UNIVERSITY OF MINNESOTA

INSTITUTE OF AGRICULTURE

AGRICULTURAL SHORT COURSES

ABSTRACT OF FOURTEENTH ANNUAL ANIMAL NUTRITION SHORT COURSE

SEPTEMBER 14-15, 1953
PETERS HALL
ST. PAUL CAMPUS, ST. PAUL

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ACKNOWLEDGMENT

A contribution from the
Northwest Feed Manufacturer's Association
has aided greatly in making this publication possible

PROGRAM

Monday, September 14, 1953
Auditorium, Peters Hall
M. O. Schultze, Presiding

A. M.

8:00	Registration -- Fee, $5.00 for the course, $2.50 for one day	
9:30	Welcome.	H. J. Sloan
9:45	The agricultural outlook for Minnesota.	E. Fred Koller
10:45	The feed situation.	W. T. Diamond
11:45	Luncheon	

J. B. Fitch, Presiding

P. M.

1:15	Ruminant Nutrition	
	The viewpoint of a bacteriologist.	(Miss) Lorraine S. Gall
	New developments in dairy cattle nutrition.	N. L. Jacobson
	New developments in beef cattle nutrition	T. W. Dowe
3:30	Visit exhibits in the Livestock Pavilion and in the Dairy Pavilion	
6:30	Banquet -- sponsored jointly by manufacturers, retailers, and nutrition short course	
	Richard W. Fisher, Assistant Football Coach, will discuss football.	
	Workable public relations.	Wm. L. Nunn

Junior Ballroom

Coffman Memorial Union

PROGRAM

Tuesday, September 15, 1953
Auditorium, Peters Hall
E. F. Ferrin, Presiding

A. M.

Swine -- Efficient Production of a Quality Product

8:45 Feeding and management of baby pigs. . . . . .Frank M. Crane

9:30 Recent research in feeding the brood sow and market pigs. . L. E. Hanson

10:45 What is market quality? -- A demonstration. . . . . . Clifford E. Cairns

11:45 Luncheon

E. L. Johnson, Presiding

P. M.

Poultry -- Efficient Production of Quality Products

1:15 What's new in poultry nutrition. . . . . H. R. Bird

2:15 The importance of quality in poultry products to the feed manufacturers. . . . . .Roy Peterson, Charles Kratachvil

3:00 The listing critics!. . . . . M. O. Schultze, Chairman, J. E. Donovan, J. W. Nelson, Eldon Roddis, Elmer Ziegenhagen

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THE ECONOMIC AND AGRICULTURAL OUTLOOK

E. Fred Koller
Professor of Agricultural Economics
University of Minnesota
St. Paul 1, Minnesota

In reviewing the agricultural outlook at this time it is particularly important to take a close look at the factors affecting the demand for food and fiber. Most of you have a pretty good idea what the agricultural supple situation is like. You are fully aware that there are large surpluses of nearly all agricultural products.

By harvest time this fall the United States will have enough wheat on hand to make a three-year supply of bread. There will be enough cotton to make our shirts for almost as long. There will be enough corn to feed the nation's livestock for nearly 18 months. We need not go on to describe our agricultural supplies. Our real concern at the close of 1953 is - "Where are the customers for all this food? What is the demand likely to be in the period ahead?"

The demand for agricultural products is very dependent on business activity in four major segments of the economy. (1) Demand is dependent to a considerable degree on what goes on in the field of <u>business investment</u>, that is, expenditures for plant and equipment, construction, and the like. (2) It is dependent in part on the level of <u>government expenditures</u>. (3) <u>Consumer expenditures</u> play a very large part. (4) Likewise, foreign or <u>export demand</u> is very important to our farm people.

Each of the foregoing areas of activity makes jobs. This, in turn, generates the incomes that makes it possible to buy what our farmers and others produce.

This summer employment over the nation reached a high of 63.2 million. Wages were at a record or near-record high in most major industries. As a result personal incomes reached an annual rate of $284.5 billion -- a new high -- and 7 per cent over a year ago. This favorable income picture has helped to support the demand for agricultural products and prevented an even worse deterioration of agricultural markets. A sharp downturn in one or several of these four segments in our economy could affect agriculture very adversely.

What are the business developments and prospects in each of the major segments in the economy? Business investment - activity in our machinery, construction, and similar industries - has been at a very high rate in the first half of 1953. It was 18 per cent above a year earlier and much better than was expected as we started the year.

Outlays for plant and equipment were at an annual rate of $28.4 billion this summer, or nearly $3 billion over a year ago. It appears that we are continuing near that rate in the third quarter of the year. This has been an important factor in maintaining demand. What are the prospects for the remainder of the year? Will the Korean truce bring the much forecasted downturn? While the situation is not as favorable as it has been, no major downturn is in sight at this time (August 20). Activity in the steel industry needs to be watched for clues to the future. Reports are that supplies are rapidly catching up with demand in steel. Farmers aren't buying farm machinery the way they were. Farm machinery makers are laying off some workers and cancelling orders for steel. Many expect the pace of the auto industry, and the demand for steel from this source, to slow down. Indicative of auto industry prospects dealer inventories of new cars on August 1 reached their highest level since before World War II. Truck production has already experienced a decline and is continuing at a greatly reduced rate.

A large volume of new construction has helped keep business investment at a high level. Construction in the first quarter of the year totaled $25.2 billion which was 9 per cent over a year ago. An unfavorable straw in the wind was a downturn in residential housing starts from 110,000 units in April to 107,000 in May and 103,000 in June. If the trend continues, there will be fewer jobs in this field and reduced demand.

Another critical factor in the business situation has been a sharp rise in inventories of all major types this year. At the end of June inventories totaled $77.3 billion, an increase of nearly $5 billion since a year ago. A substantial part of the accumulation has been in new cars, home appliances, television, and other consumer durables. Over-accumulation of inventories has given us painful business recession problems before. A reversal of the inventory-building trend could result in reduced employment and have an adverse effect on demand.

In these days of big government the demand for goods and services from this source is very important. At present the U.S. Treasury estimates that the government's expenditures in the 1953-54 fiscal year will total $74.3 billion. This is not far below the rate of expenditures in the previous fiscal year. Estimated receipts of the federal government will total only $68.5 billion leaving a deficit of $5.8 billion.

Now that we have a truce in Korea we are told that military expenditures may be cut modestly. However, it is doubtful that annual appropriations for purposes of national defense will fall below $35 billion for some time to come. We must remember that for the present we have only an uncertain military truce. A real settlement of international differences has not been effected. In such a world our military expenditures are likely to remain high. In view of this situation cutbacks in government expenditures are not likely to be as large as they were in 1945 and 1946. Reductions in government expenditures undoubtedly will be effected, but the impact on the economy probably will not be large until a real peace is assured.

Among the more important factors affecting demand for agricultural products is what you and some 160,000,000 other Americans choose to do with your money in the months ahead. Will spending continue at present rates? Or, will purse strings be tightened? So far in 1953 American consumers have been spending at an unprecedented rate. Personal consumption expenditures reached an annual rate of $230.5 billion in the second quarter of this year, which is $14 billion over the rate at the same time a year ago. This rate of spending has been encouraged by nearly full employment at good wage rates and much overtime. It has been reinforced by an unequalled increase in the use of consumer credit.

Consumer credit (borrowings for cars, appliances, furniture, etc. but not including credit for housing) rose to $27 billion at mid-year as compared with a mere $8 billion in 1940. The increase in the last year alone was $5 billion. At mid-summer the increase was at a rate of a half billion dollars a month. American consumers are drawing on their future incomes at a frightening rate. In commenting on the situation a leading magazine raises the question, "Are Americans in (debt) over their heads?" The danger signals are flying and credit men are worried. A contraction in the use of consumer credit could have a quick and jolting reaction on consumer expenditures and the whole economy. It is not a healthy situation.

Export demand for agricultural products is down considerably from a year ago. Currently farm exports are running about one-third below the 1951-52 period. Wheat exports are down 35 per cent from a year ago. Cotton shipments are down 60 per cent. There is little likelihood that there will be much improvement in demand from this source in the year ahead. Clearly the American farmer has an important stake in measures designed to improve our international trade.

An over-all review of the business situation indicates that the boom is slowing down and flattening out at this time (August 20). It is the opinion of quite a number of those who study the business situation that a moderate decline in the index of industrial production is likely to occur between now and the end of 1954 (assuming there are no major war developments). The slump in some lines of business may be quite sharp. In other lines, there may be little change. No major recession in business activity is in prospect. In view of this the domestic demand for food should continue strong through the remainder of 1953. If a decline in business develops, some reduction in expenditures for food will accompany it.

Agricultural Outlook

Now let us take a more direct look at some phases of the agricultural outlook. Agriculture has been in a period of relative price stability since February of this year. Although farm prices are down substantially from a year ago, they have not changed significantly, on the average, since February. This is somewhat reassuring after the abrupt two-year decline which apparently was stopped in February.

The index of farm prices dropped from an all-time high of 313 in February 1951 to 263 last February -- a decline of 50 points in two years. On july 15 they were only four points lower. However, they were still 12 points above the June 1950 figure.

The outlook for farm product prices for the remainder of 1953 is for not much change on the average. During the remainder of the year the prices of most of these products will follow normal seasonal patterns. Price support operations will continue important in sustaining the level of farmers' prices the rest of the year.

The index of prices paid by farmers has dropped only slightly in the past year from an index of 286 in July 1952 to 278 in July 1953. In consequence the farm parity ratio has dropped from 103 in July 1952 to 93 in July 1953.

Net farm income in 1953 will probably be about 5 per cent lower than in 1952. Last year net U.S. farm income was $14.3 billion. Based on farm receipts so far this year the 1953 figure may run around $13.6 billion. Farm purchasing power will be lower in consequence. Spending patterns in farm communities will be affected by these changes. The merchandising situation will be more difficult and much more competitive. Some real merchandising will be needed to make farm sales under these conditions.

The squeeze between farm prices and farm costs has become more severe during the past year. There is no let up in sight in this situation. The efficient farmer and the one who will adopt tried scientific methods will make a reasonably satisfactory net income under these conditions. The inefficient operator may have trouble.

For the long pull the prospect for agriculture is encouraging. Our population is growing. If business conditions can be kept reasonably stable, the demand for food will continue to grow, making a larger and larger domestic market for the farmer. Farmers will need to produce an increasing amount of food with a relatively stable acreage. This will require higher production per acre, per animal, per man. We will need to depend on our scientists more than ever.

Dairy Situation

We should take a brief look at the situation in a few of the livestock lines important to agriculture in this area. In view of the importance of dairying in the upper midwest let us review the dairy picture first.

The dairy industry has faced a number of difficult problems during the past year. Starting last fall there was a rapid upsurge of milk production. Winter and spring production in the early months of 1953 was extraordinarily heavy. It is likely that the total milk output for 1953 will be about 118 billion pounds, the third largest on record, and compared with 115.1 billion pounds in 1952.

Much of the increased milk production was channeled into the manufactured dairy products -- butter, cheese, and nonfat dry milk solids. Butter production so far this year, to August 1, is 23 per cent over a year ago; cheese 18 per cent; and nonfat dry milk output is up about 23 per cent.

The large increase in the manufactured products has brought the prices of these products down from the levels of a year ago to the government price support levels - 66 1/2 cents a pound for butter (at New York), 37 cents for cheese, and 16 cents for the dried nonfat solids.

To support the dairy markets the government has continued to make large purchases since last December. The purchases through July 24, 1953 have been as follows.

	Butter	American Cheese	Nonfat Dry Milk Solids
Purchased:		1,000 pounds	
April 1, 1952 to April 1, 1953	143,348	75,269	210,419
April 1, 1953 to July 24, 1953	175,584	135,816	258,063
Total	318,932	211,085	468,482

The government has large quantities of these products on hand. The hang over the market and will prevent these dairy products from having much of a seasonal price rise this year. Much of the supply will be donated for various relief uses. More permanent solutions for this problem are being sought by the dairy industry and the government at this time.

Changing demands for dairy products also have added to the problems of the industry in recent years. The per capita consumption of milk fat has declined from 31.2 pounds before the war to 27.3 pounds in 1953. Per capita consumption of the solids not-fat in milk have risen from about 40 pounds to 47 pounds in the same period.

Factors in the decreased use of milk fat are: (1) The use of fat-type table spreads is down -- particularly butter. This has been accelerated as increasing numbers of people have shifted to low-fat diets. (2) There has been an increasing substitution of vegetable fats for milk fat. The substitution of oleomargarine for butter is only one phase of this problem. Vegetable fats are being used to displace milk fat in ice cream, in canned milk, and other dairy products. (3) There has been an increased use of low-fat and nonfat dairy products. Sales of ice milks and sherbets have had a very large increase. The use of skim milk for beverage and cooking purposes has boomed.

The squeeze on the outlets for milk fat has been particularly hard on the dairy industry of this area. Minnesota, Iowa and Wisconsin have been the leading butter states. Depressed markets for butter are presenting dairy farmers and dairy plants with a difficult adjustment problem. In Minnesota many farmers have gone out of dairying or reduced their herds. Many smaller creameries have been closed for lack of volume.

Relatively high and inflexible price supports for butter have discouraged its consumption and held an umbrella over the market of the substitute product. A more realistic price policy for this product is a must.

Until April 1, 1954, the government is committed to support the price of milk and butterfat at 90 per cent of parity. At this time it is not clear what solution the dairy industry will propose for its problem. An industry committee is working on a solution for the problem.

Over the longer term the industry must strive to maintain its competitive position for the consumer's food dollar by greater efficiency at the farm production level, at the dairy plant, and in the market distribution system. Better feeds and feeding are important aspects of such a program.

Livestock Situation

Beef cattle producers like our dairy producers have confronted problems of rising output and falling prices in the past year. Since 1949 cattle numbers have climbed steadily -- going from 77 million head to 94 million on January 1, 1953. Any increase this year will be slight since marketings for slaughter, which have been heavy all year, may be large enough to prevent any increase on next January 1. If numbers fail to increase this year, the expansion phase of the current cattle cycle will be the shortest on record.

Cattle have moved to slaughter at record volume in the first half this year. For January-June the increase averaged a little over 30 per cent more than in the same period in 1952. The large slaughter is cutting into the cattle inventory on farms and bringing the cyclical expansion of cattle production close to a halt. This offers promise that cattle prices will show more stability in the next few years than previously seemed likely, provided that the demand for meat stays strong.

Prices of top grade cattle are expected to average higher in the months ahead than during the spring (July report). Prices of lower grades are expected to fluctuate considerably the rest of 1953. No pronounced trend in either direction is likely.

Toward the close of previous cattle cycles cow slaughter has taken place on a large scale and rapid rate. Numbers eventually have been reduced more than market prospects justified, just as they have been over-expanded during the upward phases of the cycle. Large scale slaughter of cows is not now anticipated. A break in the drought in the southwest and new government credit programs are offsetting earlier fears of heavier sales.

Unless consumer demand should be curtailed by a relatively sharp recession, the market for beef is expected to continue large. A rapidly rising population will help consume larger amounts of beef. No radical cut-back of beef is called for. Closer culling to cut costs of production would seem in order.

The hog business has presented an interesting picture this year. The number of pigs raised, spring and fall of 1953, is estimated at 84.2 million head. This is a decline of 8 per cent from the 91.7 million of 1952 and 18 per cent from the 102.2 million of 1951.

Hog producers cut back their 1953 spring pig crop by 10 per cent. Even though the hog-corn ratio has been favorable and hog prices have been good this past winter and spring, farmers are planning to have 5 per cent fewer sows farrow fall pigs this year than last.

The cut in the fall pig crop is expected to come outside the Corn Belt. Producers in the Corn Belt expect to keep the same number of sows as last fall, but those outside this area are planning a 17 per cent reduction. If farmers follow through on these intentions, the hog market next winter-even allowing for some drop in demand caused by a possible letdown in business activity-should be a favorable one.

I shall not comment on the feed outlook since Mr. Diamond will cover that subject in the next discussion.

Prepared August 20, 1953

THE FEED SITUATION

W. T. Diamond
Secretary, American Feed Manufacturers Association

A crystal ball isn't necessary to foresee which side of the balance feed supplies will be this fall. A near-record supply of feed grains and concentrates is in prospect.

This has been another good crop year, despite drought conditions in some parts of the country. In addition, we have large stocks of some feedstuffs, particularly corn, on hand from previous crops. The supply of all feed concentrates for the new feed year will be close to the 1950-51 record. The Department of Agriculture looks for a supply six percent larger than the total available last October 1.

Contributing to the near record supply will be a carry-over of the four major feed grains at least one-third larger than the carry-over last year. Figuring prominently in the supply picture is the prospect for another bumper corn crop. If we get a corn crop approximating 3-1/3 billion bushels, and if we carry-over an estimated 800 million bushels of old corn, October 1 will find us with a corn supply slightly larger than the 1949-50 record and 17% above the 1946-50 average.

Supplies of oats and barley will not differ greatly from those of last year, although the quality of the oat crop has been disappointing.

The amount of by-product feeds available for 1953-54 is expected to equal the volume fed in each of the past three feeding years. The soybean acreage was about two percent larger and the harvest promises to approximate 300 million bushels. Despite abandonment of some cotton acreage, we will have our third relatively large crop in succession. Total bales may be down 3-4%, not as much as U. S. D. A. had hoped for. Look for supplies of cottonseed cake and meal at least as large as for the past year. Linseed will be available in greater supply, the result of an increased production of flaxseed. All told, vegetable proteins should be in more adequate balance with anticipated needs than has been true for any recent year. Matter of fact, there is an excellent possibility that for the first time in history, we will enter the new feed year with a carry-over of soy.

An increased use of urea and its resultant sparing effect on vegetable proteins is a supply factor worth watching. Last year, about 50,000 tons of urea were used in ruminant feeds. This tonnage spared about 300,000 tons of protein for other feed uses. During recent years, protein has been a supply problem. Even today, the supply is not sufficient to provide an optimum diet for our livestock and poultry population. However, as an increasing tonnage is spared from ruminant feeds, a proportionately greater tonnage will be available for use in swine and poultry feeds. Whereas urea production has been limited, new plants and expansion of existing production will increase domestic output substantially in the not too distant future.

The supply of animal protein presents a relatively favorable picture. Meat scrap and tankage output during the first half of 1953, was the highest during the last nine years of record. Meat scrap tonnage was up 9% while the output of tankage increased 14% over the first half of 1952.

Even the hay supply is estimated to be above the 1952-53 supply by a small margin. Of course, the balance sheet at the end of the 1953-54 feed year will be influenced by the number of grain consuming animal units raised. If the volume of meat, milk and eggs which might be produced in any given year depended entirely upon the available feed supply, we certainly could look forward to a record output during the next 12 months. Fortunately, or unfortunately, as the case may be, other factors affect this type of correlation. Despite an abundance of feed, present indications are for a further small reduction in the number of grain consuming animal units for the coming year. Compared to the post-war peak, the decline is rather significant. At the same time, the feed supply per animal unit is expected to establish a new high.

It is no big surprise that the current carry-over of feed is as sizable as indicated. Improved feed conversion efficiency has made it possible to produce a given amount of meat, milk and eggs with a smaller amount of feed. Five continuous years of excellent crop conditions have contributed much to the present stockpile. Support prices have been at levels which resulted in an accumulation of stocks of corn, wheat, cotton, etc., as contrasted to their movement into channels of consumption. Support prices have stimulated corn production in some areas which normally would be feed deficit areas. Good weather has made "sellers" out of "buyers" in these instances.

Sooner or later, our tremendous feed supply will have to be translated into human food. One point to keep in mind is: What goes into storage must someday come out. Storage is like a dead-end street. It gets one nowhere. There is indication that the government is not interested in piling up a billion bushel of corn. The administration appears to be looking for every conceivable "outlet" to dump some of the surplus. Carrying costs are tremendous and there is some feeling that it would be better to move stocks at a discount if for no other reason than to get rid of them. The way the emergency feed program has been administered in the Southwest is evidence of current thinking in Washington about surplus stocks.

Bumper crops always make us grateful, but they more often than not are accompanied by price problems. Net farm income has been going down for the past two years; yet prices paid by farmers have continued relatively high. Stating it another way: The farmer's share of the consumer's food dollar is at a post-war low while his costs are at a post-war high. This condition must be appreciated because it will be reflected in the feed manufacturing industry it is hasn't been already.

We are living in what might be termed a "high octane" era. As a result, it might be well to take stock of our present position as it relates to other segments of our economy. The "revolution" in agricultural production has been so marked that adjustments must be made constantly in our method of appraising the feed supply and use picture, for example.

Since 1925, nearly one million American farms have merged and one and one-half million workers have been freed for industrial and other work. During this period, the size of the average American farm has increased from 145 to 215 acres.

A quarter of a century ago, 30 1/2 million persons lived on 6,372,000 farms. They produced food for 116 million Americans. Today, a little over 23,000,000 reside on 5,382,000 farms and they produce food for 160 million. Slightly fewer acres of cropland were harvested last year than in 1925, yet a 34% larger population was fed and more adequately, too.

In view of some present-day surpluses and the accepted fact that we are the best fed nation in the world, it is difficult to visualize the possibility of not having enough food. However, at the rate our population is increasing, we can reasonably expect about 190 million Americans by 1975. To provide the diet to which we have become accustomed for 190 million would require the production from an additional 100 million crop acres. Since we are not likely to reclaim 100 million crop acres, our task must be accomplished mainly through improved efficiency in feed production and feed conversions.

If the census forecasters are reasonably correct in the matter of population trends, and if we do maintain our present rate of per capita consumption, it is estimated that we will need these increases in animal numbers each year:

- 1 1/2 million 200 pound hogs
- 1/4 million 1000 pound steers
- 24 1/2 million 3 pound broilers
- 5 1/2 million hens to lay 84 million dozen eggs
- 800 thousand 20 pound turkeys
- 180 thousand dairy cows to produce 112 million gallons of milk

Latest reports indicate our population has passed the 160,000,000 mark on schedule and preliminary estimates indicate per capita consumption is holding even to strong. The feed manufacturing industry occupies a very enviable position. We are a basic industry and the service we perform for agriculture is in the interest of an improved food supply. It is true we are in business to manufacture feed. However, in reality, we are in business to help keep 160,000,000 Americans well fed, healthy and strong. Individually and collectively, we can perform a more important function than has ever before been possible. It would not be out of order to say that we are living in an era of opportunity.

The feed manufacturing industry, as we know it today, is a new industry even though some feeds were formulated and sold to farmers more than 50 years ago. We can more fully appreciate the tremendous progress which has been made in the science of feeding if we stop to realize that as late as 1920 only three vitamins were recognized by poultry researchers as essential for growth and development. During the twenties, experimental work showed the values of several minerals and few more vitamins. During the thirties, the use of fairly complex formulas was introduced. However, it was not until World War II that progress in feed formulation had its greatest impact on American Agriculture.

There are many reasons for the phenomenol growth of the feed industry. Perhaps the most outstanding is the fact the industry has moved continuously in the direction of improved service to its customers. The feed industry has rightfully earned a position of importance through its continuous sorting of methods, policies and products.

With a steadily increasing population, it is fortunate that feed conversion efficiency has moved forward at such a tremendous rate. Of our total crop production, 84% is returned to our animal industries in the form of feed or by-products of feed.

The most dramatic reflection of progress in feed efficiency has been demonstrated by the poultry records plotted at Cornell University since 1914. These records show a 1914-1918 annual egg production of 87 eggs per hen. Feed consumption was 9.25 pounds per dozen eggs. By 1949-50, production per hen moved up to 194 eggs while feed consumption per dozen eggs dropped to 6.9 pounds. This represented a 25% savings in feed. The American Feed Manufacturers Association has shown a similar trend. In 1936, on a national level and using U.S.D.A. figures, a ton of feed produced 3217 eggs. Last year, a ton of feed produced 4200 eggs.

As the result of increased feed efficiency, better marketing efficiency, and a favorable supply of labor and capitol, Dr. Herrell De Graff of Cornell University, has shown that the commercial broiler industry has been able to double production within four years under a declining price of approximately 25% relative to feed price.

To appreciate the growth of the feed manufacturing industry one does not need to go beyond World War II for statistics. In 1946, our industry supplied 20% of all the feed, exclusive of roughage and pasture, which was consumed by livestock and poultry in the United States. In 1947, we supplied 22.4%; in 1948, 24.3%; in 1949, 24.7%; in 1950, 23.2%; in 1951, 26.2% and in 1952, 27%. This trend is even more important than the dollar value or tonnage volume for the industry because it indicates the real progress which is being made in feeding the nation's livestock and poultry.

By looking at the amount of feed our industry supplies for the various classes of stock, we may find a clue to the potential for our industry. At present, two-thirds of all the feed used by the poultry industry comes out of some manufacturer's branded bag. Thirty percent of all the concentrated feed used by dairy cattle is supplied by our industry. Twelve - fourteen percent of the feed consumed by beef cattle is a manufactured feed. But only five percent of the feed used in the production of pork falls in this category. I am not trying to infer that we expect to achieve an increase of one-third in poultry, three-fourths in dairy, six-sevenths in beef and nineteen-twentieths in swine feed tonnage, but I do want to say that some improvements in feeding patterns for certain kinds of stock can be and must be effected if all farmers and feeders are to produce as efficiently and as economically as present knowledge has made possible.

Last year was a good year in our industry. Feed tonnage reached a new all time high of 34.4 million tons, the fourth consecutive year we have established a new record. Compared to pre-war this volume represents a 100% increase. Not too many years ago, our production pattern was characterized by peaks and valleys. Today, the volume of our service is fairly consistent month to month. Our low volume month will account for 7% of our annual production while our high volume month will barely exceed 9% of our annual production.

Individually, manufacturers have generally kept pace with the increased volume of the industry. Some manufacturers naturally have moved ahead, volume-wise, faster than others. Those who have fallen behind may have neglected some of the fundamentals basic to success.

Because feed formulation is such a scientific operation, a manufacturer must keep abreast of the newest developments in nutrition research in order to pass along any new advantage to his customer. The establishment of a formula on paper is only the beginning. The formula must be proven under practical conditions, and I do not mean in the customer's feed lot. In addition to biological results; the feed must produce economical results. The manufacturer must prove these things himself, at his own expense and with his own animals or birds. In an attempt to measure the amount of "applied research" conducted by the industry, the 63 manufacturers who are represented on our Nutrition Council submitted data on the number of animals used in experimental work on company farms during one year. Recently we released this data and it is interesting to note that these 63 companies last year used nearly 2 million animals and birds - enough to stock the 1700 farms which might be contained in an average midwestern county.

Manufacturers are demanding from suppliers and distributors, an increasingly higher quality and consistence in ingredients. The ingredient supplier in finding that his product must have merit because through quality control the manufacturer is screening the good from the inferior. A complete feed of otherwise high quality ingredients can fail be including even one inferior ingredient. For this reason, ingredient supply industries are doing considerable research to improve their products.

The best formula with the highest grade ingredients obtainable can be worthless unless properly mixed. Our mills, today, must mix minute quantities of certain ingredients in such a way as to insure their presence in proper proportion in as little as a day's supply for a baby chick. Milling processes are becoming more complex as a result of the complexity of feed formulation. To meet this challenge, equipment suppliers are being called upon to develop machines which will serve this new need. This is going to require additional research. It is going to require testing in the equipment laboratories just as the testing of ingredients is required in the laboratories of suppliers.

The best formula, the best ingredients, the best mixing equipment and the most technical supervisory skill will enable a manufacturer to turn out an end product which can give results. However, the manufacturer has one more responsibility to the farmer and feeder. Without a feeding program, a customer can not achieve maximum success. Without a feeding program, the best bag of feed manufactured can not be expected to give good results.

Today's feeding program must be considerably more scientific than was necessary 10 years ago. It goes without saying, the feeding program of tomorrow may have to be geared to an even "higher octane" level. The trend is toward larger and larger livestock and poultry production units. Specialization is becoming more common. In 1918, 30% of our nation's population was engaged in agricultural activities. Today, only 15% are so engaged. Thus, fewer and fewer people are producing more and more of our protective foods - meat, milk and eggs.

The future growth of our industry will depend upon our ability to keep pace with new knowledge and new methods. It will rest upon our ability to meet the new responsibilities which will accompany additional growth. In other words, our future is in our own hands and we will have to mold our own course.

LET'S GIVE THE RUMEN BACK TO THE RUMINANT

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"Let's give the rumen back to the ruminant", may sound like a completely unscientific statement. After all, isn't every ruminant equipped with a rumen? Then why do we have to give it back to them? The answer lies in the treatment or management of the rumen. True, every ruminant possesses a potentially useful rumen but in many cases through feeding or management practices the rumen functions inefficiently. If this is true, is it serious? The answer in the light of recent research and recent economics is definitely yes. The ruminant is of importance in our economy because it is able to live and thrive on a ration composed largely of inexpensive roughage that would be inadequate for the support of non-ruminant animals. Since the efficiently functioning rumen is the reason for this success, isn't it only common sense to make the best use of this wonderful organ and to get the most out of its peculiar capabilities? The answer is certainly yes.

Of course, the practical side of this interesting question is "how do we go about it?" First, research must offer an understanding of how the food is digested in the rumen and then this information must be put into practice in order to help the rumen to do an efficient job. Although research is just beginning to scratch the surface, some understanding has been obtained about the rumen and rumen function. This paper will consider rumen structure and physiology, the role of rumen environment and microflora in the digestion of food, the end products formed from the digestion of food in the rumen, and what factors affect the rumen flora and environment.

Rumen Structure and Function

A study of the rumen has shown it to be a very large organ which in the mature ruminant can hold as much as 50 gallons of rumen ingesta. There are no enzymes secreted into the rumen which can digest the food and digestion occurs through the agency of the rumen microflora. The only secretion into the rumen is copious quantities of saliva which neutralizes the acids formed through bacterial decomposition. The food passes out of the rumen after it has been sufficiently broken down to allow exit through the reticulo-omasal orifice. The soluble end products are absorbed through the rumen wall or can pass out of the rumen and reticulum in the fluid portion of the ingesta. This material may then be absorbed from the omasum or abomasum. The breakdown of the protein of the bacterial cells is accomplished in the abomasum by the same enzymes of digestion contained in the simple stomached animal and the functioning of the lower digestive tract is similar to that found in the non-ruminant.

Rumen Environment and Microflora

The rumen is an ideal fermentation vat and practically all of the food that enters this first stomach is processed by the rumen microorganisms. The proper rumen environment is necessary for efficient rumen function. A study of the rumen environment shows that although various factors influence the environment, it usually is anaerobic and has a pH near neutrality. There are great numbers of organisms, usually about 100 billion or more per gram present in the rumen contents. These organisms are anaerobic which means they do not thrive in the presence of air and they are able to carry out many unusual functions which convert the relatively unavailable nutrients in the ration to a form which is available to the ruminant as food. There are several important functions which the nearly 25 different rumen organisms isolated and studied perform in the digestion of a ruminant's ration. For instance, much of the energy contained in a roughage ration is in the form of the insoluble carbohydrates of fiber. Highly important bacteria in the rumen act upon this fiber and convert it into soluble forms of energy, such as the short chain fatty acids, propionic, acetic and butyric, which are used by the host ruminant as food. Some of the energy is converted by the micro-organisms in their cells into a complex carbohydrate called a polysaccharide. These polysaccharides can be used by the animal for energy when the bacterial cells are digested in the abomasum. Other bacteria act upon the more available carbohydrates of the roughage and grain to produce lactic acid. Some bacteria in the rumen are able to produce B vitamins. Thus, although the ration as originally fed may have been deficient in B. vitamins, the action of the bacteria in the rumen upon the nutrients contained in the ration provides an ample source of these vitamins for the animal's use. The bacteria in the rumen are also capable of changing simple nitrogenous compounds such as urea into the protein of their own cells, which are highly nutritious for the ruminant. For this reason ruminants are the only animals which can use such inexpensive forms of nitrogen. Some of the minerals in the ration are used by the bacteria in making essential vitamins and other important compounds. These results demonstrate that the nutrients in the ration are processed in the rumen by the rumen flora present, and that these bacteria if allowed to function properly can do much to increase the nutritional qualities of a roughage ration.

A study of the nutrient requirements of pure cultures of rumen bacteria helps to establish what foodstuffs must be provided to the bacteria by the ration. This aids materially in compounding a ration that will support a good rumen flora.

End-Products

After the bacteria have digested the ration, the nutrients become available to the animal in various ways. The water soluble nutrients such as the organic acids and some of the free vitamins produced in the rumen may be absorbed into the blood stream directly from the rumen. Other nutrients such as the proteins, polysaccharides and vitamins which are incorporated into cells of the microorganisms are digested after the cells leave the rumen, usually in the abomasum and intestines. The products of this digestion are absorbed and used by the animal in the usual way to produce valuable commodities such as milk, meat, hides, and wool.

Factors Affecting Rumen Flora and Environment

Since it has been established that a good type of rumen flora is necessary for the proper nutrition of cattle and sheep, it is essential to understand the conditions needed to encourage a good rumen flora.

It has been shown that the ration itself is the most important single factor in determining the environmental conditions and the type of rumen flora found. For instance, when too much available carbohydrate is fed, a low pH occurs in the rumen through the piling up of lactic acid. If this pH is low enough and persists for a long enough period of time, the desirable roughage digesting type of flora is largely replaced by the type of bacteria which act upon the available carbohydrate, and the digestion of roughage is depressed. In addition, the host ruminant is fed lactic rather than propionic, butyric and acetic acids. If the ration is deficient in some mineral nutrient, the rumen sometimes becomes less anaerobic. This results in a change in the usual anaerobic rumen flora to facultative types of bacteria, which do not provide the animal with the usual nutrients, and roughage is usually not well digested on a deficient ration.

In compounding the ration not only the proper chemical constituents must be present in the rumen, but they must be available at the right time to the rumen microorganisms to insure efficient use. For example, it is well known that simple nitrogenous compounds such as urea have not proved too satisfactory for supplementation of a wholly roughage ration. That is because the bacterium is a simple organism with a very limited capacity for storing nutrients, and the sources of energy and of nitrogen must be avilable to the organisms at the same time in order for these constituents to be used by these organisms and converted into food for the ruminant. The energy in the forage is usually less avilable to the organism than the nitrogen in the urea. Probably most of the urea has passed out of the rumen and is lost to the rumen microorganism and, therefore, to the host, before the energy from the fiber becomes available. This demonstrates that not only the chemical composition but the availability of the nutrients in the forage or ration is important in determining its utilization by the ruminant.

The physical properties of the food as it enters the rumen are important too. Microscopic examinations show that jagged, irregular surfaces produced during the ingestion and chewing of long roughage offer a better place for bacteria to attack a fiber than a clean-cut smooth surfacesuch as chopped fibers present. Food must remain in the rumen long enough to be digested by the bacteria. Finely divided feed may pass from the rumen too quickly to allow maximum bacterial action, which brings about a deficiency of nutrients produced by the rumen bacteria. All of these factors must be considered when preparing a satisfactory ruminant ration, since it is apparent that the physical and chemical composition of the ration play a very important role in influencing rumen flora.

Discussion and Summary

It can easily be seen that the rumen flora and environment so essential to the ruminant can be changed by feeding and management practices employed. The properly functioning rumen is primarily suited to process the inexpensive roughage, which is of great economic importance. By feeding the wrong feeds or combination of feeds, the rumen flora may be changed so that the efficiency of normal rumen functions such as fiber digestion, B vitamin synthesis or urea utilization may be interfered with. For instance, it has already been discussed that the practice of heavy grain feeding created a rumen flora and environment that cannot efficiently digest fiber. When urea is fed it must be properly balanced with other nutrients to allow for a maximum utilization of urea. The feeding of a ration deficient in minerals can lead to an inefficient rumen flora and environment. If roughage is fed in a too finely divided form it may pass out of the rumen undigested. All of these factors influence the ability of the rumen to function properly.

Although rumen research is incomplete at this time, some use can be made of the information at hand and many things can be done to make more efficient use of the rumen. It is important not to fall into the common error of resorting to the kind of feeding practices that mask poor rumen function. For instance, it is preferable to use heavy grain feeding only after the rumen has demonstrated that it can not process enough nutrients from good roughage to do the required job. By taking into consideration and encouraging the primary function of the rumen, which is fiber digestion, the wonderful capabilities of the rumen to process inexpensive types of feed can be used to the fullest extent and a sounder ruminant industry will result. This is just another way of saying-- give the rumen back to the ruminants and let them show their appreciation in dollars and cents!

RECENT DEVELOPMENTS IN DAIRY NUTRITION

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Any attempt to summarize recent developments in dairy cattle nutrition is hazardous, since time limitations preclude the possibility of devoting adequate attention to the many diverse areas. Therefore, although a number of problems which have been particularly attractive to the research worker will be given brief mention, major comments will be reserved largely for those areas that may be of primary interest to this audience.

One of the gratifying features of research activities in recent years has been the attention directed toward the more fundamental aspects of nutrition. This trend must be encouraged if progress is to be made toward a more complete understanding of the complex nutritional interrelationships in the animal body. The focusing of interest and activities on basic problems has resulted in part from the development of techniques that have made such studies possible. Many chemical procedures of recent origin have broadened the scope of study of dietary components and of the metabolism of various nutrients by the animal. New and improved methods for study of rumen physiology and bacteriology have greatly enhanced research activities in this field. Moreover, highly useful techniques are being developed for the determination of the digestibility of various feed components and for the measurement of forage consumption by grazing animals.

The most critical period in the development of the dairy animal is from birth to approximately 4 months of age. It is not unusual, therefore, that the nutrition of the young calf has been one of the major areas of research effort.

Whole milk replacements

Changes in dairy marketing practices have reduced the availability of skimmilk on the farm and have enhanced the development of limited whole milk feeding and whole milk replacement plans. Currently most of these programs limit the calf to approximately 225 to 350 pounds of whole milk, or an equivalent amount of whole milk replacement, fed over a period of not more than 7 weeks. This early transition to a hay-concentrate diet has created new and challenging nutritional problems.

Vitamin requirements

Current calf feeding programs have focused attention on the vitamin needs of the calf. Since the newborn calf is deficient in vitamin A and since an early supply of this vitamin is necessary for survival, studies of the prenatal and postnatal vitamin A nutrition of the calf have been very popular. Most of the principal ingredients of whole milk replacements are extremely low in vitamin A. Therefore, supplementation, preferably at a level of not less than 15,000 I.U. of vitamin A per pound of milk replacement, is essential.

Other fat-suluble vitamins, particularly vitamins D and E, also have been the subject of research. Vitamin E investigations (many of which have been conducted at the Minnesota Agricultural Experiment Station) have contributed valuable information relative to the nutritional role of this vitamin.

The development of semi-purified diets (semi-synthetic milks) has created a new avenue of approach in calf nutrition studies. By the use of diets of this nature, research work (much of which has been conducted at the Illinois Agricultural Experiment Station) has established the dietary need by the young calf for many of the B-complex vitamins, including thiamine, riboflavin, pyridoxine, choline, biotin and vitamin B_{12}. It also has been shown that niacin in the diet apparently is not essential for the calf. Research of this nature has made possible the characterization of the deficiency symptoms as well as the establishment of estimates of requirements.

Fat requirements and metabolism

For many years various Agricultural Experiment Stations have been conducting studies designed to determine the effects of various dietary fats on the growth and health of young dairy calves. It has been demonstrated that the calf reacts adversely to many vegetable oils, particularly those that are highly unsaturated (such as corn and soybean oils). The various fats and oils (animal and vegetable) have rather marked effects on blood plasma fat levels. For example, milk fat in whole milk and crude soybean oil promote high levels; butter oil and lard, intermediate levels; and hydrogenated soybean oil, low levels of blood plasma fat. Since the crude soybean oil causes scouring and poor growth (despite the high blood plasma fat levels) whereas the other fats are quite satisfactory, further research seems necessary before the nutritional implications of these observations on plasma fat levels can be ascertained.

Semi-synthetic diets have been employed to study fat requirements. By the use of this technique it has been demonstrated that a dietary source of fat is essential to the calf. Although the specific lipid component(s) involved have not been identified positively, clarification may be anticipated in the realtively near future.

Most milk replacements are low in fat content but whether added fat will improve the response to these diets is yet to be determined. It is generally accepted that a certain minimum amount of fat in the ration of the lactating dairy cow is essential for maximum milk production.

Mineral metabolism

Much interesting research has been conducted recently on mineral metabolism, with cobalt being perhaps the best example. The use of radioactive tracers is particularly well adapted to mineral research and promises to be even more useful in the future. Semi-synthetic diets also have been employed effectively in investigations of mineral requirements of the calf.

Antibiotics

The discovery that some antibiotics have a remarkable growth-promoting effect in some species and the interest in the development of milk replacements and calf starters has stimulated considerable investigation into the effects of antibiotics on dairy animals. Studies at a number of Agricultural Experiment Stations indicate that the growth of calves (as measured by body weight gains) is increased approximately 20 to 25 per cent by antibiotic feeding over the period from birth to 2 - 4 months of age. Antibiotic-fed calves also usually consume more feed, are more thrifty and show a lower incidence of diarrhea. Thus far, aureomycin and terramycin have received the most attention and both have been found to stimulate growth. The most economical effective level seems to be somewhere between 10 and 30 mg. daily per 100 pounds body weight (5 to 15 mg. per pound dry matter in the feed). Many other antibiotics are being evaluated but the results either are inconclusive or are not sufficiently extensive to warrant definite conclusions.

There are some indications that arsenicals may have growth-stimulating properties. This also may be true for some of the detergents but most of the latter have been ineffective insofar as growth-promoting effects are concerned.

The introduction of an antibiotic (aureomycin or terramycin) into the diet of ruminating dairy calves produces an increase in weight gains over a period of several weeks. Removal of an antibiotic from the diet results in a prompt cessation of the accelerated growth rate but the initial advantage is maintained for a considerable period of time. There are indications that continuous antibiotic feeding from birth to parturition has no appreciable effect on the ultimate size, breeding efficiency, or efficiency of feed utilization of dairy animals. Moreover, data available at present indicate that the introduction of antibiotics at moderate levels into the rations of lactating cows has no apparent effect (beneficial or detrimental) upon the animals.

At present it seems probable that the dairy animal most likely to benefit from antibiotic feeding is the young calf, particularly under conditions where scouring and high morbidity and mortality are encountered. Until further information is available on the long-time physiological and economic relationships, recommendations can be tentative only.

Rumen physiology and bacteriology

Great progress has been made in the area of rumen physiology and bacteriology in recent years but future possibilities are even more promising. A number of new techniques for more exacting studies have been developed and attention has been directed toward the characterization of rumen bacteria and the determination of the nutritional requirements of these microorganisms.

The use of urea in dairy rations has received comparatively little attention during the past 7 years but many studies were reported prior to that time. It seems probable that more research will be directed in the future toward urea and various ammoniated compounds in dairy rations. Present indications are that the urea content of concentrate mixtures for dairy cattle should not exceed 3 per cent and that urea should not be fed to young calves.

Forage utilization

The development of new techniques for forage utilization studies has served to stimulate research in this area. Since forages are of primary importance in the nutrition of the dairy animal (with the exception of the young calf), a better understanding of the preservation and utilization of these feeds is essential. Moreover, this information is as important to one engaged in the formulation of dairy concentrate mixtures as it is to the livestock producer since to provide for the total needs of the animal the contribution of each of the dietary components must be known.

Many other areas of research are worthy of consideration. In recent years the relation of nutrition to metabolic disorders such as ketosis and milk fever have been subjected to intensive investigation. The results have provided a better understanding of the physiological bases for these difficulties. In some instances effective prophylactic and/ot therapeutic measures have been devised. Moreover, many noteworthy investigations relative to the digestion and metabolism of nutrients warrant elaboration but cannot be treated adequately herein.

RECENT RESEARCH ON RUMINANT NUTRITION

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Ruminants, because of the physiology, of their digestive tract, are able to convert materials which are unsuitable for human food into products which man can consume. In fact, the cattle and sheep industries rest chiefly on the ability of cattle and sheep to convert forage crops, silage, straw, and other rough feeds into human food, and other useful products.

Beef cattle and sheep are well adapted to the use of rough land and sparce grazing. Today beef and mutton are the chief human food produced on about 3/4 of the total land area of the United States. Also, the improved land, about 26% of the total in the United States, produces more feed for livestock than the unimproved. In addition to the concentrates produced and fed to ruminants a large amount of hay, straw, silage, and other roughages are produced.

It is the compound stomach of the ruminant that makes it possible for vast amounts of roughage to be converted into high quality human food. The compartments of the ruminant stomach are the rumen, or paunch, the reticulum, the omasum, and the abomasum, which in a mature cow have a capacity of about 50-60 gallons.

Intensive research during recent years has added greatly to our knowledge concerning the function of the rumen and its place in ruminant nutrition. We now know that a great deal of fermentation, digestive and synthesic activity occurs in the rumen. Tremendous numbers of microorganism are found in the rumen where they synthesize vitamins of the B-complex, they synthesize protein from non-protein nitrogen, they convert high fiber forages into digestible nutrients. The principal organisms are bacteria and protozoa; however, yeast and molds are also found in the rumen. The yeast and mold are generally thought to find their way into the rumen with feeds consumed by the cow.

The nutritional requirements of the ruminant and the rumen microorganisms are naturally closely related. These requirements can be listed in 4 broad groups.

1. Energy
2. Protein or nitrogen
3. Minerals
4. Vitamins

There are a number of factors that effect the efficiency with which a feed stuff or ration is utilized by cattle, a few of them are:

1. The adequacy of the feed or ration with respect to essential nutrients
2. Physical nature of the feed or ration
3. Relation of easily digested carbohydrates to crude fiber or cellulose in the ration
4. Inherited capacity of the individual animals to gain or grow to which the feed or ration is fed.
5. Previous nutritional treatment of the animal

Broadly speaking life is controlled by heredity and environment. Whereas one can control certain phases of environment he can not change the genetic make up of an animal, and the genetic make up of each individual does set the limits of an animal to produce. Thus an animal cannot produce beyond its inherited ability in any given environment however, the adequacy of the nutritional environment determines to a large extent whether the inherent capacity will be attained. For example - In our steers fattening experiments we have observed the following variation during a 140 day feeding period.

Steer No.	Starting Wt.	Final Wt.	Total Gain	
57	707	910	203	Difference 134 pounds
435	733	1070	337	
50	627	800	173	Difference 145 pounds
493	677	995	318	

These examples are extreme but they do indicate the wide differences that do occur. Undoubtedly much of this difference is due to inheritance.

Individual feeding trials at the Nebraska Experiment Station have revealed rather wide differences in ability to gain. In these tests gains have varied from about 1.7 pounds per head daily to about 3.0 pounds daily. These studies have also shown that individuals may vary greatly in the amount of feed required to make 100 pounds of gain. One group of bull calves all by the same sire required 690 pounds of feed per 100 pounds of gain, a second sire group required 849 pounds of feed to make 100 pounds of gain. Studies by the U. S. D. A. and various State Experiment stations indicate that a large share of the ability to gain is inherited.

It has been known for a long time that a ration lacking in one or more essential nutrients would not produce gain as efficiently as a ration adequate in essential nutrients; and that the addition of the lacking nutrient would improve the ration. Further, it is well known that an excess of one nutrient may create an imbalance even though the ration is adequate in other nutrients. Oscar Kellner, in Germany, was one of the first to show that the addition of an excess of starch to a roughage ration materially depressed the digestibility of other nutrients.

At the Nebraska Experiment Station in Lincoln, Nebraska, cattle on wintering rations were fed adequate phosphorous, the calcium was varied to provide the following calcium - phosphorous ratios 2 to 1, 4 to 1, 8 to 1, and 12 to 1. Two year average daily gains were 1.3, 1.2, 1.1 and 0.99 pounds per head respectively for the four groups.

Heifer calves fed growing rations containing different levels of phosphorous reflect the value of adding phosphorous to a ration lacking in this element. One group of the heifer calves received one pound per head daily of soybean oilmeal, they consumed 12.1 pounds of prairie hay and gained 99 pounds per head during 168 day period. A second group received one pound of a supplement containing 95.9 % soybean oil meal and 4.1% monocalcium phosphate, they consumed 13.8 pounds of prairie hay per head daily, and gained an average of 152 pounds per head during the 168 day period. The addition of the phosphorous did two things, it improved appetite and it increased daily gain.

The associative effectives of nitrogen (protein) and phosphorous in cattle rations was shown by the results obtained with four other groups of heifer calves fed growing rations. Group 1, received 1 pound of corn grain per head daily as a supplement, they consumed an average daily ration of 10.3 pounds of prairie hay and gained an average of 41 pounds per head during the 168 days. Group 2, was fed 1 pound per head daily of a supplement containing 94.2 per cent corn and 5.8 per cent monocalcium phosphate, they consumed an average of 10.5 pounds of prairie hay per head daily and gained an average total of 40 pounds per head during the 168 day period. Group 3, required one pound per head daily of a supplement containing 86.7% corn and 13.3% urea; they consumed 12.6 pounds of prairie hay daily per head and gained 99 pounds each during the 168 day period. The fourth group was fed one pound of a supplement containing 81.5% corn, 6.0% monocalcium phosphate and 12.5% urea, they consumed 13 pounds of prairie hay daily per head and gained 141 pounds each during the 168 day period.

In this example both phosphorous and nitrogen (protein) were limiting factors. And the results were limited by the (level) amount of the lowest essential nutrient.

I want to point out that 13% urea is more urea than is generally recommended for practical use and that such a supplement should be used with caution. These pellets were relatively unpalatable and generally the cattle required 24 hours to clean up 1 pound per head. This probably partly accounts for the good results obtained with such a high level of urea.

Unpublished data from the Nebraska Experiment Station indicates that urease action in the rumen is rapid. In vitro studies show that within 20-30 minutes urease in the rumen will hydrolyze large amounts of urea to ammonia and carbon dioxide.

Thus the ammonia becomes available too rapidly for complete and efficient utilization by rumen microorganisms and is either eliminated from the body or if a great excess is available may be toxic. This suggests that be feeding urea in small amounts over a long period of time the ammonia can be utilized more completely and with less danger. Undoubtedly research will in time find ways of utilizing larger quantities of urea more efficiently in cattle rations. Maintaining a sulfur nitrogen ratio of 1-15 is a rather recent development in that direction.

Recently wintering trials were conducted at the University of Nebraska to determine the effects of various supplements when fed with alfalfa silage. The experiments were designed so that the effects of substituting blackstrap molasses or soybean oil meal for corn could be estimated. These substitutions were made on an equal total digestible nutrient basis. All of the cattle were fed an equal amount of roughage, alfalfa silage or alfalfa silage and alfalfa hay, and either 4 pounds of ground shelled corn; or 2 pounds of corn and 2 pounds of soybean oil meal; or 3.3 pounds of corn and 1 pound of blackstrap molasses; or 1.4 pounds of corn, 1 pound of blackstrap molasses and 2 pounds of soybean oil meal per head daily.

The value of substituting 1 pound of liquid molasses for 0.7 pound of corn is indicated by the following comparison.

The cattle that did not receive molasses made an average daily gain of 1.73 pounds per head and a total gain of 193 pounds per head. The cattle that received molasses made an average daily gain of 1.67 pounds per head and a total of 187 pound per head. The difference of 6 pounds in favor of the cattle that did not receive molas indicates that in this experiment there was no advantage in adding the molasses.

The cattle that received soybean oil meal made an average daily gain of 1.80 pounds per head and an average total gain of 202 pounds. The cattle that did not receive soybean oil meal made an average daily gain of 1.60 pounds per head and an average total gain of 179 pounds per head.

The difference of 23 pounds gain in favor of the lots receiving the 2 pounds of soybean oil meal indicates that there was some advantage in substituting 2 pounds of soybean oil meal for 2 pounds of corn. Whether or not the additional gain would pay for itself depends on the comparative cost of corn and soybean oil meal.

These trials are to be repeated this fall and winter.

In recent years the use of dehydrated alfalfa products in cattle rations has increased. The addition of one or two pounds of dehydrated alfalfa to basic rations of poor quality roughage has been shown to offer distinct improvements in gain. The value of dehydrated alfalfa with different combinations of feeds and with different basal ration is being investigated by a number of experiment stations.

The value and effectiveness of beef cattle supplements still depend on the kind and quality of the basal feeds in the rations. Thus, a complex supplement which is highly effective when fed with a given ration in one area may be less valuable when used in a different area with a different combination of feeds. No panacreas have been discovered or compounded and probably the greatest miracle of ruminant nutrition is the ability of the ruminant to utilize such a wide variety of low quality feeds.

PIGS, FROM BIRTH TO WEANING

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During the past few years there has been a tremendous increase in the amount of research work dealing with the nutritional requirements of the pig for the growth period from birth to weaning. The logical starting procedure for a study of the nutritional requirements of the baby pig has been to study the composition of the sow's milk. When the literature dealing with the nutrition of the baby pig is reviewed, it is found that the subject is not as new as was originally supposed. A report published in 1892 shows that two professors from the Yale Medical School reared 3 newborn pigs on centrifugalized skimmed cow's milk with an addition of 2 per cent lactose or dextrose. Their work showed that pigs could thrive on a skimmilk diet but that the addition of sugars was advantageous. There was no reference to the age of the pigs. However, the average initial weight indicated that the pigs were not older than 1 or 2 days.

Most of the early workers used the baby pig as an experimental animal for testing the safety and adequacy of the formulas for the human infant. It was felt that results obtained with baby pig feeding would be applicable to the feeding of the human infant due to the physiological similarity of their digestive systems. Since the early reports there has been a series of papers pertaining to the compostion of sow's milk. The most recent and exacting work has been done by Braude (1947) and Bowland (1948) and their groups.

About one third of all pigs farrowed die before reaching weaning age. This huge loss prompted the development of modified milk formulas for the baby pig in order that pigs may be raised away from the sow. During the past two years several commercial organizations, as well as many of the colleges and universities, announced the development of practical modified milk formulas for the baby pig. In almost all cases investigators reported heavier weaning weights for pigs reared by artificial means than for sow-raised pigs. However, field results have shown that in most cases management conditions are such that it is impractical to wean pigs from the sow on a large scale younger than about 10 days of age. The modified milk formulas will continue to be a valuable crutch for the swineman with poor milking sows and orphan pigs. Furthermore, they are a valuable research tool for determining the nutritional requirements of the baby pig.

The development of the modified milk formulas has stimulated research dealing with the nutritional requirements of the baby pig. Scientists at Washington State College and the University of Idaho have found that the inclusion of 0.65 mgs. of pyridoxine per kilogram of "synthetic milk" was sufficient to prevent the occurrence of symptoms of a pyridoxine deficiency. They also showed that 1.30 mgs. of calcium pantothenate and 0.65 mgs. of riboflavin per kilogram "synthetic milk" could prevent the appearance of pantothenic acid and riboflavin deficiency symptoms.

Workers at Illinois reported that both aureomycin and chloromycetin stimulated the feed consumption and rate of gain of baby pigs fed an alpha protein synthetic milk. Oklahoma workers used a modified milk formula to demonstrate that there is a partial utilization of D Tryphtophan in the baby pig. More research will soon be forthcoming and many more of the nutritional requirements will be derived.

The early recommended creep rations for pigs have led to our modern commercial pig starters. Pig starters, in general, are designed to be nutritionally adequate in themselves for the pig after four weeks of age. The general practice is to introduce a pig starter in a creep when the pigs are 10 days to 2 weeks old. The sow usually reaches her peak milk production at about 3 weeks. Thus, there is usually sufficient milk for the litter so that there is not a significant consumption of pig starter until the pigs are 4 or 5 weeks of age.

Pig starters are a new development. Thus, information as to what constitutes a good pig starter is limited. Pig starters whould be as palatable as possible to encourage early consumption. Pelleted formulas have been proven to be more palatable than the meal type. Certain ingredients are more palatable than others. Rolled oats, hulled oats, milk by-products, shelled corn, soybean oil meal and sugar are classified as palatable ingredients. The inclusion of sugar either in or on pig starter pellets has received a lot of publicity during the past year. The value of sugar appears to have been somewhat overestimated.

Ingredients such as alfalfa meal, ground whole oats, tankage, and high levels of minerals are classified as unpalatable and tend to discourage the early consumption of starters. Pig starters should be of the high energy type formulation as the baby pig, like the baby chick, has a relatively small stomach and an intestinal tract of limited capacity.

Catron at Iowa makes the following nutrient recommendations for a pig starter:

Protein	16 to 20%	Vitamin A	3000 to 4000 I. U. /lb
Fat	3 to 4.0%	Vitamin D_2	400 I. U. /lb
Fiber (maximum)	3.5%	Riboflavin	3 to 4 mgs. /lb
Calcium	0.9 to 1.2%	Niacin	20 to 30 mgs. /lb
Phosphorus	0.6 to 0.8%	Pantothenic Acid	7 to 10 mgs. /lb
Salt	0.5%	Choline	450 mgs. /lb
Antibiotics	20 mgs.	Vitamin B_{12}	10 mgs. /lb
Trace Minerals	0.1 to 0.2%		

More recently the trend in feeding baby pigs has been to develop dry formulas suitable for weaning the baby pig at a very early age. Preliminary experimental work at our own research farm indicated that pigs could be weaned from the sow and placed on a dry ration at an earlier age than was heretofore thought possible. In one of the first experiments two groups of pigs were started at an average weight of 12 pounds. 27 days later these pigs weighed 30.0 pounds. This was an average daily gain of 0.67 pounds per day. Through this same period the pigs needed only 1.59 pounds of feed to produce a pound of gain. After the preliminary work a total of 99 pigs were used in studies to develop a dry formula which would promote optimum growth in the baby pig. In almost all cases the pigs were weaned from the sow at an average weight of 10 pounds or less. The pigs were lotted into groups of 4 or 5 pigs each on the basis of litter, weight, and sex. Whenever possible, lots were replicated. All trials were terminated when the pigs were approximately six weeks of age. The basal ration was composed of dried skimmilk, dried whey, lard, soybean lecithin, rolled oats, ground corn, and appropriate vitamin, antibiotic, and mineral fortification. The first trial was designed to study the value of fats in the baby pig's diet. Rations containing 7.5, 10.0, 12.5, and 15.0 per cent fat were fed. The following table presents the data collected from this experiment.

Table 1. A STUDY OF THE VALUE
OF FATS IN A DRY FORMULA FOR BABY PIGS

Ration	Ave. In. Wt.	Ave. Final Wt.	Ave. Daily Gain	Feed Eff.
Trial 1				
7.5% Fat	9.20	28.25	.68	1.64
10.0% Fat	9.28	30.38	.75	1.72
7.5% Fat	9.65	28.25	.78	1.57
10.0% Fat	9.50	30.25	.87	1.55
Trial II				
10.0% Fat	9.08	27.25	.76	1.60
12.5% Fat	9.08	27.50	.77	1.74
15.0% Fat	9.13	25.50	.68	1.49

A study of table 1 readily shows that the pigs fed any of the dry formulas were very efficient in feed conversion. The feed conversion ratios approached those reported by investigators feeding the liquid milk formulas. On the basis of these experiments 10% fat appears to be the optimum level for pigs of this size and age.

In further trials various levels of dried skimmilk were fed. The rations contained 0%, 13%, and 40% dried skimmilk. Table 2 presents the data collected from these trials.

Table 2. A STUDY OF VARIOUS LEVELS
OF DRIED SKIMMILK IN A DRY FORMULA FOR BABY PIGS

Ration	Ave. In. Wt.	Ave. Final Wt.	Ave. Daily Gain	Feed Eff.
Trial 1				
0% Dried Skimmilk	8.45	21.25	.46	2.33
13% Dried Skimmilk	8.45	23.75	.55	1.81
40% Dried Skimmilk	8.40	26.25	.64	1.91
Trial II				
13% Dried Skimmilk	10.08	26.00	.57	2.00
40% Dried Skimmilk	10.08	30.25	.72	1.81

As shown in table 2 the pigs receiving the 40% skimmilk ration weighed an average of 5 pounds more at 44 days than the lots receiving the 0% formula. Thus, as the per cent of dried skimmilk was increased, there was a corresponding increase in the average daily gain. In general, as the per cent of dried skimmilk was increased, there was a decrease in the amount of feed required to produce a pound of gain.

With the knowledge that is available at present I think we can confidently predict that there is going to be a strong trend for weaning pigs much earlier. Two to three weeks with the sow provides the baby pig all the benefits of the colostrum milk; usually an adequate supply of nutrients; and a goodly amount of body warmth. At the end of this period the sow has completed her usefulness. The drain of lactation has not affected her body weight and consequently, she can be marketed or rebred shortly. Even though baby pig rations are more costly than gestation rations, the efficiency of pork production favors this method. Housing requirements can also be greatly reduced as it is very feasible to house two litters in the space formerly occupied by one sow and her litter. Thus, there are many advantages to this type of program.

FEEDING THE BROOD SOW AND MARKET PIGS

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In spite of all of the research in swine nutrition there is a tremendous gap in out knowledge regarding specific, quantitative nutrient requirements of the brood sow or gilt. I have been particularly impressed with that fact in reviewing some of the available literature in this field.

As a start in the attempt to fill in some of the gaps we are now completing the second year of study on the effects of limited feeding on growth and reproduction in gilts.

For the first experiment, sixteen pairs of littermate gilts were placed in two groups (one littermate in each group) at an average weight of approximately 120 lbs. in December 1951. The "normal"-fed group was self-fed until May 16, at which time the gilts were placed on pasture. The limited-fed group was hand-fed throughout at a rate which permitted a steady, but limited, increase in live weight gains. The normal group was hand-fed while on pasture, but at a higher rate than the other group. The same feed mixture was fed to both groups. When the gilts were penned for farrowing all of them were fed and handled in the same manner on an individual basis. When the pigs were 4-7 days old the sows and litters were moved to pasture and allotted in the original groups. After being brought back to full-feed, following farrowing, both groups were self-fed and their pigs were creep-fed. After weaning the sows were full-fed an average of 23 days and then sold for slaughter. Carcass measurements were obtained on all sows that weaned pigs. Table 1 includes a summary of the growth and performance records of the gilts.

Table 1 - The effect of limited feeding on growth and reproduction of gilts. December 21, 1951, to November 12, 1952

Feeding level	Normal			Limited		
No. animals	16-12*			16		
Growth and feed consumption record						
Dates	Av. wt. /gilt	Total feed consumed/gilt		Av. wt. /gilt	Total feed consumed/gilt	
December 21	120			119		
February 15	218	460		171	254	
April 10	297			216		
May 16	342	719		241	446	
When penned for farrowing	429	388		304	205	
When moved to pasture	385	65		272	54	
			1632			959
At weaning	388	559		343	758	
Nov. 12 (marketed)	433	284		394	323	
	Total	2475			2040	
Net gain per sow	334			275		
Mean selling price-cwt.	$15.56			$15.65		

Performance record

Item	Normal	Limited
Av. no. live pigs farrowed	8.23	7.0
Av. birth wt. of live pigs	2.85	2.63
Av. No. pigs weaned	8.17	6.70
Av. 56-day weight	31.7	27.5
Feed/100 pound net gain of sows and pigs	438	463
Feed cost per weaned pig**	$6.41	$5.62
Feed cost per pound of weaned pig	0.202	0.204

* 16 gilts started, 12 finished

** Total feed cost (feed at 3.5 cents per pound) - Increased value of sows divided by the number of pigs weaned. The value of the sows is the actual selling price less $25 per head (initial estimated value per head).

The "Normal" group of gilts ate large quantities of feed during the self-feeding period from December 21 to May 16. They also made good gains. The "limited" gilts were always hungry and were difficult to feed, because their patience was all gone long before feeding time each morning and evening. Their feed allotment was increased for a time before breeding was started in order to increase their gains during this period. The feed allotment was increased near the end of the gestation period too in an attempt to increase the birth weight of the pigs. All but one of the gilts in both groups were bred between April 10 and May 16. It will be noted that the limited gilts were 80 pounds lighter than the normals on April 10 and 100 lbs. lighter on May 16. At farrowing this differential had increased to 125 lbs.

The difference in number of pigs farrowed is largely due to three small litters in the limited group. However, the birth weights were consistently lighter in the limited group. The survival of pigs during the suckling period was excellent for both groups.

From December 1951 until after farrowing, when the gilts and their litters were moved to pasture, the gilts in the Normal group had consumed 1632 lbs. of feed per head. The limited gilts consumed only 959 lbs. of feed during this period. This appeared to be a real saving. However, when the limited gilts were allowed to eat all the feed they wanted after being moved to pasture, they ate almost 200 lbs. more feed per head than the normal gilts. It is clear too that this feed was not used for milk production because their pigs averaged 4.2 lbs. lighter at weaning than the pigs from the normally fed gilts. The limited gilts used the feed instead to make body weight gains. The average gain per gilt during this period was 71 lbs. (Normals averaged 3 lbs.) per head and one gilt gained 124 lbs. during this 7 week period. The weaning weights of the pigs indicate that the feeding of the limited gilts during the growth and gestation period had a detrimental effect on the subsequent milk producing ability of the gilts thus fed.

After weaning the sows were self-fed until they had become reasonably smooth. This was a mistake, on the basis of prevailing feed and hog prices. The normal group of gilts consumed 284 lbs. of feed per head and gained 45 lbs. each. The limited gilts consumed 323 lbs. of feed per head and gained 51 lbs. This is equal to 631 and 633 lbs. of feed per 100 lbs. gain for the normal and limited groups, respectively. With feed at 3.5 cents per pound this is a feed cost of more than $22 per 100 lbs. of gain. The best of the gilts sold for $15.75 per 100 lbs.

One of the goals of this experiment was to be able to market the gilts at light weights after the pigs were weaned. It is clear that this goal was not achieved, primarily because we underestimated the ability of hungry gilts to eat and to gain weight, even though they were nursing pigs. No conclusions have been drawn as to the advisability of limited feeding of gilts, as was done in this experiment, during growth and gestation. We think that we learned a few things and on the basis of these observations we are repeating the experiment with a few modifications. To date (August 15, 1953) the growth and feed records are similar to those obtained in 1951-52.

Feeding Market Pigs — Antibiotics

Our studies with antibiotics have continued. In the University Farm herd less response to antibiotic feeding was obtained this year than in previous years. This is shown by the following data for pigs from weaning to 200 lbs. fed in dry lot.

Year	Average Daily Gain, lbs	
	No antibiotic	With antibiotic
1951	1.40	1.63
1952	1.45	1.63
1953	1.74	1.79

The same picture is apparent for pigs fed on pasture from weaning to 200 lbs.

Year	Average Daily Gain, lbs.	
	No antibiotic	With antibiotic
1951	1.43	1.60
1952	1.46	1.58
1953	1.50	1.45

The basal ration was changed this past year for the dry-lot pigs to provide a lower protein level than was previously fed. Thus, the results from 1952 are not strictly comparable to those obtained in 1953. However, it is clear when a comparison is made within any single year that less response was obtained in 1953 than in previous years. These results indicate that the general use of antibiotics for the past 3 years (at University Farm) in feeding growing pigs has controlled certain intestinal infections so well that these infections are not a problem in the herd today. In other words the pigs used this year were healthier pigs than those fed in 1951, even though the latter were apparently healthy.

The response of suckling pigs to antibiotic feeding presents a slightly different picture, in our herd.

Average Daily Gain of Pigs From 3 Weeks to 8 Weeks of Age

Year	Starter without antibiotic	Starter with antibiotic
1951	0.37	0.64
1952	0.43	0.71
1953	0.63	0.73

The relative response was not as great in 1953 as in 1952 or 1951, but it was still a real response. It is interesting to note in all of these data that the decrease in response is largely due to the improved performance of the control pigs.

I see nothing in this data to indicate that harmful organisms found in the pigs digestive tract are becoming refractory to the antibiotics. Thus, I think we should continue to use antibiotics as an insurance factor in our rations, even though we will not get a definite response in all cases. As you folks well know, conditions on many farms are not as favorable for the production of healthy pigs as they are at University Farm.

Arsenicals for Weaned Pigs

This past year we have devoted considerable time to a study of the value of arsenicals in the rations of growing pigs. We are interested in this for two reasons: First, and most important, are arsenic-fed hogs safe for human food? Secondly, does arsenic improve the ration in terms of performance of the pig to which it is fed?

In a preliminary study in 1951 we found that sodium arsanilate did improve the growth rate of pigs to which it was fed. Subsequent studies showed that our control ration was deficient in vitamin B_{12}. In two trials last year our basal ration was fortified with B_{12}. In the first trial arsanilic acid was added at levels of 30, 60, or 90 grams per ton of mixed feed. The pigs fed arsenic grew somewhat faster than the controls during the early part of the experiment, but they failed to maintain this advantage to market weight. There was no difference in the feed efficiency figures for the feeding period as a whole. In the second trial 60 grams of arsanilic acid was added per ton of mixed feed and three different protein levels were fed. A fourth group was fed corn and supplement, free-choice. Arsanilic acid was added at a level of 240 grams per ton of supplement. In this trial all levels of protein fed produced excellent growth and efficient use of feed.

Of the 80 pigs used in these two trials 72 head were slaughtered for carcass evaluation. In addition, samples of liver, kidney, muscle, skin and fat were taken from each carcass and assayed for arsenic content (under supervision of L. E. Carpenter, Hormel Institute). The pigs were slaughtered at different time intervals after arsenic was removed from the diet to determine the length of time required to lose the arsenic that may have been stored.

The assays showed that the pigs did store arsenic in the tissues at all levels of arsanilic acid fed. The storage was greater on the 90 gram level than when the 30 gram level was fed. The liver contained the most arsenic and approximately twice as much as the kidneys per gram of fresh tissue. The amount stored in muscle, skin and fat was very much less and in no case did it amount to more than 0.40 part per million (As_2O_3). When arsenic was withdrawn from the ration for 2, 4 or 7 days before slaughter, the arsenic content of the tissues was greatly reduced. The pigs on the 30 or 60 gram levels had lost most of their stored arsenic within 4 days after the arsenic was withdrawn. The pigs fed 90 grams arsanilic acid required 7 days to lost most of their stored arsenic.

It is clear that the feeding of arsenic at the levels used in these experiments is no hazard to human health. Many sea foods normally contain much more arsenic than the tissues of these pigs. Furthermore the legal tolerance of arsenic (As_2O_3) allowed as a residue on sprayed fruits is 3.4 parts per million. Of the many assays made only a few of the liver samples exceeded 3.4 parts per million and these were from pigs fed the higher arsenic levels and killed without withdrawal of the arsenical prior to slaughter.

In out last experiment this past winter we continued the study of the influence of arsanilic acid on the protein requirements of pigs. In this trial as in the previous trials the ration was composed of corn, tankage, soybean meal, linseed meal, alfalfa meal, salt, mineral, and vitamin B_{12}. This winter we also fed a vitamin B-complex supplement. The pigs were fed four levels of protein, with and without arsanilic acid. We used 2 lots of 5 pigs each on each treatment. The results are combined and summarized in Table 2.

Table 2 - The influence of arsanilic acid on protein requirements of growing pigs. Winter, 1952-53. (10 pigs per lot - all weights in pounds)

From weaning* to 200 lbs.								
Lot No.	1	5	2	6	3	7	4	8
Protein Level								
weaning to 125 lbs.	18	18	16	16	14	14	14.4	15.1
125 lbs. to 200 lbs.	15	15	13	13	11	11	12.8	12.2
Arsanilic acid								
grams per ton	60	0	60	0	60	0	240**	0
Av. daily gain	1.82	1.80	1.82	1.80	1.82	1.81	1.86	1.79
Av. daily feed	6.5	6.6	6.2	6.4	6.3	6.0	6.6	6.5
Feed/100 lbs. gain	356	371	344	356	346	364	351	362

* Initial wt. 32 lbs.   ** Per ton of supplement

It will be noted that all lots of pigs made exceptionally rapid gains. The slight difference is not significant though it is in favor of the arsenic-fed pigs at each level of protein. The difference in feed efficiency averages about 4% in favor of the arsenic-fed pigs and this slight difference is also quite consistent at all protein levels. Apparently our low protein level was not low enough to really measure any "protein sparing" effect arsanilic acid may have. A "protein sparing" effect has been indicated in several low protein N balance studies which we have made. These studies support the findings of others that the protein requirement of the pig is not as great as was formerly believed.

Summary

Our studies show that some limited feeding practices can have an unfavorable effect on reproduction and lactation in gilts. This occurs even though the ration fed is apparently well balanced when fed in more liberal quantities.

Antibiotics are not producing the striking results this year that they have produced in previous years. The difference in results is attributed to a general improvement in herd health over the period of the past 3 years. The data show that the gains made by control pigs (not fed antibiotics) are much better in 1953 than in 1951, whereas antibiotic fed pigs have not changed much in their rate of growth during this time.

Our studies support the findings of others that weaned pigs do require much less protein than we believed formerly.

Arsanilic acid, in most of our experiments, has appeared to improve the growth rate of the pigs when they are small but much of this early advantage is lost by the time the pigs reach market weight. We must add however that much of our arsenic data has been obtained with better quality (less intestinal ailments) pigs than were used in the earlier studies with antibiotics. Pigs fed arsanilic acid do store arsenic in their tissues, but the amount stored is not a hazard to public health if we use the legal tolerance of spray residue on fruits as a guide. Furthermore, stored arsenic is rapidly excreted when arsenic feeding is stopped.

A Demonstration

WHAT IS QUALITY IN HOGS

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Contrary to general public opinion, hog type has changed radically during the past forty years. These changes came about in direct response to the adjusting demand for the products produced from the hogs. This demand has varied all the way from one extreme of war-time circumstances to the other extreme of meeting strictly the home makers demands for pork and lard. This change is evident upon inspection of recognized champions in any major breed throughout the various divisions of this forty-year period. For the purpose of the demonstration, five champions of the years 1910 - 1920 - 1930 - 1940 - and 1950 at the Iowa State Fair in the leading hog producing state of the nation, clearly emphasises this point.

Hog producers today are again faced with the necessity of selecting, breeding, and properly feeding hogs which will produce the maximum amounts of quality products as desired by the modern-day consumer and a minimum amount of the less popular products. To fulfill this requirement, a hog producer must consider type, nutrition, cost of gain, degree of finish, labor and management, as well as marketing in his production operations.

To help producers better appreciate two of these important factors, colored slides and carcasses are used to show the relationship of proper type and degree of finish in the live hog to the quantity and quality of products available from the carcasses of these same hogs. The demonstration clearly shows the range in both type and finish and the inter-relationship of one to the other as it affects the quality of pork produced.

In summary, it can be said that the present day desired meat-type hog is a firm fleshed animal that weighs in the 200 to 240 lb. bracket. It has a carcass length of at least 29 1/2 inches with an average fat-back thickness close to 1 1/2 inches. Hogs of this type according to the latest experiment station data, can be produced as cheaply as less desired kinds. This type of hog is available in all of the major breeds and can be produced in greater quantity through proper selection, breeding and feeding. This is a necessary step to insure for the hog producers a ready market. As the pork product demands are more closely met, the more consumers will ask for these products and in turn the better will be the market for quality hogs.

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WHAT'S NEW IN POULTRY NUTRITION

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Recent experience has led us to expect a new sensation in the field of poultry nutrition every year. The past 12 months have not lived up to this expectation, but they have produced good solid work which was useful and necessary to the evaluation of past sensations. A sensation may be a stimulus to effort and progress or it may be a numbing shock. Recent sensations in poultry nutrition are stimulating effort and leading to progress. If the effort necessary to evaluate and correlate these sensations were not forthcoming, it is easy to see how a state of shock might result in the feed industry.

Investigators in poultry nutrition have been stimulated recently to a realization that the nutrition of an animal does not occur in a vacuum but is related to heredity, maternal nutrition, and physical and biological environment. Everybody knew all this years ago, but it is quite possible to know something and not appreciate its inportance.

The antibiotics have focused attention upon the nutritional significance of the internal ecology and the external physical environment. From the first discovery of the growth stimulating effect of antibiotics, it was suspected that they produced this effect by their influence on microorganisms in the intestinal tract. The English work showed that chicks kept in a "new" or "clean" environment grew as well without as with an antibiotic, and the Notre Dame work showing that the same was true of germ-free chicks indicated that the growth-stimulating effect of antibiotics in a complete diet must be ascribed to their ability to hold in check the growth-depressing organisms which become established in environments long occupied by chickens. The English work was confirmed at the Ontario Agricultural College and at Beltsville. Experiments at Beltsville on the movement of chicks from new to old environments with or without antibiotics served as the basis for the theory that an antibiotic in a nutritionally complete diet permits better growth because it gives the chick partial protection against potentially harmful organisms during the time that the chick is becoming adjusted to them. After the chick has had time to make this adjustment (4 weeks in the Beltsville experiments), the antibiotic can be withdrawn with no ill effect on growth. A chick started in a new environment does not encounter these organisms. If later changed to an old environment without an antibiotic, he goes through a period of retarded growth similar to that which characterizes the newly-hatched chick placed in an old environment without antibiotic. But also, as in the case of the newly-hatched chick, the retardation of growth can be prevented by feeding an antibiotic.

Most investigators have found that a dietary antibiotic is of no benefit to laying hens receiving a nutritionally complete diet. It seems reasonable to believe that a mature bird would be well enough adapted to the intestinal population so that an antibiotic would not be beneficial. The South Dakota station has reported increased egg production as the result of feeding an antibiotic. Perhaps something was amiss among the inhabitants of the digestive tracts of these particular hens, and the antibiotic corrected the difficulty.

There are numerous and conflicting reports concerning the ability of antibiotics to spare various required nutrients. It was demonstrated at Wisconsin that an antibiotic reduces the thiamine requirement if the vitamin is given by mouth but not if it is injected. Evidently intestinal microorganisms compete with the chick for dietary thiamine, and if the organisms are held in check by an antibiotic, the chick's apparent thiamine requirement is decreased. We must expect that the population of such competing organisms would vary in different environments. Such variation would account for the conflicting reports on sparing effects of antibiotics. Three different laboratories have reported, respectively, that an antibiotic decreases niacin requirement, that it increases niacin requirement and that it has no effect. One laboratory found that an antibiotic spared folic acid while another found that an antibiotic intensified folic acid deficiency.

There is also disagreement as to whether an antibiotic decreases protein requirement. The Ontario Agricultural College reported that an antibiotic enhanced utilization of protein and energy. If the enhancement of protein utilization were in proportion to the enhancement of energy utilization, there would be no decrease in protein requirement, expressed as percent of diet. In order to show a decrease in protein requirement the antibiotic would have to enhance protein utilization to a greater degree than carbohydrate. Apparently the situation is not always the same. It was reported from Beltsville that protein requirement was decreased but this has been denied in reports from Ontario and British Columbia.

Evidence is accumulating that the arsenicals produce their growth stimulating effects, at least in part, by the same mechanisms as do the antibiotics. The Texas station found with chickens and the Ontario Agricultural College with turkeys that the antibiotics and arsenicals studied produced parallel effects on growth and intestinal microflora. There is still no explanation for the observation that in many but not all tests an antibiotic and an arsenical supplement each other with respect to their effects on growth. New evidence has been reported on the safety of one arsenical, namely arsanilic acid. Abbott Laboratories have reported the toxic level for chicks to be at least five times the level now permitted in feeds. Arsenic retention, at the permitted intake level, was no hazard. Arsenic retention in eggs remained within the safe range even when hens were fed twice the permitted level of arsanilic acid, according to a report from the Michigan station.

Research on vitamin B_{12} in the past few years has greatly increased our appreciation of the importance of maternal nutrition to chick performance. A recent report from the Maryland station expresses the relationship as follows: If the dams are fed no B_{12}, the chicks require 27 micrograms per kilogram; if the dams are fed 4 micrograms per kilogram, the chicks need 12; if the dams are fed 8, the chicks need 3; and if the dams are fed 16 the chicks need none.

Experiments at Beltsville in which radioactive B_{12} was injected into B_{12} deficient eggs showed that chicks hatched from these eggs and given a B_{12} deficient diet still retained within their bodies when they were 12 weeks old 1/3 of the radioactive vitamin injected into the egg. This helps to explain why the B_{12} which the hen stores in her eggs has such a great effect on chick performance. Furthermore, it was found in the Beltsville studies that the radioactive B_{12} injected into the eggs accounted for all the B_{12} in the chicks up to 6 weeks of age, but after that non-radioactive B_{12} increased rapidly, probably as the result of synthesis in the intestinal contents. These results help to explain why B_{12} is a critical vitamin during early growth but not during later growth.

Numerous and somewhat conflicting figures for B_{12} requirements have been reported for chicks and breeding hens. Careful study of these figures indicates that under commercial conditions, chicks need about 4 micrograms per pound of feed and breeding hens about 2 micrograms.

The problem of requirement for various nutrients during the later stages of growth has one factor in common with the problem of the relation of the dam's diet to the diet of the progeny. Just as the day-old chick's requirements may vary depending on the stores he received from the egg, so the 8-week-old chicken's requirements may vary depending on the stores accumulated during early growth. This difficulty and the greater cost of experimentation with older chicks have discouraged work on this subject in spite of its practical importance. It is encouraging to note that in the past year, there have been several papers on requirements during the later period of growth.

According to a report from the laboratory of the Eastern States Farmers' Exchange, the 8-week-old chick requires 0.72 percent of lysine. This figure bears the same relation to the protein requirement, 16%, as the baby chicks' lysine requirement, 0.9%, bears to its protein requirement 20%. Reports from Wisconsin indicate that between the ages of 8 and 12 weeks the phosphorus requirement is 0.5 percent and that between the ages of 6 and 12 weeks, the niacin requirement is 5 mg. per lb. of feed.

The starting chicks requirement for niacin continues to be a source of contention. Maryland and the Ontario Agricultural College have reported results indicating a requirement of 18 mg. per lb. However, a collaborative study involving a large number of laboratories showed a requirement of not more than 12 mg. per lb. Experiments at Cornell, Minnesota, and the Ontario Agricultural College showed that a high level of niacin prevents, or helps to prevent, perosis in ducklings, goslings, and poults. A combination of 20 mg. of niacin and 5 mg. of alpha tocophenol added per lb. of diet prevented hock disorder in turkeys.

In view of recent outbreaks of hemmorrhagic disease in commercial flocks, some recent observations at the Michigan Experiment Station are of particular interest. The blood of turkeys that were fed a practical diet containing 1% of alfalfa meal failed to clot in the pullorum tube agglutination test. Raising the level of alfalfa meal to 5% restored normal clotting. The causes of the hemmorragic disease in commercial flocks remain to be established, but one may speculate on the possible influence, first, of reduced levels of alfalfa meal, the principal dietary source of vitamin K and second of dietary antibiotics which might limit intestinal synthesis of the vitamin.

There appear to be at least 3 unknown factors that are required for optimal growth of chickens, and that may be present at suboptimal levels in practical diets. One of these is supplied by fish meal, fish solubles, and meat meal and to a lesser degree by yeast. There is evidence that some other microorganisms synthesize this factor in greater concentration that does yeast. Deficiency of the factor can be demonstrated quite readily in diets made up of commercial feedstuffs, thus indicating that the factor is not widely distributed. The presence of an antibiotic in the diet does not reduce the requirement for this factor. Recent reports from Maryland, Idaho, and Beltsville describe procedures for concentration of this factor.

A second factor is found in whey, other milk by-products and yeast. It appears to be more widely distributed than the first because, although deficiency can be demonstrated in practical diets, it is difficult to do so consistently. Requirement for this factor is definitely reduced by feeding an antibiotic. In some experiments the effects of this factor have been duplicated by feeding orotic acid. The factor may be orotic acid or a related compound.

A third factor is present in fresh forage juice. There is disagreement between laboratories as to whether or not this factor is present in alfalfa meal.

This does not by any means exhaust the list of unknown growth factors but these are the three which may be present at inadequate levels in practical diets. Using purified diets, the Iowa Station has studied a factor present in unsaturated fats, and the Wisconsin Station a factor supplied by, or spared by, dextrinized starch.

It seemed natural to begin this discussion of "What's New in Poultry Nutrition" by talking first about the antibiotics and arsenicals and then about the vitamins. The discussion cannot be completed without referring to the new emphasis on some old subjects. Nutritional science began with energy and protein before the existence of vitamins was known. Research has made it possible to supply the essential minerals and most of the vitamins very economically. It seems likely that the best possibilities for further improvements in economy of feeding lie in more efficient utilization of energy and protein. As a result of this prospect there is an increased emphasis on the energy content of poultry feeds. Contributing also to this increased emphasis is the realization that the chicken is more versatile than we had supposed in its ability to use different levels and sources of energy. Increased levels of energy in broiler feeds are already an old story, and interest has now been directed toward making the same change in laying diets. In experiments at the Connecticut Station, two laying mashes were compared, one of which contained 14% more productive energy per pound than the other, principally because of its higher content of corn. The high efficiency diet resulted in production of 15% more eggs per unit of feed and a 9% higher efficiency index than did the standard diet. Its ingredient cost at prices prevailing in early 1953 was only 5% greater than that of the standard diet. In experiments at Beltsville, the number of Calories of productive energy per unit of laying mash was increased 17% by adding fat to the diet. Efficiency index was also increased 17% and ingredient cost was increased only 6%.

One way to increase efficiency of protein utilization is to use synthetic amino acids to correct the deficiencies of feed proteins. Synthetic methionine is already being used in this way. Its practical importance lies in the fact that it is the one essential amino acid not furnished abundantly by soybean oil meal, our principal protein supplement. Another amino acid, lysine, though now too expensive to use in commercial feeds has interesting possibilities because it is the limiting amino acid of cottonseed meal, meatmeal, and sesame meal.

There is always someting new in poultry nutrition. Even while we are sitting here in this meeting, the work goes on extending the field, and revising, qualifying and correlating its different areas. A talk on "What's New in Poultry Nutrition" may be out of date by next week or perhaps even by tomorrow. What I have been telling you is simply a very brief review of the past year's work as it looks from the vantage point of this particular hour.

THE IMPORTANCE OF QUALITY IN POULTRY PRODUCTS

Charles Kratochvil, Jr.
Meadowlands Produce Inc.
Red Wing, Minnesota

We are shell egg dealers buying direct from producers on a graded basis, and also buy a large number of graded eggs from buying stations and centralized points. We buy eggs only, feel eggs are a specialized industry and better work can be done by specializing. There are many factors that enter into operating an egg processing plant such as ours that are overlooked by those not actually engaged in this business.

Public Demands Better Eggs

The public today wants better eggs than were generally accepted prior to World War II. During this period eggs were being served to men in the armed forces and consumed in larger quantities than ever before. This habit of eating eggs for breakfast helped stimulate the present demand for this farm product. While Government buying is still a big factor on the present market they are not the largest. Many new uses for egg products are cake mixes, yolk solids, shampoos, many carloads of shell eggs are still being exported. Here also quality is the biggest factor.

Newspapers, Radio, and Television advertising the food value of eggs by various organizations connected with the poultry industry, plus the efforts of home economic classes, and demonstrations by University personnel in cooking schools has made the housewife very quality conscious. She knows eggs and demands twelve good eggs per dozen. She has become quality minded. Therefore, only through quality can we expect to hold present volume of sales and create more demand to hold present high price levels to the producers and help keep Minnesota as a leading egg producing state. Without quality the egg market will be lost as was the poultry meat market to the South and Southeastern broiler areas.

Quality is effected by breeding, feeding, and the handling of eggs. All the improvements needed, or faults now found in eggs at consumer level can be traced to lack of concern or lack of knowhow somewhere in the industries. Consumers quite generally prefer yolks of light golden color and thick egg whites. Why not give it to them if they are willing to pay for it.

Producers Responsibility

On the other hand the egg producers, in my opinion, must make many improvements by selecting the best chicks for production and feeding to produce quality eggs, and the part that egg packers are vitally interested in, the maintaining of fresh quality before marketing. Still speaking of quality, the eggs start deteriorating the minute they are laid and unless properly cared for by frequent gathering and cooling before packing are ruined and there is nothing that can be done be anyone to restore this quality loss. Statistics note that nine out of ten housewives keep eggs in refrigerator.

We hear much from farmers as to variation of price of one brand feed to another. We take no stand here, we remain neutral, but remind them that feed which produces even a few more eggs per month per layer is worth more than just plain feed. It's the profit over feed cost that determines the true value of feed!

Industry Has Responsibility Too

The people connected with the poultry industry--egg buyers, feed manufacturers, poultry equipment manufacturers--must cooperate and help educate the egg producers to produce eggs according to modern methods. (Suggest leaflets be placed direct into feed bags) Because only through exercising the best modern methods will he get the best returns on his investment, reduce his labor, prosper, and run in the black figure. His neighbor gets the idea and a quality program is born and all connected with industry make headway.

The better egg assembly plants are constantly improving their methods of handling eggs, streamlining, candling, sizing, packing operation, and use the latest material handling equipment to rush good quality eggs to markets. Eggs are being handled faster than ever before, special built transport trucks carry eggs to market with better refrigeration units, (temperature control) More and more buying stations are installing cooling rooms for eggs as they should have for proper handling of eggs. U. S. D. A. has egg graders in most of the better plants supervising quality. All this tends toward delivering a better product to the consumer.

The weakest link in the program is at the producers level. Most think all their eggs are Grade A. Some still think that two weeks to three weeks in the basement is OK.

Country Cousin Throws A Curve

The inland country stores which handle eggs as a sideline are the biggest offenders regarding egg quality. They are not equipped to properly handle eggs, deal on case count basis with no deduction for loss just to hold their farm trade. The bigger the grocery account the better his egg grade. Stores ruin more eggs than can be imagined, just to sell a few dollars worth of groceries. Few grocery stores have the facilities and trained labor to properly handle eggs, most sell eggs at a loss or dollar exchange. The bad feature is that generally eggs bought this way find their way to nearby metropolitan areas and are sold over the counter as quality eggs. The consumer gets taken and egg sales remain slow directly affecting market prices. Many Twin City consumers prefer buying eggs direct from nearby farms.

The Twilight operators hurt quality programs. Usually some hustler enters into areas where quality programs have been set up and buys straight basis from better producers ruining years of work done by legitimate produce houses. Twilight operators usually go out of business in six months to two years, but strangely enough others start up. They may have been used car dealers, gas station operators, etc., who heard ironically of the big money made in the egg business.

The Challenge To Industry

The teaching of egg standards plus finding people with ability to do the work presents a labor problem to every egg assembly plant. No two eggs are exactly alike. Two candlers will grade a case of eggs differently, they may be close but not alike. The biggest difference lies between an 'A', a borderline 'A', and a 'B' grade egg. Yet candling though not one hundred percent accurate is the only way for produce houses to determine egg quality. Breaking an egg to determine quality would place us out of business. It's been proven that an experienced candler recognizes Grade 'A' quality by candling closely enough to compare with Grade 'A' broken out Quality.

The most difficult inedible egg to catch while grading is a sour rot. The easiest is a black rot.

Shell protecting eggs with mineral oil helps to preserve quality but does not answer all the questions on how to get quality to the consumer. Basically quality starts at the producer level. It presents the big problem. Can and will industry meet this challenge. I think that with an all out effort for a quality program we can.