

SIXTH EDITION

DISEASES
OF
POULTRY

✦
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OF
POULTRY

✦
EDITED BY
M. S. Hofstad
WITH
B. W. Calnek
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W. M. Reid
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EDITORIAL BOARD FOR THE
AMERICAN ASSOCIATION OF
AVIAN PATHOLOGISTS

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TO *H. E. Biester* AND *L. H. Schwarte*



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FOREWORD



THE FIFTH EDITION OF *Diseases of Poultry*, edited by H. E. Biester and L. H. Schwarte, further solidified the position of this book as the standard in the field of avian diseases all over the world. The retirement of these editors has occasioned the launching of this completely revised sixth edition under the sponsorship of the American Association of Avian Pathologists with a five-member board serving as editors. This was a logical time to take stock, to attempt a reorientation, and to keep pace with the rapid changes in the avian disease picture.

Within a period of less than 50 years, poultry keeping has developed from a "pin money" farm activity or a hobby to a highly sophisticated industry, marketing products worth over \$6 billion per year in the United States alone. The rapid evolvement of mass production and distribution methods has imposed increased and unique demands on those scientists working in the field of avian medicine. No longer are the effects of disease control practices or lack of them

limited to farms or areas in any one country. Because of speedy international traffic and the dissemination of breeding stocks, the same disease problems have become worldwide in incredibly short periods of time. The avian pathologist and his decisions now have significant importance in places far distant from his laboratory.

Avian pathologists have responded to these disease challenges and have devised control methods which have stemmed losses quickly and effectively. But the fact remains that in the long run, disease eradication and not temporary control must be the ultimate goal. An outstanding example is the virtual disappearance of pullorum disease from breeding flocks in the United States, a disease which 30 years ago was one of the greatest causes of chick mortality. Most of the younger avian pathologists trained within recent years have never seen pullorum infection in young chicks. What makes this accomplishment even more noteworthy is that the eradication program was carried out under a voluntary, co-operative scheme.

To attempt disease eradication without complete knowledge of the natural history of the disease will be futile. Patient, intensive study of the epizootiology of the diseases and modification of flock management techniques are necessary to achieve the ultimate goal. This book is the most recent effort to present this basic information.

The rush of progress in dealing with immediate disease problems of the poultry industry has caused many to forget the significant role various avian species have played as research

animals. In the field of nutrition the fowl has been of key importance. The word vitamin was coined by Eijkman when he demonstrated in 1897 the existence of what we now call thiamin deficiency. Vitamin K, folic acid, and B12 were other vitamins first discovered in work with poultry nutrition.

The practical application of genetic selection for control of plant diseases is well known. The breeding of fowl resistant to Marek's disease has been demonstrated as a practical possibility, and future editions of this book may well include significant sections on genetic resistance to various other diseases.

Not until the life cycle of avian malaria was worked out by Ross in 1898 did the missing parts of the human malaria transmission story fall into place.

Can one evaluate properly the stimulus that was given to virology when Goodpasture and Woodruff in 1931 cultivated the fowl pox virus for the first time in chicken embryos?

Little did we know that the first transmission of a solid tumor (sarcoma) to chickens with cell-free inocula by Peyton Rous in 1911 was to have such importance in resolving our leukosis problems 50 years later. The significance of this work to medical science was belatedly recognized by the awarding of a Nobel Prize to Rous in 1966.

More recently the cultivation of the RIF virus by Rubin in 1965 removed much of the expense and frustration that formerly accompanied research with avian leukosis. These findings stimulated tremendous activity in many laboratories where leukosis re-

search had been abandoned. For the first time the groundwork was laid which eventually permitted clarification along strictly objective lines of the differences between Marek's disease and lymphoid leukosis. As this is being written, experimental vaccines for the protection of poultry against Marek's disease are being tested in the field. Favorable results obtained thus far bid fair to result in commercial vaccines for the protection of poultry against tumors and nerve lesions caused by Marek's disease. This will be the first time that prevention of tumors in food-producing animals on a large scale will have been accomplished.

If there is anything that avian pathologists have learned during the last 30 years, it is that poultry disease control in the face of fundamentally wrong husbandry practices will fail. Avian tuberculosis did not come under control until aged birds were shown to be unprofitable.

Chronic cholera and infectious coryza were constant scourges in the 30s and 40s when housing of multiple age groups was the usual practice. Again the economic superiority of pullet flocks initiated the "all in, all out" system and those diseases virtually disappeared. But now the large, expensive environment-controlled houses have caused poultrymen to keep more than one age group in a unit with the resultant reappearance of coryza and cholera. On the other hand, newer developments in poultry house ventilation and positive pressure, filtered air systems are showing promise in preventing exposure of birds to air-borne infections.

Tremendous changes are taking place in poultry rearing practices. Not only will the approach to disease control have to be adapted to the new conditions but the diseases themselves will change in character. Infectious diseases will decline in importance; toxicologic, nutritional, genetic, and husbandry problems will demand in-

creasing attention. Change is the order of life, and avian diseases are no exception.

This sixth edition of *Diseases of Poultry* is a worthy successor to the previous ones and presents the considerable achievements in the field without apologies.

P. P. LEVINE

✧

PREFACE

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THE PASSING of time has brought on the retirement of the previous editors of *Diseases of Poultry*, H. E. Biester and L. H. Schwarte. It was their wish that future editions of the book become the responsibility of the American Association of Avian Pathologists (AAAP), an organization concerned with all areas of avian medicine, including the publication of the *Journal of Avian Diseases*. This Association acknowledges the great contribution which Dr. Biester and Dr. Schwarte have made in editing previous editions; it is for this reason that the sixth edition is dedicated to these two men. Our hope is that future editions can maintain the high quality of the previous editions.

The AAAP selected an editorial board of five members to undertake the revision of the book for the sixth edition. Each member was assigned responsibility for a group of specific chapters.

To avoid going to a two-volume book, the board decided to eliminate several chapters not directly concerned with disease. The justification for eliminating anatomy, nutrition, genetics, and hematology was that these subjects were covered better in other publications and that the authors could not do justice to these areas in the allotted space.

Other changes in the book were made to avoid duplication. The material in the chapter on turkeys was incorporated into other appropriate chapters. A new chapter on neoplastic diseases was introduced to consolidate in one chapter the information on tumors of poultry.

An attempt was made to reduce the number of listed references at the end of each chapter by instituting a policy of selective reference citation. Many authors were able to reduce the number of references; others maintained approximately the same number by eliminating some and adding more recent references.

The editorial board expresses appreciation to the many previous authors who have made *Diseases of Poultry* the valuable reference and textbook that it has become. We welcome the new contributing authors whose efforts have made possible the sixth edition.

EDITORIAL BOARD

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SIXTH EDITION

DISEASES OF POULTRY





CHAPTER 1

PRINCIPLES OF DISEASE PREVENTION: DIAGNOSIS AND CONTROL



D. V. ZANDER

*Heisdorf & Nelson Farms, Inc.
Redmond, Washington*



DETAILED INFORMATION on the diseases of poultry, including diagnostic procedures and techniques and specific prevention and control measures for each disease, is contained in this book. This particular chapter acquaints the reader with basic principles of poultry sanitation and disease prevention and control. It also introduces the student to basic necropsy procedures and provides specific information on the usual insecticides and disinfectants, with special emphasis on formaldehyde fumigation. For information on the specific diagnostic techniques and control measures, the reader is referred to the chapters covering each disease.

This chapter will not cover all the detailed disease control methods adapted to modern trends or to all types of poultry, but will attempt only to outline and illustrate some fundamental concepts. Each ranch is different; therefore, the basic concepts must be applied according to conditions and facilities existing on individual ranches. To keep abreast of the flow of research and information, a constant review of current literature and recommendations applicable to specific diseases, special enterprises, and various geographic areas is necessary to supplement what is given here.

Standard textbooks on poultry and turkey production, husbandry, and nutrition are other sources of information (Taylor, 1949; Marsden and Martin, 1955; Card, 1961; Titus, 1961; Ewing, 1963).

HOST-PARASITE RELATIONSHIP

Disease results when normal body functions are impaired, and the degree of impairment determines the severity of the disease. Disease may occur due to deficiency of a vital nutrient or ingestion of a toxic substance. It may result from injury or physical stress with which the bird cannot cope, or it may be the consequence of the harmful action of infectious and parasitic agents.

Some nutrient deficiencies are temporary and reversible when the nutrient is supplied in adequate amounts; others are irreversible. Disease resulting from stress is related to the severity and duration of the stress. Injuries, such as extreme debeaking, tend to persist for a long time and may be permanent. Diseases caused by infectious and parasitic agents are frequently complex and depend upon characteristics of both host and parasite.

Whether or not disease results from an encounter of host and parasite depends on the number, type, and virulence of the parasite, the route of entry to the body, and the defense status and defense capabilities of the host. The latter is dependent partly on the nutritional status, partly on the environmental stresses, partly on the genetic ability of the host to organize resistance mechanisms, and partly on the kind and timing of the countermeasures (drugs, changed environment) employed by man.

Some virulent organisms overcome very rapidly the resistance of even the healthiest hosts. Less virulent strains or types cause moderate to severe illness, but most birds respond and return to a state of health. Still other strains or types cause no marked reaction, and the host shows little or no obvious symptoms of ill health. Some microorganisms are not considered pathogenic because they are usually found in and around those individuals considered "normal," but it must be recognized that the so-called "nonpathogenic" and low pathogenic organisms can also cause serious losses when the right circumstances exist. Severe physical stresses such as chilling, overheating,

water deprivation, starvation, and concurrent infection by other disease agents can reduce the host's ability to resist and thus precipitate a disease condition which can be detected (e.g., clinical mycoplasmosis following infectious bronchitis, or clinical salmonellosis in chicks that have been chilled).

Coccidiosis provides a good example of the relationship of the number of invading organisms to the severity of the resulting infection, since the morbidity and mortality of the host species is usually proportional to the number of coccidial oocysts ingested. A similar situation exists for many other infectious diseases. A mild roundworm infection may not be serious, whereas a severe infection can be very detrimental to the health of the bird. The number of infective virus particles in a live virus vaccine (its titer) may be so low that a good immunizing infection does not occur following administration of the vaccine. A good reason for removing moribund and dead birds from a flock is to reduce the number of infectious organisms available to pen mates. Thorough washing and disinfecting of a building may not render it sterile but can reduce the number of infectious organisms to such a low level that there are too few to initiate a flock infection of sufficient magnitude to be recognizable as disease.

It is important to remember that man has the ability to alter the probability of a bird or flock becoming infected as well as the severity and outcome of an infection.

INFLUENCE OF MODERN POULTRY FARMING PRACTICES ON HOST AND PARASITE

Avian disease specialists must continually seek new knowledge about the nature and control of specific diseases. Meanwhile, those persons responsible for production of poultry meat, table eggs, hatching eggs, baby chicks and poults, feed ingredients, and mixed feeds should put into practice those basic techniques and management principles which will prevent the occurrence of disease. They should also provide the physical facilities necessary for control and elimination of those diseases which occasionally gain entrance so they do not become a perpetual burden. The economic losses due to disease can mean the difference between success or failure in the poultry business. Those who disregard the basic principles of disease prevention may suc-

ceed in times of a favorable market but do not remain competitive when the margin of profit is very small.

The poultryman who puts into practice the fundamental management practices which prevent disease outbreaks has very little need for detailed knowledge of the many infectious diseases which affect poultry. One does not need to be an expert on symptoms, lesions, and cures for diseases which are kept out of the flock through proper management.

When new farms and buildings are designed and constructed and the production programmed with the objective of excluding diseases or eradicating them when they gain entry, poultry can be maintained free of most common diseases in a practical manner with a minimum of effort. Facilities need not be new to be adequate. Frequently old farms can be enlarged and the production reprogrammed to exclude or eradicate diseases. Many old poultry buildings, hatcheries, and feed mills can be redesigned to greatly favor exclusion, eradication, or control of disease. Strict application of disease preventive management techniques has enabled poultrymen to maintain specific pathogen-free chickens on farms of usual design and construction (Chute et al., 1964).

The trend in all agricultural industries continues toward larger units, fewer farmers, and corporate enterprise. The chicken and turkey industries have been leaders in this trend which has placed emphasis on efficiency of operation and lower costs of production. In fact, survival in the industry has depended upon continual adoption of newer and more efficient practices. It is sometimes forgotten that efficiency of disease prevention is as important as efficiency of cleaning, feeding, bird handling, and egg processing. The resulting evolution of management systems has altered the emphasis in disease control practices and will continue to do so in the future. For example, the shift in housing of egg-laying flocks from floor pens to cages has altered the approaches to the control of intestinal diseases and parasites and increased the emphasis on control of cannibalism. New problems in feed formulation have arisen because certain vitamins and minerals normally found in the litter were not available to birds in cages.

Corporation farming accentuated the tendency toward integrated control and oper-

ation of two or more segments of the industry such as feed manufacturing, breeder flock management, hatchery operation, pullet rearing, broiler and turkey grow-out phases, laying farm production, egg processing, turkey and broiler slaughter and processing, and even retail distribution. Integration has concentrated under one decision-making body the disease control practices for millions of birds as well as several phases in the chain of production of eggs and meat. Thus sound health practices and emergency quarantine measures decided upon by one or a few individuals can be quickly and effectively applied to large numbers of birds. Through integration it has become economically practical to employ veterinarians full time and place responsibility for disease control directly in the hands of specialized avian pathologists. Disease considerations are sometimes reduced to simple cost accounting, whereby the economic loss from a disease and the costs of treating it (or of deliberately exposing the flocks to the infectious agent) are weighed against the cost of eradication and maintaining the clean status before determining the course of action.

Where established management and industry practices allow or contribute to the spread and propagation of some disease agent, attempts are frequently made to deliberately expose flocks to the disease at an opportune time. This practice is successful for some virus diseases and has led to the widespread use of specially prepared vaccines. The practice is much less successful for bacterial infections and is more likely to perpetuate the disease. Except for prevalent and highly contagious diseases for which effective vaccines are available, it is usually more economical to keep poultry free of disease than to burden them with it deliberately or by accident, provided the costs of eradication and maintaining a free status do not exceed the costs resulting from outbreaks of the disease.

Widespread and daily shipments of hatching eggs, poults, chicks, started pullets, and adult fowl across state and national boundaries have necessitated reevaluation of old concepts of health regulations. Specialized avian pathologists have evolved to guide the course of health control measures, and diagnostic facilities—both private and governmental—are available in major poultry producing areas of the world. Except where importation and usage are re-

stricted by government regulation, high-quality vaccines and drugs are available wherever poultry is raised commercially. Breeding of poultry on a scientific basis has created strains of uniform quality with a high degree of resistance against those diseases for which satisfactory drugs and vaccines are not available. Good quality feed is the rule, not the exception.

Yet disease still takes a heavy toll from all types of poultry enterprise. The man who exercises the farm management decisions—whether it be the caretaker, owner, flock supervisor, corporate manager, or money lender—has the power to reduce these losses through management for disease control. He must be made aware of his responsibility and continually encouraged to develop a philosophy of disease prevention through management.

The cardinal principles of disease prevention and control are the same for the chicken hobbyist, fancy bird breeder, and game bird farmer as for the corporation with several million turkeys, broilers, or laying hens. The backyard flock maintained without regard for disease control can perpetuate a disease which constitutes a threat to a large productive industry. On the other hand, since most backyard flocks are not vaccinated, they may be susceptible to those diseases against which the large commercial flocks are vaccinated. The greatest hazard to commercial poultrymen created by fancy breeds and backyard flocks is the possible perpetuation of diseases which have been eradicated from the commercial poultry industry. For this reason, it is a sound principle that no employee of a commercial poultry unit have any poultry at home.

SOURCES OF INFECTION AND COUNTERMEASURES

Infections may gain entrance to a flock of birds from various sources some of which may more conveniently enter because of errors in management and industry practices. In order to understand why various preventive practices are recommended, it is important to review briefly the sources and route of infection.

MAN

Because of his mobility, duties, curiosity, ignorance, indifference, and carelessness,