.4950
	—night	10.2	3.1	.3162
"	4—morning	14.6	3.7	.5402
	—noon	10.8	4.6	.4968
	—night	10.4	3.2	.3328
"	5—morning	14.1	3.4	.4794
	—noon	11.5	4.9	.5635
	—night	10.8	3.9	.4212
"	6—morning	13.2	3.1	.4092
	—noon	10.9	3.8	.4142
	—night	11.	3.6	.3960
"	7—morning	14.2	3.4	.4828
	Totals	243.9		9.3469
	Test computed from daily weight and tests		3.83	
	Composite test and fat from same		3.8—9.268	

SHORTHORN—14th PRINCESS OF THULE.

		Lbs. milk.	Test.	Lbs. fat.
July	17—Three milkings	29.1	4.0	1.1640
	18—noon	8.7	4.7	.4089
	—night	8.0	3.8	.3040
"	19—morning	11.0	3.8	.4180
	—noon	9.1	4.8	.4368
	—night	8.0	3.5	.2800
"	20—morning	9.9	3.1	.3069
	—noon	10.3	4.2	.4326
	—night	8.9	4.3	.3827
"	21—morning	10.8	3.8	.4104
	—noon	10.7	5.0	.5350
	—night	9.4	4.6	.4324
"	22—morning	10.5	3.4	.3570
	—noon	10.3	4.3	.4429
	—night	9.4	4.5	.4230
"	23—morning	10.8	3.9	.4212
	—noon	9.3	3.9	.3627
	—night	8.5	2.7	.2295
"	24—morning	12.0	3.8	.4560
	Totals	204.7		8.2040
	Composite test		4.1	
	Computed from daily test		4.008	

SHORTHORN—DAISY D.

Date.		Lbs. milk.	Test.	Lbs. fat.
July	17—Three milkings, beginning noon	25.7	3.5	.8995
"	18—noon	8.4	3.5	.2940
	—night	9.0	3.3	.2970
"	19—morning	12.2	3.8	.4636
	—noon	8.4	2.9	.2436
	—night	10.5	3.2	.3360
"	20—morning	12.7	3.8	.4826
	—noon	10.4	4.0	.4160
	—night	9.4	3.0	.2820
"	21—morning	9.9	4.1	.4059
	—noon	*2.0	5.2	.1040
	—night	1.7	4.2	.0714
"	22—morning	5.8	6.7	.3886
	—noon	2.8	5.4	.1512
	—night	3.9	4.4	.1716
"	23—morning	6.7	5.0	.3350
	—noon	5.7	4.3	.2451
	—night	5.3	4.0	.2120
"	24—morning	9.6	4.0	.3840
	Totals	160.1		6.1831
	Composite Tests		3.8	
	Computed		3.86	

*Cow was sick from noon of 21st to noon of 23rd.

SHORTHORN—MISS MOLLY.

Date.		Lbs. milk.	Test.	Lbs. fat.
July	17-18—Three milkings	33.3	3.7	1.2321
"	18—noon	10.2	4.5	.4590
	—night	8.4	3.1	.2604
"	19—morning	13.6	3.9	.5304
	—noon	10.3	4.6	.4738
	—night	9.4	3.4	.3196
"	20—morning	12.9	3.5	.4515
	—noon	10.0	3.6	.3600
	—night	10.1	3.6	.3636
"	21—morning	13.0	3.7	.4810
	—noon	10.9	3.6	.3924
	—night	11.0	3.6	.3960
"	22—morning	13.8	4.2	.5796
	—noon	10.8	3.8	.4104
	—night	10.6	3.2	.3392
"	23—morning	14.4	4.1	.5904
	—noon	11.2	4.1	.4592
	—night	12.0	3.7	.4440
"	24—morning	14.6	4.1	.5986
	Totals	240.5		9.1412
	Composite Test		3.8	
	Computed from daily test		3.8	

SHORTHORN—QUEEN BESS.

Date.	Lbs. milk	Test.	Lbs. fat.
July 17–18—Three milkings	33.1	3.8	1·2578
" 18—noon	10.3	4.5	.4635
—night	10.5	3.9	.4095
" 19—morning	12.0	3.1	.3720
—noon	10.9	4.4	.4796
—night	9.6	3.2	.3072
" 20—morning	11.4	3.6	.4104
—noon	10.6	3.8	.4028
—night	10.9	4.0	.4360
" 21—morning	9.3	3.4	.3162
—noon	4.9	4.3	.2107
—night	6.6	5.2	.3432
" 22—morning	8.6	3.2	.2752
—noon	9.1	3.4	.3094
—night	11.2	3.7	.4144
" 23—morning	13.4	3.6	.4824
—noon	10.7	4.0	.4280
—night	11.7	3.8	.4446
" 24—morning	13.5	4.2	.5670
Totals	218.3		8.3299
Composite Test		3.7	
Computed from daily tests		3.8	

SHORTHORN—ROSE 3RD.

	Lbs· milk.	Test.	Lbs. fat.
July 17–18—Three milkings	30.9	3.5	1·0815
" 18—noon	10.7	5.2	.5564
—night	9.1	3.5	.3185
" 19—morning	10.6	3.0	.3180
—noon	10.8	4.9	.5292
—night	8.6	3.1	.2666
" 20—morning	11.5	3.2	.3680
—noon	10.5	4.2	.4410
—night	10.6	4.0	.4240
" 21—morning	11.4	3.1	.3534
—noon	9.8	3.8	.3724
—night	10.8	3.3	.3564
" 22—morning	12.9	3.4	.4386
—noon	11.2	3.8	.4256
—night	11.2	3.8	.4256
" 23—morning	12.8	3.1	.3968
—noon	11.0	3.8	.4180
—night	11.4	2.8	.3192
" 24—morning	14.0	3.1	.4340
Totals	229.8		8.2432
Composite Tests		3.6	
Computed from daily tests		3.59	

GUERNSEY.

Date.	MARY MARSHALL.	Lbs. milk.	Test.	Lbs. fat.
Aug.	14—noon	8.8	6.1	.5368
	—night	8.4	5.4	.4536
"	15—morning	10.9	5.	.5450
	—noon	8.2	6.1	.5002
	—night	8.2	5.8	.4756
"	16—morning	11.	5.4	.5940
	—noon	7.8	5.7	.4446
	—night	8.0	5.4	.4320
"	17—morning	10.5	5.2	.5460
	—noon	8.5	6.0	.5100
	—night	8.1	5.5	.4455
"	18—morning	10.6	5.4	.5724
	—noon	8.5	6.3	.5355
	—night	7.6	5.4	.4104
"	19—morning	10.8	4.9	.5292
	—noon	7.7	5.0	.3850
	—night	9.3	5.9	.5487
"	20—morning	10.4	5.1	.5304
	—noon	8.5	5.7	.4845
	—night	8.7	5.4	.4698
"	21—morning	10.4	5.5	.5720
	Totals	190.9		10.5212
	Per cent. fat		5.51	
	Composite test and resulting fat		5.4—10.3086	

Date.	MEDORA FERN.	Lbs. milk.	Test.	Lbs. fat.
Aug.	14—noon	5.7	3.	.1710
	—night	7.1	4.2	.2982
"	15—morning	10.2	4.7	.4794
	—noon	6.4	5.4	.3456
	—night	5.4	4.8	.2592
"	16—morning	9.4	5.6	.5264
	—noon	2.3	3.5	.0805
	—night	7.9	3.	.2370
"	17—morning	9.3	5.0	.4650
	—noon	5.	4.8	.2400
	—night	8.5	4.6	.3910
"	18—morning	7.4	3.8	.2812
	—noon	4.7	3.6	.1692
	—night	7.3	4.5	.3285
"	19—morning	9.1	5.9	.5369
	—noon	2.3	3.6	.0828
	—night	8.8	4.0	.3520
"	20—morning	9.	5.2	.4680
	—noon	no milk.		
	—night	10.3	5.3	.5459
"	21—morning	10.7	4.2	.4494
	Totals	146.8		6.7072
	Per cent. fat		4.57	
	Composite test and resulting fat		4.6—6.7528	

MARY MARSHALL 5604—GUERNSEY—THE WINNING COW IN THE PAN-AMERICAN MODEL DAIRY HERD, 1901.

Record for the six months—5,611 pounds milk, test 5.36 per cent, or 301.13 pounds butterfat, making 354.26 pounds churned butter. Profit in production of butterfat, $59.43. At time of test was owned by Mr. Ezra Michener, Carversville, Pa. Purchased at close of test by A. C. Loring, Minneapolis, Minn., price $1,000. Mary Marshall was tested six months in the Model Dairy and the test completed by the Minnesota Agricultural Experiment Station; her record for the year, from May 1, 1901 to April 30, 1902, is 8,212.57 pounds of milk, average test 5.99 per cent, making 468.4 pounds butterfat. She was dropped April 29, 1891 and was therefore in her tenth year. She was fresh April 15, 1901. (Picture shows front, side and rear view of this cow as she looked while in the test).

PROCRIS OF PAXTANG.

Date.		Lbs. milk.	Test.	Lbs. fat.
Aug.	14—noon	12.2	6.6	.8052
	—night	9.4	4.1	.3854
"	15—morning	11.8	3.8	.4484
	—noon	9.7	5.6	.5432
	—night	9.9	3.8	.3762
"	16—morning	11.7	4.8	.5616
	—noon	9.	5.7	.5130
	—night	7.1	2.8	.1988
"	17—morning	12.9	4.	.5160
	—noon	9.6	6.9	.6624
	—night	7.6	5.8	.4408
"	18—morning	11.6	4.	.4640
	—noon	9.8	5.2	.5096
	—night	8.8	4.3	.3784
"	19—morning	12.	4.3	.5160
	—noon	9.6	6.	.5760
	—night	8.6	4.6	.3956
"	20—morning	12.3	5.1	.6273
	—noon	8.8	5.2	.4576
	—night	8.5	4.8	.4080
"	21—morning	10.4	4.8	.4992
	Totals	211.3		10.2827
	Per cent. fat		4.87	
	Composite test and resulting fat		4.9	10.3537

VEGA.

Date.		Lbs. milk.	Test.	Lbs. fat
Aug.	14—noon	7.3	4.3	.3139
	—night	7.3	3.7	.2701
"	15—morning	10.2	4.4	.4488
	—noon	7.9	5.1	.4029
	—night	6.2	4.	.2480
"	16—morning	11.	5.2	.5720
	—noon	7.6	6.	.4560
	—night	6.6	4.7	.3102
"	17—morning	10.1	5.	.5050
	—noon	6.8	4.4	.2992
	—night	7.	4.2	.2940
"	18—morning	10.2	5.2	.5304
	—noon	6.6	4.6	.3036
	—night	6.9	3.5	.2415
"	19—morning	9.9	4.6	.4554
	—noon	7.	5.	.3500
	—night	7.	4.2	.2940
"	20—morning	9.3	4.8	.4464
	—noon	6.8	4.1	.2788
	—night	7.6	4.1	.3116
"	21—morning	10.3	4.8	.4944
	Total	169.6		7.8262
	Per cent fat		4.61	
	Composite test and resulting fat		4.6	7.8016

CASSIOPIA.

Date.		Lbs. milk.	Test.	Lbs. fat.
Aug.	14—noon	10.8	4.9	.5292
	—night	9.	3.9	.3510
"	15—morning	12.1	4.2	.5082
	—noon	9.5	5.1	.4845
	—night	9.1	4.1	.3731
"	16—morning	11.6	4.8	.5568
	—noon	9.9	5.0	.4950
	—night	7.5	3.4	.2550
"	17—morning	14.1	5.3	.7473
	—noon	9.5	4.8	.4560
	—night	9.2	4.	.3680
"	18—morning	12.2	3.8	.4636
	—noon	9.9	4.6	.4554
	—night	9.3	4.	.3720
"	19—morning	12.7	3.8	.4826
	—noon	9.9	4.5	.4455
	—night	9.5	4.	.3800
"	20—morning	12.7	3.9	.4953
	—noon	9.4	4.2	.3948
	—night	10.2	4.2	.4284
"	21—morning	11.9	4.3	.5117
	Total	220.		9.5534
	Per cent fat		4.34	
	Composite test and resulting fat		4.35	—9.57

INCREASE IN RICHNESS WITH ADVANCE OF LACTATION PERIOD.

For the six months' test every one of the fifty cows made a gain in richness of milk incident to the advance of lactation period. By averaging the four weekly composite tests for each cow for the first and last month we have a fair basis for determining this gain without having to contend with the fluctuations from week to week caused by things seen and unseen.

Comparing these averages for the months of May and October, we find that every cow gained, from the Guernsey, Cassiopia, with a gain of only .1%, to Queen, the Polled Jersey, with a gain of 2.01%. The average gain for the five cows of the different breeds was as follows: French Canadian 1.07, Jerseys 1.05, Polled Jerseys .90, Shorthorn .87, Guernseys .85, Brown Swiss .7, Red Polled .65, Ayrshire .57, Holstein .48, Dutch Belted .39; the case of Cassiopia was an exceptional one. Her average test for May was 4.34, June 3.99, July 4.12, August 4.36, September 4.71 and October 4.44, the gain being steady from June to October, but low for October.

Of the fifty cows, twenty-eight tested higher each month of the six than for the preceding month; eleven cows spoiled their progression by averaging lower for some one month than for a preceding month. Of these eleven, six dropped off during July, two during June and one each for August, September and October.

Six of the fifty cows were off an average test for two months of the six, and the remaining five cows were high for just one month out of the six (so as to spoil the progression) or else were mixed too badly to show any attempt at a progression.

As most of the drops for a month or two came in the months which were excessively hot and the cows known to be very uncomfortable from heat, it is reasonable to attribute most of these drops to this cause.

Considering that, with a few exceptions, all the cows in the test had calved within two months of the opening, which would bring them six to eight months in lactation at the close, a natural conclusion from the data here given would be that: with cows calving in spring and stabled through summer, the per cent. of fat increases as the period of lactation advances.

Relation of test to profitable butter production.

One of the most valuable things to be learned from this test is the very wide difference in the performance of individuals of the same breed. If five individuals of each of these breeds, gotten together in most cases after considerable search and pretty careful selection among the available animals by men supposed to be good judges, show such a great range in earning capacity as we find here, what must be the case in the herds of even our most intelligent farmers who have been too busy or too indifferent to apply the test and scales to the individuals of their herds.

The following tabulation gives the best and poorest cow, from the standpoint of profit on butterfat, in each breed, with the number of position, average fat test, cost of feed, and net profit:

Breed.	Cow.	No.	Test.	Cost feed.	Profit.
Guernsey	Mary Marshall	1	5.36	$29.16	$59.40
	Medora Fern	43	4.36	24.36	29.36
Jersey	Primrose	4	5.64	26.81	50.25
	Rexina	29	3.98	25.48	38.52
Ayrshire	Betsy 1st	8	3.59	28.57	46.07
	Lady Flora	28	3.4	27.68	38.70
Holstein	Beauty	6	3.42	32.65	49.35
	Meg.	33	3.25	34.11	36.60
Red Polled	Mayflower	2	4.45	28.69	52.10
	Tryste	40	3.68	27.15	31.59
Brown Swiss	Belle T	19	4.09	28.38	41.23
	Nicola	42	3.25	29.18	30.35
French-Canadian	Denise	21	4.03	23.52	40.64
	La Bouchette	47	3.67	18.65	22.94
Shorthorn	Miss Molly	15	3.71	32.36	43.01
	Daisy D	44	3.43	32.38	28.80
Polled Jersey	Queen	16	5.63	23.60	42.89
	Phyllis	37	4.38	23.83	33.20
	(Justina left out)	Stripper.			
Dutch Belted	Belle of W	31	4.15	26.93	38.02
	Alberta	50	3.09	24.11	11.49

It is interesting to notice that in every instance the most profitable cow tested high (for her breed) and the least profitable one low. Is not this significant? In several breeds the richness of milk in fat for the five cows is graded just in order to their position in point of profit. Notice the Jerseys in the order of their profit from highest to lowest. The tests run: 5.64; 4.74; 4.4; 4.27; 3.98. The Brown Swiss: 4.09; 3.8; 3.61; 3.45; 3.25. In nearly all the breeds this same uniform progression in richness corresponding with profit holds good, with slight irregularities in some.

Results of test.

The awards in the test were made as follows: For greatest net profit on estimated butter, to the Guernseys by $4.66. For greatest net profit on churned butter, to the Guernseys by $5.86. For greatest profit on total milk-solids, to the Holsteins by $26.44. For greatest profit on total milk-solids and gain in live weight, to the Holsteins by $31.63.

(I.)		Butter fat.		Estimated butter.	
	Lbs. milk.	Per cent.	Lbs.	Lbs.	Value.
Guernseys	27127.6	4.6	1248.1	1468.3	$367.07
Jersey	26987.1	4.58	1234.9	1452.8	363.20
Ayrshire	32998.2	3.6	1219.4	1434.6	358.65
Holstein	39260.2	3.25	1275.8	1501.0	375.25
Red Polled	28694.9	3.98	1141.8	1343.3	335.83
Brown Swiss	30892.6	3.63	1123.1	1321.3	330.34
French Canadian	24664.7	3.99	984.1	1157.7	289.44
Shorthorn	31885.6	3.57	1138.8	1339.6	334.96
Polled Jersey	20328.8	4.66	948.3	1115.6	278.91
Dutch Belted	24893.5	3.4	847.5	997.0	249.26

(II.)	Estimated butter.		Total solids.			
	Cost of Feed.	Net Profit on butter.	Per cent.	Lbs.	Value.	Profit
Guernseys	$136.99	$230.08	13.9	3775.0	$339.75	$202.76
Jersey	137.78	225.42	13.9	3770.0	339.30	201.52
Ayrshire	140.98	217.69	12.6	4185.3	376.68	235.70
Holstein	164.69	210.56	12.0	4742.6	426.83	262.14
Red Polled	138.03	197.80	13.1	3773.7	339.64	201.61
Brown Swiss	147.26	183.08	12.7	3943.9	354.95	207.69
French Canadian	113.10	176.34	13.3	3287.4	295.86	182.76
Shorthorn	162.12	172.84	12.8	4086.6	367.79	205.67
Polled Jersey	109.47	169.44	13.9	2831.7	254.85	145.38
Dutch Belted	132.32	116.94	12.3	3066.5	275.98	143.66

The gain in live weight during the test for the different breeds was as follows: Shorthorns 802 pounds; Holsteins 391; Dutch Belted 376; Red Polled 349; French Canadian 288; Polled Jersey 275; Ayrshire 218; Brown Swiss 198; Guernsey 195; Jersey 189.

Every one of the fifty cows entering the test May 1st came through the six months' trial in good condition, nearly all having gained a little in weight (some of the more beefy ones gaining considerable as is indicated by the best gains).

A tabulation of results of this test combining the production of butter-fat and solids not fat has been made at what may be called farmers' prices, that is, the net price of butter to the creamery patron plus feeding value of skim milk. For the months during which the test was conducted (May 1 to November 1) 16c. is taken as this value of butter, and by a sort of established rule among experimenters and writers, 2c. per pound for solids not fat, or about 18c. per 100 pounds of average skim milk.

The following table shows the standing of the herds on this very practical basis:

Breed.	Value butter at 16c lb.	Value solids not fat. 2c lb.	Total credit.	Cost of feed.	Net Profit.
Guernseys	$234.93	$50.54	$285.47	$136.99	$148.48
Ayrshire	229.53	59.32	288.85	140.98	147.87
Jersey	232.49	50.50	282.99	137.78	145.21
Holstein	240.16	69.34	309.50	164.69	144.81
Red Polled	214.93	52.64	267.51	138.03	129.54
Brown Swiss	211.41	56.41	267.82	147.26	120.56
French-Canadian	185.23	46.07	231.30	113.10	118.20
Shorthorn	214.34	58.95	273.29	162.12	111.17
Polled Jersey	178.50	37.67	216.17	109.47	106.70
Dutch Belted	159.52	44.38	203.90	132.32	71.58

"All that is great in man comes through work; and civilization is its product."
—*Samuel Smiles.*

"Knowledge, in truth, is the great sun in the firmament. Life and power are scattered with all its beams."—Daniel Webster.

BREEDS OF COWS; VIEWS ON THE BUILDING UP OF A DAIRY HERD.

BY PROF. S. M. TRACY, FORMERLY DIRECTOR MISSISSIPPI AGRICULTURAL EXPERIMENT STATION.

Biloxi, Miss.

The article that follows is a brief review of the qualities of the leading breeds of dairy cattle and suggestions in regard to herd management, comprising a part of farmers' bulletin No. 151, recently issued by the U. S. Department of Agriculture. Its writer and purpose are well set forth in this paragraph recommending its publication by the bureau:

"The bulletin was prepared by Prof. S. M. Tracy, formerly director of the Mississippi Agricultural Experiment Station, as the result of twenty years' residence, experience and observation in Mississippi, with particular reference to Southern conditions and needs. The aim has been to give simple directions for the encouragement and information of those to whom the care of cows and their products is comparatively new, as is the case in the region for which the bulletin has been specially prepared."

While the report as a whole has special reference to dairying in the southern states, the selection that is here given has its field of application everywhere, and is full of helpful, practical suggestions to every reader.

The illustrations with this article show splendid types of Ayrshire, Devon, Holstein, Brown Swiss and Dutch Belted cows, while numerous views of noted cows of all prominent breeds appear in the experiment station reports elsewhere—notable examples of what has been accomplished up to the moment, and the best of guides for the dairying—the higher order of dairying—of the future:

BREEDS OF COWS.

The best cow for any dairy is the one which will give the greatest profit. To which one of the so-called dairy breeds this cow will belong depends on the location, the character of the pastures, the care given to the herd, and whether the product to be marketed is milk, butter or cheese. The dairyman who depends wholly on the sale of milk may find it more profitable to keep a different breed from the one he would select were he making butter or cheese, while, if he wishes to produce beef and also a moderate amount of milk or butter, a still different breed may be better adapted to his purpose. Many swine raisers claim that there is "more in the feed than in the breed", but this is not true of cattle. The best breed for milk or butter is never the best for beef.

The more common breeds for dairy purposes are the Jerseys, Ayrshires, Guernseys, Holstein-Friesians, Devons and milking strains of Shorthorns, though Dutch Belted, Brown Swiss, and a few other breeds have their admirers among dairymen.

The Jerseys.

The Jerseys, formerly known as Alderneys, are in this country the most common breed, where cows are kept for strictly dairy purposes, and with no regard for beef qualities. The cows are small, generally weighing below 1,000 pounds, usually rather angular in outline, nervous, good feeders, and producing liberal yields of very rich milk. For generations they have been bred exclusively for the production of butter. Their milk is usually very rich, that from a large number of cows tested at various experiment stations, as reported by Professor Woll, averaging 5.4 per cent of butter fat, and those at the Columbian Exposition averaging 4.88 per cent. They are such persistent milkers that it is sometimes difficult to dry them off between calves, and the records of many herds show an average yield of over 5,000 pounds of milk per cow per year. Records of individual cows show much larger yields, some running as high as 10,000 to 12,000 pounds, and there are two well authenticated records of cows which have produced over 16,000 pounds of milk within twelve months. That the milk of Jersey cows is rich in butter fat is shown by the fact that many herds produce an average annual yield of over 300 pounds of butter per cow. Herds averaging 400 pounds per cow are not uncommon, while single animals have produced more than double that amount within the same time. Jerseys are more numerous than cows of any other single breed in the South, and many of the native cattle in that region show a strong mixture of Jersey blood.

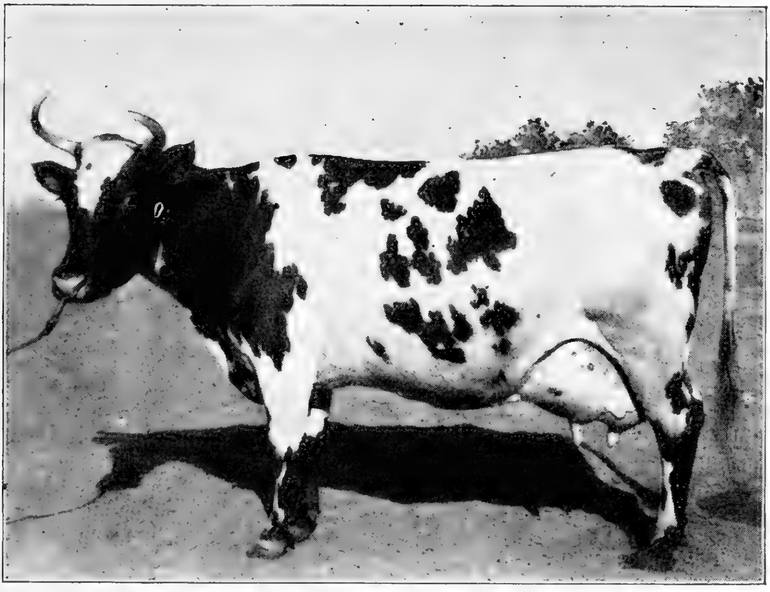
The Ayrshires.

Ayrshires resemble Jerseys to a considerable extent, and are very popular in the dairy sections of Canada and the Northeastern states, though not common in the South. The cows are rather small in size, seldom weighing more than 1,000 pounds each, but are good milk producers, 5,000 pounds of milk per year being a common yield. One noted herd, averaging 14 cows in milk, has a record of an average product of 6,407 pounds of milk per year for each cow for nineteen years. In another case 19 cows averaged 6,956 pounds in one year, and in numerous instances single cows have given from 10,000 to 12,000 pounds. The milk is somewhat above the average in quality, though not so rich as that from the Jerseys. Woll gives the average fat content as 3.6 per cent. while the New

York (Geneva) Experiment Station gives it as 3.57 per cent. The cows are not as gentle as are the Jerseys and Holsteins, but are more active, better "rustlers," will live on poorer feed, and will find grazing on rougher pastures. Steers and dry cows fatten readily, and, though small, make excellent beef.

The Holstein-Friesians.

The Holstein-Friesians, though one of the oldest of the dairy breeds in Europe, are of comparatively recent introduction into this country, and are giving excellent satisfaction wherever they are handled



GLADYS DRUMMOND—TYPICAL AYRSHIRE COW.
Owned by J. F. Converse, Woodville, N. Y. Has Won Several Prizes in the Ring.

under proper conditions. They need luxuriant pastures, rich feed and good care to make them succeed well, and are likely to be disappointing when they are not given the best of feed and attention. The cows are large, weighing from 1,000 to 1,400 pounds, and are irregularly marked with black and white. They are very gentle and easy to handle. They fatten quickly at any age, and so are readily turned into beef when past their usefulness in the dairy. The calves are large and strong, and the surplus males always bring good prices as veal, or they may be made into profitable steers. The cows yield enormous quantities of milk, sometimes averaging per month an amount equal to their own weight, for ten or twelve successive months.

Although the quantity of milk produced is far beyond that from most other breeds, its quality is usually poor, and in some cases has been below the standard fixed by state or municipal laws. The milk is usually lighter colored than that of the Jerseys, even when fairly rich, and those who have been accustomed to milk of a richer appearance sometimes object to buying it on account of the absence of color, which gives an impression of poorer quality. Many individual cows, however, produce milk of excellent quality, and there are records of cows which have yielded as much as 25 pounds of butter in a week.

The Devons.

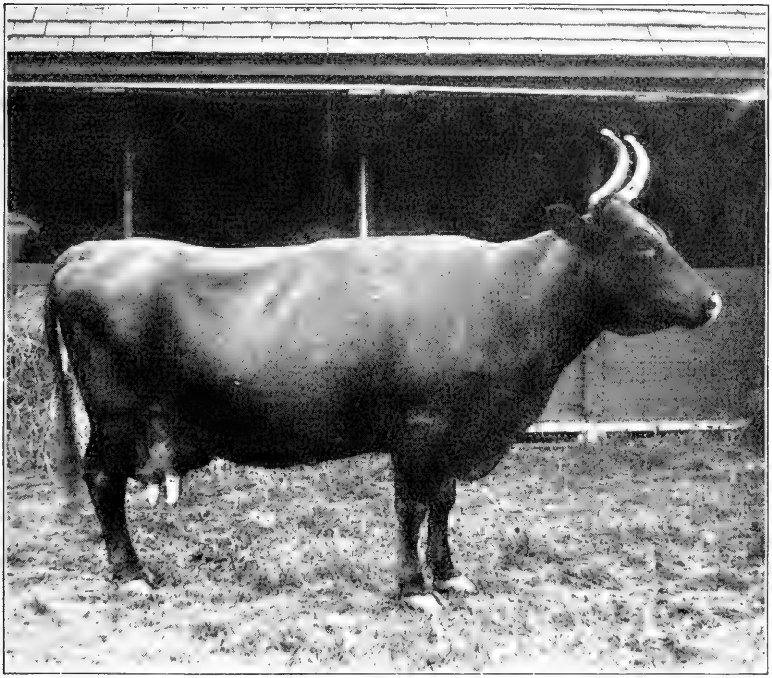
Devons are very popular in many localities, especially where the production of milk and butter is not the sole object for which the animals are kept. The cows are of good size, averaging perhaps 1,000 pounds in weight. They are good rangers, quick and active, but very docile, easily handled, and fair but usually not persistent milkers. The milk, however, is unusually rich in quality, the tests reported by Professor Woll averaging 4.6 per cent. of butter fat, while tests of 72 animals reported by the New York Experiment Station averaged 4.15 per cent. Some families of the Devons contain heavy milkers, yields of 5,000 pounds per year being not uncommon. Where it is desired to combine beef production with dairying the Devons are very satisfactory, as the calves grow rapidly and the steers fatten very quickly. It is important to note that Devons have been sucessfully introduced in different parts of the South, and have shown their value in improving the common stock of the country for both milk and meat. The steers make better work oxen than those of any other breed.

The Shorthorns.

While the Shorthorns are usually regarded as a beef breed, there are many good milkers among them, and the "milking strains" are favorites where the production of beef is the main object, and at the same time a good yield of milk and butter is desired. Individual cows of this breed have been known to produce 10,000 to 12,000 pounds of milk in a season, and entire herds have averaged from 6,500 to 7,500 pounds. The milk is of good quality and creams easily, though the butter is usually pale in color. At the Columbian Exposition test the Shorthorn milk averaged 3.64 per cent. of butter fat, while the report of Prof. Woll gives the average as 3.97 per cent. These cattle are less common in the Gulf States than are those of the other breeds mentioned, and, where found, they have been raised almost exclusively for the production of beef, but it is not difficult to find there individuals and even large herds which are also profitable dairy animals. This is particularly true of grade cows of this blood—the offspring of Shorthorn bulls from milking families.

THE DUAL-PURPOSE COW.

Though many attempts have been made to develop a breed of cattle profitable for both beef and milk, success in that direction has not yet been reached, and it seems more than probable that such a breed will never be secured. It is the natural tendency of every cow to use her



JENNIE MAY 7157—TYPICAL DEVON COW.
Owned by Stockwell & Gifford, Sutton, Mass.

surplus food either in growth and the accumulation of fat, or in the production of milk. Either of these tendencies may be greatly strengthened by intelligent breeding and selection, but no breed has ever been developed which excels in both beef and butter-making qualities, and improvement in either direction has usually been accompanied by a corresponding loss in the other. It is true that there are some breeds which make animals of fair size and which are also fair dairy animals, but they are only fair as either. The best beef animals and the best milking animals have never been found in the same individuals or even in the same breed, and the cattle raiser who attempts to raise beef for a living and at the same time to make money by using his cows in a dairy, is almost sure to find one branch of his business unprofitable. A profitable beef animal is one thing, while a profitable dairy cow is something quite different. The man who expects to make his living from a dairy should select the breed which will give him the greatest amount of butter and milk from the smallest number of animals at the least cost.

Dairy breeds compared.

All breeds have admirers who point with pride to the large milk records made by their favorites. Each breed has its special good qualities as well as its peculiar weaknesses, and no one of them is best suited to all localities or to all branches of dairying. In breed tests made by the Maine, New York (Geneva), and New Jersey Experiment stations, the breeds tested have made averages which place them in the following order:

1. As to yield of milk: Holstein, Shorthorn, Ayrshire, Guernsey Jersey, Devon.

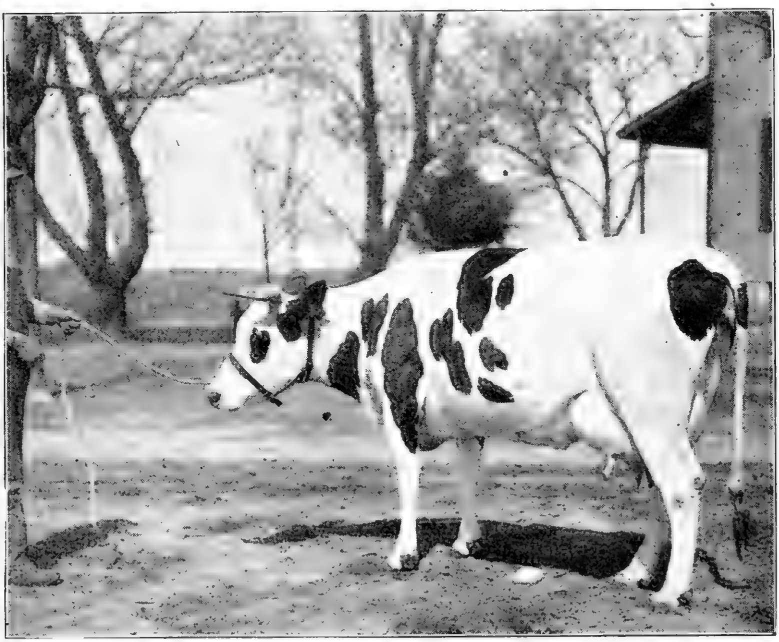
2. As to richness of milk: Jersey, Guernsey, Devon, Shorthorn, Ayrshire, Holstein.

To summarize the matter of breeds: The Jerseys produce a large yield of rich milk and are good rustlers, but of little value for beef; the Ayrshires are good milk-producers, will thrive on a poorer pasture than most others, and are easily fattened when wanted for beef; the Holstein-Friesians produce an immense yield of milk which is not rich, and are easily made into good beef, but require the best of care and an abundance of rich and succulent feed; the Devons produce a moderate amount of rich milk and are quickly made into good beef; the "milking strains" of Shorthorns produce a good yield of milk which is of good quality, and can be turned into excellent beef at any time, but are not good rustlers and need the best of pastures to do well. Probably three-fourths of the pure-blooded cows now in the Gulf States are Jerseys.

DAIRY HERD MANAGEMENT.

Whatever breed may be chosen for the dairy or for any other purpose, the individual animals should be good of their kind. A good pure-bred animal is the best, but a poor specimen of any breed, no matter how good its pedigree, is worth less than a good scrub.

The cows. The selection of animals for the foundation of a dairy herd is a matter which requires great care, judgment and experience. The best of feed and management cannot make a profitable cow of one which naturally gives only a small amount of thin milk. When one has unlimited means at his disposal, it is comparatively easy to buy cows which have established records as heavy milkers, but that method is too expensive for the dairyman who must depend on the sale of dairy products for his income. Under all ordinary circumstances it is better to begin by buying the best herd which can be afforded, and then to maintain and improve it by raising calves from the best cows and occasionally buying a cow which is known to be unusually good. As the herd increases beyond the desired limit, either by breeding or by purchase, the inferior cows should be sold, so that the quality of the herd as a whole will show a constant improvement. The



HANNA MELCHIOR 43017—TYPICAL HOLSTEIN-FRIESIAN COW.

Owned by Frank B. Fargo, Lake Mills, Wis. When four years and nine months of age—April and May, 1902—produced in four weeks official test, 1,980.09 pounds of milk, containing 59.577 pounds fat.

poorest cows in the herd should always be for sale at little more than their beef value, while the best should always be kept until their period of usefulness is past.

When it is not possible to purchase pure bloods, the first cows purchased should be good grades of the breed selected. None but good animals should be purchased at any price, as a poor cow—one which will not yield at least 200 pounds of butter in a year, or its equivalent in milk—will little more than pay her board. A real lover of cattle (the only man who will succeed as a dairyman) will not be satisfied without owning a few pure-bred and registered animals.

THE BULL. In all cases the bull should be a pure-bred, and he should be selected from a family of good milkers. Usually it is better to buy a young bull, as one which has been raised on the place and has learned to know his master is much more easily handled than is a mature animal when brought to a strange place. When a good bull has been secured and has proved his merit, he should be kept as long as possible. He should always have kind and gentle treatment, but there should never be any question as to who is master. A ring should be put into his nose by the time he is a year old, and he should always be led by a strap or staff snapped into this ring. Whenever he is tied he should be fastened with a rope he cannot break, and all fences should be so high and strong that he will never attempt to go over or through them. When a young bull is handled properly he never learns his strength, and so will be handled with comparative safety, but success in a single unruly attempt will teach him a lesson he will never forget. Many bulls live to old age without showing any unpleasant temper, but one should never be trusted, as the older he becomes the greater is the liability to a sudden vicious outbreak.

It is much better for both the health and temper of the bull to give him abundant exercise, either in a pasture or at work. When he can not have a pasture to himself it is good economy to use his surplus energy in doing useful work on a tread power. Such a power, of sufficient size to give him all needed exercise, costs little, and it is much better to have him do the churning, pumping, cutting hay and grinding feed than to have him waste his time and strength tearing up the ground or attempting to get out of his lot, or to become lazy and vicious standing in his stable. While it is not often good practice to keep him in the pasture with the cows, he should be kept in their sight as much as possible, and in the same stable at night.

WHEN COWS SHOULD "COME FRESH". Whether cows should be bred to drop their calves in the fall or in the spring depends largely on how the marketing is to be done. Milk and butter usually bring better prices in winter than in summer, and when such products are disposed of at wholesale it is better to have the larger supply when prices are highest, but when one sells at retail to regular customers he must arrange to have his supply nearly constant in order to hold his trade.

A cow will give more milk and give it at a smaller cost when her calf is dropped in the fall than when she is "fresh" in the spring. When a cow "comes fresh" in the fall she is almost immediately put on her winter feed and will continue to give a liberal supply of milk until the spring grazing stimulates a renewed flow during the later months of her lactation period. Her dry period then comes in late summer, when prices are usually low, when stabling is uncomfortable, and when the handling and care of the milk is more troublesome than at any other time. Service in December or January will allow the cows to rest during the hottest and most trying months, when they give the smallest profits, and make them most productive when prices are highest.

"DRYING OFF" COWS. The cow should "go dry" a month to six weeks before she is expected to calve. Some cows are such persistent milkers that it is impossible to dry them off; but such cases are rare, and can usually be prevented if the young cow has the right treatment after her first calf. If she does not show a strong inclination to go dry when within two months of the time she is expected to drop a calf, her feed should be made as light

NANCY 465—TYPICAL BROWN SWISS COW.

Owned by E. M. Barton, Hinsdale, Ill. First prize cow in Brown Swiss Class at Minnesota, Wisconsin and Illinois state fairs in 1897, at Trans-Mississippi Exposition, Omaha, and Illinois and Wisconsin state fairs in 1898, at Minnesota and Wisconsin state fairs in 1899, and at Illinois state fair in 1901. Since this date Nancy dropped triplet calves. She has a twelvemonth's record of 9,925 pounds milk and 552 pounds butter. Nancy was dropped March 15, 1887; her weight is 1,400 pounds.

as will keep her in fair flesh, she should be given little or no grain feed, and the milking should be done less thoroughly. Occasionally a cow will be found which will persist in giving milk through the entire gestation period, and in such cases the only thing to be done during the last month is to milk her sufficiently to prevent the udder from becoming caked or inflamed. Any milking during that month beyond what is absolutely necessary for the health of the cow causes a strain on the vitality of the calf, is encouraging a bad tendency, and should be avoided. On the other hand, if the young cow shows an inclination to go dry too soon, every effort should be made to prolong her milking period, which can usually be accomplished by giving her more succulent food and a moderate increase in her grain ration. With nearly all cows the length of subsequent lactation periods is determined by the length of the first period, so it is of the greatest importance that the length of the first period be made as long as possible without crowding the second period too closely.

CALVES. The calf should never be allowed to suck its dam after the first day, and many dairymen never allow a calf to suck at all. Any cow which is worth keeping in a dairy secretes more milk than it is possible for

TYPICAL DUTCH BELTED COW AND TWIN CALVES.

Owned by S. A. F. Servin of "Valley Farm," Warwick, N. Y. The Valley Farm herd numbers 65 head and has a long record of prizes won at state fairs and other exhibitions, taking 41 first premiums and 26 seconds in 1901 alone, and winner of three championship cups for the three years successively shown, 1897, 1898 and 1901. Two cows from this herd, Belle of Warwick and Madeline, were leading cows of their breed at the Pan-American Model Dairy at Buffalo. The Dutch Belted cattle are native of Holland, though a distinct breed from the Holsteins.

the young calf to use, and the sooner the cow and calf are separated the better for both. When the calf is taken away at once, and the milking is done by hand, the cow soon forgets her offspring and comes to regard the operation of being milked as the natural means of relief for her udder. She will "give down" her milk to the milker as readily as to the calf, the owner can be sure that the udder is completely drained at each milking, and there will be far less danger from sore teats or a caked bag than when the milker attempts to divide the milking between a headstrong calf and the pail. The calf should always be given the first milk which comes from the cow after it is dropped, but the younger it is when it has its first lesson in drinking from a pail, the easier it can be taught. At first, the milk should be given while it is fresh and warm, and, if it is unusually rich, it should be diluted with warm water. After the calf is two weeks old, a little sweet skim milk may be mixed with the fresh milk, and the amount may be gradually increased until the calf is a month old, when skim milk may be fed alone, though it should be fed warm until the calf begins eating other food. Scours and diarrhea are usually caused by overfeeding or by feeding milk which is too rich.

The calf should be kept growing constantly from the time it is dropped until it has reached full size, and this should be done by the aid of all the hay and roughage it can be induced to eat, and with only a small amount of grain. When the growth is made principally on hay and pasture, the calf may become very pot-bellied, but that is in no way objectionable, as a large belly indicates a large development of the digestive organs, and a stomach capable of holding and digesting a large amount of feed is an absolute necessity to every animal which is to become a profitable cow.

If the dam is a grade cow of a small-sized breed and the calf is a male, it is often better to kill the calf as soon as it is dropped; also such pure-blood male calves as are not wanted for service or for sale as breeders. Bull calves of the larger breeds are better worth keeping, at least until they can be made into veal, but the man who makes dairying his principal business will seldom find it profitable to raise and fatten steers.

Heifer calves should be handled very often to keep them gentle, and frequent manipulation of the udder during the first pregnancy will do much to stimulate its development. This frequent handling of the udder is of no little importance, not only in securing its better development, but also to make the heifer so familiar with the operation that when her calf is dropped she will take the milking as a matter of course, and will not require to be "broken." The heifer should be served so that she will drop her first calf when she is about two years old, as breeding when young will make a more productive cow than when the mating is delayed until another year. When the first calf is not dropped until the third year, one calf and one year of milking are lost, and the heifer acquires a tendency to use her surplus feed in the laying on of fat instead of in the secretion of milk—a tendency which will be retained through life and which would have been avoided by earlier breeding.

"I have but one lamp by which my feet are guided, and that is the lamp of experience. I know no way of judging of the future but by the past."—Patrick Henry.

COMMON AILMENTS OF COWS AND CALVES, AND THEIR TREATMENT.

BY DR. A. H. HARTWIG, VETERINARIAN.

Watertown, Wis.

ACUTE INDIGESTION.

Acute indigestion is the sudden cessation of digestion whether partial or complete, and just as soon as you get suspended digestion, fermentation and decomposition take place at once, evolution of gas is inevitable, and, unless relieved, serious results will follow. It is often fatal in from 20 minutes to 60 hours, but if the animal lives 24 hours, she will likely recover. Most of the deaths occur in the first 6 or 7 hours.

CAUSES. Overloading of the paunch; cold, frosted or frost covered fodder; the feeding on pastures before the proper season; very hot or cold drinks, and external colds. improper feeding; a sudden change from dry to green food or from green to dry; new hay ingested to excess, especially if the animals drink a large quantity of water immediately after eating; eating the placenta, mouldy or decomposing food, and foreign bodies of all kinds.

SYMPTOMS. The animal keeps away from the manger; the back is arched upward, the limbs are gathered together, the coat becomes stairing and the animal expresses an anxious countenance; the ears and horns are alternately cold and hot; there are often chills and muscular tremblings; the appetite and rumination are suspended. The abdomen becomes inflated and is especially prominent on the left side. The paunch is lifted by gases; its contents can only be felt by exerting strong pressure upon it, which sometimes produces a dull bruit. The movements of the paunch and its bruits are weakened and sometimes entirely suspended. Defecations are rare; the fecal matters are harder and of a darker color than normal, and often enveloped in a thin crust; we may find them ring-streaked and leaving a putrid odor; they are sometimes covered with mucus and form clammy and shiny masses. When diarrhea exists, the excrements are mixed with alimentary matters which have not at all been digested.

The animal has slight colics, indicated by stamping and kicking towards the abdominal walls, frequently towards the flanks, and twitching the tail.

TREATMENT. Submit the animal to a severe diet; such is always the first indication to follow, and it must be enforced as long as rumination is interrupted.

Increase the thirst by giving salt freely, if the patient will not lick it, drinks with salt must be administered in order to induce her to drink water as much as possible. If there is constipation, or if defecations are infrequent, 1 to 1½ pounds of epsom salt and 2 drams of powdered ginger may be given in two quarts of warm water. In very urgent cases of bloating the trocar and cannula should not be spared in order to allow the gases to escape from the paunch. Where the peristaltic movements are wanting, 3 drams of tincture of white helebore may be given.

CHRONIC INDIGESTION.

This is a functional derangement of the stomach; it comes on slowly and requires a long time to cure. During its existence it is not serious or dangerous; that is in the ordinary case. It is very common in dairy cows, and there are three influences that operate to produce it. First, errors in feeding; second, changes in the gastric and other secretions; third, abnormalities affecting the movements of the stomach, such as cancerous and other growths.

SYMPTOMS. The animal usually has a capricious appetite, sometimes hungry, sometimes no appetite, an unnatural thirst, unnatural hunger for alkalies, will lick the walls and eat the mortar from between the bricks, eat large quantities of clay, etc.; this all shows a tendency to indigestion, hence the animal's desire to obtain alkali. The limit of their thirst is their capacity; they often turn up their upper lip in bad cases. As the disease runs on, the coat becomes stairing and rough, the animal thin and pot-bellied; there is palpitation of the heart.

TREATMENT. Give a complete change in food. Grass is best if in season. When feeding grain have it ground and mix it with bran half and half; limit the water to one-half bucket four or five times daily and dissolve in each drink one-half teaspoonful of bicarbonate of soda.

Then give the following: Arsenicum 1 dram; powdered gentian root 1½ ounce; powdered hydrastis 1½ ounce; powdered nux vomica 1½ ounce; powdered wood charcoal 2 ounces; mix and make into 12 powders. Give one in food morning and night until relieved.

DYSENTERY OF THE NEWLY BORN CALF.

This affection and pyemic polyarthritis are the most fatal diseases of young age. It is also observed in the foal, lamb, dog and cat.

According to some of our most eminent authorities, it is so common in certain districts of Austria that in one region, in a total of 3,318 calves 1,196 have been affected by it, of which 1,152 (97 per cent.) died. In 1884, in the same districts, its mortality was 55 per cent. In general it is developed from the first to the third day following birth; after the fourth day it is much less frequent; young animals are often affected by it before having sucked; milk, therefore, has nothing to do with the development of the disease. Its exciting cause is evidently an infectious element yet unknown, which is contained in the excrements and is carried by them.

The symptoms are almost similar in all species. The calf refuses to partake of food, it shows symptoms of restlessness, bellows and ejects, by violent efforts, very soft diarrheic excrements which soon become liquid, whitish (mucous diarrhea), or mixed with clots of curdled milk (white dysentery); they are very often bloody; later, we notice continued and involuntary evacuations. The patients, which are exhausted remain constantly recumbent; at intervals they are subject to convulsions; the expired air has a fetid odor. The animals often die within twenty-four hours, sometimes within three days. In many cases all the calves of one stable will perish. Those which survive remain weak and sickly for a long time.

TREATMENT. The prophylaxis consists in separation of the healthy from the sick animals, and disinfection of the premises as well as the genital canals of the females before and after parturition. The same disinfecting agents may be employed as are recommended for Epizootic.

ABORTION. When dysentery of the calves exists in an enzootic state in a stable it is proper to place the cows with calves in an isolated and well-kept stable one or two months before parturition. Experience has taught that these means are much more efficient than medical treatment.

The first indication of treatment is the administration of a light laxative—(one or two table spoonfuls of castor-oil); then give each calf

Tincture of Opium. drams 2
Tannin and
Salicylic acid—of each, drams 1½
Mix.

Give in a pint of linseed tea every three hours until relieved.

INFECTIOUS ABORTION OF THE COW.

EPIZOOTIC ABORTION.

There is scarcely a disease among dairy cows which brings about so great a loss to the owner as does epizootic abortion.

So common is this trouble in the dairy districts of this country that the practicing veterinarian in these districts is almost daily confronted with these questions:

What can I do for my cows, they are aborting one after another, and the production of milk from my herd is rapidly decreasing. The cows do not thrive well after aborting, some continue to discharge a fetid substance from the genitals for a considerable length of time, and others will not breed, no matter how often they are served in their regular periods of heat.

Can I do anything to stop the cows from aborting, or to prevent the disease from going through my entire herd? These complaints have become quite general in dairy districts.

Epizootic abortion has been known to exist permanently on some farms, and to cause for many years serious pecuniary loss.

This enzootic or epizootic character of an accident which is usually produced by trivial causes, such as contusions, acute febrile diseases, cold, poisoning, ingestion of tainted or mouldy food, and unwholesome drinks, indicates that it is sometimes of an infectious nature.

As long as its pathologic agent is not known, epizootic abortion must be classified in the group of specific diseases.

The infection seems to be produced by a "stable miasma." It has been demonstrated that the virulent agent exists in the discharge of the genital canals and in the foetal fluid; by the intermediation of these liquids healthy animals may be affected. By introducing into the vagina of healthy cows the vaginal mucus of a cow which had just aborted, abortion has been produced in from nine to twenty-one days after inoculation.

Experience has sufficiently demonstrated that the disease is eminently contagious, and that it may be transmitted directly or by certain intermediaries through the vaginal discharge, litter, by persons who are charged with the care of the patient, by owners or veterinarians(after the extraction of the placenta from an animal which has aborted) and even by breeding males.

The transmission of the disease from a cow which has aborted to its immediate neighbors is the rule, and it is much favored by the existence, behind the animals, of a trench where the vaginal discharge and excrementitious matters accumulate.

The causes to which the disease was formerly ascribed—tainted food, rainy years, bad quality of food, permanent stabling, close breeding, etc,—are but predisposing conditions. By weakening the organism they facilitate the introduction and pullulation of the infectious matter.

Epizootic abortion may establish itself in the best kept stables—a fact which proves that uncleanliness plays but a secondary etiological role.

Nothing positive is as yet known as to its pathology. It is very probable that the infectious agents penetrate into the womb through the vagina and as, like specific agents in other diseases, their pullulation in the foetal envelopes determines sufficient alterations to lead to abortion. The process is, no doubt, propagated from the covering to the foetus, as the death of the latter seems to demonstrate antepartum in most cases of epizootic abortion.

At the present time it is not known whether the virus may penetrate into the blood through the respiratory or intestinal tracts. Some authorities consider the cause of abortion an infectious inflammation of the serous coating of the uterus. Others claim that the specific agent multiplies between the uterine mucous membrane and the chorion, that it does not exercise any noxious influence upon the former, but that it attacks the envelopes after each new conception; it would thus determine repeated abortions, and lead to sterility by communicating to the uterine secretion an acid reaction which is fatal to the spermatozoids.

In the cow, abortion generally takes place from the third to the seventh month of gestation; the symptoms are: a redness of the vaginal mucous membrane, on which we frequently observe eruptions in the form of pimples, about the size of a millet seed, discharge from the vulva of a reddish liquid, and a lessening of the lacteal secretion, which acquires the consistency of the colostrum. Three days after the appearance of the discharge the abortion takes place and gives rise only to insignificant general symptoms; the foetus is usually dead. Sometimes the mother suffers for a long time. She may become sterile.

Treatment.

The prophylaxis is very important. If once started it is impossible to prevent abortion; the medical agents are of no avail.

We must, first of all, isolate the sick animals; it is advantageous to put the healthy cows at pasture, if grass is in season. It is also necessary to destroy the after-birth and the foetus, and thoroughly disinfect the stable in which the cows have aborted; whitewash the walls and give plenty of light in the stables. About the best agent to apply to the floor is air-slaked lime. Apply it once daily after cleansing, covering the entire floor with a thin coat. In addition to the above it is well to spray the entire stable with a solution of creolin or chloro-naptholium twice or three times a week.

The cows which have aborted should not be allowed to retain the afterbirth; the same must be completely removed, and the uterus and vagina thoroughly cleansed by irrigating same with a tepid 1 to 5,000 solution of bichloride of mercury, using from 8 to 10 quarts of the solution once daily until the disappearance of the vaginal discharge. This can best be done by means of a large fountain syringe, conducting the rubber tube by hand into the fundus of the organs. Until the vaginal discharge has entirely disappeared, no cow should be used for breeding purposes.

We may also increase the resistance of all the animals by means of food rich in nitrogen and by administration of iron tonics.

Subcutaneous injections of a 2% solution of carbolic acid have been experimented with, which have given variable results. Theoretically, carbolic acid seems to be inefficient; in the organism it is rapidly transformed into sulpho-phenic acid, which is without effect.

In case of sterility, a change of bull may have a favorable influence; this has been explained by the constitutional condition of the progenitor;

it depends perhaps upon the fact that the male sometimes becomes an agent of transmission of the disease.

MILK FEVER.

This is a peculiar affection, especially prone to the best members of the dairy herd. It rarely occurs in cows with their first calves, and not often in old animals. From five to nine years appears to be the critical period. Well fed animals are more liable to the disease than those in poor condition. It generally occurs after an easy delivery, and rarely follows difficult labor or abortion. Usually it sets in within three days after parturition.

SYMPTOMS.

This disease is a form of paralysis associated with the process of parturition. First there may be noticed a vacant stare of the eyes and slight twitching of the muscles; her gait becomes unsteady, gradually losing control of her hind parts; staggering, she will finally fall to the ground, usually unable to rise. She will lie on her chest with her neck arched to one side placing her muzzle upon her flank, her eyes become fixed and glassy, her respiration labored. She grates her teeth and expresses all evidences of being in great pain. A stage of stupor will follow the above in a short time and death ensues in from 6 to 12 hours, if not relieved.

TREATMENT.

Dissolve 2½ drams of potassium iodide in a quart of water which has been previously boiled, and keep the solution as nearly as you can the temperature of the body blood. Then milk every drop of milk from the cow's udder, and clean the udder with soap and water. Then disinfect the udder and teats with a solution of zenoleum (1 teaspoonful to a pint of water). Then take a small glass funnel and attach to same a rubber hose about 5 feet long; affix to the end of this hose an ordinary milking tube, insert the milking tube into the teat and slowly pour in your solution, dividing it equally between the four teats. When this is done apply massage to entire udder for 5 or 10 minutes every hour until the cow comes to her feet. Do not allow the calf to suck during the time the cow is being treated.

If the cow is costive, remove the contents of the rectum by hand. In case of a weak heart, small doses of aromatic spirits of ammonia may be given with water every hour. Avoid large and bulky doses, or your patient may suffocate from same. If your patient is not on her feet in 8 or 10 hours, the above udder injection dose may be repeated, but it is rarely necessary. This is practically the Schmidt treatment, and is almost a specific. About the best known prevention is to avoid high feeding before calving.

BUILDING SILOS, GROWING THE CORN, AND MAKING SILAGE.

BY A. W. TROW, DAIRYMAN.

Glenville, Minn.

Silo and Silage.

To attain the best results the dairyman should have a silo, as by it the cows can be furnished with a palatable and succulent food the year round. All kinds of stock thrive on green grass and as silage has the same laxative and corrective qualities, it is equivalent to grass. By the use of silage stock may be kept in that healthy, sleek condition that cannot be otherwise obtained except when running on good summer pasture. In short, silage is grass in winter.

The silo solves the problem of storing corn fodder.

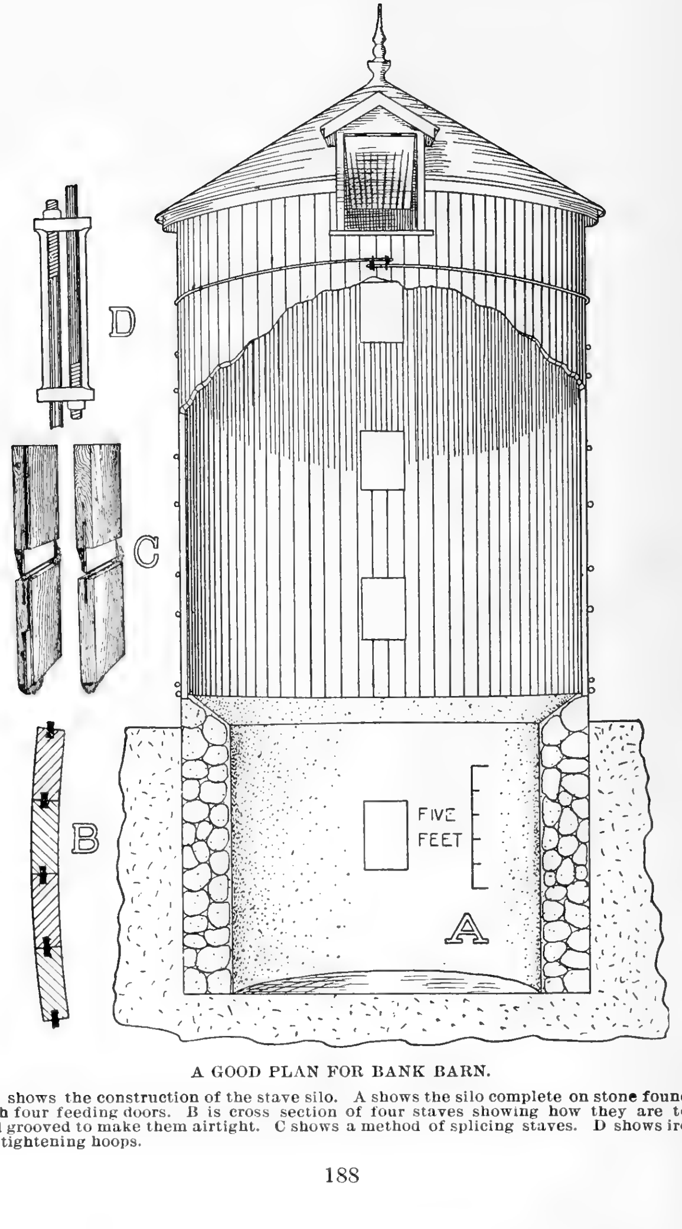
As corn fodder has come to be one of the surest and most productive of the forage crops that grow in the dairy belt, it has become necessary for us to seek the best and most convenient means of handling it. Its reliability and enormous yield renders it almost indispensible to those who would make a profitable production of milk on high priced lands.

The advent of the corn binder, which has taken the place of the old hand corn knife, has solved the question of harvesting corn fodder. However, there is yet an absence of any economical system of handling dry corn fodder in the barn in any form that brings it to the manger in a condition that is relished by the cow and consumed without waste. It is beyond the question of a doubt that for the feeding that must be done inside the barn the adoption of the silo is the only alternative.

While young stock, sheep and horses, may be fed corn fodder in sheltered yards and on well sodded pastures where the refuse will be away from the buildings, the dairy cow must receive her feed in a comfortable barn.

Silage as a Substitute for Soiling.

Many of our farmers who farm on high priced lands have practiced a system of soiling by planting corn of different periods of maturing, sorghum, peas, oats, rye and other forage plants, to furnish a green feed to partially or entirely supplement pasture. These farmers are beginning to realize



A GOOD PLAN FOR BANK BARN.

Figure shows the construction of the stave silo. A shows the silo complete on stone foundation, with four feeding doors. B is cross section of four staves showing how they are tongued and grooved to make them airtight. C shows a method of splicing staves. D shows iron lugs for tightening hoops.

that the most of these soiling crops can be dispensed with and all the feed raised at one time and in one field in the shape of corn fodder, gathered at one harvest and put into the silo for the following summer feeding, and thus eliminating the extra expense of caring for so many fields and avoid the danger of a failure in some of the many crops that must enter into a complete system of soiling.

The Expense of Storing Silage.

The expense of filling is often urged as an objection to the silo, but if a careful account of all labor is kept, of handling corn fodder by any other method by which it is so prepared that the stock will consume it as they

CORN HARVESTER AT WORK IN FIELD CUTTING CORN FOR SILO.

do silage, and in a form that it may be conveniently handled inside the barn, it will be found that the expense will be as much or more than when it is placed in the silo.

While there is more labor required for hauling in the green corn for the silo than when dry, there is also a large amount of labor saved in other ways, as when corn goes into the silo the shocking is eliminated and there is no husking, shelling or grinding.

There is not a better place for the corn grain than with the fodder in the silo.

Expense of Building.

The cost of a building or a container for silage is no more than when shelter is provided for hay, especially when a good hay barn is compared with a tub silo. Many farmers have become so accustomed to building high priced barns that they do not question the expense of a thousand-dollar hay barn, while they consider a $150 silo an extravagance.

LOCATION.

The silo should be placed close to the feeding place as silage is very heavy. If located on the outside it should be well secured to the barn, to prevent the wind from wrecking it while empty; when built above three feet from the barn the space between silo and barn can be so boarded up as to make a chute down which the silage may be thrown at feeding time.

CAPACITY.

A twenty cow dairy will need a silo about 16 feet in diameter by 26 feet high to hold the necessary silage for a six months feeding period. It has been found that a silo 36 feet high contains five times as much as one 12 feet high, which is due to the increased density by settling; it is best to build not less than 24 feet high.

A silo 25 to 30 feet deep will contain on an average approximately enough silage in one cubic foot to feed one cow one day, from this may be computed the size of silo required.

CHEAP SILOS.

Much dissatisfaction has come from building cheap tub silos, that at slight provocation have become wrecked, and no end of discouragement has followed the building of elaborate concerns which were placed inside of other buildings and lacked the proper construction and ventilation, causing them to soon become worthless from decay.

Tub silos properly constructed have been standing for ten years and are still in a good state of preservation. The main requisite is to have them made of strong staves of good material held together by a sufficient number of hoops and well secured to the barn, and the hoops kept reasonably tight while the silo is empty.

BUILDING A TUB SILO—FOUNDATION.

This should be built of good brick or stone, and settled well in the ground to keep out rats; otherwise, a cement floor should be provided to answer the same purpose. If the drainage is good, a ground floor is as good as any for the ensilage to rest upon.

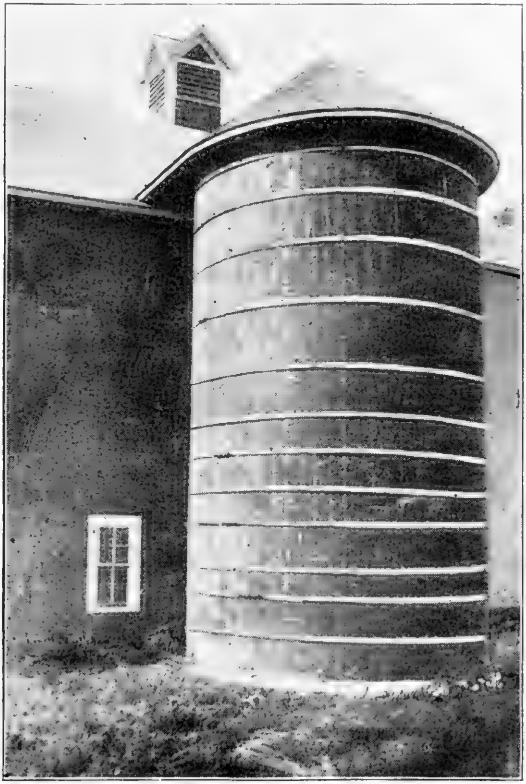
Many tub silos are now being built without a foundation. A narrow trench is dug in the ground one or two feet deep. The tub is set up in this trench and then this ditch on both sides is filled in and above the ground with a mixture of cement and sand. While this method has not passed the experimental stage it is highly recommended by some.

THE STAVES.

The tub silo is built on the same principle as a huge barrel, without the bulge in the middle. Either 2x6 for a small silo or 2x8 for a large one may be used for staves. Bevel the edges of these staves, and have them straight so that the pressure of the hoops when tightened will bring them close together, and the moisture from the silage will cause the cracks to close and render the silo air tight.

SETTING UP THE STAVES.

The most convenient plan for building this tub is to make, from cheap boards, two circles of the same diameter as the inside of the silo to be erected.



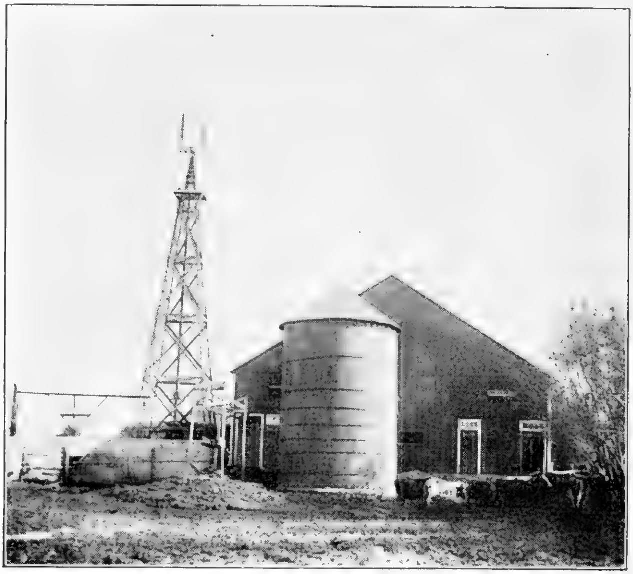
SILO WITH SHINGLE ROOF AND FLAT HOOPS.

One of these circles should be laid on the foundation, and the other supported fourteen or fifteen feet directly above the lower one. The staves can then be temporarily fastened to these circles until the hoops are put on and drawn up, after which the circles may be removed.

HOOPS.

The hoops should be made either $\frac{3}{16}$ x 3 inches flat iron, or of $\frac{5}{8}$ inch round iron, and placed two feet apart at the bottom, with a gradual increase of distance between the hoops until top ones are five feet apart. For tightening these hoops cast iron lugs may be used, or if hardwood is plenty, a very good lug can be made of a 4x6 hardwood timber.

These may be made to answer for staves by turning them edgewise. They will thus fill four inches as a stave and project four inches on the outside, through which the hoops can be tightened. It is advisable as a matter of convenience in putting up and tightening the hoops to have three or



SILO WITH BOARD ROOF AND ⅝ INCH ROUND-IRON HOOPS.

four of these lugs. If three 4x6's are used the hoops will need to be about 19 feet long, three of which will reach around an 18 foot silo.

OPENINGS.

Openings should be provided every five or six feet for taking out the silage. They should be sawed on an outward bevel from the inside. The pressure of the silage will cause this door to fit very tightly. A strip of building paper securely tacked over the inside of this, with the silage well tramped against it, will obviate all danger of spoiled silage.

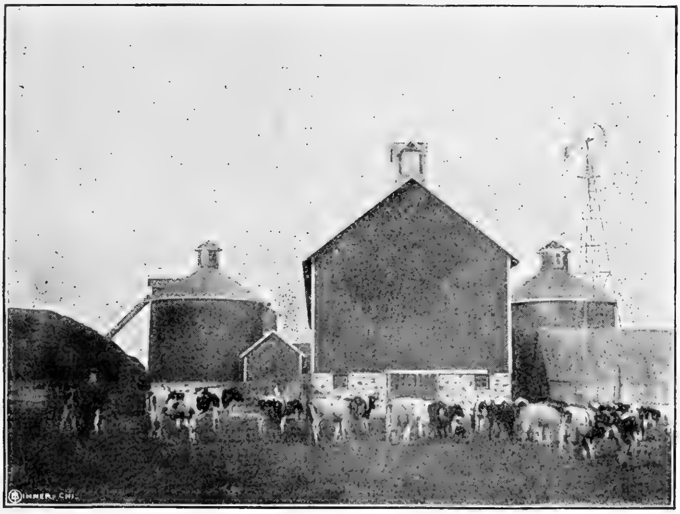
PAINTING.

A thick coating of hot coal tar, applied to the inside, will avoid any possibility of the tub leaking air, and will also do much toward preserving the wood.

ROOF.

Much time and expense will be saved if the roof is not put on until the silo is filled the first time. This will obviate the necessity of building a high and expensive staging, for the silage can be used for that purpose. The roof may be made of boards. A board roof answers every purpose, costs but a few dollars, and can be put on in a very short time. A pair of strap hinges can be fastened to two or three of the boards, which will make a cheap and convenient door for taking in the cut corn.

There is nothing to be gained by having a water proof roof, as moisture is not detrimental to silage. The main object of a roof is to keep the tub



TWO ROUND SILOS WITH STONE FOUNDATIONS AT HUBBLETON, WIS.

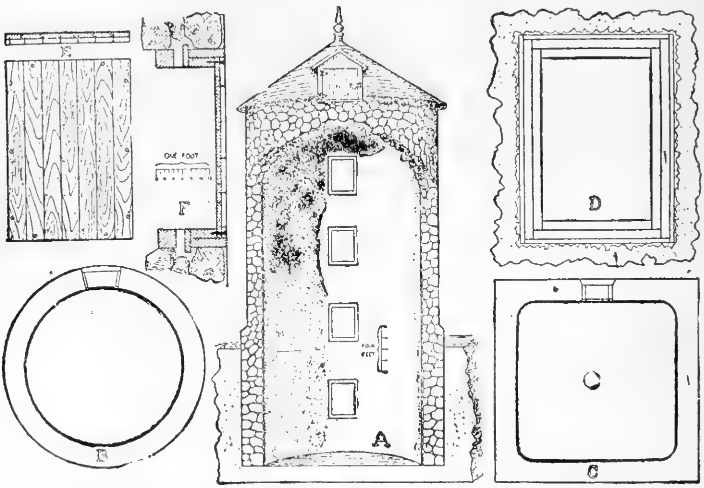
in shape while empty and keep out the snow in winter. Many silo builders are now putting on flat roofs, and some are building without any roof at all.

STONE SILO.

Another form of silo that is practically everlasting and particularly recommends itself in those localities where there is an abundant supply of stone is the stone silo. While we have had no personal experience in their construction we here compile the following suggestions and illustrations from the works of Professors Woll and King (Wisconsin Experiment Station).

The stone walls should be at least sixteen inches thick, and should be jacketed with wood on the outside, to prevent injury from frost, and to form dead air spaces, which will insure perfect preservation of the silage clear up to the silo wall. The early stone silos were not protected in this manner, and, as a result, the silage often spoiled several inches around the silo walls, the stone being more or less porous, and being a fairly good conductor of heat and cold. This applies still more to brick than to stone walls. With the outside covering nailed to studdings, 2x4, no trouble will, however, be experienced in either case. Ventilation of the silo frame must be provided for as in the case of wooden silos.

The following arrangement of constructing stone silos has proved very convenient, and will make good, substantial silos. The silo is built five to



CONSTRUCTION OF A KING CIRCULAR ALL STONE SILO.

A shows a section of the silo, with conical roof, and the arrangement of filling, and feeding doors B and C are ground plans of circular and rectangular stone silos; D, E. F shows construction of feeding doors. The construction of door jambs, to make them air tight, will be seen in the illustration. The doors are made of two layers of 4-inch matched flooring, with a layer of 2-ply saturated acid and alkali proof paper, and are held in place with large screws or lag bolts, as shown in E and F. The face of the jambs should be lined with 2-ply P. and B. Ruberoid paper or its equal; this will act as a gasket to make the door perfectly air tight.

six feet into the ground, if it can safely be done; the foundation wall is made two feet thick, and at the level of the ground a 4x6 sill is laid on the outer edge of the wall and bedded in mortar; a wooden frame is then erected of 2x6 studding, sheeted on the inside with common flooring, and on the outside with ship lap boarding, with or without building paper on the studding. The stone wall is then continued on the inside of this wooden frame up to the plate, the corners well rounded off, and the whole inside cemented.

The stone or brick wall must be made smooth by means of a heavy coat of a first-class cement. Since the acid juices of silage are apt to gradually soften the cement, it may be found necessary to protect the coating by a whitewash of pure cement every other year before the silo is filled. If this precaution is taken the silo will last for generations; some of the earliest stone silos built in this country have now been filled every season for over twenty years without deteriorating perceptibly.

Like the wooden silos, stone silos may be rectangular, square or circular; if built according to either of the first two forms the corners must be rounded off so as to assist the settling of the siloed mass, and avoid loss through insufficient settling of the mass in the corners.

PLANTING.

Corn is beyond all question the best material for making silage; however, many other materials are used, Clover, green oats, peas, and even sugar beet pulp is often used, yet it is safe to predict that the corn plant will always be the chief material used, especially in the corn belt; its enormous yield and the difficulty in handling corn fodder in other forms particularly recommends it for this purpose.

Some recommend extremely thick planting for the silo while others prefer thinner planting that will produce coarser stalks and the necessary corn to make a portion of the grain ration; in our own experience we have obtained more satisfactory results from the thinner planting thus securing a fair percentage of ears.

WHEN TO FILL.

Corn-fodder for the silo should be cut at about the same stage as for the shock, viz: when the lower leaves begin to turn yellow or when the small ears are half or two thirds dented.

MACHINERY FOR SILO FILLING.

We are frequently asked if the shredder can be used in silo filling. A shredder can be used, yet we prefer a cutter. Cut silage packs better than shredded, then most shredders are combined huskers and shredders and it is a difficult task to get the ears to go through a machine that was designed to keep the ears back. The husking rolls are made small for the purpose of snapping off the ears, while feed cutter rolls are made large or with pegs to grasp the ears. We have found it next to impossible to adjust the husking rolls so they will not snap off the ears and still give the necessary draft for feeding the machine. Last season many farmers who used the husking machines for silo filling were forced to allow the machine to husk out the green ears. Now this is a very wasteful thing to do, as there is no better nor cheaper way of handling those ears than in the silo.

There is but one way of making a satisfactory use of the combined husker and shredder for silo filling—that is, get a machine with two sets of feed rolls, one small set for husking, and for silo filling one must have a large roll that will grasp the ears, or a small roll covered with pegs of the feed cutter style. One thing is certain—the same arrangement will not work for both husking out the ears and cutting them for the silo, and one will do well to steer clear of the machine agent who advises to the contrary.

ELEVATORS VS. BLOWERS.

Formerly all feed cutters were provided with sprocket wheel and chain elevators for elevating the cut fodder. Recently many firms have displaced their elevators with blowers. They are much more convenient than the elevators providing they are substantially made and have the necessary force to blow the fodder to the top of the silo. Many purchasers have been recently disappointed by getting machines that would not blow the fodder over 20 feet high, hence it is wise to exercise caution in selecting a blower.

SIZE OF CUTTER.

The size of feed cutter mouth should be large enough to take a good sized bundle of corn, for when it is necessary to divide the bundle the feeding becomes very slow and tiresome.

POINTERS ON SILO FILLING.

Don't fill the silo until the corn begins to glaze or you will have sour ensilage.

Don't allow the fodder to wilt badly before putting into the silo, or it will lose much of its succulence and not thoroughly pack.

Cut fine and pack well to exclude the air, as air promotes decomposition.

Do the best part of the tramping about the edge.

If you are without silo experience, don't try experiments, but take advice straight from those who have succeeded.

Keep the elevator chain very tight, as a loose chain is liable to jump sprockets and cause a bad wreck before the power can be stopped.

Don't wait for the dew to dry off nor stop for a rain while filling silo, if you can keep the men at work, for water does no harm.

If possible, leave the top of the silo open after filling, as a frequent wetting maintains a damp surface mold, that excludes the air. If it is impossible to leave the top exposed, a frequent wetting and tramping down will be very beneficial.

If your corn gets frosted or badly wilted, place a barrel above the foot of elevator, fill with water and make a small hole at the bottom that will allow enough water to escape to make the fodder heavy as it was while green.

THE PHYSIOLOGY OF MILK SECRETION—WITH NOTES ON THE EFFECT OF FOODS, DRUGS, EXPOSURE, EXERCISE AND ABNORMAL BODILY CONDITION.

BY A. W. BITTING, M. D., INSPECTOR, CITY BOARD OF HEALTH, LABORATORY OF COMPARATIVE PATHOLOGY, INDIANA AGRICULTURAL EXPERIMENT STATION.

Lafayette, Ind.

In reproduction among the higher animals, the offspring at birth are not sufficiently matured to be able to subsist alone; neither are they surrounded by food that is already prepared for them. It is therefore necessary that Nature should provide for a part or whole dependence upon the mother for subsistence, during such time as is required for development to a state capable of independent existence. As a means to this end we find a mammary gland in a very large group of animals, the secretion from which is known as milk, and is a perfect food. Milk contains all the nutriment required by a growing body, in proper proportions, in a palatable and easily digestible form. For these reasons persistent efforts have been made to domesticate animals and develop this function to the highest degree as a source of food for people. How successful these attempts have been is exemplified in the milking capacities of several animals now used for this purpose. Animals in a wild state furnish a quantity of milk only sufficient for the young, and only for such time as is necessary for their maintenance. Under domestication, the cow in particular, has been developed to produce a quantity sufficient to support several offspring, and to keep up the secretion almost continuously.

The mammary gland being an accessory organ of generation, it is but natural that it should be rudimentary at birth and without function. It remains in this condition until the reproductive function becomes active, at which time it begins to develop quite rapidly, and continues to do so until the end of the first period of gestation. Like other organs of the body, it grows with the general growth, and from usage. Its functional activity does not ordinarily begin until near the close of the period of gestation, reaches its maximum at from ten to fifteen days thereafter, and then gradually declines and practically ceases in from six to ten months. If the gland should be examined at birth, a whitish fluid will be found in the ducts, but it is not true milk. True milk may occur however, at a very early date, and without the stimulus of pregnancy. A case as follows came under the notice of the writer. A farmer gave a young calf to his son to feed and care for. The little fellow began going through the motions of milking his pet, and in the course of a few weeks surprised his father by producing a half pint of milk. While this is an exceptional quantity for a young calf, the observation has frequently been made that small quantities will be present in the udders of calves that suckle each other while being weaned. Gabby reports the case of a heifer that had never showed signs of œstrum, suddenly developing a large udder and was milked constantly for three years.

The male is possessed of a rudimentary mammary gland, but the writer is not aware that it ever develops functional activity under any form of stimulus in the lower animals.

THE CHARACTERISTICS OF MILK.

The first secretion of the mammary gland before or immediately after birth, is an acrid, viscous, yellowish fluid, having slightly alkaline reaction and a specific gravity greater than water. It is called colostrum, and immediately precedes the true milk secretion. Colostrum differs from milk in that it contains a higher per cent of total solids, largely of an albuminoid character, also in the abundance of mineral salts. The albuminoid substance is present in the form of small organized bodies, varying in size from a small fat globule to five or six times the size of large fat globules, and are known as colostrum corpuscles. These colostrum corpuscles are the cells which have been lying quiescent in the alveoli of the gland. Upon the sudden development of functional activity in the gland, these are swept away. The increased albuminoid content is so marked that it may be detected by simply heating, as well as by the more delicate chemical methods. The fat, the casein and milk sugar are present in less quantity than in normal milk. The taste is slightly acid, the odor strongly animal, and sometimes putrescent. The effect upon the body is as a mild cathartic. The transition from colostrum to milk is gradual, requiring from three to six days. If a cow be milked constantly, no colostrum, or only a slight quantity, will be present, showing that it is the result of the resting of the cells, and not a special product.

Milk is the normal secretion of the mammary gland. It is a true emulsion, an opaque, bluish white or yellowish white liquid, slightly heavier and more viscous than water, is nearly neutral, possessed of a slight animal odor and a pleasant sweetish taste.

The odor of milk is due to the extremely small particles of fat, casein and insoluble ash held in suspension. Each species of animal has its peculiar odor, and in addition it may be affected to some degree by the feed. The fat gives a yellowish tint and the casein and ash the opalescent appearance

By many, yellowishness is regarded as an indication of richness. While yellowish milk is usually rich, it does not necessarily follow that white milk may not be rich. The yellowish character is to a certain extent also a breed characteristic. The bluish color has the effect of neutralizing the yellow and making the whole have a whiter appearance than it otherwise would.

The specific gravity of milk varies from 1.029 to 1.035, the average being 1.032. The variation is with the per cent. of total solids present and not with the per cent. of fat. A very high per cent. of fat will have the effect of lowering the specific gravity, but the relation between the specific gravity and fat is not sufficiently close to warrant using the former in estimating the latter.

The viscosity of milk is greater than that of water, on account of the character of the solids it contains, and especially upon the state of aggregation of the fat globules.

The reaction of milk is variable. The milk of the herbivora is generally described as normally alkaline, but at times it is also said to be possessed of an amphigenic reaction, that is both alkaline and acid. In 1892, Professor Huston of this station, made a series of experiments to determine the reaction of milk, and obtained an acid reaction in all cases. His method differed from those usually described and is as follows: To 25 c. c. of milk 5 c. c. of normal H. Cl. solution was added to get a positive acid reaction, then titrating with one-half normal potassic hydrate solution until a neutral reaction occurred. In freshly drawn milk (28 samples) it required .01648 c. c. of normal potassic hydrate to neutralize 1 c. c. of warm milk, or .01694 c. c. to neutralize the same quantity of cooled milk. The acidity of milk after standing, is from changes which it undergoes through bacterial fermentation.

The milk of all animals shows essentially the same constituents, and analysis shows that these apparently differ only in the relative proportion of the several constituents present, a condition analogous to the body fat.

The composition of milk is of a very complex character. It consists of a mixture containing water, proteids, carbohydrates, organic and inorganic acids, and animal salts. Minute quantities of ammonia, urea, hypoxanthin, chyme, chyle, biliverdin, cholestrin, mucin, lecithin, kreatin, leucin and tyrosin are sometimes present.

A much used classification is as follows: Water, fats, albuminoids and ash. All the constituents taken together, except the water are known as milk solids. These comprise from 12 to 15 per cent. of the total. Vieth compiled the results of 120,540 analyses, covering a period of eleven years and found the average per cent. of solids in milk to be as follows:

Total solids	12.9
Solids not fat	8.8
Fat	4.1

The solids exist in milk in solution, in semi-solution and in suspension. Analyses of cows' milk, as quoted by Wing,[1] are given in table 1.

TABLE 1.

Substances.	American (Babcock)	English (Oliver)	German (Fleischman)	Freuch (Cornevin)
Water	87.17	87.60	87.75	87.75
Fat	3.69	3.25	3.40	3.30
Casein	3.02	3.40	2.80	3.00
Albumen	.55	.45	.70	.....
Sugar	4.88	4.55	4.60	4.80
Ash	.71	.75	.75	.75

Peter Collier of the New York Experiment Station made analyses of milk during one entire period of lactation, from several breeds of cows, with the following results:

TABLE 2.

ANALYSES OF COWS' MILK AS GIVEN BY COLLIER.[2]

Breed.	Number analyses	Water	Total solids	Solids not fat	Fat	Casein	Milk Sugar	Ash	Nitrogen	Daily yield
Holstein	132	87.62	12.39	9.07	3.46	3.39	4.84	.735	.540	22.65
Ayrshire	252	86.95	13.06	9.35	3.57	3.43	5.33	.696	.543	18.40
Jersey	238	84.60	15.40	9.80	5.61	3.91	5.15	.743	.618	14.07
American Holderness	124	87.35	12.63	9.08	3.55	3.39	5.01	.698	.533	13.40
Guernsey	...	85.39	14.60	9.47	5.12	3.61	5.11	.753	.570	16.00
Devon	112	86.26	13.77	9.60	4.15	3.76	5.07	.760	.595	12.65
Average	172	86.37	13.64	9.40	4.24	3.50	5.05	.731	.534	16.20

1 Milk and its Products. H. H. Wing, 1897.

2 New York State Experiment Station, Rept. 1891.

According to Koenig, the limits of variation as collected from about 800 analyses taken from all parts of the world are as follows:

	Maximum.	Minimum.
Water	90.69	80.32
Fat	6.47	1.67
Casein	4.23	1.79
Albumen	1.44	.25
Sugar	6.03	2.11
Ash	1.21	.35

While the range of variation seems considerable, some of the constituents, notably that of fat, may show even greater variation, in milk secreted by normal, healthy cows. Babcock found the milk of a single cow giving a small quantity, contained as high as 10 per cent. of fat. He further states that no analysis showing more than 9 per cent. of fat is recorded from a cow giving more than 15 pounds of milk per day.

When milk is examined under the microscope, it appears as a clear liquid in which are suspended an immense number of spherical bodies that are of a light yellowish appearance and are highly refractive. These constitute the fatty part of the milk and are known as milk globules. Their small size and the viscous nature of the milk serum, tend to prevent the coalescence of the globules. The size of these globules varies in all milks varying from 2 mmm. up to 30 mmm.'s in diameter (1 mmm. equals 1—25,000 of an inch). The size also varies with the milk drawn, whether it be first, middle or last drawn, as may be seen by the following records given in table 3.

TABLE 3.

NUMBER OF GLOBULES OF EACH SIZE PER THOUSAND GLOBULES.

Size in Mmm's	1st milk	Middle milk	Last milk	Whole milk	Skim milk
4	95	18	68	70	365
6	220	90	153	190	425
8	427	215	238	319	120
12	152	443	204	180	54
16	67	180	127	121	24
20	20	54	85	76	12
24	10	00	25	19	...
28	9	00	00	...	...

As the period of lactation advances the globules increase in number and the average size diminishes, so that after several months the total number of globules per cubic centimeter may be two or three times as great as at first, but the size correspondingly smaller and the per cent. of fat approximately the same.

P. Collier records[1] the results of a large number of determinations of the size of the globules in the milk of different breeds. The size of the globules diminishes as the period of lactation advances, that is the relative number of large globules diminishes and the smaller globules increase. He found[2] that the relative number was 100 in the first quarter, 137 in the second quarter, 149 in the third quarter, and 187 in the fourth quarter of the period of lactation. That is, a given quantity of milk contained 89 per cent. more fat globules in the last quarter than in the first.

O. Schnellenberger[3] found essentially the same thing, and estimated that a liter of milk contained 2,480 millions of globules at the beginning and 4,449 millions of globules at the end of the period of lactation.

F. W. Woll agrees with the previously cited writers and further adds that age has no apparent effect, and that the morning milk contains more large globules than the evening milk.

The milk from certain breeds, as Jerseys and Guernseys, is characterized by large globules, while that of other breeds, as Ayrshires and Holsteins, usually contain small globules. There is, however, a wide individual difference in all breeds, Jerseys sometimes producing small globules and Holsteins large ones. In normal milk the globules are uniformly distributed throughout the whole mass, but to a greater or less extent collected in groups. For a long time it was thought that each cell was surrounded by its own membrane, the membrane of Acherson. This membrane was supposed to be derived from the cell of protoplasm. According to Babcock no such membrane exists, and he is supported in this view by nearly all recent investigators. It is now considered that milk is a natural emulsion, and that what appears to be a membrane is not different from what is seen in other emulsions, having the fat similarly divided.

The fat of milk is very complex, being a mixture of six or eight distinct fats, some being volatile and others not. The following in Table 4 is the composition submitted by Wiley.[4]

TABLE 4.

COMPOSITION OF BUTTER.

INSOLUBLE FATS.

Olein	42.21	Oleic acid	40.40
Stearin and palmatin	50.00	Stearic and palmic acid	47.50
	92.21		87.90

1 New York Experiment Station, Report 1891.

2 Experiment Station Record, Volume V., p. 95.

3 Experiment Station Record, Volume V. p. 95.

4 Principles and practice of Agricultural Analysis. H. W. Wiley, 1897.

SOLUBLE FATS.

Butyrin	4.67	Butyric acid	3.49
Caproin	3.02	Caproic acid	2.40
Caprylin and Rutin	.10	Caprylic acid and Rutic acid	.80
	7.79		6.69

The insoluble solids constitute a little more than 92 per cent. of the total fat, are stable and suffer little from the organized ferments. They are tasteless and nearly neutral. They are composed of glycerol united with fatty acids. The peculiarity of these fats lies in the proportion of the different ones present. The presence of a greater proportion of stearin raises the melting point, while a high proportion of olein lowers it.

The proportion of these fats is fairly constant, but in the case of feeding cotton seed meal to cattle, the melting point of butter is raised and would seem to indicate that the per cent. of stearin was increased. No analyses are available to determine whether this is the case or not.

The volatile fats constitute less than eight per cent. of the total fats in milk, but they are of great importance, as they impart the taste and odor and give the peculiar animal characteristics.They are probably more easily affected than any other constituent of milk.

The casein is the chief proteid constituent of milk. It is insoluble in water and exists in milk in a semi-colloidal condition. It differs from other proteids in that it is coagulated by rennet and dilute acid, but not by heat.

Albumen is the soluble proteid of milk, and is similar to blood albumen. It is coagulated by heat when subjected to a temperature of 175 to 180 degrees Fahr.

Lactose or milk sugar is a carbohydrate peculiar to milk, as it is found nowhere else. It differs from cane sugar in that it is less soluble in water, has less specific gravity, only a slightly sweetish taste, does not readily undergo alcoholic fermentation, but is easily broken up by lactic acid forming bacteria.

Babcock and Russell have demonstrated that milk also contains an organized enzyme, which will cause slow changes upon standing. Their studies have not been continued for a sufficient length of time to give it a full description.

The organic acid is citric acid, and probably exists most often in combination with calcium and potassium.

The ash or inorganic constituents of milk represent less than one per cent. They exist in compounds of sodium, magnesium, calcium, iron and phosphorus.

These salts exist in soluble and insoluble states. The soluble salts are sodium chloride and potassium citrate, and the insoluble phosphates of magnesium, calcium, potassium and iron.

It is also of interest to note in this connection that the inorganic matter in milk exists in the same relative proportions as in the new born. The salts in milk do not exist in the same relative proportion as in the blood which also tends to disprove the theory so long maintained that the separation of milk is largely a process of transudation.

QUANTITY AND QUALITY OF MILK SECRETED.

Wild animals secrete only a sufficient quantity of milk to meet the needs of their young until they become sufficiently developed to secure their own food. Under the influence of domestication the functional activity of the gland has been greatly developed both in the quantity produced and in the duration of the period of lactation. In all good dairy cows the period should extend over several months, and in some it is practically continuous. The average yield per cow is less than 4,000 pounds per annum, but in good dairies it is more nearly 6,000 pounds, and in individuals it will greatly exceed that amount. In one instance it was over 30,000 pounds.

The flow of milk is greatest shortly after parturition and gradually decreases until the close of lactation.

As milk is dependent upon the metabolism of the mammary gland, this is in turn dependent upon the quantity of blood passing through it. For large milking capacity it is necessary that there should be large glandular development, but more important still, a large circulation of blood in the part. The cow must receive an ample supply of food and have the capacity to eat, digest, assimilate and turn into blood the elements necessary to form milk. Some time after parturition there is a tendency toward a shrinkage of the vessels of the udder, and this becomes more marked as the period of gestation advances. All the excess nutrition of the body is needed for the developing foetus, and hence a lessening of the functional activity of the gland. That pregnancy is an influence tending to diminish milk secretion is demonstrated by the fact that spayed cows will continue to produce milk a long time, even two to five years, during which time the quantity and quality make a very gradual decrease. While pregnancy has its influence upon the period of lactation there are other factors that are of even greater importance and cannot be overlooked, the most important of which is the regularity and thoroughness of the emptying of the gland. If the milking process be done at irregular intervals or incompletely, the activity of the gland soon ceases. Shortage of feed or water, or disease may result in immediate cessation of secretion. The ordinary period of lactation is from nine to ten months throughout the life of the animal. The first and second periods are somewhat shorter.

The quantity and quality of milk secreted each day is fairly constant. Variations do occur within certain limits and may be due to numerous causes. In general, the evening milk contains about a half per cent. more fat than morning milk, but the latter exceeds the former by about 25 per cent. in quantity. An attempt has been made to explain this by attributing it to the fall in temperature during the night, requiring some of the fat to keep up the body heat and to the lessened activity of the animal. Fleischmann and Vieth experimented upon a German herd of 119 cows, and found that the fat in the evening milk not only varied within wider limits than in the morning's milk, but also observed that from March until July, the period of greatest activity of the gland, that the morning milk was richer in fats than the evening milk. The difference in the quantity of milk drawn morning and evening is due in part to the greater length of time allowed to elapse between the evening and morning milking. This may possibly also account for some of the differences in the percentage of fat. In general the milk richest in fat is that drawn after the shortest period, and this has been shown to be true in cases where cows have been milked three or four times a day. After the third or fourth week of lactation the percentage of fat in the milk remains nearly constant until the seventh or eighth month, or until the quantity of milk begins to rapidly diminish.

The daily variations in the milk are sometimes considerable. Such variations may be ascribed to changes in the weather, temperature, food, surroundings, indisposition, etc.

The monthly variations in the quantity and quality of the milk are less marked, than the daily variations. Cows coming fresh in the spring rapidly better the quality of their milk, beginning about five months after calving, but cows coming in in the fall maintain a fairly even quality throughout their entire period of lactation. The quantity of milk is augmented when cattle are first turned out to pasture and during drouth, but this must be ascribed to food conditions, and not to seasonal variations. The richest milk is produced after the seventh month.

The yearly changes in quantity are slight. The increase in the second and third producing years is marked, but after that it is rarely more than 3 per cent. The changes are so dependent upon feeding that no conclusions can be drawn upon this point.

The percentage of the fat in milk is affected by the age of the cow. The young cow produces a milk poorer in fat than during vigorous middle age. The fat may fall to a very low per cent in old age.

There is considerable difference in the percentage of fat in the milk taken at the different parts of the milking. Schmidt made complete analyses of first drawn milk and last drawn milk, and found that this difference was almost wholly due to the fat, there being eight times more fat in the end milk than in the fore milk. We have made many tests of the fat and found the per cent. to be about five times as great in the end as in the fore milk. The explanation offered for this is that the fat at first lodges or adheres to the lactiferous ducts, and that in reality a separation of cream begins in the udder, and this fat would as far as circumstances permitted, seek to float on the denser fluid in the cisterns and teats. The udder of a cow killed immediately after milking showed on examination, that the ducts contained a residue of rich milk and it is probable that the whole of the fat is never drawn at each milking.

There has been a large number of theories advanced as to the methods by which milk is elaborated, most of them based upon the assumption that it is a comparatively simple chemical and physical problem. All the earlier theories were based upon such assumption, the physiologist regarding the mammary gland as an organ to separate certain elements from the blood in definite proportions as milk. It was regarded that the process was largely one of transudation through a special membrane, on the same principle that exchange of gases by osmosis, occurs rapidly in the tissues of the lungs. It was assumed that the fat of the food, and the water and the salts taken into the alimentary canal were absorbed and taken into the blood and then eliminated by the mammary gland. The milk serum was regarded as escaped blood serum, and that the other products were derived from the blood or epithelial cells. The gland was assumed to be a semi-passive organ, receiving the milk already prepared, and only requiring elimination in the proper proportions.

It was upon the foregoing assumption, that the great majority of experiments have been made for the purpose of augmenting the quantity or quality of the milk. If this assumption were correct, then the quantity or quality of milk produced would only be limited by the ability to digest and assimilate food.

Probably the most satisfactorily planned and executed experiment to settle this theory was made by Jordan and Jenter.[1] The object was to determine whether the fat in the milk was derived from the fat in the food. During the entire experiment of fifty-nine days, analyses were taken of the feeds and milk and the urine and faeces collected to determine where everything had gone. For two weeks the cow (a grade Jersey) was fed on ten pounds of timothy hay, six pounds of corn meal, five pounds of ground oats and one pound of wheat gluten. Then the same foods were fed with all or very nearly all the fat extracted. For a short time after the change there was a decided variation in the milk solids, but this was soon overcome, and the milk regained its normal composition and maintained it with only slight variations, that could not be assigned to any cause, throughout the entire period. The milk fat yield for the seventy-five days was 62.9 pounds and the food fat contained 11.6 pounds, of which only 5.7 pounds were digested. This extra fat could not have come from the previously stored body fat, because in the beginning of the experiment the cow was thin in flesh and gained forty-seven pounds of body weight, and was judged to be a fatter cow at the end than at the beginning. The milk fat could not have come from the protein, because during the fifty-nine consecutive days, 38.8 pounds of milk fat was secreted and the urine nitrogen was equal to about 33 pounds of protein. According to any

1 Bulletin 132 New York State Experiment Station.

accepted method of interpretation, not over 17 pounds of fat could have been produced from this amount of neutralized protein. For the greater part of the milk fat, they could draw no other conclusions than that it is formed partially at least, from the carbohydrates. Several experimenters have proven that body fat may be formed from carbohydrates, and the foregoing experiment only strengthens the analogy between milk and body fat in this mode of formation. This experiment completely disproves the transudation theory, as the conditions under which it was conducted were wholly under control. It further offers an explanation for the results of many other experiments conducted along the same line, but not so completely carried out.

The transudation theory also meets a serious set back in the fact that the fats in the milk are unlike the fats in the food or body, and that casein and milk sugar are not found in the blood or the gland itself.

Another theory that has had many supporters, is that milk is the result of the separating of part of its constituents, as the water serum and salt from the blood, and part due to a fatty degeneration of the cells lining the alveolar cavities, the fat globules being due to the degenerated cells and the casein due to the undegenerated portion of the cells. This theory is actively supported by many of the best physiologists. Smith, after examining all the phases of milk secretion, sums up the whole as follows: "The process of milk secretion may therefore be regarded as a process of metabolism of the epithelial cells, which undergo decomposition, and discharge the resulting products into the excretory ducts." He regards "fat as a product of fatty degeneration of the protoplasmic cell contents, for it is not increased but actually diminished by an increase of fat in the foods. On the other hand an increase of proteids in the diet will cause an increase in milk fat. In microscopic examination of the epithelial cells of the mammary gland, oil globules may be actually seen to increase in size and number, until often the protoplasmic content becomes almost entirely replaced by oil globules which entirely agree in their characteristics with the oil globules found in milk." In feeding animals on a highly albuminous diet, they increase in weight and produce more fat in the milk, at the same time showing that they cannot be filling the pail from adipose tissue. However in herbivora not enough albuminoids are being taken up to account for this fact, so that some must be derived from the blood.

P. Collier made an investigation[1] to determine the number of fat globules found in milk in a given time. He made his observations on a large number of cows and found on an average each secreted seven-tenths of a pound or nearly 19.6 cubic inches of milk per hour, and that there were 152 fat globules in each .0001 cubic inch of milk. He concluded that this was equivalent to secreting 136,000,000 fat globules per second. He

1 New York State Experiment Station, Rept. 1891.

duplicated his work on twenty-three other cows, and found they secreted on an average of 138,200,000 fat globules per second. Collier also recognized the fact that milk contains ingredients that must be the result of some special activity, as the casein and milk sugar are not present in the blood, and the fat only in traces, thus precluding the possibility of being derived by transudation. A good cow may produce two and a half kilograms of albuminoids, fat and sugar. (five pounds). The weight of the total solids of a gland producing that amount of milk solids is only about 1.16 kilograms (two and one-fourth pounds) which would necessitate a complete renewal of tissue 2.09 times a day. He might have added that the epithelial cells constitute only a small part of the gland structure, and it would therefore require even more rapid renewal. This would require an almost incredible cell growth, so that we are forced to assume that although the growth and disappearance of certain cells is of the greatest importance, the organic substances in milk are modified from substances in the blood and lymph into the forms we find them in milk, by the functional activity of the cells. The estimates upon the rate of cell multiplication as made by Dr. Collier are only approximate, but are certainly near enough to the truth to warrant drawing the conclusion that fat is not the result of fatty degeneration of the cells. In fact such a process is incompatible with our knowledge of the physiology of cell reproduction or disintegration.

Soxhlet has recently advanced the theory[1] that milk is the result of the disorganization of tissues, either as according to Voit, of the milk glands themselves or, according to Rauber, of the white blood corpuscle. Thus according to Soxhlet the constituents of food cannot be directly converted into components of milk, but must first be used for the construction of some tissue and afterwards be decomposed and then utilized in the production of milk fat. A normal butter fat could then be produced by food devoid of fat, and feeding any kind of food devoid of fat although rich in fat forming constituents, would not have the effect of changing the character of the milk fat present in milk. Abundant feeding with nutritive but non-fatty foods, could only increase the percentage of decomposing milk tissue. Carbohydrates could contribute to the body fat, but not to the milk fat, because they contribute nothing to the milk producing tissues, but on the contrary, when fed in conjunction with food poor in protein, they diminish the milk fat because the total diminishes the amount of nitrogenous food, that is, substances which produce tissue. It is only fat in food which renders the exclusive increase of milk fat possible, by causing a migration of body fat to the milk.

A close examination of the theory, and the explanation given by Soxhlet, shows that it explains many phenomena that could not be explained by the transudation or cell disintegration theories. It must be admitted

1 Journal Royal Agricultural Society, 3d Ser., Vol. III, pp. 655-662.

however, that it ignores any special constructive power in the gland itself, and treats milk as an excretory product.

The latest theory is to regard milk as a product of metabolism of the cells of the mammary gland. It is in all essential characters a secretory product, and not an excretory product. In viewing the physiology of the formation of milk in such a light, it is only regarding it in the same way as saliva, gastric and pancreatic juices. It may be argued that these glands secrete a special product to be used in the animal economy, while milk is not so used. All excretory glands, as the kidneys, liver and sweat glands, find their material already prepared in the blood, the result of activity in other parts of the body, and they serve as a means of eliminating it. Secretory glands, as the pancreas, salivary glands, etc., do not find their active principles in the blood, but construct them within their own especial cells. The mammary gland does not find fat, casein and lactose in the blood, but constructs them within its own tissues. The recognition of the mammary gland as an organ having a special function will explain fully all the difficulties met in trying to reconcile all other theories with the facts as they are observed.

The theory of special cell metabolism is supported by the behavior of the gland, viewed from an anatomical standpoint. The cells differ when at rest and when active. When at rest the cells lining the alveoli lie flat and close to the wall. Their nuclei are small and spindleform. During a period of activity they are much enlarged, filling nearly the entire cavity, and the nuclei are prominent. The cells may be seen in all stages of reproduction, and in these particulars the gland shows the same characters as seen in the secreting glands already mentioned.

This theory is further sustained by the antecedents of the milk. When fat is taken into the intestine and assimilated, it no longer has an existence as fat, but is broken up into various combinations. Fat as deposited in the body is not the same as the fat in the food. The proportions of olein and stearin have been changed to meet the peculiarity of the animal. Where the analytic and synthetic process take place is not known. It is now recognized that it is not necessary that the fat in the body be derived from the fat of the food, but that the carbohydrates supply the necessary materials. With these proofs of synthetic process going on, to produce body fat, it is not unreasonable to suppose that a similar process may take place in the formation of milk.

The milk sugar or lactose is a product of metabolic activity of the protoplasm of the secreting cells of the mammary gland. This particular form of sugar occurs nowhere else in the body. It is a typical carbohydrate, and is found in the milk of animals fed exclusively upon meat, thus showing that the carbohydrates of the food are wholly unnecessary. Of all the constituents the milk sugar is least affected by external conditions.

The casein of milk is thought to be formed the same as the fat, although authorities differ on this point. The evidence seems to be in favor of this theory, for at the beginning and at the end of lactation the albumin which is normally less than one-seventh of the casein, is actually in excess of it, and albumin is a normal constituent of both blood and milk. Smith says casein is developed at the expense of the albuminous cell contents, since it is absent from the blood. The alkali albuminate is derived from the breaking down of the protoplasm and nuclein, which is always found as a part of the casein and is derived from the nucleus which disappears in the process of secretion. The proportion of casein in the milk is increased by greater perfection in the activity of the cells. In the formation of colostrum, the albuminoid matter is greatly in excess of that after secretion is well established, and with the decrease of albumin, there is a proportionate increase in casein. A ferment has been extracted from the mammary gland which will convert albumin into casein.

The water, no doubt, passes directly from the capillaries into the milk follicles, and carrying with it the mineral constituents in solution.

The functions of the mammary gland are performed involuntarily. There seems to be some connection between the mammary gland and the central nervous system, but how much control can be exercised by will, has not been determined. Locally the stimulus seems to be the empty milk duct, for when the ducts become full, the secretion is partially checked, but is considerably stimulated during the process of emptying.

INFLUENCES AFFECTING MILK PRODUCTION.

Breed.—Heredity has a most marked effect upon milk production. The different breeds are the result of the selection of animals of certain types, and some have been selected to produce very rich milk, others large quantities of milk and in others no attention has been paid to this quality. The difference in the quality of milk due to breed, includes not only the amount of fat, the color and melting point of the fat, but also the size of the milk globules. In some breeds the globules are large, in some they are small, and in some they may be mixed, large and small. While the breed has a most marked influence, there is also considerable variation of the individuals in each breed.

No figures are available, that give a good index to the amount of milk and the period of lactation in the different breeds of cattle in this country. The only animals of which we have record are individuals mainly owned by Experiment Stations, or in breeding establishments, which are of more than average in quality.

Heredity.—As a breed represents only the characters of individuals fixed by selection for successive generations, it is but natural that we should find like influences in families, but in a less marked degree. Heredity has its effect in stamping individuality, both in the quantity and quality, and no stronger proof is needed than the records of the noted families of the breeds.

Age.—Age will influence the quantity of milk. From two until five years there is a gradual increase in the quantity, after which time it remains about the same during the periods of activity, until the age of eleven or twelve years, and then it decreases.

PREGNANCY.—This state always has the effect of decreasing the flow, first due to a tendency for the body to take on flesh for a time after conception, and in a later period the nutrition is utilized for the fœtus. It is in respect to the period of lactation that individuals show the widest variation. With many, the effect of again becoming pregnant is so slight as to be scarcely noticeable, and with others it is so great as to interfere with the usefulness of the animal.

THE INFLUENCE OF FOOD UPON MILK SECRETION.

During the period when physiologists attempted to explain practically all changes upon chemical and physical bases, the teaching was that milk resulted from a separation of its constituent elements from the blood, the separation taking place in the udder. Upon this teaching the belief became fixed that the quantity and quality of the milk secretion was in a measure dependent upon the amount and kind of food the animals received. The influence of this teaching is still potent; many elaborately planned experiments have been made by individuals and Government Experiment Stations to determine the truth or falsity of this view. The results have been very confusing, unless all the data be known. It must be admitted that a large per cent. of practical dairymen believe they can take poor or average cows, and by good feed and management greatly increase the quantity and better the quality of the milk produced. The results at Experiment Stations have not been wholly in accord with this view. No doubt but that the dairyman taking a cow in poor condition, scarcely receiving sufficient food to maintain the body nutrition, and giving her good care and abundant feed, will be able to increase both the yield and quality. The Experiment Station or person who takes an animal in a good state of nutrition, and feeds highly, may still further increase the flow or maintain it, and may improve the quality for a short time but not permanently. The error too often committed by the dairyman in drawing a proper conclusion, is, first, testing the milk for quantity and quality which is below the normal for the animal because of her impoverished condition, and second, in drawing the conclusions from the temporary change occurring soon after the change in food. The experiment stations, as a rule, use only well nourished cattle, and consequently do not find such marked changes, and furthermore they keep the records for a longer period of time, so that the conclusions are not biased by the incomplete data obtained from the temporary changes. Among those who believe that the quality of milk is practically a fixed character in any given individual and not subject to more than temporary variation by the feeding, are G. H. Whitcher and S. M. Babcock.[1] The latter sums up the matter as follows:—"My opinion is, that the quality of milk so far as it is measured by the per cent. of fat, depends almost entirely upon

1 Rural New Yorker, July 15, 1891.

individual peculiarities of the animal and so long as sufficient food is supplied and consumed, very little depends upon the kind of food. External conditions, which often are not apparent, seem to have a greater influence upon the richness of milk than the kind of feed. This is shown by the fact that the daily variations in the per cent. of fat in the milk from the same cow, when no change has been made in the ration are often greater than occur when a radical change in the food is made." Furthermore, the same ration will affect different animals differently. According to this theory, the man who endeavors to keep up the standard of his milk by careful feeding cannot attain that end, and has no advantage over his neighbor who uses the cheapest ration possible.

According to other writers, as Youatt[1] and Wing[2] the food has considerable influence upon the quality, but not to the same extent as the quantity. In fact, with cows kept under favorable conditions, with an abundant supply of food, it is hardly possible to increase the proportion of fat to other solids by a change in the food. While the total solids cannot be easily affected, the character of the constituents may be influenced and this is notably so of the fat. For example linseed meal, gluten meal and certain other foods make a soft oily fat, while cottonseed meal, the seeds of the various legumes, and wheat bran make a hard fat. The constituents,. other than fat, are not so easily affected. when cows are fed on watery herbage, brewers' grains or other food containing a high percentage of water, the milk becomes poorer in solids. The explanation offered for this last condition is based on the assumption of a more watery character of the blood, due to excess of water in the food. A poor, watery diet impoverishes the blood, and leads to the production of watery milk.

The assumption of a watery diet producing a watery milk is not fully in accord with close observation, as it has been found that the fat content is not diminished by turning cattle from dry feed to pasture. It is in line, however, with the statements so frequently accredited to health boards, that cattle fed on brewers' grains and starch refuse, have a lower fat content in the milk than those using dry feeds. My own analyses do not show sufficient difference to be able to decide from the milk test alone which dairy uses sloppy feed and which uses dry feed and pasture. The average of a large number of analyses from dairies using slop feed shows about one-half per cent. less fat than dairies using dry feed and pasture. No factor other than food seems to account for the difference.

As this phase of the subject has received so much attention from station workers, the following summaries of experiments may be of special interest.

COMPARISONS OF GRAINS AND BY-PRODUCTS.

Corn Meal and Shorts. An experiment was conducted by the New Hampshire Experiment Station,[3] to compare corn meal and shorts. The

1 Complete Grazier, 1893. 2 Milk and its products, 1897.

3 Bulletin No. 8, New Hampshire Experiment Station. G. H. Whitcher.

nutritive ratios were 1 to 6.8 and 1 to 6.1 respectively. A difference of .34 of a pound of milk per day was realized in favor of the corn meal.

CORN MEAL AND COTTONSEED MEAL. The same station[1] found that a ration with corn meal, having a nutritive ratio of 1 to 5.5 and one with cottonseed meal, 1 to 4.5 gave a gain of .44 of a pound of milk more per day per cow in favor of the cottonseed meal. Of the five cows one gained on the wide ratio, two remained the same and two gained on the narrow ratio.

CORN MEAL AND GLUTEN MEAL. Corn meal was used in a ration having a nutritive ratio of 1 to 9.2, and the gluten meal at 1 to 2.4. This resulted in a decrease in the flow of milk each time the change was made from the narrow to the wide ration. Gluten meal also made a softer butter than the corn meal.[2]

BRAN AND OATS. Have about equal values.[3] At the Wisconsin Experiment Station, two feeding experiments were carried on for the purpose of ascertaining the value of ground oats and bran for milk production. The cows were fed the same quantities by weight of bran and oats, eight pounds daily per head in the first experiment, and ten pounds daily in the second, with an addition of corn meal, hay, corn silage, and corn fodder. It was found that the cows invariably did better on the oats. The fat content on the average remained the same.

BARLEY AND OATS, and a mixture of palm nut meal, rape seed cake and sunflower seed cake, were compared in co-operative experiments in Denmark. There was no change in the chemical composition of the milk from the different rations, although the quantity of the milk increased with the heavier oil cake feeding.

GLUTEN MEAL AND COTTONSEED MEAL. Gluten meal was found equal to cottonseed meal when fed in such quantities as to make the digestible matter equal.[4] At the Massachusetts Station these feeds gave practically the same results.

GLUTEN MEAL AND OTHER MEALS. Seventy cows were used in a test to determine the comparative value of gluten meal and corn meal and bran.[5] High grade gluten meal was found to have a higher feeding value than equal weights of corn meal and bran. The milk was slightly richer, but not sufficiently so to be of practical importance. The fat was disproportionately increased to other solids.

GLUTEN MEAL AND LINSEED MEAL. Gluten meal and linseed meal

---

1 Bulletin 8, New Hampshire Experiment Station. G. H. Whitcher.

2 Bulletin No. 13, New Hampshire Experiment Station. A. H. Wood and C. L. Parsons.

3 Report of the Maine Experiment Station, 1896. J. M. Bartlett.

4 Report of the Maine Experiment Station, 1896. J. M. Bartlett.

5 Bulletin 48, Vermont Experiment Station. J. L. Hills.

were compared in feeding tests, and showed no marked difference in the quality of the milk.[1]

GLUTEN AND WHEAT MIDDLINGS. The nutritive ratio of the gluten feed was 1 to 7.7 and the middlings 1 to 8.4. The milk yield was in favor of the gluten feed. Only one cow was used in the experiment, and thus it becomes of very little value.[2]

GLUTEN AND SHORTS. The ratio of the gluten feed was 1 to 7.2, and of the shorts feed, 1 to 7.6, with slight advantage in favor of the gluten. Here again, only one cow was used. This was in connection with the previous experiment.

COTTONSEED MEAL. Butter is not appreciably affected by cottonseed meal, unless that feed be made one-half or more of the grain ration.[3] Cottonseed meal also made a butter which was very hard and difficult to churn.[4]

COTTONSEED AND BRAN. Cottonseed had the effect of increasing the quantity of milk, but not the quality, when displacing bran in a diet. With cottonseed diet, the melting point of the butter was 99 degrees, and with the bran 93 degrees. This experiment was conducted upon 12 cows for 10 weeks.[5]

COTTONSEED AND GRAINS. Cottonseed had the effect of increasing the melting point from 95.33 degrees on a straight grain and hay diet, to 105.44 degrees on a diet of cottonseed meal and beets, and decreasing the volatile acids from 14.41 parts to 10.15 parts in the fats. The quality of the milk was improved so that 21 pounds of milk produced a pound of butter against 22 and 23 pounds without the cottonseed meal. The color was also made whiter.[6]

COTTONSEED. Steamed cottonseed gave better results than raw, and the cost was one-half less than cottonseed meal. Butter from the steamed seed feeding was better than that from the raw seed feeding.[7]

SUGAR MEAL, CORN AND COB MEAL.—Sugar meal produced 8 per cent greater yield of milk than corn and cob meal. Sugar meal produced 27 per cent. greater yield of butter fat. It also produced 14 per cent. greater yield of milk solids and 9 per cent. more solids not fat. Sugar meal produced .58 pounds of fat, an equivalent of 17 per cent. more than corn meal. Sugar meal also produced .73 pound or 6 per cent. increase in total solids

---

1 Report of the Mass. Experiment Station, 1891.

2 Bulletin 8, New Hampshire Experiment Station. G. H. Whitcher.

3 Bulletin 32, Iowa Experiment Station. C. F. Curtiss.

4 Bulletin 13, New Hampshire Experiment Station.

5 Bulletin 17, Penn. Agr. Experiment Station. Thomas F. Hunt.

6 Bulletin 18, Texas Experiment Station. George W. Curtis. Bulletin 29 corroborates the thermal test.

7 Bulletin 13, Mississippi Experiment Station. E. R. Lloyd.

per hundred pounds over corn meal. Eight cows were used in a 60 day experiment to determine these points.[1]

OILS.—Cottonseed oil, corn oil, palm oil, cocoanut oil, oleo oil, stearin oil. These were fed to three cows for the period of fifteen days—a period too short from which to be able to draw positive conclusions. The author's deductions were:

1st.—That the first effect of an increase in fat in a cow's ration is to increase the per cent. of fat in the milk.

2nd.—That with the continuance of the ration the tendency is for the milk to return to its normal condition.

3rd.—That the increase in fat is not due to the oils but to the unnatural character of the ration.

4th.—That the results in this experiment tend to confirm the conclusion expressed in previous bulletins from this station, that the composition of cow's milk is determined by the individuality of the cow, and that although an unusual food may divert for a time the composition of the milk its effect is not continuous.

COTTONSEED OIL produced the hardest butter, and corn oil the softest.[2]

TALLOW. Tallow was fed to ten different cows for a period of ten weeks: during six weeks each cow ate on an average of two pounds of tallow per day. No increase in milk fat followed.[3]

MILK. Feeding whole milk to two cows on pasture had the effect of keeping up the flow and the per cent. of fat. Skim milk did not do as well as whole milk, but showed some increase over no milk.[4]

CORN FODDER AND BEAN VINES. G. H. Whitcher found that by the feeding of a herd, six pounds of corn fodder to each daily, that he received 217.54 pounds of milk, or an increase of 5.54 pounds daily over the same period during which five pounds of bean vines were being fed. He also substituted six pounds of millet for six pounds of corn fodder, and found an increase of .35 of a pound, an amount so small that it does not mean anything one way or the other.

CORN FODDER AND CORN SILAGE have the same value.[5] At the Missouri Station the fodder fed cattle gave milk richer in fats and in solids.[6]

CORN STOVER AND HAY are of equal value.[7] Corn fodder has essentially

1 Bulletin 14, Iowa Experiment Station.

2 Bulletin 18, New Hampshire Experiment Station, A. H. Wood.

3 Bulletin 92, Cornell University Experiment Station, H. H. Wing.

4 Bulletin 17, Iowa Experiment Station, James Wilson and G. E. Patrick.

5 Bulletin 105, New York Agr. Experiment Station, Van Slyke.

6 Bulletin 8, Missouri Agr. Experiment Station. J. W. Sanborn.

7 Report Vermont Agricultural Experiment Station, 1889, J. L. Hills.

the same value as English hay.[1] Corn fodder produced slightly less milk, and of a slightly poorer quality than hay.[2]

SILAGE FROM FROSTED CORN gave slightly poorer results than from unfrosted corn.[3]

SILAGE AND HAY. The Maine Experiment Station Reports upon an experiment to determine the comparative value of good hay and corn silage. The estimates were made upon the basis of the digestible matter of each. For two months corn silage partly took the place of good hay, but it had the effect of only slightly changing the quality. The percentage of fat remained the same, but there was a small increase in quality. Whitcher made a similar experiment, using timothy grass, but in this case the silage showed decided advantages.

CORN AND CLOVER SILAGE. The Vermont Experiment Station compared corn silage with clover silage, with the result that all ten of the cows gave a better quality of milk on corn than on clover silage. The butter fat was 35 per cent. higher, or 8 per cent. better in the milk during the corn silage feeding period.

SILAGE. Change from dry feed to silage resulted in slight increase in both quantity and quality.[4] Silage produced less milk than hay, the quality being the same.[5] Silage feeding favored milk and butter production, while timothy hay favored fat production.[6] Silage produces a softer butter than hay.[7] At the Maine Station silage was slightly better than hay for milk production.[8]

SOY BEANS were better than the vetch or oats in five out of six cases.[9]

HUNGARIAN HAY gave poorer returns than silage.[10]

PRAIRIE HAY is equal to timothy hay.[11]

BERMUDA HAY and timothy hay are equal.[12] The cows were given a preliminary ration of 1:6 and changes made in the hay.

CLOVER HAY caused an increase or prevented the natural decrease at

1 Report Massachusetts Agr. Experiment Station, 1888.
2 Report Vermont Agr. Experiment Station, 1890, J. L. Hills.
3 Report Vermont Agr. Experiment Station, 1889, J. L. Hills.
4 Bulletin No. 9, New Hampshire Agr. Experiment Station, G. H. Whitcher.
5 Report Vermont Experiment Station, 1890. J. L. Hills.
6 Bulletin 4, Minnesota Agr. Experiment Station. Edward D. Porter.
7 Bulletin 13, New Hampshire Experiment Station, A. H. Wood and C. L. Parsons.
8 Report of Maine Agr. Experiment Station, 1889.
9 Report of Maine Agr. Exp. Station, 1890.
10 Report Vermont Exp. Station, 1889, J. L. Hills.
11 Bulletin 30, Minnesota Agr. Exp. Station, T. L. Haecker.
12 Bulletin 21, Mississippi Agr. Exp. Station, E. R. Lloyd.

each period at which it was used. A shrinkage occurred at each time the change occurred away from the clover

VETCH HAY caused a slight gain.

MIXED HAY gave an increase over mixed and oat hay.

OAT HAY had less value than other fodder. The effect was upon quantity and not quality.[1]

PEAS AND OATS hay were not relished, but when eaten gave high value.[2]

APPLE POMACE has about the same value as silage.[3]

BEETS were found to increase the flow of milk, but not enough to pay for the extra cost of the ration.[4]

SUGAR BEETS as well as carrots almost without exception temporarily raise the quality of milk.[5] They give butter of good color which keeps well, but like that from potatoes, is not of high grade.[6]

SUGAR BEET PULP, pound for pound, on the basis of dry matter, was found to be equal to corn silage. The milk produced from feeding the beet pulp, as it comes from the sugar beet factory, is worth about one-half that of corn silage. In this experiment five cows were used for a period of eleven weeks, the time being equally divided between the two feeds. There was no constant effect upon the percentage of fat.[7]

ROOTS WERE COMPARED WITH SILAGE in a feeding trial with the result that apparently the roots seemed to do best, but estimated on the basis of air dried content, the silage gave the best results.[8]

GREEN FOOD. A change from dry to green food increased the quantity but only slightly altered the quality.[9]

CARROTS had the greater value, pound for pound, for the vegetable matter they contained than corn silage.[10]

POTATOES produced a butter that is colorless and lacks keeping qualities.

PASTURE WITH GRAIN RATION ADDED. An experiment was conducted to try the influence of the addition of a grain ration to cows on pasture. Three

---

1 Bulletin 13, New Hampshire Agr. Exp. Station, G. H. Whitcher.

2 Report Vermont Agr. Exp. Station, 1889, J. L. Hills.

3 Ibid.

4 Bulletin 5, Ohio Agr. Experiment Station, Vol. III.

5 Report Massachusetts Agr. Experiment Station, 1889.

6 Bulletin 17, Iowa Agr. Experiment Station. F. A. Leighton and D. B. Bisbee.

7 Bulletin 183, Cornell Agr. Experiment Station. H. H. Wing and Leroy Anderson.

8 Bulletin 26, Penn. Agr. Exp. Station. H. J. Watters and R. J. Weld.

9 Bulletin 9, New Hampshire Exp. Station. G. H. Whitcher.

10 Report Mass. Agr. Exp. Sta., 1888.

cows were kept on a pasture only, and three were given grain. The lot on pasture only decreased from 20.60 pounds to 17.88 pounds of milk and .86 pounds to .77 pounds of fat, and the per cent. of fat increased from 4.19 to 4.29 pounds from June 8 to September 21. During the same period the grain fed lot decreased from 20.55 pounds to 13.09 pounds of milk, and .86 to .65 pounds of fat, and increased the per cent. of fat from 4.18 per cent. to 4.95 per cent. The final result was too close to draw a definite conclusion.[1] This work was duplicated and reported in bulletin 22, when Lot I produced a total of 118.4 pounds of butter fat and Lot II, 119.72 pounds. Lot II consumed 2,822 pounds of wheat bran and cottonseed meal. The experiment was again repeated and reported in Bulletin 36, at which time the grain feeding showed better because of the short pasture.

PASTURE ALONE. For the production of milk there is no feed so cheap as grass.[2] Changing cattle from barn feeding to pasture resulted in more and better milk.[3]

DROUTH caused a great shrinkage in milk.[4]

MISCELLANEOUS. The following rations (1) cottonseed, corn meal and wheat bran, (2) peas and barley, and (3) linseed meal, corn meal and wheat bran, were alternated through three periods. There was less variation because of the changes of feed than is often seen in uncommon feeding; the quantity was diminished slightly in passing from the first to the second, and increased in passing from the second to the third feeding. The melting point of the butter and the percentage of olein was lower in the second than in the others.[5]

HEAVY GRAIN. In general it may be said that the limit to assimilate a heavy grain feed and respond in milk produce is dependent upon the individuality of the animal.[6]

LIGHT AND HEAVY MEALS. Light foods as bran, are often as good, weight for weight, as heavier for quantity and quality of milk, but seems to cream less thoroughly than from heavier meals.[7]

HEAVY GRAIN had the effect of decreasing the hardness of the butter.[8]

NUTRITIVE RATIO. No relation was found between the nutritive

---

1 Bulletin 13, Cornell Univ. Agr. Ex. Sta. I. P. Roberts and H. H. Wing.
2 Bulletin 52, Cornell Univ. Agr. Ex. Sta. H. H. Wing.
3 Report Vermont Exp. Station, 1890. J. L. Hills.
4 Bulletin 105, New York Agr. Exp. Station 1890. L. L. Van Slyke.
5 Report of Maine Agr. Ex. Station, 1891.
6 Report Vermont Agr. Exp. Station, 1890. J. L. Hills.
7 Report of Vermont Agr. Exp. Station, 1890. J. L. Hills.
8 Bulletin 13, New Hampshire Agr. Exp. Station, 1890. G. H. Whitcher.

values of fodders and the products formed, or between the albuminoids of the food and the casein in the milk.[1]

Changing Feeds. The final results in changing food showed that there was little change in the total fat produced, as change in quality was compensated for by quantity.[2]

Diet. The influence of a certain diet may have a widely different effect on different animals.[3] No relation was found to exist between foods and volatile fatty acids, except in the case of skim milk.[4]

Narrow and Wide Rations. Two rations containing approximately the same quantity of digestible matter, one narrow and the other wide, gave from 20 to 36 per cent. more milk on the narrow, and from 30 to 40 per cent. higher total solids on the narrow, than on the wider rations. In the experiment three cows were used for three periods of thirty-five days each. The wide ration was 1 to 12:3; the narrow ration 1 to 6.7.[5]

Rations may have equal digestible constituents, but be derived from different sources, as follows:

	Ration I.	Ration II.
Timothy hay	5	15
Corn silage	40	25
Oats ground	5	0
Peas ground	6	0
Malt sprouts	0	2
Brewers grains dried	0	3
Buffalo gluten feed	0	3

Ration No. 1 is supposed to have the larger proportion of easily digestible carbohydrates, but it had no advantage over No. 2 in milk production.[6]

The effect of widening a nutritive ratio from 1:5 to 1:9, and from 1:5.6 to 1:8 was to cause a decrease of from 8 to 13 per cent. in the flow.[7] With the same cows hardness depends more upon the character of the feed than upon the nutritive ratio.[8]

While the foregoing experiments are typical of the work done to determine the effect of food upon the quantity and quality of milk, they

1 Report of Vermont Agr. Exp. Station, 1889. J. L. Hills.

2 Bulletin 30, Nebraska Agr. Station. C. L. Ingersoll and H. B. Duncanson..

3 Report of Mass. Agr. Exp. Sta., 1888.

4 Bulletin 13, New Hampshire Agr. Exp. Sta. A. H. Wood and C. L. Parsons.

5 Report of Maine Agr. Exp. Station, 1893. W. H. Jordan.

6 Bulletin 141, New York Agr. Exp. Station. W. H. Jordan and C. G Jenter.

7 Bulletin 9, New Hampshire Agr. Exp. Station. G. H. Whitcher.

8 Bulletin 13, New Hampshire Agr. Exp. Station. A. H. Wood and C. L. Parsons.

seem to show that some foods have more effect upon milk production than others. In all cases the influence is within narrow limits, and can all probably be accounted for by the general effect upon the body, or by one food being more palatable than another and therefore more agreeable to the animal. The effect upon milk is probably no greater than it is upon the body as a whole.

The discrepancy between the results obtained by different experimenters may often be accounted for by the difference in the method of conducting the experiments. The usual length of time given to each period in a feeding experiment is ten days or two weeks. Many foods have a temporary stimulating effect, which food naturally shows in such short-period experiments, and which would disappear if the period were continued for a longer time.

The duration of the period, which should be given to an experiment, was also studied at the Vermont Experiment Station. Their results show that the period should be about four weeks, in order to make a comparison of quantity, and that the period should be six weeks or more in order to get a comparison in quality. This is another evidence of the slow rate at which physiological changes take place in an organ having a fixed habit, and also the folly of drawing conclusions from short experiments upon animals.

Effects of Certain Foods and Drugs.[1] A great many substances may be transmitted to the milk. The volatile fats that are derived directly from the food may give either desirable or undesirable flavors to the milk. The characteristic flavors we esteem are due to the grasses, clover and like fodders, while the undesirable are due to leek, garlic, onions, turnips, cabbages, fish, etc. We also find poisonous substances such as camphor, turpentine and camomile, aloes, arsenic, lead and tartaric acid transmitted to the milk. Milk to which aloes, mercury and copper have been transmitted, frequently is injurious. If proper precaution is taken the undesirable flavors and detrimental effects may be easily obviated, since all these flavoring oils pass off through the excretory channels in a comparatively short time. We shall find them present in the greatest amount, not only in the milk but in all the tissues of the animal during the time the fodder containing them is undergoing digestion, and by the time digestion is completed, the volatile products will have almost entirely passed away. Thus, if care is taken in feeding so that it will be performed at least eight to ten hours before milking, there will be slight danger of contaminating it. If milking should occur in four or five hours, the milk will have an undesirable flavor. Taking advantage of this, and feeding the cow immediately before or after, dairymen are often enabled to feed large quantities of turnips, and even onions without contamination of the milk. The presence of wild garlic

---

1 Experiment Station Record, Vol. V., p. 973.

and wild onions in the pasture, is a source of bad flavor to the milk. Of course the remedy here is to remove the wild garlic and onions. It is claimed that placing a small piece of saltpeter in the milking pail will counteract the odor of the turnips. A peck of onions fed to a cow will impart no more odor to the milk than will a small piece of onion added to the milk. Vandenhoydouch[1] reports a case in which milk of all the cows of a village became bitter, although the cows were healthy. The cows were fed on Swedish turnips which had been washed in foul ditch water. As soon as this was discovered and remedied the milk became all right. Weigmann and Zurn report a case in which the straw used for bedding caused soapy milk. E. Hess, J. Schaffer and H. Lang have observed the effects of glaubers salts[2] on some of the cattle of Switzerland. They fed four cows, increasing from 40 to 60 grains per head daily, and compared the results with common salt. The cows gave signs of disease of the udder, such as bloody milk, caking and catarrh. After four days the milk was again normal, but had a taste similar to a weak solution of glaubers salts. The most striking change in the milk was a decrease in the ability of the casein to be curdled in rennet. The effect of feeding potassium chlorate, according to Bieler, was an increase in the yield of milk at the expense of quality. Cornevin found that pilocarpin increased the sugar from about .65 of a gram to 5.5 grams per litre.

Soxhlet[3] has succeeded in demonstrating that butter made from cows fed oil has a melting point of 10 degrees F. higher than normal butter.

Effect of Water. There is a popular notion that the more water that a cow can be induced to take into the system, the more milk she will yield. To prove this, animals were fed silage two periods, with corn fodder between, and succeeding which corn fodder with silage was used. In every case where there had been a decrease in milk flow there had been a decrease in total amount of water taken into the system and in every case where there had been a gain in the milk, there had been an increase in the amount of water taken into the system. Three cows drank for both silage periods 2,182 pounds of water, and both fodder periods 2,849 pounds of water, but the silage eaten contained 2,489 pounds of water, so that the total water taken during the silage period was 6,226 pounds, while for the fodder period only 5,435 pounds of water. For the silage periods the cows gave 19.07 pounds of milk, and the fodder periods 18.51 pounds of milk, showing that during the period in which the greatest quantity of water was taken into the system they gave the most milk in return. It is also shown that as the period of lactation advances the amount

---

1 Experiment Station Record, Vol. V., p. 971.
2 Experiment Station Record, Vol. V., p. 971.
3 Journal Royal Agricultural Society, Third series, Vol. III, p. 655-662.

of decrease of water taken into the system and the amount of milk produced are almost exactly in the same proportion, that is, the decrease of water taken in during the second silage period was 19 per cent. of the amount in the first, while the milk decreased 20 per cent.

In the fodder period, the second shows a decrease of 14 per cent. of water and 13 per cent. of milk over the first period, while in all the periods the decrease of 14 per cent. of water and 13 per cent. of milk occurred from the first.

That this is not chance, but characteristic of cows, will appear from a study of the experiment made during three years at the Wisconsin Experiment Station[1] and in seven out of eight tests the cows took more water into the system daily and gave more milk while eating silage than on corn fodder, and in the other cases the amounts were equal, thus showing that the rations which produced the most milk contained the most water. When silage was fed with water at 39 degrees F. there were 2.9 pounds of water drank for each pound of milk yielded.

Minnesota conducted a like experiment, giving three cows water at 70 degrees, and three cows water at 33 degrees. The three cows receiving the warm water drank an average of 95 pounds daily; those receiving the cold water drank 87 pounds daily. No special difference could be attributed to the one over the other, either on the milk or butter. The animals receiving the warm water gained 43 pounds, while those receiving the cold water gained 140 pounds.[2] A similar experiment conducted in Michigan[3] from January 19 to March 14, using water at the freezing point and at 60 degrees, showed that on four cows there was a gain of only 45½ pounds of milk during the entire period. It is also recorded by the Vermont Experiment Station that water at 40 degrees was taken as freely as that above.[4]

There is supposed to be a difference in the comparative value of warm and cold water for milk cows. To prove this, two experiments were conducted at the Wisconsin Experiment Station to ascertain the effect of the temperature of the water on the milk production. One experiment lasted for sixty-four days and the other one for sixty days. There were six cows used in each test. One lot was given water at a temperature of 32 degrees F. and the other 70 degrees F. In the first experiment the time was divided into three periods of sixteen days each with intervals between them. At the close of these periods the water temperatures were reversed, that is, the cows which received water at 32 degrees F. were given water at 70 degrees F.

---

1 Wisconsin Agricultural Experiment Station, Bull. 21, and Reports '89-'90.

2 Bulletin No. 4, Minnesota Agr. Exp. Station. Edward D. Porter.

3 Michigan Agr. Exp. Station, Bulletin 41.

4 Report Vermont Agr. Exp. Station, 1889. J. L. Hills.

and vice versa. The warm water gave the best results, making 1.002 pounds of milk more per day. The cows ate more while on warm water than on the cold. The fat content was about the same in the samples of the different milk.

It is an interesting fact that a cow in full flow of milk requires from one-fourth to one-third more water than when she is not giving milk, and a cow giving a large quantity of milk requires more than one not giving so much. Cows not giving milk require from 70 to 80 pounds daily upon dry feed and from 100 to 120 pounds daily when giving milk.

The Effect of Change in Temperature and Storms. The effect of sudden change in temperature seems to affect the secretion of milk in an indirect manner through the nervous system. It would be but natural to expect that some effect would be noticed either upon the quantity or quality or both. An examination of the milk in butter fat record of the cow Early Morn at the Indiana Station for one year, fails to show any connection between the quantity or quality of her milk, and the condition of the weather. In fact, her greatest variations occurred at times when the weather was stationary. It may be remarked in this case, that this might be due in part to the unusual good protection which she received.

The study made upon the effect of temperature at the Vermont Experiment Station and its results seems to show that the effect of temperature upon the quality of milk is an inverse one, that almost two-thirds or exactly 61 per cent. of the changes in quality were in opposite directions to the changes in temperature. During the period under observation there were thirty-one changes of temperature; seventeen rising, ten falling, four stationary. On fifteen of the days, when the weather became warmer the fat in the milk decreased, and as the weather became cooler, the fat increased. The tendency from this would seem to be that the milk became richer when the temperature was falling, and less rich during the rising temperature. In the test in 1892, there were 55 chances for comparing the effect of changing temperature upon the per cent. of total fat in milk, and 33 to test the effect on the per cent. of total solids. There were 22 cases of rising, 21 of falling and 12 of stationary noon temperature. During the twenty-one days the fat percentage in night's milk changed in opposite direction to the temperature, during eighteen it changed in the same direction, and in four cases there was no change in fat per cent., thus confirming the former test. The total solids were found to rise and fall in much the same way as the fat. During the thirty-three days of the first half of the test, in which the calculations of the solids were made, there were fourteen days of rising, twelve of falling and seven of stationary noon temperature. On fifteen days the total solids percentage in the night milk varied inversely, on seven days the changes were in the same direction and there were four cases of no change. A little more than two-thirds (68 per cent.) of the changes were in the opposite direction to the temperature changes. In the experiments, the changes in the inverse direction were more decided than those in the same direction.

During the test made in 1891 by the Vermont Experiment Station[1] there were several heavy storms. The amount of milk delivered immediately following these was larger than just before. The quality of milk cannot be said to vary much in any direction, but the milk of the second morning after the storm was less in quantity and richer in quality than before. The amount of this disturbance was not in accord with the size of the storm. The cows do not appear to have made any change in the quantity or quality of the milk on the approach of the storm, and no connection is traceable between the storms and pounds of butter produced. Observations after sixty storms show that after seven there was diminished quantity and after three there was no change.[2]

In experiments conducted at this station (Indiana) in 1893 milk cows exposed to the weather in the winter, but provided with night shelter, made a very unfavorable showing, as compared with those given shelter in the stable excepting for brief airing when the weather was suitable. The exposed cows ate more food, lost in weight and also in milk yield, while the sheltered ones gained in weight and made a better showing. At the Kansas Experiment Station similar results were obtained.

Regularity and Uniformity of Milking. While the process of milk secretion is a continuous one, it is not entirely uniform, for, as is generally believed, the rate of secretion is increased greatly while milking. Again, in proof of this the distention of the milk ducts and reservoirs by milk already present, acts as a check upon secretion. In all cases the udder becomes unduly distended with milk between milkings, and an increased flow will be secured by milking off the milk. The time of milking should be regular, for a difference of an hour will frequently make a difference of 10 per cent. in the amount secreted, and if the irregularities are frequent a diminished flow will result, The amount given is also considerably affected by the way in which the milk is drawn. In general it may be said that rapid milking is conducive to a large flow. At all times the milk should be drawn so that no discomfort is caused to the animal, and in this respect there is a great difference among milkers. A rapid, uniform stroke, with a firm touch of the teat and a stroking motion of the lower part of the udder gives the best results. Babcock has found that certain milkers get not only more, but richer milk than others from the same cow.

The Vermont Experiment Station undertook to demonstrate[3] the fact that fast milking is more advantageous than slow. In so doing, eight cows

---

1 Rept. Vermont Agr. Exp. Station, 1891.

2 Bulletin 30, Nebraska Agr. Exp. Station. C. L. Ingersoll and H. B. Duncanson.

3 Vermont Experiment Station. Report of '91, page 55.

were used in the experiment—four full milkers and four strippers. The slow milking took from two to two and one-half times as long as the rapid milking. The experiment proved two things: 1st. The diminution in the milk flow from one period to another; 2d. Essentially unchanged quality. All the cows gave less when milked slowly, although in three cases the difference was but slight. The same station demonstrated that the quality is lowered but the quantity increased by milking them three times a day.

Two cows milked every hour for seventy-two hours gained both in quantity and per cent. of fat. The gain the first day was much greater than on the subsequent day.[1]

[2]H. H. Dean tried milking diagonal teats to see if there would be an increase in the milk production. With one cow there was no difference; with another, less milk was given. F. Albert tried a similar experiment and found that by milking the quarters or diagonal teats that there was a marked increase in the quantity. He was so sure of his conclusions that he strongly recommends that this method of milking be always followed.

Dr. E. L. Sturtevant had the different quarters of the udder of a cow milked separately a number of times, and the milk weighed, and the total solids and fat determined. He found a marked difference in the quality of the milk from different quarters of the udder. Dr. Babcock made a similar experiment along the same lines and his results may be briefly stated that, for any single milking the results fully confirmed those of Dr. Sturtevant and showed a decided difference in the quality of the milk from different teats: If, however, the whole series be considered it is evident that the order in which the teats are milked is the chief factor which affects the quality of the milk. Dr. Babcock says in conclusion, "It is doubtful about there being any difference in the physiological function of the different quarters of the udder." At the Indiana Experiment Station like experiments were conducted with the same results. At the North Carolina Station cows milked one teat at a time showed a less per cent. of fat than those milked as usual.[3]

Effect of Exercise. Though locomotion is detrimental to the yield of milk, it is a mistake to suppose that uninterupted confinement in the stall is the most economical treatment for a milk cow. With moderate locomotive exercise, the slight reduction in quantity of milk appears to be fully compensated by the increased yield of solids. Munk undertook to to settle this point, and experimented with thirty cows and found that when they were allowed half an hour daily exercise the total quantity of the milk as well as the fat and casein increased, though much exercise exerted an adverse influence on the yield. When cows are on grass their increased

1 Bulletin 9, New Hampshire Agr. Exp. Station. G. H. Whitcher.

2 Experiment Station Record, Vol. V., p. 965.

3 Bulletin 116, North Carolina Agr. Exp. Sta. F. E. Emery.

appetites in the presence of an abundance of food quite makes up for any loss incurred in the movement necessary to obtain that food. Hence it is desirable that stall fed milk cows should have daily exercise. Very violent exercise sometimes has the effect of producing very much change in the quality as well as the quantity. It always has the effect of lessening the quantity but the effect upon chemical composition is not known. There are numerous instances, however, in which the physiological effect of taking milk from an exhausted animal has proven injurious. It is generally recognized among farmers that it is unsafe to allow a calf or colt to suckle when the dam is overheated. Two observations upon this point are recorded as follows:

On April 30, 1893, at Lake City, Fla., a fine cow was owned by Mr. P. She had a calf some five miles from home and the calf was a week old, strong and healthy. The calf was hauled home in a buggy and the cow made to walk. She ran a considerable of the distance and was exhausted when the barn was reached. The calf suckled on arrival home and soon became very sick with a violent diarrhoeal discharge.

In 1895 the cows owned by some people in West LaFayette, were herded by a boy. He drove them home very hurriedly one night to avoid a rain storm. They were somewhat overheated and gave a small quantity of milk that night. Two calves became attacked with diarrhoea. Several people were also affected. In two cases mammitis was the result of the bruising of the udder in running.

Effect of change of Location. The effect of a change of quarters on the quantity and quality of milk was experimented upon by the Vermont Station. The herd was milked and then driven three and one-half miles to new quarters. Composite samples were taken of the milk of seven cows for four milkings before and after the change. There were six and one-tenth per cent. larger yields of milk ingredients followed the change. Babcock found in a similar experiment a falling off in both quantity and quality, but the increase of the succeeding days more than compensated for the decrease. A change in the stable routine, as feeding out of order or at irregular times, may have like effect.[1]

Effect of Nervousness. Both the secretion and the excretion of the milk are under the control of the nervous system, but the exact mode whereby the nervous influence is exerted, remains to be worked out. Indirectly, however, the secretion of milk must largely be affected through the sympathetic nervous system, whose center is a chain of nervous element extending along the general body cavity just beneath the back bone. The nerves act by controlling the caliber of the blood vessels, and thus regulating the blood going to the udder. It is a well established fact, that anxiety of the mother, caused by removal of the young, as well as by sudden fear —all chance excitement of any kind—will cause a partial and sometimes

1 Bulletin 116, North Carolina Exp. Sta. F. E. Emery.

a complete suppression of the milk secretion. Not only is the amount of milk secreted affected by the nervous state of the animal, but its composition is also changed even when the quantity remains the same. Unkind treatment of the cow, willful or otherwise, is found to show its effects in diminishing the yields of milk. Ill ventilated, badly drained or too draughty cow houses, careless exposure in bad weather, irregular feeding, brutal usage, fast driving, the mad rushing about, provoked by the attacks of ox warble fly and a variety of other causes, are bound to exert an influence upon the nerves, the effect of which will be certainly recorded in the milk pail. At the Vermont station a test was made of dairy cows at home and at the fair ground,[1] to determine the effect of the nervous excitement on the milk flow. The results indicate that the tendency of nervous excitement is to lessen the quantity of milk and to variously affect the quality, according to the individuality of the animal, the fat being the most variable ingredient. In general, the activity of the animal and the nervous excitement decreases the flow of milk, stall fed animals producing more than grazing animals.

The Effect of Rage, Fright and Sudden Shocks all have a marked effect upon the quantity and probably upon the quality. Flint reports Vermois and Becquerel as mentioning a very striking case, in which a wet nurse in a hospital lost her child from pneumonia and was deeply affected and grieved. She immediately had a marked diminution in the quantity of her milk and a diminution in the proportion of salts, sugar and butter. There was an increase in the casein. The same writer quotes Sir Ashley Cooper as mentioning two cases in which the secretion was instantly and permanently arrested by terror. There are a large number of such reports due to mental impressions.

Similar observations have been made upon animals. On August 12, 1892, Lake City, Fla., the following case occurred: A fine cow owned by Mrs. T. had a healthy calf four days old at her side. The cow was of a very nervous temperament, and particularly averse to dogs. Upon the night of that date the dog strayed into the stall next to the cow and calf. The cow made frantic efforts to get at the dog, and was in a state of excitement for six hours. The calf remained quiet and unharmed. Three hours after the calf suckled, it died.

Another case occurred August 10, 1891, at Bourbon, Ind. A valuable mare was owned by Mr. C. She had a foal six weeks old. The day was very hot and the mare was used at the harrow, and the colt left in the shade. The mare fretted greatly and was worked a couple of hours longer than usual to finish a piece of work. The foal was allowed to suckle as soon as work was stopped. It died in about four hours. No cause could be assigned,

---

1 Vermont Experiment Station. Report 1895.

except the possibility of the milk having become altered both by fretting and work.

It has also been observed that after sheep have been frightened or worried by dogs, a number of lambs may die which have in no way been disturbed or injured by the dogs. It seems in such cases as though the milk had induced the trouble.

Effect of Abortion. The Vermont Experiment Station[1] has made several observations on the effect of abortion, on the quantity and quality of milk, the most important of which are as follows: That there is a shrinkage of over one-third of milk yield, a gain of one-tenth in quality, shrinkage of nearly one-third in butter yield and a more even quality of milk throughout the year was obtained. In seven out of eight cases the quality of the milk both as regards fat and solids not fat, was better than that given after normal calving.

The herd at the Minnesota Experiment Station has likewise been troubled with abortion. In the following table are the records of five cows for six months immediately following normal calving, which preceded abortion, and for six months following abortion.

TABLE 5.

Influence of Abortion on Quantity and Quality of Milk.

NAME OF COW.	Normal Calving			Abortion		
	Pounds milk	Per cent. fat	Pounds fat	Pounds milk	Per cent. fat	Pounds fat
Beckley	2,891	5.89	170.3	2,032	5.84	118.6
Clara	3,437	4.40	151.2	2,937	4.63	135.9
Rosey	3,784	5.40	142.7	3,765	5.79	153.9
Lorry	4,181	4.54	189.6	2,736	4.76	130.0
Sulley	3,324	4.41	146.3	3,737	4.68	174.9

Three gave less milk and butter after abortion than after normal calving, two gave more, four gave better milk and one milk of the same quality. The differences on the whole, were less pronounced than in the Vermont herd.

Effect of Sickness. A general disease may have an immediate effect upon the quantity and quality of milk. The usual result is to make

1 Vermont Experiment Station. Report 1892.

a diminution of the quantity, and frequently it does not return to normal after the animal has gotten well.

The effects of an overfeed is shown in table 6, below, the overfeed having been given March 11, the dates following showing fluctuation until a normal condition was again established.

TABLE 6.

Date	Pounds milk, a. m.	Per cent. fat	Pounds milk, p. m.	Per cent fat
3—11	16.3	4.8	10.8	7.5
12	3.8	4.2	6.8	9.5
13	2.2	18.	1.7	14.
14	3.8	14.	5.2	2.9
15	6.2	8.	4.5	8.4
16	7.8	6.8	7.	5.8
17	10.	4.4	8.5	4.4
18	11.	4.4	8.1	4.8
19	12.6	4.4	9.8	6.
20	13.7	4.5	10.6	5.4

Effect of Tuberculin. The effect of tuberculin has been noted by a number of writers, and has been made the subject of special experimental research at three different experiment stations. The result of all the work is to show that tuberculin probably has no effect upon the quantity or quality of milk. That equal or greater changes may take place at any time without the injection of tuberculin. In some cows the quantity of milk is slightly increased, and in others it is decreased. The principal experiments to determine the effect of the tuberculin injection have been conducted at the Cornell and North Dakota experiment stations.

Effects of Dehorning. The effects of a surgical operation, such as dehorning, upon the milk flow is of only a temporary character. The effect of dehorning has been observed at several of the experiment stations, and the effect has usually been of temporary shrinkage in the milk, lasting only a few days. At Minnesota the cows were divided into two lots, part dehorned and part left to witness the act. Those dehorned had a shrinkage of seven per cent. in quantity of milk and three per cent. in fat. Those witnessing the work and smelling the blood lost three per cent. in quantity and eleven per cent. in fat.[1] In Georgia only twenty pounds of milk were lost the first day after dehorning eight cows.

Effects of Spaying. The immediate effect of spaying is to cause a shrinkage in the milk flow. This is usually recovered in two or three days. The prominent effect is to prolong the period of lactation for two or three years. It neither increases the daily yield or improves the quality.

1 Bull. 19, Minn. Ex. Sta., Clinton D. Smith and T. L. Haecker.

"Our knowledge is the amassed thought and experience of innumerable minds."

—*Emerson.*

MANAGEMENT OF DAIRY WORK ON THE LARGE ESTATE OF BILTMORE FARMS.

GOLDEN ROSEBAY CALLED "A QUEEN AMONG COWS"—HIGH BREEDING OF OTHERS OF THE DAIRY HERD.

Biltmore, N. C.

Among the famous dairies maintained by American capitalists, probably that of George W. Vanderbilt at Biltmore, N. C., known as Biltmore Farms, is the most extensive and unique in its appointments. This vast estate within a few miles of Asheville is said to contain 168 square miles, on which dairying and other farm industries are carried on chiefly for the interesting occupation the management of them affords, but with full regard to satisfactory returns from every source.

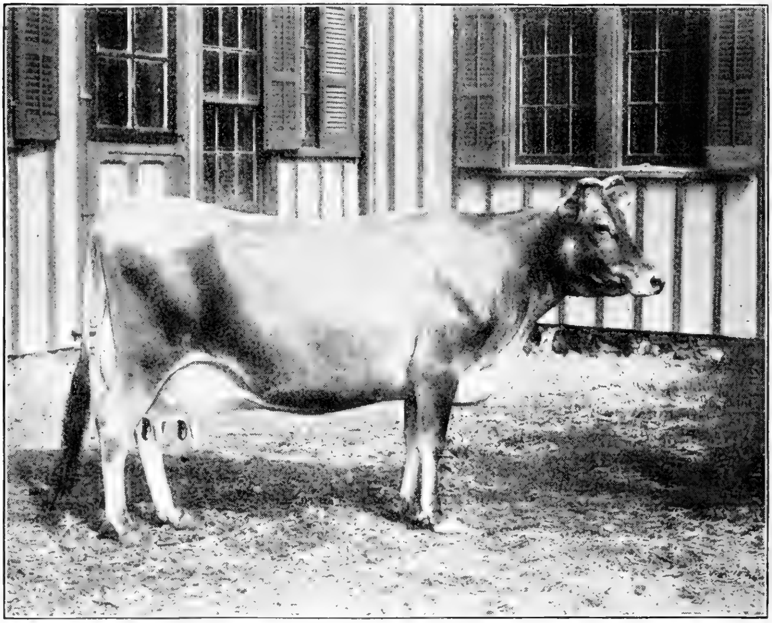
A herd of several hundred Jersey cows is kept for milking and the milk retailed in surrounding cities from wagons belonging to the farms. Naturally in a herd of this nature there are many famous dairy animals, one of which—Golden Rosebay 157333 — has received especial commendation at the hands of cattle experts.

At the 1901 sale of imported Jersey cattle held by T. S. Cooper of Coopersburg, Pennsylvania, Golden Rosebay was called the "queen among the cows" and proved her title by topping the sale at the price of $2,775, Biltmore Farms being the purchaser.

The picture shows her in her five year old form, as she looked on the day of sale, and where she won praise for her beauty, capacity and disposition, thus reviewed by a correspondent:

"The honor of 'queen among the cows' was early conceded to Golden Rosebay, the daughter of Golden Lad that caught everybody's eye and was the center of a critical throng all day. 'Perfection' was the almost unanimous distinction accorded her, and by the time she entered the ring she had been so thoroughly inspected, so completely looked at, felt and fondled; so metaphorically turned upside down and inside out and sized up, that a less phlegmatic constitution would have gone to pieces in the nerves. But Golden Rosebay urbanely submitted to all the pulling of hide and rubbing of udder, and took so kindly to the excursion trips of various sets of fingers up one milk vein and down the other, with stop-overs at teats and milk holes, that her disposition was put down as the third of her good qualities—following beauty and capacity.

"She came into the ring like a queen—and a queen she is. No words wasted in soliciting a starting bid on her. Some one said something about a thousand dollars, and a half-dozen other somebodys raised it; she went by hundreds to $2,500, then by fractions until $2,775 was reached and she was passed into the possession of Biltmore Farms; and superintendent George



GOLDEN ROSEBAY—IMP. JERSEY 157,333.
Has Milked 24 Quarts Daily—Bought by Biltmore Farms for $2,775.

F. Weston, who had her bid in to his account, was the envy of many a breeder at the ringside."

Golden Rosebay has milked as high as 24 quarts daily, and is one of four of the best daughters of Golden Lad in America, all owned by Biltmore Farms. The quartet consists of Golden Rosebay, shown in the picture, Golden Kola with a record of 1,367 pounds of milk in 30 days, making 73 pounds, 6 ounces of butter, Golden Beatrice who sold for $1,400 at the same sale, and Golden Ora who has a record for one year of 8,988 pounds of milk making 606 pounds of butter. A son of Golden Kola, Kola's Golden Lad, won Junior champion award at the Charleston Exposition, 1901–2, and has been placed in service in the Biltmore herd.

Superintendent George F. Weston tells of dairy management on Biltmore Farms in a letter as follows:

"While great attention is paid in the Biltmore herd to the breeding operations both to increase the persistent milking qualities, as well as total milk yields, and to improve the type, the herd is really a dairy herd, founded on a milking basis, and the sale of milk and cream is the principal of the many enterprises carried on on these farms. With the completion of a central dairy barn and creamery, they have now commenced the equipment of small outstanding dairy farms which will be run upon the co-operative system; that is, the farm in running order with all necessary buildings, cows, utensils, pastures, etc., will be turned over to a tenant who will separate the cream there and carry it to the central creamery, utilize the skim milk in the feeding of his calves and Berkshires, and he will receive for his work a monthly amount which will represent the income from the sales after a certain sum has been deducted for interest on plant and cost of marketing from the price that the Biltmore Farms receive for their products. This amount will be about the same as if the tenant lived in a dairy section, owned his cattle and plant, and was selling his milk at a creamery. Dairying conducted along modern lines is a new thing in this section and many problems have been worked out, such as the best pastures and soiling crops, and, to a certain extent, a market has to be created for high class products. The demand for these, however, is continually on the increase and it is intended to continue equipping these farms until this demand is fully met.

"About 25 cows will be kept on each farm in order to make them small so that the social and educational features of the settlement may be worked up to the best advantage with good schools, etc., as these will have to be independent of those now conducted by the Biltmore Estate in the village."

Not all patrons can secure cows like Golden Rosebay and her sisters, but none need be barred from using this ideal to breed up to and greatly improve over those now owned. A farm will support a Golden Rosebay as readily as it will sustain life in a $25 scrub. It lies with the owner to set his own standard of production and perfection.

"A man's true wealth is the good he does in this world."—Mahomet.

DAIRY ANIMALS OF THE UNITED STATES AS REPORTED UPON BY TWENTY STATE EXPERIMENT STATIONS.

COWS NOTED FOR THEIR MILK AND BUTTER RECORDS—SIRES NOTED FOR THEIR WORTH AS HEADS OF DAIRY HERDS—FACTS OF LIVE INTEREST FOR DAIRY HERD OWNERS.

By Prominent Authorities on Dairying.

What has been accomplished by dairymen in the past, should be the best guide to the possibilities of dairying of the present hour and of the coming years which readers of this volume shall have in which to attain their measure of success as led on by industry and a healthy ambition. In the pages that follow, are records of many prominent dairy animals tested and noted for their excellence as profit makers, and serving to illustrate proven ideas of breeding, use of feed, and value of generally better care and thought than many have been in the habit of giving their dairy herds.

The reports are from the records of the agricultural colleges and experiment stations to which they are credited, and give in brief the results obtained from cows, how it was done, and the reasons therefor. Bearing in mind that the experiment stations strive to make their start where the dairy farmer must make his, and in their treatment of the herd handle it as they know the dairy farmer must do from force of environment or limit of expense, the owner of cows who reads these records, will do so with a better understanding of their meaning to him, and the results he, himself, should be able to secure.

Good dairy cows and good dairy sires are the ground-work in successful dairying, and enough of them to make milk production worth while the effort is the superstructure. The reports teem with illustrations and examples of the best known to the investigators whose reports are here given, and in many are important suggestions drawn from carefully made observations covering long periods of time and a wide range of experiment. Their value to the creamery patron will depend upon himself, how well he shall make use of what is here presented for his interests.

These pages are largely a record of the results of good dairying.—results such as the previous chapters have sought to point out the way by which the dairy farmer may attain them. They are the proof, not of theories, but of the methods in daily practice by the best dairy herd keepers and dairy animal breeders. No pet ideas are here expounded, but simply a collation of facts is presented as they stand in the open records of the stations where these animals have been reared, or as they have come under the notice of the author who tells of their breeding and their worth in the dairy. They comprise records of poor cows, of fairly good cows, of very good cows, and of exceptionally good cows, as well as reports on sires of exceptional excellence as heads of dairy herds, and here and there a more complete comment on whence this excellence comes and why. It is expected that the creamery patron seeking improvement in his dairy herd will find these reports a most interesting and instructive additional feature.

ALABAMA.

Agricultural Experiment Station at Auburn.

Report by Prof. J. F. Duggar, Agriculturist.

Our records here are only of two years' standing, and I regret that I cannot give so much information as is desired.

Our best cow is a Jersey—Susanna Hazen 160,809. At three years of age, with first calf, she made 330 pounds of butter and received only ordinary treatment. Her cost of keep was $25 and she gave us a profit of $50. She is now in her second year of lactation, and now, four months after second calf, is yet making a pound of butter a day, receiving only ordinary care.

She is a beauty as to form, color and disposition. Her yearling heifer is a great beauty also, teats well placed far apart; the udder comes well forward and has large folds of loose skin running well up behind. She has the typical dairy form, like her mother, and is as gentle and kind as a kitten. Her capacity is wonderful.

Our second best cow has a record of 315 pounds of butter in one year. She is of perfect dairy type and performs according to the care she receives. Last year she gave a profit of $29, but it was an off year. She is a Jersey.

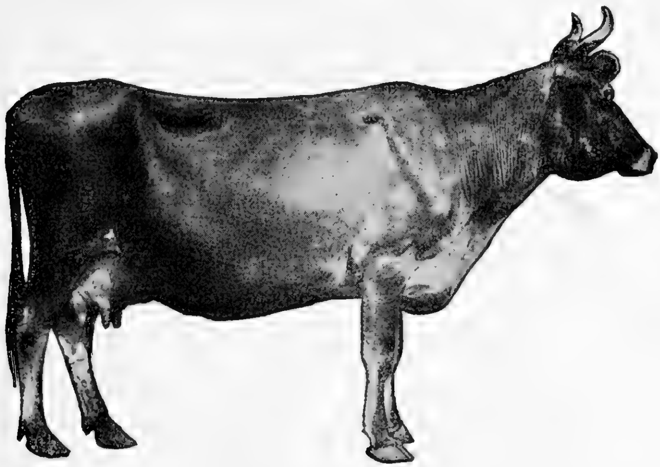
The yearly production of butter of the average cows in our state is about 75 to 100 pounds. Dairying here is badly neglected, though we have many advantages over other sections—a large variety of good yielding forage crops, a long pasture season and a mild short winter, all tending to cheap production.

CONNECTICUT.

Agricultural Experiment Station at Storrs.

Report by C. L. Beach, Professor of Dairy Husbandry.

The study of individual cows of the college herd indicated that in the cows of this particular herd the form and type of the cow is more reliable than breed alone as an indication of her productive capacity, grade cows of a distinctive dairy type surpassing thoroughbreds whose type indicated lack of dairy quality. In order to test the relation of form or type of cows to profitable production, we divided the whole herd into three groups, each cow in the herd being included in the group to the type of which she most nearly conformed. The divisions were made according to the physiological features of the cow, and the study of the particular form of each cow,



COW No. 2*—REPRESENTING THE DAIRY GROUP.
Her Own Record for One Year (see table 1) is, Milk 8,465 Pounds, Butter 509 Pounds.

along the lines suggested by Prof. T. L. Haecker, in his study of the cost of production with the herd of the Minnesota Experiment Station.

The first group includes the thin, spare, deep bodied cows, and has been called the "Dairy group." The second group includes those carrying too much flesh, and is styled the "Fleshy group." The third group contains those lacking depth and width of the barrel, and are designated as "Lacking abdominal capacity." The results of this grouping and a comparison of the types included in each group are given on the following pages.

1. *Dairy group.* The cows in this group are spare, with deep bodies and well sprung ribs. The average production of the group is 351 pounds

of butter, and 6,190 pounds of milk. The average cost of each pound of butter is 12 cents, and each 100 pounds of milk is 69 cents. They yield an average profit of $21.49 as butter cows, and $20.24 as milk producers. The cow chosen to represent this group is No. 2, Copper Queen, shown in the cut on page 237.

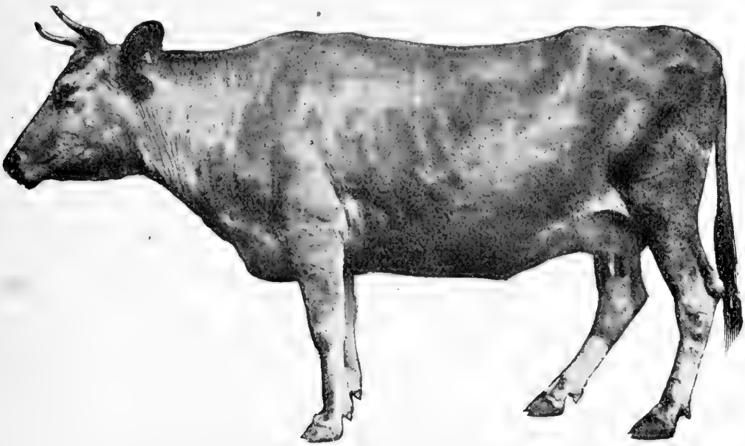
TABLE 1.

Record of the cows grouped under the dairy type.

Cow.			Cost of food for 1 year.	PROFIT.		BUTTER.		MILK.	
No.	Age.	Breed.		From butter at 18c. per lb.	From milk at $1.00 per 100 lbs.	Amount produced in 1 year.	Cost of food for producing 1 lb.	Amount produced in 1 year.	Cost of food for producing 100 lbs.
	Yrs		$	$	$	Lbs.	Cts.	Lbs.	Cts.
1	9	Grade Guernsey,	44.54	40.42	41.04	472	9.44	8558	52
⋆2	10	Jersey	48.80	42.82	35.85	509	9.58	8465	58
3	2	Grade Guernsey..	40.60	25.64	19.64	368	11.00	6024	67
4	6	Jersey	40.21	24.59	13.58	360	11.10	5379	75
5	6	Jersey	38.18	23.02	11.96	340	11.20	5014	76
6	7	Grade Holstein ..	36.73	19.61	20.57	313	11.70	5730	64
7	13	Guernsey,........	42.18	22.08	22.17	357	11.80	6435	66
8	2	Grade Guernsey..	37.78	17.66	22.99	308	12.20	6077	62
9	6	Grade Jersey	42.88	18.86	30.16	343	12.20	7304	59
10	7	Grade Jersey ..	36.71	16.75	8.69	297	12.40	4540	81
11	8	Ayrshire....... ..	47.06	20.44	35.43	375	12.50	8249	57
12	7	Grade.Guernsey..	40.04	20.62	7.50	337	12.50	4754	84
13	10	Grade Jersey ..	44.08	19.28	21.40	352	12.50	6548	67
14	9	Grade Jersey	41.00	15.88	14.00	316	12.90	5500	75
15	8	Grade Guernsey..	43.13	8.89	12.95	289	14.90	5608	77
16	10	Guernsey, ...	42.68	7.36	5.96	278	15.30	4864	88
Average for the group ...			41.66	21.49	20.24	351	12.00	6190	69

2. *Fleshy group.* The cows in this group are large framed animals. The neck is thick, the shoulders heavy, the loin wide, withers round, crops full, brisket heavy, and as a class they are animals that take on flesh easily and look smooth and plump. They make an average of only 217 pounds of butter each, and less than 4,000 pounds of milk. When the labor expended in their care is taken into consideration, they are all kept at a loss. They charge in cost of food 18.1 cents, or 6 cents more than the dairy group,

for each pound of butter, and 31 cents more for each 100 pounds of milk. The cow No. 23, shown in the cut below, is chosen to represent this group.



COW No. 23*—REPRESENTING THE FLESHY GROUP.
Her Record for One Year (see table 2) is, Milk 5,069 Pounds, Butter 276 Pounds.

TABLE 2.

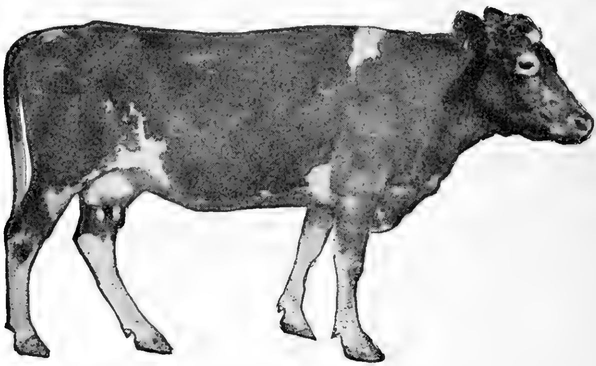
Record of the cows grouped under the fleshy type.

COW.			Cost of food for 1 year.	PROFIT.		BUTTER.		MILK.	
No.	Age.	Breed.		From butter at 18c. per lb.	From milk at $1.00 per 100 lbs.	Amount produced in 1 year.	Cost of food for producing 1 lb.	Amount produced in 1 year.	Cost of food for producing 100 lbs.
	yrs.		$	$	$	Lbs.	Cts.	Lbs.	$
2	8	Grade Jersey.....	40.77	5.49	-4.48	257	15.8	3629	1.12
*23	9	Jersey...........	46.21	3.47	4.48	276	16.7	5069	.91
24	4	Grade Guernsey...	32.36	-2.66	- .95	165	19.5	3141	1.03
25	7	Ayrshire.........	35.05	-4.09	3.21	172	20.3	3826	.92
Average for the group..			38.59	.55	.56	217	18.1	3916	1.00

—Represents amount lost.

3. *Group lacking abdominal capacity.* This group contains five cows lacking in depth and width of barrel. They consume a little less food than group 1, and yield considerably less profit in return from both milk and butter. The cows in this group differ from those in group 1 in both form and disposition. No. 18 in the group is a quarrelsome animal, and the

boss of the herd. No. 19 is a very nervous cow, and uses her energy in unnecessary work. No. 20 is a discontented animal, always on the alert for an open gate, and often found where she ought not to be. As a group these cows are "light on their feet," and very active animals, which may account somewhat for their low production. They charge in food 14.9 cents for butter and 77 cents per 100 pounds for milk. They are not profitable animals, and should be weeded out of every dairy herd. The cow representing this group is No. 20.



COW No. 20*—REPRESENTING THE GROUP LACKING ABDOMINAL CAPACITY.
Her Record for One Year (see Table 3) is, Milk 4,122 Pounds, Butter 246 Pounds.

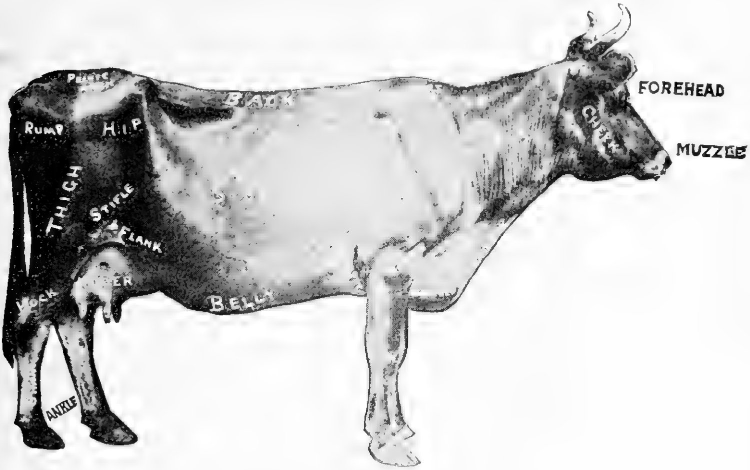
TABLE 3.

Record of the cows grouped under the type with small barrel.

Cow.			Cost of food for 1 year.	Profit.		Butter.		Milk.	
No.	Age.	Breed.		From butter at 18c. per lb.	From milk at $1.00 per 100 lbs.	Amount produced in 1 year.	Cost of food for producing 1 lb.	Amount produced in 1 year.	Cost of food for producing 100 lbs
	Yrs		$	$	$	Lbs.	Cts.	Lbs.	Cts.
17	6	Grade Jersey	37.59	13.17	13.24	282	13.3	5083	75
18	7	Grade Guernsey	41.75	10.81	6.53	292	14.3	4828	86
19	7	Ayrshire	41.27	10.21	30.61	286	14.4	7188	57
*20	7	Guernsey	39.36	4.92	1.86	246	16.0	4122	95
21	6	Ayrshire	39.22	2.72	14.79	233	16.8	5401	73
Average for the group			39.83	8.36	13.40	267	14.9	5322	77

ANATOMICAL AND PHYSIOLOGICAL FEATURES OF THE DAIRY COW.

Intelligent and progressive farmers and dairymen are becoming more familiar with the fact that milk and butter producing qualities of cows are accompanied by a general vigor, conformation, temperament, fineness, bearing, and other features that are quite characteristic. Dairymen who profit most in the keeping of cows familiarize themselves with these characteristics and understand their relationship to capacity for production. This is understood best by those who have had long experience with cows, and have studied under widely varying conditions their general form and manner, especially in connection with accurate records of performance.



DAIRY TYPE (COW No. 2)
To Illustrate Points Referred to in the Text.

In a general way such knowledge includes some idea of the anatomy and physiology of the cow, particularly with reference to the general locality, development, and functions of the various organs concerned in the production of milk and butter.

In a discussion of this subject the dairy cow may be considered as a complex machine developed for a particular purpose, consisting of a framework of characteristic form, supporting parts that are most essential to the purpose and parts that are less essential, the essential parts being those directly concerned in the production of milk and butter, while the less essential parts are only indirectly concerned.

The figure above of cow No. 2 shows the outline and general features of a profitable cow of the dairy type, and illustrates points referred to in the following paragraphs:

In the opinion of the writer it seems justifiable to state that the general constitutional vigor of the cow is of primary importance, and that of nearly as great importance are efficient digestive organs; large and well formed milk organs; strong heart and good blood circulation; large, strong lungs; and a highly developed nerve system. For convenience in the present discussion these are called the essential organs, and are considered here with some remarks concerning their uses or functions.

Digestive organs. Milk is a manufactured article, produced by the cow from the food which she consumes. The capacity of a cow for producing milk depends largely upon her capacity for digesting food and assimilating it into her tissues. For the accommodation of a large and efficient digestive apparatus a good dairy cow should have a long, deep and wide barrel with well sprung ribs. This form of middle piece gives ample room for the storage of food, and for an apparatus capable of disposing of large quantities of the coarse, bulky fodder which the cow consumes.

Milk organs. The milk organs are quite intimately concerned in the productive capacity of the cow, as it is in these that the milk and butterfat are finally elaborated from the food. It is not altogether clearly understood how the milk is made in the gland, but it seems quite probable that it is produced by the epithelial cells within the udder. So far as is known, the quantity of milk that can be produced depends in a large part upon the number and activity of these cells. The number of such cells is limited by the size of the udder and the amount of fatty tissue it contains. The dairy cow should therefore have a large udder capacity, the larger the better, but the size of the udder should not be due to any large amount of fat or flesh. There should be an elasticity of the tissue with a shrinkage of the udder when empty. The udder should have considerable surface extending far forward and well up behind. It should be well balanced and symmetrical in shape, indicating good development in all quarters; for the more perfectly developed the organ is, the larger the amount of milk it will be likely to yield. It should be spread considerably from side to side also, while the teats should be even and squarely placed. To make room for such a capacious, well developed udder, the hind legs of the cow should be wide apart, the thighs should be thin, and the flanks high arched.

The activity of the udder, or the amount of work done in it, is indicated to some extent by the quantity of blood that passes through it, which depends quite largely upon the capacity of the blood vessels which are connected therewith. It is important, therefore, that there should be a strong and full development of the arteries and veins of the udder and abdomen. The milk veins should be large and elastic, should extend well to the front, and should enter the abdomen through large or numerous orifices, thus permitting a strong flow of blood through them with a minimum of resistance as it returns to the heart. Besides these veins, there is a network of them in the forequarters of the udder, and still others pass upward behind, which, when large, indicate considerable productive capacity.

Pelvic organs. Dairying is based upon the maternity of the cow. It is the mother function that arouses the milk organs into activity for the feeding of the offspring. Many generations of selection and breeding by man have prolonged the period of activity of these organs in the dairy cow, but the beginning is always a function of reproduction, which must occur with considerable regularity in profitable cows. In order that this may occur with the least tax upon the general vigor and activity of the cow, she should have broad hips and a high pelvic arch, furnishing ample room for the young before birth and providing for its easy delivery.

Heart and lungs. The chest should be deep, providing room for generous sized heart and lungs. These organs, vital in every animal, are required to do more than ordinary work in the dairy cow. The digestion of a large amount of food and its conversion into milk require an expenditure of energy and vitality equal to that expended in the performance of hard work. Therefore, there should be a vigorous circulation of blood and ample provision for its purification and for a large supply of oxygen.

The nerve system. The digestive tract prepares the food for assimilation into the tissues, the udder elaborates the milk, the heart forces the blood with its load of food and oxygen through the body, the lungs supply oxygen to the blood and remove from it the products of the oxidation which takes place in the body; but the brain and nerve system are concerned in all these operations. Through the influence of this system the activities of all the organs are aroused, guided, controlled and harmonized. In the cow the heart and lungs are ever active. The digestion, absorption and assimilation of food, and perhaps the mysterious elaboration of milk, are constantly going on. Collier estimates that a cow giving an average quantity of milk produces, on an average, 138,210,000 fat globules per second during each 24 hours. This and the secretion of the other constituents of the milk illustrate the amount of activity in the milk organs alone, and suggest the need of a highly developed nerve system. The more pronounced of the outward signs that indicate this nerve development are a bright, lively, and prominent eye, this prominence causing a dished face; a wide forehead; a wide junction of the skull and spinal column, indicating a large brain; a large prominent backbone, giving room for a well developed spinal cord; a long slim tail; and considerable energy and vigor and style of action.

The correlation of parts. It is to be observed that further help in the study of dairy cows is an understanding of the reciprocal relations between the different parts of the body. It is in accordance with this correlation that the parts of the body here spoken of as less essential may be said to be indirectly concerned in the production of milk; for the same food can not be used at the same time for both forming flesh and producing milk; hence the smaller the amount of food used in the formation of tissues of these less essential parts, the larger the amount that will be left to be converted into milk.

Less essential parts. The energy of the dairy cow is directed as completely as possible toward the production of milk and butter. The tendency to produce milk has been increased as much as possible by breeding, inheritance and development; and likewise, the tendency to lay on flesh has been restrained. Thus the less essential parts of the dairy cow have been depleted or have "paid tribute" to the parts which are more essential to the purpose for which she was bred. This has resulted in developing a cow with a fine, slender head and neck; light fore quarters with but little flesh; rear quarters thin, incurved at the rear and sides, showing but little flesh; sharp withers; spare crops; and a generally thin, bony, angular body, devoid of all unnecessary flesh.

The writer is aware that this idea of the type of the "special purpose" cow is opposed by advocates of the "general purpose" cow, as well as by numerous breeders, owners and experimenters. Correct conclusions as to the exact type of cow best adapted for large dairy performance can only be drawn after studying the records of *many cows, from the economic standpoint, and for full lactation periods.* Even then there may be exceptions to the general conclusions arrived at. But the dairyman is seeking for the cow most profitable for his own particular purpose, and will usually be guided by the general law of averages.

AVERAGE PRODUCTION OF BUTTER PER COW.

In order to get some idea of the actual average production in Connecticut the writer, during the summer of 1899, made a canvass of a large number of herds whose owners patronized one of the large creameries in this state. From data collected in this canvass an average production of butter per cow was estimated, and is tabulated below. The amounts stated here are based upon the quantities of actual butter-fat delivered to the creamery, together with the careful estimates of the quantities of milk, cream and butter used by the different families on the farms where the herds were kept, as well as the amounts of milk used in raising or fattening calves on the farm.

Average annual production of butter per cow by the herds of the patrons of one Connecticut creamery.

1 herd	comprising	10 cows	averaged	300 or more	pounds
8 "	"	58 "	"	250 to 300	"
16 "	"	133 "	"	200 to 250	"
14 "	"	89 "	"	150 to 200	"
8 "	"	102 "	"	less than 150	"
47 herds	"	392 "	"	199	"

The results of this canvass show that only one herd averaged more than 300 pounds of butter per cow per year, and only eight herds averaged from 250 to 300 pounds. The actual butter production per cow per year in the whole 47 herds of 392 cows averaged 199 pounds. From the best data available it appears that the average conditions in New England require that a cow shall produce not less than 250 pounds of butter per annum before she can begin to yield a profit, when the cost of food, labor and other items are computed at the market prices. Yet the above canvass shows that only one-fifth of the cows included in the examination exceeded this amount, while the general average is 50 pounds below it. If these figures are taken as a fair index of the average production throughout the state then it would seem that the dairy industry in Connecticut is far less profitable than it ought to be.

It is not difficult to discover sufficient reason for such poor showing, locally and generally, on the part of Connecticut herds. Improper and irrational feeding and poor care and management are causes in a great many instances in which the quality of the cows might assure better results under different feeding and care. There are records of experiments in which herds of very ordinary cows, under proper care and feeding, have produced surprising amounts of milk and butter, and have yielded handsome profits. But a little careful study of dairy herds leads to the conclusion that no inconsiderable part of the trouble lies in keeping cows that no system of feeding nor the best care and management could ever make profitable, at least so far as the dairyman is concerned.

ILLINOIS.

Agricultural Experiment Station at Urbana.

Report by W. J. Fraser, Assistant Professor of Dairy Husbandry.

Rose. A grade cow, age 14 years, weight 1,225 pounds. Production for five lactation periods as follows:

June 6, 1894, to February 24, 1896, time 1 year, 8 months, 18 days—14,462.1 pounds milk, 703.89 pounds butterfat, 821.1 pounds butter.

April 7, 1896, to December 6, 1897, time 1 year, 8 months—14,536 pounds milk, 762.19 pounds butterfat, 889.22 pounds butter.

February 14, 1898, to February 27, 1899, time 1 year, 13 days—12,497.5 pounds milk, 506.93 pounds butterfat, 591.41 pounds butter.

April 10, 1899, to July 2, 1900, time 1 year, 2 months, 22 days—12,579.5 pounds milk, 637.45 pounds butterfat, 743.69 pounds butter.

August 27, 1900, to September 22, 1901, time 1 year, 25 days—6,018 pounds milk, 291.13 pounds butterfat, 339.65 pounds butter.

Description: Wedge shape as viewed from top and front; general appearance robust; head broad between eyes, well dished, quite fine; eyes large, bright, prominent; horns good length, small, fine; muzzle large; neck long, quite fine, well attached to shoulders and head; back straight, strong; tail, large, fine; switch large; withers sharp; hips broad, prominent; good length from hip points to thurl bones; chest very deep; ribs far apart, well sprung; abdomen very large; legs well shaped, strong; hide medium, loose; hair medium; secretions abundant, yellow; udder large, capacious, well

ROSE—A GRADE COW.
Produced 658.9 Pounds Butter in One Year.

balanced; teats good size, easily milked, well placed; milk veins large, tortuous, few small branches; temperament very active, sensible, maternal.

ZUIDER ZEE AGNES.

Description: Wedge shape as viewed from top, side and front; general appearance hardy; head fine, broad between eyes, well dished, clean cut; muzzle large; eyes medium, quite prominent; horns good length, small; neck long, slim, well attached to head and shoulders; back straight, strong; tail long, fine; switch large; withers sharp; loin strong; hips broad, prominent; good length from hip points to thurl bones; chest lacking in depth; ribs large, far apart, well sprung; abdomen large, well shaped; hide loose, pliable;

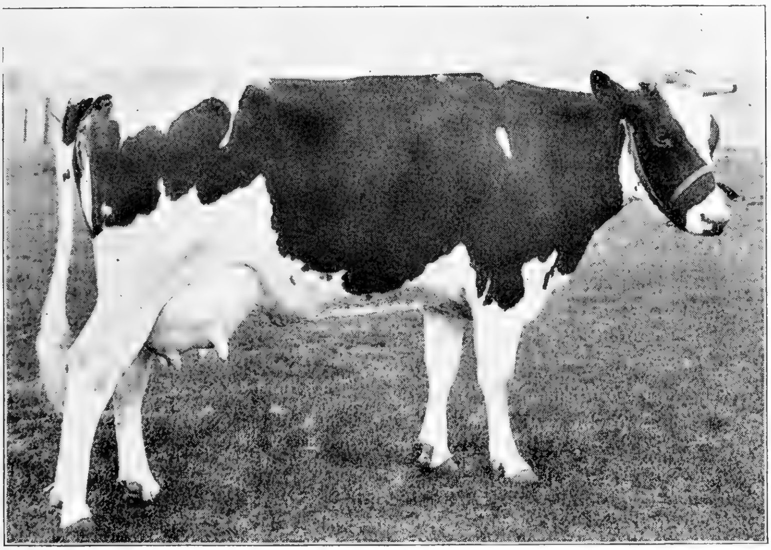
secretion abundant; udder very large, well balanced, good quality; teats well placed, good sized, easily milked; milk veins large, tortuous. Age, 5 years; Weight 1,250 pounds.

First lactation period, one year, produced 11,364.2 pounds milk, 390.77 pounds butterfat, 455.9 pounds butter.

First six months of second lactation period produced 8,280 pounds milk, 277.31 pounds butterfat, 323.53 pounds butter.

Yield for one day, 76 pounds milk.

Average yield for 30 days, 68 pounds milk.



ZUIDER ZEE AGNES—HOLSTEIN-FRIESIAN.
Produced 455.9 Pounds Butter in One Year at Four Years Old.

TINA CLAY'S PIETERTJE BELL.

Description: Wedge shape as viewed from top, side and front; general appearance hardy; head broad between eyes, fairly well dished; eyes large, bright, prominent; muzzle large; horns small, long; neck long, slim and well attached to shoulders and head; back straight, strong; tail long, fine; switch large; withers quite sharp; loin strong; hips broad, prominent; length from hip points to thurl bone fair; chest lacking in depth; ribs far apart, well sprung; abdomen large; legs strong, well shaped; hide rather thin and loose; secretions quite abundant; udder large; capacious, fair quality, slightly cut up between the teats, somewhat fleshy; teats large; milk veins large, quite straight, unbranched; temperament nervous. Age 12 years. Weight 1,200 pounds. Production for one year—12,416.9 pounds milk, 414.68 pounds butterfat, 483.79 pounds butter.

The production of two other cows as recorded at the station is given as follows:

JOCKEMKE. Holstein-Friesian, imported. From June 19, 1895, to June 18, 1896, time one year—15,070.1 pounds of milk, 568.63 pounds butterfat, 663.4 pounds butter.

TINA CLAY'S PIETERTJE BELL—HOLSTEIN-FRIESIAN.
Produced 483.79 Pounds Butter in One Year.

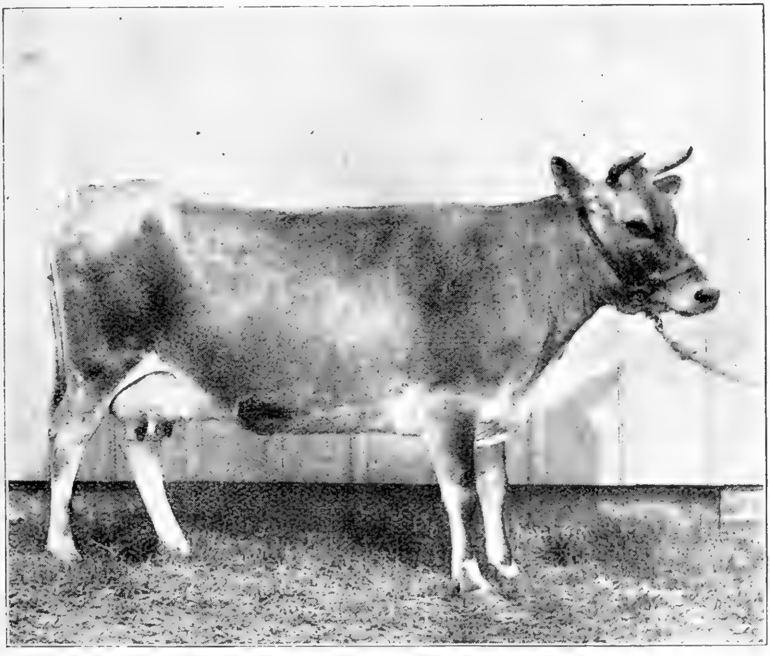
EXILE'S TORMENT. Jersey. First lactation period, time 1 year, 5 months —7,620.4 pounds milk, 412.43 pounds butterfat, 481.17 pounds butter. Second lactation period, first 6 months—4,586.8 pounds milk, 237.38 pounds butterfat, 269.94 pounds butter.

INDIANA.

Agricultural Experiment Station at Lafayette.

Report by C. S. Plumb, Director.

The Indiana station has owned several very superior cows, although we have no continuous year's test of both milk and butterfat that will show the best capacity of these individuals. At the present time there are four animals of interest in the herd, two being Holstein-Friesians that have



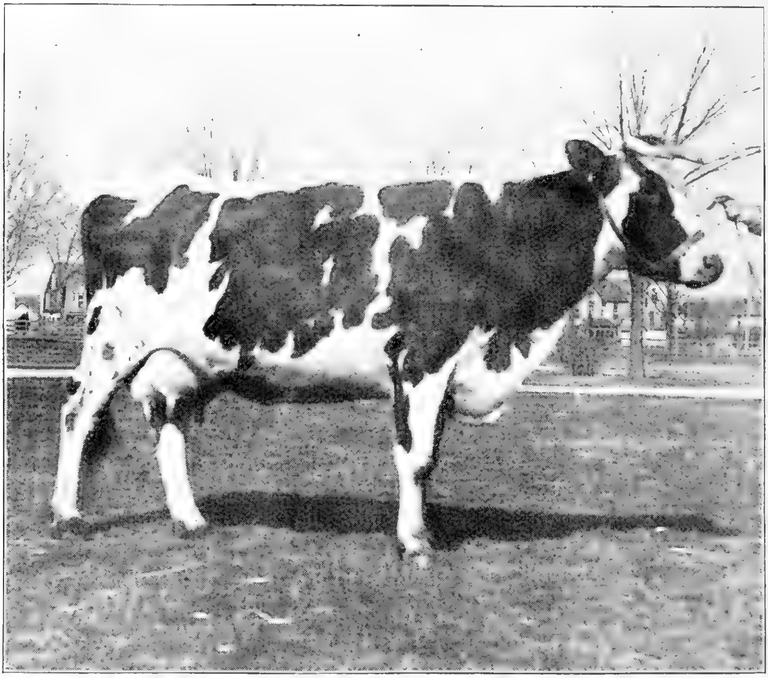
JERSEY COW "EARLY MORN" 506,661.

made records which have placed them in the advanced registry of the Holstein-Friesian Association of North America, and two Jerseys with recorded tests in the butter books of the American Jersey Cattle Club. The following records of two cows may be of interest to readers of this book:

Early Morn was a daughter of Ruby's Harry, 15,664, a son of Fancy's Harry, 9,777, that was killed in a railroad wreck before his merits as a bull became known. She was from Pinky Spry, 18,316, a daughter of Tormentor

3,533 imp. On the sire's side, Early Morn was also a great granddaughter of Tormentor, through Ruby's Torment, her granddam.

Early Morn was dropped April 4, 1887, and came into the possession of the Indiana Station in December, 1890, where she remained until her death in May, 1899. She was a large Jersey, having weighed nearly 1,300 pounds in her time. Her udder was very superior, the front part being nearly perfect, the hind part however, not being quite as full as it should be. Her milk veins were simply fair. The udder was very elastic and



HOLSTEIN-FRIESIAN COW "MANADA PURDUE 3rd," 50,483.

milked down well. She always carried plenty of flesh, and had fine handling quality.

In 1897 a careful record was made of Early Morn's work. During that period, beginning with April 13, ending January 13, 1898, during a period of 275 days, she produced 5,830.3 pounds of milk. Samples from each milking, by Babcock test, showed 330.60 pounds of pure butterfat, equal to 1.2 pound per day. For the first five and one-half months of this period of lactation all of her cream was saved and churned separately, the milk being run through a separator, and made 248 pounds and one-half ounce of butter, worked and salted one ounce to the pound.

From March 12 to 19, 1895, a special test was made of Early Morn, and this was reported to the American Jersey Cattle Club, and is in the published tests of the club. During the test (7 days) she produced 248.8 pounds of milk from which was produced 17 pounds 13¼ ounces of butter, worked and salted one ounce to the pound. She consumed during the trial 84 pounds of hominy, 42 pounds of bran, 21 pounds of oil meal, 55 pounds of clover hay, 193 pounds of silage.

For 11 months ending January, 1894, she produced 6,737.7 pounds of milk, an average of 20.9 pounds a day, while for 396 days ending in 1896 she made 7,754.8 pounds, an average of 19½ pounds a day.

MANADA PURDUE 3RD.

This Holstein-Friesian cow was dropped at the Indiana Agricultural Experiment Station on November 16, 1894, and was sired by Pietertje Netherland Artis, 13203, her dam being Manada Purdue, 22043. The sire was by Pietertje Netherland 12804, a son of Netherland Duke 1571 H. H. B., and Pietertje 3rd, 11244, while on the dam's side he was a grandson of Prince of Artis, 2479 H. H. B. His six nearest female relatives averaged about 18,000 pounds of milk a year each.

On the dam's side, the granddam of Manada Purdue 3rd, was an imported cow by the name of Manada, that was a very fine example of the dairy type, and withal a superior Holstein, excepting in the quality of her milk.

On January 30 of this year, Manada Purdue 3rd dropped a bull calf which on the day of birth weighed 125 pounds, the heaviest calf dropped at Purdue University in 11 years. On Monday morning, February 24, a test was made of this cow for seven days. During this period she produced 489 pounds of milk which by Babcock test showed 16.72 pounds pure butterfat. Her milk was run through a separator, and from the cream in two churnings were made 19 pounds three ounces of unworked butter, and 17 pounds 15¼ ounces of worked butter, salted one ounce to the pound. The greatest amount of milk she produced in one day was 75.4 pounds on Tuesday, which showed 2.6 pounds pure butterfat.

During this trial she consumed 63½ pounds of clover hay, 300 pounds of silage, 60 pounds of bran, 42 pounds of gluten meal, 28 pounds of hominy feed and seven pounds of oil meal. On the basis of figures adopted by the Holstein-Friesian Association of North America, the cost of this feed would be $1.32. This is, however, considerable lower than prevailing prices for feed this winter would make it.

A year's test prior to 1902 of this cow has not been made, as her period of lactation has been broken into to use as a nurse cow on some show stock, but during 1902 she is under careful test in every way to measure up her working capacity, samples of her daily milk being subjected to Babcock test. She is a cow however that will yield a good margin of profit over the cost of production.

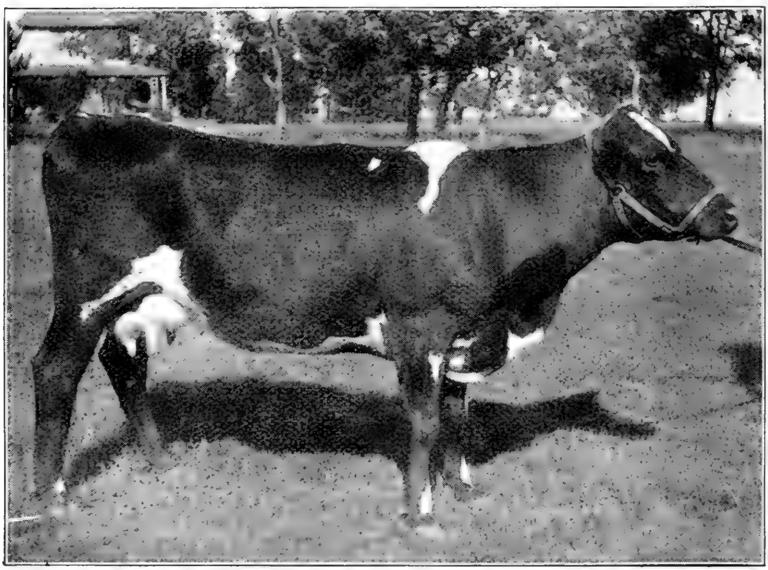
KANSAS.

Agricultural Experiment Station at Manhattan.

Report by Professor D. H. Otis, Dairy Husbandman.

Of the cows presented under this report Professor Otis says:

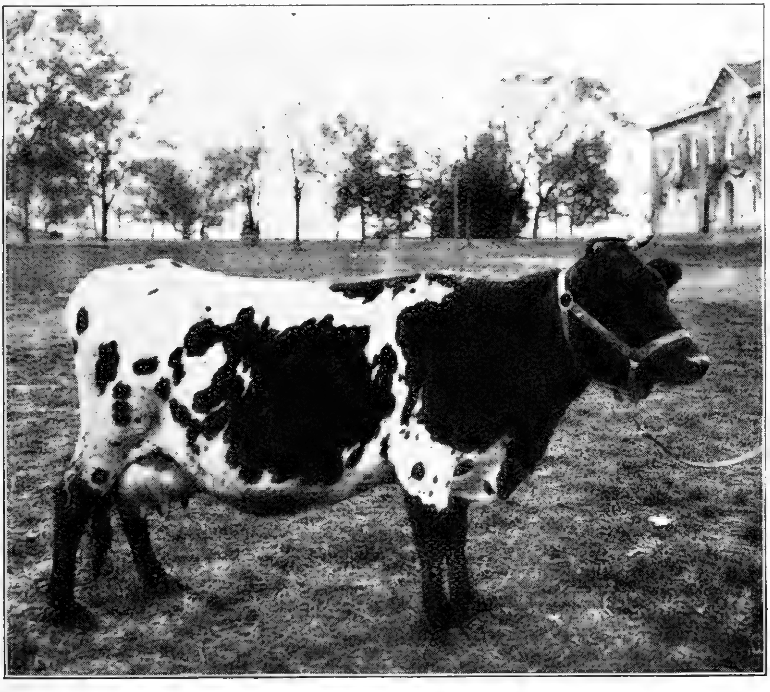
"We send you some pictures of our best scrub cows, together with their records. I would say that the cows were common cows picked up here and there over the country, and we have no information as to their age or previous treatment, before coming to college. The general type is



SCRUB COW No. 33.
Year's Record—Milk, 8,642; test, 3.7; butterfat, 320.59.

given in the picture, and I do not know as I can add anything in the way of characteristics that would be of particular value; they are simply cows. They have made good records for common stock. According to Secretary Coburn's reports the average Kansas cow produces less than 90 pounds of butter a year. I made an investigation four years ago in one of the best creamery districts of the state and found that the average cow of 82 different herds visited produced 125 pounds of butter a year."

Professor Otis has "picked these cows up here and there" and necessarily from among those furnishing the average of 90 to 125 pounds butter yearly. The excellent record these have made while at the college, is, therefore, mostly the result of better care and handling, showing in a practical manner what a dairyman can do with his own herd by giving thought to



SCRUB COW No. 72.
Year's Record—Milk, 7,965 pounds; test, 4.27 per cent.; butterfat, 340.42.

the cow's needs in the way of foods to stimulate milk secretion and the comfort of correct stable management. Professor Otis' letter, the pictures that follow, and the yearly records of milk and butter production of these "picked up scrub cows" will tell their own story to the patron who is honestly trying to improve his herd and his dairying methods.

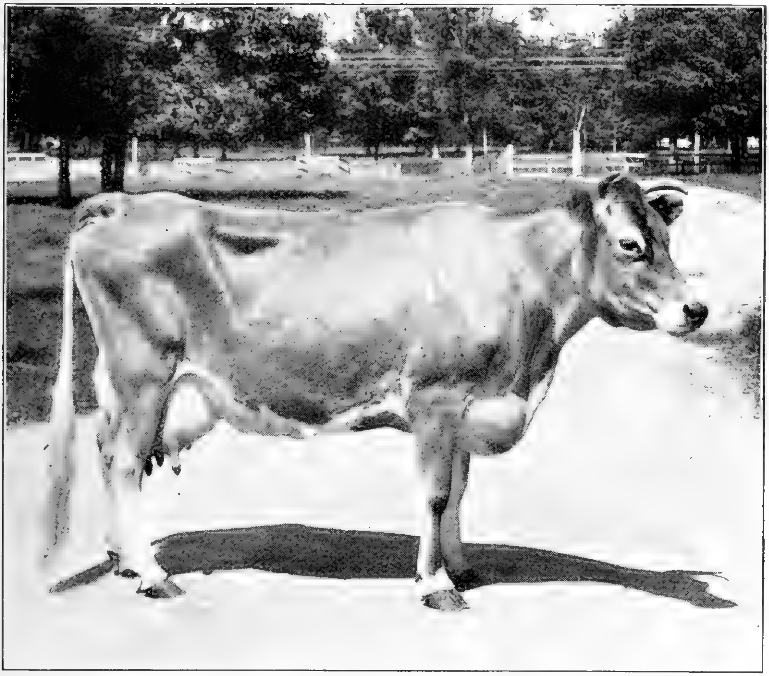
KANSAS—SCRUB COW No. 20.
Year's Record—Milk, 9,116 pounds; test, 4.21 per cent.; butterfat, 383.7.

KENTUCKY.

Agricultural Experiment Station at Lexington.

Report by D. W. May, Animal Husbandry.

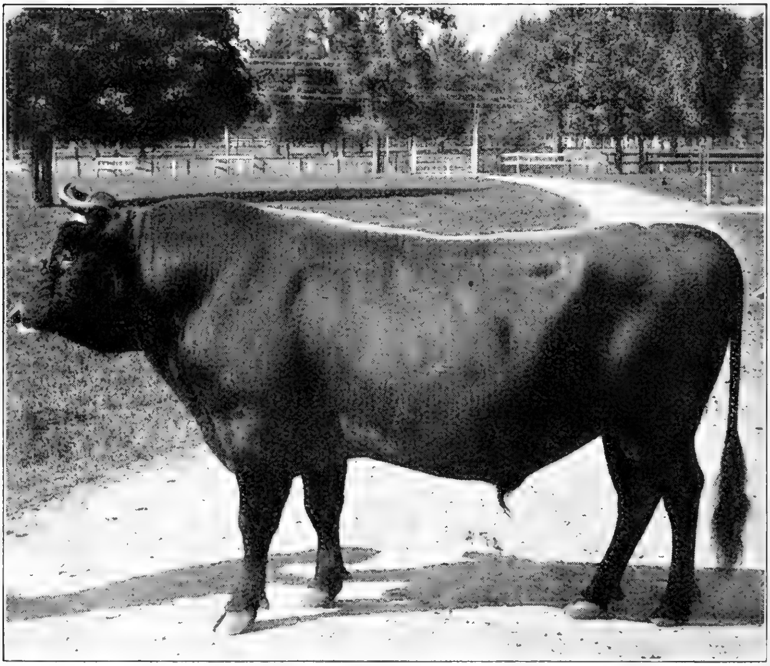
The station owns a herd of Jersey cattle, containing among other good animals, Dollie's Valentine, 105049. This cow was dropped February 14, 1894, and is out of Dollie Fay, 105047, by Oonan's Tormentor Pogis, 30505. Dollie's Valentine has made 18 pounds 1 ounce of butter per week and a



DOLLIE'S VALENTINE 105,049—JERSEY.
Produced in One Year 10,218 Pounds of Milk, Yielding 676.5 Pounds Butter.

yearly record of 10,218 pounds of milk and 676.5 pounds of butter. This represents an average of 27.99 pounds of milk and 1.85 pounds of butter daily for one year.

I send a photograph of Guenon's Lad, 54422. This imported bull was owned by the Kentucky Agricultural Experiment Station. He was dropped January 21, 1897. He took first prize at the Interstate Fair at Louisville in the fall of 1901, winning over the prize bull of the Pan-American Exposition of the same year. Shortly after this he was sold for $3,550.



KENTUCKY—GUENON'S LAD 54,422—JERSEY.
Prize Bull at Interstate Fair, Louisville, Ky., 1901. Sold for $3,550.

MARYLAND.

Agricultural Experiment Station at College Park.

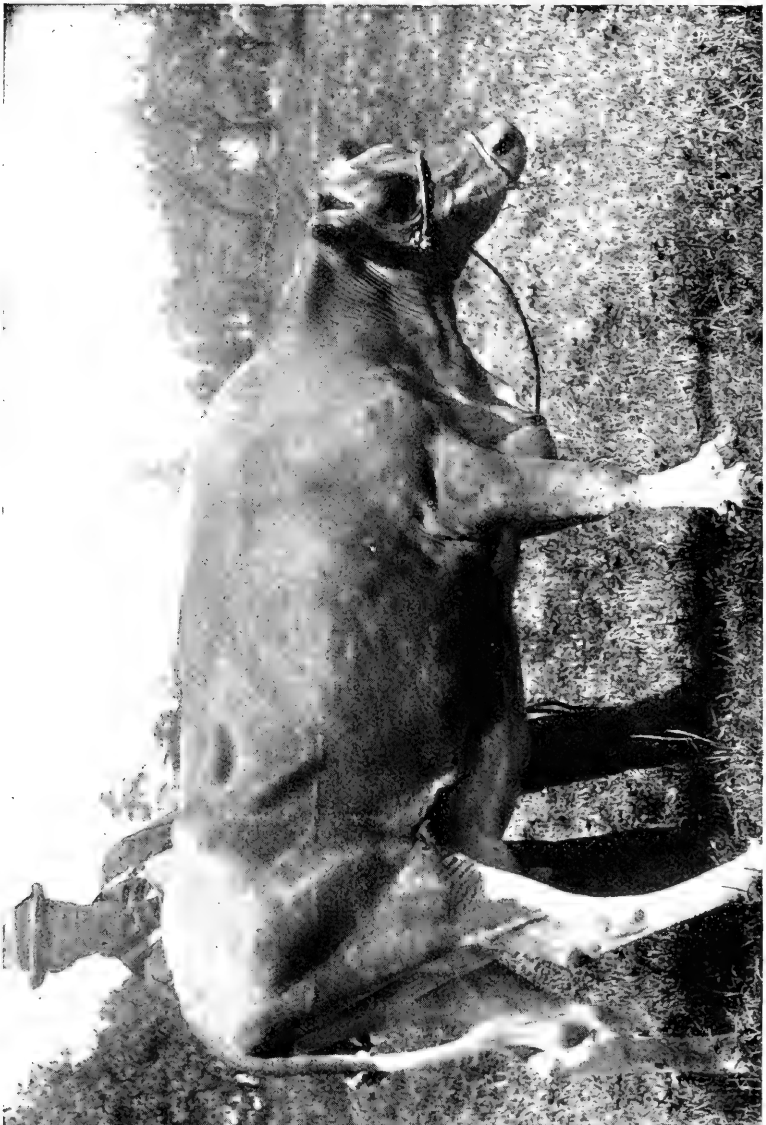
Report by H. J. Patterson, Director.

There is no doubt but that good care and feeding of cows, systematically carried out from year to year, will change their individuality and cause many cows to take a place among good and even extraordinary animals that are now occupying places of indifference and obscurity simply because they do not have a proper chance. The force of this is illustrated by the following records given of cows Nos. 7 and 15. Further details of similar results with many other cows have been published in bulletin No. 69 of the Maryland Station.

Cow No. 7 was purchased by the Maryland Experiment Station from a herd of average cows for the state, and, as far as could be judged, she was no better than the average of the herd. Her ability at that time is shown by her first year's record at the station, as she produced but 258 pounds of butter, which is likely better than she had been doing before as she was much better fed. She was at this time in what might usually be called the prime of her life for dairy purposes. In the five years she has been owned by the station her yearly butter yield has constantly increased, to 268 pounds the second year; 357 pounds the third year; 362 pounds the fourth year; and 442 pounds the fifth year. She is a high-grade Jersey and, as can be seen by the illustration, decidedly not of the beef type. She is a very dainty and comparatively light feeder, which is her serious fault, and, while she does not produce a large quantity of milk, it is very rich in fat.

No. 15 was purchased by the Maryland Experiment Station from a Baltimore consignment of western cattle. When she was purchased she was of a decidedly beefy tendency, and the record of her first year's butter yield at the station shows her to have been a very poor cow from the dairy standpoint at that time. The first year she was owned by the station she produced 183 pounds of butter; the second year, 286 pounds; the third year, 359 pounds; the fourth year, 338 pounds; and the fifth year, 386 pounds. The illustration shows her to have Hereford blood, which is very likely the predominant strain, as when she is bred to the most prepotent Jersey or Guernsey bulls, her calves invariably are colored like the Hereford breed without any markings whatever from the sire. Since purchasing by the station, No. 15 has lost all of her tendencies to lay on flesh.

The sketches sent by the station are of cows which were selected as being average animals for this state, and it is doubtful if they had remained under the same conditions as that from which they were taken, whether their best yearly yield would have been any better than their records for the first year they were owned by the station. It simply shows what can be made from a great many average cows found on dairy farms if they are given the proper treatment.



COW No. 7—HIGH GRADE JERSEY. Yield Increased fron 258 Pounds to 442 Pounds Butter in One Year.

COW No. 15—GRADE HEREFORD. Yield Increased from 183 Pounds to 386 Pounds Butter in One Year.

MICHIGAN.

Agricultural Experiment Station at St. Anthony Park.

Report by C. D. Smith, Director.

Yearly records are reported by Professor Smith of three of the best cows of the station herd as follows:

Belle Sarcastic, Holstein-Friesian, H. B. 23039, produced in one year, 21,075.8 pounds of milk containing 632.78 pounds fat. In a lactation period of sixteen months gave 27,626.3 pounds milk containing 827.22 pounds fat.

Houwtje D., Holstein-Friesian, H. B., 12005, produced in one year 19,025 pounds milk containing 660.14 pounds fat.

Rosa Bonheur 5th, Holstein-Friesian, H. B. 11227, produced in one day 106.75 pounds milk, and in 10 days, 2,989 pounds milk containing 26 pounds fat.

MINNESOTA.

Agricultural Experiment Station at St. Anthony Park.

Report by Professor T. L. Haecker.

COWS FOR THE DAIRY.

The Minnesota Experiment Station has completed the eleventh year in which complete records have been kept of the amount of milk and butterfat yielded by each cow at every milking and the amount and kind of food given each day, with its chemical composition. Some of the discoveries made by this comprehensive and careful work have been referred to in the chapter on economical feeding of dairy cows, in which the subject is treated from the feeder's standpoint. No reference is made to the kind or type of cow that makes the best return in the dairy, and to make the Creamery Patrons' Handbook a more complete guide for the dairyman, a little definite information on this subject seems desirable.

Every farmer has observed that there are good cows and poor cows in every breed. Some cows yield a large mess of milk when fresh, but soon begin to shrink in flow; some give only a medium yield when fresh, but are very persistent milkers; some make a very creditable showing in yield, but the milk contains a small per cent. of butterfat. Some that are not adapted for dairy work, have, under a forced process of feeding, given satisfactory and even large returns for a year or two and then have died or failed to respond to further forcing, but unfortunately nothing is said or written in regard to this particular phase of the work.

The records of the station referred to show that a test covering a short period, or even one or two years, throws but little light on the kind of cow that is best adapted for dairy work. This is clearly demonstrated in the year's test of the Guernsey cow, Sweet Briar, and the common cow, Fairy.

ONE YEAR'S RECORD.	Lbs. Milk.	Lbs. Butter.
Sweet Briar, Guernsey	3501	206
Fairy, Common	8867	384

AVERAGE OF FIVE YEAR'S RECORD.	Lbs. Milk.	Lbs. Butter.
Sweet Briar	6501	380
Fairy	6544	286

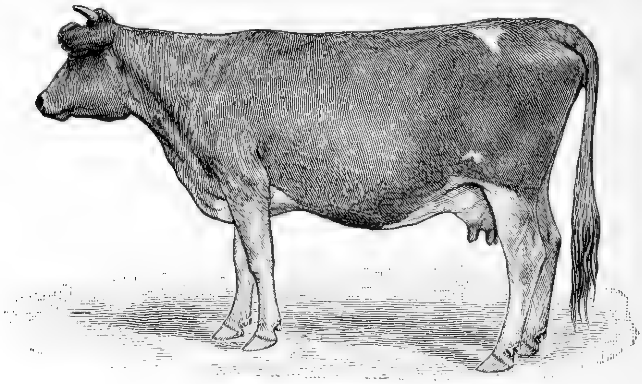
Had the record ended with only one year's test the common cow would have been declared the better, but by continuing the test during the five years it was found that Sweet Briar was by far the better butter cow. Both entered the station herd when they were six years of age. Fairy remained six years, when she passed her usefulness, being 12 years old and failing to breed. Her average yearly yield during her life was 6331 pounds of milk and 273 pounds of butter, while Sweet Briar is now in her 17th year and is due to calve on New Year's day. Her yield for the ten years has been as follows:

SWEET BRIAR—PRODUCTION FOR PAST TEN YEARS.

Year.	Milk.	% Fat.	Butter Fat.	Butter.
1891–2	6510.3	5.22	339.59	396.19
1892–3	7352.0	5.00	367.48	428.72
1893–4	4515.6	5.03	227.40	265.30
1894–5	7534.1	4.96	373.50	435.75
1895–6	6604.0	4.86	321.28	374.83
1896–7	7770.9	5.41	420.86	491.00
1897–8	3501.3	5.06	177.10	206.62
1898–9	5301.9	4.95	262.74	306.53
1899–0	5491.7	4.76	261.58	305.18
1900–1	7160.5	4.27	305.75	356.71
Average	6174.2	4.95	305.73	356.68

From this table we see that even under exceptionally good care, cows will vary considerably from year to year in the flow and quality of milk, and that it requires several years of careful and accurate testing to determine the value of a cow in the dairy. Sweet Briar is doubtless the only cow in

America whose every mess of milk has been weighed and tested separately for eleven consecutive years. She has completed her 15th lactation, but the last, being for year 1901–2 has not yet been computed. During the 14th lactation her yield of butter was just equal to the average for the last ten

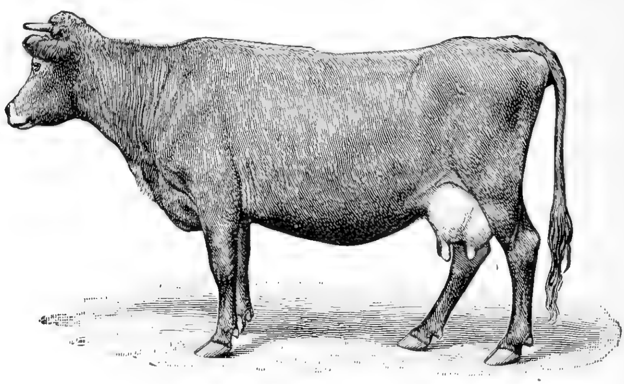


GUERNSEY COW—SWEET BRIAR.

years given in the table. She is still sound and gives promise of doing good work the coming year.

THE TYPE OF COW ADAPTED TO PROFITABLE DAIRYING.

While, as has been shown, it is not possible to determine the degree of usefulness a cow may have by a short test, or even a year, it has been definitely determined that it is an easy matter to measure her value for the



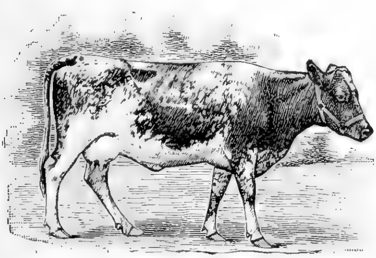
A GOOD DAIRY COW.

dairy by her form or conformation. If a cow has a roomy, deep middle piece, she is invariably a good feeder. Now, if she is a good feeder and does not have the disposition or heredity to convert her food into meat, she will, if carefully handled and well fed, be a good milker. She may not be a large butter producer, because that depends upon the quality of her milk—which is a matter of heredity, and no person has yet been able to tell by the mere inspection or handling of an animal what that quality may be; but if she is spare in conformation, and a good feeder, she may be safely selected as a profitable cow.

The cows of this type have, in all careful and impartial trials, covering several years, shown their great superiority in the dairy, irrespective of breed. It is with cows, very much as with horses. Now and then one can find a blocky, heavy-boned horse that has the elements of speed in him, but he soon gets out of wind and is distanced in the race. So a cow of beef heredity and form, may, for a short time, do creditable dairy work, but she has thus far failed to show staying qualities. To show the comparative usefulness of these two types we again refer to the Minnesota tables covering 20 yearly records of each type with the following averages:

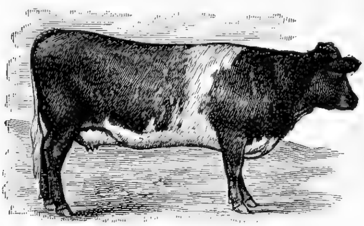
	Lbs. Milk.	Lbs. Butter.
Dairy type cows	7876	430
General purpose cows	6035	295
In favor of dairy type	1841	135

Valuing the skim milk at 15 cents per 100 pounds, and allowing one-eighth of the milk for cream, there is an excess of $2.42 in favor of the dairy type cow for skim milk, and allowing 16 cents net for butter, the 135 lbs. that the dairy type cows gave over that given by beefy cows, amounts to $21.65, making a total of $24.07 as the amount the dairy cow earns annually over and above the yearly earnings of the dual purpose cow.



FAIRY—A MEDIUM DAIRY COW.

It is, however, recognized that the average farmer, or even the average creamery patron, does not make dairying a specialty, and that farmers and creamery patrons have, as a rule, common cows of mixed breeding. It is a question whether the special dairy cow would give as large returns under the care ordinarily bestowed upon cows, as they have made under the care of dairy specialists; be that as it may, the cows of the creamery patron, as a rule, are common cows, and he is interested, or should be, in their possibilities. The records referred to show that the common cow under proper care will give, on an average, 6035 pounds of milk and 295 pounds of butter per year, while statistics show that the average yield of the cows of the country is just half that amount. This means that the common cow of the country would give twice as much milk and butter if she received as good care and were as well fed as she should be. To be conservative, and within the range of that which could be easily accomplished by feeding judiciously grains and roughage grown on the farm, let us assume that under proper care cows would give 5000 pounds of milk and 250 pounds of butter. This would net the patron $40, while a yield of 150 pounds nets him only $24, making a difference in the receipts for butter alone of $16 per cow, assuming that the butter nets him only 16 cents a pound. Let every creamery patron apply this to his own herd, study these methods and see if it will not pay him to handle and feed his cows properly. We are milking about 16,000,000 cows, and an addition of $16 per cow per year would increase the income of the owners by $256,000,000. A sum certainly worth striving for.



A POOR DAIRY COW.

There are great possibilities in store for those who wish to make dairying a specialty and are willing to devote their energies and brains to the business. In the long run nothing leads more surely to a competency, but it demands close attention to learn just how to treat cows so that the largest return may be secured.

Do not begin with pedigreed stock, but lay the foundation of your herd with good common cows. Place at the head a good registered sire of the breed you prefer. Thus you should serve your apprenticeship in dairying. Gradually as they pass from the herd because of age or your mistakes, their places can be filled by the grades, and as these begin to pass the period of usefulness and you have become a trained handler and feeder, you will be in a position to lay the foundation for a profitable herd of full-bloods. Buy a few registered females and soon you will be a successful breeder and dairyman.

If you have made judicious selections of registered stock, be very shy about going outside of your own herd for a sire. In selecting one, see that he is roomy in the middle and has light quarters; that his dam is a good performer, is easy milking, has long teats well placed on an udder well rounded out in the fore quarters. He should have a straight and high tail-head, eyes quick and expressive, and poise of body stately. If the offspring are satisfactory, keep him during his lifetime and then let one of his best sons take his place, as judicious linebreeding has always brought best results with dairy stock. A bull should have a ring put in his nose as a yearling, and should always be handled with a staff. Never put yourself in a position where he can do you harm, no matter how gentle he may seem to be. Treat him kindly but firmly, give him plenty of exercise, but never give him the freedom of yard or pasture with the herd.

MISSOURI.

Agricultural College and Experiment Station at Columbia.

Report by Prof. C. H. Eckles, in Charge of Dairy Husbandry.

This station has maintained a good herd of dairy cows for several years, the average yearly income of which has been $90 per cow for butter alone. The records of individual cows are not yet extensive enough to be of general interest. Carefully gathered statistics show the average Missouri cow to produce 4,000 pounds of milk per year and 140 pounds of butter.

MONTANA.

Agricultural Experiment Station at Bozeman.

Report by Prof. R. S. Shaw.

A dairy department has only recently been established at this station. Some dairy herd studies were begun during the past April. This department has not been neglected because of a lack of natural dairy conditions in the state, but through need of funds for proper equipment. A small grant made by the state legislature at its last meeting has made the erection of a building possible.

The dairy building, which is now complete, furnishes quarters for butter and cheese making, and the equipment is such that instruction can be given in both lines. Under the same roof a laboratory, class room, office, and storage and curing rooms have been provided. The equipment is such that both instruction and investigation work can be carried on to good advantage.

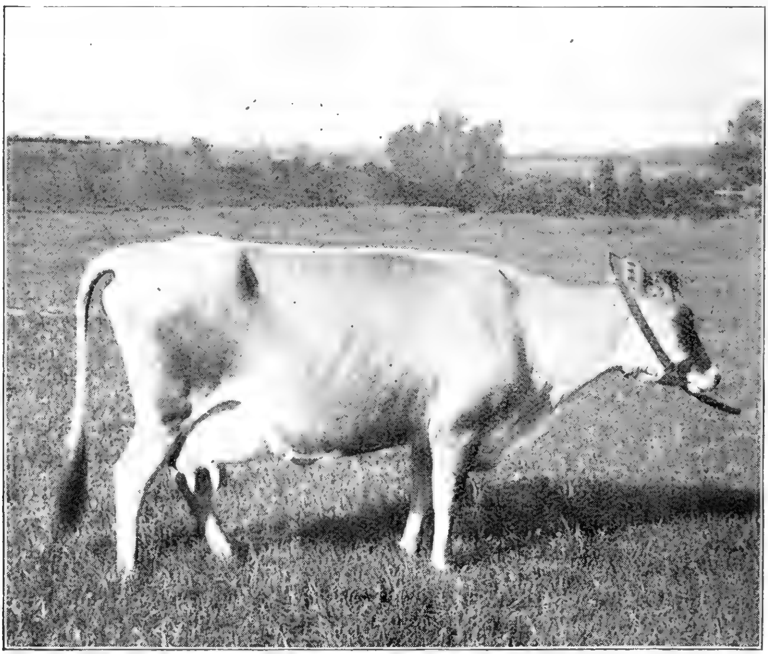
The natural conditions presented in western Montana are particularly favorable to the dairy industry. There is an abundance of nutritious pasture, and of water and the most suitable climatic conditions. This industry can be expected to develop rapidly in the state.

NEBRASKA.

Agricultural Experiment Station at Lincoln.

Report by A. L. Haecker, Professor of Dairy Husbandry.

The Nebraska Experiment Station for the past six years has kept accurate records of a dairy herd ranging from ten to fifteen cows. The herd until recent years has been largely composed of high-grade Jersey cows, but during the past year a number of Holsteins have been added. The following individuals illustrate type and conformation of some of the specimens of the herd:



ANNIE—HIGH GRADE JERSEY.

The record will show this little cow to be a highly developed dairy specimen. Her four years' record was made on light feed, consisting in the summer of grass only, and in the winter months of alfalfa-hay and beets for roughness, corn and bran for grain. Her development is strikingly strong as an economic producer, but she is just a little too delicate, and unfortunately was taken sick in the fifth year of her record. She is a high-grade, having about fifteen-sixteenths Jersey blood, and weighs about 750 pounds.

ANNIE—FOUR YEARS' RECORD.

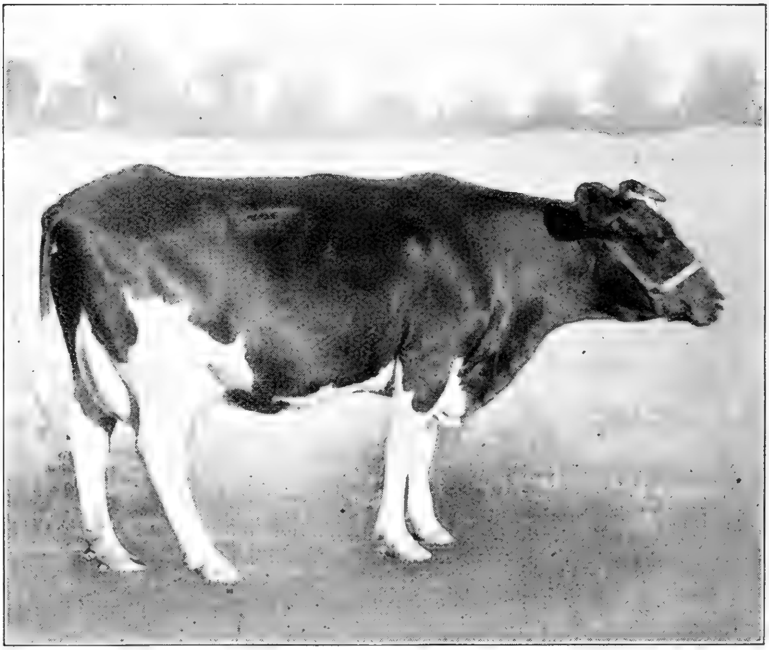
Year.	Pounds Milk.	% fat.	Pounds butterfat.	Pounds butter.
1897	6,977.25	4.49	313.39	365.62
1898	6,907.19	4.55	314.64	367.08
1899	5,250.39	4.56	239.41	279.31
1900	7,028.30	4.50	316.27	368.98

CORA—HIGH GRADE JERSEY.

"A little cow with a big record." This is the title we have given Cora She is also a high-grade Jersey, and weighs from 700 to 800 pounds. She is still in the herd and I believe is making her largest record this year. She has much the same type and conformation as the cow Annie, but is a little more thrifty and hardy, holds her head a little higher and seems to have a stronger constitution.

CORA—FIVE YEARS' RECORD.

Year.	Pounds milk.	Pounds butterfat.	Pounds butter.	Cost of feed per year.
1897	8,073	352	411	$25.27
1898	7,302	313	365	$24.92
1899	7,099	295	345	$20.50
1900	7,088	298	348	$26.20
1901	7,535	354	383	$28.20



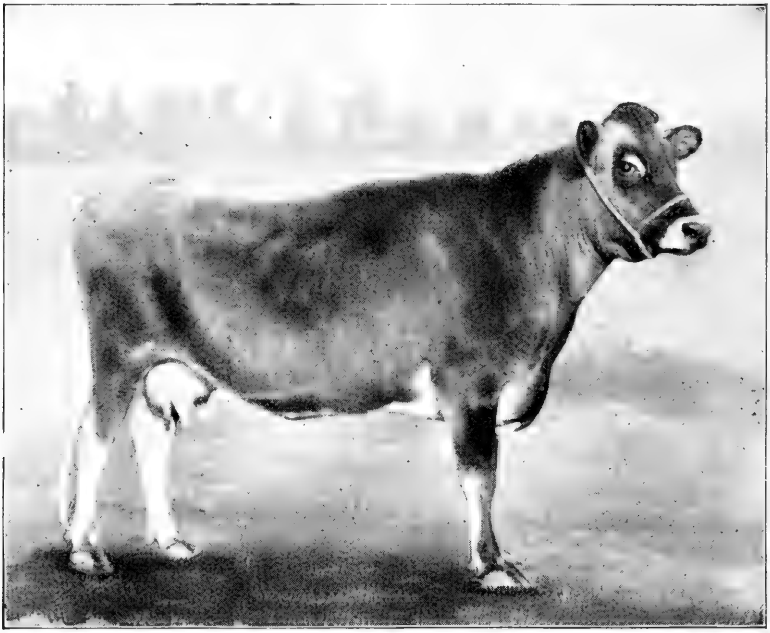
BESSIE McKINLEY—FULL BLOODED HOLSTEIN.

The cow Bessie McKinley is a full-blooded Holstein cow, No. 46141 H. F. H. B. This cow has not been in the herd long enough to obtain a yearly record, but the following weekly record will show her to be an excellent dairy cow. She is a large animal, weighing between 1,200 and 1,300 pounds, and has a strong and vigorous constitution. She is a heavy feeder and I think will make an exceptionally good yearly producer. Record for seven days starting October 6 and ending October 12, 1901: Pounds of milk, 363. Average test, 3.9. Pounds butterfat, 14.16. Pounds butter, 16.52.

JUNO—HIGH GRADE JERSEY.

The cow Juno has been given here to illustrate a type lacking capacity and having the wrong conformation for a dairy cow. Juno has a record of 86 pounds of butter in one year. After such a performance it was naturally thought best not to keep her, so we have but one year's record to show. She was a healthy cow, strong and vigorous, but steer-like in shape, having heavy shoulders and crops, with small barrel and undeveloped mammary glands. Juno was also a high-grade Jersey and her breeding is much the same as the cows Annie and Cora. This is a good illustration of the importance of judging cows by type rather than by breed.

The cow Diana 2nd is a high-grade Jersey of rather stocky build. She weighs about 1,100 pounds. She gives a small flow of milk, but it has a high per cent of butterfat. She is inclined to carry a good deal of flesh, which makes ber butter rather expensive when com-



DIANA 2nd—HIGH GRADE JERSEY.

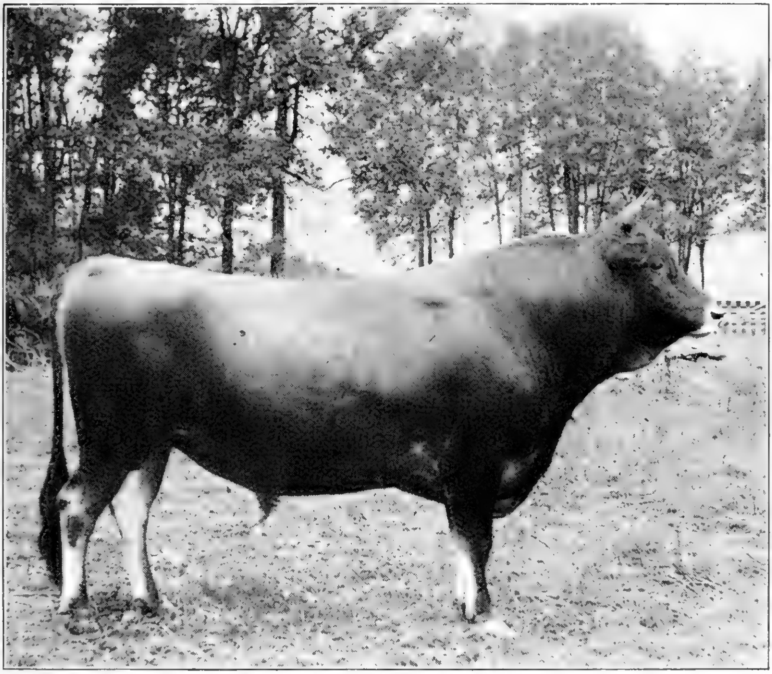
pared with the butter of highly developed dairy types. She is a strong, healthy cow and a large feeder, but is disposed to go dry after eight or nine months of lactation. The following record was made last year, which is a good average but not the best:—Pounds milk, 4,971. Pounds butterfat, 261. Pounds butter, 304. Cost of keeping, $32.10.

OREGON.

Agricultural Experiment Station at Corvallis.

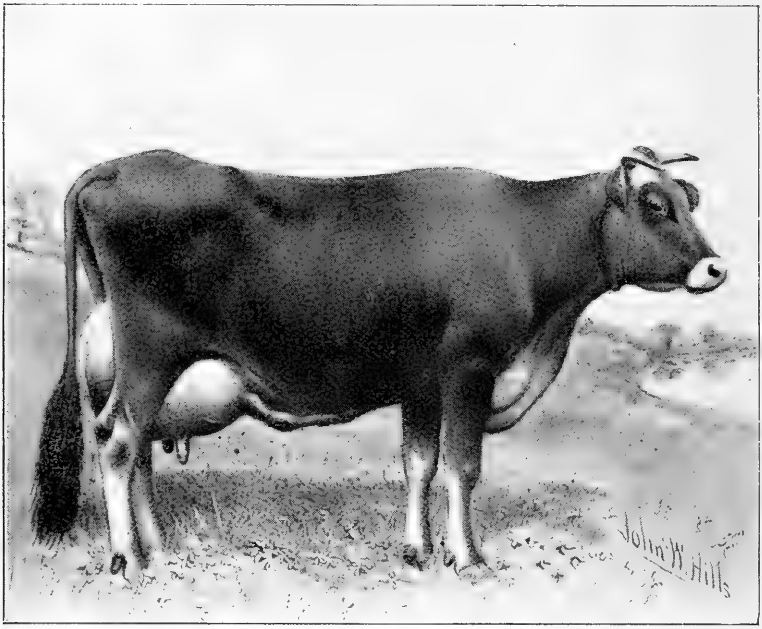
Report by F. L. Kent, Assistant Agriculturist.

The herd at the college contains a number of very promising young cows, but as a whole it is not typically representative of the best in the state. What is supposed to be the best among the dairy herd records of Oregon is submitted as follows:



"THE BEST JERSEY BULL IN OREGON."
Inda Landseer Rioter, A. J. C. C. 52,103.

Inda Landseer Rioter, A. J. C. C., 52103. Sired by Miller and Sibley's bull Rioter of St. L. 8th; dam, Inda Landseer 2nd—a cow that gave over 60 pounds of milk per day, and made over 30 pounds of butter in seven days in her four year old form. Sweepstakes bull at the Oregon State Fair in 1901. Property of D. H. Looney, Jefferson, Marion County, Oregon. Said by men of wide experience to have no superior among the Jersey bulls of the United States.

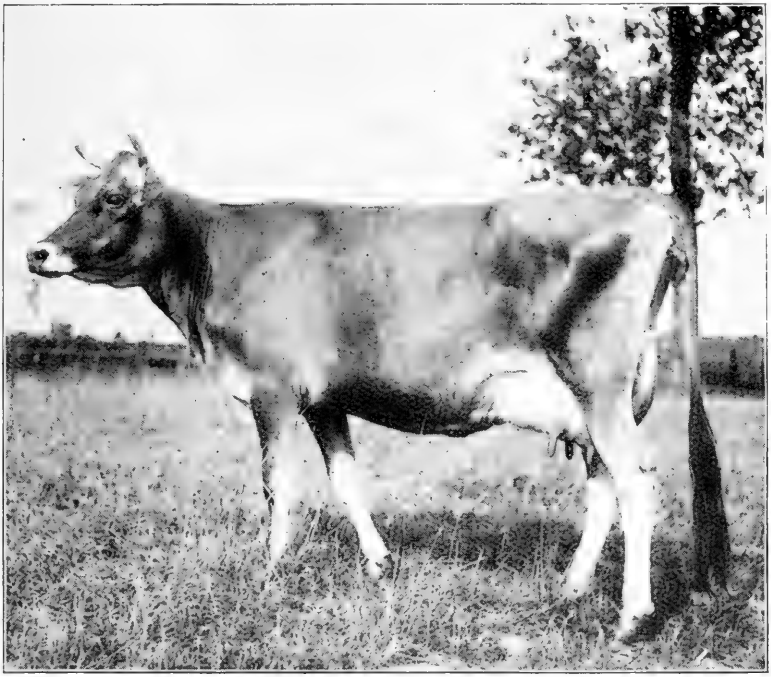


BELLE JEFFERSON 136,329—JERSEY.
Has a Milk Record of 52 Pounds a Day on Grass. Butter Record, 21.5 Pounds in Seven Days.

Two cows are shown from what is said to be the best Jersey herd on the Pacific Coast, that of the Crystal Springs farm of the W. S. Ladd estate, Portland, Oregon. The herd comprises 100 head of selected Jerseys. Mr. F. E. McEldowney, manager, has made several trips east, each time purchasing one or two carloads of choice animals. There are many cows in this herd that are noted for their large production of milk and butter. Two of the best cows, Belle Jefferson and Golden Glow, are shown in the illustrations.

A registered Jersey herd owned by H. West, Scappoose, Oregon, shows an average production per year per cow as follows:

1896—361 pounds butter; 1897—386 pounds; 1898—392 pounds; 1899—428 pounds butter, 6,775 pounds milk; 1900—452 pounds butter as the average per cow in that year.



GOLDEN GLOW 129,238—IMPORTED JERSEY.

Fed on Ordinary Rations Produced 40.5 Pounds Milk in One Day. Butter, 18 Pounds 3 ounces in Seven Days.

The average production per cow per year for the entire state is 150 to 200 pounds butter, with a number of herds showing averages above 300 pounds per cow annually. Some good records of cows of Ayrshire, Holstein, and Jersey breeds of the college herd are given as follows:

Topsy. Pure bred Ayrshire. Milk in one year, 6,341 pounds, butter 304 pounds.

Martha. Pure bred Holstein. Milk in one year, 9,288 pounds, butter 349 pounds.

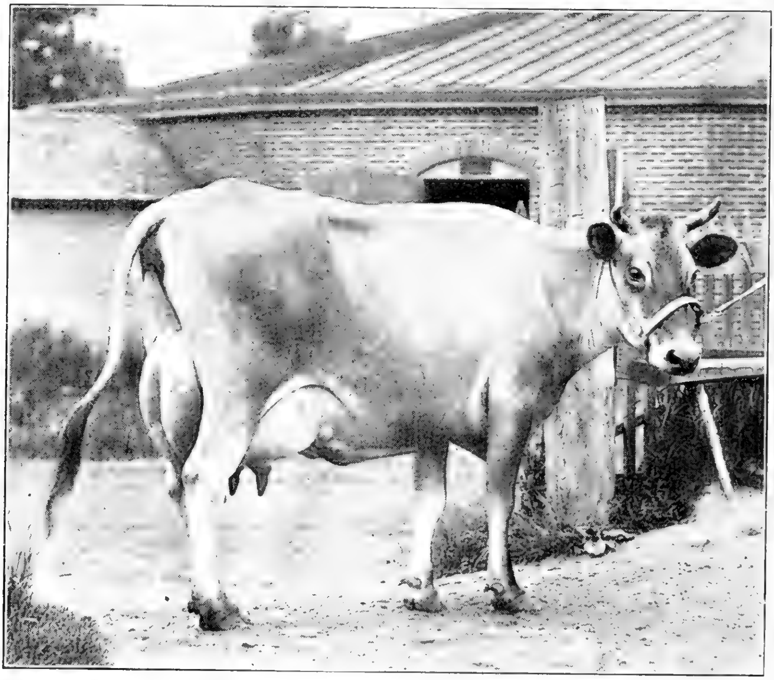
Francis Stevens. Registered Jersey. Milk in one year 7,252 pounds, butter 381 pounds.

PENNSYLVANIA.

Agricultural Experiment Station at State College.

Report by Harry Hayward, assistant professor of dairy husbandry.

Professor Hayward reports the best cow of the station herd as a grade Guernsey, "Ramona", who in a lactation period of 369 days betewen calves gave 10,351.6 pounds of milk testing an average of 4.367 per cent. fat, or 452.1 pounds, equivalent to 527.47 pounds churned butter. This on the



ADELAIDE OF ST. LAMBERT 73,652—JERSEY.
Produced 82¾ Pouuds of Milk in One Day.

ordinary feed of the herd which consisted of eight pounds of grain a day with soiling crops in summer and hay and corn stover in winter. Ramona is described as wedge shaped, deep through the heart, down well in the flanks; large roomy abdomen and excellent udder, with a well developed milk system.

The illustration presented is of the noted Jersey cow Adelaide of St. Lambert, a member of the Miller & Sibley herd, at Prospect Hill Stock Farm, Franklin, Pennsylvania, and of whom the owners write as follows: "For the 31 consecutive days ending June 24, 1898, she gave a total of 2,005¼ pounds of milk. During this period she was milked three times daily at intervals of eight hours. Every milking was witnessed by at least two persons, and sometimes as many as six persons were present. The cow weighs 1,002 pounds, hence she gave in the month over twice her weight. Her best day for us was 75¾ pounds, but her best record for her former owner, Mr. Henry Harrison, of Cannington, Province of Ontario, was 82¾ pounds for one day during the month of May, 1897. She holds the world's Jersey milk record for the period of a day, two weeks, three weeks, four weeks and thirty-one days. Her sire is Comely's Stoke Pogis 19327 and her dam Princess Minette 24042. Seventy-five per cent. of the blood of Adelaide of St. Lambert is what is known as St. Lambert blood. She is descended from Stoke Pogis 3rd on four different lines and has 31¼% of his direct blood. It is worthy of note in passing that all the highest milk records in the Jersey breed have been made by animals of very similar breeding. For a time Ida of St. Lambert held the world's Jersey record. She was a daughter of Stoke Pogis 3rd. La Petite Mere 2nd and Mathilde 4th, who for a time each held the world's Jersey milk record for a year, were both daughters of Stoke Pogis 1259, the sire of Stoke Pogis 3rd and Stoke Pogis 5th. A granddaughter of the latter bull, Jimp, holds the world's Jersey milk record for the period of a week. The latter bull also leads all other bulls that ever lived in the number of granddaughters with standard butter tests. We know of 183 and probably there are more.

"Adelaide of St. Lambert was dropped January 9, 1890. She has an enormous barrel, the largest we ever saw on a Jersey, and naturally a voracious appetite and excellent digestion. By the Babcock test she indicated to us at several different times that she was making from 4¼ to 4⅓ pounds of butter a day. About a year after her great milk yield, when she was not giving nearly so much, we set her milk by itself for a week and churned it and she made of butter when salted one ounce to the pound and well worked ready for market 21 pounds, 5¾ ounces.

"The photograph was made by a local photographer and the plate not retouched. It will be seen that the fore udder is full and symmetrical, teats large and well placed and that the rear udder also rounds out very nicely and comes high up behind."

SOUTH CAROLINA.

Agricultural Experiment Station at Clemson College.

Report by C. M. Conner, assistant agriculturist.

I am sending a photograph of one of our Jerseys, Clemson's Beauty, together with her milk record. We have very few good cows in this state. Dairying has not made much headway here yet. The average butter production per cow in this state is very low, not over 150 pounds. Every effort

CLEMSON'S BEAUTY 73,444—JERSEY.
Produced 445.3 Pounds Butter in One Year.

is being made to get the people interested in dairying and in a measure the efforts have been successful. Clemson's Beauty was sired by St. Bernard No. 4,849. She was six years old when the test was made and was fed just like the rest of the herd, no effort being made to force her. She produced 445.3 pounds of butter in the year.

SOUTH DAKOTA.

Agricultural Experiment Station at Brookings.

Report by A. H. Wheaton, dairyman of the station.

We have no cows on the college farm at present from which to quote records, so the best I can do is to send a report of our herd as tested in the year from January 1, 1893, to January 1, 1894. The milk was weighed from each cow at each milking and an accurate account kept of same for the entire period.

The whole herd have been kept on prairie grass for pasturage, but were fed some fodder corn when grass began to get short from drouth. While on grass they were not fed grain except, perhaps, a pint each of bran and shorts night and morning as an inducement for them to take their places in the stable to be milked.

In winter they were fed on fodder corn and millet for hay, and when we had it, ten pounds of bran and shorts to each cow per day, and when the days were warm enough not to freeze, they were allowed to run in the yard and to ricks of fresh straw. But when the weather would not permit of outdoor exercise they were fed straw at noon in the stable, which seemed to be highly relished by them. The stables are in a basement where the temperature is easily kept above freezing. No hay was fed them during the winter. These cows have not been crowded in any way, the object being to keep them as nearly as possible as a good, prudent dairy farmer should keep cows in Dakota, and the figures given in the table below are not intended to show the best possible results obtainable, but to show the practical results of keeping a herd of good dairy cows as any ordinary farmer can keep them if he will. The writer believes that he is thoroughly acquainted with the conditions surrounding the average farmer in this state and believes it to be the duty of this department to try those experiments first which may be of the most practical benefit to him, and most easily reached by him, with the means he may have at his command, with as little extra outlay as possible.

Following is a brief report of seven of the best cows in the herd. Only those that produced above 300 pounds butter in the year are here listed.

America 1. Shorthorn, roan in color, six years old; came fresh in May. Produced 8,066.09 pounds milk, test 4%, making 403.3 pounds butter.

MAGGIE HUGHES. Shorthorn, red in color, five years old; came fresh in April. Produced 5,840 pounds milk, test 5.5%, making 401.2 pounds of butter.

LAURETTA. A fine type of Guernsey, six years old; came fresh in March. Produced 6,129 pounds of milk, test 5%, making 383.06 pounds of butter.

LAKEMAN LASS. Holstein Friesian, an imported cow, 10 years old; came fresh in December just prior to beginning the year's test. Produced 8,032.14 pounds of milk, test 3.29%, making 330.12 pounds of butter.

MARY CLAY. Shorthorn, red color, nine years old; came fresh in June. Produced 5.774.06 pounds milk, test 4.52%, making 325.23 pounds butter.

LILLY. Ayrshire, red and white spotted, seven years old; came fresh in May. Produced 5,268 pounds milk, test 4.93%, making 324.5 pounds butter.

HEBRON. Devon, dark red, five years old; came fresh in March. Produced 4,570.15 pounds milk, test 5.65%, making 322.65 pounds butter.

TENNESSEE.

AGRICULTURAL EXPERIMENT STATION AT KNOXVILLE.

REPORT BY PROF. ANDREW M. SOULE, VICE-DIRECTOR AND AGRICULTURIST.

There are some excellent herds in the dairies of Tennessee, from which some records may be of interest.

The reports are from the Glencliff Farm, Nashville, Tennessee, and Ewell Farm, Spring Hill, Tennessee.

Rioter's Exile of St. Lambert, 48228—the pure St. Lambert bull at head of Glencliff Farm herd of Jerseys, belonging to D. S. Williams of Nashville, Tennessee—is out of Letty Rioter 73475, a cow that produced 24 pounds and two ounces of butter in seven days from 318 pounds of milk, and gave 1,183 pounds milk in 30 days—nearly 5½ gallons daily.

Individually he is a magnificent specimen of a vigorous dairy bull, and

RIOTER'S EXILE OF ST. LAMBERT 48,228—JERSEY.

before he was five years old (he is now in his sixth year) he produced the following tested daughters:

			Butter in seven days. lbs.	oz.
Exile's Lady Mathilda	#152,314	testing,	23	6
Hugo Riotress Elf	152,126	"	23	3
Exile's Monde Coquette	143,807	"	23	4
Exile's Brier Coquette	151,536	"	23	1
Rioter's Edith Hugo	142,248	"	23	1
Vivienne's Allie Pogis	153,242	"	22	6
Exile's Alexia	152,315	"	22	3
Exile's Hugo Lassie	152,391	"	22	3
Exile's Dido B	153,276	"	22	2½
Exile's Mary B	145,753	"	18	1¼
Exile's Hugo Maiden	152,392	"	15	2

This is a result that no other bull ever attained at such an age, but need not be surprising when his breeding is considered. He is sired by Exile of St. Lambert, 13657, the sire of 94 tested daughters, which is more than any other bull ever produced.

Letty Rioter was double granddaughter of Stoke Pogis 3d, one of the greatest sires that ever lived, and out of Lettie Coles 2d, who had a test of 21 pounds 8 ounces of butter in 7 days, from 300 pounds 15 ounces of milk, and a year's record of 10,533 pounds of milk.

TORMENTOR 3,533, AT NINE YEARS—IMP. JERSEY.

Letty Rioter not only produced this wonderful bull (Rioter's Exile of St. Lambert) but also three superb daughters as follows:

		Butter in seven days lbs.	oz.
St. Lambert's Riotress, testing		24	6
St. Lambert's Letty	"	22	8½
Riotress Signal	"	21	5½

Letty Coles 2nd, 48128, also produced three other high testing daughters. Is it any wonder that Rioter's Exile of St. Lambert should get high testing progeny? He traces seven times to Imported Stoke Pogis, ten times to imported Victor Hugo—the last named bull Governor Hoard is said to have pronounced the best dairy type and temperament he ever saw.

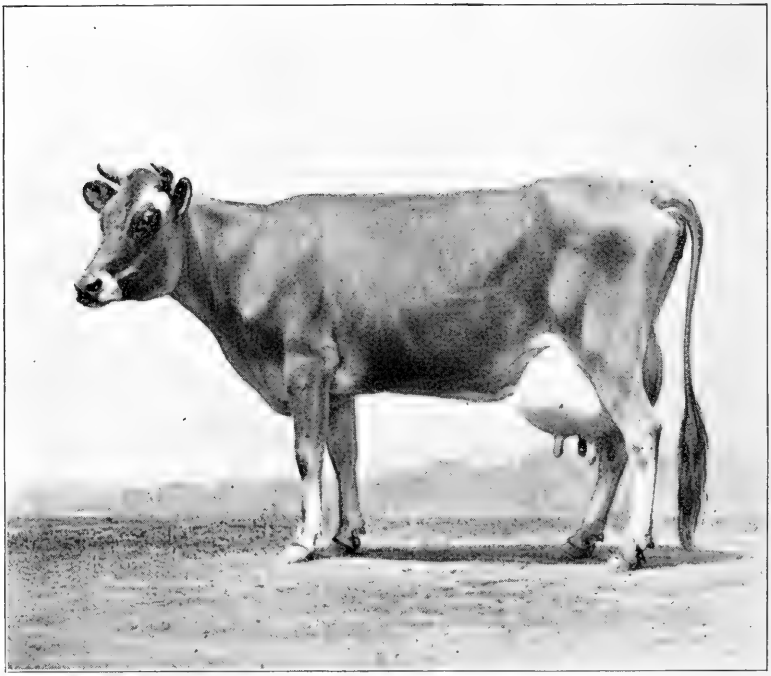
IDA'S STOKE POGIS 13,658, AT THREE YEARS—JERSEY.
Dam was Ida of St. Lambert 24990, whose Record was 67 Pounds Milk in One Day, 455 Pounds 8 Ounces in Seven Days.

George C. Brown of Ewell Farm, Spring Hill, Tennessee, sends photographs of two noted Jersey bulls—Tormentor 3533 (shown on page 280) and Ida's Stoke Pogis 13658—and one noted Jersey cow, Duchess of Bloomfield 3653, with this brief mention:

"Tormentor sired 41 cows with standard butter tests and some 400 to 500 of his descendants have standard records.

"Ida's Stoke Pogis, cut down in the bloom of his life, still sired over 30 with records, and he has two granddaughters by a son of Tormentor that have official tests of over 32 pounds.

"Duchess of Bloomfield had four tested daughters and five sons that were successful sires, and she did much for the breed by her wonderful milking qualities, combined with a singular beauty which attracted great attention, besides winning her many premiums."



DUCHESS OF BLOOMFIELD 3,653—JERSEY.

A famous cow in the earlier history of the breed. Calved January 29, 1874. In 61 days ending June 29, 1882, gave 2,706 pounds of milk. Her weight was 720 pounds, thus in two months producing milk over $3\frac{3}{4}$ times her own weight.

Mention is also made of another famous Jersey bull of Tennessee, King Koffee, Jr., 12317, the property of W. Gettys, Ingleside Farm, Athens, Tennessee. At five months old this bull was brought south at the price of $3,500. He was born April 11, 1884, and remained in service at the head of the Getty herd until 1898.

UTAH.

Agricultural Experiment Station at Logan.

Report by F. B. Linfield, Professor of Animal Industry.

The Utah Experiment Station has no remarkable records in milk or butter production to report. This was scarcely possible from the nature of our work. Our herd was largely composed of grades and we did not have a dairy district from which to select. Moreover, the time of our

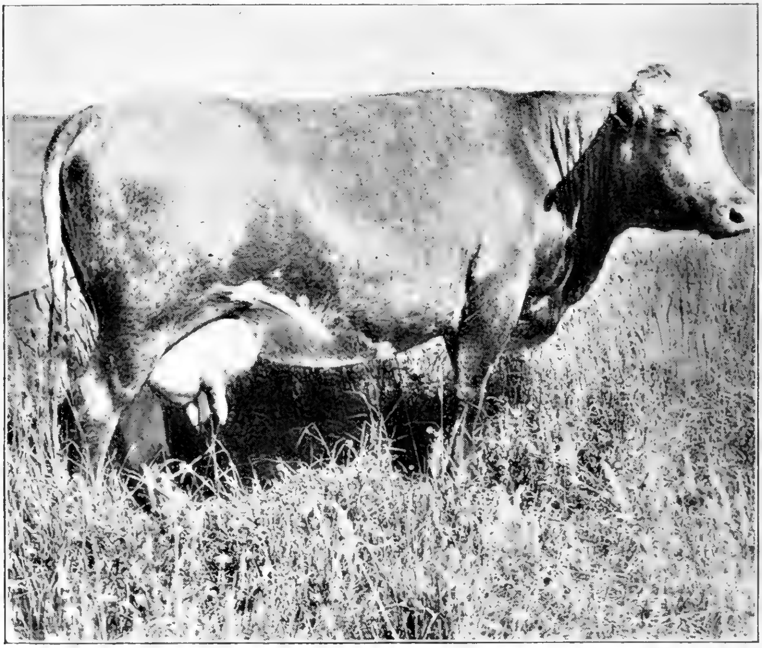
MARY CHALLENGER—PURE BRED SHORTHORN.
One Year's Record—7,228 Pounds of Milk, 285 Pounds Butter.

observations has been limited. The only breeds that have been represented on the College Farm and in the dairy herd have been Jerseys and Short horns and grades of those breeds.

The best record from a pure bred Jersey was 967 pounds of milk per month and 55 pounds of butter. The best yearly record of this cow was

6,801 pounds of milk and 365 pounds of butter. The cow is of the St. Lambert strain of Jerseys and was seven years old when the record was made.

The best Shorthorn record was from a cow that lived longer on the College Farm than any other animal the college has owned, viz: ten years. She gave 1,406 pounds of milk for one month and 50 pounds of butter. For a year her best record was 7,228 pounds of milk and 285 pounds of butter. Her milk always tested low, averaging but little over three per cent, and several mornings' milkings went as low as 2.5 per cent. fat. The



GRADE SHORTHORN—"A TYPICAL DUAL PURPOSE COW."

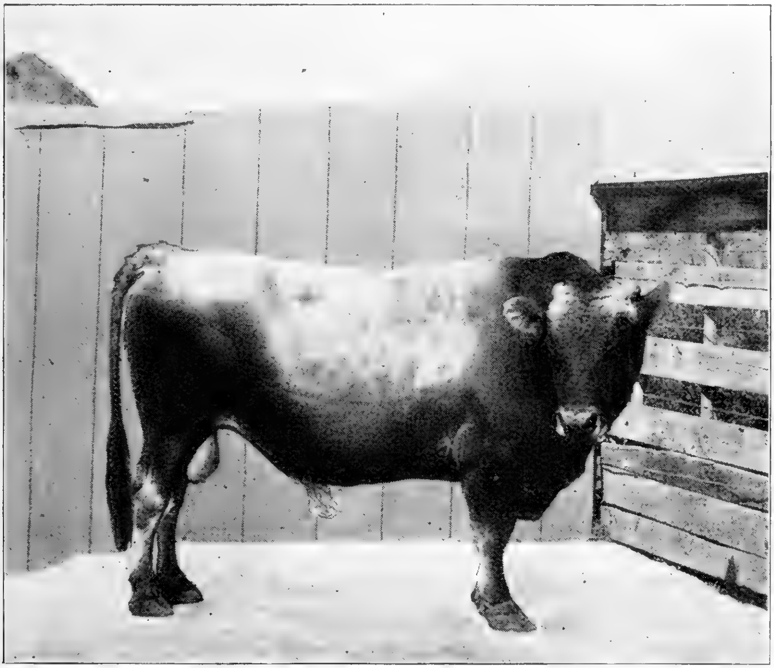
year the cow produced her best record the major portion of her feed was roughage and but little grain was fed. The picture (page 283) shows her when eight years old.

The best record made by any cow on the College Farm was by a grade Shorthorn. She gave 1,251 pounds of milk in one month and 66 pounds of butter.

For a year her best record was 8,859 pounds of milk and 424 pounds of butter. The record of this cow alternated from year to year; an extra record one year and the next year lower. The illustration above shows her when ten years old, in the first month of milking, and on pasture when she was giving nearly two pounds of butter a day. She is what I call a typical dual purpose cow.

If four years and not one were considered, then another grade Shorthorn is entitled to first place. This cow gave 7,282 pounds of milk and 367 pounds of butter on the average for four years; and varied but little from year to year. The average of the cow above described (page 284) was but 315 pounds of butter for the same period.

A record on a par with those, though only one year's record is obtainable, was made by a grade Jersey. She produced 5,659 pounds of milk



JERSEY BULL—FIRST PRIZE WINNER UTAH STATE FAIR—1901.

in a year and 402 pounds of butter. This cow gave the highest test of any cow kept on the farm, the average test for the year being 6.11 per cent. fat. For months at a time, in the latter periods of lactation, her test varied between six and eight per cent. fat for morning's and evening's milk.

It can scarcely be said that any dairy bull has become noted in this state. The practice of our farmers is against such records being made.

Very few farmers keep a bull over two years. In-and-in-breeding seems to be a bugaboo, and therefore the least approach to such a practice is avoided. In very many cases this is a mistaken notion, but the results are that a bull is usually disposed of before any opportunity of testing his heifers is possible.

The Jersey bull here illustrated (page 285) was used on the College Farm for four years, and his sire for five years before him. As far as points go, he is an almost ideally shaped bull, strong head and crest, a large barrel and light hind quarters. He was sold last fall and later exhibited at the State Fair and took first prize in his class. Neither this bull nor his sire however, produced cows from the grade herd that equaled the records of the grade Shorthorns described.

I have heard of no carefully kept records of the yearly production of cows by any farmers in this state. A few reports compiled from creamery records show that some common cows in the hands of farmers produce 300 pounds of butterfat in a year, and several whose herds will average close to 250 pounds of butterfat. I do not believe, however, that the average herd in this state will give anything above 150 pounds of butterfat.

VERMONT.

Agricultural Experiment Station at Burlington.

Report by Joseph L. Hills, Director.

The Vermont Experiment Station herd of some sixty odd animals is made up mainly of grade Jerseys. We have always had, however, from four to six registered Ayrshires, and from three to six registered Jerseys. No other breeds have been kept for many years, although some registered Holsteins were members of the herd prior to 1894. I have assumed that the report called for refers to registered animals only, but have inserted also the particularly good record of a grade Jersey.

Ayrshire, Nancy B., 9581 A. R. Was dropped April 1, 1887. Her sire was Buffalo Bill 4099 A. R. Her dam was Miss Cornelia 3rd, 8934 A. R.

She was purchased by the Experiment Station in 1894 from Mr. L. S. Drew, Burlington, Vermont, late president of the Ayrshire Breeders' Association. She has had seven full years at the station. Her milk yield has ranged from 6,068 pounds to 9,161 pounds, and averaged 7,946 pounds. Her butter yield has ranged from 288 to 416, and has averaged 362 pounds. The quality of her milk has been quite uniform, and is on the average for the seven years 3.90 per cent. She is a typical Ayrshire, has perhaps rather more of the dark red and less of the white than the generality of the Ayrshires of late years, is a hearty feeder and has made a pound of milk cheaply, and a pound of butter at medium prices. The average cost of her food yearly has been

NANCY B. 9,581 A. R.—AYRSHIRE COW.
Average Yearly Record for Seven Years, 7,946 Pounds Milk, 362 Pounds Butter.
(Somewhat out of condition and nearly dry when photographed.)

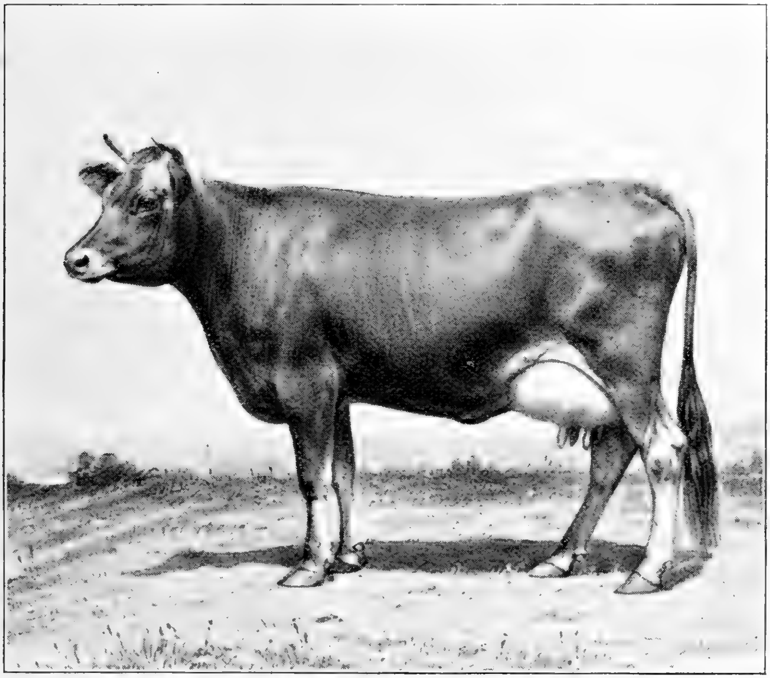
$54.57; of purchased grain $20.19; and of the sales of her butter, at prices varying from 23 to 27½ cents a pound, $91.73. The price for food has been reckoned from prices paid for grain in the several years, allowing $9 to $10.50 a ton for hay, and $3 a ton for silage and soiling crops; $5 a year for a season's pasturage per animal. The prices for roughages, it will be noted, more than cover cost of raising and harvesting in average seasons, and, indeed, are much higher than are frequently used in figuring costs of food in comparisons of this kind.

GRADE JERSEY. The cow Eva, now nine years old, was purchased for $45 of a farmer in Central Vermont, who evidently did not know what he had. Her lines of breeding are not known. She has had three years' record at this station. Her milk yield has ranged from 5,030 to 7,333 pounds, and averaged 6,182 pounds. Her butter yield has varied from 427

EVA, AT NINE YEARS OLD—GRADE JERSEY.
Average Yearly Record for Three Years, 6.182 Pounds of Milk, 475 Pounds Butter,

to 533, and averaged 475 pounds. The quality of her milk has been somewhat variable, having ranged from 6.23 to 7.27, averaging 6.86 per cent. of fat. She is a well formed cow, and fairly typical of the Jerseys. She is a hearty eater. Her food has averaged to cost $53.05; and the purchased grain $22.05. She makes a pound of milk at a medium cost and a pound of butter at very low cost, 11.3 cents a pound. Her butter, at prices ranging from 26 to 27½ cents, has averaged $127.98 a year. This last year the sale of her butter brought in $146.51, or $90.86 above the cost of feed, even rating this at the high prices referred to under Nancy B., and notwithstanding the high prices of grain which obtained during 1901.

JERSEY, MINTA BELLA, 85578 A. J. C. C. Was dropped November 8, 1891. Her sire was Obella's Rioter 23181 A. J. C. C. Her dam was Erminta V., 53553 A. J. C. C. She was bought in 1895 from Hon. H. W Vail of North Pomfret, Vermont, who was at one time a member of the executive committee of the American Jersey Cattle Club. She has had six full years' record at the station. The pounds of milk given have ranged from 4,726 to 6,860, and have averaged 5,748. Pounds of butter given have



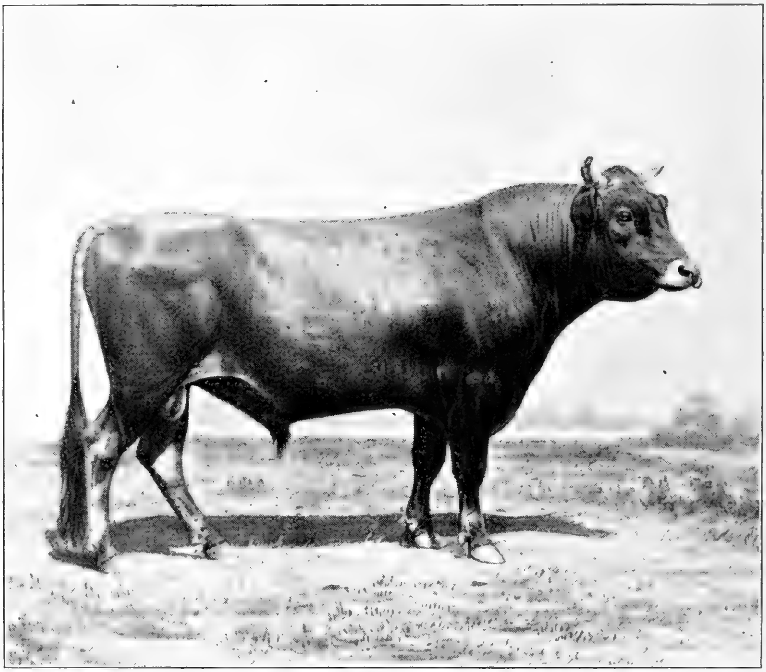
GARFIELD'S BLACK PRINCESS, A. J. C. C. 97,555, AT TWO YEARS OLD.

From April 16, 1900, to May 27, 1901, gave 8,515¾ pounds milk; average of six Babcock tests showed 6.1 per cent. butterfat, equal to 606 pounds of butter.

ranged from 345 to 458, and have averaged 405. She has been somewhat variable as regards the quality of her milk. It has always been high, but has sometimes been well above six per cent. and sometimes below. For instance, in 1899 it was 6.60, in 1900 5.72, and in 1901 5.62. She gave, however, in these three successive years, 381, 458 and 404 pounds of butter.

The average for the six years of the quality of the milk was 6.07 per cent of fat. She is a typical Jersey, of a rather spare form. She is a hearty feeder for a Jersey. The average total cost for food has been $45.47; for purchased grain $16.48. She has not made a pound of milk as cheaply as Ayrshires, although she has made it as cheap as any of the Jerseys or grade Jerseys. She ranks at the head, however, as an economical maker of butter, it having cost for food 11.2 cents a pound. The proceeds of butter sales, at prices varying from 23 to 27½ cents, have averaged $103.94 yearly. The same remarks concerning cost of food given under Nancy B. obtain here.

Quite complete statistics taken by the State Board of Agriculture some seven years ago show an average production per cow of about 156 pounds for the state as a whole. I am inclined to believe that this figure has been increased of late years, so that it probably is now 165 pounds; but this is more or less guesswork.



"THE BEST BULL EVER IN VERMONT."
Garfield Stoke Pogis, A. J. C. C. 15,963. Owned by Billings Farm, Woodstock, Vt.

In answer to the request for description of some one or more noted bulls and record cows of the state, any breed, Professor Hills submits the following letter written by Hon. George Aitken, manager of the Billings Farm, Woodstock, Vermont, and prominent in state agricultural affairs:

WOODSTOCK, Vt., March 24, 1902.

Prof. J. L. Hills.

DEAR SIR: Yours of the 21st at hand and I enclose the record of two cows, one of which, Woodstock Princess, is the dam of your Station bull, "Col. Cassius"; she made 604 pounds; the other is Garfield's Black Princess, 606 pounds. I have enclosed the photo of Black Princess at two years old; have none of Woodstock Princess. Have ordered one of Garfield Stoke Pogis; his picture ought to be in this publication, as I consider him the best bull ever in Vermont. He was the sire of 37 tested cows.

I can furnish you any number of the records, but thought you would like one of the dam of your bull.

What do you think of this for heifer with first calf? Garfield's Lily, a full sister of Lily Garfield, the champion heifer at Chicago, from September 10, 1900, to September 15, 1901, gave 6,456 pounds milk, average test of 5.8, equal to 437½ pounds butter.

Here's another: Empress Lily, who is a good deal more than half sister to your bull, with first calf from October 10, 1898, to December 3, 1899, gave 6,450¼ pounds milk, testing 6.6, equal to 496½ pounds butter, How's that for two-year olds; can you do better at the Station?

Very truly yours,

GEO. AITKEN.

The good dairyman is always enthusiastic and his pride in the record of his herd is more than pardonable; it is praiseworthy. The appended illustrations certainly picture two very fine animals.

WISCONSIN.

AGRICULTURAL EXPERIMENT STATION AT MADISON.

REPORT BY PROF. E. H. FARRINGTON, IN CHARGE OF DAIRY SCHOOL.

During the past three years the Wisconsin Dairy School has tested a number of cows on the farms of patrons of the Dairy School Creamery. The milk of each cow was weighed at the farm for two milkings of a day in each week, samples being sent to the creamery and there tested. These records in many cases were continued through the entire year. Over two hundred cows belonging to the farmers have been tested in this way. The records thus obtained furnish evidence for discussing questions in which a great majority of the creamery and cheese factory patrons of the country are interested. Probably very few farmers realize that there is so great a difference in the production of the different cows in a herd, as these tests show to be the case. The cows, however, are undoubtedly a fair representation of the one million cows that produce the butter and cheese of Wisconsin. In these tests the cows were all measured by the same standard, the weight and test of the milk for a year.

The extreme variations in the butter value of the cows of the different farmers is shown in the following table:

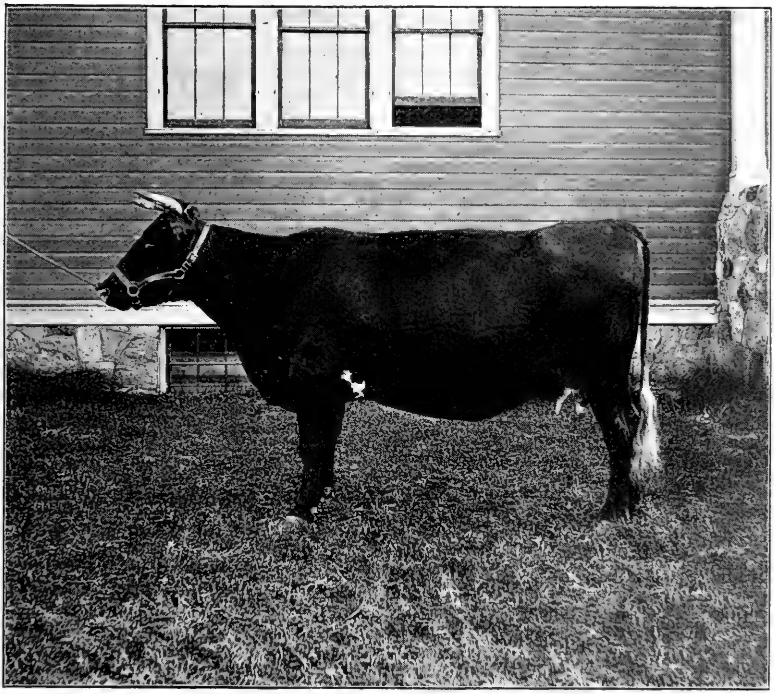
Table showing variations during one year in the butter value of the cows in patrons' herds.

PATRON.	No. of cows in herd.	CREAMERY PAID.		CREAMERY VALUE OF BUTTER.		
		Total cash.	Average per cow.	Best cow.	Poorest	Average cow.
A—1898	12	$421	$35 11	$53 35	$28 72	$36 30
1900	11	405	36 82	82 23	20 18	39 20
1901	11	424	33 55	64 93	23 51	33 92
B—1898	5	*........	....	58 21	44 83	50 00
C—1898	12	572	47 70	60 72	37 96	43 83
D—1898	6	228	38 00	55 49	39 60	44 12
1900	6	....	....	51 28	28 40	41 42
E—1898	5	227	45 40	67 47	44 40	53 40
1900	5	....	....	68 16	43 47	61 20
1901	4	....	....	70 72	59 47	62 11
F—1898	9	....	....	60 29	34 00	....
1900	7	....	....	58 70	31 90	44 00
G—1900	14	563	40 00	72 21	39 32	56 57
H—1900	8	358	44 75	66 08	17 23	50 00
1901	8	332	41 50	62 71	46 65	56 00
I—1901	24	....	....	67 85	14 56	39 00
J—1901	7	270	38 60	51 14	37 58	46 00
K—1900	8	293	37 00	54 61	22 35	39 00
1901	8	248	31 00	46 81	36 69	42 00

*Figures are not given because patrons did not bring milk to the creamery during the entire year; samples of each cow's milk were, however tested.

If, as stated by each farmer, that he fed all his cows in the same way, and the time and labor of milking and feeding the cows was approximately the same for both good and poor cows, it follows that it did not cost any more to feed the best than the poorest cows in the herd. The information furnished by such tests as these may be very valuable to the owner of the cows, and it should be of vital importance to the cow, as her life ought to depend on the record she makes. Previous to making the tests the owners of these cows had very little, if any, accurate idea of the relative value of their cows, but the record shows that the information gained is worth many times the cost of a milk weighing scale and Babcock milk test, and the time necessary to use them.

In addition to these tests of patrons' cows, many cow records are made at the Agricultural College, and tests are also conducted at various farms throughout the state. A few of these records have been taken from the Annual Report of the Wisconsin Agricultural Expei-ment Station, and are given in the following pages as worked out by Prof. Carlyle.



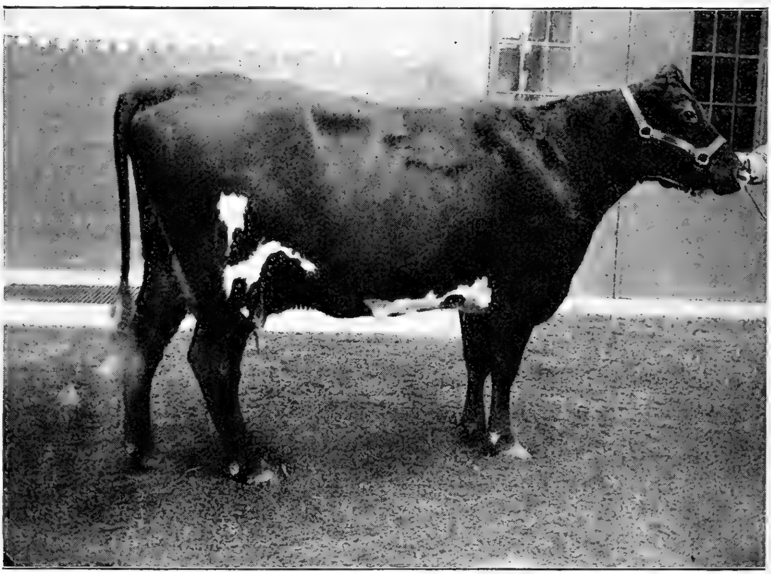
JANESVILLE ROSE—PURE BRED SHORTHORN.

Description and history. The above photograph represents a pure bred shorthorn cow 12 years old, bred by Walter Little, Janesville, Wis.

She was purchased from him a few weeks before dropping her calf, and during the first part of the year she gave every evidence of being very homesick, which in all probability was responsible for her record not being much higher. As will be seen from the photograph, she represents a good type of the up-to-date Shorthorn breeding cow. She traces directly to imported stock and is the dam and granddam of many choice cows and heifers owned by Mr. Little.

Production. During the milking period of 338 days she gave 7,833 lbs. of milk which contained 295.84 lbs. of fat, or 343.44 pounds of butter. The average amount of butter fat in her milk for the year was 4.0 per cent.

Profit. Her feed for the year cost $38.19 cents, being the second largest feed account in the herd, which is no doubt attributable to the poor condition of her teeth at twelve years of age. Her butter and skim milk products were valued at $79.25, leaving a profit of $41.06.

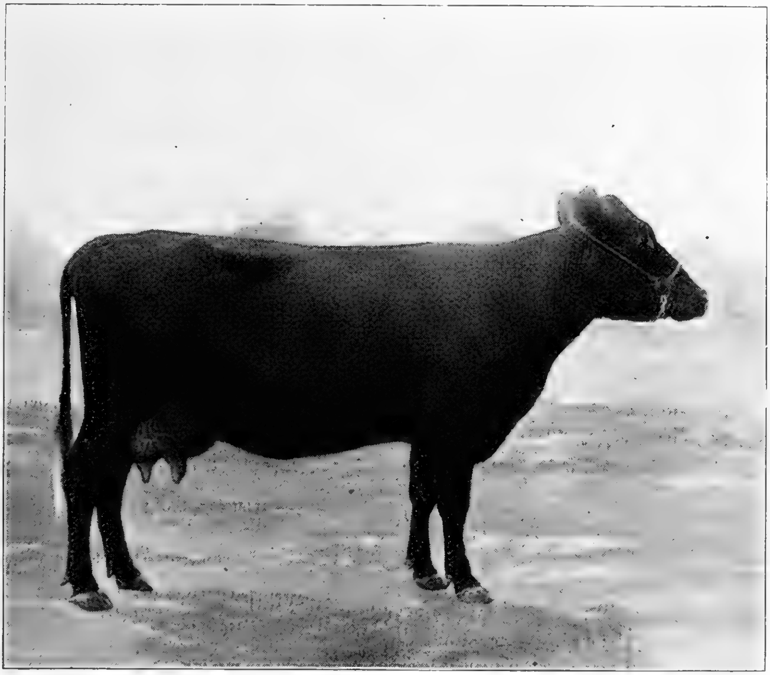


ROSE—GRADE SHORTHORN.

Rose was bred by the pure-bred Shorthorn bull General Bly of Oakland 17th 107,946. The dam of this bull was Oxford Bloom 7th of Oakland, a cow that won first prize in her class some years ago with strong competition at the Minnesota State Fair and at the Wisconsin State Fair two years in succession when shown as a Shorthorn cow by her breeders, Kiser Bros. The sire of Rose's dam was a pure-bred Shorthorn bull Sharon Duke 9th 89,384, and is represented as being a very typical Shorthorn bull, his sire being Sharon Duke of Geneva 64,454, and his dam 7th Profitable of Oakland. Rose's granddam was sired by a pure-bred Shorthorn bull bred by Wm. Kiser, and her great granddam was sired by a pure-bred Shorthorn bull bred by Wm. Lysaght, Dane Co., Wis. The fourth dam of Rose was a common scrub or native cow with no pretensions to a high type of dairy form or performance.

Production. During her last period of lactation, which lasted 365 days, she gave 11,131.7 lbs. of milk, containing 500 lbs. of butter fat or its equivalent of 584.09 lbs. of butter. The average percentage of fat in her milk for the period was 4.7 per cent.

Profit. The total feed consumed during the year cost $39.60. The total value of butter and skim milk was $131.83, leaving a profit over cost of feed of $92.23. Her butter, produced at a cost of 6.7 per pound, is cheaper than that of any other cow in the University dairy herd.



LADY—GRADE RED POLLED COW

Description. The photograph of Lady represents a grade Red Polled cow, with two crosses of Red Polled blood. She is an almost ideal type of the best dairy strain of Red Polled cattle. Very fine in the head and neck and showing a beautiful udder and milk vein system, with remarkable digestive capacity.

Production. She gave during one year 8,630 lbs. of milk with an average butter fat content of 3.98 per cent., equivalent to 345 lbs. of butter fat or 403 lbs. of butter..

DONATION—GRADE HOLSTEIN COW.

Description. This cow was donated to the University of Wisconsin by the Holstein breeders of the state. She is a three-quarter bred Holstein, her sires for two generations having been bred by Gillett & Son of Rosendale. She is an exceedingly fine type of dairy cow, one of the most perfect in this respect that can be found in the State of Wisconsin.

Production. She gave during the year 12,956 lbs. of milk, testing on the average 3.9 per cent. butter fat, equivalent to 498 lbs. of butter fat or 581 lbs. of butter.

NAN—GRADE JERSEY COW.

Description. Nan is a very small and very refined grade Jersey cow with an almost ideal dairy form. Her average weight is below 750 lbs. While exceedingly small in size she is remarkable in her constitutional development as indicated by large heart girth and the rugged vigor which is noted at every point.

NAN—GRADE JERSEY COW.

Production. During one year she gave 8,996 lbs. of milk, with an average test of 5.08 per cent. butter fat, equivalent to 451 lbs. of butter fat or 526 lbs. of butter.

ALMA MARIE 3RD.

Description. This is a small and very refined Holstein cow, her average weight for the year being about 1,000 lbs. She has a remarkable development of rear udder, somewhat light in the fore udder but wonderful milk veins. She is considered generally by Holstein breeders to be undersized.

Production. She has not completed her best year's work as yet. Has been milking six months, during which time she has given 9,576 lbs. of milk, with an average of 3.25 per cent. of butter fat, equivalent to 297.43 lbs. of butter fat or 347 lbs. of butter. She is promising remarkably well to continue this record for some months yet.

ALMA MARIE 3rd—PURE BRED HOLSTEIN.

The following report on two cows of the state that have made phenomenal butter records, and were tested during the year 1899, is taken from the herd register for January, 1900, of the American Guernsey Cattle Club, vol. 10, and an annual report of the Wisconsin Agricultural Experiment Station. After the tests the two cows were sold for $4,500, and have since maintained a most splendid record.

James H. Beirne of Oakfield, Wis., entered the two Guernsey cows, Lily Ella 7240, and Lilyita 7241, in the single cow contest of the Home Butter tests for 1899, of the American Guernsey Cattle Club. Both cows were five years old and both calved on the same day, Dec. 7, 1898, and both were sired by the same bull, Lily's Bonny Boy 2676. They were bred by N. K. Fairbanks at Lake Geneva, Wis. Lilyita's dam was Zoelita 5949, and Lily Ella's dam, Zoella 3301. Both cows produced a living calf during the year and were dry about eight days before calving.

Mr. Beirne weighed and recorded the milk of each milking and once a month took a composite sample of the night and following morning's milk and sent it to the Wisconsin Agricultural Experiment station where it was tested by the Babcock test. Four inspection samples were taken during the year by a representative of the Wisconsin Experiment Station

LILY ELLA 7,240—REGISTERED GUERNSEY.
First Prize Cow, Home Butter Tests 1899. Production in one year at five years old, 12,282.68 pounds milk, average per cent. fat 6.42, pounds fat 782.16, equal to 912.5 pounds butter. Picture above shows her as she appeared in this test.

at the barn during milking time. The tests of these samples agreed very closely with those of the samples sent by Mr. Beirne.

Mr. Beirne took charge of the cows and during the entire test he fed and milked the cows. They were stabled in box stalls and were fed the following rations per day per cow:

November, 30 lbs. silage, 4 lbs. bran, 2 lbs. corn meal and what clover hay they would eat clean. December, after the cows had calved, the feed was gradually increased to the following ration: 15 lbs. silage, 5 lbs. hay, 10 lbs. mangles, 6 lbs. bran, 4 lbs. ground oats, 2 lbs. corn meal, 1 lb. oil meal.

In January, and until February 20th, the daily ration of each was 35 lbs. silage, 5 lbs. hay, 10 lbs. mangles, 7 lbs. bran, 7 lbs. ground oats, 3 lbs. corn meal, 1 lb. oil meal, 1 lb. gluten. This ration was continued until May 1st, excepting that after February 20th the gluten meal was not fed.

In May the ration was gradually changed to 5 lbs. bran and 5 lbs. ground

LILYITA 7241—REGISTERED GUERNSEY.

Second Prize Cow, Home Butter Tests 1899. Production in one year, at five years old, 12,812.73 pounds milk, average per cent. fat 5.69, pounds fat 710.53, equal to 828.95 pounds butter. Picture shows her as she appeared in this test.

oats with pasture. In July the grain was increased by 2 lbs. corn meal.

In August, 6 lbs. bran and 6 lbs. corn meal.

In September 7 lbs. bran and 7 lbs. corn meal.

In October, 4 lbs. bran and 4 lbs. corn meal and 4 lbs. ground oats, the cows being at pasture during this time. During the winter the silage and grain were fed half in the afternoon and half in the morning; the grain was mixed and fed on the silage. The cows cleaned up their feed in about one hour; at noon they were each fed 5 lbs. cl ver hay, and at nine in the evening they were given 10 lbs. mangles. They were watered twice a day and drank about 100 lbs.

The detail records of the two cows as published in the Guernsey Herd Register are as follows:

LILY ELLA 7240.

Month.	Milk. lbs.	Fat. per cent.	Fat. lbs.	Butter lbs.	Remarks.
Nov.,'98	411.25	6.85	28.17	32.87	
Dec., "	882.44	6.00	52.95	61 78	Calved Dec. 7.
Jan., '99	1,427.14	5.5	78.49	91.57	Inspection sample tested 5.7
Feb., "	1,375.50	5.8	79.78	93.08	Composite weeks test 5.7.
Mar., "	1,377.25	6.2	85.39	99.62	Inspection sample 5.7.
Apr., "	1,141.14	6.3	71.89	83.87	
May "	1,200.25	(6.3)	75.62	88.22	Sample lost, averaged.
June, "	1,128.88	6.3	71.12	82.97	3 days composite sample 6.7.
July, "	906.81	7.15	64.84	75.64	4 days composite sample 5.7.
Aug., "	855.88	6.65	56.92	66.40	
Sept., "	800.00	7.25	58.00	67.67	
Oct., "	776.14	7.60	58.99	68.81	
Total	12,282.68		782.16	912.50	

LILYITA 7241

Month.	Milk. lbs.	Fat. per cent.	Fat. lbs.	Butter. lbs	Remarks.
Nov. '98	313.63	7.3	22.89	26.71	
Dec., "	874.14	5.9	51.57	60.71	Calved Dec. 7.
Jan., '99	1,477.38	5.3	78.30	91.35	Inspection sample 4.95.
Feb., "	1,479.50	5.0	73.98	86.31	Composite weeks test 5.28.
Mar., "	1,437.94	5.4	77.65	90.59	Inspection sample 5.5.
Apr., "	1,215.50	5.4	65.64	76.58	
May, "	1,270.75	(5.55)	70.53	82.28	Sample lost.
June, "	1,238.25	5.7	70.58	82.34	3 days composite sample 6.0.
July, "	959.00	5.86	56.10	65.45	4 days composite sample 5.7.
Aug., "	894.75	5.4	48.32	56.37	
Sept., "	839.75	5.7	47.87	55.85	
Oct., "	812.14	5.8	47.10	54.95	
Total	12,812.73		710.53	828.95	

What is strength, without a double share
Of Wisdom?—Vast, unwieldly, burdensome;
Proudly secure, yet liable to fall
By weakest subtleties; not made to rule,
But to subserve where wisdom bears command.

—MILTON.

SCALE OF POINTS FOR SCORING DAIRY ANIMALS.

RULES ADOPTED BY THE BREEDERS OF THE GUERNSEY AND THE JERSEY.

Notes by Association Committee.

Cattle breeders' associations have established standards by which excellence of any animal of the breed shall be judged and rated, as nearly as may be from long study of the points that indicate to the observer the worth of the animal for butter or for beef production, and the dairy farmer should familiarize himself with the characteristics that denote the type of animal he is dealing with. In the following are given the scoring points as adopted by the breeders of the Guernsey and of the Jersey, being considered sufficient to express to the reader those points most desired in the conformation of the dairy animal, and by which standards, with due allowance for general breed type, each reader may score his own herd and establish a standard to which each animal shall attain to keep its place in the dairy. While the Babcock test and the scales must give the final judgment of the dairy cow's standing as a profitable animal, there is need to know the way by which to judge the young animal's possible performance, and these tables of the scoring points are the key to that wider knowledge.

THE GUERNSEY.

All measurements, description and scaling shall be in accord with following scale of points for Guernsey cattle, adopted by The American Guernsey Cattle Club, December 13, 1899:

For Cows.

Dairy Temperament, Constitution, 38.	Clean cut, lean face; strong sinewy jaw; wide muzzle with wide open nostrils; full, bright eye with quiet and gentle expression; forehead long and broad	5
	Long thin neck with strong juncture to head; clean throat. Back bone rising well between shoulder blades; large rugged spinal processes, indicating good development of the spinal cord	5
	Pelvis arching and wide; rump long; wide, strong structure of spine at setting on of tail. Long thin tail with good switch. Thin incurving thighs.	5
	Ribs amply and fully sprung and wide apart, giving an open, relaxed conformation; thin arching flank	5
	Abdomen large and deep, with strong muscular and navel development, indicative of capacity and vitality	15
	Hide firm yet loose, with an oily feeling and texture, but not thick	3
Milking Marks denoting Quantity of flow, 10.	Escutcheon wide on thighs; high and broad with thigh ovals	2
	Milk veins long, crooked, branching and prominent, with large or deep wells	8
Udder Formation, 26.	Udder full in front	8
	Udder full and well up behind	8
	Udder of large size and capacity	4
	Teats well apart, squarely placed, and of good and even size	6
Indicating Color of Milk, 15.	Skin deep yellow in ear, on end of bone of tail, at base of horns, on udder, teats and body generally. Hoof, amber colored	15
Milking Marks denoting Quality of Flow, 6.	Udder showing plenty of substance but not too meaty	6
Symmetry and size. 5.	Color of Hair a shade of fawn, with white markings. Cream colored nose. Horns amber colored, small, curved and not coarse	3
	Size for the breed: Mature cows, four years old or over, about 1050 lbs	2
	Perfection.	100

For Bulls.

Dairy Temperament, Constitution. 38.	Clean cut, lean face; strong sinewy jaw, wide muzzle with wide open nostrils; full bright eye with quiet and gentle expression; forehead long and broad	5
	Long masculine neck with strong juncture to head; clean throat. Backbone rising well between shoulder blades; large rugged spinal processes, indicating good development of the spinal cord	5
	Pelvis arching and wide; rump long; wide strong structure of spine at setting on of tail. Long thin tail with good switch. Thin, incurving thighs.	5
	Ribs amply and fully sprung and wide apart, giving an open relaxed conformation; thin, arching flank	5
	Abdomen large and deep, with strong muscular and navel development, indicative of capacity and vitality	15
	Hide firm yet loose, with an oily feeling and texture, but not thick	3
Dairy Prepotency, 15.	As shown by having a great deal of vigor, style, alertness, and resolute appearance	15
Rudimentaries and Milk Veins, 10.	Rudimentaries of good size, squarely and broadly placed in front of and free from scrotum. Milk veins prominent.	10
Indicating color of Milk in Offspring, 15.	Skin deep yellow in ear, on end of bone of tail, at base of horns and body generally, hoofs amber colored	15
Symmetry and Size, 22.	Color of hair, a shade of fawn with white markings. Cream colored nose. Horns amber-colored, curving and not coarse	8
	Size for the breed: Mature bulls, four years old or over, about 1500 lbs	4
	General appearance as indicative of the power to beget animals of strong dairy qualities	10
	Perfection.	100

Explanatory Notes by Committee.

We recognize the Guernsey should be:

First. A dairy animal with a distinctive dairy temperament and conformation, having a strong, nervy structure with a corresponding flow of nervous energy, and every indication of capacity and vitality.

Second. In color of hair, a shade of fawn, with white on limbs and underpart of body are considered the prevailing markings, and some degree of uniformity is desirable.

Third. One of the important distinguishing features of the breed is the presence of yellow color in the pigment of the skin, which is indicative of rich golden color in the milk. This is very pronounced in the Guernsey and held by her to the greatest extent under all conditions of stabling and feed. The intensity of this trait is more marked in some animals and families than in others, but it should be kept at the highest standard. It is fast being recognized that this color is accompanied by a superior flavor in the milk and thus in the butter.

Dairy Temperament.

By "Dairy Temperament" is meant a strong, overruling pre-disposition or tendency to turn the consumption of food towards the production of milk with a high content of solids, especially butter fat, as against the constitutional tendency so often seen to turn food into flesh. Even in the strongest dairy breeds there are more or less frequent out-crops in male and female of the flesh making temperament. To breed from such animals, while we are striving to establish a prepotent dairy temperament or tendency, is not wise. All cattle bred specifically for dairy purposes should possess a clear and decided dairy temperament, for it is that quality of character we most desire to establish, enlarge and perpetuate in the Guernsey cow.

This is especially indicated by the shape of the head, showing brain capacity, wide muzzle, open nostril, full bright eyes, feminine neck, and a construction of the back bone indicating a strong flow of nerve power and support from the brain to all of the maternal organs.

Constitution.

In breeding our domestic animals, especially for long service like the dairy cow, it is very important that they should have abundant vital power which we call "constitution." But constitution must be judged and measured by the peculiar function the animal is bred to fulfil. With the race horse the function is speed; with the steer, the laying on of flesh; with the dairy cow, the production of milk solids. In all these various functions the animal that is to represent any one of them must show not only large capacity in the line of that function, but also the ability to endure long and well the strain of such function, and keep in good health. Constitution is best indicated by a full development at the navel, and strong abdominal walls, showing that the animal when in a prenatal state was abundantly nourished by the mother through a well developed umbilical cord.

Prepotency.

In the scale for bulls for the first time, we believe, in the history of dairy breeds, this point is introduced. The reason we have included it is that 'prepotency" is the chief consideration in the selection of the male breeding animal. The pedigree and conformation is often all that can be desired but because the bull is lacking in prepotent breeding power he is an expensive failure. This quality is in a sense difficult to perceive or describe, but we know certain animals have it in high degree and others fail of it completely. It is fairly well indicated by vigor of appearance, strong, resolute bearing, and abundant nervous energy. We would distinguish this from an ugly disposition. A bull is ugly by the way he is handled rather than by his breeding. What we want is strong impressive blood. A dull sluggish spirit and action, we consider indicative of a lack of true dairy prepotency, but we would prefer to breed to a rather sluggish appearing bull with first class rudimentaries than to a stylish one with badly placed rudimentaries.

Rudimentaries.

We consider that a well balanced and well shaped udder in the cow is largely due to the way the rudimentary teats are placed on the sire. If they are crowded close together the result is likely to be narrow pointed udders. If they are placed well apart, of good size and well forward of the scrotum, the effect, we think, will be to influence largely the production of well-shaped udders in the resulting heifers and counteract the tendency to ill-shaped udders inheritable from dams deficient in this respect. We believe the future excellence of the Guernsey cow will be greatly aided by close attention on the part of her breeders to this point.

THE JERSEY.

SCALE OF POINTS ADOPTED BY THE AMERICAN JERSEY CATTLE CLUB AT THE ANNUAL MEETING HELD MAY 6, 1885, AND IN FORCE WITHOUT CHANGE SINCE THAT DATE.

FOR COWS.

Points.		Counts.
1.	Head small and lean; face dished, broad between the eyes and narrow between the horns	2
2.	Eyes full and placid; horns small, crumpled, and amber-colored	1
3.	Neck thin, rather long, with clean throat, and not heavy at the shoulders	8
4.	Back level to the setting on of tail	1
5.	Broad across the loins	6
6.	Barrel long, hooped, broad and deep at the flank	10
7.	Hips wide apart; rump long	10
8.	Legs short	2
9.	Tail fine, reaching the hocks, with good switch	1
10.	Color and mellowness of hide; inside of ears yellow	5
11.	Fore udder full in form and not fleshy	13

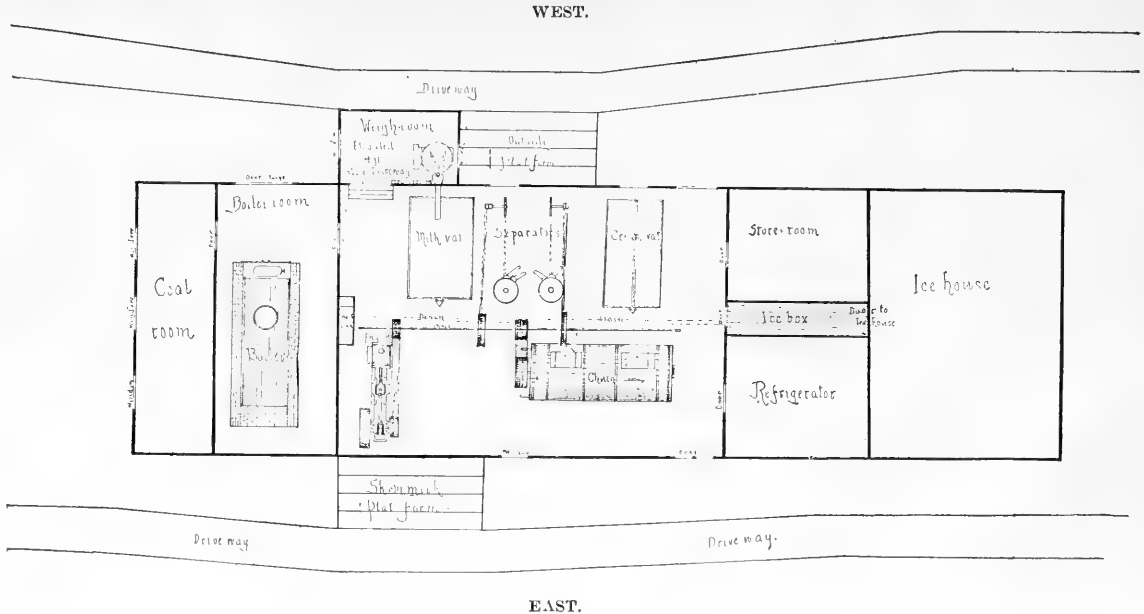
12.	Hind udder full in form and well up behind	11
13.	Teats rather large, wide apart, and squarely placed	13
14.	Milk veins prominent	5
15.	Disposition quiet	5
16.	General appearance and apparent constitution	10
	Perfection	100

In judging heifers, omit Nos. 11, 12 and 14.

FOR BULLS.

The same scale of points shall be used in judging bulls, omitting Nos. 11, 12 and 14, and making due allowance for masculinity; but when bulls are exhibited with their progeny, in a separate class, add 30 counts for progeny.

"When any great design thou dost intend,
Think on the means, the manner, and the end."
—Denham.



GROUND PLAN OF MODERN ONE STORY CREAMERY, (FRAME OR BRICK BUILDING),

Showing arrangement of driveways, receiving platform, skim milk platform, work rooms, storage rooms and machinery. Drawn from Farmers' Co operative Creamery at Hazleton, Iowa. This is considered a very convenient and compactly arranged building. Has driveway roofed over at receiving platform; cement floors and brick smokestack. An improvement, where site of factory allows, is to have receiving platform on east side, and skim milk delivery on west side, with boiler room at south end and ice house at north end as in plan above. Work room may be ventilated through wall flues into garret, with open lattice work in gable ends of garret to allow air to freely circulate.