

# OUR INDUSTRY TODAY

## *Brief Reviews of Current Topics*

### The Miracle of Milk

An important message for people of all ages

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Centuries ago alchemists in laboratories in many lands secretly tried to discover the "elixir of life." This drink or concoction would make it possible for man to have good health, long life, and perpetual youth and would enable him to perform miraculous feats, such as the prevention and cure of disease. There were those who would have paid fabulous sums for its discovery.

The early Spanish seafarers and explorers searched for this "fountain of youth" in the new world of the Americas. It took many years for man to realize that the elixir of life was close at hand, for cow's milk, recognized all over the world as "nature's most nearly perfect food," has been performing the feats that were expected of the mythical elixir of life. Within the last quarter century science has been peering into a drop of milk and has discovered the "miracle"—for no other food in the world can compare with milk in its outstanding nutritive values.

At present, milk and its products are a daily requirement for the populations in most parts of the world. From the equator, where the Arabs still use camel's milk, to the far North, where the Eskimos and Laplanders use reindeer and caribou milk, this product is the number one food item in the human diet. Although the cow and goat have been bred for milk production and are best adapted as a source of milk for man, other domestic animals are used for this purpose, including the water buffalo and zebu in India and central Asia, the yak in Asia, the llama in South America, the sheep in Asia and Europe, and the mare in Asia.

The milk of these different species contains the same constituents but varies in composition and properties (Table 2). The cow, however, supplies the largest proportion of the milk used by humans. In 1953 it was reported that in 15 specified leading dairy countries approxi-

mately 69 million cows were used for milk production. They produced approximately 335 billion pounds of milk (37). Surplus milk products are shipped in immense quantities from home countries for international trade. It is estimated that more than 700 million pounds of cheese a year, 700 million pounds of butter, 500 million pounds of condensed milk and millions of pounds of milk chocolate, milk sugar, casein, and other such products are shipped and exchanged from country to country to maintain the world food supply. The United States produces approximately 37% of the world's milk supply, and dairy products are the largest source of our agricultural income. In 1953 it was estimated that the value of milk and its products totaled \$4,370,425,000, or 19% of the gross farm national income. About 46% of the milk used in this country is consumed as fluid milk and cream, 26.7% as butter, and 10.6% as cheese (37). How did this great industry come about? When and where did man first begin to use milk and milk products?

#### Historical Background

The story of milk through the ages is fascinating reading. Just when man began domesticating animals (cattle, sheep, goats, horses) is not definitely known. However, it was a very long time ago, possibly between 8,000 and 5,000 B.C., somewhere in Asia or northeast Africa (1, 24, 40).

Thus, the use of milk has been with us even prior to the beginning of civilization. The oldest known civilizations have been revealed by excavations. A mosaic frieze on one of the oldest buildings unearthed at al'Ubaid near Babylon in the Euphrates Valley depicts what is considered to be one of the oldest records of the use of milk. The joint expedition of the British Museum and the Museum of the University of Pennsylvania in 1922 estimated this temple at Ur to be at least 5,000 years old (3,100 B.C.). Woolley, leader of the expedition, in describing the scene states, "On a panel, on one side of a reed built byre, from the door of which two

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calves are seen issuing, men seated on low stools are milking cattle; the man sits under the cow's tail milking her from behind; on the other side of the byre two men, clean shaven and wearing the fleece petticoats which in later times seem to survive as the official dress of priests and priest-kings, are pouring milk through a strainer into a vessel set on the ground, while two others are collecting the strained liquid in great stone jars" (68).

Some of the oldest written books are those of the Bible, which is considered by Jewish scholars to be 5,715 years old. The custom of reckoning from creation has been calculated to have taken place in the fall of 3,761 B.C. (21, 63). In the Bible, milk and its products were regarded as highly desirable foods and have been mentioned at least 50 times (14, 63). Palestine is praised approximately 20 times as a "land flowing with milk and honey," for example, in Exodus, 3:8, 3:17, 13:5, 33:3; Leviticus 20:24; Jeremiah, 11:5, 32:22; Ezekiel, 20:6, 20:15, and in ten other places, milk representing the common necessities of life and fertility. Cheese or curdled milk called "laban" was so relished as a food that Abraham offered it to his guests in Genesis 18:8; in I Samuel 17:18, David carried cheese to a captain of thousands, among whom were his brothers. Deborah refers to milk as "a cup of the nobles" in Judges, 5:25, and the abundance which the Israelites will enjoy in Messianic times is pictured in the figure, "the hills of Palestine will flow with milk." There are references to a substance called "hemah" in Isaiah, 49:12 and Job, 20:17; this may be either butter or curds, which were regarded as delicacies, and in Genesis, 19:12, milk was supposed to give whiteness to the teeth.

The Vedic hymns of India, written about 2,000-3,000 B.C., are also among our oldest writings. These stories concerning the Hindu people of prehistoric times indicate that milk and butter were used extensively in the diet at that time (51). The butter was changed into ghee (butter oil) which is still used extensively by the peoples of India and Pakistan. Milk was treated also with the greatest reverence and ceremony as it still is in some countries (15).

Around 2,000-3,000 B.C. various other civilizations—the Egyptian, Greek, and Roman—left many records to indicate that milk, cheese, and butter were commonly used (2). Milk played an important part in sacrificial services and was also considered to have great medicinal value (15).

About 500 B.C. in the eastern countries of Europe, Herodotus wrote that the Libyans and Tartars used mare's milk extensively. Writing about the Auschisae, he states: "They hunt locusts and when taken they are dried in the sun, and after grinding sprinkled them into milk and drank it" (10).

About the middle of the 13th century Marco Polo traveled over central Asia and reported that dairy products and milk, "airan" or cur-

dled milk, butter, and "kumiss," which is fermented mare's milk (milk wine), were much enjoyed. He stated that the Tartars were capable of much endurance and when necessary could remain a month without any food except the milk of a mare and the flesh of animals killed in hunting. He also reported that milk was dried into a kind of paste which, when about to be used, was stirred until it became a liquid and could be drunk (35).

In the 15th century, India used large amounts of dairy products. Not only the people but also hundreds of palace elephants had a diet of "rice and butter," or "milk and vegetables," or "meat, rice, fresh milk, and cheese" (44).

In Caesar's Commentaries the Germans are described as a people who did not practice agriculture; however, the major part of their diet consisted of milk and cheese (4). Cheese was also a regular part of the ration of the Roman army. The oarsmen in ancient vessels and sailors subsisted on cheese.

In the northern countries it was early found that butter would keep for a long time. It is stated that "in early times in Iceland such a quantity of butter was made that having neither earthen vessels nor casks to hold it, fir chests were constructed 30 ft. long and 5 ft. square which were filled every year with salt butter and buried in the ground where it was left until needed" (34).

Thus, it is known that the great food value of milk and its products has been recognized through the centuries.

### Milk in Culture and Religion

It has been recorded that people who had practically no domestic animals were in the lowest stages of savage culture. In two continents, America and Australia, prior to the domestication of milk-yielding animals the human mother had to suckle her babies for two or three years or until they were able to walk and partially take care of themselves. This burden along with the other chores which the mother had to perform consequently retarded the growth of population (28). The failure of the Indians in both North and South America to find many animals which they could domesticate was probably one of the reasons they did not develop a high civilization. In contrast, the people inhabiting the European, Asiatic, and African continents, who have always possessed milk-producing animals, early developed flourishing civilizations (15).

In primitive religions, food was considered sacred, especially milk, which had an important part in religious ceremonials at nearly all stages of man's development. The sanctity of the dairy is the chief element in the religion of the Toda tribes of India, and here is where the use of milk in religion reached its climax (15). In the Christian church milk was replaced by wine in the communion service. This was afterwards prohibited by canon law. In the early Christian

church the newly baptized were given milk and honey to taste as symbolizing their regeneration through baptism. This is believed to have been one of the surviving rites of ancient pagan religion (15).

### Milk and Health

History has shown that the peoples who have subsisted on diets containing a large proportion of milk and its products were unusually healthy, vigorous, and well developed. Milk users were reported as stronger and longer-lived.

Three separate and different human culture areas have evolved in which the people lived almost exclusively on milk and its products. These are the wiry, fierce Kazak Kirgliz (the Tartars) of Central Asia, the strong, lean Bedouins of Arabia, and the sturdy Bantu tribes (Kaffirs) of South Africa. These peoples, located in different world areas, are racially mixed—Mongolian, White, and Negro, but all use milk, curdled milk, cheese, and fermented milks in large amounts (1, 15, 35).

The pastoral peoples of northern India, who have dairy animals, have been found to be superior in health and strength to those of southern India (30). These "stalwart resolute races of the north of India" subsist on a diet of milk and vegetables, but the "toneless, supine, and poorly developed people" of the south and east live only on cereals (29).

In a study of the health and physique of two tribes, the Masai and Akikuya, living in Kenya, Africa, it was found that the full-grown Masai male was on the average five inches taller and 23 pounds heavier than the full-grown male Kikuyu and had 50 per cent greater muscular strength. This difference was attributed for the most part to their diet—for the weaker, poorly developed Kikuyu tribe subsisted mainly on cereals, roots, and fruit, whereas the diet of the stronger and healthier Masai tribe consisted of milk and meat (47).

Dr. E. V. McCollum of Johns Hopkins University, eminent scientist in the field of nutrition, states, "The people who have achieved, who have become large, strong, vigorous people, who have reduced infant mortality, who have the best trades in the world, who have an appreciation for art, literature, and music, who are progressive in science and every activity of the human intellect are the people who have used liberal amounts of milk and its products" (31).

Thus, the dominant and aggressive peoples of the world have always been those whose nutrition has been the best and has contained milk products. Scientific findings are now giving the reasons why milk is healthful.

### Proverbial Phrases

Proverbial phrases in which milk is mentioned are many and are still quoted. From the Bible, "land flowing with milk and honey," denoting an abundance of means, of enjoy-

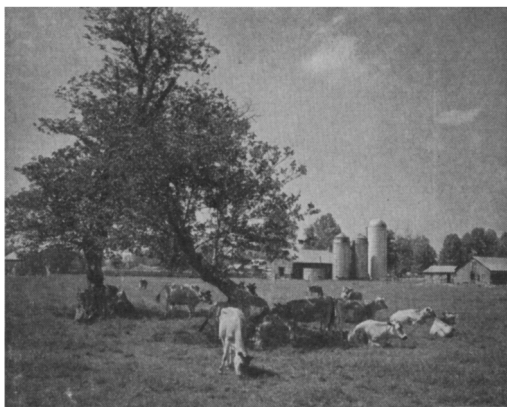


FIG. 1. From herds such as this came the 123.5 billion pounds of milk produced in this country in 1954.

ment; "milk and roses," said of a beautiful pink and white complexion; "milk of human kindness," from Shakespeare, concerning compassion characteristic of human kindness; "spilt milk," anything once misused cannot be recovered; and the "milky way," the galaxy, a way brilliant in appearance or a way leading to heaven (9, 65).

### Milk in the New World

There were no cattle in the New World at the time of the discovery of America, for the Indians had no domesticated animals. In his journal Columbus reports, "It was a wonderful thing to see . . . land fit for cattle though they have none . . ." On Columbus' first voyage to America he carried no cattle (27); a certain amount of livestock including four calves and two heifers was taken by him on his second trip, but these were taken to Cuba or South America (19).

Although several Spanish expeditions were conducted to the New World after the discovery of America, that of Coronado, 1540-1542, was the only one that brought cattle to this country; these can be traced as far as Kansas. Part of the expedition's food supply consisted of 150 cattle, from which the present cattle of the Southwest probably originated (46).

The first dairy cattle were brought to the United States during the years 1600-1700 during the colonization of America. These cattle, which served as the foundation of our great dairy industry, represented various breeds and were brought from England, France, the Netherlands, Sweden, and Denmark.

1611—*Jamestown Colony*. In 1611 the first colonists at Jamestown imported cattle and "at Christmas time, 1618, there were about 300 in the colony" (56).

1620—*Plymouth Colony*. The Pilgrims did not bring any cattle with them on the first voyage of the Mayflower. Of the 100 men in the Plymouth colony, more than half died that first

winter from malnutrition (13). For three years the colony existed without cattle, and the colonists had a difficult time. In 1624 "the good ship Charity" landed three Devon cows and one bull; after that, severe malnutrition difficulties were greatly reduced.

1624—*New Netherlands*. In 1624 a group of 30 Dutch families came to this country on the ship "New Netherland." A fort was built at Nut (Governor's) Island. A few months later, 42 more immigrants arrived with 103 head of livestock. In July, 1625, the settlement moved from Nut Island to New Amsterdam (Manhattan, New York). The production of livestock was both profitable and extensive, the black and white Holstein cattle furnishing milk, butter, cheese, meat, and hides. A New Netherland document of 1649 states, "A little hay thrown occasionally to the milk cows is sufficient" (7). New York state was a land ideally suited for raising cattle, and today, New York ranks second among the states in milk production. Wisconsin is first (37).

1629—*Massachusetts Bay Colony*. In an account of the voyage to Massachusetts Bay Colony in New England in 1629, it is reported that "The Company of New England" sent five ships for further settling of the English plantation. On one of them, the George, "her chief carriage were cattell, 12 mares, 30 kyne (cows), and some goates" (16). Other stock were sent in following years. In 1647 Delaware brought cattle from Sweden, and "large yellow" Danish cattle were imported into New Hampshire (13, 16).

As the early pioneers moved westward they took cattle with them, establishing the dairy cow in all sections of the country. Today, after three centuries, approximately 38 million cattle comprising the major dairy breeds (Jersey, Holstein, Guernsey, Ayrshire, and Brown Swiss) are being used for dairy purposes. This number includes about 25 million cows and heifers, two years old and older; about 13 million younger heifers and heifer calves; and about one million bulls and bull calves (41). Approximately 121 billion pounds of milk were produced in 1953 (37).

### How Did Milk Get Its Name?

Since the oldest written records of the human race are in Sanskrit, the word "milk" is derived from the Sanskrit word "mrjati," which means

"he strokes," or "he rubs," like the stroking action employed in milking. Our present word milk is derived from the Teutonic words "melki" or "melchan," meaning "to milk" (54). Milk is defined in most dictionaries as a white fluid secreted by female mammals for feeding their young (63).

### Phenomena of Milk Secretion

Milk is made from the materials of the blood. It has been estimated that blood makes a complete cycle from the udder to the heart and return in 52 seconds. In a 1,000 lb. cow, approximately 200 lb. of blood pass through the udder in one hour. It requires 150 to 500 lb. of blood for every pound of milk secreted (6). A cow producing 50 lb. of milk per day would require about 16,000 lb., or 8 tons, of blood to be pumped through the udder.

The cells in the mammary gland or secreting tissue in the udder take chemical compounds from the blood for the synthesis of milk. These compounds or their precursors must be present in the feed if they are to get into the blood; therefore, sound nutritional feeding of the dairy cow is important for milk production.

The cow's udder is divided into four quarters, and arteries carry the blood to each quarter. These blood vessels end as small capillaries that surround the milk-making bulbs, or alveoli, like a plastic cover over a cheese. These alveoli look like bunches of grapes and are really tiny udders. Each of these is made up of tiny microscopic milk synthesizing cells. Blood constituents pass from the capillaries to the cells and what is not used for manufacturing milk goes back to the blood circulation. Each alveolus or "grape" produces a fraction of a drop of milk daily.

On comparing the constituents in blood and milk it will be found that milk contains 90 times as much sugar, 13 times as much calcium, 10 times as much phosphorus, nine times as much lipids (fat), five times as much potassium, one-half as much protein and one-seventh as much sodium as blood plasma (6). The milk from millions of these alveoli make up the daily milk production of a cow. The milk manufactured in the cells is deposited in a hollow space in the center of the alveolus, where it is stored until milking time. Milk from each alveolus empties into a small tube, then into larger tubes that empty into the gland cistern, which holds

TABLE 1  
Average composition of cow's milk (26, 49)

Constituent	Per cent
Water	86.90
Milk fat or butterfat	4.00
Protein	3.50
Lactose or milk sugar	4.90
Ash or minerals	0.70
	100.00

Dry matter or total solids  
 Nonfat milk solids

TABLE 2  
Average composition of milk of various mammals (49)

Species	Fat	Protein	Lactose	Ash	Total solids
	(%)	(%)	(%)	(%)	(%)
Human	3.70	1.63	6.98	0.21	12.57
Cow	4.00	3.50	4.90	0.70	13.10
Goat	4.09	3.71	4.20	0.78	12.86
Ass	1.50	2.10	6.40	0.30	10.30
Mare	1.59	2.69	6.14	0.51	10.96
Camel	5.40	3.00	3.30	0.70	12.39
Ewe	6.18	5.15	4.17	0.93	16.43
Sow	6.77	6.22	4.02	0.97	17.98
Water buffalo	12.46	6.03	3.74	0.89	23.91
Reindeer	18.70	11.10	2.70	1.20	33.70
Whale	22.24	11.95	1.79	1.66	38.14

about a quart of milk. From there the milk goes to the teat cistern and into the streak canal. In milking, the pressure of the descending milk opens the sphincter muscles around the canal and forces the milk out (6, 43).

### Chemical Analysis of Milk

Scientists have found that milk contains more than 100 separate chemical components (26). A chemical analysis shows that milk contains water, fat, protein, carbohydrate, and ash. Actually, however, milk is a very complex substance, for the fat of milk is in a state of emulsion with the aqueous solution of minerals and sugar, and the protein is in a colloidal (semi-solution) suspension. Fat-soluble and water-soluble vitamins also are present.

The average composition of cow's milk is shown in Table 1. The constituents of milk minus the water are called dry matter or total solids, and the constituents minus the water and the milk fat are called nonfat milk solids. The quantitative composition of milk varies somewhat, since it is influenced by breed, stage of lactation, season, ration, and environment. The average composition of milk of various mammals (cow, goat, ass, mare, camel, ewe, sow, water buffalo, reindeer, and whale) as compared

to human milk is given in Table 2. It can be seen from the table that human milk is much lower in fat, protein, and mineral content than cow's milk but higher in lactose. These differences are corrected when cow's milk is used in early infant feeding by adding sugar and water in proper concentration. For later infant feeding, cow's milk is more nutritious because of the higher content of fat, protein, minerals, and total solids. Whale and reindeer milks are highest in fat, protein, minerals, and total solid content but lowest in sugar (lactose) concentration of all mammalian milks (Table 2).

The great nutritional value of milk is due to the high quality of its proteins—casein, lactalbumen, and lactoglobulin; to its richness of minerals, particularly calcium and phosphorus; to the easy digestibility of its fat; and to its richness in fat-soluble vitamins—vitamin A and carotene (provitamin A), vitamins D, K, and E, and water-soluble vitamins—thiamine, riboflavin, niacin, and other members of the B complex.

### Dairy Products

A variety of dairy products, possessing many of the nutritional qualities of milk, have been prepared by man. Reference has already been

TABLE 3  
Dairy products manufactured today (43, 49, 67)

Class		
Milk	Cream	Skimmilk
Creamline	Coffee (40%)	Skimmed milk
Homogenized	Cereal (20%)	Buttermilk (cultured)
Certified	Half and half	Cheese (domestic and foreign)
Soft-curd	Cultured	Cottage cheese
Chocolate	Whipping	Cream cheese
Malted	Sour	Chocolate drink
Canned fresh	Plastic	Nonfat milk solids
Concentrated fresh	Pressurized whipped	Acidophilus milk
Concentrated frozen	Ice cream	Bulgarian and other fermented milks
Condensed	Butter	Frozen desserts
Evaporated	Butter oil	Lactose
Dried or powdered		Casein
Yogurt		Whey
		Dried whey
		Dried buttermilk



FIG. 2. History reveals that milk and its products have played an important part in the development of our civilization.

made to milk products almost as ancient historically as milk itself, such as curdled milk, cheese, butter, and fermented drinks. Today, other dairy products of outstanding nutritive value are manufactured; concentrated forms of milk, buttermilk, or whey, in which some or all of the water is removed by a process of condensation and evaporation (condensed, evaporated, powdered milks, or buttermilks) are available. Various types of cream are made from milk fat; skimmilk and nonfat dry milk solids are to be found on the grocery shelf; ice cream and products like lactose and casein are some of the dairy products developed in more recent years. Table 3 gives a list of the products made from milk, cream, and skimmilk.

What are these afore-mentioned dairy products?

*Creamline milk* refers to whole milk in which the yellow butterfat rises to the top of the bottle so that a line can be seen between the cream and the rest of the milk.

*Homogenized milk* is whole milk that has been subjected to high pressure, causing the fat globules to be broken up and resulting in an even distribution of tiny particles of butterfat throughout the milk. There is no appreciable separation of the cream.

*Homogenized D milk* is homogenized milk to which vitamin D concentrate has been added so that at least 400 U.S.P. units per quart are present.

*Certified milk* is whole milk produced under rigid standards of cleanliness and certified as such by the Council of the American Association of Medical Milk Commissions.

*Soft-curd milk* is milk in which the milk proteins have been treated to produce a soft curd, making it valuable in infant feeding.

*Chocolate "milk"* is a flavored drink generally made of fluid skimmilk or nonfat dry milk solids and water, to which have been added cocoa powder, sugar, a stabilizer, and other materials. Some butterfat may be added. If the product meets the state requirements for milk fat it can be called chocolate milk.

*Malted milk* is the product made by the com-

bination of whole milk with the liquid separated from a mash of ground barley malt and wheat flour. The mixture is then dried.

*Half and half* is a mixture of half milk and half coffee cream.

*Sour cream* is made by inoculating coffee cream with a culture of lactic acid bacteria and ripening it to a low acidity and firm consistency.

*Plastic cream* is made by passing cream or high testing milk through a cream separator so that the fat content and consistency approach that of butter.

*Whey* is the portion that remains after the coagulation of the casein when cheese is manufactured. It is high in milk sugar and minerals.

*Skimmilk* is the product obtained in the separation of cream from milk.

*Pressurized whipped cream* is sweetened cream to which a gas like nitrous oxide is added under high pressure. Upon release to the air, the cream whips.

*Buttermilk* is the liquid portion of cream left after fat has been churned into butter. Though it is sometimes used as a beverage it is more often condensed and/or dried for animal feed.

*Buttermilk (cultured)* is a fermented skimmilk produced with lactic acid bacteria.

*Fermented milks* are those produced by adding bacteria that ferment or break down lactose (milk sugar) into lactic acid. This is a means of preservation used by the early users of milk. Different types of fermented milks are prepared with special bacterial cultures and by different methods of manufacture.

*Acidophilus, yogurt, and bulgarlac* are fermented milks prepared with special cultures of bacteria. These drinks, which originated in southern Europe, are supposed to have special therapeutic value.

*Cheese* is the food product made from the separated curd obtained by coagulating the casein of milk, skimmed milk, or milk enriched with cream. The coagulation is accomplished by means of rennet or other suitable enzyme, by lactic acid fermentation, or by a combination of the two. The curd may be modified by heat, pressure, ripening ferments, special molds, or suitable seasoning to produce the different varieties.

Over 400 different cheeses are recognized (52); however, cheese is usually classified into two general types—hard and soft, as follows:

Hard cheese

Very hard

Without gas holes—Cheddar

With gas holes—Swiss

Semihard

Ripened by molds—Roquefort

Ripened by bacteria—Brick

Soft cheese

Ripened by mold—Camembert

Ripened by bacteria—Limberger

Unripened—Cottage

TABLE 4  
Average composition of commonly used dairy products as compared to milk (12)

	Fat	Protein	Lactose	Ash	Water	Calories
	(%)	(%)	(%)	(%)	(%)	(per lb.)
Whole milk	4.0	3.5	4.9	0.7	86.9	310
Skimmilk	0.2	3.5	5.0	0.8	90.5	162
Buttermilk	0.5	3.5	4.6	0.7	90.7	167
Cheese (cottage)	0.8	19.2	4.3	1.7	74.0	459
Cheese (Swiss)	31.3	28.6	1.9	3.3	34.0	1,831
Cheese (Cheddar)	34.5	25.6	1.9	3.3	34.5	1,916
Cheese (cream)	39.9	14.5	1.0	1.9	42.7	1,910
Evaporated milk	7.9	7.0	9.9	1.5	73.7	629
Condensed milk	8.4	8.1	54.8	1.7	27.0	1,484
Dried whole milk	26.7	25.8	38.0	6.0	3.5	2,248
Dried skimmilk	1.0	35.6	52.0	7.9	3.5	1,630
Cream	39.9	14.5	1.0	1.9	42.7	1,910
Butter	81.0	0.6	0.4	2.5	15.5	3,325

Table 4 shows the average composition of some commonly used dairy products as compared to milk.

### Nutritional Value of Milk

Thousands of scientific studies (22, 53) in the last quarter century have shown why milk and its products proved to be so essential in the diet of early civilizations. According to our present knowledge of nutrition, six essential elements are necessary for good health and well-being of persons of all ages. These are proteins, substances which build muscle, repair and build new tissues and organs; carbohydrates, such as sugars and starches, which give heat or energy (calories); fats, which supply heat and energy; minerals, which are essential for bone and teeth formation, and for the proper functioning of the body; vitamins, compounds which permit the efficient utilization of the other food nutrients; and water, which acts as a solvent and carrier for the nutrients in the body. In addition to these six basic nutrient classes, there are many specific chemical substances in each class (with the exception of water) that must be obtained to achieve good health and well being. At least 60 nutrient elements have been found to be essential in human nutrition (53).

**Protein value.** In the protein class, eight essential amino acids, the chemical compounds that contain nitrogen, are required in the human diet. The protein foods that contain these essential amino acids are called high quality proteins and are of animal origin. The proteins in milk supply all the essential "building stones" to make muscle, blood, skin, hair, and hormones.

According to recent nutritional surveys in the United States, protein is one of the nutrients usually deficient in our diet (5, 17, 36, 45, 53, 58, 59, 60, 61, 69). In growing children, expectant and nursing mothers, and athletes in training, in whom new tissue and larger muscles

are being rapidly built, milk proteins are the best source of nutrients. To furnish the amount of protein found in one quart of milk would require five large eggs, 5½ oz. of liver, 6½ oz. of fish, 5 oz. of dried beans, 5¾ oz. of beef, or 16 slices of bread (64, 67). Dr. P. C. Jeans, professor of pediatrics, Iowa State College (20), states, "In meeting the protein requirements, one should place emphasis on the value of milk. A quart of milk daily supplies most of the protein needs of the young child and half the need at the beginning of adolescence. Such a quantity of milk contributes more protein to the diet than any other single food."

**Mineral value.** In the mineral class, 13 essential mineral elements are necessary to maintain good health and vitality. These are the bone-forming elements—calcium, phosphorus, magnesium, and manganese; the blood-forming elements—iron, copper, and cobalt; and a miscellaneous group—sodium and chlorine (common salt), potassium, iodine, sulfur, and zinc. The ash in milk contains these essential minerals, especially calcium and phosphorus. Milk is low in iron, but other foods in the diet usually supply a sufficient amount.

For nonmilk users calcium is the nutrient most likely to be lacking in diets today (3, 5, 25, 32, 36, 38, 39, 50, 53, 55, 61, 69). This mineral is the chemical element found in oyster shells, chalk, and limestone. More calcium is needed by our bodies than any other mineral. This vital mineral is essential for strong bones and good teeth, for preventing rickets, for blood clotting, for stimulating the heart, and for the regulation of muscle-nerve responses. Milk is the most important source of food calcium for people of all ages. It is the only food that is a practical source of the total daily requirement for calcium. The recommended daily calcium requirements for people of all ages is given in Table 5. One quart of milk or its equivalent supplies one gram (1/28 oz.) of cal-

cium. Although vegetables, fish, and fruits contain this vital element, it would be impossible to eat these foods in the amounts needed to supply the daily calcium requirement (see Table 6). It has been estimated that one would have to consume approximately 28 oranges, 6¾ lb. of cabbage, 7¼ lb. of carrots, 27 lb. of potatoes, or 39 eggs to obtain the equivalent amount of calcium in one quart of milk (64, 67).

Infants obtain their calcium from mother's or cow's milk. Children need calcium for bone and tooth growth, especially from 11 to 15 years of age, when the long bones grow fast. In periods of pregnancy and lactation, the amount of calcium for the new infant is obtained from the mother's body. If there is an inadequate supply of calcium in the daily diet during this period, the calcium will be withdrawn from the mother's bones and teeth, and a weakened condition will result. Since 1940 there has been a substantial increase in the number of early marriages. Two-fifths of the teen-age brides had a child in 1950, and for women under 20 there was a 33½% increase in the number of births between 1940 and 1950 (33). Dietary surveys have indicated that the teen-age group and young women do not consume enough cal-

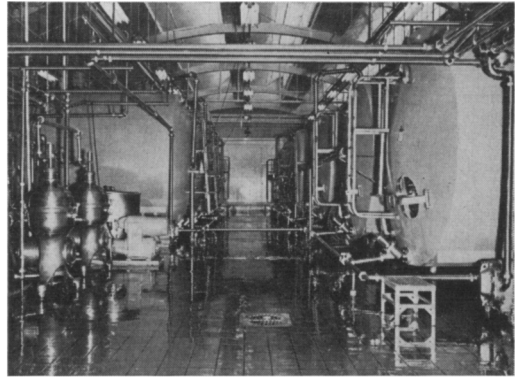


FIG. 3. Modern dairy plants are planned and equipped to process milk in a sanitary and efficient manner.

cium for optimal storage reserve, especially during pregnancy and lactation—the periods of stress. This results in a great strain on the mother who is trying to recover from mineral undernutrition (23, 25, 55). Therefore, it is important that young women maintain adequate nutrition so that their bones will be fully mineralized when pregnancy occurs.

The calcium requirement of those past middle age is now considered to be double what was formerly recommended. Instead of one pint of milk daily, older people should drink a quart or more of milk for calcium retention in bones and teeth (see Tables 5 and 6).

It has been pointed out that in older people, particularly women, the daily calcium requirement sometimes is not met because of a reduced intake of food resulting from lessened activity (38, 39, 50, 62). These people frequently experience loss of teeth and osteoporosis (loss of minerals in the bones), and hip and vertebra fractures are common (62). Dr. Genevieve Stearns (55) of the Iowa State Medical School reports, "It has been observed that the digestive juice in the stomach tends to decrease in old age so that it is not surprising that the absorption of calcium, phosphorus, and magnesium is not efficient in older people. Their requirements should resemble those of young children. A gram or more of calcium daily, taken from milk, seems highly desirable for the elderly adult . . . As the mean age of our population increases we are concerned with postponement of senescence. Maintenance of a well mineralized skeleton throughout adult life may well be a factor in the maintenance of physical vigor into old age."

Recent studies (11) with radio-active calcium in experimental animals have shown that there is a constant exchange between the calcium in the blood and the calcium in the bones. Therefore, it is imperative that all people obtain their calcium requirement daily so that their skeletal system will not become weakened as a result of the diffusion of calcium out of the

TABLE 5

Recommended daily calcium requirements for people of all ages (8, 55, 66)

	(Grams) <sup>a</sup>
Nursing mothers.....	2.0
Pregnant women	} ..... 1.5
Toddlers	
Children	
Adolescents	
Young adults	
The aged	
Adults (All not included above).....	1.0

<sup>a</sup> 1 gram = 1/28 oz.

TABLE 6

Some food sources of calcium (64, 66)

Food	Serving	Grams
Milk	1 qt. (4 cups)	1.151
Milk	1 cup	0.283
Skim milk	1 cup	0.283
Buttermilk	1 cup	0.283
Cheese (American or Swiss)	1 oz. slice	0.247
Ice cream	1/6 qt.	0.132
Cottage cheese	1 oz.	0.025
Cabbage, outer green leaves cooked	1/2 cup	0.214
Cabbage, fresh cooked	1/2 cup	0.023
Kale, cooked	1/2 cup	0.225
String beans, cooked	1/2 cup	0.065
Carrots, cooked	2/3 cup	0.022
Celery, raw	2 large stalks	0.036
Leaf lettuce	1 large leaf	0.006
Salmon, canned	1/2 cup	0.097
Oysters	6 medium	0.068
Cucumbers	1 large	0.024



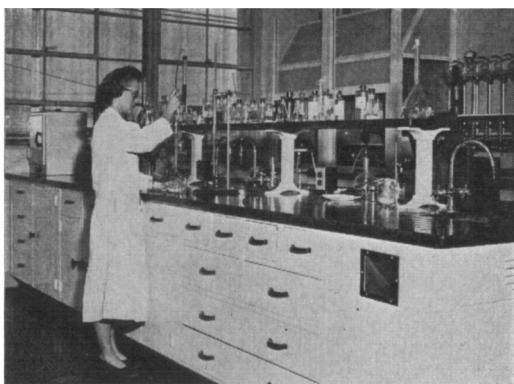


FIG. 4. Research plays an important part in the development of the dairy industry.

bones. The average lifetime of the American people reached a new high of 68.4 years at the half century (57). The Bureau of Census reported that there were 12,759,000 persons at ages 65 and over in July, 1951 (33). This means that there are more people past middle age than ever before. Therefore, these nutritional findings should be considered seriously by this group if they desire to continue to remain active and to enjoy good health.

**Vitamin value.** In the vitamin class are the fat-soluble vitamins: A, D, E, and K; and the water-soluble group: ascorbic acid (C) and the B family—thiamine, riboflavin, niacin, pyridoxine, para amino benzoic acid, pantothenic acid, biotin, choline, folic acid, inositol, and cobalamine (B<sub>12</sub>). Many more B vitamins have been discovered, and their function in human nutrition is being studied. Vitamins are essen-

tial for the efficient utilization of other nutrients.

All of the fat-soluble and water-soluble vitamins are found in milk (26). The level of ascorbic acid (vitamin C) is reduced when milk is pasteurized; however, citrus fruits are excellent sources of this vitamin and should be included in the daily diet. Of all recognized vitamins, riboflavin is most deficient in our diets, and vitamin A is next (5, 36, 39, 45, 50, 53, 58, 59, 60, 61, 69). Milk is a rich source of these two vitamins.

**Riboflavin**, one of the water-soluble B complex vitamins, is needed to prevent unhealthy skin conditions and dimness of vision. It is indispensable for growth, health, and vigor, as it is part of an enzyme system present in all living cells. A continuous supply of this important vitamin must be available from childhood through adulthood in order to remain young in appearance. A quart of milk or its equivalent in other dairy products will provide the daily requirement of riboflavin for people of all ages (Tables 7 and 8). To obtain the amount of riboflavin furnished by one quart of milk one would have to eat  $\frac{3}{4}$  lb. of cheese, 12 eggs,  $\frac{1}{5}$  lb. of liver,  $1\frac{1}{2}$  lb. of dried navy beans,  $2\frac{1}{2}$  lb. of lean beef, or  $1\frac{1}{2}$  lb. of greens (64, 67).

**Vitamin A** is a fat-soluble vitamin. It is necessary for normal growth and well being; it prevents "night blindness" (the inability to see in dim light) and promotes normal vision; it also builds up resistance to disease. This vitamin or its precursor, carotene, is present in large amounts in butter, cream, and other products containing milk fat, as well as in fresh green and yellow vegetables.

### Health-Promoting Nutrients in Dairy Products

The Food and Nutrition Board of the National Research Council has published recommended daily dietary allowances for the maintenance of health in the United States (3). Based on their recommendations, the percentage of the nutrients usually found to be deficient in the U. S. diet—calcium, riboflavin, and protein—as provided by one quart of milk is shown in Table 7. The amounts of health-promoting nutrients in dairy products are given in Table 8. These products are excellent sources of calcium, riboflavin, protein, vitamin A, and energy and should be included in the daily diet.

Many people who do not show pronounced symptoms of malnutrition are suffering from "hidden hunger" resulting from the lack of the most important nutrients in the diet—vitamins and minerals. Malnutrition results not only from insufficient food but from improper food.

### Milk and Weight Reduction

Many people are overweight; that is because they consume more calories than are needed. The secret in taking off pounds safely and still

TABLE 7

Per cent of National Research Council's recommended daily allowances of calcium, riboflavin, and protein provided by a quart of milk (67)

Group	Calcium	Riboflavin	Protein
Children:			
1-3 years	115	168	86
4-6 years	115	140	68
7-9 years	115	112	57
Girls:			
10-12 years	96	93	49
13-15 years	89	84	43
16-20 years	82	67	46
Boys:			
10-12 years	96	93	49
13-15 years	82	80	40
16-20 years	82	67	34
Women:			
Age 25 years <sup>a</sup>	144	120	62
During pregnancy	77	84	43
During lactation	58	67	34
Men:			
Age 25 years <sup>a</sup>	144	105	53

<sup>a</sup> Woman or man, active, in good health, normally vigorous, and living in temperate climates.

TABLE 8  
*Health promoting nutrients in dairy products (67)*

Product	Quantity	Calcium (mg.) <sup>a</sup>	Ribo- flavin (mg.)	Protein (g.) <sup>b</sup>	Vitamin A (I.U.) <sup>c</sup>	Energy (cal.)
Whole milk	1 cup (½ pt.)	288	0.42	8.5	390	166
Buttermilk	1 cup	288	0.43	8.5	10	86
Skimmilk	1 cup	303	0.44	8.6	10	87
Chocolate milk	1 cup	272	0.40	8.0	230	185
Malted milk	1 cup	364	0.56	12.4	680	281
Cheese (cottage)	1 oz. (2 T. <sup>d</sup> )	27	0.09	5.5	10	27
Cheese (Cheddar)	1 oz. slice	206	0.12	7.9	400	113
Cheese (cream)	1 oz. (2 T.)	19	0.06	2.6	410	106
Evaporated milk	½ cup	306	0.45	8.8	500	174
Condensed milk (sweetened)	½ cup	418	0.60	12.4	660	490
Nonfat dry milk solids	3 T.	292	0.44	8.0	10	81
Ice cream	1/7 qt. brick	100	0.15	3.2	420	167
Cream, light (20%)	1 T.	15	0.02	0.4	120	30
Butter	1 pat (½ T.)	1	trace	0	230	50

<sup>a</sup> 1 mg. = 1/28,000 oz.

<sup>b</sup> 1 g. = 1/28 oz.

<sup>c</sup> I. U. = international units.

<sup>d</sup> T = tablespoon

feel "in the pink" is to watch the diet and choose foods that supply all the nutrients required for good health and are at the same time low in total calories. Dairy products fit into this category. In Table 8 it will be seen that the usual servings of dairy products—skimmilk, buttermilk, cheese, nonfat dry milk solids—are low in calories but high in calcium, riboflavin, protein, and vitamin A and are therefore ideal nonfattening foods. Butter is high in vitamin A content and is not fattening in itself. Increased weight occurs only when the total calories consumed are more than the body requires. One should not "cut out" health-giving foods because they contain a little fat but should "cut down" instead. Dairy products can and should be included in every reducing diet. Every person, even when reducing, needs high quality protein, minerals and vitamins. To reduce and remain in good health, one should drink milk and eat cheese, ice cream, and other dairy products.

### Dairy Products Are Cheap

Agricultural economists, nutritionists, and home economists are all agreed that milk and its products are the most economical buy (42, 53, 64, 67). Dairy products have risen less in price during the past 5 years than meats, beverages, fruits, and vegetables (67). In a recent survey, the U. S. Department of Agriculture pointed out that for the money spent, dairy products offer excellent returns in proteins of high quality, calcium, riboflavin, and other minerals and vitamins. It has been estimated that the cost of the nutritional elements in a quart of milk would be nearly 60 cents if duplicated with other foods (48). If milk were used for no other reason than to supply the daily calcium

requirement, it would be worth double its price. The other nutrients are bonuses.

### Summary

Milk as a food has been used by man for thousands of years. It has been obtained from a variety of animals and has reached varied positions of importance in different cultures or even different periods in the same culture.

Milk and its products are a "must" in the daily diet. Milk is superior to any other food for muscle and bone building and for maintenance. It is an important and economic source of proteins of good quality because it contains all of the essential amino acids, the "building stones" of proteins so necessary for growth and maintenance. It contributes to the energy need; it contains mineral elements, particularly calcium and phosphorus, needed for strong bones and good teeth; and, most important, it supplies fat-soluble vitamins such as vitamin A for good growth and normal vision and the B-complex vitamins so essential for youthful appearance.

A quart of milk is a quart of health—that is the miracle of milk.

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