

Concepts of Health

broadened by new knowledge of nutrition and disease-causing factors

George H. Hart

The following extract is from an address prepared by George H. Hart for the Eleventh International Congress of Pure and Applied Chemistry, London, England, July, 1947.

NEW KNOWLEDGE of nutrition, metabolism, enzyme action, and hormone control, modified through heredity and environment and aided by molecules containing radioactive isotope elements, has made possible new concepts of health, and of illness.

Remarkable success in the prevention and control of infectious diseases through public health and biological methods has definitely increased the average life span of man.

Control of animal plagues has been equally successful.

This has resulted in the recognition of many of the more elusive causes of dysfunction—the impaired functioning of organs—and their general classification as nutritional, hereditary, or a combination of both.

Higher forms of animal life, including humans, are born with gene complexes that fix the cause of their death and age incidence factors, barring accidents, which determine the time, within limits, at which death will occur.

New factors which cause early deaths in different species are being brought to light through inbreeding to fix desirable characters.

Inbreeding work with dairy cattle has been quite successful in fixing factors for high milk production. At the same time it has uncovered fatal inherited defects in some of the offspring.

In domestic animals there has been a tendency to look upon environment as largely consisting of nutrition.

The data collected in recent years show the Brahma and Africander breeds of cattle to be more resistant to the effects of high climatic temperatures than other breeds. On extensive land areas in the semiarid parts of the world the problems of climate are of importance in well-being of animals.

The ever widening problem of photosensitization, resulting from the ingestion of light reacting substances present in certain plants, brings out the limitations of animals with partially or completely unpigmented skins in coping with this environmental factor.

A whole chain of interacting factors literally pursues the individual from implantation to death.

Vitamin Deficiency Diseases

Deficiency diseases constitute a distinct group and the list has become too long for individual discussion but experimental study has succeeded in establishing scientific facts.

Abnormalities in fetal development have been quite definitely associated with specific deficiencies.

Differential diagnosis from other conditions is complicated. Thus vitamins A, E, the B complex, particularly riboflavin and manganese deficiencies, as well as infection with *Brucella* organisms produce abortion or dead, weak, or deformed fetuses at term in different species.

Vitamin-A deficiency interferes with gestation through changes originating in the cells attaching the developing young to the mother. These same areas are the seat of invasion by *Brucella abortus* in cattle. These two conditions may act concurrently.

Borderline degree of Vitamin-A intake in the absence of storage, or exposure to a natural *Brucella* infection in vaccinated animals, neither of which would be able to produce abortion when acting alone, might do so when acting together.

The alterations in reproduction from lack of Vitamin A are reversible in both sexes and subsequent adequate intake results in normal reproduction.

In late gestation and early life, Vitamin-A deficiency in cattle may be symptomatically quite similar to three other well-known conditions—abortion from *Brucella* infection, infectious keratitis and white scours.

Brucella abortion cannot be differentiated by field observations alone. History of the nutrition of the animal, serological test on the blood of the dam, and Vitamin-A determination on the fetal liver are necessary. Positive agglutination test of the dam's blood with *Brucella* antigen is evidence of *Brucellosis*. Negative blood test of the dam and negative fetal liver test for Vitamin A with history of absence of green feed in the diet is evidence of Vitamin-A deficiency.

Infectious keratitis is a rapidly spreading disease affecting cattle of all ages with early clouding of the corneas. It is spread by flies and involves both eyes. Vitamin-A

eye lesions are more frequently seen in young animals. One eye only is often affected and the clouding of the cornea starts as small opaque spots in the deeper layers, progresses slowly with ultimate ulceration being more common. In addition there is emaciation and a history of drought or a long time on dry feed lacking green color, a field index of the amount of carotene present.

Calves born alive with no Vitamin-A storage and getting milk from depleted dams will develop a typical white scours diarrhea. It is readily controlled with Vitamin-A therapy.

The true white scours will develop in the presence of abundant Vitamin-A intake and storage, and excess intake by the affected young animals will have no effect on its frequently fatal termination.

Recent years have demonstrated bacterial action in the gastro-intestinal tract to be involved in the synthesis of nutritional factors, particularly in the B group of vitamins.

This is most conspicuous in the remarkable rumen fermentation in the animals with four stomachs, such as cattle. There is evidence that dry range conditions may limit the extent of synthesis by decreased bacterial action on poor quality rumen contents.

A long series of investigations by many researchers has shown the need for the B factors in swine, minimum requirements and syndromes in deficiency of the separate factors. Attempts to establish the deficiency of B factors as a cause of the widely prevalent necrotic enteritis in swine have not been successful.

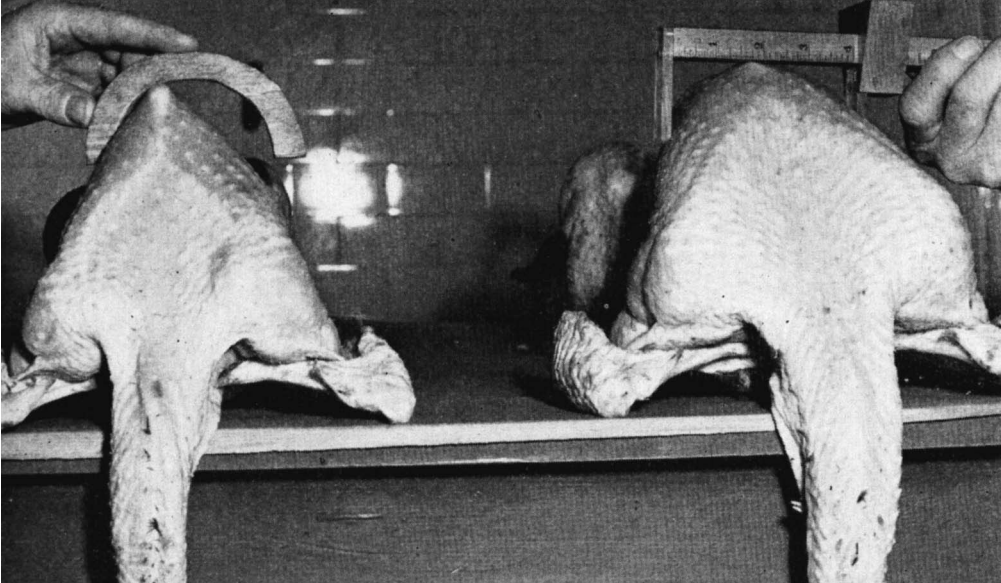
Bacterial, Protozoal, and Parasitic Diseases

Much discussion has taken place regarding vigor versus resistance to infection, but tangible evidence and actual data are not available from which to draw definite conclusions. Heredity and environment are involved. The former factors are multiple and racial. The latter include nutrition, weather, fatigue, and psychology.

Occasionally aged cows under drought conditions, offered for the first time cottonseed supplement to dry scarce range feed will die of starvation without eating any of it. This would be avoided if they had been given cottonseed cake for a few weeks at weaning time. So some humans will go a long way toward exhaustion without accepting unaccustomed diets.

Respiratory infections are not altered in incidence or severity by optimum or excess of Vitamin A. At the same time, lack of Vitamin A will cause conditions in poultry very similar to those of infectious coryza in chickens and to swell head in turkeys.

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Measuring width of breast on dressed birds.

TURKEYS

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hatch well, whereas washed clean eggs hatched as well or almost as well as unwashed eggs.

These findings emphasize the importance of producing clean eggs; keeping them in a cool room on the farm, at the receiving plant, and in transit; frequent delivery to the receiving plant or hatchery—two or three times a week—and prompt shipment from the receiving plant to the hatchery. Of course, the hatchery operator should also set the eggs promptly after they are received.

Turkey Feeding

Hatchability of turkey eggs is determined primarily by the hatching quality of the egg when laid. Methods of handling and hatching the eggs can reduce the innate hatchability of the new laid egg but cannot do much, if anything, to improve it. This is determined by breeding and by nutrition. In practice nutritional deficiencies are probably more commonly respon-

sible for hatching failures than are breeding effects, such as those resulting from close inbreeding.

Knowledge of the nutritional requirements of turkeys to ensure maximum hatchability is still incomplete. Work done some years ago showed the need for riboflavin and pyridoxine and this has been well established.

Since the needs for reproduction have not been fully established, it would be well to feed an adequate breeder ration starting about a month before eggs are expected. If lights are used, the change to a breeder mash might be made at the time the lights are started. Then as an added insurance measure fresh greens should be fed.

The turkey nutrition work has demonstrated that turkey poults require a slightly higher level of the water soluble vitamins, such as riboflavin, than chicks. Also that the higher protein requirements of turkey poults as compared with chicks are reflected in higher requirements for some of the indispensable amino acids—the building blocks of the proteins. Too low a level of lysine may or may not be the cause of the wide white bar sometimes seen on the wings of Bronze poults, but in any case the work done on protein requirements indicates that too little protein is the commonest cause of the white bar and the slow growth which often is associated with it.

While much work remains undone on the nutritional needs of young turkeys, it is expected that work can soon be started on the nutritional needs of breeding turkeys.

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HEALTH CONCEPTS

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Such widely prevalent conditions as anemias may be of varied origin involving iron, copper, cobalt, and members of the B complex.

In the human, macrocytic anemia may be due to improper diet lacking meat, milk, and eggs, resulting in an absence of the extrinsic factor, and be nutritional in origin. Folic acid may be involved. This is usually the case in sprue and other tropical macrocytic anemias.

No data on nutrition, as a factor in resistance of humans to infectious disease, have been obtained in any way comparable to known data on inherited resistance in poultry, where fowl typhoid has been reduced from 85% to 10% in five generations of selective breeding.

The situation with diseases caused by protozoa is quite comparable to infectious disease in that data are lacking, inconclusive, or in some cases, quite negative.

In the case of parasitic invasions the importance of nutrition has been more tangibly established. Thus in cecal coccidiosis of growing chickens caused by *Eimeria tenella* the feeding of a ration containing 40% dry skim milk has been demonstrated to be beneficial. Credit for this has been given to the milk sugar, to the nutritional value of milk and/or the laxative effect.

Nutrition, heredity, and disease are so closely interwoven in the development and environment of the individual that separation for even carefully controlled experiments is extremely difficult or impossible.

While great progress has been made, we now need to know the secrets that remain unknown.

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Factors involved in the yield of olive orchards are subjects of a special study undertaken by the Division of Pomology.

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—THE EDITOR

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