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REPORT

OF THE

EIGHTH INTERNATIONAL DAIRY CONGRESS

1928

MESSAGE FROM THE PRESIDENT OF THE UNITED STATES TRANSMITTING, PURSUANT TO PUBLIC RESOLUTION No. 10, SEVENTIETH CONGRESS, APPROVED FEBRUARY 25, 1928, THE ORIGINAL REPORT OF THE EIGHTH INTERNATIONAL DAIRY CONGRESS, HELD IN GREAT BRITAIN DURING JUNE AND JULY, 1928

APRIL 18, 1929

Referred to the Committee on Agriculture and ordered to be printed with illustrations

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1929

MESSAGE

To the Congress of the United States:

Pursuant to the authorization granted by Public Resolution No. 10, Seventieth Congress, approved February 25, 1928, my distinguished predecessor accepted the invitation of the British Government to appoint delegates on the part of the United States to the Eighth International Dairy Congress, held in Great Britain during June and July, 1928.

These delegates have now rendered a report of that congress in accordance with section 3 of the above-mentioned public resolution, and I therefore transmit herewith the original of that report.

HERBERT HOOVER.

THE WHITE HOUSE,
April 18, 1929.

LETTER OF TRANSMITTAL

DEPARTMENT OF STATE,
Washington, March 18, 1929.

The PRESIDENT:

In conformity with the stipulations of Public Resolution No. 10, Seventieth Congress, approved February 25, 1928, authorizing the President to accept the invitation of the British Government to appoint delegates to the Eighth International Dairy Congress, held in Great Britain during June and July, 1928, the delegates on the part of the United States to this meeting have now submitted a report on the results and conclusions of that congress.

I have, therefore, the honor to transmit herewith for appropriate submission to the Congress the report above referred to.

Respectfully,

FRANK B. KELLOGG.

The PRESIDENT,
The White House.

LETTER OF SUBMITTAL

Hon. Frank B. Kellogg,

Secretary of State, Washington, D. C.

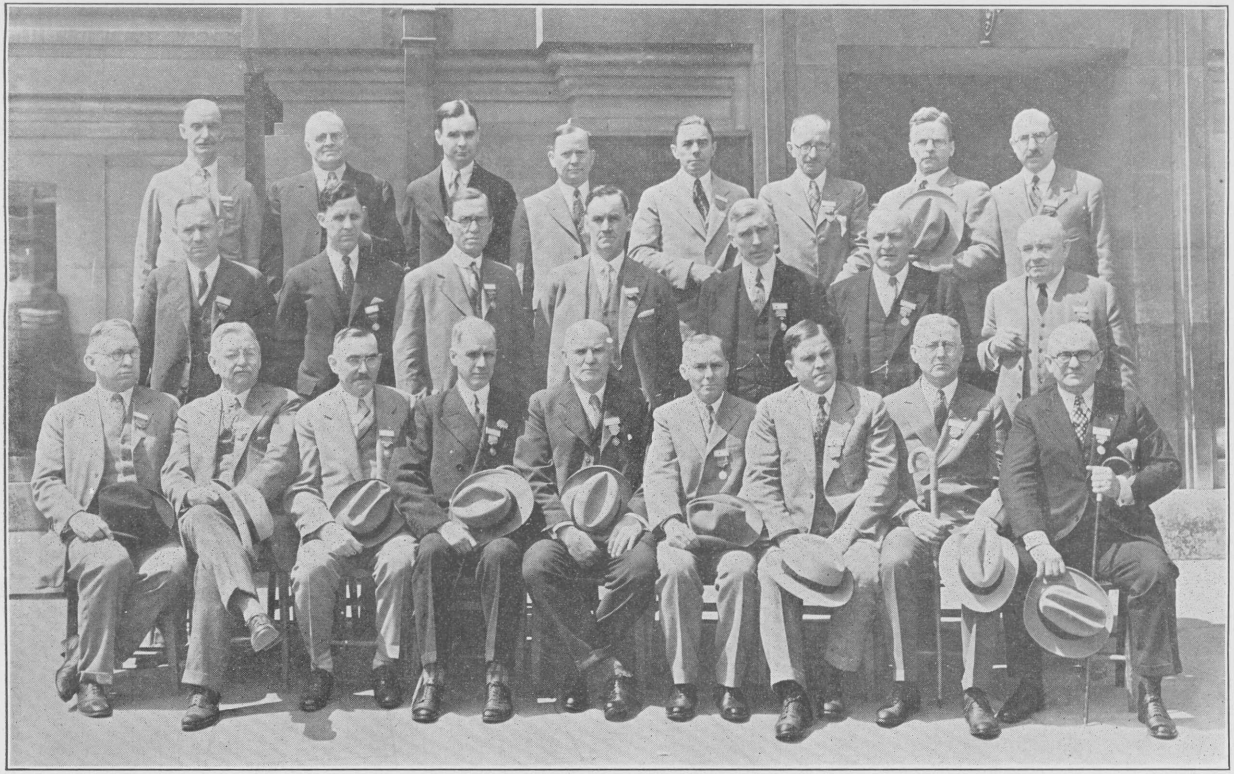
Dear Sir: We have the honor to submit herewith a report of the participation in the Eighth International Dairy Congress by the delegates representing the Government of the United States.

This congress was held in Great Britain in June and July, 1928, and the delegates of the United States thereto were designated by the President of the United States under the authority of a joint resolution of Congress, approved February 25, 1928, such appointments being transmitted to us through you.

The report herewith includes the work of the congress, all action taken by the delegates of the United States, and a summary of the results and conclusions of the congress.

Respectfully submitted.

R. W. Dunlap, *Chairman.*
A. M. Loomis, *Secretary.*



Back row (left to right): Dr. G. E. Sherwood, W. F. Schilling, Prof. J. B. Fitch, Dr. C. W. Larson, A. L. Haecker, P. H. Kasper, O. F. Hunziker, Dr. J. G. Lipman
Middle row: Fred Rasmussen, G. B. Caine, A. J. Glover, J. D. Mickle, Prof. A. A. Borland, W. H. Jeffers, O. S. Jordan
Front row: A. M. Loomis, J. C. Rundell, E. M. Bailey, H. E. Van Norman, Hon. R. W. Dunlap, Dr. L. A. Rogers, Prof. O. E. Reed, E. T. Rector, and D. M. Dorman

REPORT OF THE EIGHTH INTERNATIONAL DAIRY CONGRESS

On January 5, 1928, the President transmitted to Congress a report from the Secretary of State conveying the information that an invitation had been received from the Government of Great Britain to take part in the Eighth International Dairy Congress, then planned to be held in Great Britain in June and July of that year and that the Secretary of Agriculture to whom the invitation had been referred stated that there was much interest and that it was the desire of the Department of Agriculture that this invitation should be accepted.

After deliberation, Congress passed, and the President on February 25, 1928, approved the following joint resolution:

[PUBLIC RESOLUTION—No. 10—70TH CONGRESS]

[H. J. Res. 156]

Joint resolution authorizing the President to accept the invitation of the British Government to appoint delegates to the Eighth International Dairy Congress, to be held in Great Britain during June–July, 1928, and providing for an appropriation of $10,000 for the payment of the expenses of the delegates

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the President of the United States be, and he is hereby, authorized and requested to accept the invitation of the British Government to participate in the Eighth International Dairy Congress, to be held in Great Britain during June–July, 1928, as set forth in the message of the President of January 5, 1928, printed as Senate Document Numbered 36, Seventieth Congress, first session, and to appoint delegates to said dairy congress.

SEC. 2. That the sum of $10,000, or as much thereof as may be necessary, is hereby authorized to be appropriated for the payment of the expenses of the delegates in attending such congress, including the compensation of employees, transportation, subsistence, or per diem in lieu of subsistence (notwithstanding the provisions of any other act), and such other expenses as the President shall deem proper.

SEC. 3. That the delegates shall make a report to Congress of the results and conclusions of the said dairy congress.

Approved, February 25, 1928.

Shortly thereafter, the following delegates named by the President were notified of their appointments by the Secretary of State and a first meeting of the members of this delegation was held in Washington, D. C., on May 8, 1928, when a dinner in their honor was given

by the American Dairy Federation. At this meeting the objects to be accomplished by the American representatives in the World Dairy Congress were discussed, and an informal organization was perfected by the election of Dr. H. E. Van Norman as honorary chairman, Hon. Renick W. Dunlap as chairman, and A. M. Loomis as secretary.

LIST OF DELEGATES ON THE PART OF THE UNITED STATES TO THE EIGHTH INTERNATIONAL DAIRY CONGRESS, JUNE–JULY, 1928

Hon. R. W. Dunlap (Ohio), Assistant Secretary of Agriculture, Washington, D. C.

Dr. L. A. Rogers, Acting Chief, Bureau of Dairy Industry, United States Department of Agriculture, Washington, D. C.

Mr. Roy C. Potts, Chief Dairy Marketing Division, B. A. E., United States Department of Agriculture, Washington, D. C.

Dr. G. E. Sherwood (dairy farmer), Kimball, Minn.

Mr. John Brandt, president, Land O'Lakes Creameries (Inc.), Minneapolis, Minn.

Mr. A. J. Glover, editor, Hoard's Dairyman, Fort Atkinson, Wis.

Mr. J. D. Mickle, State Food and Dairy Commissioner, Portland, Oreg.

Prof. J. B. Fitch, Kansas State Agricultural College, Manhattan, Kans.

Mr. A. M. Loomis, American Dairy Federation, Washington, D. C.

Mr. P. H. Casper (cheese manufacturer), Bear Creek, Wis.

Prof. A. A. Borland, Pennsylvania State College, State College, Pa.

Prof. O. E. Reed, Michigan Agricultural College, East Lansing, Mich.

Dr. C. W. Larson, director National Dairy Council, 910 South Michigan Avenue, Chicago, Ill.

Dr. H. E. Van Norman, American Dry Milk Institute, 160 La Salle Street, Chicago, Ill.

Mr. A. L. Haecker, president Allied State Creamery Association, Lincoln, Nebr.

Mr. Harry Bull, secretary Dairyman's League, Campbell Hall, Orange County, N. Y.

Judge J. D. Miller, president National Cooperative Milk Producers Federation, 120 West Forty-second Street, New York, N. Y.

Mr. E. T. Rector, president Fairmont Creamery Co., Omaha, Nebr.

Mr. W. F. Schilling, president Twin City Milk Producers' Association, Raymond and University Avenues, St. Paul, Minn.

Mr. Fred Rasmussen, secretary International Association of Ice Cream Manufacturers, Harrisburg, Pa.

Mr. E. M. Bailey, president American Dairy Federation, Pittsburgh, Pa.

Dr. Robert S. Breed, bacteriologist, Agricultural Experiment Station, Geneva, N. Y.

Mr. T. H. McInnerney, president National Dairy Products Corporation, 120 Broadway, New York, N. Y.

Dr. E. B. Meigs, Bureau of Dairy Industry, Department of Agirculture, Washington, D. C.

Mr. Frank S. Harmon, director of the Ohio Guernsey Breeders' Association, 3515 Euclid Avenue, Cleveland, Ohio.

Mr. H. W. Jeffers, Walker-Cordon Laboratory Co., Plainsboro, N. J.

Mr. D. M. Dorman, president the California Dairies, Los Angeles, Calif.

Prof. O. F. Hunziker, Blue Valley Creamery Co., 1137 West Jackson Boulevard, Chicago, Ill.

President O. S. Jordan, Dairy and Ice Cream Machinery and Supplies Association, 225 West Thirty-fourth Street, New York City.

J. C. Rundall, president De Laval Separator Co., 600 Jackson Boulevard, Chicago, Ill.

J. G. Lipman, director New Jersey Agricultural Experiment Station, New Brunswick, N. J.

Caine, G. B., professor, Utah Agricultural College, Logan, Utah.

Several other meetings followed on board the U. S. S. *Leviathan* on which transportation was arranged for the majority of the delegates. Delegates other than those traveling on the U. S. S. *Leviathan* joined the *Leviathan* party in London, so at the opening session of the Congress on the morning of June 27, 1928, all the members of the United States delegation were present except Mr. John Brandt.

Frequent meetings of the United States delegation were held while the Congress was in session. Attached to this report is a memorandum of each of the meetings held by the United States delegation. Various members of the delegation were assigned to report the different sessions. The opening session was assigned to Prof. A. A. Borland of State College, Pa.

The sessions of the World's Dairy Congress in London were held in Central Hall, Westminster, a large and conveniently arranged building, situated almost in the shadow of Westminster Abbey and two blocks from the Houses of Parliament.

OPENING SESSION OF THE CONGRESS

The first session was conference Section I, on milk production, on Wednesday morning, June 27, 1928. The preceding day had been spent in the business of registering the delegates, arranging transportation for the various trips to dairy plants and dairy farms.

Presiding at the opening session was the Right Hon. Walter Guinness, Minister of Agriculture and Fisheries for Great Britain, who stressed in his opening address the fact that notwithstanding the competition between all dairy countries in the world markets, all were united in cooperative efforts to improve the conditions in the industry.

M. Jules Maenhaut, president of the International Federation for the Encouragement of the Dairy Industry, and Dr. F. E. Posthuma, chairman of the Federation of Cooperative Dairy Associations of Holland, also made addresses at the opening session of the congress.

The principal American paper at the opening session on milk production was by John D. Miller, of the Dairymen's League, one of the official delegates from the United States. Mr. Miller's paper on "The Dairymen's League and its Milk Pool in the United States of America," appears in full in the appendix of this report.

Other speakers and subjects at the opening session were as follows:

Mr. R. B. Boutflour, M. Sc. (director of dairy husbandry, Harper-Adams Agricultural College): "Limiting Factors in the Feeding and Management of Milch Cows."

Mr. James Mackintosh, O. B. E., N. D. A., N. D. D. (National Institute for Research in Dairying, University of Reading): "The Feeding of Dairy Cows."

Dr. Stefan Weiser (Director of the Royal Hungarian Animal Physiology Experiment Station, Budapest): "The Protein Requirements of Dairy Cow."

M. Eschweiler (State Scientific Agriculturist, Belgium): "The Feeding of the Dairy Cow."

Dr. J. B. Orr, D. S. O., M. C., M. A., M. D. (Director of the Rowett Institute, Aberdeen): "Calcium and Phosphorus in the Metabolism of the Lactating Animal and Factors that Influence their Assimilation," read by H. E. Magee, M. B., D. Sc., Rowett Institute, Aberdeen.

Capt. John Golding, D. S. O., Chevalier du Mérite Agricole, F. I. C. (National Institute for Research in Dairying, University of Reading): "Some of the Effects Produced in the Richness of Cows' Milk by Feeding Cod-Liver Oil."

Em. Van Godtsenhoven: "The Rational Use of Skimmed Milk in the Feeding of Calves."

E. Marre (Hon. Director of the Agricultural Services, member correspondent of the Academy of Agriculture, agricultural proprietor): "The Importance of Salt in the Feeding of Dairy Cows."

Mr. Harold Jackson, J. P. (England, chairman of the Central Council of Milk Recording Societies): "Milk Recording."

M. J. De Tilloux and M. G. Verpoorten: "Milk Control in Belgium."

Prof. Dr. O. Wellmann (Hungary): "Milk Control Associations and Stud Bookkeeping in Hungary."

Dr. Vaclav Bronsky (Proprietor of the Heinovka Farm, Prague VIII, Czechoslovakia): "Production of Hygienic Vitaminized Milk (Ultra-Lakta), Prague, Czechoslovakia."

The subjects of these papers indicate their general interest, and special comment can be made about the value of the information contained in all of them, but especially in the papers by Mr. Boutflour, Mr. James Mackintosh, and M. Eschweiler, the latter paper being an especially interesting discussion of various factors in feeding, and Dr. J. B. Orr's paper on Calcium and Phosphorus. Dr. E. B. Meigs, a delegate from the United States, took an interesting part in the discussion, and Mr. W. F. Schilling closed the discussion of the day by offering a vote of thanks to the president for his services and to the authors of the papers.

CONFERENCE SECTION II

While the opening session on milk production was in session, in an adjoining hall conference Section II, on "Milk Distribution and Manufacture," was going on. A report of this session was assigned to Prof. Otto F. Hunziker, of the research laboratories of the Blue

Valley Creamery Co., Chicago. Doctor Hunziker was also author of the leading American paper entitled "Metals and their Various Influences on Milk." In fact, Doctor Hunziker's paper was one of the leading scientific papers of the entire congress in the judgment of many of the delegates who discussed it. It also appears in the supplement to this report.

A list of the papers presented at this conference section on milk distribution and manufacture is as follows:

Prof. B. Lichtenberger (Dairy Research and Experimental Institute, Kiel): "Scientific Work in the Sphere of Scheming, Building, and Arranging of Dairies."

Prof. Sigurd Orla-Jensen, Ph. D., D. Sc. (Royal Technical College, Copenhagen): "A New Investigation Concerning the Low Temperature Pasteurization of Milk and Reaction for Controlling the Pasteurizing Temperature."

Dr. H. C. Corry Mann, O. B. E.: "The Safety Factor of Pasteurized Milk."

Dr. G. Dalla Torre (Vice Director of the Experimental Dairy Station, Lodi): "Studies in the Holding Method of Pasteurization," read by Mr. G. F. Gosney, the section secretary.

Prof. Giuseppe Fascetti (Director of the Experimental Dairy Station, Lodi, Milan): "On the Pasteurization of Milk in the Production of Some Types of Italian Cheese," read by Mr. G. F. Gosney, section secretary.

Dr. A. J. Swaving (Holland): "Guarantees as to Purity, Genuineness and Composition of the Dutch Milk and Milk Products."

Dr. Paul Tolney (Ministerial Counsellor, Chief of Department for Milk Industry at The Royal Hungarian Ministry of Agriculture): "Hungarian Government Regulations for the Milk Industry."

Doctor Devich (Ministerial Secretary, Hungary): "Connection of the Activities of Administrative and Judicial Authorities in the Production, Treatment, and Utilization of Milk."

Mr. G. T. Pyne, A. R. C. Sc. 1, Ph. D. (University of Cork): "Some Factors Influencing Viscosity in Cream." Mr. J. Lyons, A. R. C. Sc. 1, N. D. A., N. D. C., coauthor.

Among those listed, the names of Prof. Sigurd Orla-Jensen, of Copenhagen, and Dr. A. J. Swaving, of Holland, stand out especially by reason of their world-wide prominence. Doctor Swaving's paper on the complete regulation which is in force in Holland to guarantee purity, genuineness, and quality of their products, attracted special attention.

Much attention and considerable discussion both at this session and at other sessions centered in the subject of pasteurization. Dr. H. C. Corry Mann's paper opened this discussion. Pasteurization of milk for fluid distribution and consumption is not nearly so widely practiced in other countries as in the United States, and this fact resulted in discussions of questions which have been passed upon and considered settled in the United States.

SPECIAL SECTION A

Special section A, an animal physiology in reference to milk production, was also in session on the opening day. This was reported by Prof. J. B. Fitch, of the Kansas Agricultural College, Manhattan, Kans. This section was called together by the president, F. H. A. Marshall, Esq., with J. Hammond, Esq., as secretary. After a brief introduction by the president, stressing the importance of the papers on the program for dairymen, the papers were summarized by the authors.

The program of papers given was as follows:

Prof. Nils Hansson: "The Nutritive Requirements of Milch Cows in Relation to the Composition of Milk Produced," read by Professor Johansson, Upsala, Sweden.

Prof. J. Hansen (professor of animal production, Landwirtschaftliche Hochschule, Berlin): "The Specific Effect of Feeding-Stuffs on the Milk Yield of the Cow."

Prof. John W. Gowen (The Rockefeller Institute, Princeton, N. J., U. S. A.): "The Problem of Correction of Milk Yield and Butterfat Yield for Age."

Mr. H. G. Sanders (Cambridge): "The Standardization of a Lactation Record."

Professor Voitellier (professor of zootechnie, Institut National Agronomique, (Paris): "The Necessity for Milk Recording Societies to Publish the Quantity of Milk and Fat Content Actually Observed, Whatever May be the Value of Corrections for Age, Service, Period, etc."

Mr. C. Zwagerman (Government cattle expert, Middleburg, Holland): "Data on the Lactation Records as a Basis for a Rational Breeding for Production."

Miss Margaret K. White and Mr. T. J. Drakeley (Department of Chemistry and Rubber Technology, Northern Polytechnic, London; British Dairy Farmers' Association, London): "Breed Standards and Point Adjustments for Age and Period of Lactation in Milking Trials."

Professor Tuff (professor of animal breeding, Landbrukshioskole, Aas, Norway): "Factors Affecting Milk Yield."

Mr. E. J. Roberts, M. A., M. Sc. (University College of North Wales, Bognor): "A Comparison of Milk Yields Given by Heifers in their First Lactation With Those Given by the Same Animals at Later Periods."

Dr. Andrew C. M'Candlish (advisory officer in milk production, the West of Scotland Agricultural College): "Is There any Relationship Between the Age of the Heifer at First Calving and Her Ultimate Production?"

Prof. R. Prawochenski (professor of animal husbandry, Jagellonian University, Cracow, Poland): "Correlation Between the Surface of White Markings in the Colour of Holstein-Friesian Cows and Their Productiveness" (milking records and percentage of fat in milk), and "Correlation between the Color of Muzzle and Milking Productiveness among Polish Red Cows."

Dr. Josef Proks (Dairy Institute, l'Ecole Polytechnique, Prague): "The Individuality of the Mammary Glands of the Cow."

The papers in this section were of a technical character, of great interest to the scientific and educational leaders of the industry. A brief discussion on Prof. Nils Hansson's paper by Mr. E. J. Sheehy (University College, Dublin) suggested the adaptation of a universally used starch unit instead of the various feed units which

are now being used, this starch unit to be used by all workers in giving nutritive requirements.

The paper presented by Miss Margaret K. White and Mr. T. J. Drakeley on breed standards and adjustments was a long and detailed study of the effects of age and lactation periods in milking trials. Professor Prawochenski, of Poland, suggested that there should be standardization all over the world as to lactation periods. No action was taken on the suggestion.

Dr. John W. Gowan, of Princeton, N. J., presented a paper which appears in full in the appendix.

Of special importance of those from the United States was a tribute paid by Dr. C. H. Eckles, of Minnesota, to the president of the session, Dr. F. H. A. Marshall, F. R. S., D. Sc., reader in animal physiology, University of Cambridge. Doctor Marshall's book on animal physiology and his outstanding work on the physiology of milk secretion have attracted students in animal physiology throughout the world. In presenting a motion thanking Doctor Marshall for presiding at this section Doctor Eckles paid fitting tribute to his work. This motion was passed, concluding the session.

SECOND DAY'S SESSION

Conference section 1, on milk production, was conducted on Thursday, June 28, 1928, with E. W. Langford, Esq. (past president of the National Farmers' Union) presiding. The report of this session was assigned to Mr. Sam. H. Greene, a delegate from the California Dairy Council.

The papers presented at this session were as follows:

Dr. Stenhouse Williams: "Education and Advisory Work amongst Milk Producers, and the Handling of Milk at the Farm."

Dr. Otto Gratz (director of the Royal Hugarian Dairy Experiment Station): "Dairy Education in Hungary."

Prof. Dr. Franz Zaribnicky (Veterinary College, Vienna): "The Instruction of the Dairy Staff."

Dr. Clyde King (University of Pennsylvania): "Relationship between the Milk Producer and the Milk Dealer."

Mr. E. White (managing director Midland Counties Dairy, Birmingham): "Purchasing Milk on a Quality Basis."

M. Mesureur (Belgium): "The Rôle of the Association of Milk Producers, and Their Methods."

R. M. Veeman (late vice president of the Frisian Cooperative Association for Export of Dairy Products, Leeuwarden, Holland, deceased): "The Standardization of the Quality of Dairy Products."

Mr. W. Smith (Imperial dairy expert, Bangalore): "Indian Dairying."

Professor Gorini: "Lord Lister as a Pioneer of Clean Milk Production."

The paper of Dr. Clyde King, of the University of Pennsylvania, the principal contribution of this session from a United States delegate, appears in full in the appendix.

There was much interest in Dr. Stenhouse Williams's paper detailing the system of education in use in Great Britain among the milk producers and those handling milk on the farms. This was one of the most interesting features brought out not only by Doctor Williams's paper but by the experiences of members of the United States delegation who visited various schools where the farm boys and girls were brought together for short courses and intensive training in the care of dairy cattle, sanitary handling of the product, and the most practical methods of home manufacture of dairy products. Most of the cheese for which various sections of Great Britain are famous is the product of the home dairy industry, and cheese making is one of the particular subjects taught in these dairy schools.

Mr. W. F. Schilling, one of the United States delegates, took part in the discussion of Doctor King's paper, giving something of the experience which the dairy farmers of the United States have been through in bringing about their cooperative organization and participation in the business of marketing fluid milk.

The paper of M. Mesureur, on the association of milk producers in Belgium, proved of special interest, and one of the new and interesting high lights brought to the Congress was found in the paper of Mr. W. Smith, on Indian dairying. Mr. T. Murari, a native Indian, added much interesting information about the dairy industry in his country.

CONFERENCE SECTION II

Conference Section II, on milk distribution and manufacture, was continued on the second day. The report of this was assigned to Mr. A. M. Loomis. Presiding over this session was J. H. Maggs, Esq., president of the Federation of Dairymen's Associations of Great Britain.

The principal paper from a United States delegate at this session was that of Dr. H. E. Van Norman, who was introduced by the president as "the greatest living authority on the production and distribution of milk powder in bulk." His paper on "Dry Milks" is printed in full in the appendix to this report.

Another interesting paper from a United States delegate was also given at this session on "Development of the Ice Cream Industry in the United States," by Mr. Fred Rasmussen, of Harrisburg, Pa., which also appears in full in the appendix; and a third paper from the United States, which is also printed in full in the appendix, was presented by Prof. Grover Dean Turnbow of the University of California, "Newer Phases of Processing Ice Cream."

Other papers which were presented at this time were as follows:

Prof. A. Miyawaki, Ph. D. (Hokkaido Imperial University, Sapporo, Japan): "Some of the Physical and Chemical Properties of Powdered Milk."

Prof. Albert Mertens (professor at Louvain University): "The Manufacture of Ice Cream in Belgium."

Mr. E. A. Evans (United Dairies, London): "Retail Distribution of Milk in Large Cities," presented by Mr. Gordon Evans.

Mr. N. N. Bhose, B. A. (deputy chairman Cooperative Milk Societies' Union, Calcutta): "The Transport and Distribution of Milk in India."

Prof. Dr. Otakar Laxa (Prague): "The Importance of Yoghourt for the Tropics."

Mr. G. Sutherland Thomson, F. R. S. (Edin.) N. D. D., B. F. D. (London): "Methods of Grading Butter as Practised in Various Countries, and Their Influence on Manufacture."

Mr. F. Wigan (Australian Commonwealth Representative): "Australian Methods of Manufacture and Grading of Butter for Export."

Mr. Jan Brabant (secretary of the Butter Control): "Butter Control in Belgium."

Dr. J. A. Ruddick (dairy commissioner for Canada): "Canadian Cheese in the World's Market."

Dr. Otto Gratz (Director of the Royal Hungarian Dairy Experiment Station): "The Lipolysis of Worked Butter, Several Days after Preparation."

Herr Hoffman: "Activated Milk."

Dr. G. Dalla Torre (vice director of the Experimental Dairy Station, Lodi): "On the Microbial Flora of Belpaese."

A glance at this list will indicate that the dairy manufacturing industries of the world were practically all represented in this session of the congress. The full report of this session is, without doubt, an encyclopedic summary of the world status of the dairy industry.

Professor Miyawaki's discussion of powdered milk indicated the intensive way in which the Japanese scientists are investigating every dairy problem. Captain Golding of Reading University offered some very constructive suggestions on the use of powdered milk, experiments which had been conducted indicating its value in bread making, and particularly the importance of this and other developments of the dairy industry to utilize by-products and the waste products of dairying.

The paper of Professor Mertens, of Louvain University, on the manufacture of ice cream in Belgium, and the discussion which followed, indicated the slow development of the ice-cream industry in western Europe. Professor Mertens said, "The manufacture of ice cream as an industry does not yet exist in Belgium, but retail production is increasing." Other information which was presented shows that this same situation exists in most of the other western European countries although special efforts are being made at this time to develop the ice-cream industry in Denmark.

The paper of Mr. E. A. Evans, of London, was a complete statement of the fluid-milk distributing system in Great Britain where pasteurization and modern methods like those in use in the United

States are revolutionizing this industry. An entirely different picture was given of production and distribution in India, by N. N. Bhose, of the Cooperative Milk Societies' Union in Calcutta, where milk is still distributed in the ordinary eastern brass water pot.

Mr. G. Sutherland Thomson's paper on methods of grading butter was, in fact, a review of the butter industry of most producing, and the principal importing, countries, while Mr. F. Wigan, of Australia, and Dr. J. A. Ruddick, of Canada, gave very complete reviews of the dairy industry in their respective countries.

Mr. Roy C. Potts, of the United States Department of Agriculture, took part in the discussion by describing the methods of butter grading which are used by the Bureau of Agricultural Economics of the United States Department of Agriculture; and Mr. D. M. Dorman, of Los Angeles, president of the International Association of Ice Cream Manufacturers, closed the discussions of the session by offering a resolution of appreciation to the officers and those on the program.

SPECIAL SECTION B

Special Section B, on veterinary medicine in reference to dairy cows, a most important session of the Congress, was held in Central Hall, Westminster, on Thursday, June 28, 1928. The reporting of this session for this report was assigned to Dr. E. B. Meigs, of the official United States delegation.

The meeting was presided over by Lieutenant Colonel Brittlebank, C. M. G., D. V. S. M., M. R. C. V. S., president of the Royal College of Veterinary Surgeons. The subject for discussion was "The Veterinarian in Relation to Milk Supply." The paper by Capt. A. W. Pillers, F. R. C. V. S., D. V. S. M., deputy veterinary officer of the city of Liverpool, is summarized as follows:

It is now generally admitted that human beings can acquire tuberculosis and other diseases from milk, and that some form of control of the milk supply is desirable. The training and experience of the veterinarian render him peculiarly fitted to take an important part in the control of the milk supply. Most veterinaries would formulate three standards for milk consumed by the public, on the grounds of prevention of disease alone: (1) Milk from inspected cows free from tuberculosis; (2) milk from cows which have been subjected to regular routine veterinary inspection; (3) milk pasteurized for such a time and at such a temperature as to kill pathogenic bacteria.

(1) Although the tuberculin-tested herds have doubled or tripled since 1924, their number is still very small, and at the present rate of advance it will be a long time before any considerable part of the milk supply comes from such herds. More rapid progress toward the eradication of tuberculosis has been made in the United States,

and it seems likely that further steps will in time be taken in Great Britain.

(2) The proportion of tuberculous milk in the general supply has shown little or no tendency to decrease between 1900 and 1926. Under the present Government regulations the inspection of milk and of dairy herds is irregular and inadequate, and the regulations should be changed.

(3) Pasteurization, when properly carried out, is undoubtedly a valuable protective measure for the milk consumer; but on account of its tendency to change the taste of milk and to destroy its anti-scorbutic properties it is not to be regarded as an ideal method of producing a safe milk supply.

The paper was discussed by Mr. G. P. Male, M. R. C. V. S., reading; Mr. J. S. Lloyd, F. R. C. V. S., D. V. S. M. (Vict), chief veterinary officer, Sheffield; Capt. J. Howard Jones, O. B. E., M. R. C. V. S., county veterinary inspector, Glamorgan; and Capt. Sidney Villar, F. R. C. V. S., chief veterinary inspector, Middlesex.

The president then called on three distinguished members of the congress, as follows:

Professor Doctor von Ostertag, representing the Wurttemberg Home Office, who stated that in Germany the existence of tuberculous cows was made public, and that this regulation had worked satisfactorily. He spoke of other pathological conditions in cows such as streptococcic mastitis and contagious abortion.

Dr. W. G. Savage, representing the County Council of Somerset, who spoke of the difficulties of having full-time veterinarians for the routine inspection of the milk supply. This procedure would cost about 2 shillings per cow per year. The cost should partly be borne by the cities, and the inspection should be coupled with some plan for reducing the incidence of tuberculosis among cows. He would be in favor of routine inspection if these suggestions could be carried out.

Prof. Ch. Porcher, of the Veterinary School at Lyons, France, who stated that the inspection of milk was little advanced in France. The inspection of barns and herds is entirely facultative. He spoke of the importance of paying attention to mammary infections in general as well as to tuberculosis.

In the voluntary discussion which followed, it was developed that there is much controversy in England over the efforts which are being made to free that country from tuberculosis in the dairy herds. The whole discussion showed much greater cattle-owner opposition to testing and official preventive measures than exists in the United States.

The other paper presented at this session was "The Spread of Streptococcus Mastititis in Hungary and the Importance of this Disease from the Standpoint of Hygienic Milk Supply," by Dr. Otto Fettick; read by Dr. F. C. Minett (research institute in animal pathology, Royal Veterinary College, London), coauthor.

THIRD DAY OF THE CONGRESS

The third general conference section held on Friday, June 29, considered the general subject of milk consumption, administration, and control. The report of this meeting was assigned to Dr. C. W. Larson, of the United States delegation.

Two important papers from United States delegates were presented at this session, one prepared by Dr. E. V. McCullom, of Johns Hopkins University, "Nutritive Value of Milk and the Importance of Milk in the Human Dietary," read by Doctor Hamil in the absence of Doctor McCullom; and the other prepared by Mr. M. D. Munn, president of the National Dairy Council, of Chicago, "Increasing Consumption of Dairy Products by Educational Methods," presented by Dr. C. W. Larson in the absence of Mr. Munn. These papers appear in full in the appendix.

Without doubt these two papers and the paper of Dr. Corry Mann, of England, on the value of dairy products in the diet during school age, and the review of the work now being done in various European countries to increase the consumption of milk, indicated the high-water mark of the progress of the dairy industry as reflected by the proceedings of this World's Dairy Congress, 1928.

All of these papers showed clearly that the methods which have been used, quite largely under the leadership of the National Dairy Council in the United States, to increase the consumption of milk and its products and resulting in marked improvement of human health, have been carried on with conformity with established laws of health and diet, and without serious encroachment upon other food products. That is, all of the work in the United States, in England, and on the Continent has been based upon the necessity for the use of milk and dairy products as supplements to existing diet systems, as well as emphasizing the intrinsic food value of the products themselves. All of the papers showed a sharp increase in the use of fluid milk, with the resulting beneficial effects not only on the dairy industry and other agricultural industries but on human health and longevity.

Space will not permit the use of the large amount of information found in the paper of Dr. Corry Mann, but in general it can be said that his paper was a discussion of actual experimental feeding conducted among English public schools and public institutions for the

care of children. One illustration which Doctor Mann used, showing the results of the proper amount of milk and butter in the diet, is as follows:

The interesting history of twins who were reared with devoted care—but in different homes and with a different diet sheet—will help to establish this contention. In the year 1907 a woman brought to my out-patient department one of her twin boys. The father, I learnt in confidence, was a man of good birth and position. When the twins were 2 years old, being then quite healthy but much underweight, an offer was made to relieve the mother of all responsibility for their upbringing.

She would only part with one of them, whom I will call A, and two years later she brought B at the age of 4 years to hospital for advice. The boy B was undersized. He weighed only 29 pounds instead of an average 35 pounds. There were no signs of disease. The mother was only able to provide an adequate diet of poor quality for her son, but apart from this fact he received every care and attention and he remained healthy. At intervals I continued to see this boy and I have full details of his development at 7, 10, 12, and 17 years, the last occasion being in 1920. He remained small and much underweight for age. From the age of 3 years onwards rarely did he receive more than 5 ounces of milk; margarine was used in the house, entirely, and the detailed account of the diet showed that it averaged 40 calories per pound of body weight, while fully 68 per cent of the calories were provided by carbohydrate and only 18 per cent by fat. Since 1920 I have learned that he has become a clerk in the city of London. He is now a man of 25 years of age and he remains, in adult life, of poor physique.

The history of his twin brother A is interesting. Strangely enough A was brought to see me as a private patient in the year 1913, for advice on some trivial disability, when he was 10 years old, the foster parents being quite unaware that I knew the twin brother. At the age of 10 A weighed 70 pounds—well above the standard of weight for age. He was receiving also every care and attention in a comfortable home. His diet—strangely similar in calorie value to his brother's—included 1½ pints of milk daily and at least 2 ounces of butter. He was exceedingly sturdy—a well-built frame with good muscular development. He continued to make excellent progress, proceeded to public school, later to a university and at the present time—aged 25 years—he is abroad in Government service, a healthy and well-developed man.

Doctor Mann's paper was very admirably supplemented by Mr. J. G. Stapleton, member of the National Milk Publicity Council of England, who described the work being done by that organization.

As the list of papers will show, methods of increasing consumption of milk in Germany, Belgium, Austria, and Switzerland were discussed, and the proposition was made for the formation of a central European dairy council, work which has been carried out since the Congress was held, in cooperation with the National Dairy Council of the United States.

It is also interesting to note that one of the few systematic exhibits which was made in connection with this World's Dairy Congress was devoted to the methods in use in increasing human knowledge of the importance in the human diet of milk and its products. One large room in Central Hall, Westminster, was used for these

exhibits, in charge of Dr. C. W. Larson, one of the members of the United States delegation. The work which is being done in the United States by the National Dairy Council and the numerous local dairy councils made up the largest single exhibit, but the examples of the work being done in almost every European country were also on exhibit.

The list of papers which was presented in this session was as follows:

Prof. E. V. McCollum, Ph. D., Sc. D. (department of chemical hygiene, Johns Hopkins University, Baltimore): "Nutritive Value of Milk and the Importance of Milk in the Human Dietary," read by Dr. Hamil (of Ministry of Health).

Dr. Corry Mann: "The Value of Dairy Produce in the Diet During the School Age, and a Comparison Between the Diet of a Child in a Poor Industrial District and that of a Public School Boy in England."

Dr. Elia Savini and Dr. Oreste Garzia: "The Direct and Indirect Determination of the Energy Power of Milk in Relation to the Nutritive Needs of the Child."

Sir John Robertson, C. M. G., M. D., LL. D. (professor of public health, Birmingham University): "Milk and the Public Health from the Standpoint of Communicable Disease."

Prof. H. R. Kenwood, C. M. G., M. B., F. R. S. E., D. P. H.: "The Importance of Milk as a Public Health Agent."

Doctor Seidel (Vienna): "Is Milk Only to be Regarded as Food? Or Is It Also an Important Part in the Biological-Chemical Working of Both Human and Animal Bodies?"

Mr. M. D. Munn (president of the National Dairy Council, Chicago): "Increasing Consumption of Dairy Products by Educational Methods," presented by Dr. C. W. Larson.

Mr. J. G. Stapleton (member of the National Milk Publicity Council, England): "Propaganda with Regard to the Consumption of Milk."

Dr. S. Weiss (Vienna): "New Ways to Increase the Consumption of Milk."

Mr. Shaw (Belgium): "Propaganda for the Consumption of Milk."

Dr. Moriz Ertl (former Minister of State, Vienna): "The Milk Propaganda Campaign in Austria."

Dr. Ernest Eber (Royal Economical Counsellor, Director of the Hungarian Dairy Propaganda Commission): "The Formation of a Central Office of Propaganda Organizations."

SPECIAL SECTION B

That veterinary medicine in its relation to dairy animals was much emphasized at this congress is shown by the continuance of special section B, devoted to that subject, during the third day of the congress, Friday, June 29. This session was also reported by Dr. E. B. Meigs, of the United States delegation.

The subject for discussion was "Some Aspects of the Milk Problem With Special Reference to the Need for a State Veterinary Health Service." Mr. Trevor F. Spencer, M. R. C. V. S., of Kit-

tering, England, had the principal paper on this subject. The following persons took part in the discussion: Mr. Hugh Bigg, F. R. C. V. S., county veterinary inspector, Hamilton; Mr. A. Gofton, F. R. C. V. S., chief veterinary inspector, Edinburgh; Capt. Robert Simpson, F. R. C. V. S., D. V. S. M., chief veterinary inspector, Cumberland; Major Alex. Douglas, M. R. C. V. S., D. V. S. M., county veterinary officer, Ayr; and Prof. J. Share-Jones, D. V. Sc., F. R. C. V. S.

The discussion at this session was one of the liveliest of the entire congress, again emphasizing the difference of opinion which exists, particularly in Great Britain, relative to both the effects of tuberculosis on milk supply and the steps which should be taken officially. The fact that this question has been practically settled in the United States by the general agreement in the tuberculosis eradication work which is done in a cooperative way by the Federal Government and the various States, makes this discussion of interest only in showing the struggle which is being made in other countries.

Near the close of the session a resolution was introduced to the effect that "all dairies in England should undergo routine inspection," and this was seconded. As a substitute, a compromise resolution was offered to the effect that "in the opinion of this conference, the attention of the Government should be drawn to the unsatisfactory state of the present law as applied to animals in connection with public health." Those favoring the first resolution refused to accept the substitute, and finally the original resolution was passed. The second resolution was then offered and passed as an additional resolution.

The formal papers presented at this session were as follows:

Mr. Trevor Spencer, M. R. C. V. S. (Kettering): "Some Aspects of the Milk Problem with Special Reference to the Need for a State Veterinary Health Service."

Prof. Dr. Franz Zaribnicky (Veterinary College, Vienna): "The Veterinary Control of Dairy Stables and Its Importance for the Production of Milk."

Comm. Dr. Leonardo Grassi, M. C.: "Hygienic Milk Production in Italy."

FOURTH DAY OF THE CONGRESS

The fourth day of the congress was spent in a visit to the farms owned and conducted by King George V, of England, located near his principal country residence at Windsor. Nearly the entire membership of the congress visited these two farms, one a farm devoted to the production of beef cattle, and the other to the King's dairy. An unusually fine herd of dairy shorthorn cattle was seen at the dairy farm, and the delegates were shown the dairies and the methods of handling the milk.

FIFTH DAY AT READING

On Monday, July 2, the congress was moved to the national institute of dairying, a part of the University of Reading, in the city of Reading, where the sessions on bacteriological and chemical technique were held. The report of special section C, on dairy bacteriological technique, was assigned to Dr. R. S. Breed, one of the United States delegates. Dr. R. Stenhouse Williams, professor of dairy bacteriology at the national institute for research in dairying, University of Reading, presided over this session.

Dr. R. S. Breed's paper on The Control of the Sanitary Quality of Market Milk was one of the most important papers in this section. It appears in full in the appendix.

The other papers presented at this section were as follows:

Professor Barthel (Sweden): "The Casein Splitting Properties of Starters," Porf. W. Sadler, of Vancouver, co-author.

Prof. S. Orla-Jensen (Polytechnic School, Copenhagen): "The Judgment of Milk from the Hygienic Point of View, with Special Reference to Conditions in Denmark."

Prof C. Gorini (Royal College of Agriculture, Milan, Italy): "The Identification of Acidoproteolytes."

Prof. Robert S. Breed, Ph. D. (chief for research, New York Agricultural Experiment Station, Geneva, N. Y.); "The Control of the Sanitary Quality of Market Milk."

Professor Mohr (The Dairy Research and Experimental Institute, Kiel): "Modern Methods of Laboratory Control for Milk Supply."

Professor Burri (director of the Swiss Dairy and Bacteriological Experiment Station, Berne): "The Quantitative Smear-Culture: A Simple Means for the Bacteriological Examination of Milk."

Prof. C. F. Van Oijen (hygiene laboratory, Veterinary School, Utrecht, Holland): "Methods of Testing the Cleanliness of Milk in Germany."

Dr. M. Grimes, M. Sc., Ph. D. (dairy science department, University College, Cork, Irish Free State): "A Study of the Use of the Methylene-blue (Reductase) Test in the Grading of Milk."

The list of names which appears at this session includes many of the leading bacteriologists of the dairy world, and much new information of special interest to those engaged in both the practical and educational work of the industry is found in the complete papers. Those attending the congress found both in this session, in the national institute and in other dairy schools, particularly at Kilmarnock in Scotland, very advanced work going on for the study of dairy bacteriology.

At the very close of this meeting, an interesting incident occurred which was very pleasant to the American delegates. The chairman, before adjourning, spoke of the importance of the papers which had been presented and the high standing of those who had presented them, then said:

There has been one voice silent in this room this morning; a man of the very highest distinction in the States, a man who was extraordinarily kind to those of us who went to the United States in 1923; I refer to Doctor Rogers of Washington. [Applause]. I would like you to know what a great pleasure it is to all of us in this country to see him here.

SIXTH DAY OF THE CONGRESS

The work of the sixth day, also held at the national institute for research in dairying at the University of Reading, was special section D, dairy chemical technique. The presiding officer of this session was Prof. Renwick H. Leitch, professor of dairying at the West of Scotland Agricultural College. This was the only section of the congress in which there was no paper by a representative of the United States. The reporting of this session was assigned to Dr. L. A. Rogers, one of the members of the United States delegation.

Devoted entirely to the technical chemistry of milk, it was of interest to find that most of the papers and discussions had to do with the use of the determination of freezing point as a method of detecting adulteration. The opening paper by Mr. Harold T. Cranfield, advisory chemist of the Midland Agricultural and Dairy College, was an instructive review of the difficulties in the way of chemical determination of abnormal and adulterated milk. Then followed two or three papers discussing the use of the freezing point as a means of detecting adulteration.

The paper by J. H. Buchanan and O. E. Lowman developed the fact that the freezing-point determination for added water would not be invalidated if the water added contained mineral matter in the proportions ordinarily found in hard water. In the discussion at this session it was developed that holding samples for as long as 50 hours at room temperature does not affect the freezing-point determination. Feed is not an important factor in affecting the composition of milk, but the solids-not-fat may be varied by a combination of abnormal conditions. The seasonal variation is important and the solids-not-fat may be affected by an abnormal secretion.

In Europe the tendency is to control the milk by the detection of adulteration, while in the United States the composition is maintained by minimum standards and by paying for milk on the basis of its fat content.

Two of the subsequent papers discussed the use of the refractometer in determining added water in milk.

Dr. C. H. Eckles, of the University of Minnesota, St. Paul, summarized the experience of the United States dairy industry in this matter of using chemical methods to determine adulteration, by pointing out that although the invention of the methods which had

been under discussion is to be credited to Doctor Howarth, of Minnesota, the method is apparently not used in the United States. He explained that, in the first place, we do not have much occasion to detect adulterated milk because our laws fix a minimum fat and a minimum of total solid contents, so that it is illegal to sell milk below these standards even if it is pure natural milk; and, in the second place, that long series of investigations in the United States concerning factors which affect the composition of the various constituents of milk seem to show that feed is not a factor of any particular significance.

The chairman expressed particular thanks to Doctor Eckles for his contribution to the discussion, and expressed the wish that English legislators had the courage of the legislators of Minnesota and of the United States to lay down an absolute standard.

The speakers at this session and the papers presented were as follows:

Mr. Harold T. Cranfield (advisory chemist, Midland Agricultural and Dairy College): "Natural Variation in the Composition of Milk, and the Difficulties Encountered in Distinguishing Between Abnormal and Adulterated Milk."

Dr. J. D. Filippo (Holland): "The Freezing Point of Milk," read by Doctor Van Raalte, of Holland.

Mr. J. H. Buchanan and Mr. O. E. Lowman: "The Freezing Point of Milk as a Means of Detecting Added Water," read by Mr. J. Wood.

G. D. Elsdon, B. Sc., F. I. C., and J. R. Stubbs, M. Sc., F. I. C. (Liverpool): "The Value of the Refractometer in Milk Analysis."

Mr. John Hanley: "Appreciation of the Refractometer Test."

Dr. L. Bem (Budapest): "The Ash and Non-Fatty Solids Content, the Specific Gravity and the Determination of the Refractive Index of the Calcium Chloride Serum in Individual Samples of Milk."

SESSIONS IN SCOTLAND

July 4, the American national holiday, was spent by the delegates to the World's Dairy Congress on a most interesting journey on specially arranged extra sections of the "Flying Scot," said to be one of the finest trains in all England if not in the world, en route from London to Edinburgh, Scotland. The journey took the congress through some of the most interesting agricultural and manufacturing districts of Great Britain, through cities and villages of historic interest, through the great industrial center of western England, across the lowlands of Scotland and, just as darkness fell, within sight of the Scottish Highlands and into the wonderful and historic old city of Edinburgh.

The sessions of the congress in Edinburgh were brief but most interesting. Music Hall, on George Street, was the place of the

conference, almost in the shadow of the walls of old Edinburgh Castle. Maj. Walter Elliott, Undersecretary of State for Scotland, presided in place of Sir John Gilmour, Secretary of State for Scotland, who was unavoidably detained. The chairman's opening address was a word picture of the agriculture of Scotland, a revelation to most of the delegates as to the energy, thrift, and success of the agriculturists of this part of Great Britain.

The first paper of the Edinburgh conference was another of the outstanding contributions to the literature of milk consumption. Its subject was Milk Consumption and the Growth of School Children: A Test in Scottish Schools. It was presented by Dr. Gerald Leighton, prepared by J. B. Orr, D. S. O., M. C., M. D., D. Sc. (Glas.), chairman of research committee of Scottish Milk and Health Association; Gerald Leighton, O. B. E., M. D., D. Sc., F. R. S. E., medical officer (foods), Scottish Board of Health; Sir Leslie MacKenzie, M. D. LL. D., chairman, investigation committee; Miss M. L. Clark, statistician.

The paper gave the details of results of adding milk given to the children in a number of schools in several cities in Scotland as a part of the school luncheon. Its importance was due to the long time covered and the large number of children, and the fact that identical feeding occurred in seven different cities. Children from 5 to 6 years all receive three-fourths of a pint each school day; from 8 to 9 years, 1 pint; from 13 to 14 years, 1¼ points. One group received whole milk, a second group received separated milk, a third group received an amount of biscuit calculated at the same energy-equivalent as the amount of separated milk, and a fourth group was used as a control, and received no supplementary feeding. The milk was given at the schools under supervision.

Attached to the paper was a complete tabulation of results; they were summarized, however, in the following four statements:

1. In height the children who received whole milk or separated milk are significantly better than those who received biscuit or the "controls," at all ages.

2. In height the children who received biscuit tend to be significantly less than the "controls" at the ages of 5 to 13 years.

3. In weight the children receiving whole or separated milk are significantly better than those receiving biscuit or the "control" groups at 5 years and at 8 years old. At 13 years old no results are quite significant but the children receiving whole or separated milk are better than those receiving biscuit.

4. In weight the children receiving the biscuit are almost significantly better than those in the "control" groups, but at 5 years old they are almost significantly worse. This suggests that the biscuits tend to depress the increase in both height and weight at the ages of 5 years and 13 years, the two periods of most active growth.

Dr. E. B. Meigs, of the United States Department of Agriculture, took part in the discussion at this point by commenting upon the apparent importance which had been given to separated milk, that is, milk without cream, in these tests. His discussion is of such general value that it is copied here in full:

Mr. Chairman, ladies and gentlemen, I was very much impressed, especially by the difference between separated milk and whole milk. It is probably going very much in the right direction, but I think a word of warning ought to be issued here against the supposition that skimmed milk is really just as good a food as whole milk. We must remember that these children were observed only over a short period and only one criterion of the effect of the food was observed, that is to say, the growth. I suppose it would raise some opposition to go from experiments on children to experiments on rats, but we can do with rates certain things which we can not do with human beings, and very interesting experiments were conducted in the United States on the effects of skimmed milk as a whole source of vitamin A compared with whole milk in the case of rodents. The diet of one set of rats was made up of skimmed milk powder and whole wheat, and that of another set whole milk powder and whole ground wheat. The rats who got the latter compound have been able to reproduce perfectly normally; in other words, that is a complete diet for rats. In the case of the rats that got the skimmed milk powder and whole ground wheat, one of the sources of vitamine A was cut out. The average life was reduced to less than half what it was in the other set of rats and the reproduction was not successful at all, so that as far as the life of the colony was concerned, it was reduced to perhaps one and a half generations. There are not lacking human results to the effect of rations which are low in the butter-fat vitamin; that is, the A vitamin. On this subject we have the work of Bloch, of Denmark, who found that during certain periods of the war when all the butter in Denmark was being exported to other countries the result was the prevalence of an eye disease in children which is a well-known result with rat experiments from lack of the A vitamin. This disease was cured very easily by adding butter to the diet and when the conditions were taken away and less of the butter was exported, the incidence of the disease became very much less, so that although the question of how far skimmed milk can be substituted for whole milk in the diet of children is, of course, a very necessary and important one, it ought to be recognized. I think that there are limits to this and that before drawing any very wide conclusions much more careful work ought to be carried out.

The session closed with an interesting and detailed statement on the Scottish milk-selling agency, otherwise known as the Scottish milk pool, presented by Mr. A. E. Magee; a very interesting experience in dairy cooperation which parallels, in many respects, the most successful cooperatives in the United States.

The papers presented at this session but not read were:

Prof. Ch. Porcher (Veterinary School, Lyons): "Casein."

Prof. Dr. Otakar Laxa (director of the Lactological Institute, Prague): "The Discoloration of Commercial Casein."

VISIT TO THE TROSSACHS

The afternoon of July 5 was spent in visiting milk plants, and manufacturing enterprises in the city of Edinburgh and dairy farms near by. The following morning the entire party was taken on a most delightful sight-seeing trip through the Trossach section of Scotland, including the Loch Katrine and Loch Lomond made famous by Sir Walter Scott, reaching Glasgow late in the evening.

SESSION IN GLASGOW

No formal session of the congress was held in the city of Glasgow but a reception was given the delegates at the Glasgow city hall on the evening of their arrival, presided over by the right honorable the lord provost of Glasgow, Sir David Mason, O. B. E. At this final meeting at which all the delegates of the congress were together, an address was made by Hon. Rennick W. Dunlap, Assistant Secretary of the Department of Agriculture of the United States, chairman of the official delegation, and by Dr. H. E. Van Norman, honorary chairman of the delegation. In concluding his address Mr. Dunlap offered the following resolution which had been prepared and adopted by the delegates of the United States, expressing their acknowledgement of thanks and appreciation for the work of the congress:

Resolved, That the delegates representing the United States of America, for our country, our industry, and ourselves, express in this formal way our appreciation of the privilege of participating in the proceedings of the Eighth International Dairy Congress.

Our acknowledgments are due to the dairy industry of Great Britain, and to their organizing committee, and other representatives who, under the patronage of their sovereign, His Majesty King George, have in this congress marked a new, long step in advance in the economic and scientific position in our industry.

We wish to thank the officials of His Majesty's Government in England and Scotland, and the officials of the municipalities of London, Reading, Edinburgh, and Glasgow, for the honors they have shown the congress, and to thank the people of those cities, and of all Great Britain, for many courtesies and splendid entertainment.

From the ladies of our party there is also an expression of sincere thanks for entertainment and many kindnesses.

We in the United States know the value of conferences and conventions in the advancement of knowledge, and still more in the increase of friendship and good will between all sections of our people. In this great congress it is our experience and our belief that a fine spirit of international understanding and international good will has been developed by this meeting of the delegates of more than 40 nations which will have far-reaching beneficial results. We also wish to call to the attention of all people the added knowledge which has been announced at this congress concerning the value of dairy products as human food, a protection and improvement of human health. We are sure that the dairy industry of the world has been very fortunate and greatly benefited by the prominence given this subject in the program and the work of the congress. The leadership of the congress, and the work it has done, have our highest commendation.

MANY TRIPS AND ENTERTAINMENTS

The delegates to the World's Dairy Congress were accorded many social functions, and no record of the proceedings of the congress would be complete without reference to some of the events and the hospitality extended on every hand.

On Tuesday, June 26, a luncheon was given by the British Government to the members of the International Dairy Federation, presided over by the Right Hon. Walter Guinness, M. P., Minister of Agriculture and Fisheries. This was followed in the evening by a reception by the Right Hon. A. N. Chamberlain, M. P., Minister of Health, on behalf of the Government at Lancaster House, when over a thousand delegates were in attendance.

On Wednesday evening, June 27, all members of the congress were invited to a reception at Guild Hall, Old City of London, given by the lord mayor and lord mayoress. These dignitaries assisted by the full staff of the lord mayor's government were gracious hosts, and provided an elaborate entertainment of music and dancing, enjoyed by one of the largest assemblages of the entire congress sessions.

On Thursday evening, June 28, the committee responsible for the organization of the congress, arranged a reception of the delegates at the Crystal Palace, together with supper and musical entertainment, followed by an interesting display of fireworks. About 1,200 delegates were at the Crystal Palace that night.

Many dairy farms, breeding establishments, and London city dairy plants were visited by the delegates during the time of their stay in London, and special honors were constantly shown the visitors. Special trips were arranged and carried out by the management of the congress.

The social functions included a luncheon to all the lady delegates and the wives and daughters of delegates, on Friday, June 29, at the Cafe Royal, when Lord Desborough, chairman of the congress committee, presided. In the evening a dinner was given by the British Government to the official delegates at the Whitehall rooms, at which the Right Hon. Walter Guinness, Minister of Agriculture and Fisheries, presided.

On Sunday, July 1, Mr. and Mrs. Titus Barham were "at home" at their charming home at Sudbury Park, and extended a cordial welcome to the delegates and members attending the congress. This invitation was accepted by a large number of the delegates, who visited this certified dairy and breeding establishment and spent a most enjoyable afternoon at the beautiful and hospitable home.

The vice chancellor of the Reading University gave a reception on the evening of July 2. On the evening of July 3, the British

Dairy Farmers' Association gave a dinner to the official delegates to the congress and guests, at the Holborn Restaurant. Lord Desborough, as president of the British Dairy Farmers' Association presided.

The delegates left London for Scotland on July 4, and on the evening of the 5th a civic reception was given to the delegates by the city of Edinburgh, when the lord provost welcomed the delegates to the capital of Scotland.

On July 6 the delegates had a most enjoyable journey through the Trossachs to Glasgow, where in the evening there was a civic reception by the lord provost and the corporation of the city.

On Saturday, July 7, the delegates visited Kilmarnock Dairy School and the Burns country, and the great Ayrshire dairy section in County Ayr. Tea was most kindly provided by the chairman of the Scottish committee and his wife, Col. and Mrs. W. T. Houldsworth.

On Sunday, July 8, the delegates returned to England, and while some visited the Lake district, others came direct to London.

From Tuesday, July 10, to Saturday, July 14, the Royal Agricultural Society's show was held at Nottingham, where in a building covering an acre of ground was brought together one of the most complete collections of dairy appliances ever seen. The exhibition was visited on Wednesday by their majesties, the King and Queen, who expressed great interest in all they saw, and their delight that the congress had been a success.

On Thursday, July 12, those delegates who were able, paid a visit to the city of Birmingham, and after seeing some of the larger dairy plants in the city during the forenoon, were entertained by the lord mayor at a luncheon. In the afternoon a visit was paid to Messrs. Cudbury Bros. Bournville Factories, and this brought to an end the World's Dairy Congress of 1928.

ROYAL AGRICULTURAL SHOW AT NOTTINGHAM

Most of the delegates from the United States, after the ending of the sessions of the congress at Glasgow, accepted the invitation of the organizing committee and spent a day or two at the Royal Agricultural show held in 1928 at Nottingham, one of the fine industrial and residential cities of the midland country of England.

This was a great agricultural and industrial fair, on a par with the annual fairs held in any great agricultural State in the United States. In honor of the World Dairy Congress a large pavilion had been erected for the display of dairy machinery—first time, we were told, that such a special exhibit had ever been made.

In this dairy machinery pavilion a rest and reception room was provided for all delegates of the World Dairy Congress, and in this room the King and Queen held a brief reception on the day set apart as special World Dairy Congress day. Afterward the King and Queen and their party made careful inspection of the modern dairy machinery on exhibit. A number of important exhibits were of American machinery. Several other countries outside of Great Britain were also represented with interesting exhibits.

At this machinery show as well as in milk plants visited, note was taken both of the amount of American machinery which was in use, and of the close relationship between the American machines and those made in Great Britain. It was apparent that the mechanization of the milk industry has not proceeded as far in any European country as in the United States, and that along with the development of their machinery, on new and original lines, there was also large use made not only of the American machinery, but of machines closely following the American patterns and designs.

Many other types of machinery were shown at this show, especially farm machinery used in handling the very large root crops produced in Great Britain for cattle feed and handling their very large hay crops. With a climate in which there is much more rainfall than in most parts of the United States, the problem of properly conserving the hay crop, and handling it with the greatest economy of hand labor, is a large one and it had apparently led to the development of machines for raking, tedding, drying, and handling hay practically unknown in the United States.

The point of largest interest for the United States visitors at this show was the livestock show. All breeds of animals produced in Great Britain were shown, and beside the dairy cattle show there was a very full showing of horses, beef cattle, sheep, and swine. The dairy cattle exhibit, said to be one of the best ever brought together at a royal show, was reported for this report by A. L. Haecker, one of the official United States delegates.

DAIRY CATTLE EXHIBITS AT NOTTINGHAM

DAIRY SHORTHORN

There were 247 entries in this class, 112 of which were bulls and 125 females. First prize aged bull, Anderson Champion Bates, was exhibited by Robert M. Troy, and the first prize aged cow, Greenleaf 78th, was exhibited by Lawrence Hignett.

Milk-production requirements are made for all cows and heifers 4 years old and over, as follows:

For aged cows 5½ years old and over, the production of 8,000 pounds of milk during a lactation period of 315 days is required.

For cows 5 years old, a production of 6,500 pounds of milk during a lactation period of 315 days is required.

For cows 4 years old, a production of 5,500 pounds of milk during a lactation period of 315 days is required.

This requirement brings into the ring a large number of cows having already made good record in production.

The exhibit in total was excellent and demonstrated the fact that England has been for many years breeding shorthorns that have strong milking tendencies.

Shorthorns in this show were divided into three classes:

1. Shorthorns in the beef class.
2. Dairy shorthorns.
3. Lincolnshire Red Shorthorns.

The Lincolnshire Red Shorthorns are classed as dual purpose but the breed does not require the dairy production records that are made for the dairy shorthorn class. There were 79 entered in the Lincolnshire Red Shorthorn exhibit, and some very excellent animals were shown.

BRITISH FRIESIAN

There were 174 entries of this breed, and some very fine herds and animals were shown. The first prize aged bull, Hache Buringa, was exhibited by Edward Hollingsworth, and the first prize aged cow, Terling Lead 18th, was exhibited by Lord Rayleigh.

This breed is practically identical to the Holstein Friesian breed of the United States, but as a class, the animals on exhibit carried more flesh.

In milking qualities and type they would compare well with Holstein Friesian cattle shown at the fairs in the United States. The milk and butter production made by the individuals does not run as high as the records of the cows shown in America. More attention is probably given here to producing big records than is given in England.

JERSEY

There were 121 entries in this breed. The first prize aged bull, North Stokes Beechnut, was exhibited by Sir Harold Mackintosh, and the first prize aged cow, Cowdray Pioneer 11th, was exhibited by Haydon Stephen Fox.

The Jersey exhibit would compare very well with some made at any one of our large shows or fairs. No particular requirement is

made as to milk record or color markings of the individual. In size, type, and milking qualities they are practically identical to the best strains of Jersey cattle bred in the United States.

The first prize 4-year-old Jersey cow, Watton May Moon, exhibited by Mrs. Evelyn, was a splendid animal of very excellent type and dairy conformation. This animal was fawn and white in marking, but showed a highly developed dairy quality.

GUERNSEY

There were 116 entries of this breed. The first prize aged bull, Downe Valentines Honor of Bimiera, was exhibited by Sir Eric Hambro. The first prize aged cow, Jane of Tregonning 7th, was exhibited by George Blight & Son.

As an exhibit, the Guernsey cattle were not quite as good in type and milking quality as compared to what we generally find at our shows in the United States, but some very fine animals were shown. The first prize 4-year-old cow, Calehill Dewdrop, exhibited by A. Chester Beate, was a most excellent animal, being of excellent conformation and showing spendid milking qualities.

Some defects as to type were noticeable, such as drooping rumps and cut-up front udders. This breed, however, is making excellent progress and becoming more popular, due to the high color of the milk and cream.

AYRSHIRE

There were 29 entries of this breed. The first prize aged bull, Dunlop Radiance, was exhibited by Col. W. T. Houldsworth, and the first prize aged cow, Mid-Kelton May 4th, was exhibited by Alfred Barclay.

The exhibit of Ayrshire cattle at the show this year was unusually light, due, no doubt, to the fact that many shows were in progress in Scotland at that time. The few animals exhibited were of a very good class and would compare most favorably to our best exhibits in this country. The animals all seemed to carry considerable flesh, which was noted in all the breeds exhibited both in the dual purpose and dairy sections.

KERRY

There were 53 entries of this breed. The first prize aged bull, Valencia Shah, was exhibited by Kerry Estate (Ltd.), and the first prize aged cow, Valencia Sunflower, was also exhibited by the Kerry Estate (Ltd.). This small dairy breed originating in Ireland, is becoming more popular in the British Isles and the exhibit in total was a very excellent one. Some cows were exhibited which had a very good record of butter and milk.

DEXTER

There were 41 entries in this class. The first prize aged bull, Ratcliff Belberry, was exhibited by Sir Arthur Wheeler Bart; and the first prize aged cow, Grimstead Tropoleim, was exhibited by Lady Loder. The Dexter cattle are also a small breed and show marked dairy development.

RED POLLS

There were 66 entries of this breed. The first prize aged bull, Gaddesby Gauntlet, was exhibited by E. and B. Moore; and the first prize aged cow, Litchfield Red Gauntlet, was exhibited by the same breeders. The Red Polls in England, as in this country, are a dual purpose breed. The exhibit was a very good one and compared with our best exhibits of this country. The animals carried considerable flesh, but the cows in milk also showed a marked dairy development. As an exhibit, they seemed to show more size than many of the Red Polls exhibited in the United States. The mature animals were especially long of body and well covered with flesh.

The crossing of breeds is practiced more in the British Isles than in the United States, and many comments are made as to the merits of crossing one breed with another or with the shorthorn, which is the most numerous in England. Much care is taken in the placing of rewards and on the whole, the judging was of high order.

The exhibits in all of the breeds showed more mature animals and fewer calves and young stock than the exhibits of our fairs and shows. This, no doubt, is caused by the classification which divides animals of the aged class, and gives less money and classes for young animals.

In England much interest is taken in the breeding of pure-bred stock, and the catalogue of entries shows the winners for past years. In some classes the winnings are shown for a period of five years. This is an encouragement for breeders to continue their exhibits for a series of years.

The prizes given are liberal and in some classes run to fifth place, also reservation, highly commended, and commended.

RESULTS AND CONCLUSIONS

It has been generally recognized that Great Britain has held a strong position in respect to the development of improved livestock of all classes for many years. Their livestock on the whole is of excellent quality and their herds contain few animals of poor quality. While representatives of practically all dairy breeds known to-day are to be found in England, the vast majority of the cows used for

milk production are termed milking shorthorns and may be classified as a dual-purpose breed. On practically all the farms visited in England, this breed of cattle predominates. The average production of shorthorns in England is said to be about 7,000 pounds of milk per year and a test of 3.6 per cent butterfat.

An important factor in the leadership of the British in the development of the various breeds of cattle and other livestock is the flexible system which they use in the selection and improvement of their registered cattle. The British cattle herd book societies or associations, with few exceptions, allow the farmer or breeder to start with grade or unregistered cattle, and after making from three to five top crosses with registered sires the offspring are eligible to registry in the herd books. The rules of practically all American herd book societies require that all animals eligible for registry must come from parents that are now registered and their ancestry must trace back to the country from which the particular breed was imported. The American breeder does not have the same freedom of making use of any individual merit possessed by an animal that is not registered in the herd books. This ruling of the British herd book societies is claimed to explain, at least in part, why the British Isles have developed great breeders and great breeds of cattle and other livestock

The farmers of England and Scotland were observed to be splendid caretakers and feeders and particularly concerned about the pasture for livestock. Much effort is being put forth by farmers and breeders as well as by the leaders in the agricultural experiment stations to build up their pastures and get the most out of them. On several farms and at the West of Scotland School of Agriculture a system of rotational pasture is being followed, with good results. The plan as followed at the West of Scotland School at Kilmarnock serves as an illustration: Sixty-five cows were pastured on 42 acres of grass land. The 42 acres of land were divided into 7 fields of 6 acres each. The 65 cows were turned on one field and allowed to remain there for four days. Then they were turned on the next field for four days and so on until they had spent four days on each of the seven pastures. Every 28 days they completed the rotation system. As soon as the cows were turned off each pasture, it was harrowed with a spike-tooth harrow in order to scatter the droppings, then an application of commercial fertilizer was made. By this system of rotation the production of milk amount to 5,000 pounds of milk per acre per year, as compared with the average production, under the ordinary system of 1,000 pounds per acre. Another advantage was the possibility of turning the cows on grass earlier in the season and keeping them on it later in the season. The rotational grazing plan also provides a richer feed, since the short grass con-

tains a higher per cent of protein more nearly comparable to the grain concentrates. From May 9 until July 9 at the time the congress met, the pasture had furnished the entire ration for all cows except those that produced more than 60 pounds per day. Cows giving more than this amount received some grain. It was evident on every hand, particularly in Scotland, that the farmer is fertilizing his pastures because he realizes the importance of obtaining the maximum feed for his cows from this source.

At one of the experiment stations, investigations were being carried on in cutting, drying, and the feeding of immature grass. Grass was being cut, dried, and pressed into brick form and it was claimed that this dry brick cake containing approximately 30 per cent protein can be substituted for high protein concentrated feed such as oil-meal cake.

Papers and discussions during the sessions of the congress, as well as the observations made by members of the delegation in various parts of Great Britain and Ireland, show a great development there in the use of milk in the diet, and in methods of handling and distributing milk. Pasteurization, bottling, and use of motor delivery have made marked progress. The use of new types of machinery in the milk handling and distribution industry is increasing and attracting great attention. Much interest was displayed in methods of increasing the use of milk in the homes and in public eating places. The results of using dairy products in diet are being made known very effectively by a milk publicity council, and by organizations in the medical profession.

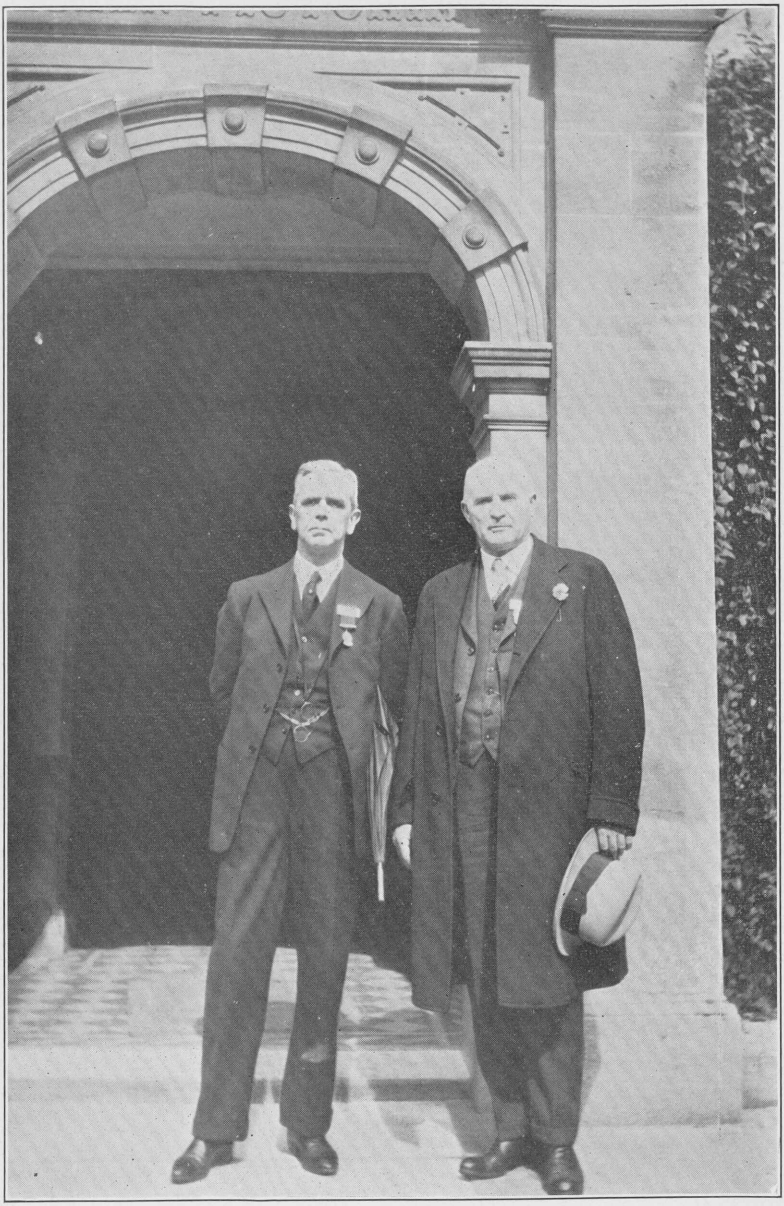
Many differences between the dairy industry in the United States and in Great Britain and many conditions, climatic and otherwise, which underlie most of these differences, were observed. Cheese manufacture is still quite generally a home industry, and there are many kinds of cheese of very high quality. There is much less use of milk as a beverage and still less use of ice cream in Great Britain than in the United States. Moister and cooler climate is one reason for this smaller consumption. The areas in which butter and cheese have heretofore been principal products are now going through the change which has already been experienced in many areas in the United States, a change to the production of milk for fluid consumption and the gradual elimination of butter and cheese making.

Only in the fluid milk industry did the mechanization of the industry seem to have made special progress. In this branch, many milk-handling machines and labor-saving machines were found in successful operation, some of American make, some of American types adapted by foreign makers; some of other European make, and some of strictly British design and manufacture. One new British machine, a combined pasteurizer and cooling machine, occupying a small

floor space, but of high capacity and unusual efficiency, attracted much attention.

In both public and private discussions, it was found that many of the problems faced by the American dairy industry—necessity for disease control, both for public health protection and the best economic interests of the industry, labor problems, and the problems of adjusting relations between the producer, the distributor and the consumer—have their counterpart in Great Britain, and to a greater or less extent in the dairy industry wherever it exists in specialized form in the other countries taking part in the Congress.

The contributions made through this Congress to the world's dairy industry, which seem to us to have the greatest value, were those relating to increasing the efficiency of the dairy cow, the organized methods of bringing to general knowledge the full value of dairy products in the diet of the human race, the economic and health importance of the control of animal diseases, the progress of sanitary science, especially the practice of pasteurization, the progress made in mechanization of the industry, the contribution of cooperative marketing organizations to the economics of the industry, and the development of the dry-milk industry as a means of conserving most valuable by-products which have been subject to great economic loss and waste.



Arthur D. Allen, Esq., O. B. E., Organizing Secretary, World's Dairy Congress, and Hon. R. W. Dunlap, Chairman, U. S. Delegation to the World's Dairy Congress

APPENDIX

DELEGATES FROM THE UNITED STATES ATTENDING THE WORLD'S DAIRY CONGRESS, 1928

Names	Addresses	Representing—
Abedor, Miss F. R.	6215 Eberhart Avenue, Chicago, Ill.	
Adams, A. S.	221 South Ninth Street, Reading, Pa.	
Adams, D. S.	do	International Association of Milk Dealers.
Adams, T. A.	do	
Bailey, E. M.	President American Dairy Federation, Pittsburgh, Pa.	United States Government.
Bailey, Mrs. E. M.	American Dairy Federation, Pittsburgh, Pa.	
Balderston, R. H.	Flint Building, 219 North Broad Street, Philadelphia.	Philadelphia Inter-State Dairy Council.
Bayard, E. S.	7301 Penn Avenue, Pittsburgh, Pa.	
Becker, Miss B.	372 St. Johns Place, Brooklyn, N. Y.	
Behm, C. S.	221 South Ninth Street, Reading, Pa.	
Blair, J. R.	14 Centre Street, Cambridge, Mass.	
Blair, Mrs. J. R.	do	
Borland, Prof. A. A.	Pennsylvania State College, State College, Pa.	United States Government and Pennsylvania State College.
Borland, Mrs. A. A.	304 South Burrow Street, State College, Pa.	
Breed, Dr. R. S.	New York State Exposition Station, Geneva, N. Y.	United States Government and State of New York.
Brooks, Miss J.	Cheltenham, Pa.	
Brooks, P. B.	Deputy commissioner of health department of health, Albany, N. Y.	
Brooks, Mrs. P.	Department of health, Albany, N. Y.	
Brooks, jr., P. L.	do	
Brown, C. A.	Wyandotte, Mich.	
Bull, H.	Secretary Dairymen's League, Campbell Hall, Orange County, N. Y.	United States Government.
Burke, A. D.	Box 105, Stillwater, Okla.	Oklahoma Agricultural College.
Caine, Prof. G. B.	Utah Agricultural College, Logan, Utah.	United States Government.
Carpenter, Dr. D. C.		
Carpenter, Mrs. D. C.		
Cherry, W. L.	Messrs. J. G. Cherry Co., Cedar Rapids, Iowa.	
Christensen, Hon. T.	Red Lake Falls, Minn.	
Compton, Miss M.	1965 Santee Street, Los Angeles, Calif.	
Cooke, E. L.	White Springs Farm Dairy Co., Geneva, N. Y.	
Coppini, J. W.		Pacific Slope Dairy Show Association.
Cowley, Miss I.	Winthrop, Mass.	
Dahle, Prof. C. D.	State College, Pa.	
Davis-Joel, jr., B.	Philadelphia, Pa.	
Donnell, F. L. O.	Portland, Oreg.	
Donnell, Mrs. F. L. O.	do	
Dorman, D. M.	President the California Dairies, Los Angeles, Calif.	United States Government and State of California.
Dunlap, Hon. R. W.	Assistant Secretary of Agriculture, Washington, D. C.	United States Government.
Dunlap, Mrs. R. W.	Washington, D. C.	
Dunn, W. J.	2 Lawrence Road, East 13.	
Dunton, A. J.	27 Burgoyne Road, South Norwood SE.	
Van Dyke, Prof. J.	82 Superior Road, Bellerose, New York.	Pennsylvania State Dairy Science Association.
Eaton, Mrs. A. K.	Lowlands Road, Harrow.	
Eckles, Prof. C. H.	University of Minnesota.	State of Minnesota.
Eckles, Mrs. C. H.	Minnesota.	
Ewing, jr., C. O.	981 Third Street, Louisville, Ky.	State of Kentucky.
Fitch, Prof. J. B.	Agricultural Experiment Station, Manhattan, Kans.	United States Government and Kansas State Agricultural College.
Fitch, Mrs. J. B.	Manhattan, Kans.	
Fitts, E. B.	State College, Pa.	Pennsylvania Dairymen's Association.
Fitts, Miss G. E.	do	
Foley, E. A.	6 Grosvenor Gardens SW.	U. S. Department of Agriculture.

Delegates from the United States attending the World's Dairy Congress, 1928—Continued

Names	Addresses	Representing—
Fox, M. E	Chicago, Ill	
Frampton, G. R	President California Dairy Council	California Dairy Council.
Frandsen, Prof. J. H	Massachusetts Agricultural College, Amherst, Mass.	Commonwealth of Massachusetts.
Fuller, Prof. J. M	University of New Hampshire, Durham, N. H.	
Gamalielson, J. E	Hilo, Box No. 705, Hawaii, T. H	
Gamalielson, Mrs. J. E	do	
Gardiner, R. St. J	Venice, Calif	
Gardiner, Mrs. R	6001 Gramercy Place, Los Angeles, Calif	
Gilbert, Miss M. A	Newington Junction, Conn	
Glover, A. J	Editor Hoards' Dairymen, Fort Atkinson, Wis.	United States Government.
Glover, Mrs. A. J	Fort Atkinson, Wis	
Godfrey, J. H	Chicago, Ill	
Godfrey, Mrs. J. H	do	
Gowen, Dr. J. W	Rockefeller Institute for Medical Research, Princeton, N. J.	State of New Jersey.
Greene, S. H	Secretary-manager, California Dairy Council.	California Dairy Council.
Griffin, jr., A	Lockwood, Ohio	Ohio State Vocational Agriculture.
Griscom, W. B	Thirty-first and Chestnut Streets, Philadelphia, Pa.	
Griscom, Mrs. W. B	do	
Haecker, A. L	Secretary Allied State Creamery Association, Lincoln, Nebr.	United States Government.
Hagstrom, E	Oakland, Calif	California Dairy Council.
Hansen, J. P. J	Bowman Dairy Co., Chicago, Ill	State of Illinois.
Harding, H. A	Mathews Industries (Inc.), 685–687–689 Mullet Street, Detroit, Mich.	
Harmon, Dr. F. S	Ohio Guernsey Breeders' Association, Cleveland, Ohio.	United States Government.
Hepburn, N. W	206 Parkside, Peoria, Ill	Peoria Creamery Co.
Hill, C. L	Rosendale, Wis	
Holt, T	Commissioner, 257 Capital Avenue	State of Connecticut.
Hood, jr., G. H	494 Rutherford Avenue, Boston, Mass	Commonwealth of Massachusetts.
Horton, Mrs. M. A. B	22 Long Meadow Road, Yonkers, N. Y	
Hucker, Dr. G. J	State Agricultural Experiment Station, Geneva, N. Y	New York State College of Agricultural and Home Economics.
Hunziker, Miss F	La Grange, Ill	
Hunziker, Miss I	do	
Hunziker, O. F	Blue Valley Creamery Co., Chicago, Ill	United States Government.
Jeffers, H. W	Walker-Gordon Laboratory Co., Plainsboro, N. J.	United States Government.
Jewell Miss I	Mt. Vernon, Ohio	
Johnson, W. L	Floyd Milk Co., 110 Buchanan Street, Winthrop, Mass.	
Jones, F. S	Rockefeller Institute, Princeton, N. J	
Jordon, O. S	President Dairy and Ice Cream Machinery and Supplies Association, New York, N. Y.	Do.
Kasper, P. H	Bear Creek, Wis	Do.
Kaupisch, H. W	Portland, Oreg	
King, Dr. C. L	Westchester, R. H., Pa	
Knudsen, T. R	1965 Santee Street, Los Angeles, Calif	
Larson, Dr. C. W	President National Dairy Council, 910 South Michigan Avenue, Chicago, Ill.	Do.
Lipman, J. G	Rutgers University, New Brunswick, N. J.	Do.
Little, R. E	228 North La Salle Street, Chicago, Ill	
Lockhart, Miss A. L	31A Duttenhofer Building, Cincinnati, Ohio.	
Loomis, A. M	American Dairy Federation, Washington, D. C.	Do.
Loomis, Mrs. A. M	Washington, D. C	
Loomis, Miss Lura D	do	
McEwen, W. R	Cedar Rapids, Iowa	
McInnerney, T. H	President National Dairy Products Corporation, 120 Broadway, New York, N. Y.	Do.
McKenzie, F. F	College of Agriculture, Columbia, Mo	University of Missouri.
McKenzie, Mrs. F. I	do	
Marcussen, W. H	110 Hudson Street, New York, N. Y	
Martin, Prof. W. H	Agricultural Experiment Station, Manhattan, Kans.	Kansas State Agricultural College.
Meigs, Dr. F. B	United States Department of Agriculture, Washington, D. C.	United States Government.
Merrell, O. E	Syracuse, N. Y	
Meyer, G. J	Milwaukee, Wis	

Delegates from the United States attending the World's Dairy Congress, 1928—Continued

Names	Addresses	Representing—
Mickle, J. D	State food and dairy commissioner, Portland, Oreg.	United States Government.
Milk Plant Monthly	327 South La Salle Street, Chicago, Ill	
Miller, Judge J. D	President National Cooperative Milk Producers Federation, 12 West Forty-second Street, New York, N. Y.	Do.
Miller, R	Maeon, Mo	State of Missouri.
Morley, L. W	324 West Twenty-third Street, New York, N. Y.	State of New Jersey American Jersey Cattle Club.
Myers, R. P		Cornell University.
Nafis, Dr. L. F	Chicago, Ill	
Neumeister, Mrs. E	Milwaukee, Wis	
Neumeister, Miss W	do	
Van Norman, Dr. H. E	160 La Salle Street, Chicago, Ill	United States Government.
O'Donnell, Mrs. F. C	Poetland, Oreg	
Olsen, H. P	501 Cherry Street, Milwaukee, Wis	
Olsen, L. S	do	
Olsen, L. S	1441 Farwell Avenue, Milwaukee, Wis	
Olsen, Mrs. L. S	do	
Osgood, C. P	Augusta, Me	
Pashkow, A. D	415 Beethoven Place, Chicago, Ill	
Pearson, C. H	170 Huntingdon Avenue, Buffalo, N. Y	
Peck, Dr. G. B	Beaumont Dairy Co., Chicago, Ill	State of Illinois.
Pellissier, F. F	Whittier, Calif	Los Angeles Creamery.
Pellissier, L. R	do	
Pellissier, Mrs. L. R	do	
Pellissier, R. E	do	
Potts, R. C	Chief dairy marketing division, B. A. E., U. S. Department of Agriculture, Washington, D. C.	United States Government.
Rahn, O	Ithaca, N. Y	Cornell University.
Rasmussen, F	Secretary International Association of Ice Cream Manufacturers, Harrisburg, Pa.	United States Government.
Rector, E. T	President Fairmont Creamery Co., Omaha, Nebr.	Do.
Reed, Prof. O. E	Michigan Agriculture College, East Lansing, Mich.	Do.
Roadhouse, Dr. C. L		Pacific Slope Dairy Show Association.
Robertson, Dr. A. H	Agriculture Experimental Station, Burlington, Vt.	
Robinson, A. J	Greenville, Pa	Greenville Dairy Co.
Rogers, Mrs. L. A	3635 South Street, Washington, D. C	
Rogers, Dr. L. A	Acting chief, Bureau of Dairy Industry, U. S. Department of Agriculture, Washington, D. C.	United States Government.
Ross, Ph. D., H. A	Cornell University, New York	
Rundall, J. C	De Laval Separator Co., Chicago, Ill	United States Government and State of Illinois.
Schilling, W. F	President Twin City Milk Producers Association, St. Paul, Minn.	United States Government.
Schubach, J	Canton, Ohio	
Sherwood, Dr. G. E	Kimball, Minn	Do.
Sidelmann, T. O	State College, Pa	
Simonson, G	Quincy, Ill	
Sorenson, S	1529 North Harding Avenue, Chicago, Ill	
Sorenson, Mrs. S	do	
Sorenson, Miss	do	
Stevens, F. C	Hollywood, Calif	
Strack-Wallace, D	350 Madison Avenue, New York, N. Y	
Sumner, J. M	Akron, Ohio	
Sumner, Mrs. J. M	do	
Taylor, G. B	Chestnut Farms Dairy, Washington, D. C	
Teeple, A. G	Akron, Ohio	
Totman, Miss C. C	Brookings, S. Dak	
Turnbow, G. D	Oakland, Calif	State of California.
Wallis, G. E	Wenham, Mass	
Wallis, Mrs. G. E	do	
Warren, G. F	Cornell University, Ithaca, N. Y	
West, H. A	Portland, Oreg	
West, Mrs. H. A	do	
Williams, S	154 West Tabor Road, Olney, Pa	Pennsylvania State College.
Willits, J. H	219 North Broad Street, Philadelphia, Pa	Inter-State Milk Producers' Association.
Wills, F. A	Philadelphia, Pa	
Wills, Mrs. F. A	do	
Wills, Miss R	Pelham Court, Germantown, Philadelphia, Pa.	
Wood, Miss A	Quincy, Ill	
Woolman, H. N	Philadelphia, Pa	State of Pennsylvania.
Woolman, Mrs. H. N	do	
Woolman, jr., H	do	

MINUTES OF MEETING OF OFFICIAL DELEGATES TO WORLD'S DAIRY CONGRESS

FIRST MEETING, U. S. S. "LEVIATHAN," MID ATLANTIC, JUNE 16, 1928

After an informal meeting of all persons on board the ship going to attend the World Dairy Congress, the members of the United States delegation who were on board held a formal meeting, called to order by Assistant Secretary of Agriculture, Hon. R. W. Dunlap.

Answering to roll call were the following accredited delegates: R. W. Dunlap, R. C. Potts, Dr. C. E. Sherwood, A. J. Glover, J. D. Mickle, A. M. Loomis, P. H. Kasper, A. A. Borland, Dr. C. W. Larson, Dr. H. E. Van Norman, A. L. Haecker, E. T. Rector, W. J. Schilling, Fred Rasmussen, E. M. Bailey, H. W. Jeffers, O. S. Jordan, George B. Caine, D. M. Dorman, and O. E. Reed.

Upon motion of D. M. Dorman, duly seconded and put by Mr. Dorman, R. W. Dunlap was unanimously elected chairman of the delegation. Upon motion of A. A. Borland, duly seconded and voted, Dr. H. E. Van Norman was elected honorary chairman of the delegation. Upon motion of R. C. Potts, A. M. Loomis was elected secretary of the delegation. Upon motion of O. E. Reed, Dr. L. A. Rogers was named as chairman of an advisory committee on report to the Congress of the United States, it being understood that Doctor Rogers should select the other members of this committee.

After discussion it was decided without formal motion to hold the first formal meeting of the delegation in Great Britain at the Picadilly Hotel on Tuesday morning, June 26, at 9 o'clock. This is a change from tentative arrangements for a meeting June 25 at 10 o'clock.

Programs of the congress, and blank forms for receipts, vouchers, and expense accounts were distributed by the chairman. After some discussion formal instructions as to vouchers and expense accounts were deferred until the next meeting.

At the premilinary general meeting preceding the delegate meeting about 80 persons were present. Mr. Dunlap presided and Doctor Van Norman called a roll of organizations represented, including the following:

National Dairy Council, Dr. C. W. Larson; Bureau of Dairy Industry, Prof. O. E. Reed; International Association of Ice Cream Manufacturers, D. M. Dorman; International Milk Dealers, Patrick Fox; Dairy and Ice Cream Machinery and Supplies Association, O. S. Jordan; American Dairy Federation, E. M. Bailey; Dry Milk Institute, H. E. Van Norman; American Association Creamery Butter Manufacturers, E. T. Rector; American Jersey Cattle Club, L. W. Morley; Bureau Agricultural Economics, Dairy Products Divi-

sion, R. C. Potts; American Dairy Science Association, A. A. Borland; National Dairy Association, H. E. Van Norman; The Dairy Press, A. J. Glover; State of Oregon, J. D. Mickle; State of Missouri, Rudolph Miller; State of New Jersey, L. W. Morley; California Dairy Counsel and State of California, Sam. H. Greene, Allied States Creamery Association and Nebraska Butter Manufacturers, A. L. Haecker; Certified Milk Producers Association H. W. Jeffers; Twin City Milk Producers Association and Land O'Lakes Creameries, W. J. Schilling.

Others who were introduced included Mrs. H. E. Van Norman, Mrs. A. J. Glover, Mrs. G. B. Caine, R. E. Little, A. M. Loomis, Fred Rasmussen, H. P. Olsen, G. R. Frampton, Director J. G. Lippman, Professor Hepburn, Professor Turnbow, Doctor Warren, Doctor Miyiwaki, of Japan, and I. E. Gamalieson, of Hawaii. Refreshments were served through the courtesy of the *Leviathan* management.

HOTEL PICADILLY, LONDON, JUNE 26, 1928

Present at the meeting of the United States delegates held at the Hotel Piccadilly, London, Tuesday, June 26, 1928, were the following members of the delegation:

R. W. Dunlap, H. E. Van Norman, E. M. Bailey, E. B. Meigs, C. W. Larson, L. A. Rogers, E. T. Rector, M. L. Dorman, Dr. G. E. Sherwood, W. F. Schilling, A. A. Borland, A. L. Haecker, P. H. Kasper, G. B. Caine, J. D. Mickle, A. J. Glover, Fred Rasmussen, O. E. Reed, Roy C. Potts, J. G. Lipman, and J. D. Miller; also several others from the United States not members of the official delegation.

Meeting called to order by the chairman at 9 a. m.

Methods of keeping expense accounts, vouchers, etc., was discussed and explained in detail by the chairman and Roy C. Potts, of the United States Department of Agriculture.

The congress program, including the visits to dairy farms and dairy plants, and to official receptions and social events was placed before the meeting and discussed. E. A. Foley, Agricultural Commissioner of the United States, connected with the American Embassy, was present, and placed the facilities of his office at the disposal of the delegates and all other representatives of the United States.

The matter of publicity, both in the British press and in the American was discussed, and the secretary was authorized to act as the publicity representative of the delegation, all statements given out to be approved by the chairman of the delegation.

Adjourned to meet on June 28 at the same time and place.

Meeting at Hotel Picadilly, June 28, 1928

Meeting called to order by Chairman Dunlap at 9 a. m. with a majority of the members of the delegation present.

The illness of Mrs. E. M. Bailey, wife of one of the delegates, was reported.

The chairman reported the sending of a message of greetings to the Prince of Wales, and the receipt of acknowledgments. Announcement was made of the plans for the entire body of delegates to the congress to visit the farms and dairies owned by the King, at Windsor, on Saturday.

The suggestion was presented on behalf of Agricultural Commissioner Foley that it would be a fitting act for the delegation to arrange for a floral tribute to the Unknown British Soldier, and have it placed with appropriate ceremony on the tomb in Whitehall.

The suggestion was approved and Chairman Dunlap authorized to have a wreath procured and to name a committee with himself as chairman to place the wreath on the tomb.

The plans for the Scottish trip, which would start on July 4, were discussed, and also plans for the United States delegation to return to Nottingham for the Royal Agricultural Show at the conclusion of the Scottish trip. The secretary was instructed to look up hotel accommodations in Nottingham.

An invitation was received to visit the city of Birmingham and inspect its milk-supply industry after the Nottingham show, and acknowledgement was ordered sent to the lord mayor and dairy committee of Birmingham.

Adjourned to meet June 29 at the same time and place.

Meeting at Hotel Picadilly June 29, 1928

Meeting called to order at 9 a. m. by Chairman Dunlap, with a majority of the members of the delegation present.

The chairman announced that the wreath for placing on the Tomb of the Unknown Soldier had been arranged for and appointed the following committee to assist him in presenting it at the Tomb of the Unknown Soldier in Whitehall, Saturday at 9.30:

W. H. Jeffers and A. M. Loomis, together with E. A. Foley of the American Embassy staff.

Colonel Hollingsworth, chairman of the Scottish subcommittee on arrangements for the congress, was present and was introduced. He spoke briefly explaining the arrangements for the Scottish trip, and in explanation of the points of historic and scenic interest to be visited, and of the dairy schools, dairy farms, and dairy enterprises of Edinburgh and Glasgow, and the dairy sections of East Lothian

and Ayr, which would be inspected. He extended a cordial invitation to all of the United States delegates to take part in all of this planned trip, and the invitation was accepted on behalf of all of the American party.

An invitation was received and accepted to attend a dinner to be given in London by the British Dairy Farmers Association on the evening of July 3.

Meeting adjourned subject to the call of the chairman.

WREATH PLACED ON UNKNOWN SOLDIER'S TOMB

The committee named, consisting of Hon. Renick W. Dunlap, chairman of the delegation, Henry W. Jeffers, A. M. Loomis, and E. A. Foley, agricultural commissioner of the United States to Great Britain, met Saturday morning at the Hotel Picadilly and proceeded to the Tomb of the Unknown British Soldier and there placed an appropriate wreath on behalf of the United States delegation to the World Dairy Congress.

FINAL MEETING OF DELEGATES

The final meeting of the delegates from the United States to the World Dairy Congress was held in the cabin of the steamer *Loch Lomond* on the afternoon of July 6, 1928.

The following resolution was presented as an expression of the thanks and appreciation of the United States delegates, and was approved, and Chairman Dunlap was instructed to present it at the meeting to be held that evening in Glasgow and to have it appear in the records of the congress:

Resolved, That the delegates representing the United States of America, for our country, our industry, and ourselves, express in this formal way our appreciation of the privilege of participating in the proceedings of the Eighth International Dairy Congress.

Our acknowledgments are due to the dairy industry of Great Britain, and to their organizing committee, and other representatives who, under the patronage of their sovereign, His Majesty King George, have in this congress marked a new long step in advance in the economic and scientific position of our industry.

We wish to thank the officials of His Majesty's Government in England and Scotland, and the officials of the municipalities of London, Reading, Edinburgh, and Glasgow, for the honors they have shown the congress, and to thank the people of those cities and of all Great Britain for many courtesies and splendid entertainment.

From the ladies of our party there is also an expression of sincere thanks for entertainment and many kindnesses.

We, in the United States, know the value of conferences and conventions in the advancement of knowledge, and still more in the increase of friendship and good will between all sections of our people. In this great congress it is our experience and belief that a fine spirit of international understanding and

international good will has been developed by this meeting of the delegates of more than 40 nations which will have far-reaching beneficial results. We also wish to call to the attention of all people the added knowledge which has been announced at this congress concerning the value of dairy products as human food, a protection and improvement of human health. We are sure that the dairy industry of the world has been very fortunate and greatly benefited by the prominence given this subject in the program and work of the congress. The leadership of the congress and the work it has done have our highest commendation.

PAPERS PRESENTED BY DELEGATES FROM THE UNITED STATES

THE DAIRYMEN'S LEAGUE AND ITS MILK POOL IN THE UNITED STATES

By JOHN D. MILLER, Vice President and General Counsel, the Dairymen's League

The corporate name of the association is Dairymen's League Cooperative Association (Inc.).

It is composed of dairy farmers engaged in collectively selling the milk produced by them.

As first organized under the name of Dairymen's League (Inc.), it was not a merchandising concern. It then functioned only as a bargaining agent. It handled no milk. It had no facilities and no practical way of obtaining funds with which to acquire facilities. It was, therefore, compelled to sell all milk at the same price.

A reorganization became imperative, and at its annual membership meeting in December, 1916, a committee was appointed to prepare a form of reorganization. The work of reorganization, retarded somewhat by the marketing problems growing out of the World War, resulted in the incorporation of the present association in March, 1919.

Membership contracts and by-laws were written and all were the subject of discussion throughout the territory for nearly two years, and at the annual meeting of the old league in December, 1920, the plan of reorganization was finally approved and the directors were instructed to make it effective at as early a date as possible. This was done, and the organization under its new name and present plan commenced operations upon May 1, 1921.

TERRITORY

The milk handled by the association is produced throughout the dairy sections of the State of New York, northern Pennsylvania, northern New Jersey, with small quantities along the western border in the States of Vermont, Massachusetts, and Connecticut.

The milk is marketed in the city of Greater New York and in other cities in New York State, and in cities in northern Pennsylvania, northern New Jersey, and eastern Connecticut.

Within this producing area and in the cities supplied resides nearly one-seventh of the population of the United States. This area is over 400 miles long and wide. It is covered with a network of railroads and improved public highways, and has within it many large industrial centers.

Not all members deliver milk during every month in the year. From this it follows that the number participating in the pool during the year is more than those participating in any one month.

During the fiscal year ending with March 31, 1927, approximately 39,000 members participated. In the month of November, 1926, 33,749 members participated, while in the same month of 1927, 35,945 members participated, an increase of 2,196. The increase for December, 1927, over December, 1926, was 3,609.

VOLUME OF BUSINESS

Gross sales for the fiscal year ending March 31, 1926, were approximately $66,630,000. Such gross sales increased to approximately $73,700,000 in the year ending March 31, 1927.

Gross sales for the first nine months of the fiscal year ending with March, 1928, were approximately $6,290,000 more than the gross sales for the same months during the preceding year.

FORM OF ORGANIZATION

The association is a nonstock, nonprofit membership corporation. It has approximately 800 local units. It is controlled by members through the election of directors.

In order that such control may be easily exercised, the territory is divided into 24 districts, corresponding to the number of directors. Directors are elected for a term of 3 years, with the term of 8 of the 24 expiring annually.

In May of each year a district meeting is held in every district where the term of office of the director is about to expire. This district meeting consists of one delegate from each local unit in that district. Each delegate casts as many votes as there were members present and voting at his local league when he was elected a delegate.

Such district meeting by a majority vote nominates a candidate for director from that district. The result is certified to the head office, thereupon an official ballot is prepared with the names of the persons thus nominated printed thereon, with blank spaces for mem-

bers to write in other names if they so desire. These ballots are distributed to the 800 local units.

On a given date members throughout the territory meet in their local league and cast their ballot for directors. Each member has one vote, and votes by proxy are not authorized.

The officers of each local league certify the result to an election board theretofore named by members at the annual membership meeting. The election board canvasses and tabulates the votes and reports the result to the annual membership meeting in June, whereupon those having a majority of the votes are declared elected.

The annual membership meeting consists of one delegate from each of the 800 local units.

From what has been stated it will be seen that members in one district nominate, while members in all districts elect, directors, resulting in the control of the organization being highly democratic.

The eight directors thus elected, together with the 16 holding over, comprise the board of directors for the ensuing year. They meet immediately after the annual membership meeting, and from their own number elect officers and also four persons who, with the president as member exofficio, comprise the executive committee. Directors meet monthly. The executive committe devote their entire time to the business of the association.

The board of directors and the executive committee are clothed with broad powers, thus permitting them to quickly decide the important questions arising daily for decision.

COUNTY PRESIDENTS

Many of the 24 directors' districts consist of more than one county.

In each county having 400 members or more there is a county organization with county officers. These are elected by the members in that county.

One of the duties of county presidents is to attend each meeting of the board of directors, except when directors are assembled in executive session. At such meeting the county presidents participate in the discussions but have no vote.

Upon their return they communicate to members the substance of the business transacted by the directors at such meeting.

FACILITIES

The association operates 216 country receiving, shipping and processing plants. Of these it owns 202 and leases 14. It owns 26 other country plants leased to and operated by others. It owns and operates wholesale distributing plants in New York City, one in Newark, N. J., an ice-cream manufacturing plant at Utica, with warehouses for storing products and supplies in two other cities.

OPERATION

Some of the members deliver milk to country plants operated by the association. Others deliver milk to country plants operated by buyers.

The association sells milk and its products at wholesale.

City distributors requiring more milk than that received by them at their country plants are supplied by the association with milk delivered f. o. b. city railroad terminals.

Some retail stores, hotels, and restaurants are supplied by the association from its city wholesale distributing plants.

MEMBERSHIP CONTRACTS

Each member contracts directly with the parent association, the local and county units functioning for other purposes. Such contract authorizes the association to sell the milk or to manufacture it and sell the resultant products and to collect the proceeds of all sales. This contract and the by-laws direct how and when proceeds of sales are to be distributed and generally authorizes the association to do what it is doing.

The contract runs continuously unless cancelled by notice of either party to the other between the 12th and 28th days of February of any year. Such notice to become effective on the 1st day of April then next ensuing.

The contract and by-laws clothe the association with broad discretionary powers. Absence of these powers would undoubtedly have prevented the association from attaining the present commercial and financial strength.

The association makes all sales, collects the proceeds thereof, blends them into one general fund, and after deducting expenses distributes such proceeds to members in payment for milk.

RETURNS TO MEMBERS

Payment to members is made on or before the 25th day of each month for all milk delivered during the preceding month. Monthly payments are only for the approximate amount due and after the end of each fiscal year with accounts settled members receive a thirteenth check, thus closing the year's business.

The weighted average returns to members for the year ending March 31, 1926, was approximately $2.32 per 100 pounds for milk testing 3.5 per cent butterfat. For year ending March 31, 1927, such returns were approximately $2.39 per 100 pounds for milk of the same fat content.

The weighted average returns for the first nine months of the fiscal year ending with March, 1927, was approximately $2.40 per 100 pounds, while for the same months of the fiscal year ending with March, 1928, such returns were approximately $2.56 per 100 pounds.

In all cases members received for milk testing more than 3.5 per cent fat, a plus differential of 4 cents for each one-tenth of 1 per cent fat, with a minus differential of like amount for milk testing less than 3.5 per cent.

During the fiscal year ending with March, 1927, the weighted average butterfat content of milk was 3.607 per cent, resulting, of course, in members as a whole receiving 4.28 cents per 100 pounds more than the price above stated.

These prices as stated are net to the member for milk delivered by him to a plant in the vicinity of his farm.

Prices stated are for the larger part of the milk handled. Grade "A" milk is sold at a premium, and this premium is also paid over to the members producing such milk.

Prices to members are uniform, subject to quality, location, and other equitable differentials established by the association.

DISPOSITION OF SURPLUS

There are wide seasonal fluctuations in production while city consumption is more constant and uniform. This results in surpluses during a part of the year.

The costs of producing milk for city consumption in this territory are so high that there are heavy losses incurred in manufacturing such surpluses. Among the causes of these high production costs are:

(*a*) Climatic conditions;

(*b*) Costs of complying with necessary health regulations; and

(*c*) More uniform production so that cities may have adequate supplies in the fall and winter. This necessitates larger production in the fall and winter months when production costs are at the maximum, thus increasing the weighted average cost for the year.

These production costs are such as to prohibit the production of this milk for manufacturing purposes alone.

Milk is, therefore, sold under a classified price system under which that sold for city consumption commands a higher price than that sold for manufacturing purposes, while such as is sold for manufacturing purposes is sold at a price that is designed to reflect the market value of the milk into which it is converted.

Such surplus is handled by the association in a variety of ways. Some is manufactured in its own plants, while some is sold to other manufacturers.

Because of the uniformity of price to members it is immaterial to them whether their milk is sold in the city at the higher price or is manufactured.

FINANCING

The association is financed by loans from members, and for this purpose it deducts from each monthly milk check such uniform amount as in its judgment is necessary to adequately finance its operations.

After the end of each fiscal year each member receives a certificate of indebtedness for the amount thus loaned by him to the association during the year. Such certificates are payable five years from their date, with interest payable yearly at the rate of 6 per cent per annum. Interest coupons are attached to the certificates.

The sixth fiscal year of the association ended on March 31, 1927. Certificates issued for that year were the sixth annual series issued. All certificates are dated May 1, with the first interest coupon being for 13 months' interest.

No application has been made to list these certificates on any exchange. In the beginning they sold at a very low price. At present certificates of all series move freely at par in exchange for property. Some of the early maturing ones move freely at par for cash, with a small discount for those maturing later.

Interest on all outstanding certificates has been paid when due, members thus having received 6 per cent on their investment from the beginning.

The aggregate loan by members to the association for the first year was approximately $4,300,000, certificates of indebtedness for which became payable on May 1, 1927. Before that date over one-half of them had been retired by purchases for the sinking fund and the remainder was paid when due.

Such loans for the second year amounted to approximately $4,600,000, certificates for which are due and payable on May 1, 1928, and up to December 1, 1927, this sum has been reduced by purchases for the sinking fund to approximately $2,250,000, with adequate funds on hand and in sight to pay all when they become due.

Funds to pay these certificates are derived in like manner by loans from members deducted from their monthly milk checks.

From this it will be seen that the association has a revolving capital fund that may be expanded or contracted as its business needs may require.

As members cease to be milk producers, or as they withdraw from the association, their right to vote for directors ends, but their certificates of indebtedness are unaffected thereby, but remain payable in accordance with their terms.

The present capital of the association is approximately $13,000,000, and as distributed over its membership making such loans results in an average investment per member of something less than $300.

This plan has been found to be a satisfactory method of so mobilizing the financial strength of members that they finance their marketing association in a way but little burdensome.

AUDITS

All accounts, books, and records are under the supervision of and audited by certified public accountants of high repute in New York City.

There is also an auditing committee, consisting of three members of the association, whose milk is being sold by the association. This committee is named each year by the members when assembled in annual membership meeting. They make report thereof to the board of directors each quarter and to the membership at each annual meeting. Such reports are also published in the Dairymen's League News going to each member, and a copy of the annual report is filed with the State department of farms and markets at Albany, N. Y.

QUALITY

The association exercises a high degree of care in its handling of milk to assure that milk reaching the cities is pure, clean, and wholesome, and to this end the association and its members cooperate with city boards of health in every way possible.

The association strives to give all possible information to members of the work that is being done. This, through the Dairymen's League News, the county presidents, divisional offices, and a small corp of field workers.

The News is a weekly publication going to all members.

Public meetings are frequently held throughout the territory, at which the association's business and problems are discussed.

HOME DEPARTMENT

The work of this department takes on a far wider scope than its name implies. It is of growing importance in league work. It is conducted by women for women and children. In this department many women on the farms work in unison. Through them the whole family becomes interested in the association and its problems. They contribute entertainment and information at local meetings, resulting in each local unit becoming more and more a social center.

CONCLUSION

In conclusion it should be stated that never before in this territory have so many farmers been confident of the future of their industry.

Members of the association now have an assured daily market; are sure of their pay, and are sure of as high a price as everchanging business conditions will permit.

Acting together in their association, members have done much; there is still much to be done.

METALS AND THEIR VARIOUS INFLUENCES ON MILK

Mr. Otto F. Hunziker, M. S., *Manager of Manufactures and Director of the Research Laboratories, Blue Valley Creamery, Chicago*

INTRODUCTION

The status of metals in dairy equipment, their properties, their resistance to corrosion in milk work and their effect on the flavor and quality of milk and milk products was brought before the World's Dairy Congress in Washington, D. C., in 1923, in papers presented by Seligman (1) and by the author (2). Those papers called attention to some of the fundamental relations that may be expected to take place under milk-plant conditions, and they quoted such plant experiences and experimental results as were then available.

The span of the past five years has seen the introduction of new metals and metallic alloys in the construction of dairy equipment. And considerable additional information has become available on the entire subject dealing with metals then and now used in milk plant equipment. It is hoped, therefore, that a brief discussion of this newer information may be of added value and service to the dairy industry, especially in view of the fact, now more fully recognized, that corrosion plays a very prominent rôle in the life of the equipment and in the determination of the flavor, keeping quality, and wholesomeness of the dairy product.

SUMMARY OF EARLIER WORK

In the 1923 reports the following general facts regarding metallic action in milk and cream were pointed out:

1. In order for any metal to suffer corrosion and to have an injurious effect on the milk or milk product, it must be capable of going into solution.

2. Solution of the metal may be the result of direct chemical action in the presence of acids, mineral salts, and other constituents of the

milk, or of contact with corrosive washing powders, chemical sterilizers, or brine. Or it may be caused by electrolysis, such as may result from the presence of two or more metals with different electrical potentials in contact with one another and immersed in the electrolyte—the milk, or other fluid product, or from stray electric currents reaching the equipment due to imperfectly insulated and insufficiently grounded motors in case of direct motor-driven machines, or leaky conduits within or in close proximity to the factory.

3. That the presence of air intensifies metallic corrosion as is particularly shown by the corrosion at the air-liquid line.

4. That injury to the flavor and keeping quality of the milk product as the result of corrosion may be due to the presence in the milk product of metallic salts or oxides which themselves have a metallic, bitter, puckery flavor, or to oxidative or catalytic action of these metallic salts and oxides on the milk constituents, or to bacterio-selective influences of certain metallic salts and oxides.

5. It was further pointed out that the salts and oxides of certain metals have distinct toxic properties, thus rendering the use of such metals unsafe from the standpoint of the wholesomeness of the dairy product.

At that time it was shown that copper and the copper alloys, monel metal and nickel silver, which were then much in use, failed to protect the milk product against metallic action, and against injury to flavor and keeping quality. Tinned copper was found suitable as log as the tin coating remained intact, but the short life of the latter greatly diminished the usefulness of tinned copper. Glass enameled equipment had then been recently introduced in the dairy field and its advent gave great promise for elimination of corrosion difficulties. From the standpoint of the inertness of glass enameled surfaces in contact with milk and cream, glass enamel proved satisfactory at least as long as the enamel remained intact. However, the great corrosiveness of the steel side of the enameled equipment, practically eliminated jacketed glass-lined tanks and confined the use of glass enamel to glass enameled shells and linings in metal coil vats. Since it is impractical to fabricate a satisfactory enameled coil for heating and cooling, the problem of metallic flavor is not completely eliminated even here. Nickel was then also just being considered for use in dairy equipment. Its introduction and use was retarded on account of mechanical difficulties in fabrication. Aluminium had not as yet reached the point of wide application in the dairy industry in this country, but had been put to considerable use abroad with apparently fair success.

The item of high cost of materials and fabrication of some of the metal products of promising suitability, such as nickel, glass enamel, etc., may serve to explain, in part at least, their failure to

enjoy their more rapid acceptance and wider use by the industry, and the continued popularity of such cheaper but less suitable metals as iron, copper, and copper alloys.

THE PRESENT INVESTIGATION

It is not the purpose of this paper to further enlarge upon the various theories dealing with metallic corrosion in milk work. The present discussion will be confined mainly to a summary of specific results of an extensive investigation, in which was studied the effect of sweet and sour milk and cream of organic and mineral acids, and of such other media as dairy equipment may be exposed to as, for instance, washing powders, chemical sterilizers, refrigerating brines, etc., on diverse metals, coated metals, and metallic alloys now available and mechanically suitable for use in dairy equipment, as well as the effect of these metals on the products themselves.

The procedure of the experiment consisted of immersing metal strips, either totally or partly, in the liquids under investigation. Every effort was made to simulate as nearly as possible the treatment and use which the equipment receives in commercial milk plant operation, such as providing wide ranges of temperature and periods of exposure, diverse successions of treatment, etc. All metal strips were thoroughly cleaned, vacuum dried, and carefully weighed before and after immersion. The color, character, and flavor of each liquid for each strip and the visible extent and character of corrosion of each strip were noted at the conclusion of each test.

GENERAL OBSERVATIONS

On account of space limitations prescribe for this paper it will be impossible to list in detail all the results obtained. However, in order to point out the relative merits of the various materials used for dairy equipment, a very brief general summary of the results in the various types of liquids used appears very valuable. A more complete report, containing full details of results, together with references to the work of others, may be found in an early issue of The Journal of Dairy Science.

Generally speaking, the results with milk and cream, sweet and sour, hot and cold, show that there is a close agreement between the flavor of the milk product and the extent of visible corrosion and loss of weight of the metal strips. Heavy loss in weight and profuse visible corrosion of the metal strips were almost invariably accompanied by the appearance of a distinct metallic flavor in the milk and cream. Slight changes in weight, however, did not always result in a corroded appearance of such strips, nor in any noticeable effect on flavor. On the other hand, there were cases of pronounced off-

flavor in the liquid but without loss, or even with a gain in weight of the respective metal strips. In the latter case the bad flavor of the milk or cream was invariably accompanied by the appearance of very profuse corrosion of the metal. The fact that these corroded metal strips did not always show correspondingly great loss in weight must be attributed to the accumulation of oxidation products which off-set, either partly or wholly, or more than wholly, the inevitable loss in weight of the metal proper. Because of this situation it was deemed essential to base the interpretation of the results not altogether on the weight figures, but also on the effect on the flavor of the milk product and on the extent and character of the visible corrosion on the metal strips.

Effect of temperature.—In general, the higher the temperature the more intense is the chemical reaction. This was true, also, in the present experiment and particularly so in the case of acids and alkalies. In the milk product, however, the effect of temperature on the relation of metals to enzymic action may modify the results obtained. Thus, in the milk held at room temperature a metallic flavor was noticed in the case of iron, copper, and galvanized iron. In the milk held at 145° F., in addition to these three metals, the nickel silver and tinned iron also yielded metallic flavor. In the milk held at 180° F., the only metals that affected the flavor were copper and iron, and in each case the off flavor was only slight. In the sweet cream, both at room temperature and at 145° F., again the copper and iron produced a very metallic flavor, nickel and nickel-silver also caused a slight off flavor. In addition to this, in the cream held at 145° F., the nickel-silver gave a very metallic flavor, and the monel, aluminum manganese alloy, and galvanized iron a slightly metallic flavor. These results suggest that the higher temperature (145° F.) intensifies the production of metallic and other off flavor, but when the temperature is raised to a point (above 176° F.) at which oxidative enzymes become inactivated, the tendency of damage to flavor is greatly reduced. It is of interest here to note that Rice and Miscall (3) found that copper was more soluble at 145° F. than at either room temperature or at the boiling point of milk.

It was also noted that the character of the flavor varies considerably with the metal. Thus copper and copper alloys tend to produce a metallic, tallowy flavor character, while zinc and iron products caused in some cases a fishy and in other a foul, putrid flavor in addition to the metallic character. Similar observations are recorded by Quamt, who reports that low-carbon steel has a greater effect on putrefaction than copper.

Effect of acidity.—Generally, the higher the acidity and the stronger the acid the more intense the metallic action. This was

the case both with the acid solutions and with the milk products. These results gave evidence that those metals which were attacked by lactic acid were affected almost equally as seriously by the other organic acids tried, even by a 2 per cent citric acid solution.

These tests gave marked proof of the great resistance of superascoloy [1] to corrosion. In the weaker organic acids, such as lactic, acetic, butyric and citric, the ordinary chromium steels, Ascoloy,[2] and Enduro,[3] resisted corrosion nearly as completely as superascoloy. But it was the inorganic acid solutions that embraced the most decisive test of resistance to corrosion. In sulphuric and hydrochloric acid solutions the ordinary chromium steels failed to stand up. They rusted and pitted profusely and lost over 100 milligrams per square inch in sulphuric acid, and nearly 200 milligrams in hydrochloric acid, suggesting that when corrosion in these stainless steel products once starts they go to pieces rapidly.

But not so with superascoloy, which contains, in addition to chromium and steel, some nickel. Superascoloy resisted sulphuric acid completely, showing not the slightest discoloration and no change in weight. In hydrochloric acid this alloy did show some attack and some loss in weight, but even here the change was not great and far less than in the case of any of the other metals and alloys under experiment.

Of the other metals, aluminum and aluminum alloy resisted corrosion in the organic acid solutions best, that is, next to the stainless steels. In sulphuric acid they also stood up better than any metals outside of superascoloy, although they suffered considerable corrosion and loss in weight. In hydrochloric acid, however, aluminum and its alloy failed to show resistance, and they lost about 100 milligrams per square inch in weight. The aluminum plated alloy, however, showed only slightly more loss in weight than superascoloy.

Next in the line of resistance to acids follow nickel and tin, Monel metal and nickel silver, tinned copper, tinned iron and copper. Of these, Monel metal and nickel silver showed the greatest resistance to the organic acids, while nickel, Monel and tin stood up best in the mineral acids.

The remaining metals, namely, iron, zinc, and galvanized iron, showed the least resistance of any of the metals in acid solutions.

In general it was noted that where the metal was able to resist corrosion in acid media it also did not produce undesirable flavors,

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[1] Superascoloy, a chromium nickel steel, containing approximately 17–20% Cr., 7–10% Ni., and less than .5% Mn., .5% Si., .025% P., and .025% S.

[2] Ascoloy, a chromium steel, containing approximately 12–16% Cr., 5% Si., 5% Mn., 0.25% P., 0.25% S.

[3] Enduro, a chromium steel containing approximately 16.5–18.5% Cr., 5% Si., .3–.75% Mn., and less than .1% C.

and was not seriously attacked by milk and cream, the highly complex colloid nature of the dairy product apparently not altering the general resistance of the metal to corrosion by acids.

Effect of alkalies.—The importance of resistance to corrosion of metallic dairy equipment in alkaline washing powders and alkalies in other form is self-evident. The cleaning of such equipment makes indispensable the use of alkalies, and yet the action of these alkalies on the metals must inevitably influence the resistance and effect of the metals on the milk product. The alkaline washing powders most commonly used in milk work are caustic soda or special alkalies, sodium carbonate, such as sal soda and soda ash, neutral sodas, such as Wyandotte cleaner and cleanser, and trisodium phosphate, either as such or in the form of such commercial preparations as Oakite Alkalies may also be encountered in brines and chemical disinfect ants.

As far as the resistance of the individual metals to washing powders is concerned, this series of tests demonstrates that the chromium steels are practically inert, and are closely followed by nickel, Monel, and nickel silver. Tin suffers considerably, especially in the case of the stronger alkalies, but its resistance is decidedly improved by the presence of a small amount of sodium chromate in the cleaner. Copper, iron, and zinc are attacked considerably while aluminum and aluminum alloy are practically destroyed. However, with the addition of sodium silicate to the soda (sodium carbonate) this washing powder does not attack the aluminum and aluminum alloy.

Effect of calcium and sodium brines.—The resistance of metals used in dairy equipment to brine is important in so far as such equipment is used for brine cooling. Both calcium and sodium brines are corrosive to several of the metals used. Efforts to diminish the corrosive action of brines have led to diverse treatments of brine, such as the addition of an alkali or of sodium chromate and dichromate, or of sodium silicate.

These results clearly demonstrate that, as far as those parts of dairy equipment as are exposed to brine are concerned, nickel, nickel alloys, such as Monel and nickel silver, and chromium steels are by far the most suitable. Of these, superascoloy and nickel proved to be the best. There is also unmistakable evidence of the utter unfitness of iron and steel for jackets and other cooling surfaces where brine is used. This explains the experience in plant operation with jacketed steel tanks, which shows the steel jackets to corrode very rapidly and to rust through in a comparatively short time, often after 18 to 24 months' use. Because of the great corrosiveness of zine in brine, galvanized iron is practically as unsuitable for such purposes as iron and steel. Aluminum and aluminum products give promise as highly satisfactory metals in sodium brine treated

with chromate or silicate, while tin and tinned copper receive their greatest protection from the chromate-treated brine. The corrosiveness of brine on all metals affected is very noticeably reduced by chromate treatment. Other treatments tried have, in general, not proved as effective as was expected.

Effect of successive steam heating and brine cooling.—The usual factory operation involves the heating with steam or hot water, and cooling with water and brine successively in the same equipment. Generally, the heating with steam or hot water is immediately followed by cooling with cold water and then with brine, after which the brine is removed and the brine-wet surface remains exposed to the air until the next day's operation, when heat again is applied first and the routine of heating and cooling is repeated.

The results of this treatment showed very much greater corrosion with most of the metals than in the case of treatment with brine alone. They demonstrated the utter unsuitableness of iron and galvanized iron in equipment used for heating and brine cooling. They further show that even ordinary stainless steels are far from immune and yield to profuse rusting. The only metals that proved reasonably resistant to corrosion were superascoloy, nickel silver, and tin. However, tin-coated metals were unable to withstand the treatment satisfactorily.

DISCUSSION OF RESULTS

In the following paragraphs it is endeavored to briefly summarize these findings by grouping the metals studied according to their all-round merits regarding resistance to corrosion and effect on flavor of milk products under general factory conditions.

Iron, galvanized iron, and tinned iron.—It will be seen from the preceding discussion that iron ranks among the metals of lowest resistance to corrosion in practically every liquid and under every form of treatment that is involved in milk work. Its rapid and intense corrosion during the short period of exposure that prevailed in the several treatments of this experiment is most convincing. In the face of these results the short life of iron equipment in commercial use is not surprising. The unsuitableness of iron is further greatly magnified where it is in direct contact with the dairy product, because its rapid corrosion was invariably accompanied by the development in the dariy product of a very pronounced, intense metallic or putrid flavor, as was also noted by Quam (4), who found that iron caused greater decomposition in milk than any other metal which he studied.

Nor does the coating of iron with zinc or tin furnish a dependable protection. In the case of galvanized iron the great corrosiveness

of the zinc itself forfeits the protection expected. In the case of tinned iron a heavy and uniform coating of tin does give satisfactory protection against corrosion, but such perfection of tin coating on iron is very rare. Moreover, the tin coating is porous, inviting access of the media to the easily corroded iron underneath. This provides corrosion centers on which action is concentrated and from which corrosion spreads rapidly. The damage is further aggravated by the use of strong caustic alkalies for washing purposes, which readily attack the tin. As a convincing example of this fact may be cited commercial experience in the washing of farmers' milk and cream cans with washing solutions of caustic alkalies. Such cans lose their tin coating rapidly, rust profusely, and soon are in a bad and insanitary condition. It is well known, though not fully appreciated, that such cans are responsible for a great deal of the metallic flavor in cream that arrives in American creameries. This situation might be materially improved by the use of washing powders that are known to be less corrosive, such as plain tri-sodium phosphate or tri-sodium phosphate containing a small amount of sodium chromate. There is no question that the factor of rusty cream cans plays a very important rôle in the production of cream of poor quality.

Copper, copper alloys, tinned copper, and tin.—On a par with iron, in its damaging effect on the quality of the milk product, stands copper. This metal has been shown to give milk and cream a most intense tallowy, oily, and metallic flavor. In the experiment here recorded both copper and iron invariably produced these objectionable off flavors. While the immediate damage to flavor may be slightly less pronounced in the case of copper than with iron, the presence of even very minute quantities of copper salts in the dairy product are capable of producing most intense progressive flavor deterioration in the dairy product with age, due to oxidative and catalytic changes, as shown by earlier work of Rogers (5), Hunziker (6), and others.

Recent work by Mattick (7) showed that an oil flavor in milk was very common in England and Scotland, and he attributes this defect to extremely small quantities of copper absorbed into the milk during cooling of the milk by the use of imperfectly tinned copper coolers. Grindrod (8) claims that sterilization of milk and evaporated milk in an apparatus made of copper, brass, or zinc, or containing these metals, causes so great damage to the milk that his process of impact sterilization is a failure for all practical purposes.

The use of vacuum pans, hot wells, forewarmers, holding vats, pasteurizers, and similar equipment constructed in part or wholly

of copper, or copper alloys, obviously represents a continuous menace to the quality of the dairy product, and yet such equipment, made of or containing such metals, constitutes the great majority of containers and apparatus used in present-day milk products plants.

The alloys of copper gave evidence of considerably greater resistance to corrosion than copper, and their immediate effect on the flavor of the dairy product was decidedly less pronounced, but appeared in many instances. Nickel silver caused metallic flavor more often than Monel metal. However, this experiment demonstrated that neither of these alloys gives dependable protection against metallic injury to the flavor of milk products and these results are fully supported by commercial experience.

The proper tin coating of copper provides the most effective protection against the corrosion of copper and its damaging effect on the milk product. Properly tinned copper offers a safe surface for exposure to milk products. Tinned copper furnishes better protection in this respect than tinned iron. Nevertheless, the life of the tin coating on copper is relatively short, and retinning at frequent intervals becomes necessary in order to guard against the presence and damaging effect of exposed copper. Even in such weak organic acid solutions as may be encountered in sweet and sour milk products, such as lactic, butyric, citric, and acetic acids, the corrosion and loss in weight was very considerable, both on pure tin and on tinned copper. In a cold .2 per cent solution of citric acid for instance, the loss ranged from 6 to 9 milligrams per square inch of metal strip.

Further experimental proof of the action of weak organic acids on tin is cited by Mantell and Lincoln (9). These investigators studied the subject from the standpoint of the food canning industry and found that citric, lactic, and acetic acids attack tin and tin alloys. The life of the tin coating is further shortened by the excessive use of caustic alkali washing powders used for cleaning, and hypochlorite solutions used for sterilizing the equipment.

Another possible contributing factor to the short life of the tin coating on copper may be the contamination of the tin with copper due to method of tinning. Thus, Merica (10) points out that in tinning copper, the tin bath tends to become contaminated with copper and there is danger of obtaining a brittle tin coating.

While the solubility of tin in the milk product is not inconsiderable, the salts of tin appear to cause no noticeable injurious effect on the flavor of the milk product. In the present experiment the pure tin proved entirely harmless in this respect. Under no condition, regardless of temperature, acidity, or time of exposure of the milk product, was there the slightest suggestion of metallic or other objectionable off-flavor. These results are in harmony with the findings

of Donauer (11) who shows that while tin is more soluble than copper, and copper alloys, it required ten times as much tin in solution as copper to produce a distinct metallic flavor. That tin is incapable of inciting progressive decomposition and damage to flavor in butter while, under identical conditions, iron, copper, and nickel-silver spoiled the butter entirely, bleaching it and making it intensely tallowy in flavor, was demonstrated by Hunziker and Hosman. (12.)

These facts may well constitute one of the principal reasons for the great popularity of tinned copper surfaces in dairy equipment. Yet the desirability of the presence in milk products of such metallic salts as the salts of tin may well be questioned.

Nickel.—Nickel has proved to be a very desirable metal in milk work. In the present experiment it was found to be very little affected by alkalis, chemical sterilizers, and brines. It is, however, not immune to the action of acids. In fact, in the several organic acids of milk and in sulphuric acid it proved considerably more soluble than tin. This fact was further substantiated also by its much greater solubility than tin in the milk products, both sweet and sour, and hot and cold. Similar results are also reported by Quam (13). Particularly noticeable is its ready tarnishing in milk products, which is also observed in the commercial use of nickel dairy equipment.

As far as the effect of nickel on the flavor of the milk product is concerned, the present experiment showed that nickel is not entirely negative. While no intense metallic flavor resulted from nickel in any of the milk products, a slightly metallic and bitter flavor was noted in the case of acidophilus milk, starter and in sweet cream, hot and cold. The ready solubility of nickel in milk suggests that nickel equipment is not so suitable for high-acid dairy products as is generally expected. Similar observations were also reported by Cornell (14) in his experience with milk plant operations, who concludes that "nickel is not so satisfactorily used in connection with the development of high-acid in dairy products." Burrell (15) reports that nickel hoops used for draining Camembert cheese were a failure and actually caused the cheese to turn green, while similar hoops made of stainless steel have proved very satisfactory.

On the other hand, Grindrod (8) who worked with sweet milk, found that "evaporated milk made in all-nickel or all-tin apparatus was very far superior to the ordinary evaporated milk" (meaning that made in copper vacuum pans). Again, an all-nickel horizontal coil vat installed in one of the factories of the Blue Valley Creamery Co. (16) was used for the pasteurization and ripening of cream. This vat has proved entirely satisfactory as far as its effect on the flavor of cream and butter is concerned. It has been in daily use for a period of over two years and at no time has there been any

indication of metallic flavor in the milk product, although the nickel has lost its original luster, shows considerable tarnish, and analysis of the cream by Quam (17) disclosed the presence of appreciable quantities of dissolved nickel. Hunziker and Hosman (12) found nickel to be equally satisfactory as tin in protecting butter against progressive flavor deterioration. Prolonged contact of nickel with butter failed to produce metallic flavor in the butter. Because of these facts the conclusion is inevitable, that nickel, similarly as tin, is a desirable metal in milk work, though its even greater solubility than that of tin raises here, too, the pertinent question of the doubtful desirability of the presence of considerable amounts of such metallic salts in the dairy product.

Aluminum.—Our results with aluminum suggest that this metal deserves serious consideration in connection with milk-plant equipment. With the exception of its instability in alkalies, its resistance to corrosion proved superior to that of iron, zinc, copper, tin, and nickel products. In organic acids, brine, sweet milk and cream, and moderately sour-milk products, such as sour cream, buttermilk, and starter culture, corrosion and loss of weight were either entirely absent or their extent was very slight. In dairy products of intensely high acidity, however, the corrosion was somewhat more pronounced and a very slight metallic flavour was discernible. This was noticeable in high-acid cultured milk, such as acidophilus milk. Commercial experience in European milk plants where aluminum equipment, because of its cheapness, is very extensively used, however, developed the fact that alumninum suffers considerable pitting in the presence of milk heated to high temperatures. For this reason the aluminum equipment in European milk factories is confined more largely to holding tanks, milk pipes, milk shipping cans, and the like. The fact, nevertheless, remains that in the present experiment both aluminum and aluminum manganese alloy showed high resistance to corrosion and gave no evidence of pitting in milk and cream, hot and cold.

Possibly the greatest draw back of aluminum and aluminum alloy lies in its lack of resistance to the corrosive effect of alkalis. Experimental observations showed these products to be severely attacked and rapidly destroyed by alkaline washing powders. Similar observations were also reported by Williams (18), who states that solutions of caustic alkalis and of chlorines rapidly corrode aluminum. The Metals Commission of Berlin (19) thus recommends that pure alkalis and acids must not be used for cleaning this metal.

In this experiment the treatment of sodium carbonate washing powder with a very small amount of sodium silicate reduced the corrosion of both aluminum and aluminum manganese alloy to a

mere slight tarnish, while in sodium carbonate alone corrosion was very marked. Thus, in sodium carbonate alone aluminum lost 4.5 milligrams and aluminum manganese alloy lost 7.5 milligrams per square inch, while the addition of one-twentieth per cent of sodium silicate reduced this loss to a gain in weight of 0.16 milligram and 0.1 milligram, respectively, per square inch. Similar treatment was also recommended as highly effective by Churchill (20) and by Seligman (1).

The silicate treatment of caustic soda and of tri-sodium phosphate, however, failed to protect aluminum from profuse corrosion. In fact, in the case of caustic soda the loss in weight was practically four times greater with sodium silicate than without silicate treatment. In tri-sodium phosphate the silicate treatment also tended to increase rather than decrease the loss in weight while treatment with sodium chronate reduced the loss in weight about 60 per cent. However, in both, treated and untreated trisodium phosphate, the aluminum and aluminum manganese alloy became coated with a very heavy jet-black tranish which condemns the use of trisodium phosphate as a cleaner for aluminum (2).

In sodium brine treated with sodium silicate, corrosion and loss in weight were exceedingly slight and the same brine treated with sodium chromate in the place of sodium silicate, had no effect on aluminum, aluminum alloy, and aluminum-plated alloy. There was no corrosion, no tarnish, no discoloration, and no loss in weight.

Another important factor greatly influencing the resistance of aluminum to corrosion in milk equipment is the physical state and purity of the metal. Thus, wrought aluminum, which is usually of relatively high purity, has been found to withstand attack far more readily than cast aluminum, which generally contains greater quantities of impurities. Seligman (1) points out that while tanks, cans, etc., made of sheet aluminum may be found unchanged after many years of use, cast fittings attached to the same containers may give out after a few years' use. The cause of the short life of the cast metal in all probability lies in the presence of impurities, thus providing the necessary elements for the formation of electrical couples and giving rise to galvanic action. For similar reasons, contact of pure aluminum with other metals intensifies solution and pitting of aluminum, and, as Seligman (1) suggests, the seriousness of the corrosion in such cases is intensified by the fact that the corrosion and pitting is often highly localized. The relative softness of aluminum is an additional objection, particularly when subjected to rough handling. This suggests the advisability of heavy construction, especially in the case of large equipment.

These several drawbacks, while serious, may be readily minimized, if not entirely eliminated, by intelligent study of the properties of this metal, and by suitable construction and proper use

of the equipment. Its cheapness, lightness, and comparative inertness in contact with the milk product recommend its more serious consideration in milk work in this country.

Chromium steels.—The chromium steels, as a group, showed very high resistance to corrosion. There was, however, some difference between the individual chromium steels. Superascoloy, the chromium-nickel steel, showed marked superiority over the ordinary chromium steel alloys, ascoloy and enduro. In fact, superascoloy ranked best of any of the metals under study. Where there was absence of corrosion in the case of several of the other metals, superascoloy invariably also proved entirely immune. In liquids and under treatment that caused serious corrosion of the other metals, superascoloy was either not affected at all, or led the list in point of resistance to such corrosion.

In only two cases did superascoloy show visible attack. One of these was successive exposure to steam, brine, and air for seven days, and even here the corrosion was exceedingly slight and far less than in the case of any other metal. The other instance refers to treatment in hydrochloric acid, and here, again, the corrosion was much less than that of the other metals, with the exception of aluminum-plated alloy and nickel, which lost only slightly more in weight than superascoloy. In no case did superascoloy injure the flavor of the milk product.

Ascoloy and enduro closely followed or were equal to superascoloy in most cases, as far as visible corrosion and loss in weight is concerned. This was true for sweet and sour milks and creams, washing powders, disinfectants, most of the brines and the organic acids. In hydrochloric acid and sulphuric acid both ascoloy and enduro corroded very profusely, lost greatly in weight, and dropped to the bottom of the list, together with zinc and iron. This suggests that when these chromium steels begin to yield to corrosion they may become very intensely affected, corroding and pitting very rapidly. This fact was further emphasized by their lack of stability under successive steam, brine, and air exposure. Furthermore, in high acid milk, such as acidophilus milk, both ascoloy and enduro produced a slight metallic flavor. Whenever these two alloys suffered corrosion the enduro proved slightly more resistant than the ascoloy. It was also noted in the case of enduro that the highly polished surface resisted corrosion considerably better than the unpolished back side. Because of these weaknesses, these ordinary chromium steels can not be considered dependable metals for use in all milk equipment. For this reason they must be looked upon as less suitable than tin and nickel which, according to these results, rank next to superascoloy. These observations are also supported by the work of North. (21) An analysis of his figures shows that superascoloy ranked first and

was closely followed by nickel and enduro. Quam (13) also compared the resistance of three chromium steels and found the superascoloy far superior to the ordinary chromium steels. Burrell (15) found chromium steel cheese vats very satisfactory.

Grindrod (8), who, before the advent of superascoloy in milk equipment considered all-nickel and all-tin the only metals suitable, reports that superascoloy has proven fully equal, and in some respects superior, to nickel in the construction and use of milk condensing and sterilizing equipment. Dahle (23) states that he used a superascoloy tank repeatedly for making pure culture milk with an acidity of 1 per cent, and noticed no spots or discoloration on the metal, nor any off flavors in the milk. MacQuigg (24) reports that high-chromium steels and chromium-nickel steels showed greater resistance to corrosion in the handling of corrosive chemicals than any other metal or alloy.

These results and experiences place superascoloy at the top of the list of suitable metals in milk work. In accepting this high ranking of superascoloy the reader should take cognizance of the fact that chromium steels are vulnerable and may suffer intense rusting and pitting when in contact, on the milk side, with certain other metals. Users of chromium steel tanks have learned that when such equipment contains rivets, bolts, fittings, or other accessories of such metals as iron, copper, nickel silver, Monel metal, etc., the resistance of the chromium steel to corrosion may be materially diminished and rust spots may appear. Rusting may also occur on welded surfaces of chromium steel in the absence of proper finishing of the weld, such as will remove all traces of iron oxide that may have formed during the welding process.

Combinations of metals.—The presence of two or more metals in the same piece of dairy equipment is fundamentally undesirable. Most metals used may differ in their electrical potentials, and this in turn invites corrosion by electrolysis. For similar reasons, impurities in metals are equally objectionable, as was pointed out in the case of cast aluminum. The corrosion-inciting effect of contact with other metals in the case of aluminum and chromium-steel equipment has already been explained under the respective heading of these metals.

Certain alloys have proven unsuitable for milk work because they, too, provide the elements for the presence of electrical couples. This appears to be especially the case with copper alloys, such as nickel silver, and to a lesser extent Monel metal. When these alloys corrode the metal that goes in solution is usually found to be the copper. It is well known by the metallurgist that in the case of nickel silver, for instance, segregation may take place during the cooling of the molten alloy, thus resulting in the formation of electrical couples

which, when submerged in the milk product, may incite electrolysis. The same situation prevails in equipment consisting of metal-coated surfaces, such as tinned iron, galvanized iron, tinned copper, whenever these coatings become defective and cause exposure of the metal underneath the coating.

These facts emphasize the importance of avoiding multiplicity of diverse metals in one and the same piece of equipment, of confining the construction of mechanical accessories and fittings that come in contact with the milk, as completely as possible to the metal of which the milk side of the equipment consists, or if different metals must be used, of giving preference to metals of similar electrical potentials. Emphasis should further be placed on the importance of purity of the metal used, the undesirability of copper alloys, and the necessity of keeping the coating of covered metals intact by recoating when the base metal becomes exposed.

While, for above reasons, the presence of more than one metal immersed in the milk product is undesirable, there are instances when the introduction of a second metal may not only be harmless but may actually be beneficial in that it may assist in retarding corrosion of the metal it is desired to protect. Thus, Quam (13) points out that aluminum, manganese, zinc, and wrought iron materially retard the corrosion of nickel and tin. Burrell (15) and McKay (25) likewise report that aluminum noticeably prevents the discoloration and pitting of nickel. In these cases galvanic action is utilized to protect the other metal against attack.

Toxicity of metals.—This experiment did not include the toxicological aspect of metals. The scarcity of comparable and tangible data available renders a discussion of this subject difficult. There appears to be no established standard of toxicity on the basis of which the several metals herein considered may be compared with reasonable accuracy. It is generally conceded that salts of such metals as chromium, copper, zinc, and tin are highly poisonous. Their solubility in milk work, therefore, is a factor of considerable importance, and the use in dairy equipment of those metals of toxic properties of which large amounts go into solution may be considered a questionable practice. This would apply both as regards their direct physiological effect on the human system, as well as their inactivating influence on the valuable milk vitamins.

SUMMARY

An experiment was conducted to determine the suitability of 19 different metals for use in milk-plant equipment. The effect of milk and cream, sweet and sour, and hot and cold, of dilute organic and mineral acids and of washing powders, chemical sterilizers, and calcium and sodium brines, on visible corrosion and loss of weight of

metal strips, both totally and partly submerged, was noted. Likewise, the influence of these metals on the flavor and character of the milk products was studied.

The results suggest the following classification of the metals studied with reference to their suitability for general use in dairy equipment from the standpoint of resistance to corrosion and effect on milk products—

(1) Superascoloy, tin, nickel.

(2) Tinned copper (heavily tinned), aluminum and aluminum manganese alloy, enduro, and ascoloy.

(3) Monel metal and nickel silver.

(4) Tinned iron, copper, galvanized iron, iron, zinc.

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[4] ADDENDUM.—Since the conclusion of this experiment the designation "Superascoloy" has been changed to "Allegheny Metal."

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THE PROBLEM OF CORRECTION OF MILK YIELD AND BUTTERFAT YIELD FOR AGE

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The changes in milk yield caused by the advancing age of the cow were first noted and a systematic attempt made to correct them in conjunction with the establishment of the advanced registries of dairy cattle. These corrections, though admittedly crude, performed a larger service. They held that milk production increased with the age of the cow up to five years, when the cow reached mature form and her milk yield became constant throughout the rest of her life. The increase in milk yield was supposed to commence at two years. The increase for each day was considered to be the same, or the relation of milk production to the age of the cow was supposed to be linear between the ages of two and five years. While exact investigation has shown these assumptions wrong, great credit is due to the men who first tried to solve this problem, for calling attention to it and for the closeness of the parallel of their assumed curve of milk yield and that actually found.

The law relating milk flow to age as stated by Pearl may be shown to hold for all breeds of dairy cattle yet studied. This law states that milk yield increases at an ever decreasing rate as the age of the cow advances until an age of maximum milk flow is reached, when the milk yield of the cow decreases at an ever-increasing rate. This law is of basic importance to all practice and research which relate to the secretory activities of the mammary gland, for an exact

knowledge of it is necessary to the theory and practice of dairy cattle breeding, feeding, and management. Yet in spite of its importance no summary has yet been made to indicate the degree of variation which may be expected in this law as it affects breeds of dairy cattle or individual animals. It is to supply this want in so far as the breeds are concerned that this paper is written. Among other things it is hoped to show:

(*a*) The variation in the mean milk flow of the different groups of dairy cattle.

(*b*) The variation in terms of the production at eight years and three months of age or practically maximum production.

(*c*) The variation of maximum production for the different groups.

(*d*) The changes in the variations (standard deviations) of the cows' milk productions at given ages.

(*e*) And, finally, to present the case for generalized correction factors for the correction of the milk production of any cow to that of her equivalent mature-form production.

The data necessary to study these questions were taken from the published papers of several different authors. They represent the mean milk production of the group of animals studied as determined for the given age of lactation. The units used to measure the cow's performance differ widely. Thus Gavin uses his "revised maximum daily yield";[1] Pearl the 7-day test, the 365-day test, and the average milk yield per week; Langmack the record for 400 days; Hammond and Sanders the lactation record; Gowen the 7-day, 365-day, and 8-month records, etc.

The correlation between a portion of a record and that of the whole lactation (Gowen) would make it appear as though the relation to the age of the cow would be quite similar for these different methods of measuring the cow's productivity.

That the difference in recording the ages of the cows is equally comparable is not so clear. The age groupings may be in 6-month intervals or 12-month intervals. The records are also based on the number of the particular location without regard to age. In view of these differences it has seemed best to divide the data into those giving the actual ages of the cows in either 6-month or 12-month groups and those recorded as the lactation number.

THE VARIATION IN THE MEAN MILK FLOW OR BUTTERFAT YIELD OF DIFFERENT GROUPS OF DAIRY CATTLE

Data showing the average production of dairy cattle for the 6-month age groups are presented in Table I. The first column gives the mid-point age of the group. The second to fifth, inclusive,

[1] The production three times exceeded during the lactation.

give the 365-day advanced registry productions, in pounds, of Jersey, Guernsey, Holstein-Friesian, and Ayrshire breeds. The sixth and seventh columns present the 7-day advanced registry data of the Jersey and Holstein-Friesian breeds. The eighth column is of particular interest as it shows the 8-month production of a purebred Jersey herd where no detectable selection of cows to remain within the herd on the basis of their previous production was practiced. These 8-month production records are especially important as comparative material with those of the advanced registry where a selection on the basis of the old requirement occurs. Columns 9 to 13, inclusive, show the relation of the butterfat yields of these breeds to age. Butterfat yield is determined as the product of the milk yield and the butterfat percentage of individual cows. Since the milk yield determines 60 or more per cent of the variation in butterfat yield, while the butterfat percentage determines less than 5 per cent, the butterfat yield should parallel closely that for milk yield when each is related to age. The graphs for the data show that such is in truth the case. Columns 14 to 25, inclusive, show the yields for the different ages as ratios of the production at eight years and three months.

The striking feature of this data is the general similarity in the direction taken by the different curves. With cows up to 8 years the lines tend to keep in their own relative positions. If the group of cows has a low relative production at 2 years of age, this group has a low relative production at 3, 4, 5, 6 years, etc. After 8 years the lines become irregular and jumbled, due presumably to the smaller numbers of cows involved. From the tendency of each breed to have its own rate of increase for its milk production with age it might be argued that generalized correction factors for all breeds would be undesirable. Close inspection of the material mitigates this conclusion somewhat. It will be noted that the 365-day Jersey, Guernsey, and Holstein-Friesian advanced registry data follow each other closely. The 7-day Holstein-Friesian data resemble these three curves fairly well. The 7-day Jersey, 365-day Ayrshire, and 8-month pure bred Jerseys are most divergent. The 7-day Jersey records are not strictly official records, and were taken when cows on test were fed and handled more like those of an ordinary commercial milk-producing herd. This would also be true of the 8-month Jersey records. The Ayrshire records have noted peculiarities, among them a later maximum of production and being subject to a direct selection requirement which must be passed for admission into their advanced registry. The fact remains after all is said that the curves for the different breeds show a 15 per cent variation in the ratios of their productions at most ages.

The curves also show a fairly wide variation in the age of maximum productions. This point is of rather minor importance in

view of the often indicated fact that as the curve of production approaches its maximum it approaches it slowly. The curve is very flat in this region. Thus, even slight variations will markedly shorten or lengthen the time age of a group of cows coming to maximum production. Such variations in many cases obviously have little relation to the animal's physiological economy.

Table II shows the data for cows grouped into yearly periods by the investigator studying the problem. The data of Pearl and Miner [1] like those of the previous 8-month Jersey records, are of much interest, as they represent the average trend of Scottish Ayrshires under herd conditions. The other data show the butterfat yields of the advanced registry cows of the different breeds as tabulated by Brody et al. These data are corrected into ratios of the production at eight years and six months as shown in the last columns of the table.

TABLE I.—*Relation between age and production*

Age of the cows	Milk yield							Butterfat yield				
	365-day advanced registry records				7-day advanced registry records		8-month records	365-day advanced registry records			7-day advanced registry records	8-month records
	Jersey	Guernsey	Holstein-Friesian	Ayrshire	Jersey	Holstein-Friesian	Pure-bred Jersey	Jersey	Guernsey	Holstein-Friesian	Holstein-Friesian	Pure-bred Jersey
1. 75	6, 506	7, 262	12, 007	7, 636	189	290	3, 471	351	371	423	10. 0	185
2. 25	6, 930	8, 042	13, 774	8, 167	206	316	3, 997	376	408	473	11. 0	210
2. 75	7, 332	8, 453	14, 264	8, 868	215	340	4, 220	397	429	503	11. 8	223
3. 25	7, 981	8, 710	15, 623	8, 960	232	385	4, 545	432	443	530	13. 5	240
3. 75	8, 381	9, 284	15, 860	9, 226	239	404	4, 917	454	473	534	14. 2	259
4. 25	8, 774	9, 637	16, 528	9, 881	244	433	4, 894	476	489	572	15. 3	259
4. 75	9, 216	9, 975	16, 972	10, 469	245	447	5, 121	493	502	581	15. 8	268
5. 25	9, 305	10, 390	17, 511	10, 673	248	458	5, 190	497	517	599	16. 4	272
5. 75	9, 516	10, 321	18, 178	10, 871	247	465	5, 368	508	516	633	16. 4	280
6. 25	9, 720	10, 598	18, 675	11, 069	252	468	5, 430	514	526	646	16. 5	283
6. 75	9, 760	10, 450	18, 760	10, 737	251	468	5, 655	515	523	644	16. 4	292
7. 25	9, 772	10, 812	18, 977	10, 770	254	467	5, 140	518	534	632	16. 4	268
7. 75	9, 877	10, 709	18, 939	10, 792	249	460	5, 532	520	532	646	16. 0	284
8. 25	10, 062	10, 887	19, 405	10, 371	250	472	5, 145	530	535	665	16. 7	265
8. 75	9, 762	10, 910	18, 560	10, 956	254	469	5, 331	504	530	623	16. 4	275
9. 25	9, 813	10, 829	18, 414	10, 759	256	466	4, 738	511	534	620	16. 1	247
9. 75	9, 596	10, 766	19, 654	11, 019	252	459	5, 143	505	524	625	15. 8	262
10. 25	9, 736	10, 739	17, 292	11, 598	255	463	5. 116	506	525	584	16. 1	265
10. 75	9, 765	10, 636	17, 500	11, 331	258	461	5, 000	514	513	530	15. 6	256
11. 25	9, 547	10, 471	19, 833	10, 291	254	458	4, 673	499	508	675	15. 7	248
11. 75	10, 455	9, 923	19, 833	10, 168	246	446	4, 950	532	484	634	15. 0	254
12. 25	8, 915	10, 677	16, 000	10, 998	254	456	4, 306	458	524	509	15. 4	214
12. 75	8, 916	10, 250	17, 000	10, 962	217	430	4, 750	481	500	-------	15. 0	235
13. 25	8, 806	9, 571	14, 500	11, 104	235	445	4, 350	475	451	-------	14. 9	209
13. 75	9, 315	9, 441	--------	10, 101	256	454	5, 250	493	477	-------	15. 8	286
14. 25	9, 517	--------	--------	9, 905	224	447	5, 000	498	-------	-------	15. 3	258
14. 75	9, 342	--------	--------	9, 591	230	380	4, 250	490	-------	-------	13. 4	235
15. 25	8, 976	--------	15. 000	9, 326	253	-------	--------	510	-------	-------	--------	--------
15. 75	8, 086	--------	--------	--------	243	-------	--------	460	-------	-------	--------	--------
16. 25	8, 223	--------	--------	--------	207	-------	--------	465	-------	-------	--------	--------
16. 75	8, 127	--------	--------	--------	228	-------	--------	437	-------	-------	--------	--------
17. 25	9, 930	--------	--------	9, 445	-------	-------	--------	-------	-------	-------	--------	--------
17. 75	--------	--------	--------	--------	-------	-------	--------	-------	-------	-------	--------	--------
18. 25	7, 512	--------	--------	--------	213	-------	--------	-------	-------	-------	--------	--------

[1] The data of Pearl and Miner are converted into butterfat by multiplying the gallons by 10 and then by the average butterfat percentage for the age.

TABLE I.—*Relation between age and production*—Continued

Age of the cows	Ratio of milk production at given age to that at 8 years 3 months							Ratio of butterfat production at given age to that at 8 years 3 months				
	Jersey	Guernsey	Holstein-Friesian	Ayrshire	Jersey, 7-day	Holstein, 7-day	Jersey, 8 months	Jersey	Guernsey	Holstein-Friesian	Holstein-Friesian	Pure bred Jersey
1.75	0.647	0.667	0.619	0.736	0.756	0.614	0.675	0.662	0.693	0.636	0.599	0.698
2.25	.689	.739	.710	.787	.824	.669	.777	.709	.753	.711	.659	.792
2.75	.729	.776	.735	.855	.860	.720	.820	.749	.802	.756	.707	.842
3.25	.793	.800	.805	.864	.928	.816	.883	.815	.828	.797	.808	.906
3.75	.833	.853	.817	.890	.756	.856	.956	.857	.884	.803	.850	.977
4.25	.872	.885	.852	.953	.976	.917	.951	.898	.914	.860	.916	.977
4.75	.916	.916	.875	1.009	.980	.947	.995	.930	.938	.874	.946	1.011
5.25	.925	.954	.902	1.029	.992	.970	1.009	.938	.966	.901	.982	1.026
5.75	.946	.948	.937	1.048	.988	.985	1.043	.958	.964	.952	.982	1.057
6.25	.966	.973	.962	1.067	1.008	.992	1.055	.970	.983	.971	.988	1.068
6.75	.970	.960	.967	1.035	1.004	.992	1.099	.972	.978	.968	.982	1.102
7.25	.971	.993	.978	1.038	1.016	.989	.999	.977	.998	.950	.982	1.011
7.75	.982	.984	.976	1.041	.996	.975	1.075	.981	.994	.971	.958	1.072
8.25	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
8.75	.970	1.002	.956	1.056	1.016	.994	1.036	.951	.991	.937	.982	1.038
9.25	.975	.995	.949	1.037	1.024	.987	.921	.964	.998	.932	.964	.932
9.75	.954	.989	1.013	1.062	1.008	.972	1.000	.963	.979	.940	.946	.989
10.25	.968	.986	.891	1.118	1.020	.981	.994	.955	.981	.878	.964	1.000
10.75	.970	.977	.902	1.093	1.032	.977	.972	.970	.959	.797	.934	.966
11.25	.949	.962	1.022	.992	1.016	.970	.908	.942	.950	1.015	.940	.936
11.75	1.039	.911	1.022	.980	.984	.945	.962	1.004	.905	.953	.898	.958
12.25	.886	.981	.824	1.061	1.016	.966	.837	.864	.979	.765	.922	.808
12.75	.886	.941	.876	1.057	.868	.911	.923	.908	.935	-------	.898	.887
13.25	.875	.879	.747	1.071	.940	.943	.845	.896	.843	-------	.892	.789
13.75	.926	.867	-------	.974	1.024	.962	1.020	.930	.892	-------	.946	1.079
14.25	.946	-------	-------	.955	.896	.947	.972	.940	-------	-------	.916	.974
14.75	.928	-------	-------	.925	.920	.805	.826	.925	-------	-------	.802	.887
15.25	.892	-------	-------	.899	1.012	-------	-------	.962	-------	-------	-------	-------
15.75	.804	-------	-------	-------	.972	-------	-------	.868	-------	-------	-------	-------
16.25	.817	-------	-------	-------	.828	-------	-------	.877	-------	-------	-------	-------
16.75	.808	-------	-------	-------	.912	-------	-------	.825	-------	-------	-------	-------
17.25	.987	-------	-------	.911	-------	-------	-------	-------	-------	-------	-------	-------
17.75	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
18.25	.747	-------	-------	-------	.852	-------	-------	-------	-------	-------	-------	-------

TABLE II.—*Relation of milk yield and butterfat yield to age*

Age of the cow	Milk, Ayrshire mean weekly yield	Butterfat, Ayrshire mean weekly yield	Butterfat							
			Ayrshire 365-day	Guernsey 365-day	Holstein 365-day	Holstein 305-day	Jersey 365-day	Shorthorn 365-day	Holstein	7-month record
	Gallons	*Gallons*								
1.7	-------	-------	-------	368	-------	-------	353	252	-------	-------
2.5	13.61	0.524	350	412	508	413	383	272	12.46	24.0
3.5	13.84	.540	378	452	570	475	443	285	14.91	28.1
4.5	15.23	.591	418	492	615	493	486	352	16.20	33.1
5.5	16.46	.612	448	511	644	513	502	376	17.39	35.0
6.5	17.47	.645	455	521	666	544	516	383	17.26	37.4
7.5	18.05	.666	478	528	665	547	521	405	17.32	37.1
8.5	18.26	.668	453	527	659	566	524	402	17.25	38.7
9.5	18.56	.676	454	524	654	541	510	403	17.19	36.9
10.5	18.74	.675	472	512	652	529	509	411	16.80	37.9
11.5	18.11	.657	423	486	650	538	513	369	16.34	33.8
12.5	18.46	.665	450	500	595	441	453	397	15.96	32.1
13.5	18.75	.677	436	447	569	510	470	399	15.54	33.3
14.5	17.95	.644	375	491	550	-------	447	360	15.04	34.8
15.5	18.13	.635	392	446	475	-------	551	353	15.40	-------
16.5	17.88	.654	-------	-------	-------	-------	-------	-------	-------	-------

TABLE II.—*Relation of milk yield and butterfat yield to age*—Continued

Age of the cow	Milk, Ayrshire mean weekly yield	Butterfat, Ayrshire mean weekly yield	Ratio of butterfat yield at given age to that at 8 years 3 months							
			Ayrshire 365-day	Guernsey 365-day	Holstein 365-day	Holstein 305-day	Jersey 365-day	Shorthorn 365-day	Holstein	Long-lived, 7-month record
	Gallons	*Gallons*								
1.7				0.698			0.674	0.627		
2.5	0.745	0.784	0.773	.782	0.771	0.726	.731	.677	0.722	0.620
3.5	.758	.808	.834	.858	.865	.839	.845	.709	.864	.726
4.5	.834	.885	.923	.934	.933	.871	.927	.876	.939	.855
5.5	.901	.916	.989	.969	.977	.906	.958	.935	1.008	.904
6.5	.957	.966	1.004	.989	1.011	.961	.985	.953	1.001	.966
7.5	.988	.997	1.055	1.002	1.009	.966	.994	1.007	1.004	.959
8.5	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
9.5	1.016	1.012	1.002	.994	.992	.956	.973	1.002	.996	.953
10.5	1.026	1.010	1.042	.971	.989	.935	.971	1.022	.974	.979
11.5	.992	.984	.934	.922	.986	.950	.979	.918	.947	.873
12.5	1.011	.996	.993	.949	.903	.779	.864	.988	.925	.829
13.5	1.027	1.013	.962	.848	.863	.901	.897	.992	.901	.860
14.5	.983	.964	.828	.932	.835		.853	.896	.872	.899
15.5	.993	.951	.865	.846	.721		1.052	.878	.893	
16.5	.972	.979								

TABLE III.—*Relation between lactation yields and production*

Lactation	Shorthorn and Friesian, revised maximum	Crossbred Shorthorn, yearly yield	Jersey	Angler, 400 days' yield	Fynske, 400 days' yield	Jutland, 400 days' yield	Crossbred Shorthorn, lactation record	Ayrshire
1	24.5	6,386	4,818	5,694	5,350	5,588	4,909	5,246
2	32.0	6,814	5,415	6,531	6,046	6,443	5,424	5,692
3	36.0	7,344	5,994	7,522	7,051	7,622	6,004	6,085
4	38.2	7,280	6,389	8,336	7,565	7,963	6,014	6,421
5	39.5		6,326	8,456	8,159	8,622	6,396	6,704
6	40.0		6,446	9,116	8,175	8,527		6,941
7	39.5		6,365	8,569	8,410	8,907		7,114
8	39.5			8,632	8,383	8,376		7,240
9				8,165	8,335	8,639		7,313
10				7,573	7,993	8,633		7,329
11								7,287
12								7,203
13								7,056
14								6,862
15								6,610
16								6,306
17								5,949

Lactation	Ratio of production at given lactation to that of sixth lactation							
	Shorthorn and Friesian	Crossbred Shorthorn	Jersey	Angler	Fynske	Jutland	Crossbred Shorthorn	Ayrshire
1	0.612	0.877	0.747	0.625	0.654	0.655	0.768	0.756
2	.800	.936	.840	.716	.740	.756	.848	.820
3	.900	1.009	.930	.825	.863	.894	.939	.877
4	.956	1.000	.991	.914	.925	.934	.940	.925
5	.987		.981	.928	.998	1.011	1.000	.966
6	1.000		1.000	1.000	1.000	1.000		1.000
7	.987		.987	.940	1.029	1.045		1.025
8	.987			.947	1.026	.982		1.043
9				.896	1.020	1.013		1.054
10				.831	.978	1.013		1.056
11								1.050
12								1.038
13								1.017
14								.989
15								.952
16								.919
17								.857

The ratios of Table II present the same general impression as those of Table I. This would be expected since the butterfat yields are almost entirely determined by the milk yields. Thus the butterfats have an initial rapid increase with age, the impulse dying off until a maximum production anywhere between 7 and 11 years is reached when the butterfat yield again declines. The variation in the percentage noted for any one age is fairly wide, amounting to anywhere between nine and fifteen hundredths.

Hammond and Sanders have brought together the data of several investigators on the relation of production to age. These data are tabulated on the basis of the lactation number rather than age. In view of the fact that there is a high correlation between lactation number and age the general relations between these curves and those of the preceding two tables should be closely comparable, allowing about one year for each lactation, the first lactation commencing at two and a half to three years. Table III shows this material for the records not yet presented. To make the table comparable with the two preceding it, the ratios of the first lactations' productions as given by Hammond and Sanders are converted into pounds. The ratios are then determined, using the sixth lactation as the basis, since the sixth lactation and eight years of age for the cow would closely correspond.

The general form taken by the data of Table III is notably like that taken by that of Tables I and II. A fairly wide range of ratios between the production at the given lactation and that at the sixth lactation is noted. This range amounts to from ten to fifteen hundredths. The curve of Tocher appears to be a fitted curve, the raw data not being given. The curve for the Angler breed conforms fairly well with those of the other breeds up to the sixth lactation, save that it is slightly lower. From the sixth lactation on, however, this curve drops off rapidly.

TRUNCATION OF ADVANCED REGISTRY DATA AND ITS EFFECTS ON THE RELATION OF AGE TO PRODUCTION

Those familiar with advanced registry data recognize the fact that the requirement for entry cuts off or eliminates the lowest producing cows of the breed from having their productions recorded. The question naturally arises as to the effect of this truncation on the average production curves. The writer some years ago approached this problem by fitting normal curves to the truncated portion of the Guernsey 365-day advanced registry records. Davidson has recently published an important paper in which he approaches the problem by fitting a log-transformed equation to the truncated data of the Jersey registry of merit records. The essential outcome of these

studies shows that while the requirement for entry into the advanced registry does select a slightly larger producing group of cattle the mean curves of production when plotted against age parallel each other rather well. In view of this fact it appears to be a justifiable procedure to use the advanced registry data as they are given in the determinations leading up to the curves showing the ratios of productions at one age in comparison with those at other ages. The data as previously given will consequently be used as they are derived from the raw advanced registry material of the different breeds.

TABLE IV.—*Average ratio of milk production or butterfat yield at given ages to that at 8 years 3 months for breeds of Table I*

Age	Ratios to mature form production	
	Milk yield	Butterfat yield
1.75	0.673	0.658
2.25	.742	.725
2.75	.785	.771
3.25	.841	.831
3.75	.852	.874
4.25	.915	.913
4.75	.948	.940
5.25	.969	.963
5.75	.985	.983
6.25	1.004	.996
6.75	1.004	1.000
7.25	.998	.984
7.75	1.004	.995
8.25	1.000	1.000
8.75	1.005	.980
9.25	.984	.958
9.75	1.000	.961
10.25	.994	.956
10.75	.989	.925
11.25	.974	.957
11.75	.978	.944
12.25	.939	.868
12.75	.923	.907
13.25	.900	.855

GENERALIZED RELATION BETWEEN MILK YIELD OR BUTTERFAT YIELD AND AGE

The general summary of the work so far presented may be stated. For careful work with any breed where the same data are to be utilized for further study, it is desirable to determine the age relation to milk yield or butterfat yield for those data. For data on grades or other such mixed breed material, this conclusion might also hold, although probably with less force. The recommendation appears to have much less weight when the correction factors are to be determined on one set of data and later applied to similar subsequent data for the same breed. Thus, when the 7-day Jersey records are examined, they present a slightly higher curve than the later 365-day records. When the 7-day Holstein-Friesian records are examined, however, they do not show this difference with the later 365-day

records. The variation of the relation of milk yield to age from breed to breed is but little more than that for the different sets of data for the same breed.

These facts strongly suggest that the variation of two or more groups of records for the relations of milk production to age for the same breed of cattle is due to other causes than any innate difference of the physiology of the cows themselves. These causes may be very special causes and possibly simply due to random sampling, which should be smoothed out rather than accentuated in utilizing the milk and age relation of one set of data to age-correct the milk yields for a subsequent set of data. Granting such a view, the generalized correction factor for age and milk yield as determined for all breeds will have a real place. These averages are presented in Table IV as determined from Table I.

Table IV shows the average ratios of milk production or butterfat yield for each age to the standard age, eight years and three months. These curves are based on production records of the Jersey, Guernsey, Holstein-Friesian and Ayrshire cattle. In general, each group of records has its curve take a distinctive trend. It is either above or below the average curve. For milk yield the mean curve is above the Jersey (365-day), Guernsey, Holstein-Friesian (7-day and 365-day) curves. It is below the Ayrshire, Jersey (7-day), Jersey (8-month) curves. The consistency of the relation is shown by the sign of the differences between the average curve and the mean curve. The Jersey (365-day) has 22− to 1+; (7-day) 19+ to 4−; (8-month) 14+ to 6−; Guernsey 19− to 4+; Holstein-Friesian (365-day) 20− to 3+; (7-day) 17− to 6+; and Ayrshire 23+. The average differences are Jersey (365-day) −0.029; (7-day) +0.025; (8-month) +0.014; Guernsey −0.014; Holstein-Friesian (365-day) −0.045; (7-day) −0.013; Ayrshire +0.062. The case is slightly worse than these differences show, as each curve tends to follow a course with respect to the average curve which is either above the average curve over a long period, or below it for a long period, depending on the places of crossing the average curve if such exist. On the basis of these facts each curve could be said to have its own position in space. That this position is not entirely due to the physiological differentiation of the breeds would seem to be indicated by the fact that the Jerseys' 365-day records show minus differences, whereas the 7-day and 8-month records are positive and to an equal degree. The Holstein-Friesian 365-day records are much further below the average curve than the 7-day records. The Jersey registry of merit offers an opportunity to test this further by using the data accumulated since they changed their requirement for entry,

a change from 360 pounds +0400 pounds for the five year or over class. These records have been tabulated and are presented in the following table:

Age	Milk yield	Butterfat yield	Ratio to production at 8 years 3 months		Milk yield	Butterfat yield	Ratio to production at 8 years 3 months	
			Milk yield	Butterfat yield			Milk yield	Butterfat yield
1.75	7,381	402	0.684	0.713	6,851	370	0.667	0.683
2.25	7,858	427	.728	.758	7,223	393	.704	.724
2.75	8,268	453	.766	.803	7,601	413	.740	.761
3.25	8,792	480	.814	.852	8,259	447	.805	.825
3.75	9,594	522	.889	.926	8,723	473	.850	.873
4.25	10,052	536	.931	.951	9,081	494	.885	.911
4.75	10,370	557	.960	.989	9,534	512	.929	.944
5.25	10,526	564	.975	1.000	9,671	517	.942	.953
5.75	11,006	567	1.019	1.005	9,897	531	.964	.979
6.25	10,681	559	.989	.991	10,078	536	.982	.989
6.75	10,637	561	.985	.995	10,119	536	.986	.988
7.25	10,884	573	1.008	.016	10,101	536	984.	.989
7.75	11,089	571	1.027	1.013	10,251	540	.999	.997
8.25	10,797	564	1.000	1.000	10,266	542	1.000	1.000
8.75	11,182	591	1.036	1.049	10,128	524	.987	.967
9.25	10,782	557	.999	.987	10,140	529	.988	.975
9.75	11,294	581	1.046	1.030	10,010	528	.975	.973
10.25	10,720	547	.993	.969	10,123	529	.986	.975
10.75	10,681	558	.989	.990	10,086	531	.982	.980
11.25	11,113	575	1.029	1.020	9,888	522	.963	.963
11.75	11,200	571	1.037	1.013	11,182	572	1.089	1.055
12.25	11,093	571	1.027	1.012	9,489	492	.924	.907
12.75	10,688	537	.990	.952	9,555	528	.931	.975
13.25	10,564	550	.978	.976	9,115	500	.888	.922
13.75	10,282	497	.952	.881	9,662	516	.941	.952
14.25	10,814	522	1.002	.926	9,985	520	.973	.960
14.75	10,684	562	.990	.997	10,638	545	1.036	1.005
15.25	8,834	405	.818	.718	8,976	510	.874	.941
15.75					9,220	509	.898	.939
16.25	16,008	774	1.483	1.373	8,223	465	.801	.857
16.75	10,700	592	.991	1.050	9,270	530	.903	.978
17.75					9,930	590	.967	1.088
18.25	9,106	515	.843	.913	7,512	407	.732	.750

Comparison of the ratios of Tables IV and V demonstrates again the variation which may be found in the correction factors even within the same breed and class of animals. The divergence amounts to larger correction factors for the milk yields in both groups of data, the older cows particularly tending to yield more milk.

These facts lead to the conclusion that the generalized relation of milk yields to age as found for all breeds of cows is in large measure true when applied back to the individual breed or group. The general trends are the same. The resemblance is not absolute, however. Individual breeds or groups show more or less consistent differences. Study of the groups within a given breed indicates that the consistent differences may not be as important as might first appear. The case therefore appears fairly good for generalized correction factors to be applied to most data on milk yields requiring age correction. This conclusion also holds for the butterfat yields.

THE VARIATION OF MAXIMUM PRODUCTION FOR THE DIFFERENT BREEDS OF CATTLE

The preceding tables furnish the most comprehensive material in existence to answer the question, When is the age of maximum productivity in the milch cow? These charts substantiate the conclusions of Pearl and Gowen, based on certain of the individual curves, that the maximum production is found around 8 years of age with a variation of about two years either side of this age for individual cases. This variation appears to be partly due to breed but more generally due to random variations, as the curve for production with age is quite flat during this period, approaching and regressing from its asymptote slowly. The average ages of the three highest productions for the different groups are shown in Table VI.

TABLE VI

Group of records	Milk yield	Butterfat yield
Jersey (365-day)	9.3	9.3
Guernsey (365-day)	8.8	8.3
Holstein-Friesian (365-day)	10.9	8.8
Ayrshire	10.3	--------
Jersey (7-day)	10.4	--------
Holstein-Friesian (7-day)	7.8	7.0
Jersey (8-month)	6.9	6.9
Ayrshire (mean weekly)	11.2	11.2
Ayrshire (365-day)	--------	8.2
Guernsey (365-day)	--------	8.5
Holstein-Friesian (365-day)	--------	7.5
Holstein-Friesian (305-day)	--------	7.5
Jersey (365-day)	--------	7.5
Shorthorn (365-day)	--------	9.2
Holstein-Friesian (7-day)	--------	6.5
7-month record	--------	8.5

Table VI shows the averages of the three highest productions for the different groups of cattle. This measure of maximum production, though far from ideal, gives an indication of the age of maximum yield. A better measure is the actual maximum of the fitted data since this indicates the weighted trend of all points. These maxima have been indicated elsewhere. The random variation introduced in the age of maximum production by the method of grouping the data is clearly noted in the determinations of those grouping by half years and those grouping by full years. The age of maximum production varies between 6.5 and 11.2 years, with an average of 8.7 years. The age of maximum milk production is slightly older than the age of maximum butterfat yield due to the negative correlation between butterfat percentage and age.

The data have shown that the average milk yields for Jersey registry of merit cattle at 2 years old is 6,855 pounds and 9,829 pounds

at 8 years and 3 months, or the average milk yield at 8 years is 1.434 times the milk yield at 2 years, since $\frac{9829}{6855}=1.434$. If it be supposed that milk production at 2 years and at mature form stand in the direct relation of their means it would be necessary to multiply the 2-year production by 1.434 to obtain the probable mature form production. This method of determining the correction factors for age and milk yield is the one customarily employed with results which are satisfactory for most practical purposes. A slightly more exact method takes into account not only the changes in the variation of the milk yields and butterfat productions with age but also the changes in the variation of the milk yields and butterfat percentages with age. This variation is particularly important for milk production as this variation has a definite relation to age represented by small standard deviations at 2 years old and increasing at an ever decreasing rate until the mature form of the cow is reached at about 8 years of age when the variation decreases at an ever increasing rate. The importance of this variation to the correction of records to a mature form basis is best illustrated in graphical form. Figure 1 shows the frequency distribution of Jersey cows' milk yields at 2 years of age, solid line, and at 7 to 8 years of age, dotted line.

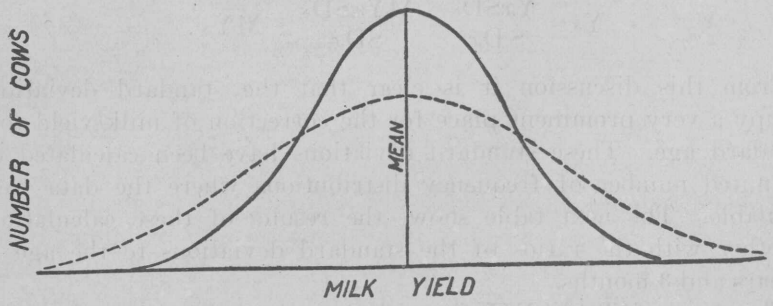

Figure 1 shows the milk yields of Jersey cows under ordinary herd conditions.[1] It represents all the cows in one large herd. There have been no selections like that which takes place in the registries of merit. The solid line represents the frequency distribution for numbers of cows making the given milk yield, the cows being 2 years of age. The dotted line represents the frequency distribution of cows tested at 7 to 8 years of age. The curves were made to correspond by bringing together the mean milk yields of each and then distributing each around this average production.

[1] Gowen, John W. 1920. Studies of Milk Secretion. V. On the variation and correlations of milk secretion with age. Genetics, v. 111–188.

It is obvious that in this purebred Jersey herd the 2-year-old cows are much less variable in their milk yields than the cows which have reached the mature age, 7 to 8 years, From this fact the conclusion is equally obvious that a cow, a certain distance from the average production at 2 years, to occupy the same position among the other cows at 8 years, must have a milk yield much further away from the average 8-year production. The ratio of the differences from the average yield for cows within these different distributions would be in the ratio of their standard deviation or the standard deviation of 8 years divided by the standard deviation at 2 years which gives the relative position of the cows for their 8-year distribution as contrasted to their 2-year distribution.

The degree of variation which exists in the milk production of cows at different ages is therefore a very important item considering the effect of age on production. The formula which determines the relation of age to milk yield is milk yield at mature form (Ys) equals milk yield at x age (Yx) multiplied by the standard deviation for the milk yield at the standard age (SDs) divided by the standard deviation at x age (SDx) minus the milk yield at x age (MYx) multiplied by the standard deviation at the standard age (SDs) divided by the standard deviation at x age (SDx) plus average milk yield at standard age (MYs), or in equation form

$$Ys = \frac{YxSDs}{SDx} - \frac{MYxSDs}{SDx} + MYs .$$

From this discussion it is clear that the standard deviations occupy a very prominent place for the correction of milk yield to a standard age. These standard deviations have been calculated on a limited number of frequency distributions where the data were available. The next table shows the results of these calculations together with the ratios of the standard deviations to the age of 8 years and 3 months.

The data of Table VII show the standard deviations for milk productions and butterfat yields with age for the available data. The picture presented by these standard deviations resembles that shown for the means. The standard deviations, as might be expected, show fairly wide variations from breed to breed, the variations becoming extreme toward the later years of life due to the decrease in numbers of cows on which information is available.

TABLE VII.—*Standard deviation of milk production*

Age, years	Holstein-Friesian		Jersey		Guernsey, 365-day	Ayrshire [1]	8-month Jersey	Ayrshire, Pearl and Miner	
	365-day	7-day	365-day	7-day				Age	
1.75	2,637	50.5	1,263	40.7	1,513	1,604	503	2:5	2.514
2.25	2,883	54.5	1,394	39.4	1,745	1,691	820		
2.75	2,864	61.6	1,517	38.0	1,807	1,827	865	3:5	2.449
3.25	3,440	69.7	1,554	38.9	1,891	1,723	972		
3.75	3,412	68.9	1,819	39.2	1,977	1,565	1,275	4:5	2.743
4.25	3,729	69.2	1,977	39.2	2,061	1,824	1,056		
4.75	3,517	72.6	1,963	40.2	2,158	1,698	1,116	5:5	2.755
5.25	3,928	70.9	1,971	39.3	2,203	1,534	1,252		
5.75	3,867	73.4	1,953	43.1	2,043	1,825	1,282	6:5	2.962
6.25	3,794	75.7	2,144	42.7	2,349	2,326	1,368		
6.75	4,010	71.8	2,118	45.8	2,199	2,115	1,349	7:5	2.970
7.25	4,086	78.2	2,226	48.1	2,313	1,834	1,200		
7.75	4,735	70.2	2,262	43.0	2,318	1,472	1,284	8:5	2.969
8.25	4,058	80.3	2,284	45.2	2,197	1,344	1,326		
8.75	3,987	78.0	2,325	46.9	2,474	1,609	1,281	9:5	2.909
9.25	3,111	89.7	2,098	44.6	2,359	2,287	1,246		
9.75	3,987	74.5	2,007	52.0	2,345	1,500	1,343	10:5	3.037
10.25	4,406	79.4	2,252	36.3	2,304	2,888	904		
10.75	3,038	72.2	2,209	61.6	2,351	2,537	1,369	11:5	3.330
11.25		79.4	2,090	56.9	2,307	1,534	1,026		
11.75		68.1	2,047	46.9	1,780	1,009	748	12:5	3.087
12.25		75.1	2,745	52.5	2,065	1,020	1,117		
12.75		61.7	1,689	34.9	2,005	3,775	655	13:5	2.986
13.25		56.8	2,240	42.2	1,944	1,479	1,068		
13.75		69.0	1,479	62.6	1,552	1,000	908	14:5	3.640
14.25		64.5	1,379	35.5	816	2,062	748		
14.75		84.2	2,000	53.4				15:5	3.306
15.25			2,211	11.6	1,639				
15.75			1,090					16:5	2.364
16.25			2,227	40.1					
16.75			471	35.7					
17.25			471						
17.75									
18.25									

[1] The advanced registry data of the Ayrshire do not show this rise in the standard deviations with age. One cause to which this difference may be attributed is the obviously low standard deviation at 8 years and 3 months. What other peculiar influences on the data have caused this effect are unknown.

Standard deviation in ratio to 8-year 3-month production

Age, years	Holstein-Friesian		Jersey		Guernsey	Ayrshire	8-month Jersey	Ayrshire, Pearl and Miner		Average columns, 11–17
	365-day	7-day	365-day	7-day				Age		
1.75	0.650	0.629	0.553	0.900	0.689	1.208	0.379	2 : 5	0.847	0.633
2.25	.716	.679	.610	.872	.794	1.275	.618			.715
2.75	.706	.767	.664	.841	.823	1.381	.652	3 : 5	.825	.742
3.25	.848	.868	.680	.861	.861	1.300	.733			.808
3.75	.841	.858	.796	.867	.900	1.185	.960	4 : 5	.924	.870
4.25	.919	.862	.866	.867	.938	1.374	.796			.875
4.75	.867	.904	.859	.889	.982	1.283	.842	5 : 5	.928	.891
5.25	.968	.883	.863	.870	1.003	1.155	.944			.922
5.75	.953	.914	.855	.954	.930	1.377	.967	6 : 5	.998	.929
6.25	.935	.943	.939	.945	1.069	1.759	1.032			.977
6.75	.988	.894	.927	1.013	1.001	1.597	1.017	7 : 5	1.000	.974
7.25	1.007	.974	.975	1.064	1.053	1.385	.905			.996
7.75	1.167	.874	.990	.951	1.055	1.109	.968	8 : 5	1.000	1.001
8.25	1.000	1.000	1.000	1.000	1.000	1.011	1.000			1.000
8.75	.983	.971	1.018	1.038	1.127	1.215	.966	9 : 5	.980	1.017
9.25	.767	.868	.919	.987	1.074	1.728	.940			.926
9.75	.983	.928	.879	1.150	1.067	1.132	1.013	10 : 5	1.023	1.003
10.25	1.086	.989	.986	.803	1.049	2.181	.682			.932
10.75	.749	.899	.967	1.363	1.070	1.917	1.032	11 : 5	1.122	1.013
11.25		.989	.915	1.259	1.050	1.155	.774			.997
11.75		.848	.896	1.038	.810	.762	.564	12 : 5	1.040	.831
12.25		.935	1.202	1.162	.940	.770	.842			1.016
12.75		.768	.740	.772	.913	2.853	.494	13 : 5	1.006	.737
13.25		.707	.981	.934	.885	1.117	.805			.862
13.75		.859	.648	1.385	.706	.755	.685	14 : 5	1.226	.857
14.25		.803	.604	.785	.371	1.978	.564			.626
14.75		1.049	.876	1.181				15 : 5	1.114	
15.25			.968	.257	.746					
15.75			.477					16 : 5	.796	
16.25			.975	.887						
16.75			.206	.790						
17.25			.206							
17.75										
18.25										

Standard deviations of butterfat yields

Age, years	Jersey 365-day	Holstein-Friesian 365-day	Guernsey 365-day	Holstein-Friesian 7-day	Jersey	Holstein-Friesian	Guernsey	Holstein-Friesian	Average standard deviation ratio
1.75	72.2	88.3	71.0	1.97	0.592	0.548	0.641	0.608	0.597
2.25	80.4	109.1	86.2	2.26	.660	.677	.778	.698	.703
2.75	82.0	111.5	89.9	2.46	.673	.692	.812	.759	.734
3.25	94.8	127.1	92.7	2.83	.778	.789	.837	.873	.819
3.75	102.8	114.4	98.5	2.88	.843	.710	.889	.889	.833
4.25	103.6	138.6	102.5	2.99	.850	.860	.925	.923	.890
4.75	103.7	134.4	105.1	2.93	.851	.834	.949	.904	.885
5.25	100.7	155.5	104.7	3.06	.826	.965	.945	.944	.920
5.75	112.8	147.5	99.7	3.05	.925	.915	.900	.941	.920
6.25	110.5	151.0	121.1	3.00	.906	.937	1.094	.926	.966
6.75	114.2	152.8	117.2	2.89	.937	.948	1.058	.892	.959
7.25	120.8	139.0	114.9	3.16	.991	.862	1.037	.975	.966
7.75	118.0	140.0	119.3	2.90	.968	.869	1.078	.895	.953
8.25	121.9	161.2	110.8	3.24	1.000	1.000	1.000	1.000	1.000
8.75	110.5	129.0	116.4	3.07	.906	.800	1.051	.948	.926
9.25	112.2	110.9	119.2	2.79	.920	.688	1.076	.861	.886
9.75	117.3	133.7	115.5	2.60	.962	.830	1.043	.802	.909
10.25	116.0	138.1	110.4	3.01	.952	.857	.997	.929	.934
10.75	109.6	83.4	105.9	2.49	.899	.517	.957	.769	.786
11.25	105.3	209.5	100.6	2.63	.864	1.300	.908	.812	971
11.75	130.7	150.7	86.0	2.42	1.072	.935	.776	.747	.883
12.25	90.9	73.8	94.5	2.71	.746	.458	.853	.836	.723
12.75	132.1	125.0	90.0	2.00	1.084	.776	.813	.617	.823
13.25	80.5		96.8	2.40	.660		.874	.741	.758
13.75	82.8		47.9	2.21	.679		.432	.682	.598
14.25	74.5		23.6	2.17	.611		.213	.670	.498
14.75	108.0			.90	.886			.278	.582
15.25	41.5		54.5		.340		.492		.416
15.75	112.2				.920				.920
16.25	40.8				.335				.335
16.75	70.7				.580				.580
17.25									
17.75									
18.25									

The general trend of the standard deviation is similar to that shown for the means, in that the standard deviations of production increase at an ever-decreasing rate toward the age of maximum variation, from which point the variations tend to decrease at an ever-increasing rate, the form of the curve being parabolic rather than logarithmic.

The standard deviations of production have been reduced to the ratio of the given standard deviations to those of eight years and three months.

Examination of these data shows that the ratio of variation for the different breeds may vary considerably, as much as a fifth of the total ratio. The different breeds of cattle furthermore appear to keep their relative position with regard to this variation. If the given group of cows shows a low variation in one age, they tend to show this low variation at succeeding ages. It would seem, therefore, that the variation for any given group of data is likely to be fairly consistent for that group, tending to occupy the same relative position with regard to the rest. If the 7-day standard deviations are compared with the 365-day standard deviations for the Holstein-Friesian and Jersey breeds, it will be noticed that for the Jerseys the 7-day standard deviations appear to be above the average whereas for the 365-day they appear to be below the average. The 7-day Jersey record unfortunately did not have the supervision which went with the official production registry work. As these 7-day Jersey results appear to differ quite widely from the rest and this lack of supervision may be the cause, it appears desirable to omit them from the average coefficients. The columns of averages do not include these 7-day Jersey results.

The general formula for the correction of production for age may well come in for scrutiny at this time. The formula was—

$$Ys = \frac{Yx\ SDs}{SDx} - \frac{MYx\ SDs}{SDx} + MYs$$

The closely similar nature of the mean and standard deviation curves for milk production suggests that the coefficients of variation or the ratio of the standard deviations to the means might be constant. Analysis of the data on this question indicates that within certain limitations such a conclusion may be justified. If so the prediction equation takes the following form since the coefficient of variation of one age equals that of any other,

$$100\ \frac{SDx}{MYx} = \frac{SDs}{MYs} - 100.$$

$$Ys = Yx\ \frac{MYs}{MYx}$$

The influence of the standard deviation curve is thus only partially effective, if effective at all, in the problem of age correction of milk and butter-fat production. For many of the age corrections to be applied to milk records in practical work these standard deviations could no doubt be neglected. In more critical work the nature of the relationship should be investigated on the data used.

SUMMARY

This paper presents the case for age correction of the records of milk production together with an analysis of the general problem. The essential facts noted are these. The average milk yields of dairy cattle, grouped by breed, differ markedly and consistently when plotted on age. The general shape of these curves for all breeds is the same, showing that milk yield is related to age in a manner such that milk yield increases with age at an ever-decreasing rate until an age of maximum production is reached, when it declines at an ever-increasing rate as age advances. The ratio of the production at a given age to the production at mature form is similar for the different breeds but not identical. The standard deviations of milk yields with age show much the same trends as those shown by the mean milk productions, rising at an ever-decreasing rate to a maximum at about eight years and declining from that maximum as age advances. A curious relation exists between the means and standard deviations of the different ages, as the ratio between them tends to approach a constant. If such is the case age corrections based on the means will account for the whole correction. Data to facilitate these corrections are presented. It should be recognized throughout, however, that these corrected records do not predict what the cow will do in another lactation; they only indicate what the cow's record was equivalent to in terms of mature-form production.

RELATIONSHIP BETWEEN THE MILK PRODUCER AND THE MILK DEALER

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Milk producers sell and milk dealers buy milk. The immediate relationship is, therefore, one of seller and buyer.

If the farmer produced his milk from weeds and cornstalks and if the dealer sold his product to the denizens of a blue moon, the relationship would be simple and of little concern.

But the case is not so simple. The dealer sells to a consumer, an earthly consumer who has many other wants, many standards, and

the usual human measure of fancies, whims, sterotyped ideas, and health needs. The producer has alternatives as to what he may do with his time and with his capital. So while the dealer buys from the farmer and sells to the consumer, the producer has a direct interest in the price the consumer pays, and in the consumer's needs, beliefs, and ideas about his product; for those needs, beliefs, ideas, even fancies, constitute the demand for what he has to sell and the demand for the product affects the farmer's price. This is true whether this dealer in the middle sells wholemilk or any of the products of milk.

THE LAW OF SUPPLY AND DEMAND

"But the law of supply and demand fixes prices, and neither the farmer nor the dealer can do anything about it." This is a statement that represents the point of view of the old school of pessimistic economics. If we believe that, we should stop all advertising, pull down all billboards, and stop all farm meetings in which production is discussed.

But the factors in both supply and demand are largely man-made. And being man-made, we can do something about them. Moreover, the factors all vary and can be changed. Whether anything coming out of a relationship where the factors are so tractable as in both supply and demand can be called a law, we need not stop here to discuss. But rather let us list some of the factors in supply and in demand and then ask how well-directed human endeavors are changing and may change those factors. In this relation of conscious human effort as applied to each of the factors making up supply and demand, we will find the vital relationships between those who produce milk and those who distribute milk and its products.

Milk producers have alternatives as to what they will do with their land, their equipment, and their labor. To be sure some may be so situated as to market or as to natural advantages that they would continue to produce milk at a price that would bankrupt others not so situated. But a sufficient number of producers in any given territory will have alternatives sufficient to measurably increase or decrease the supply of milk. The extreme alternative is to abandon the farm and seek employment either in industrial establishments or in farms with better native advantages, or with better market facilities. Or the decision may be to stay on the same farm but to produce other commodities. And nowadays in any one of these decisions knowledge, spread through conscious endeavor, helps make the decision.

SOME ILLUSTRATIONS

To just what crop is a given piece of land best suited? Some of the facts essential to an answer to this question have to do with the chemical analysis of the soil. Some have to do with principles of crop rotation. Some depend upon the market. Some depend upon the skill and knowledge existing in the community. Some may have to do with suburban values. Some—the most important—deal with whether schools are at hand and with the religious traditions of the farmers. Some may have to do with breaking down age-old traditions as to methods. Some may have to do with choice of seeds or of plants. What soil bacteria can be made to thrive? Can the soil be drained or irrigated? Is labor dear or cheap? These are but a few of the factors determining whether pasture and feeds for milch cows can profitably be produced on a given farm at a given price. The factors involved are not adamant, unless as to native soil ingredients; and something can be done by man even about these. The factors all yield to the growing science of soil use and to the growing mobility of producers to new methods and new facts.

I have listed in the following table just a few of the factors influencing the supply of and demand for milk. I have also given briefly some steps that may be taken to influence each of these factors through conscious policies. The list is incomplete necessarily, as time and space forbid even an attempt at an exhaustive list.

I have tried to divide these factors into those influencing demand and those influencing supply. I have tried also to classify the factors that can be influenced by individual action and those that can be influenced mainly by cooperative action and those that can be influenced by community or public action. This distinction soon gets into borderlands where the distinctions disappear. That only points to the close human relationships in all these matters.

SOME FACTORS INFLUENCING THE SUPPLY OF MILK

The factors	What the individual producer may do	What producers or milk dealers or both may do cooperatively	What the community or Government may do
Winter weather too severe.	Protection from cold in modern barns; possibly choice of breeds of cattle.	Organize the transportation and delivery of milk to help meet these problems.	Keep channels of transportation open.
Summer weather too hot.	Shade trees or sheds for cattle; proper cooling of milk.	Receiving stations for cooling milk; facilities for hauling.	Adequate refrigeration in transportation.
Land too wet	Tiling of fields. Improved methods of cultivation.	Expert advice; technical knowledge.	Drainage or levees where area is large.
Land too dry	Irrigation; frequent cultivation; adaptation of crops.	Technical assistance	Irrigation reservoirs; experiment stations for testing methods, seeds, and crops.
Lands depleted in certain elements essential to growth of animal or vegetable life.	Lime, phosphorus, nitrogen, iodine, or other needs can be supplied.	Practical guidance and advice.	Experimental and extension work in land utilization.

SOME FACTORS INFLUENCING THE SUPPLY OF MILK—Continued

The factors	What the individual producer may do	What producers or milk dealers or both may do cooperatively	What the community or Government may do
Motive of land ownership absent.	Thrift	Cooperation in getting necessary legislation.	Land and credit legislation.
Labor not skilled in dairy methods or dairy sanitation.	Each farmer can learn the facts and teach them to his help.	Producers' organizations can and do send out trained advisers.	Short-term agricultural schools.
Special pests	Prevention methods, such as crop rotation; use of poisons.	Technical advice and, if necessary, special aid.	Quarantine; research in experiment stations as to preventive methods.
Widespread disease such as tuberculosis or contagious abortion or foot-and-mouth disease.	Isolation of infected animals; care in purchasing.	Technical aid and securing cooperation of public authorities.	Quarantine; indemnity funds; technical knowledge.
Small output per cow	Selection of cows and sires.	Cow-testing associations; bull associations; dissemination of information as to what the best farmers are doing.	Credit associations; investigation of essential factors and their dissemination.
Wages too high	Use of power machinery and labor-saving devices.	Cooperation with public authorities in training help or in establishing special schools.	Changes in immigration laws.
Living standards on farms too low.	Seek other occupations or turn to other uses of land, labor, and capital; improved methods to lower unit costs and hence increase unit profits.	Educate the consuming public as to the facts among farmers as compared with other industrial groups.	Tariff policies; credit policies; favorable laws as to cooperative buying and selling.
Inadequate transportation facilities.	Adapt containers and farm deliveries to new or better methods.	Secure cheaper and better transportation through cooperative hauling so as to get volume; ask for rate adjustments.	Railroad-rate policies; water-transportation facilities; better public highways.
Too much milk produced.	Increase unit profits but lower total output.	Price policies that will tie into national and international markets.	Education of both ruralf and city consumers as to the food value of milk.

SOME FACTORS INFLUENCING DEMAND BY CONSUMERS

Consumer uninformed as to relative food value of milk at stated prices.	The occasional consumer will inquire as to the facts; the average consumer will buy as habits direct.	Educational campaigns leading direct to the consumer and also fixing consumption habits and standards among school children.	A people whose mental and physical standards are dependent on the vitamins found in milk may well afford to put money into the education of consumption standards.
Milk does not look good nor taste good.	Buy the best the market offers or talk much about the worst. Refuse bad milk.	Improve sanitation, refrigeration, and care from cow to consumer. Build up cream line.	Inculcate national standards as to consumption habits so that milk is "approved" as bever age.
Belief that pasteurizing milk harms it.	Consult one's physician or dietitians.	Disseminate information as to the health reasons for pasteurization.	Spread health standards among physicians and consumers.
Supply of milk undependable.	Keep demand constant	Stabilize production by price plans.	Essential changes in transportation tariff or other public policies.
Fear that milk may be carrier of disease.	Demand pasteurization	Improve sanitation on farm and in plant.	Pasteurization laws and ordinances.
Racial or provincial prejudice against milk.	Be open-minded as to facts.	Dramatize the need	Adult and child education.
Low buying power in community; low wages.	Enhance skill; prove dependability; migrate; help emphasize to employer the community value of higher wages.	Join in policies that will encourage the earning power best suited to the community.	Community encouragement of local industries; changes in public policies.
Seasonal variation in price to consumer sufficient to lower consumption habits.	Be ready to approve cooperative efforts.	Stabilize price through basic and surplus plans; encourage production in seasons of low production and discourage it in seasons of high production.	Aid in creating the public opinion that will sustain stabilized price plans; encourage stable production; legislation when necessary.

Merely naming the factors that influence the supply or demand for milk and listing what may be done about them, emphasizes at once how difficult these factors are of individual control and how easy they are of cooperative guidance. No producer can materially affect the supply of milk. No one consumer can drink so much milk as to make any measurable change in total demand. Nor can any one dealer, however large, materially change either production or consumption, though he can do so to a greater extent than can any single producer or consumer because of the larger quantity he handles. But producers acting together, or dealers acting together, or consumers acting together, can change substantially either supply or demand as they may set out to do. And all three acting together may produce results in the best interests of all. Only by cooperative effort may those results be produced—for the interests in common are far greater than the differences.

WHAT THE PRODUCERS MAY DO THROUGH COOPERATION

Producers in the first place can make a fair bargain possible by cooperative selling. When buyers are few and sellers are many, the sellers are at a disadvantage. The haggle of the market out of which comes price equilibrium assumes power both to sell and to withhold. Farmers acting one by one can not effectively exercise the power to sell or to hold. That is true of any farm product, but it is peculiarly true of a perishable product such as milk. For with milk the power to withhold is the power to find at once an alternate market or to change output over a substantial period only. It is not the power to take one's eggs back home and put them in water glass for three months. Selling cooperatively means to sell with equal bargaining power. And no dealer and no consumer can find rational objections to such a bargain. Indeed, it is in the long-time interest of both to assure just such a bargain.

WHAT THE DEALERS CAN GAIN BY COOPERATION

Some buyers may well argue that the evils of cooperative selling may overcome its advantages. Such buyers point to instances of advertisements paid for by selling cooperatives attacking the milk dealer in a way prejudicial to milk consumption. They may point to publicity solicited by such cooperatives with the intent of harming the business of milk buyers. They may point to the efforts of such cooperatives to undersell the very dealer who is handling his products. Such evils have existed. It would take us too far afield to inquire in each instance to what extent these methods have been inspired if not made necessary by the tactics of the dealers themselves. But whatever their cause, they are seldom if ever worth the

price. Their use can not be denied so long as the spirit and effort of cooperation are wanting. But granted a joint cooperative effort, and such methods of course can find no justification. He who wants to sell his product dare not destroy his market.

The buyers then must face the possibilities of abuse of cooperative selling just as farmers single handed must face the possibilities of abuse of large-scale buying.

What may the dealer expect to gain by accepting the risk incident to dealing with adequately organized producers?

The dealer can first of all expect rational market knowledge to take the place of irrational bargaining methods. Wherever organized selling must accept its responsibilities, its representatives learn that the abuse of selling power can prove a powerful boomerang. A price higher than market facts warranted has broken down about as many cooperative selling organizations as too low a price has created.

Having made up their minds to bargain, cooperative selling and cooperating buyers must needs next know their facts. Out of the very necessities of informed and open selling has come a growing call for market knowledge. These facts—price factors whether in supply or demand—can be reasonably ascertained and on the basis of those market facts prices can be rationally agreed upon. Out of such facts comes the science of buying and of selling—the science of marketing.

THE MOBILITY OF STABLE PRICE FACTORS

We have already listed some of the factors determining the supply and demand for milk. The essential characteristic of each of these factors is its stable character. The other essential characteristic is that each is subject to conscious change.

Let me illustrate. Ignorance of the food value of milk as compared with other foods at given prices is a factor that is stable. It doesn't change until somebody changes it. But it can be changed. Methods adopted to change ignorance into knowledge must simply be as big as the job. A good advertising campaign may in one week increase current consumption 10 per cent. I have seen that done. But that 10 per cent is hard to keep. And it is harder still to get the next 2 per cent. To get that result, consumption habits of old and young must be changed. And the most difficult of educational tasks is that involved in changing habits. No single individual can expect to change them materially; but cooperative effort can and does.

The habits and traditions in handling milk cows play an important part in milk production. Such habits and traditions are not easily changed. But they can be changed. The size of the job requires cooperative effort to get appreciable results.

Just because price factors are relatively stable, future prices can be established. And just because these factors can be changed, however slowly, it pays to make prices cooperatively.

Both dealers and farmers have much to gain, therefore, first by organized cooperative selling, then by cooperative buying, and then by joint efforts to change in a way favorable to the best long-time interests of the industry practically all the factors entering into supply and demand.

And not the least of the advantages to both is an open price. Cooperative selling must have a known and open price. There can be no lasting negotiations unless all concerned are in on the negotiations. A known and open price tells the producer exactly what he may expect. And he may plan his herds accordingly. An open price puts competition on a known basis, with both buyer and seller interested in maintaining it. Competition is better informed and hence fairer even though keener, particularly as to quality and as to service.

WHAT THE CONSUMER MAY GAIN THROUGH COOPERATIVE EFFORT

The consumer wants a wholesome quality of milk or its products at a price that will maintain production on that quality basis. Consumers have tried the boycott. They have, through health officials, sometimes tried the big stick. Neither has worked. What the consumer wants in quality it takes time to produce.

A consumer does not want for her children milk that is a carrier of disease. It is penny wise and pound foolish to save by buying insanitary milk and then pay out large sums in doctors' bills and in human suffering. No farmer the world round knowingly prefers to sell disease. Their interests are in common. They must meet on a common price ground fair to all.

The methods necessary to improve the sanitary conditions surrounding milk can best be adopted through cooperative endeavor. The will to do comes first and that means mutual understanding.

A good quality of milk free from contamination at an equitable price is brought to the consumer by cooperative effort and by cooperative effort alone.

The producer, the middleman, and the consumer have interests in common that are greater than their differences, and the common interests can be put to the front to the mutual advantage of all by cooperative effort only. By cooperative effort I mean not sweetly singing the refrain and doing nothing, but working at each and every force affecting supply or demand to the end that each force may be guided to its greatest good to the greatest number, and of these it is easier to influence those affecting supply than those affecting demand. For the economic factors in demand are more immediate.

COMMODITY COMPETITION

Each economic epoch in the world's history has had its own form of competition. I think we are on the threshold of another epoch in competition. I believe the competition in the generation to come will be between commodities rather than primarily between individuals. It is to a large extent that already. The art of selling has wedded the art of cooperative marketing. The lumber folks join to advertise lumber and the steel folks unite to push the sale of steel. Apple growers tell us to eat an apple a day to keep the doctor away, and growers of raisins tell us to eat raisins to get the iron our systems need. The order of the day is cooperative selling, including cooperative advertising of commodities. Commodity producers join in securing good will for their product. Such is the new business way. And it has great social advantages in its favor.

But in such an era, through cooperation all those concerned with a commodity, from the first producer of raw material to the ultimate consumer, must match the wits of their representatives with the wits of the representatives of those selling other commodities.

Good roads and the automobile have put the cross roads merchant largely out of business and a new and greater shopping center has taken its place. Advertising is country wide in its appeal. And the world now lies before it. The World War taught new lessons as to how to get large numbers of people to act together and that art has reached the market place. He who stands against it loses his market. He who stands with it gains his market. And that means cooperative effort.

Out of market facts comes prices and out of prices come new market facts. Prices are not the result of iron laws that bind the hands of endeavor and stifle the voice of social need. On the contrary, price can be made the expression of conscious direction of underlying economic and social forces, to the good of all concerned.

COMMUNITY COMPETITION

Another change with which we have to learn to live if we want our rightful place in the market, is that community competition is taking its place alongside commodity competition.

Far-flung transportation systems of low cost and quick service are bringing community into competition with community as never before. No longer may advantages in natural gifts nor even local advantages of nearness to market be maintained or developed without touching public policies such as rail or water rates, or subsidies to merchant marines, or tariff policies, or public policies toward integration of business. The market place is no longer a side street

in a province; barter is now between commodities aided or retarded by public policies, and the world is the market.

Competition between individuals is then no longer the essential market fact. We now have competition between commodities strengthened by competition between communities.

Peoples compete with peoples.

In such a day and age who wants to stand alone? He who so prefers, votes against cooperative effort. But he who wants his place in to-day's industrial Sun, will join in cooperative effort to get for his industry through self-government the place that industry merits—a place it can get and keep by consciously directed, cooperative effort only.

THE RELATIONSHIP BETWEEN MILK PRODUCER AND MILK DEALER

The present-day relationship between milk dealer and milk producer is that of buyer and seller, but in a new economic order. It starts with cooperative selling by producers that they may be on an equal bargaining basis with large buyers. It continues through the bargain as to the price the buyer shall pay to producer.

And then it proceeds to join hands to expand the market by better care of the milk from the cow to the cradle. It cooperates with consumers to get good will for the product. It takes its stand in the market to give milk as a commodity an equal chance with any other competing consumption demand. It adopts self-government in industry so that government may be free for greater tasks of national, racial, or community expression. It joins with government to get public policies that will give one community equal opportunities with others, at least under similar conditions.

And all this done first for the local and then for the national market, the next relationship must be in the world market, where trade barriers must be so equalized that the best interests of all can in the end be maintained while caring first for one's own.

He who milks his cow in the lowlands of Belgium or in the Highlands of Scotland, in the States, or in the islands of the far seas; he who works at a bottling plant in New York City or at a pasteurizing plant in London; he who earns his living in making cheese in Switzerland or butter in Australia; he who sells these products on the market; and he who extends credit; each must lift his eyes to his market place which was once only the near-by road crossing but is now the four corners of the globe. And unless he wants to have as little to do with his price as a minnow in the briny deep, he will join in cooperative efforts in the finest and best sense of that word.

DRY MILKS

By Dr. H. E. Van Norman, *President the Dry Milk Institute, Chicago, Ill.*

Mr. Chairman, ladies, and gentlemen, may I first steal a moment to express the extreme gratification that it is to me to come to this wonderful congress and meet so many of those who shared in our congress three years ago, and to pay a tribute to your organizing secretary, and to the committee, and all who have helped in bringing about such wonderful success. I am sure, as you learned new things in our country when you came over, so our people have already expressed to me much pleasure and surprise at the things they are learning here.

My first point is that as a dairy industry we are interested in all products, and we can not selfishly promote one product at the expense of another. Whenever there is a surplus in one kind of dairy product all dairy products reflect that in their price, which we are all interested in. Therefore, in the promotion of any given product we must bear in mind the relation of that to all the others. May I here express our admiration of the splendid exhibit of promotion materials that is available here, and I hope there is none of you who will leave without seeing them.

THE ART OF DRYING PERISHABLE FOODS FOR STORAGE OR TRANSPORTATION NOT NEW

American Indians dried the meat of buffalo and deer.

People of many lands dried fish and fruits.

Tartars dried milk for use of armies, wrote Marco Polo, in 1298. They boiled the milk, skimmed off the creamy part, and put the remainder out in the sun to dry. Each soldier starting on a journey was supplied with about 10 pounds of this dry skim milk. A half pound was "put every morning in a leathern bottle with as much water as is thought necessary. By their motion in riding the contents are violently shaken and a thin porridge is produced on which they make their dinner."

VITAL PART MILK PLAYS IN THE DIET

Milk a universal alternative for infants.—The milk of the camel, the reindeer, the ass, the mare, the sheep, the goat, the water buffalo, and the cow are all used as food for man and his young. The extent to which cow's milk supplements, and even supersedes, human breast milk has earned for the humble cow in the United States of America the affectionate title "the foster mother of man."

Milk supplies essentials for growth, bone, and strength.—Scientists, with test tubes and animal cages, have shown the vital importance of milk in the diet of man from infancy through maturity and even in the frailty of old age.

Increasing consumption.—The American dairy industry joins forces with public health and educational agencies in the advocacy of the importance of diet for health and recognition that no diet for man is complete without an adequate supply of milk products. Result—an increase of 26 per cent in the consumption per capita of milk in the United States of America in the past six years.

FOOD VALUE OF SKIM MILK SOLIDS

Composition.—Milk is, roughly, seven-eighth water, one-eighth food solids, three-fourth of the milk solids are in the skim milk. For each pound of butter the cow yields she produces about two pounds of skim milk solids. One pound of skim milk solids fed to young pigs equals three pounds of corn (maize) for production of gain in weight.

Minerals supplied by dry skimmed milk.—"Certain functions of the body are not rightly performed if the food does not supply a proper balance between calcium and phosphorus. * * * The ash constituents of milk * * * furnish all the inorganic elements needed in nutrition and in exceptionally favorable proportions," says Doctor Sherman,[1] Columbia University.

Protein in dry skim milk.—"The protein * * * (of wheat flour) * * * can not * * * be efficiently transformed into body protein unless combined with other foods wisely chosen," says Dr. McCollum,[2] Johns Hopkins University. Further, one pound of milk protein is as valuable as 3 pounds of protein from cereals or legumes.

Lactose in dry skim milk.—"Lactose favors development of acidophilus bacteria in the intestinal tract and lessens the effects of putrefactive forms," says Doctor Rettger, of Yale, and Doctor Sherman, of Columbia University.[3]

Vitamins.—Substantially the same as in the milk before dehydration.

DEVELOPMENT OF DEHYDRATION OF MILK

History.—Grimwade, patented in Great Britain in 1855, first commercially usable process which required the addition of carbonate of soda or potash, and the addition of cane sugar before drying on

[1] Sherman, H. C.: "Food Products," p. 23, 88.
[2] McCollum, E. V.: "Newer Knowledge of Nutrition," p. 127.
[3] Rettger, L. F.: "Proceedings World's Dairy Congress, 1923," vol. 2, 1139. Sherman: "Food Products, 1924," p. 87.

rollers. First dried milk manufactured in the United States of America, patented 1883, marketed 1887, was a malt extract and milk combination. About 1898 milk was successfully dried without the addition of substances foreign to milk. Since then development has been rapid.

Types of drying equipment.—There are three general types of drying equipment—roller, spray, and belt—each with some modifications.

Open roll equipment.—Double or single steam-heated drums to which a thin film of milk adheres, dries, and is scraped off before the roll completes one revolution. Just process patent issued in the United States of America in 1902, in England patented as Just-Hatmaker process.

Vacuum roll.—The drum inclosed in vacuum chamber. Patented in 1903 both in Germany and in the United States of America. Its commercial use in the United States is relatively recent.

Spray system.—Stream of milk discharged in finely atomized condition into current of warm air. First patent in United States issued to Percy in 1872, later in Germany and again in the United States of America in 1901, since which time the real commercial development dates.

Belt system.—Precondensed milk is aerated, spread on chain belt, and passed through drying chamber, resulting in light porous flakes as distinct from finely powdered milk. United States patent issued to Campbell in 1901.

Detailed history, recorded in "Condensed Milk and Milk Powder," fourth edition, 1926, by Hunziker.

Extent of dry milk industry.—Whole milk, skim milk, buttermilk, cream, malted milk, and whey are all successfully dried commercially. First United States of America statistics for 1916 report 16,463,000 pounds dry skim milk, 2,123,000 pounds dry whole milk; 1926, 91,718,000 pounds dry skim milk, 10,768,000 pounds dry whole milk, 31,378,000 pounds dried buttermilk; 1927, production dry skim milk estimated over 100,000,000 pounds. Australia, New Zealand, Netherlands, Canada, as well as the United States of America, are each reported as producing dry skim milk in amounts from 6,000,000 to 70,000,000 pounds annually.

USES AND MARKETS FOR DRY SKIM MILK

Bread.—The minerals, protein, and lactose of dry skim milk combine in an ideal way with the natural composition of wheat flour to increase food value, better the appearance, texture, keeping and toasting quality, and yield. Six pounds of dry skim milk with each 100 pounds of flour are equivalent to the use of all fluid skim milk for

required liquid in the dough. American bakers are using from 3 to 8 pounds for each 100 pounds of flour. Dry skim milk offers a most economical improvement of quality in nearly all bakery products.

Biscuit and cracker manufacturers are adding dry whole and dry skim milk to many base cakes, fillings, and coatings to improve the food value, appearance, texture, and sales appeal.

Ice cream.—For ice-cream manufacture, dry skim milk is an ideal source of nonfat milk solids to balance "the mix." It may be kept in dry storage, no refrigeration required. Its uniformity of composition and availability for fluctuating demand commends its use. Blends with cream or butter as a source of required milk fat.

Prepared flours which include dry skim milk keep well, have added quality. It is used in pancake, waffle, doughnut, biscuit, and cake prepared flours.

Candy.—Use of dry skim milk eliminates much trouble from surplus moisture, variation in composition, and spoilage in manufacture of many types of candy, chocolates, and sweets.

Sausage.—Many types of sausage are much improved in flavor, appearance, and cooking quality by the addition of dry skim milk.

Animal feeding.—Eckles,[1] of the University of Minnesota, says: "No substitute for milk in raising calves." Dry skim milk is a convenient alternative in the absence of liquid skim milk for calves, baby chicks, laying and fattening birds, foxes, and dogs.

INSTITUTIONAL USE

Ideal supplement.—Dry skim milk and butter are ideal supplements to fluid milk supply in institutional cooking where amount required for large numbers of persons permits purchase in wholesale quantities and where the cooking process blends the ingredients.

Charitable homes, orphanages, hospitals, schools, dormitories.

Penal institutions, prisons, reformatories.

Construction and other industrial camps distant from safe milk supply.

Health resorts, hotels, and camps.

Army and Navy establishments distant from market supply.

Hotels and restaurants, cafés, cafeterias, tea rooms, pensions.

Dining cars, clubs.

All the foregoing named institutions will find dry skim milk a valuable addition to the food list, to build up minerals and protein deficiencies in the diet; with added butter it is an economic means of supplementing the fluid milk supply.

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[1] Eckles, C. H.: "University of Minnesota Bulletin," 215.

AMERICAN DRY MILK INSTITUTE (INC.)

Organization.—Is an association of manufacturers of dry skim milk who produce two-thirds of all made in the United States of America.

Purpose.—1. To do for the industry what the individuals can not do for themselves.

2. To increase appreciation of and demand for dry skim milk.

Financial support is by payment each month of a definite sum on each pound produced the preceding month.

Activities include research, statistical service, promotion, development of standards and grades.

Statistics.—Report of total production, sales, stocks on hand, and weighted average price f. o. b. factory are compiled monthly, usually by the 17th of the month, and supplied to all manufacturers cooperating.

Research.—Laboratories not maintained by the institute, but research fellowships are supported in recognized public educational and research institutions, such as University of Minnesota, Cornell University, Pennsylvania State College, American Institute of Baking, and the Technical Bureau of the Biscuit and Cracker Manufacturers' Association.

Bread research discloses that the use of dry skim milk adds to the period dough is at best for cutting—i. e., a stabilizing influence—quality of bread improved as skim milk solids are increased up to 7 per cent of weight of flour; volume increases with added dry skim milk.

Crackers and biscuit research.—A number of valuable formulas have been developed by the research fellowship.

Ice cream research.—A very decided lack of accurate information as to behavior and methods of use of dry skim milk in ice cream exists. Thorough study is in progress.

Dental research.—The institute is supplying milk for a fundamental study by leading American authorities on influence of diet on teeth.

Animal feeding.—The institute is financing definite organized research at two different institutions and has supplied small amounts of dry skim milk for informal trials at others.

Promotion and propaganda.—The putting of acquired information into the hands of those who will be interested in seeing it, and in increasing their use of dry skim milk.

Publications include a bimonthly publication of new uses and helpful ideas; booklets summarizing the uses of dry skim milk;

bulletins on special topics giving technical information; magazine articles and newspaper stories.

Other promotional work includes—

Addresses at conventions.

Moving-picture film prepared and shown at many meetings. Still film on method of bread making is in process of development.

Exhibits are prepared for national gatherings of important industries interested in the use of dry skim milk.

Demonstrations: A demonstration service by an experienced, practical baker, with speaking ability, employed full time, is maintained.

OPPORTUNITIES FOR DEVELOPMENT

Dry whole milk.—With perfection of methods for preserving dry whole milk it becomes increasingly available for infant feeding and family use in territories not adequately supplied with fresh milk of uniformly high quality and freedom from contamination. It is convenient—safe, economical, uniform. To the millions of people in many lands who are inadequately supplied with fresh milk, dry whole milk offers an adequate alternative.

Dried buttermilk.—Drying of this by-product has made available to poultrymen and manufacturers of mixed feeds, a high animal protein feed carrying also high and very desirable minerals—especially calcium and phosphorus.

Dry skim milk.—The conservation of skim-milk solids for human use is an economic asset to the Nation; transfers much of it from unprofitable animal use and even flagrant waste to the diet of man—is the highest type of national conservation.

Public need.—People in many countries need more calcium, protein, and lactose in their diets, for which there is no better source than skim-milk solids.

Foods improved.—Breads, biscuits, cookies, puddings, soups, dressings, chocolate drinks, cakes, offer a most convenient method of adding dry skim milk to diet. Particularly economical where commercial bakers supply them.

Economy.—Institutions with large numbers to feed will find dry skim milk an economical addition to food list and an asset in balancing the diet.

Possible consumption.—In the United States of America, if commercial bakers would use dry skim milk equivalent to fluid skim milk in bread, 200,000,000 additional pounds annually would be required—to say nothing of requirements in many other uses. In Great Britain 200,000,000 to 300,000,000 pounds would be required; many other countries in proportion.

THE FUTURE

Authorities on health and nutrition are in accord on the high value of calcium, protein, and lactose of milk, and the widely distributed need of more of them in the human diet.

Amount of skim-milk solids produced but not conserved for human food is tremendous, 2 pounds for each of the quarter billion pounds of butter produced annually in our country, and corresponding amounts in every butter-producing country. Much of their vast supply of human food is now wasted or unprofitably utilized. It is not increased in value by feeding to animals—it is already in highest form of food for man.

Uses and needs for dry skim milk reported and suggested herein are more than enough to consume advantageously and economically all the skim-milk solids available in many lands. Whether this conservation of an important by-product of the dairy industry, this addition of a vital food product to the human diet list, is made the most of will depend on the united effort of leaders in the dairy industry, in distribution, in nutrition and home economics research and teaching to the end that consumer appreciation shall be developed.

DEVELOPMENT OF THE ICE-CREAM INDUSTRY IN THE UNITED STATES

Mr. Fred Rasmussen, *Executive Secretary, International Association of Ice Cream Manufacturers, Harrisburg, Pa.*

Almost two centuries before Dolly Madison, wife of the fourth President of the United States, introduced ice cream at a function at the Executive Mansion in Washington, Charles the First pensioned the French cook, Di Mirco, who first served ice cream at an English royal banquet. A stipulation in the terms of that pension provided that the Frenchman should keep the process of making ice cream a secret and make it only at the command of His Royal Highness. This enthusiastic early reception of ice cream was in spite of the fact that Charles the First had no idea of the food and health value of ice cream, which is now so strongly recommended by leading dietary experts.

ICE CREAM—A DAIRY PRODUCT

Ice cream on the average contains about 22 per cent of milk solids, which is almost twice the amount found in whole milk. Therefore, ice cream can properly be classed as a dairy product. Ice cream differs from some of our other manufactured dairy products, like

butter and cheese, in that it is not manufactured solely from the constituents of milk, but contains in addition sugar, fruit, nuts, chocolate and other flavoring.

The amount of dairy products, however, used in the manufacture of ice cream in the United States, calculated in terms of whole milk, is almost equal to the amount of milk used in the manufacture of cheese and exceeds the amount used in the manufacture of condensed and evaported milk. In 1926, 4,464,144,000 pounds of milk or its equivalent was used in the manufacture of ice cream.

RELATION OF ICE-CREAM INDUSTRY TO DAIRY FARMER

Milk, cream, condensed and evaported milk, milk powders, and butter are used in the manufacture of ice cream. Thus the industry offers a market in varying amounts for all these products. It acts as a balance wheel for the entire dairy industry and has a stabilizing effect on prices; 67.5 per cent of the total yearly production of ice cream is made during the months of May, June, July, and August.

A small surplus of milk often keeps down or breaks the price and there is no doubt that the ice-cream industry, which has its heaviest production during and directly following the heaviest production of milk, helps to increase the price the farmer receives for milk during the summer months. The production of milk by the farmer is limited by the consumption of all dairy products. Therefore, to create a demand and sale for dairy products in any form, based upon their economy and value in the diet, is of advantage to the dairy farmer.

ICE CREAM A FOOD NOT A CONFECTION

Commercial ice cream in the United States to-day is no longer looked upon as a confection or a luxury. It has a definitely established place in the dairy industry and it is generally considered a wholesome, nourishing, and essential food in the diet of American people.

Dr. E. V. McCollum, an outstanding figure among American dietary authorities, writes to millions of housewives, in McCall's Magazine, July 1926:

> There is no more attractive way of serving milk to your family than in good ice cream. We have constantly emphasized the importance of drinking more milk, for the average amount consumed per person is still far too low. The more frequent serving of ice cream at the family table is one of the easiest ways of getting milk into the diet, especially for children who do not like milk and for persons who demand food with marked flavors.

The subject of ice-cream manufacture is a part of the dairy instruction given in the State agricultural colleges. Every year

hundreds of young men, trained in the art and science of making commercial ice cream, enter the industry. Further development comes through the research of the United States Department of Agriculture and practically all of the State experiment stations.

INVESTMENT, PRODUCTION, AND CONSUMPTION

The industry has made rapid progress during the last 20 years. There are approximately 4,000 wholesale ice-cream manufacturers in the United States. The capital investment is over $450,000,000. The total production in 1926 is estimated at 324,000,000 gallons, with a per capita consumption of 2.78 gallons, compared with 1.04 gallons in 1905. This includes ice cream made by retailers and in the home.

FACTORS IN THE DEVELOPMENT OF COMMERCIAL ICE-CREAM MANUFACTURE

The outstanding factors in the development of the industry are the application of machinery, modern methods of manufacture, composition of product, special refrigeration, methods of distribution, legislation, and the activities of the International Association of Ice Cream Manufacturers, which to-day is fostering an industrial development program.

Machinery.—Machinery has made possible quantity production of ice cream. Introduction of the brine freezer in about 1900 was the first important step. Constant improvement has been made in this type of freezer. The 40-quart freezer, which was formerly used with the temperature of the brine of 5° to 10° above zero, has been improved and enlarged to 80, 100, and 120 quart sizes, using a brine temperature of zero to minus 10° F. The time of freezing has been decreased from about 15 minutes to 8 to 10 minutes. A 100-quart freezer will turn out around 3,500 quarts in 10 hours. Some of the largest factories have manufactured over 25,000 gallons in one day. With a battery of freezers it is necessary to have adequate hardening rooms, where a temperature of from zero to 10° below may be maintained. A large factory may have hardening facilities to carry 150,000 gallons, with sales as high as 70,000 gallons in one day. It is easy to see that such capacity is necessary to take care of the peak demand.

The development of pasteurization equipment and holding tanks has made possible preparation and storing of ice-cream mix for quantity production. The homogenizer has become an essential part of a well-equipped factory.

Composition.—Following is the range of solids contents of commercial ice cream:

	Per cent
Butterfat	10.0 to 14.0
Serum solids	8.0 to 10.0
Sugar	12.0 to 16.0
Gelatin	.2 to .5

Flavors and fruits.

While several of the States require a minimum butterfat content of 8 per cent, by far the major portion of commercial ice cream contains from between 10 and 12 per cent butterfat.

An important factor in the development of the ice-cream industry in the United States is the control of the product in manufacture from day to day. The modern ice-cream plant, equipped with a control laboratory, makes possible the daily standardization of its product so that the solids contents vary within narrow limits.

The blending of the different flavors with the dairy products is an important factor in the pleasing palatability of ice cream. Synthetic flavors are not used. Chocolate, nuts, and fruits are put into the hoppers on the freezers in sufficient amounts to bring out the characteristic flavor desired.

Flavors.—The three popular flavors—vanilla, chocolate, and strawberry—comprise approximately 73.36 per cent of the total volume of sales:

	Per cent
Vanilla	55.48
Chocolate	10.06
Strawberry	7.82
Other flavors	26.64

Each process in the manufacture of ice cream is closely supervised. Recording thermometers keep a daily record of mixing, pasteurizing, freezing, and hardening temperatures. Progressive ice-cream manufacturers test the product daily, not only for chemical content but also for bacterial content. This careful attention to the manufacture of ice cream assures the consumer a uniform product of high quality.

DISTRIBUTION OF ICE CREAM

Wholesale manufacturers produce approximately 66 per cent of the total amount of ice cream consumed in the United States. A report of 240 typical ice-cream plants shows the following channels of distribution:

	Per cent
Drug stores	29.2
Confectionery stores	27.8
Restaurants and hotels	12.8
Groceries	11.1
Wayside stands	3.8
Cigar stores	2.1
Unclassified	13.2

The expansion of the ice-cream industry during the last 20 years is in a large measure due to constant widening of distribution.

Universal sale of ice cream has been stimulated in a measure by the manufacturer furnishing the dealer with ice cream retailing equipment and giving him a great deal of service. Almost universally, the cabinet from which the dealer sells ice cream is owned by the manufacturer. Before the electric cabinets and the electric soda fountains came into use the manufacturer generally gave free service of ice and salt.

The development and introduction of mechanically refrigerated cabinets increased the investment of the manufacturer in dealer equipment. In some sections, investment in electric cabinets alone will average between 40 and 50 cents per gallon of ice cream sold in a single year. Since 1923, practically every ice-cream manufacturer has equipped part of his dealers with mechanical refrigeration. A recent survey showed that 57.7 per cent. of the plants reporting had equipped more than 40 per cent of their dealers with mechanically refrigerated cabinets. When electric cabinets are furnished without cost to dealers, it is easy to understand how this type of equipment has added greatly to the investment in the industry and to the cost of doing business. The tendency is to work towards furnishing the equipment on such a basis that the manufacturer receives interest on the capital involved.

Sales per dealer.—A survey of the sale of 58,208,000 gallons of ice cream, distributed by 87,975 dealers, showed that the average annual sale per dealer was 661.6 gallons. There are, however, a number of dealers along our highways, at summer resorts, in parks and other places, who only operate from 4 to 6 months, which would tend to lower the average annual sale per dealer.

Transportation.—Good roads and the use of trucks have helped manufacturers to get the widest possible distribution of ice cream. In extreme cases, ice cream is shipped by truck as far as 150 miles. The latest development in the truck is the use of mechanically refrigerated bodies. This enables the manufacturer to keep ice cream under mechanical refrigeration from the time the mix goes into the freezer until served and retailed to the public in the dealer's store. Solid carbon dioxide is the latest refrigerant of the ice-cream industry. The use of this product, still in the experimental stage, appears to have great possibilities for shipping purposes as well as for local refrigeration.

Canvas jackets which recently came into use, instead of the old ice and salt tubs, have simplified express shipments. Reports of 368 ice-cream plants show a distribution of their sales to be as follows:

	Per cent
City	65.82
Suburban (including country and adjacent cities and towns served by trucks)	21.04
Express	13.14

Package and fancy ice cream.—Approximately 88 per cent of the ice cream is sold in bulk and 12 per cent in brick or in packages. Of the bulk ice cream a large percentage is sold by the numerous retail establishments in sodas, sundaes, and cones. The balance is dipped by retailers in pint or quart containers for carry-out purposes. Owing to the difficulty of packing a uniform amount into the containers and the shrinkage involved in dipping, this is not an entirely satisfactory method of dispensing ice cream. Efforts are now being made to increase the sale of factory-filled packages for home consumption.

A great many manufacturers have a department for making ice cream in fancy forms. They may take the shape of individual molds for holiday and special occasions, like flowers, fruits, and ornaments, or figures like Santa Claus and Cupid, or the ice cream may be shaped into cakes or replicas of buildings, monuments, and ships.

INDUSTRIAL PROTECTION AND PROMOTION

Legislation.—Every industry meets problems which require united action. The ice-cream industry met such problems through the organization of the National Association of Ice Cream Manufacturers more than 25 years ago. This association has now become the international association and has affiliated with it 28 State and regional associations and members in Canada, Australia, and Argentina.

The first problem dealt with was that of protection against unfair express rates and unfair legislation. Fair and reasonable legislation is a help to industry rather than hindrance. It has the advantage, first, of the establishing of public confidence in the industry and in the product; and, secondly, of helping to prevent unfair competition. Regulatory officials, as a rule, desire to do what is right as they see it. An association can render valuable service to an industry by working in close cooperation with regulatory officials and furnishing facts and data for their guidance. This association, through its officers and through committees, is cooperating with organizations of regulatory officials and scientific societies to promote legislation which will assure the public a safe product and give maximum development to the industry.

Statistics and Service.—An industry can not be conducted economically without basic statistics. The records of the past and

present are needed to judge the future. The International Association of Ice Cream Manufacturers has a well-developed bureau of service and statistics which gathers and distributes information quarterly upon production trends and upon manufacturing and distribution problems. All the data collected is of great value to the individual companies in that it enables the individual to see definite trends in the industry. By comparing the records of his own company with the average of many companies a manufacturer knows how his company stands in the industry. This bureau is conducted in cooperation with the Dairy and Ice Cream Machinery and Supplies Association, as the statistics gathered are very valuable to its members.

Through the statistical service and through files kept of trade journals and of research and experimental publications an industrial reference library is being developed. This is necessary to answer the numerous questions sent to the association offices, both from inside and outside our membership.

Research.—The International Association of Ice Cream Manufacturers does not maintain a research laboratory. The research committee of the association promotes research work through cooperation with the dairy departments of the State agricultural experiment stations. Under the auspices of this committee each year a volume of abstracts of experimental and research work is published. These volumes also contain statistics, calculations, and tables for daily use in the factories. They are indexed according to subjects and become a very useful and valuable handbook for ready reference for ice cream manufacturers.

Uniform cost accounting.—With the enormous investment in the industry and the high cost of manufacture and distribution primarily due to the extensive use of refrigeration and the frequency of service it is easy to realize the importance of having detail figures on the cost of manufacture and distribution.

Three years ago, through a committee of accountants, engineers, and executives of the industry, a uniform cost accounting system was developed, which is rapidly being put to use by members of this association. The purpose of this system is to promote uniform accounting in the industry and to eliminate waste. Wherever introduced it leads to a detailed study of all operations. Uniform cost accounting in the industry is promoted through the cost accounting bureau of the association. A certified public accountant is at the service of the membership to assist in the installation of the system. Through this system expense and cost comparisons are made. Individual members report their expenses of operation and cost on special blanks. Each company is given a number and the tabulated reports of all companies are sent to all who participate

in the comparisons. Each company is able, therefore, to compare the cost of operation, item by item, with that of others. It is needless to say that items running high will receive special attention.

The distribution of the expense dollar in the ice-cream industry for 1926 was as follows:

	Per cent
Products	41.02
Manufacturing	15.50
Selling	9.3
Delivery	24.88
Administration	9.3

Advertising.—The advertising expenditure of our more successful manufacturers averages approximately 1 cent a quart of their production.

This average of 4 cents a gallon for advertising is used in every conceivable form of appeal, carried to the consumer in varied classes of media. Newspapers, outdoor posters, sidewalk signs, street-car cards, direct-mail advertising, store and window displays, cinema reels, radio programs, lectures in schools, demonstrations at fairs and exhibitions, sampling campaigns, prize contests, and advertising novelties are all used by ice-cream manufacturers. Some concentrate their advertising appeals in a few of these media, while others spread their activities so as to include most of them.

In this advertising, the manufacturer attempts to attract the public's attention to many different appeals that may be advanced for his product or the reliability of his establishment. The advertisement may call attention to a new flavor, a new form of package, a new system of delivery, or any other innovation.

In the individual ice-cream manufacturer's local advertising there is no single universal appeal put forward for ice cream as a desirable commodity. The nine or ten million dollars represented in this advertising done by individual manufacturers is largely devoted to competitive effort, one manufacturer as against his neighboring manufacturer. Each strives to sell an increasing proportion of the ice cream consumed in the community over which he can distribute his product.

Cooperative advertising.—Through a survey, it was found that commercial ice cream met a sales resistance in the minds of some people who lack an understanding of the basic constituents of the product and of the very rapid progress made in the scientific and sanitary manufacture and distribution of commercial ice cream. This misunderstanding, which was quite general, was shown also by a considerable volume of negative publicity appearing in newspapers, magazines, and other printed material. The negative publicity and

misunderstanding of commercial ice cream was directed, not against any particular brand, and thus was a reflection upon the industry as a whole and could, therefore, not be overcome by the advertising of individual brands.

To promote a greater public appreciation of ice cream as a food product, having and deserving an important place in the diet, a large number of our manufacturers are giving one-third of a cent per gallon of their annual production to a national cooperative publicity campaign.

The cooperative advertisements in leading magazines are run over the name of the research council of the ice-cream industry. The advertisements attract attention by virtue of illustrations, in four colors. Each advertisement stresses the idea that ice cream is a healthful food, a wholesome dairy product, and good for all the family, in that it is made of pure, rich milk and cream.

Similarly, the healthful properties of ice cream are kept before the medical and dental professions by means of advertisements in the journals of the American Medical and American Dental Associations.

In addition to this, the research council of the ice-cream industry, at regular intervals, supplies the newspapers and the magazines of the country with articles based on the opinions of leading dietary experts on the food value of ice cream.

The result of this work has greatly increased the amount of favorable comment read by Americans on the health value of ice cream. Many of the leading men in the ice-cream industry in our country feel that this cooperative effort is essential to increase our per capita consumption of ice cream. Concentrating the national cooperative effort on the establishment of public appreciation of ice cream as a food, local advertising can continue to be devoted to increasing the sales of the individual advertiser's product. An increase in per capita consumption by virtue of the cooperative campaign will help all manufacturers concerned to increase sales of their individual brands of ice cream.

CONCLUSION

Commercial ice-cream manufacture in the United States has a history of 77 years. The lessons to be drawn from this history should prove valuable for countries where commercial ice-cream manufacture is still in its infancy.

1. Ice cream finds a ready market because of its appetite appeal, hence the most fundamental factor in its maximum acceptance is quality. The basic constituents are milk products, which are the

important factors in its palatability and health value. Therefore laws and regulations which prescribe minimum legal limits for milk products are essential. Opinions vary as to the amount. Not less than 10 per cent milk fat with a total milk-solids content of 18 per cent is proving a satisfactory minimum limit.

2. As to sanitary requirements, the same fundamental principles as applied to milk, with minor qualifications, will apply to the manufacture and distribution of ice cream.

Dr. E. V. McCollum, of the school of hygiene and public health, Johns Hopkins University, Baltimore, Md., in the same article from which I quoted in the beginning of this paper writes:

> The constant rise in the standards of cleanliness and wholesomeness in the milk and cream industry has been one of the greatest helps in raising the standards of the ice-cream industry. Another important reason for the rise in ice-cream standards is that the manufacture of ice cream has steadily passed into the hands of larger manufacturers who are in a position to invest in modern machinery and to provide the wholesome surroundings necessary for the preparation of high-grade products. This is a matter of great importance both in the dairy and ice-cream business. There is no place in a city for the one-man ice-cream manufacturer any more than there is a place for the one-wagon milk-delivery man. Neither has enough capital to buy the equipment necessary to give his patrons the service which modern health standards require.

3. Easy accessibility promotes the sale of a product. Universal distribution of commercial ice cream in the United States has been accomplished by a very large investment in retail equipment and by service. This is sound as long as this investment is on a basis of interest on the capital and a depreciation sufficient for replacement. On the other hand, if the equivalent and service are not based upon this principle, sooner or later they become a competitive tool and one of the most destructive forces to the profit in the industry.

4. Competition in industry is no longer confined to competition among manufacturers in the same industry. To-day, we find intense organized competition of industry against industry, each trying to get as large a share as possible of the consumer's spending budget. This competition, through trade association, takes the form of cooperation in research standardization, uniform accounting, merchandising, education and advertising. As essential as these activities are in old-established industries, they are even more essential in new industries, where a new product is to be introduced. Commercial ice cream manufacture is in its infancy outside the American continent. Its introduction can be accomplished more rapidly if manufacturers now in the field in the respective countries will cooperate through a trade association to protect the quality of their product by sound legislation, by adopting fair trade practices and by cooperative

publicity. The more cooperation between manufacturers, the more rapid will be the progress.

5. The standing of the industry and the product depends upon the ability to convince the public of the following facts:

Ice cream is a dairy product. The constitutents of milk give to ice cream its health and food value. Ice cream contains milk's minerals, proteins and carbohydrates and the vitamins so essential to life and growth. For these reasons it is good for your children, used extensively in hospitals and sanatoriums for the sick and convalescent and is recognized by doctors and dietiticians as a protective food, building up body resistance against disease.

The officers and membership of our association in the United States wish me to extend to you their most cordial greetings. Those of you who are interested in developing the ice cream industry on a commercial basis in countries where it is a comparatively new enterprise, have their best wishes. They feel you can succeed in accordance with your most optimistic expectations. Our members observe that our visitors from your countries can usually be numbered among the most enthusiastic consumers of the wholesome product of our industry. To like ice cream is not peculiarly an American characteristic. The appreciation of its delicate flavors and fascinating consistency is common to most humans who come in contact with it. As you make good ice cream more and more attractively available to your people, we believe, and sincerely hope, you will prosper in large measure.

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NEWER PHASES OF PROCESSING ICE CREAM

PROF. GROVER DEAN TURNBOW, *Acting Head of division of dairy industry, University of California, member of the research committee of the International Association of Ice Cream Manufacturers*

INTRODUCTION

The manufacturer should have, above all things, an appreciation of the quality of his ice cream. Too often he labors under the de-

lusion that his product is the best that can be produced. Every ice-cream manufacturer should have some standard for his product. Once a standard is selected, changes should be made only after careful deliberation. The adoption of a standard, however, by no means assures the quality of the product. It is only the first essential. The second is to secure the necessary ingredients of the right quality. The manufacturer must then see that these are properly combined according to the standard adopted, and then processed skilfully, keeping in mind the complexity of the product that is being built. He is dealing with true solutions, colloidal solutions, suspensions, and emulsions, having true, apparent, and basic viscosity. The quality of the product is greatly affected by the chemical and physical treatment during the processing.

In determining standards, naturally, food value of the product can not pass without consideration. Ice cream has a legitimate place in our nutritional plan. It is true that frozen food products have been regarded as a confection in the past. Due to certain instabilities of some of the constituents used in the manufacture of an ice-cream mix, it has not been possible, up to the present time, to balance an ice cream so that it has the proper nutritive ratio (assuming that milk approaches the ideal very closely). It does, however, contain most of the essential vitamins. It is especially high in certain mineral salts, the importance of which for the most part have been overlooked.

For economic reasons, coupled with the desire to manufacture a product of high quality, ice cream has assumed for the most part a composition approximately as follows:

	Per cent
Butterfat	10.0–14.0
Milk solids, not fat	10.0–11.0
Sucrose	14.0–16.0
Gelatin	0.2– 0.5

in addition to the various fruits and flavors.

TO PRODUCE A SMOOTH ICE CREAM

Any addition of solids tends to produce a smooth product, but for obvious reasons, the composition will remain approximately as stated, except that possibly the milk solids not fat content may be increased. The cow produces, for illustration, in each 100 pounds of milk, approximately, 12½ per cent total solids, of which, roughly, one-third is butterfat and two-thirds milk solids, not fat. As long as ice cream containing approximately an equal quantity of butterfat and milk solids not fat is manufactured, the ice-cream industry will not be making economic use of the milk solids produced. As

the industry grows, the surplus will naturally increase. Furthermore, the cost of milk production has increased yearly and as a result, close to a maximum price must be obtained for the butterfat, since the industry has been built up on butterfat values, leaving two-thirds of the cow's production with very little market value. To increase the butterfat much above the usual percentage would increase the cost of the commercial ice cream, making the price such that the volume of consumption would be materially decreased. To increase the sugar above the usual percentage would make the product too sweet and would increase the cost of refrigeration unduly. To increase the edible gelatin above the present percentage would produce a product that would not melt. This is a decided objection to the consumer and immediately gives an impression of artificiality. To increase the milk solids not fat above 12 per cent at the most, under past methods, would cause the lactose to crystallize (1), producing the defect known in the trade as sandy ice cream.

Recently, in the United States, ice cream has been manufactured in which a part of the sugar in the milk solids not fat has been added in such form that additional amounts of milk solids not fat may be used in the finished product up to as high as 20 per cent and not produce sandy ice cream under normal methods of marketing. A milk solids not fat content of 20 per cent, along with the other constituents necessary to complete the mix, produces an ice cream that is too dry and crumbly. In actual practice it has been found that 15 per cent is about the maximum amount that can be used. If all the ice cream in the United States contained an additional 5 per cent of milk solids not fat, approximately 70,000,000 pounds additional of milk solids not fat would be used annually. As stated above, any increase in solids, as long as they remain in a stable form, aids in the production of a smoother ice cream. If an increase in the solids could be milk solids not fat, it would aid the industry and would produce an ice cream higher in food value with a balance between the fat and carbohydrate more nearly correct. In addition, the ice cream would be materially increased in its mineral contents.

An additional advantage in increasing the solids in the mix is that it makes density control more nearly possible, probably by aiding in the stabilization of the emulsion. The more stable the emulsion, the less it is affected by the mechanical action of the freezer dasher during the unloading process (2).

TABLE 2.—*Basic, apparent and true viscosity and surface tension of ice cream mix processed one, two, and three times*

Number of times mix was processed	Aged													
	Fresh				5 hours						24 hours			
	Temperature ° C.	Shaken	Viscosity		Temperature ° C.	Shaken	Viscosity		Surface tension dial reading	Dynes centimeter per second	Temperature ° C.	Shaken	Viscosity	
			° M.	Poises			° M.	Poises					° M.	Poises
1	16.7	0	9	0.7921	16.7	0	38.5	3.3884	75.43	63.70	15.6	0	64.0	5.6327
					16.7	1,400	8.5	.7481	75.43	63.70	15.6	1,400	8.5	.7481
2	16.7	0	8.5	.7481	16.7	0	18.0	1.5842	75.72	63.96	15.6	0	29.0	2.5523
					16.7	1,400	7.0	.6161	75.76	63.99	15.6	1,400	6.5	.5721
3	14.4	0	4.5	.3961	16.7	0	10.5	.9241	75.87	64.08	15.6	0	30.0	2.6403
					16.7	1,400	5.5	.4841	76.0	64.19	15.6	1,400	5.5	.4841

Number of times mix was processed	48 hours				72 hours					
	Temperature ° C.	Shaken	Viscosity		Temperature ° C.	Shaken	Viscosity		Surface tension dial reading	Dynes centimeter per second
			° M.	Poises			° M.	Poises		
1	15.6	0	79.0	6.9529	15.6	0	114.0	10.0333	75.41	63.68
	15.6	1,200	8.5	.7481	15.6	1,400	8.5	.7481	75.50	63.76
2	15.6	0	34.0	2.9923	15.6	0	52.0	4.5766	75.90	64.11
	15.6	1,200	6.5	.5721	15.6	1,400	7.5	.6601	75.96	64.16
3	15.6	0	34.5	3.0364	15.6	0	34.0	2.9924	75.96	64.16
	15.6	1,200	5.5	.4841	15.6	1,400	5.5	.4841	76.00	64.19

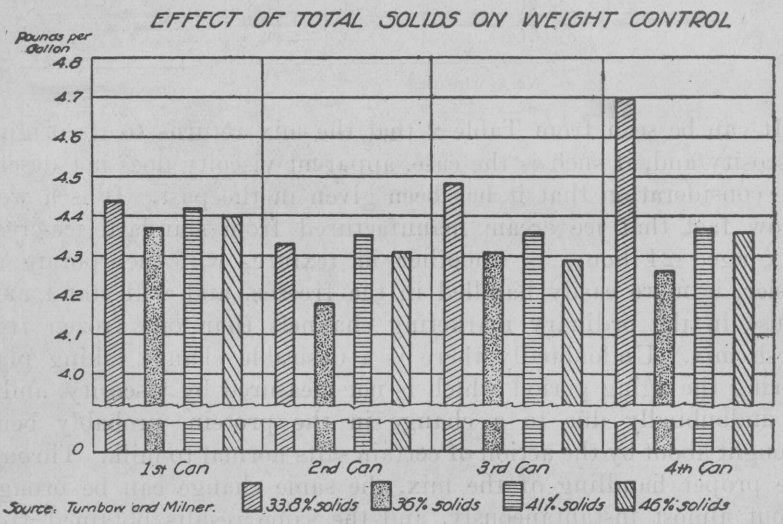
It can be seen from the table that there is very little variation in the density, or weight per gallon, of ice cream from the various cans drawn from the freezer when the total solids in the mix were as high as 36 per cent. Even at 41 per cent total solids, control was maintained within narrow limits. From data available, however, absolute density control can not be maintained due to the dasher in the freezer. This particular point will be discussed later on in the paper.

A few years ago, it was thought that the viscosity of the mix had much to do with the controlling of the density of the finished product. It has been known for a long time that there is a certain amount of true viscosity in an ice cream mix and in addition, there is a certain amount of colloidal viscosity due to the formation of a gel structure which may be termed apparent viscosity. Apparent viscosity is obtained during the aging period which usually takes place at a temperature of 34°–40° F., and for a period of 24 to 48 hours' duration. In order to obtain yield and smoothness, many ice-cream manufacturers believe that the apparent viscosity obtained

during the aging period is necessary. The apparent viscosity of the mix obtained during the aging period depends somewhat upon the processing, the amount and quality of gelatin used, and the time and temperature that the mix is held in the aging vat. A mix held for long periods of time becomes very viscous and it is difficult to incorporate into it the necessary amount of air in order to make it a palatable product. It is, therefore, naturally assumed that the long periods allowed for aging made possible the development of too much viscosity and caused difficulty in incorporating air.

At the California Experiment Station (3), ice cream mixes were processed in the usual way. Viscosity determinations were made, using the new improved MacMichael viscosimeter. The mix was

TABLE 1.



aged for varying periods of time, and was agitated by various methods and as can be seen from representative data in Table 2, the method of processing affects the basic viscosity, and each time the mix is rehomogenized the viscosity is decreased. The apparent viscosity maintains approximately the same relationship during the aging period, although it is very unstable and by sufficient agitation, of the mix such as it received in the freezer, it will return to a basic viscosity which coincides with the viscosity of the fresh mix. The true or original viscosity is dependent upon the composition of the mix. The apparent viscosity is largely dependent upon the quality and amount of gelatin used. (4) Representative data is shown in the following tables:

TABLE 3.—*Effect of quality of gelatin on viscosity (0.5 per cent)*

Various grades	Viscosity (centipoises)	
	24 hours	48 hours
1	260	936
2	936	1,508
3	1,352	2,600
4	2,860	(1)

[1] Too heavy to run.

No. 30 certified wire used.

Time aged (hours)	Amount of gelatin (per cent)	Viscosity (centipoises)
24	0.2	64.6
24	.3	102.0
24	.4	428.0
24	.5	1,224.0
24	.6	2,892.0

No. 34 wire used.

It can be seen from Table 2 that the mix returns to its original viscosity and, if such is the case, apparent viscoity does not deserve the consideration that it has been given in the past. It is a well-know fact that ice cream manufactured from standard ice-cream mix aged 24 hours is smoother in texture, will incorporate air easier, is more easily handled in the freezer, and will stand more abuse in the ordinary marketing channels than one frozen from fresh mix. Undoubtedly there is a desirable change taking place during the aging period which is not measured by viscosity, and it is undoubtedly due to a change in the protein, probably being brought about by the action of certain salts normal to milk. Through the proper handling of the mix, the same change can be brought about almost instantaneously, and the same results obtained from aging 24 to 48 hours. It is not far distant until milk will be received at the plant in the morning and the ice-cream mix will be assembled, pasteurized, homogenized, cooled, and frozen immediately, thus producing a finished product that is fresher, one that should be lower in bacterial count, and of better quality throughout. In fact, this is being done in some places now.

PHYSICAL FACTORS AFFECTING DENSITY CONTROL

Regardless of the composition of the mix, true, apparent, or basic viscosity, variation in density must be expected. The desirability of accurately controlling the density of ice cream is beyond question. A uniform product could actually be produced if it were

possible to control accurately the density of the ice cream, which would mean the amount of food solids in a gallon of ice cream. The freezer, as we know, is the important factor of the physical phase, the dasher being the active principle. The dasher is divided into an outside mechanism, comprised of the scraper and unloading arms or wings, and an inside mechanism, the beater. The two parts of the dasher in the present-day freezers operate conversely. During the freezing and whipping period, this is desirable, but it has been found that during the unloading process the severe treatment given the product by the dasher tends to decrease the density as the first can is being drawn, and while the second can is being drawn the action is reversed and the density is increased, which continues as each succeeding can is drawn.

It has been further shown that the beater or inside mechanism in certain makes of freezers is largely responsible for the variations. By reconstructing the transmission on a freezer so that the beater may be disengaged during the unloading process, very close weight control can be obtained. This is illustrated in the following table.

TABLE 5.—*Density variation in consecutive cans as drawn from freezer while beater was off during drawing—Data taken in pounds per gallon from 20 freezers*

	First and second can	First and third can	First and fourth can	First and fifth can	First and sixth can
Average variation	0.029	0.059	0.124	0.116	0.075
Maximum variation	+.10	−.16	+.23	+.20	−.10
Minimum variation	±.00	.02	±.00	±.00	+.05
Maximum positive variation	+.10	+.15	+.23	+.20	+.05
Maximum negative variation	−.07	−.10	−.20	−.15	−.10

To illustrate further the effect of the beater, Table 6 is given, using the same freezer and part of the same mix as in Table 5, and showing that the variations in density are much larger due to operation of beater during the unloading process.

TABLE 6.—*Variation in weight per gallon of ice cream as drawn from freezer with beater on while drawing, in pounds per gallon*

Batches	First and second can	First and third can	First and fourth can
1	−0.32	+0.40	
2	−.43	−.33	−0.03
3	−.24	−.17	−.18
4	+.06	−.08	
5	−.36	−.26	−.52
6	−.22	−.32	+.92
7	−.56	−.56	−.70

With certain makes of freezers, and incidentally, there is a wide variation in the efficiency of the various makes of freezers, the revolutions per minute of the scrapers of the outside mechanism of the freezers influences materially the time to freeze and whip, and the resulting quality of the ice cream. This is briefly illustrated in the following table:

Freezing process

Speed of scraper, revolutions per minute	Speed of beater, revolutions per minute	Brine range °F	Time to freeze	Time to whip	Total time
			′ ″	′ ″	′ ″
70	150	−2	12 07	16 43	28 50
106	150	−2	7 21	11 24	18 45
140	150	−2	7 0	5 18	12 18
211	150	−1	6 23	4 29	10 52

With each increase of speed of the scraper during the freezing process, there is a decrease in the time to freeze the ice cream. This can be better explained when we consider that during the higher speeds, the scraper blades tend to keep the inside wall of the freezer free from frozen ice cream, and in addition the increased speed aids in a more rapid transfer of heat. The frequency with which the blade of the dasher passes a given point on the inside wall of the freezer determines quite materially the size of the ice crystal allowed to form. Quick freezing is highly desirable. Therefore, as much of the moisture as possible should be frozen in the freezer. With an increased revolution per minute of the dasher, a stiffer cream can be unloaded from the freezer, thereby allowing more water to be frozen in the freezer which in itself produces a smoother textured ice cream.

FACTORS AFFECTING CRYSTALLIZATION

Research applying directly to ice cream is new compared to some of the other branches of the dairy industry, and study of the factors affecting crystallization in ice cream has been difficult, primarily because in most cases no accurate scientific method has been applied to this specific piece of research. Valuable as is the organoleptic test, it does not lend itself to the most satisfactory observations possible for scientific study. Microscopic study of hand sections of ice cream advocated by some is unsatisfactory and observations are misleading due to the fact that the sample is distorted as a result of the treatment, also because the sections are too thick and irregular to allow for proper illumination of the section being examined. In the study of sandiness in ice cream, microscopic observation of the lactose crystals after centrifuging has been shown to be satisfactory;

in fact, it is still recommended as the most satisfactory method since the relative smallness of the lactose crystals, compared with the ice crystals normally present in ice cream, make observations difficult and less satisfactory in microtome sections.

Microtome sections can be satisfactorily prepared for observation and with great care they can be made suitable for work in photomicrography, the tilt of the knife and temperature of sectioning being particularly important. Carbon dioxide for freezing may be used although it was found that with most ice cream studied this was not necessary. When used simply as a means of freezing the sample on to the microtome attachment, no difference could be detected in the observations due to a change in structure, as compared to samples adhered to the attachment by the aid of albumin or dextrin.

In the work reported, most of the sections were cut at about 0° F. by the aid of a rotary type microtome. With special batches having low freezing points, lower temperatures were more satisfactory for sectioning. Cover glasses were used over the sections under observation and measurements of air cells and crystals were made on an ocular scale previously standardized against a stage micrometer scale.

The California Experiment Station is at the present time making a study of the factors affecting crystallization in ice cream. This particular point of research is made possible through a scholarship maintained by the California & Southwestern States Ice Cream Manufacturers' Association, and Mr. W. C. Cole is actively engaged in this study.

Most investigations have stressed the importance of the various solids of the ice cream mix as affecting crystallization, and it is known that any increase in total solids results in a smoother product, primarily because of the decrease in the amount of water left to crystallize as ice, also because the solids added do not in most cases lend themselves to crystal formation when subjected to the normal processing of the ice cream. Lactose is relatively insoluble, as shown by the following table from the International Critical Tables, (Vol. II, p. 346) and may crystallize out.

TABLE 8

Temperature ° C.	Per cent lactose	Temperature ° C.	Per cent lactose
0	10.6	74.0	46.2
15	14.4	88.2	56.0
25	17.8	100.0	60.5
39	24.0	121.5	69.4
49	29.7	158.8	81.1
64	39.7	200.0	92.5

It is possible to have lactose present in ice cream in quantities exceeding the saturation point and still not have sandiness develop providing it is properly dispersed in such condition and the temperatures are such that crystal growth does not take place. Sucrose and other sugars normally present in ice cream result in a smoother product not only because they replace part of the water but also because at the eutectic point the tendency is to produce a mixture of small crystals rather than the larger crystals formed at higher temperatures.

The fact that 60 per cent or more of normal ice cream mixes is water and that as such it is the main factor affecting texture of ice cream is leading some investigators to give more attention to processing and particularly to the freezing process itself.

Homogenization is almost uniformly recognized as a means of improving the texture of the ice cream. Many theories have been advanced to explain this, but none of them seems entirely satisfactory. Recently the addition of certain of the ice-cream ingredients at various stages in the process of manufacture has been given some consideration, and it is now known that this can be used as a means of controlling sandiness in ice cream.

RATE OF FREEZING

As previously stated, the rate of freezing is a factor of major importance in cotrolling the texture of ice cream. It is possible to get extreme variation in crystal structure by varying this factor alone, as is shown by the microphotographs.

Organoleptically, the sample illustrated (No. 1), which was frozen quickly with no agitation, using carbon dioxide, was outstanding in smoothness and did not have that excessive coldness typical of so many ice creams; while in No. 2, which had exactly the same composition as the mix used in No. 1 but was frozen slowly at 0° F., which would be ordinary hardening room conditions, it was icy, rough, very cold, and pronounced stratification was apparent. From these two it would appear that the only value that agitation has in the freezer is the rapid transfer of heat. The temperature at which the mix is drawn from the freezer is very important, and, as was previously stated, the higher the speed for most makes of freezes the more water can be frozen in the freezer, because a stiffer ice cream can be unloaded. The following illustrations show that effect of agitation and particular the effect of drawing the ice cream from the freezer at various temperatures. The ice cream represented by Nos. 2, 4, and 5 was drawn from the freezer at a cooler temperature than either No. 3 or No. 7, and the crystals are smaller and also the increased length of time of agitation does not materially aid in further dispersing the ice crystals.

It is easily seen that the size of the crystals in No. 5 are much smaller than in No. 3, and likewise No. 3 is much smaller than No. 7. These represent only one mix, and are given only as an illustration of what can be easily duplicated.

The question of yield is a story by itself. Several authorities have written of the importance of the uniform distribution of small air cells throughout the ice cream as a means of controlling texture. At the time of writing, experimental work at the California Experiment Station is not complete on this phase of the work, but the work so far indicates that air cells, if important, are only of minor importance, at least at and shortly after the time of freezing. Certainly, it is possible to get a variation from very smooth to very coarse ice cream without the incorporation of any air during the freezing process. The following table shows little correlation between size of air cells and size of crystals in ice cream.

It is not intended to convey here the idea that air is not necessary. In order to produce a palatable ice cream, one that is not soggy and doughy, due to too great a density, it is necessary to separate the solids, and air offers the most convenient and economical means of so doing. This same principle has been made use of for a number of years in the culinary art.

Knowing that increased solids produces a smoother ice cream, it seems desirable, therefore, to make use of the maximum amount of solids. Solids increase the cost of the mix; therefore, a slightly increased yield is necessary in order to make the product economical as well as to improve the quality. Certain State regulations have been adopted in attempting to control the manufacture of ice cream so that the consumer may receive a more uniform product. A uniform product to the consumer means a uniform product to the dealer. Shrinkage is the manufacturer's problem as well as the dealer's, and for the most part the shrinkage in dispensing a gallon of ice cream is in direct proportion to the food solids to the gallon that the ice cream contains.

This has been approached from three angles: (1) A definite yield has been placed upon the ice cream. Such a law is detrimental to the industry in that any increase in water would decrease the cost and increase the weight. Such a law stimulates production of poorer ice cream. A law requiring a definite weight per gallon is unjust for the same reason. The State of California has worked out a method for regulating the manufacturing of ice cream which though only having been in operation a short time, looks very promising. This State requires that each gallon of ice cream must contain a definite amount of food solids to the gallon, food solids being defined as sugar, milk solids not fat, and butterfat. If a very low food solids content ice cream is manufactured, it is necessary for the manufac-

turer to take a low yield which will automatically increase the weight. On the other hand, if the manufacturer makes an ice cream of high butterfat or high food solids, he is allowed to increase his yield so that the food solids per gallon may be constant. This, naturally, decreases the weight slightly and increases the overrun. The consumer is entitled to a clean, wholesome, palatable, and uniform product.

During storage temperatures which approach the freezing point of ice cream greatly augment the growth of large crystals. This applies not only to lactose crystals but ice crystals as well. Some have ventured the explanation that a decrease in the viscosity as a result of increase in temperature is responsible for this crystal growth. This may be a factor, but the dissolving of the smaller crystals as the temperature approaches the melting point, and the subsequent deposition of the same from solution on the larger crystals remaining, which serve as nuclei when the temperature is lowered, seems a more likely explanation.

TABLE 9.—*Microscopic observation record*

Sample No.	Magnification	Size of air cells			Size of crystals			Remarks
		Minimum	Maximum	Average	Minimum	Maximum	Average	
1	100	None.	None.	None.	23×30	182×274	106×152	Stratification.
2	100	None.	None.	None.	30×45	167×243	91×137	Large crystals; few ice cycles.
3	100	15×15	91×122	45×61	15×30	45×258	38×122	Few air cells; ice cycles plentiful.
4	100	15×22	76×122	45×61	15×22	182×228	61×76	Few air cells; few ice cycles; crystals more uniform.
5	100	15×22	152×304	61×106	15×15	76×106	38×53	Few air cells; crystals quite uniform.
6	100	15×15	228×425	76×91	15×15	61×106	38×53	Similar to sample No. 5.
7 [1]	430	None.	None.	None.	3·5×3·5	14×18	7×9	Very smooth.
8 [1]	430	None.	None.	None.	3·5×3·5	14×25	9×11	Do.
9	100	17×17	117×200	67×83	33×42	83×166	67×83	Medium, coarse.
10	100	17×33	133×200	83×100	17×25	83×100	50×50	Smooth.
11	100	17×25	133×200	67×83	17×33	100×133	50×67	Smooth; few ice spines in air cells.
12	100	17×17	133×200	42×50	25×42	83×133	50×67	Few spines.
13	100	17×33	300×333	83×100	17×42	117×200	83×100	Ice cycles present, coarse.

[1] Mix frozen with carbon dioxide.

Very low overrun maintained in all of the above samples of ice cream.
Frozen in direct expansion freezer; return ammonia at 0° F. ±.

The International Ice Cream Manufacturers' Association, of which Mr. D. M. Dorman is president, realizing the value of true research, maintains a research council for assisting in carrying on research work and perpetuating and summarizing the research work for the benefit of the industry.

Recapitulating, it may be said:

(1) A definite standard is necessary.

(2) The quality of the materials used in assembling the mix should be of the best, the entire mix should be properly pasteurized

with the correct amount of agitation, should be homogenized at pasteurization temperatures, should be cooled immediately to 34 to 36° F., and under present methods, should be aged for from 24 to 48 hours.

(3) The mix should be frozen in the freezer as rapidly as possible and the maximum amount of water should be frozen in the freezer. This requires sufficient speed of the dasher to unload the freezer. The beater or internal mechanism of the freezer is one of the major factors causing the variation in weight during the unloading process.

(4) The true viscosity, or the viscosity of the fresh mix, is important. The colloidal, or apparent viscosity developed during the aging period, is secondary, and is destroyed shortly after the mix enters the freezer. Gelatine is the prime factor in the development of colloidal viscosity during the aging period. The basic viscosity when reached in the freezer is apparently identical to that of the original mix before aging.

(5) The composition of ice cream, although important, can not be changed sufficiently to eliminate the difficulties encountered from unsatisfactory crystallization of ice; although this may be used as a control of lactose crystallization.

(6) An increase in the total solids of ice cream results in a smoother product, primarily because of the corresponding reduction in water content, and secondarily, because certain of the added constituents inhibit crystal growth.

(7) Homogenization of ice cream results in a smoother finished product, but the exact cause of this phenomenon is not known.

(8) The importance of determining and controlling the proper rate of freezing, the proper temperature of drawing the ice cream from the freezer, and the most satisfactory storage temperature must be given due consideration if crystallization is to be controlled and ice cream of desirable texture produced.

(9) In order to stimulate manufacturers to produce a desirable ice cream, State regulations seem necessary. Such regulations must be just and fair. Standards based on food solids to the gallon appear to be sound.

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NUTRITIONAL VALUE OF MILK AND THE IMPORTANCE OF MILK IN THE HUMAN DIETARY

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The studies in the field of foods and nutrition which have been so actively prosecuted during the last 25 years have all tended to bring to light the fact that practically all of our ordinary foods are deficient in one or more respects. The biochemist of to-day visualizes an adequate diet as a mixture of about 35 nutrient principles. Of these, 18 or 19 are derived from proteins. It is not yet clear just how many of these amino-acids are indispensable. The body requires the sugar glucose or some other carbohydrate which can supply glucose, together with at least nine inorganic elements—sodium, potassium, calcium, magnesium, chloride, iodine, phosphorus, sulphur, and iron, and at least five vitamins, A, B, C, D, and E.

The science of nutrition received a great impetus about 1906 through the demonstration in experiments on animals carried out at the University of Wisconsin that rations could readily be prepared from ordinary natural foodstuffs of vegetable origin, all of which had essentially the same chemical composition as respects protein, digestible carbohydrate, and total digestible nutrients, and yet have remarkably different values when fed to animals as the sole source of nutrient. In these early experiments rations were derived exclusively from the products of a single type of plant, e. g., wheat plant, oat plant, maize plant, etc.

Further studies have shown that all the cereal grains, tuber and root vegetables, fruits, and even the muscle tissues of animals are so constituted as to provide everything which is necessary for satisfactory nutrition in amounts which will promote physiological well-being either during growth or in adult life. Rations derived from such sources, even though very complex in character, cause stunting of the young, early ageing in the adult, heightened susceptibility especially to lung infections, and are inadequate for the

support of normal lactation. Milk produced by lactating animals on diets restricted to these sources proves to be deficient in several respects, so that young suckled by mothers on inadequate diets fail to develop in a normal manner.

Out of such studies we have come to appreciate the primary importance of understanding the supplementary values of different foods for each other. By supplementary values we mean that what is lacking in one food will be supplied by another which is so constituted as to contain in relative abundance those nutrient principles in which another food is relatively deficient. A vast amount of experimental work has been done during the last 20 years to determine which foods, when combined, tend to enhance each other's value.

All cereal grains, tubers, roots, fruits, and meats contain too little calcium to promote the well-being of either the growing young or the adult. All of these, especially meats and grains, are disproportionately rich in phosphorus in proportion to the calcium which they contain. We know from numerous investigations relating to rickets and similar conditions which can be brought about by restricting young animals to faulty diets that a favorable quantitative relationship between calcium and phosphorus is very important for the promotion of normal bone development.

Many of the tuber and root vegetables, and most of the fruits, as well as the cereal grains, contain smaller amounts of vitamin A that are optimal in the diet. All foods derived from the plant world or from land animals are very deficient in vitamin D. All dried fruits and foods cooked by ordinary household methods are essentially lacking in the vitamin C, the antiscorbutic vitamin.

The tendency during the last century toward the manufacture of refined cereal products has accentuated the deficiencies of the diet of many Europeans and Americans. Whole wheat, whole maize meal, and unpolished rice are decidedly superior in their dietary properties to the bolted flour, degerminated maize meal, and polished rice in respect to quality of protein, quality of inorganic content, and vitamin content.

An inspection of the types of diets on which mankind has long subsisted in various parts of the world seems to justify laying special emphasis upon two types of human dietaries. One is employed by approximately half of the human race in the wettest parts of the world, where rice is the cereal grain and where, owing to the great density of human population, animal industry can scarcely be said to exist. I refer to southern and eastern Asia. Here the diet differs from the typical American diet of the present day mainly in two respects. These people never had in historical times appreciable amounts of dairy products. They do, however, eat very large

amounts, as compared with the people of the United States, of that class of vegetable of which the leaves are eatable. The other type of diet referred to is that of people in the more arid regions of the world where farming yields little return, but where human beings can subsist in great measure through conversion of the pasturage into human food through the agency of domestic animals. Such people subsist in great measure upon sour milk, curds, butter, and meat, with moderate amounts of vegetable food. In both of these regions physical perfection appears to be distinctly greater than that which is achieved by people in the United States of the present generation.

Animal experimental studies have shown that milk and leaves of plants occupy a unique position among our available foodstuffs, in that they are so constituted as to correct, when suitable amounts are included in the diet, the defects of cereals, tubers, roots, and meats. For this reason it was suggested 10 years ago that they be distinguished by the term "protective foods."

It is unnecessary to dwell upon the specific nature of the deficiencies of each of our more important natural foods, but it may be said that in general there is a marked tendency of the diet of the average American of to-day to be deficient in the element calcium, to be somewhat overrich in phosphorus in proportion to the amount of calcium it contains, to be deficient in the vitamin A, and in some cases in the vitamin C, as well as the antirachitic principle associated with certain fats, the vitamin D. Numerous experimental studies with animals have established the remarkable value as supplementary foods of either milk or leaves. This is one of the well-established facts in animal husbandry.

In 1919–20 I had an opportunity of making a study on the group of negro children in an orphanage in Baltimore, which brought out very clearly the deficiencies of a diet consisting essentially of products derived from cereal grains, and including hominy, rice, barley, white flour, cornstarch, corn meal, oatmeal, bread, dried beans, mackerel, beef, ham, pork, potatoes, string beans, carrots, onions, turnips, beets, cabbage, squash, Kohl rabi, preserves, apples, bananas, animal fats, and sugar. Approximately 4 to 5 per cent of the calories of the diet were derived from meat, and much less than this of the leafy type of vegetable. The institution contained 236 children of all ages up to 14. Their history showed clearly that the dietary was insufficient to promote satisfactory physical development notwithstanding its wide variety and the fairly appetizing quality. The children were all more or less stunted, many very badly. Over a period of 15 months two groups of children in this orphanage were compared, one being maintained on the institutional diet, the other on the institutional diet supplemented with one quart per child daily

of whole milk made by dissolving a high-grade milk powder (Merrell-Soule) in cold water. The extraordinarily rapid gains made by a number of the children on the supplemented diet, and the good gains made by nearly all who were not handicapped by tuberculosis, presented a very marked contrast to the children who continued to subsist on the institutional regimen.

During the last decade in many places throughout the United States the beneficial effects of milk drinking have been demonstrated on tens of thousands of children. The results have all tended to support the view that a very considerable portion of the youthful population in the United States subsists too largely upon a diet having essentially the properties of one derived from white bread, muscle meats, potatoes, and sugar, the sugar consumption being excessive. Where such diets are used the substitution of approximately 1 quart of milk per day improves the dietary in a remarkable manner.

As far back as 1918 I suggested the desirability of a dietary regimen in the United States and Europe which would include a greater consumption of these two classes of food, i. e., milk and the leafy type of vegetables, which have proven in human experience to be our most valuable supplementary foods. These are so constituted as to make good the deficiencies of almost anything else we are likely to eat.

Optimal conditions of nutrition during the time when the teeth are forming (before birth and in childhood) will go far toward insuring that the tooth structure will be excellent. It is during these periods that the nutrition of the mother and child are of the greatest significance from the dental standpoint. It is also of great importance for the preservation of the teeth that a state of good general health should be maintained and especially that the digestive tract, of which the teeth form a part, be kept in an hygienic condition. While a few have criticized the use of milk in the diet on the basis of supposed injurious effects on the teeth, I have found nothing in human experience which would support this view. It is, of course, a matter of great importance that each meal should be concluded with some detergent food so as to automatically cleanse the surface, and the well-known principles of mouth hygiene should always be applied. The well-established facts which have revealed the relation between infected teeth and other foci of infections derived from the teeth make the problem of developing a good set of teeth, and of safeguarding their health through proper nutrition and mouth hygiene, one of the most important factors in public health.

The right kind of a diet can best be described by making clear that certain kinds of diets which we employ very commonly are unsatisfactory. If a man should go to a hotel dining room and order

the following menu, he would think that he had ordered a good dinner:

Clear soup; broiled steak; horse-radish; fried egg plant; apple pie; olives; butter; cheese; French fried potatoes; buttered peas; hot rolls; coffee.

If he were familiar with the science of nutrition he would know that this list of foods would not keep one in a healthy condition. It does not contain any of the protective foods, milk and the leafy vegetables.

Many thinking people have wondered during the last few decades why it is that so many men and women begin to look old at 40 to 50 years, and why the teeth of nearly every one are so poor that they decay early. The answers to these questions could not be given until the subject of nutrition was investigated by scientific methods. With accumulating knowledge regarding what in chemical terms constitutes an adequate diet, and knowledge of the exact nature of the different foodstuffs which enter largely into our diet, the answer has become apparent. We are not taking the right combinations of foods.

It has been discussed in the preceding chapters how modern investigations on foods have shown that all the cereal products such as are eaten so extensively nowadays, viz, wheat flour, corn meal, rolled oats and rice, have several deficiencies from the dietary standpoint, and all have about the same deficiencies. The tubers and fleshy roots such as potatoes, beets, sweet potatoes, carrots, and turnips, likewise have very similar nutritive qualities. It has been found that their deficiencies in certain respects coincide with those of the cereal grains, so they do not serve, when eaten with the flours and meals and other cereal foods, to correct their defects. Even lean meats like ham, steak, veal, or lamb do not contain certain nutritive essentials which are lacking in milled cereals and tubers.

Suppose we visit a cafeteria in the evening where many business people are taking their dinners before going to their homes. If we audit their trays we shall find a surprising number satisfying their appetites upon such menus as the following:

1. Meat pie, stewed tomatoes, white muffins, butter.
2. Corn beef hash, mashed potatoes, succotash, bread, corn bread, butter.
3. Meat pie, raised biscuits, potato salad, coffee.
4. Beef croquette, mashed potatoes, stewed tomatoes, bread, butter.
5. Stewed tomatoes, white flour muffins, corn bread, butter, lemonade, currant pie.

Most of the people who are making the principal meal of the day on such a list of foods are overtired at the end of their day's work. Do not most of them feel restless? How many of them are rested when it is necessary to get up and prepare for a new day's effort? How many are so balanced mentally that they find an evening at

home spent in reading some of the world's greatest books the most satisfying kind of rest and recreation? Is it not true that most of the people we have watched at their evening meal want an evening of excitement and entertainment rather than one of rest and self-improvement? Those who suffer from the right kind of fatigue want to go home and rest. Those who are chronically tired but who still crave excitement are generally living in the wrong way. When we have described their daily diet as consisting largely of meat, bread, potatoes and sugar, and other foods having dietary properties which do not enhance the nutritive value of these staples we have discovered one of the most significant factors in determining why the present generation of adults is below normal in health.

The author has studied hundreds of combinations of foods on thousands of laboratory animals. He has also given a great deal of time and effort to learning the dietary habits of mankind in different parts of the world. These studies have included the past as well as the present practices in the choice of food. He has correlated this information with the physical development and health conditions as these relate to natural vitality. This experience has given them a new insight into the remarkable value of certain kinds of food for the improvement of the quality of those which now form the bulk of our food supply.

The secret of success in nutrition, in so far as it relates to providing the body with exactly what it needs for proper functioning, without heaping upon it a mass of worthless material which it must work over and metabolize in order to get a little nutriment, lies in eating more of certain foods in place of certain of the things of which we now eat too much. We should not quit eating the foods which we have listed as incomplete. They are incomplete because they lack, absolutely or relatively, certain substances which the body needs. They are good foods, provided we take them with certain other foods which supplement their deficiencies. The foods which supply what a diet of meat, bread, potatoes, and sugar lack, we have called protective foods.

The protective foods are milk and leafy vegetables. The most common and appetizing among the latter are lettuce, romaine, water cress, cabbage, Brussels sprouts, chard, kale, spinach, turnip tops, beet tops, dandelion leaves, etc. These and similar leafy vegetables are eaten in large amounts by certain of the oriental peoples, but they have not found a very prominent place in the American diet. We are not taking enough of the protective foods to make good the deficiencies of our meat, bread, potato, and sugar diet.

We can greatly improve our diet and reap all the benefits which accrue from highly satisfactory nutrition by eating somewhat less of our staple, refined foods, and more of the protective foods. By

doing this we shall be intensifying the use of milk, which is recognized by physiologists and medical men everywhere as the one food for which there is no effective substitute. We shall be borrowing the best feature of the oriental diet, and one without which many millions of human beings could not exist. The results of scientific investigation support the view that if one will obey the following three precepts regarding the selection of food, a diet will be secured which will be highly satisfactory for the preservation of vitality and health:

(1) Everyone should take daily throughout life approximately the equivalent of a quart of milk. Some of this may be taken as a beverage, or in ice cream, cream soups, creamed vegetables, custards, buttermilk, etc. As a nation we are taking about half this amount.

(2) Once a day a liberal serving of greens or potherbs. These should be cooked. These include such leafy vegetables as we have enumerated above. This practice should go far toward correcting the tendency to constipation which is in part brought on by our refined foods. Constipation is in part to be attributed to the sharing of the intestine in the general debility which results from a faulty selection of food. In part it results from bad habits of personal hygiene.

(3) Twice each day a salad should be eaten. A salad, according to definition, is a preparation of herbs, vegetables, or fruits, as lettuce, celery, water cress, etc., usually dressed with salt, oil, vinegar, and pepper, or a dish of chopped meat or fish mixed with vegetables and seasoned with oil, vinegar, and other condiments. Many prefer more elaborate salad dressing than oil, vinegar, etc. Salads may be simple or complex according to choice.

Salads encourage the consumption of a certain amount of raw foods, especially fruit, cabbage, celery, tomatoes, etc. It has been pointed out that vitamin C is very unstable. It is found, however, in raw foods, especially those of vegetable origin. Salads have the virtue of being filling foods, and tend to discourage overeating. They also encourage chewing, a practice now sadly neglected, to the detriment of the digestion. A slogan which we would like to have everyone remember and act upon is: "Eat what you want after you have eaten what you should." Those who adopt this slogan as a guide to eating will find it easily possible to take a diet which will promote physical well-being and at the same time secure all the satisfaction of catering to the appetite that is consistent with our view that we should be moderate in all things.

Many will ask how about the vitamins which have been advertised within the last few years? The answer is that these are contained in the food we eat provided the selection which we recommend is followed. There were a great many people in the world with fine physical development, good health, and long life before it became known that there was such a thing as a vitamin. It is true that there is danger of running short of certain of them if we live in the unsatisfactory manner which characterizes the habits of many Americans

to-day. However, there is no safer advice than this: The place to get vitamins is in the market, in the grocery store, from the milkman, and from the garden, and not from the drug store. The only exception to this is in regard to the vitamin D, which is best secured from cod-liver oil.

If adherence to the system of diet which we have recommended in this chapter seems like going to a lot of trouble, consider the difference in the value of a life of health, optimism, vigor, and enthusiasm as contrasted with lassitude, chronic fatigue, constipation, lack of resolution, and of initiative. One of the most effective ways of securing the former is through good nutrition. One of the surest ways to reap a harvest of misery is through chronic malnutrition.

INCREASING CONSUMPTION OF DAIRY PRODUCTS BY EDUCATIONAL METHODS

By Mr. F. D. MUNN, President of the National Dairy Council, Chicago

Prior to 1919 two important facts were definitely established emphasizing the need in the United States of an organization to inform the public of the importance of dairy products in the diet. Firstly, examination for service in the World War disclosed that a large number of young men of serviceable age had physical imperfections, largely due to insufficient use of essential and protective foods. Secondly, research by leading dietary scientists had demonstrated that milk and milk products supplied food elements vital to growth, body maintenance, and health.

PLAN OF ORGANIZATION

In June, 1919, we began to develop the National Dairy Council as an organization to increase consumption of milk, butter, cheese, and ice cream through educational methods. This work was started with the public declaration that the council organization would promote child health and human welfare by advocating a broad health program in which milk and its products occupy a fundamental place. The council has steadfastly adhered to this. This program is based on the following eight health rules:

Use four glasses of milk each day.
Eat some vegetable besides potato every day.
Eat fruit every day.
Drink at least four glasses of water every day.
Play part of every day out of doors.
Sleep many hours with the windows open.
Brush teeth every day.
Take a bath oftener than once a week.

The organization consists of a national and affiliated regional unit organizations, the latter being located in large consuming centers. The funds for the national office in Chicago, Ill., are raised by voluntary contributions from the different branches of the industry whose business is largely national in scope, such as butter manufacturers, dairy breed associations, cheese and dairy machinery, and supply organizations.

The funds for carrying on the educational work in the regional units are raised by the milk producers and milk dealers in such local territory. Producers supplying the milk for sale contribute 1 cent per hundred pounds and the dealers receiving such milk contribute an additional 1 cent per hundred pounds on all milk sold in such regional territory. Five per cent of the funds raised in the local units go to the national office for use in preparation of material, holding conferences, building good will and national prestige. The remaining 95 per cent is spent entirely in the local territory. To illustrate what is meant by a regional unit, we will take one large city as an example. Work carried on in such a unit covers that city and the territory embracing the milk shed area for supplying milk for that city and the surrounding cities and towns. The work in such territory is conducted through an organized regional unit in cooperation with the National Dairy Council. There are 14 of these organized affiliated units. These units cover about one-seventh of the territory of the United States and about one-fifth of the population. The balance of the country is covered from the national office by methods more fully detailed later on.

The work in the local territory is under the supervision of an executive secretary and the methods used are generally similar in each territory, as well as similar to those used in the national office.

The educational work of the council is conducted through departments such as nutritional, dramatic, publicity, quality improvement, exhibits, motion picture, and industry service departments. The entire council organization is built on a very closely cooperative and coordinated relationship between the national office and the regional units and the work carried on under plans, methods, and material developed and prepared through periodical conferences of the executive secretary and heads of the departments in the regional unit organizations with the executives and heads of departments of the national office. In these conferences methods, projects, plans, and material are worked out, which are used through the entire country. Before any educational material thus prepared is used it is approved by leading nutritional and educational authorities.

The National Dairy Council is an incorporated organization and has in its membership representatives from every department of the

dairy industry, including producers, pure-bred dairy cattle organizations, manufacturers and distributors of dairy products, as well as the makers of machinery and equipment used in such manufacture and distribution. It has a board of 35 directors selected from each of the various classes of membership. This gives every branch of the industry, as well as every section of the country, representation on the board.

The regional units are developed through a local executive committee selected by the contributors in such local territory in cooperation with the national office. This local executive committee has charge of the funds and business management of the unit. In addition to such executive committee, the council has in the various unit territories advisory committees composed of the health commissioner of such city, an official from the educational department, a representative from the medical organization, local welfare organizations, as well as any civic organizations in such local territory. Conferences are held with this advisory committee on methods for work in the local community. Such advisory committee is valuable in helping the council organization make contracts and to give prestige and create good will in the local community.

The extensive area of the United States and the fact that many large consuming centers are separated by hundreds and often thousands of miles make it necessary and desirable to have unit organizations. This plan has proven very useful in many ways. It supplies a means of executive representation in several widely separated areas through whom contacts are made with educational and welfare groups in large cities and is a valuable source of information that would not otherwise be available. It also tends to coordinate the dairy industry.

METHOD OF WORK

The United States is composed of 48 different States. In each of these States are various educational, health, and welfare organizations each working within their respective States. In connection with these, there are voluntary national associations or organizations so that these various State and local groups meet not only in the State where they exist as State organizations, but in conference by delegate representation and national meetings. In each city within the State are local educational and school organizations as well as health and welfare associations. These are explained that you may better understand the reference hereinafter made to agencies and organizations with whom and through whom the educational work of the council is carried on.

The council realized at the outset that the greatest progress would be made by securing the cooperation and support of these various

health, welfare, and educational organizations throughout our country. These groups at that time had not developed plans or material most effective for distributing health education information. The efforts of the National Dairy Council were first directed to maturing plans and material for this work and then to securing the confidence of the various health, educational, and welfare groups in the integrity of the council, its ideals, the sincerity of its purpose, and the soundness of its plans.

The success of these endeavors is best measured perhaps by the fact that at the end of eight years of endeavor the dairy industry of the United States, through the council organization, has the whole-hearted support of the scientific, health, educational, and welfare organizations throughout the entire country. As a result of the cooperation thus secured, the dairy industry in America has health educational workers in every part of the country with whom the council cooperates in advocating the consumption of milk and its products as a fundamental part of health development.

Surveys have been made to determine the effectiveness of health educational endeavor based on the health program approved by health educators and to which the council organization adheres. The American Public Health Association with the American Child Health Association surveyed 86 cities of approximately 50,000 population each, situated in different sections of the United States. This survey showed that five cities, where the child's average of milk consumption was above a pint a day, the rating in full health requirements both in the school and the health department was the highest.

A school survey in one of the large eastern cities disclosed that the entrance of children from the lower grades into the high school caused an amazing increase in the average per capita use of milk in the school lunch room. The school authorities of that city believe this is accounted for only by the fact that these children, before entering high school, had regular health habit training and formed the practice of using milk regularly in such health training.

In each of the above cases the dairy council organization had cooperated with educational and health authorities in a general health program. These surveys also bear out the contention of health educators that health teaching, to be successful, must include the whole health program and that emphasis on one of these health rules invariably leads to teaching of all eight. It is also conclusive proof that the method used by the council organization, in supplying for school use throughout the country material and suggestions which tend to promote a broad health program, definitely increase the consumption of milk and its products.

During the past nine years a vast amount of research work has been done by dietary scientists which more and more emphasized the important part that dairy products play in the growth of children and the development of health. We make the wide dissemination of this information an important part of our work.

This ever-increasing fund of information of the importance of milk, butter, ice cream, and cheese as healthful and protective food supplies the council with ample opportunity and material for enlarging as well as intensifying its efforts. The council endeavors at all times to present these facts in such a manner as to make health education of children and the observance of health habits by adults a pleasurable and self-interest effort rather than a task.

At the time the National Dairy Council began its work, health teaching, especially in the lower school grades, had not been generally adopted. This fact necessitated council workers going into the schools, in cooperation with the teachers, and doing work that should be done by the teachers themselves. The education material developed by the council was new, and, in many ways, unique and had a direct appeal to the teachers and educational authorities that gave it immediate use.

As health teaching has become more and more a part of the school curriculum the council has gradually changed its methods so as to supply a type of material to be used by teachers themselves. Its workers are now devoting more of their time in demonstrating to teachers and health educational groups the methods by which its material can be used, rather than actually going into the schools. It is the policy of the council at all times to keep in step with all progressive health education movements.

The far reaching effect of this method is best illustrated by reference to one city typical of many. This city is centrally located and has a population of about 220,000. Two council workers presented council projects, stories, and plays to the health nurses in the schools as well as the principals of each school in the city. Three of these presentations were made to these groups and material supplied for carrying on the work, consisting of health stories projects, slide talks, and health plays. It required three weeks' time of two council workers to make these presentations to the groups above mentioned. As a result of projects and material thus supplied and their use and application explained and demonstrated by the council workers, the teachers and nurses in that city did health educational work in the schools during the school year which would have required the full time of three council workers throughout the entire year, if done by them.

This particular instance is typical of what is being done in several cities in the United States by the council.

AGENCIES WITH WHOM THE COUNCIL COOPERATES

The National Dairy Council organization is cooperating in a systematic and well organized way throughout the United States with the following agencies and groups:

1. Public health department:
   - City and county health commissioners.
   - State boards of health.
2. Educational groups:
   - Public, private, and parochial school teachers.
   - Normal schools (for teacher training).
   - Teachers' training departments of universities.
   - United States Department of Agriculture—Extension division and home economics department of State colleges.
3. Organizations of boys and girls:
   - Girl Scouts—Y. W. C. A.
   - Boy Scouts—Y. M. C. A.
   - Camp Fire Girls. 4-H boys and girls clubs.
4. Welfare organizations:
   - Antituberculosis associations (county, State and National).
   - American Red Cross.
   - Health center clinics.
   - Visiting nurses and other welfare leaders.
   - Settlement houses.
   - Municipal parks and playgrounds.
5. Adult groups:
   - Women's clubs, farm bureaus, and community clubs.
   - Parent-teacher organizations.
   - Industrial groups such as Bell Telephone companies.
   - Church and fraternal organizations.
6. Factory and office employees (through health clinics or medical officers).
7. Professional groups: Physicians, dentists, and nurses (through national or regional associations).

We realize that some of the organizations above enumerated may not be familiar to or even existing in some of the countries represented in this Congress, but they are actual functioning organizations in the United States supplying a most effective agency through which health education information can be disseminated. Council work with these different agencies will be grouped in this paper as much as possible, thus avoiding unnecessary detail as well as duplication of expression.

In the United States each State has its own State health officer and health board charged with the supervision of health matters within the State. Under our system of government each county and city has or can have a health commissioner who, in cooperation with the State department, is responsible for health regulations within such local territory. The council organization works with these health departments by supplying them with various forms of material, health project work, and the latest information on the

importance of milk and its products in child growth and health development.

As a direct means of cooperating with and assisting health officials, the council organization is doing educational work in quality improvement. This work consists of a system of inspection and education which enables the producers to supply the best quality of milk possible. Money is made available for this work by producers and distributors of milk in territory where this work is carried on and the work itself is done cooperatively with the men engaged in producing and marketing the milk.

This character of work brings home to the producer not only the means and methods by which he can produce a high quality of milk, but the importance of the production of such quality as a successful marketing enterprise. This character of educational service is beneficial to both producers and the consuming public and is a valuable cooperative contribution to health authorities.

Producers throughout the United States are rapidly coming to realize that one of the greatest assets they have in the sale of their product is quality, and are endeavoring to produce a product which will command confidence and invite consumption.

Material and methods used in this very important work of quality improvement are on display in the council exhibit at this congress.

The council also supplies health officials with exhibits picturing in visual form material that will stimulate and develop good health practices. These visual displays are used by health officers in their communities, at conferences, and conventions in spreading health information. Millions of people are reached through this channel. These health officials, both State and local, are usually members of the American Public Health Association, a large and efficient national organization, which through meetings and annual conventions, establishes general policies which are followed in various communities by its members.

At the annual meeting of this association in 1927 the Nationl Dairy Council was invited to present demonstrations of health education methods which it has found practical and effective. The Dairy Council was given one hour and a half each day on the regular program of the convention, during which presentation was made of council stories, plays, and projects found most effective in stimulating interest in health and increasing the practice of health habits in which dairy products take a fundamental place. The 2,000 health authorities were supplied with copies of this material for use in their respective communities.

By far the largest part of the work of the council organization is done in connection with the school systems of the United States. As already stated, the council is now endeavoring, as far as possible,

to supply project work and health education material to the teachers and through them stimulate in the children the observance of proper health practices. All this material is prepared with two definite things in mind; namely, to make the observance of health requirements a pleasurable effort and to develop a proper health attitude in the mind of the child. These objectives are reached through various methods, such as stories, plays, posters, and projects, all relating to health. In addition to these, talks illustrated by slides and moving pictures are used.

Project suggestions are furnished to teachers, correlating health with history, geography, and civics, showing the way in which the practice of proper health habits throughout the ages, especially in the use of dairy products, has been a vital force in the development of nations. Health education in America has become so important that it is now considered fundamental in all educational effort and the development of strong, healthy bodies is recognized as its first objective. The importance of this was recognized in the International Educational Congress held in Edinburgh three years ago, when a resolution was passed declaring that health is the first objective in education.

In addition to the work being done by the council organization with teachers, it supplies material which is used by prospective teachers in normal schools and other teacher-training institutions for developing new health educational programs.

Time and space will not permit a detailed description of either methods used or material supplied by the council organization. We have on display at the congress samples of some of the material plays and projects used in the methods already outlined. The effectiveness of the educational methods of the council organization is strikingly illustrated by what has been accomplished in cooperation with the extension departments of State universities with one of the largest groups of boys and girls in the United States, called the 4-H club organization, in which there are over 600,000 boys and girls. The council presented a project at a convention of club leaders which had been developed as to subject matter and methods of work in cooperation with the extension department of one of the State colleges. This nutrition project was then tried out in a single county in this State.

Briefly, this project consists of four demonstrations illustrating the importance in the diet and the ways of using the health protecting foods—dairy products, vegetables, and fruits. The different parts of this project were assigned to different club teams consisting of from 4 to 10 girls each. These groups came together in a competitive demonstration rally in which they presented the facts they had learned in relation to proper food selection and the

application of such foods in the development of health. This demonstration shows the actual preparation of foods in attractive and appetizing ways and each demonstration is followed by a short play which tells the same story in dramatic form.

It was the introduction into the study of foods of this romantic method of presentation that has made the "health food show" the most popular nutrition project the extension divisions of many State colleges have ever used in their club work.

From this single demonstration in the State in which it started, this year the health food show has become the major nutrition project throughout the entire State. Two States have adopted it in their regular printed course of study and it is at present being developed through State colleges with their 4-H clubs in 16 other States. When you realize that each time this nutrition project is started in a State it means that it will eventually be presented at a rally of hundreds of the State club leaders of the entire State who afterwards present it in their respective local communities, it gives you some idea of the extent to which one piece of constructive, cooperative health effort has been incorporated into the educational work of our country. Pictures and material descriptive of this particular project are available at the exhibition booth of the council. Other methods of teaching aid are being furnished to other club groups in the United States such as Girl Scouts, Boy Scouts, Camp Fire Girls, Young Men's and Young Women's Christian Associations.

The National Dairy Council always endeavors to cooperate with existing welfare organizations rather than to attempt to create new organizations. These existing organizations are a most effective means of reaching large groups of people with the importance of the health message. Here, as with the educational groups, council material is prepared and adapted to supplement the work being carried on by these welfare organizations.

As an instance, there is throughout the United States an organization of nurses whose duties are to do home nursing. Through their intimate contact in the home they have a splendid opportunity for presenting proper nutrition information. In one city, after a single lecture by a dairy council worker before the entire group of nurses for that city and the distribution of material that would be useful to them, the nurses reported that they were able to talk food values in simple terms to women in their homes because they had these attractively planned, effective pieces of literature from which to discuss this subject. The various welfare organizations with whom cooperative work is most effectively done are enumerated in number four in the list of organizations already mentioned.

Experience shows that it is more difficult to change the food habits of adults than to develop proper food habits with children.

The appeal to the adult must be based largely upon self-interest. It is also possible to combine with this appeal to selfish interest, the benefits that examples of parental observance of proper food habits may have in developing these habits in the child.

Council demonstrators meet with various organizations of mothers, such as housewives' clubs, supper clubs, open-air nutrition classes, and parent-teacher groups, and through these groups reach thousands of mothers of various nationalities.

At these demonstrations the importance of dairy products with other protective foods is presented in a convincing way by the preparation of simple diets in which these foods are properly correlated. The opportunity to see the preparation of these foods in edible form and actually taste the finished dish has proved a most convincing method of changing improper food habits to proper ones.

In order to reach the great industrial groups of the country, educational material has been developed for use in factories and places of employment. This material makes a direct appeal to the workers in the interest of their own health and ability to enjoy life. Its purpose is to convince them that by the observance of proper food habits and simple health requirements, they can perform their daily labor with greater ease and less fatigue than otherwise and at the close of the day be in better condition to enjoy home and outside recreation.

As illustrative of what has been accomplished with this group, factories where thousands of employees work, milk is being used as a mid-morning lunch or with the noon lunch by 75 per cent, or more of the employees. This milk service is established in cooperation with the management and once introduced in a factory its benefits are so great that the employees themselves insist upon a continuation of such milk service and the opportunity to secure an adequate supply at lunch time.

Professional groups such as doctors and dentists are supplied with material which keeps them informed concerning new research information related to dairy products. This information is furnished to them in simple form which they may use as the opportunity offers either in the office or homes they may visit. Exhibits are also displayed at the various national, State, and local conventions of these professional groups visualizing in attractive form council activities and the most recent information on food, nutrition and health.

Through the service department of the council organization, educational material is supplied to those engaged in the manufacture and distribution of dairy products for use with their customers. This material is supplied in large quantities and results in a wide distribution in the homes throughout the entire country.

In addition to the dissemination of information on the importance of dairy products in relation to health, through the agencies and methods already outlined, the council organization maintains an extensive press publicity department. This department is responsible for the dissemination of press publicity, prepared by the entire dairy council organization, through the daily press, various health and trade journal and news organizations, including syndicate writers. Through these various press agencies it is estimated that during 1927 council material appeared in publications with an approximate circulation reaching 50,000,000 people. Authoritative information on nutritional subjects is distributed through a clip sheet issued monthly containing articles written and approved by nutrition specialists. This clip sheet is furnished to the metropolitan press and its material is widely used by leading daily papers in most of the large cities of the United States. The value of this service is emphasized by the fact that leading daily papers throughout the United States have written to the national office asking that they be supplied with the clip-sheet material prepared by the council organization.

During the year 1927 the council organization expended in its various activities through the United States $756,501 and distributed 9,143,251 pieces of literature emphasizing the importance of dairy products in relation to child growth and adult health. More than 200,000 school teachers have received and used one or more pieces of council material.

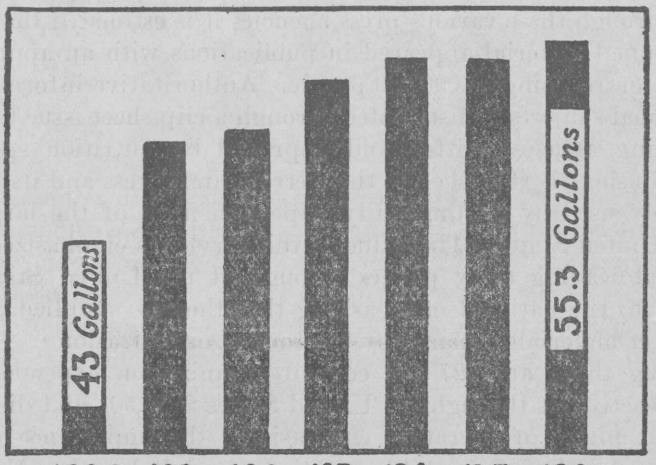
RESULTS OBTAINED

It is impossible to give an accurate estimate of the number of children whose health practices have been stimulated or adults whose food habits have been improved by dairy council material. Every section and community in the United States has been reached with some form of council activity and millions of people impressed with the importance of dairy products in relation to their health. This fact is shown by the very large increase in consumption of these products during the past seven years.

At the time the educational work of the council was started in 1920 consumption of dairy products in the United States, expressed in pounds of milk, was eighty-nine and one-half billion pounds. During the year 1926, according to Government estimate, the consumption of dairy products in the United States, expressed in pounds of milk, was approximately one hundred twenty and three-quarter billion pounds, or an increase over 1920 of 34.7 per cent. This was in part due to an increase in population; but allowing for this increased number of persons as shown by census reports, the per capita consumption of dairy products during 1926 over 1920 was approximately 25 per cent or one-fourth greater than in 1920. This

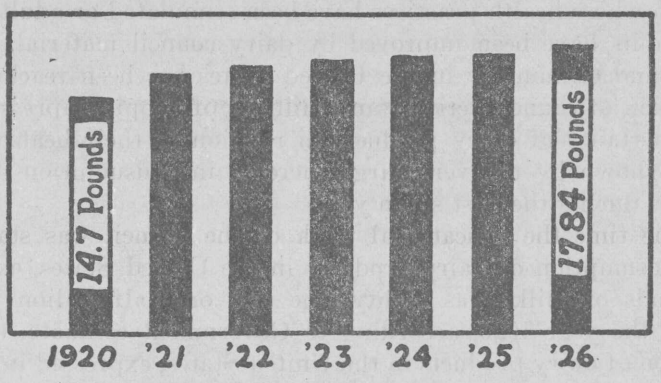
enormous increase in consumption is largely due to educational work done and material supplied by the council, together with the cooperative efforts of educational and welfare agencies stimulated by council effort and material.

The following chart shows the yearly increase in the consumption of milk in fluid form, in the United States, 1920 to 1926:



28·6% Increase in Per Capita Milk Consumption in 6 Years.

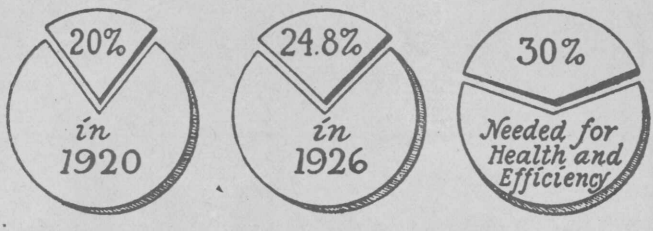
The chart below shows the increase in consumption of butter in the United States, 1920 to 1926:



21·36% Increase in Per Capita Butter Consumption in 6 Years.

A survey made during the year 1920 indicated that approximately 20 per cent of the consumer's food dollar was used for dairy products. Increased consumption raised this to 24.8 per cent in 1926. Dietary scientists state that in the interest of health and efficiency at least

30 per cent of the consumer's food dollar should be expended for dairy products. It is the aim of the council to reach this goal of 30 per cent.



Portion of the Consumer's Food Dollar Spent for All Dairy Produce in U.S.A.

An accurate estimate of the value of the health education work the council organization is doing can not be made without considering the direct benefit to child growth and development and its effect upon the future life of our country. The children of to-day who are receiving this important information on the relation of proper diet to health and happiness will soon themselves be home builders and wage earners and making practical application and use of the fundamental information they are now receiving on proper health practices.

Up to a very few years ago little thought was given to food efficiency. It was a popular belief that any food which satisfied hunger met all requirements. To-day we know that the important question is, "What foods best stimulate growth, supply body demands and health protection?" Science has demonstrated that milk and milk products are necessary foods for these purposes. For this reason the value of the educational work done by the council is not alone measured by the increased consumption of dairy products. This endeavor is a service to humanity as well as the dairy industry. The greatest asset the individual citizen can have is a strong, healthy body in which to develop mental and physical efficiency out of which alone can come a successful contented life. National greatness is assured when made up of such a citizenship.

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