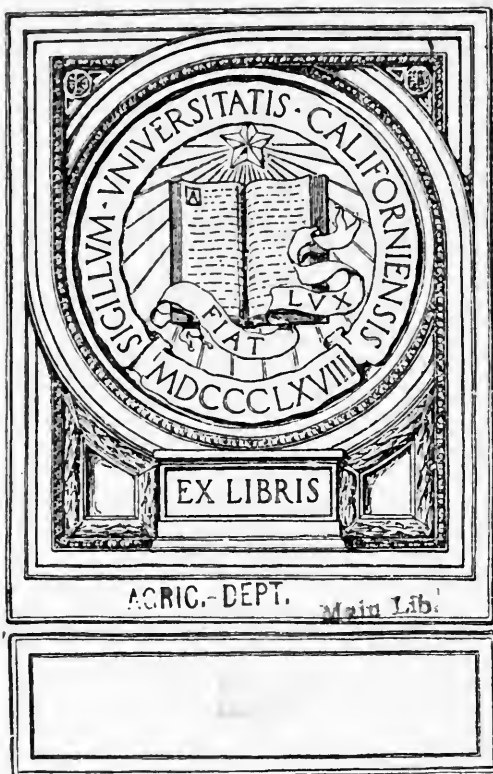


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POULTRY DISEASES AND THEIR
TREATMENT

ORONO, MAINE.
FEBRUARY, 1911.



(398-12-10)

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AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE.

**POULTRY DISEASES AND THEIR
TREATMENT**

Compiled by
RAYMOND PEARL, FRANK M. SURFACE, AND MAYNIE R. CURTIS.

ORONO, MAINE.
FEBRUARY, 1911.

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TABLE OF CONTENTS.

	PAGE
Introduction	1
Chapter I. General Considerations Regarding the Treatment of Poultry Diseases	4
Prevention Rather than Cure the Ideal.....	5
Breeding for Health, Vigor and Sound Constitu- tion	6
Chapter II. Poultry Hygiene	9
Poultry House Hygiene and Sanitation.....	10
How to Clean a Poultry House.....	10
Disinfection	11
Formaldehyde Gas Disinfection.....	12
Cresol Disinfectant	12
Fresh Air and Light.....	14
Avoid Dampness	15
Provide Clean and Dry Litter.....	15
Hygienic Feeding	15
Avoid Overfeeding	15
Provide Plenty of Green Food.....	16
Provide Fresh and Clean Drinking Water	16
The Land	18
Exercise	20
External Parasites	20
Disposal of Dead Birds.....	20
Isolation of Sickness	21
The Essentials of Poultry Hygiene.....	21
Chapter III. The Diagnosis of the Diseases of Poultry.....	22
External Symptoms	22
Post-Mortem Examinations	24
How to Make a Post-mortem.....	25
Chapter IV. Poultry Materia Medica	28
The Medicine Chest	28
An Antiseptic Ointment	30
Tables of Apothecaries' Weights and Meas- ures and Their Metric Equivalents.....	31
Chapter V. Diseases of the Alimentary Tract.....	32
Diseases of the Crop.....	32
Impacted Crop (Crop Bound).....	32
Inflammation of the Crop.....	34
Enlarged Crop	36

	PAGE
Diseases of the Stomach (Proventriculus) ..	36
Inflammation of the Stomach (Gastritis)	36
Diseases of the Intestines.....	37
Simple Diarrhea	37
Enteritis (Dysentery)	39
Constipation	41
Indigestion	42
Chapter VI. Poisons	44
Common Salt, Nitrate of Soda, Lyes.....	44
Arsenic	44
Copper	44
Lead and Zinc	45
Phosphorus	45
Strychnine	45
Ergot of Rye	45
Treatment for Poisons in General.....	46
Chapter VII. Diseases of the Liver.....	47
Hypertrophy or Enlargement of the Liver...	50
Fatty Degeneration	51
Atrophy or Wasting of the Liver.....	52
Congestion and Inflammation of the Liver...	52
Jaundice	52
Blackhead (Infectious Entero-Hepatitis)...	53
Cercomoniasis	55
Sarcomatosis and Carcinomatosis	55
Chapter VIII. Tuberculosis	57
Etiology	58
Diagnosis	59
Methods of Contagion	63
Treatment	64
Chapter IX. Cholera	66
Diagnosis	67
Etiology	68
Treatment	69
Chapter X. Diseases of the Abdominal Cavity.....	72
Peritonitis	72
Abdominal Dropsy or Ascites.....	73
Chapter XI. Internal Parasites	75
Diagnosis of Worms in General.....	75
Tape Worms	76
Nodular Tæniasis	77
Round Worms	82
Flukes	83
Chapter XII. Diseases of the Respiratory System.....	85
Anatomy and Physiology	85
Catarrh	87
Bronchitis (Croup)	88
Influenza (Epizootic, Grippe, Distemper)....	89

	Roup (Contagious Catarrh, Diphtheria, Diptheritic Roup, Canker)	90
	"Pip" (Inflammation of the Mouth).....	102
	Canker	103
	Thrush	103
	Aspergillosis (Mycosis of the Air Passages)	104
	Congestion of the Lungs.....	107
	Pneumonia	108
	Tuberculosis	110
	The Air-sac Mite	110
Chapter XIII.	Diseases of the Circulatory System and Blood..	112
	Pericarditis (Inflammation of the Pericardium, Dropsy of the Heart Sac).....	112
	Endocarditis (Inflammation of the Internal Membranes of the Heart).....	112
	Myocarditis diphtheritica	113
	Enlargement of the Heart (Hypertrophy)..	113
	Rupture of the Heart and Large Blood Vessels	113
	Diseases of the Blood.....	114
	Infectious Leukemia	114
Chapter XIV.	Diseases of the Nervous System.....	118
	Apoplexy (Hemorrhage of the Brain).....	118
	Heat Prostration	118
	Congestion of the Brain (Vertigo, Cerebral Hyperemia)	119
	Epilepsy	119
Chapter XV.	Diseases of the Kidneys, Rheumatism and Limberneck	121
	Gout	121
	Visceral Gout	121
	Articular Gout	121
	Other Diseased Conditions of the Kidneys...	122
	Rheumatism	123
	Limberneck	123
Chapter XVI.	External Parasites	124
	Keeping a Poultry Plant Free from External Parasites	124
	Lice	125
	How to Make an Effective and Very Cheap Lice Powder	130
	Mites	132
	Scaly Leg	135
	Depluming Scabies	142
	Other Mites Affecting Poultry.....	144
	Other External Parasites	145
Chapter XVII.	Diseases of the Skin	147
	Favus	147
	White Comb	150

	PAGE
Chicken Pox (Sore Head or Epithelioma Contagiosum)	150
Chapter XVIII. Diseases of the Reproductive Organs.....	155
Anatomy and Physiology	155
Diseases of the Ovary.....	160
Atrophy	160
Gangrene of the Ovary.....	163
Ovarian Tumors	163
Abortion of Eggs	164
Yolk Hypertrophy	164
Failure of Follicle Wall to Rupture.....	165
Diseases of the Oviduct	165
Inflammation	165
Prolapse of the Oviduct.....	167
Obstruction of the Oviduct (Egg Bound)	169
Rupture of the Oviduct.....	173
Gangrene of the Oviduct.....	174
Breaking of Egg in Oviduct.....	174
Abnormal Eggs	175
Vent Gleet	177
"Break Down"	179
Diseases of the Male Reproductive Organs..	180
Chapter XIX. Diseases of Chickens	181
White Diarrhea	181
Intestinal Coccidiosis	183
Bacillary White Diarrhea	186
Diagnosis of White Diarrhea in General	189
Treatment	190
Prevention	192
Leg Weakness	192
Aspergillosis or Pneumomycosis	193
Emphysema	194
Gapes	195
Chapter XX. Poultry Surgery	201
The Treatment of Cuts, Tears and All Open Wounds	201
Abscess	202
Bumblefoot	202
Broken Bones	203
Frozen Combs and Wattles.....	203
Anesthetizing Poultry	203
Glossary of Technical Terms.....	205
Index	209

LIST OF ILLUSTRATIONS.

	PAGE
Fig. 1. Showing condition of liver in "blackhead." (Modified after Moore)	54
Fig. 2. Breast bone of a fowl showing excessive emaciation in tuberculosis. (After Ward)	60
Fig. 3. Liver of fowl affected with tuberculosis. (After Ward)	61
Fig. 4. Spleen from tuberculous fowl cut through the middle. (After Koch and Rabinowitsch).....	61
Fig. 5. Intestine and mesenteries of a fowl affected with tuberculosis. (After Ward)	62
Fig. 6. <i>Drepanidotaenia infundibuliformis</i> , a tape worm of the fowl. (After Stiles)	77
Fig. 7. Intestine of a fowl turned wrong side out to show tape worms in nodular fieniasis (After Pearson and Warren)	78
Fig. 8. Sketch showing method of introducing turpentine directly into crop. (From Gage and Opperman)....	80
Fig. 9. Worms protruding from a section of the intestine of a fowl. (After Bradshaw)	82
Fig. 10. <i>Heterakis perspicillum</i> , (From Salmon)	83
Fig. 11. Trematode worm or fluke showing internal structure. (From Thompson after Sommer).....	84
Fig. 12. Lungs of a bird. After Salmon).....	85
Fig. 13. Right lung of a goose. (After Owen).....	85
Fig. 14. A lobule of the lung of a bird represented in ideal longitudinal section. (After Owen)	87
Fig. 15. Showing appearance of hen a day before death from roup. (From Harrison and Streit).....	91
Fig. 16. Showing swelling of head in severe roup. (From Harrison and Streit)	92
Fig. 17. Head of a bird. The lower figure shows the maxillo-ocular sinus, which opens into the socket of the eye and communicates with the nasal cavities. The upper figure shows the roup tumor on the head caused by the filling of this cavity with cheesy pus. (From Megnin)	93
Fig. 18. Head of a fowl 22 days after inoculation with a culture of the roup bacillus. (From Harrison and Streit)	95

	PAGE
Fig. 19. Throat and bottom of mouth with false membrane (m) 14 days after inoculation. (From Harrison and Streit)	95
Fig. 20. A section of a false membrane of a roup-y fowl. (From Harrison and Streit)	96
Fig. 21. Head of a bird with diphtheritic roup affecting the mouth and tongue. (From Megnin)	96
Fig. 22. <i>Aspergillus fumigatus</i> . Greatly enlarged. (After Mohler and Buckley)	106
Fig. 23. <i>Cytodites nudus</i> . The air sac mite. (After Theobald)	110
Fig. 24. The common hen louse (<i>Menopon pallidum</i>). Greatly enlarged. (From Banks)	126
Fig. 25. <i>Lipcurus variabilis</i> . A louse that infests poultry. Much enlarged. (From Banks after Denny)	127
Fig. 26. <i>Goniodes dissimilis</i> . A louse that infests poultry Much enlarged. (From Banks after Denny).....	127
Fig. 27. Feathers showing eggs or "nits" of the common hen louse. Enlarged. (Original)	128
Fig. 28. The common "red mite" of poultry, <i>Dermanyssus gallinae</i> . (After Osborn)	133
Fig. 29. A. Normal leg of hen. B. Leg of hen affected with scaly leg. (After Megnin)	136
Fig. 30. Photograph of the leg of a hen affected with scaly leg. (After Haiduk)	137
Fig. 31. Photograph of the adult female of the mite <i>Knemidocoptes (Dermatoryctes) mutans</i> . After Haiduk)..	138
Fig. 32. Photograph of the six-legged larvae of <i>Knemidocoptes (Dermatoryctes) mutans</i>	139
Fig. 33. Section of the skin of the leg of a fowl affected with scaly leg. Enlarged. (After Haiduk)	140
Fig. 34. Egg containing female <i>Sarcoptes laevis</i> var. <i>gallinae</i> . (From Theobald)	142
Fig. 35. <i>Symplectoptes cysticola</i> . Connective tissue mite. (After Theobald)	144
Fig. 36. "Harvest bug," <i>Tetranychus (Leptus) autumnalis</i> , larval form. (After Murray)	145
Fig. 37. Head and neck of a fowl affected with generalized favus. (After Pearson)	147
Fig. 38. The fungus <i>Achorion schouleinii</i> which causes favus in poultry	148
Fig. 39. Sore-head crusts on comb, eye-lids and skin. (After Cary)	151
Fig. 40. The reproductive or egg-producing organs of a hen. (After Duval)	156
Fig. 41. Showing shapes of abnormal eggs sometimes found. (From von Durski after Landois)	161
Fig. 42. Triple yolked egg. (Original)	176

LIST OF ILLUSTRATIONS.

ix

	PAGE
Fig. 43. Showing shapes of abnormal eggs sometimes found. (From von Dürski after Landois)	178
Fig. 44. Diagrammatic representation of the life history of a Coccidium. (After Cole and Hadley)	184
Fig. 45. Ten-day White Leghorn chicks showing symptoms of bacillary white diarrhea. (After Rettger and Stoneburn)	189
Fig. 46. Normal ten-day White Leghorn chicks. (After Rett- ger and Stoneburn)	189
Fig. 47. Trachea (windpipe) of a pheasant, showing gape worms (<i>Syngamus trachealis</i>) attached to the mu- cous membrane. (After Megnin)	196
Fig. 48. A pair of <i>Syngamus trachealis</i> attached. (After Meg- nin)	196
Fig. 49. A pair of <i>Syngamus trachealis</i> (After Megnin)	197
(After Megnin)	197

POULTRY DISEASES AND THEIR TREATMENT.

INTRODUCTION.

It is probably safe to say that considerably more than 50 per cent of the correspondence of those engaged in poultry work in the agricultural colleges and experiment stations in this country relates to poultry diseases. The poultryman or farmer sees that some, or perhaps all, of his birds are ill, and he straightway writes to the nearest college or station to know what the disease is, and what to do for it. The Maine Station has for many years been the recipient of a great number of such inquiries. It is an unfortunate, but in the nature of the case an unavoidable fact, that in many instances it is quite impossible to make any really satisfactory reply to these inquiries. In the vast majority of cases the person who writes the letter is quite untrained in pathology and either describes no symptoms at all or only those very general ones which are common to nearly all the ills of poultry. To one who has not handled this class of correspondence it would seem almost incredible that there should be so many letters of the following type: "I have lost about a third of my chickens in the last few days. They seem a little dumpish for a while and then die. What is the trouble and what shall I do for it?" To diagnose and prescribe on such a basis of information is impossible. Yet the hard fact remains that the correspondent's chickens *were* ill and *did* die, and he *needs* help to get out of the trouble.

To meet this need so far as possible, and in response to a definite request on the part of the organized agricultural interests of the State the present work has been prepared. What it aims to do is to give a clear and reasonably complete compilation and digest of the information now existing in the literature regarding the commoner diseases of poultry, their diagnosis, etiology, treatment and prognosis. It should be clearly understood that the book is essentially a compilation. The Maine Station has never conducted any special investigations regarding poultry diseases, and does not propose to in the imme-

diate future at least. No one connected with the Station at the present time has any expert, first hand knowledge of poultry pathology. This being the case, the Station assumes no responsibility for the contents of this book beyond that involved in the compilation and editing. That is to say, the Station does not guarantee that any of the remedies or treatments herein proposed will cure any diseased condition. It merely puts before the public what appears to be the best and most reliable information now existing regarding these matters. If this information is incomplete, or fails in the attainment of the desired end, the fault lies with the original authority not with the compiler. Further it should be said that no attempt has been made to discuss all the detailed technical accounts of the scientific study of avian pathology, appearing in technical journals in this country and Europe, and the work is, therefore, not complete in this sense. This material is primarily of interest only to the professional student of pathology. This book is not written for him at all, but for the practical poultryman.

It is not intended that this book should displace any of the standard works on diseases in the poultryman's library. On the contrary it is intended merely to supplement these. In fact the writers would most urgently advise that every poultry keeper buy either one or both of the following books:

"The Common Sense Poultry Doctor" by John H. Robinson, Farm Poultry Publishing Co., 232 Summer St., Boston, Mass. Price 50c. This seems to the writers to be, on the whole, the best existing book on diseases for the practical poultryman.

"The Diseases of Poultry." By Dr. D. E. Salmon. For sale by Schmid's Bird & Pet Stock Emporium, 712 Twelfth St., N. W., Washington, D. C. Price 50c. This book gives a more thorough treatment of the subject, but is written rather more from the standpoint of the veterinary practitioner than from the standpoint of the practical poultryman.

In writing this work free use has been made of the standard authorities on the subject, including the books cited above, as well as the following:—

"Diseases of Poultry," by Leonard Pearson.

"Farm Poultry Doctor," by N. W. Sanborn.

"Reliable Poultry Remedies," published by the Reliable Publishing Co., Quincy, Illinois.

"Die Krankheiten des Hausgefüßels," by F. A. Zürn.

"Manual of Poultry Diseases," by Vale.

"Diseases of Poultry," by F. Woodroffe Hill.

Also use has been made of the portions of standard works on poultry husbandry, which deal with disease.

In every case acknowledgement is made to the authorities cited.

CHAPTER I.

GENERAL CONSIDERATIONS REGARDING THE TREATMENT OF POULTRY DISEASES.

There is general agreement on the part of authorities on poultry pathology and practical poultrymen of long experience that in general, "doctoring" poultry is not advisable. The reasons for this attitude are primarily the following:

1. The unit of production with poultry (i. e., the individual bird) is of relatively small value, and if a man's time is worth anything it is too valuable to spend treating sick chickens individually unless they are show specimens of great individual value.

2. The "cured" chicken is a menace to the owner, because its identity is likely to be overlooked or forgotten, with the result that it goes into the breeding pen and perpetuates through its offspring the constitutional weakness which was one fundamental factor in bringing about the result that it, rather than some of its fellows, was ill.

This point of view has been well stated by Wright in the following words:

"In a large proportion of cases of disease, the birds *ought* to die or be killed. Even where there is no constitutional taint, the fact that they have succumbed to circumstances which have not affected others, marks them out as the weakest, which unaided Nature would assuredly weed out, and which if we preserve and breed from, perpetuate some amount of that weakness in the progeny. Rheumatism, for instance, can be cured; of that there is no doubt. But the vast majority who have had such success, agree that the effects are either *never* recovered from as regards strength and vigor, or else that the original weakness continues; and the same may be said of some severe contagious diseases, such as diphtheritic roup, which may affect the strongest. On the other hand, many diseases also apparently contagious, and so attacking healthy birds under certain predisposing conditions of exposure or other coincident strain upon the system, do not ap-

pear to leave serious results behind them, and are tolerably definite in symptoms and character. It is these which may be most successfully treated, and in which treatment is most worth while where fowls of value are concerned. But it is significant that nearly all breeders who rear really large numbers of poultry, gradually come to the conclusion that, except in special cases, with valuable birds, the most economical treatment of serious disease occurring in a yard is—execution. Concerning this matter each must judge for himself.”

In the case of the utility poultryman, keeping poultry solely for the eggs and meat they produce, practically the only diseased conditions which it will pay him to treat at all are those in which the treatment can be applied to the flock as a whole, without the necessity of handling individual birds. Thus, for example, in cases where the flock “goes off its feed,” or has simple indigestion or a simple cold, the birds can be treated successfully as a flock. On the other hand, in the case of the fancier, who has individual birds of considerable value there will be a much wider range of diseases which he will feel that it is profitable for him to treat. There are, of course, certain diseased conditions which demand individual treatment, but in which the treatment is so simple and the outcome is almost certain to be so good, as to justify its employment even in the case of birds of ordinary value. An example of such a condition is found in a crop bound bird. Robinson sums the matter up very well in the following basic rule for poultry doctoring:

“Give treatment when it can be applied to a flock conveniently and with reasonable expectation of beneficial results, and treat individuals, if necessary, when treatment is simple, easy, and needs to be administered but very few times.”

Prevention Rather Than Cure the Ideal.

The aim of every poultry keeper, whether his interest is in the fancy or the utility end of the business, should be to breed and manage his birds so as to prevent entirely, or reduce to a minimum, the occurrence of disease. In other words, the attitude should be that the end to be sought is to prevent the occurrence of disease, rather than to rely on a rather dubious ability to cure it after it is there. Such a standpoint is sound from every point of view; it is in line with the whole development of modern medicine. The poultry doctor should regard his function

as the same as that of the Chinese physician, who is primarily employed to keep the patient from becoming ill, only secondarily to cure him.

Now there are fundamentally two factors involved in the continued maintenance of good health in poultry (or, for the matter of that, in any other animal). These are:

1. *A sound and vigorous constitution*, which if present, is something innate and "bred in the bone," and which, if *absent*, must be bred into the stock.

2. *A system of poultry management (including feeding, housing, etc.) which is thoroughly and absolutely hygienic.*

Let us consider each of these factors separately in some detail.

Breeding for Health, Vigor, and Sound Constitution.

To have a high degree of constitutional vigor in the foundation stock is one of the most certain assurances that the poultryman will not be troubled with disease. This is of primary importance. In order to breed constitutional vigor into the flock the poultryman must train himself to recognize at a glance the condition of his birds. Are they in good condition or not? Regarding the aspect of fowls in health and disease Salmon has the following to say:

"We say that a bird is in good health when it appears lively, has a clear eye, a bright red comb, is quick and active in its movements, has a good appetite and when the various organs perform their functions in the manner in which they are observed to act in all birds that are vigorous and thriving. On the other hand, we say a bird is diseased when some function or functions of its body are not performed as they are the great majority of individuals, or when some organ presents an unusual form or appearance. Disease has, therefore, been defined as a life the manifestations of which deviate more or less from the normal. Practically, we say a bird is diseased when we observe that one or more of its functions are not carried on in a normal manner, or when we find unusual growths, injuries, or parasites affecting any of its organs."

In a recent article Dr. P. T. Woods (Amer. Poult. World, Vol. 1, Jan. 1910) gives some excellent advice in regard to breeding for health and vigor. This is, in many respects, the best brief summary of this important subject which we have been able to find in the literature. He says:—

"The Health Type.—For all practical purposes, the type of health and strength and the type of weakness, of lacking bodily vigor, are easily differentiated. Do not mistake the purely nervous energy of closely bred thoroughbreds for an indication of vigor. This may be simply the mettlesome spirit of the thoroughbred and alone is of no great value as a guide to health; combined with satisfactory physical qualities it is a desirable asset."

"Choosing the Male Bird.—Always bear in mind that the male bird is for all practical purposes half of the flock. The male should be fully matured, well developed specimen, neither too young nor too old. Male birds from twelve months to two and one-half years old usually make the best breeders. He should be the son of sound healthy parents and should, so far as possible, inherit from them the qualities which are desired for chicks of his get. He should be particularly strong in all points of physical vigor, and Standard requirements, where his mates show any traces of weakness. Have him as nearly perfect in Standard shape as possible, and of medium size and weight for the variety. Too heavy males often seriously injure their mates and are not desirable in the breeding pen."

"The head should be rather large, broad and of good shape, well carried. The eye should be bright, round and full with no irregularities in shape of pupil. The comb, face and wattles should be a good healthy color, neither too pale nor too dark. The beak should be rather short, stout and set well at the base. The long, flattened beak of 'crow headed' birds or the misshapen 'hawk bill' are almost certain signs of physical weakness. The neck should be of medium length for the variety and rather full; the long, thin, 'scrawny' neck goes with the 'crow head.'"

"The body should be well filled out and carried in the well-set-up manner indicative of a well ordered system of nutrition,—a good digestion. The plumage should be bright, lustrous and carried rather closely for the variety."

"Mopey, dopey, loosely feathered birds with dull plumage and a listless 'don't care for life' manner are too short on good health to be of value as breeding stock."

"The legs should be medium short for the variety, strong and rather large boned and set well apart. The keel bone should be firm and straight. There should be no deformities."

"Leggy birds, knock-kneed and with crooked breast bones are always lacking in physical vigor even if it does not show on the surface."

"The male should be attentive and gallant to his mates, should have a clear lusty crow, free from any rattle at the end. He should be sound in wind and able to fight or run without shortness of breath or livid appearance of face and comb."

"A good breeder will have a good appetite and will usually be of a rather 'scrappy' disposition, disposed to resent any interference with his mates by other fowls or by the attendant."

"Choosing the Female.—The female should be a well-grown, well-developed, fully-matured pullet or sound and vigorous yearling or two year old. The health type will be active, alert and inclined to be talkative, 'singing' cheerfully, and disposed to scratch and forage. She is usually the first off the roost in the morning and the last to go to bed at night. Head, eye, condition of plumage and leg requirements are practically the same as those called for under 'Choosing the Male Bird,' making due allowance for sex."

"The body should be broad, deep, well filled out and medium large for the variety. The breast should be broad, full and well meated; the back should be broad and the tail well spread at the base. Wry tails, crooked backs or keels, or pinched tails should disqualify for the breeding pen. The abdomen should be well carried and rather full, but should not 'bag down.'"

CHAPTER II.

POULTRY HYGIENE.

Second in importance only to high constitutional vigor and health is attention to the basic rules of hygiene and sanitation in the management of poultry. In view of the prevalent misunderstanding or lack of understanding of these principles it seems wise to devote one chapter to an outline of the more important points which need to be looked after in hygienic poultry keeping. Attention to the rules and principles here set forth will go a great ways towards preventing the occurrence of disease. This does not mean that if these rules are *not* followed disease and destruction will forthwith result. Everyone knows of plenty of instances of more or less successful poultry keeping under the most insanitary and unhygienic of conditions. So similarly human beings are able when forced to do so to live under unhygienic conditions. But every civilized country in the world believes that the most economical insurance against the steady loss of national wealth which the prevalence of disease involves is the enforcement of sanitary regulations throughout its domain. Again, many men who do not carry fire insurance on their buildings go through life without having any of them burn down. But this is no argument against the fact that it is a sound economic policy to carry fire insurance. In poultry keeping many may be successful for a time in managing their birds in defiance of the laws of sanitation and hygiene; a *very few* may be successful in this practice for a long time, but in the long run the vast majority will find that thorough, careful, and intelligent attention to these laws will be one of the best guarantees of *permanent* success that they can find.

Poultry hygiene and sanitation will be considered here under 7 main heads, as follows: 1. Housing. 2. Feeding. 3. The Land. 4. Exercise. 5. External Parasites. 6. Disposal of the Dead. 7. Isolation of Sickness. What is said under all of these heads is intended to apply (unless a specific statement to the contrary is made) both to adult birds and to chicks. No

discussion of the hygiene of incubation, or of the relative merits of artificially and naturally hatched chickens will be undertaken here, because there are special subjects falling outside the field of general poultry hygiene.

I. POULTRY HOUSE HYGIENE AND SANITATION.

1. *Cleanliness.*—The thing of paramount importance in the hygienic housing of poultry is *cleanliness*. By this is meant not merely plain, ordinary cleaning up, in the housewife sense, but also bacteriological cleaning up; that is, *disinfection*. All buildings or structures of whatever kind in which poultry are housed during any part of their lives should be subjected to a most thorough and searching cleaning and disinfection—*at least* once every year. This cleaning up should naturally come for each different structure (i. e., laying, colony or brooder house, individual brooder, incubator, etc.) at a time which just precedes the putting of new stock into this structure.

How to clean a poultry house: Not every poultryman of experience even, knows how *really* to clean up a poultry house. The first thing to do is to remove all the litter and loose dirt which can be shovelled out. Then give the house—floor, walls and ceiling—a thorough sweeping and shovel out the accumulated debris. Then play a garden hose, with the maximum water pressure which can be obtained, upon floor, roosting boards, walls and ceiling, until all the dirt which washes down easily is disposed of. Then take a heavy hoe or roost board scraper and proceed to scrape the floor and roosting boards, *clean* of the trampled, and caked dressing and dirt. Then shovel out what has been accumulated and get the hose into action once more and wash the whole place down again thoroughly and follow this with another scraping. With a stiff bristled broom thoroughly scrub walls, floors, nest boxes, roost boards, etc. Then after another rinsing down and cleaning out of accumulated dirt, let the house dry out for a day or two. Then make a searching inspection to see if any dirt can be discovered. If so apply the appropriate treatment as outlined above. If, however, everything *appears* to be clean, the time has come to make it *really* clean by *disinfection*. To do this it is necessary to spray or thoroughly wash with a scrub brush wet in the solution used all parts of the house with a good disinfectant *at least twice*, allowing time between for it to dry. For this purpose 3 per cent

eresol solution is recommended. The chief thing is to use an effective disinfectant and plenty of it, and apply it at least twice. A discussion of disinfectants immediately follows this section. To complete the cleaning of the house, after the second spraying of disinfectant is dry apply a liquid lice killer (made by putting 1 part crude carbolic acid or eresol with 3 parts kerosene) liberally to nests and roosts and nearby walls. After all this is done the house will be *clean*. In houses cleaned annually in this way the first step is taken towards hygienic poultry keeping.

The same principles which have been here brought out should be applied in cleaning brooders, brooder houses, and other things on the plant with which the birds come in contact.

What has been said has reference primarily to the annual or semi-annual cleaning. It should not be understood by this that no cleaning is to be done at any other time. On the contrary the rule should be to keep the poultry house *clean* at all times, never allowing filth of any kind to accumulate and using plenty of disinfectant.

Disinfection.—In the matter of disinfection there are several options open to the poultryman. He may make his own disinfectant, or he may purchase proprietary compounds like Zenoleum, Carbolineum or a host of other "eums" which confront him at every turn in his reading of poultry periodicals, or he may buy a plain disinfectant like formaldehyde, or carbolic acid.

The Experiment Station has tried various disinfectants with a view to finding the most useful, when the factors of efficiency, ease of application and low cost, are considered. There is probably no more effective disinfectant than formaldehyde, but after trying it out it was necessary to abandon it as a general poultry house disinfectant. The difficulty was that a man could not stand the fumes long enough to spray and scrub out thoroughly a pen. Formaldehyde is very good where it can be used, and there is no cheaper disinfectant, efficiency considered. Dr. P. T. Woods has recently advocated the formaldehyde gas method for disinfecting poultry houses, using the permanganate method of generating. This, however, is indicated only for rooms which can easily be closed up air tight. It costs too much in time and trouble to make any form of "fresh air" poultry house even moderately air tight. The formaldehyde gas method is well adapted to disinfecting and fumigating feed rooms, incuba-

tor cellars, brooder houses and all houses which can be readily made air tight. For the benefit of those who wish to use the method for such purposes the following directions are given. This will give a very strong fumigation and disinfection but such is indicated about poultry establishments.

Formaldehyde Gas Disinfection: First make the room as tight as possible by stopping cracks, key-holes, etc., with pieces of cloth or similar substance. Open drawers and doors of bureaus, wardrobes, and closets to allow free access of the gas. Use a metal or earthen dish for a generator, of sufficient size so that the liquid will not spatter or boil over on the floor, since the permanganate will stain. The temperature of the room should not be below 50° F. and more effective disinfection will be obtained if the temperature is 80° F. or above at the beginning. Sprinkle boiling water on the floor or place a kettle of boiling water in the room to create a moist atmosphere. Spread the permanganate evenly over the bottom of the dish and quickly pour in the formaldehyde (40 per cent strength as purchased). Leave and tightly close the room at once and allow to remain closed for 4-6 hours or longer, then air thoroughly." *Use 23 ounces of permanganate and 3 pints of formaldehyde to each 1000 cubic feet of space.*

For general disinfectant purposes about a poultry plant the Station has found the cheapest and most effective disinfectant to be compound cresol solution. This is used here for spraying and disinfecting the houses after they are cleaned, disinfecting brooders, brooder houses, incubators, nests and everything else about the plant which can be disinfected with a liquid substance. Any person can easily make this disinfectant. The following revised directions for its manufacture are quoted from Bulletin 179 of this Station.

Cresol Disinfectant.—The active base of cresol soap disinfecting solution is commercial cresol. This is a thick, sirupy fluid varying in color in different lots from a nearly colorless fluid to a dark brown. It does not mix readily with water, and, therefore, in order to make satisfactory a dilute solution, it is necessary first to incorporate the cresol with some substance like soap which will mix with water and will carry the cresol over into the mixture. The commercial cresol as it is obtained, is a corrosive substance, being in this respect not unlike carbolic acid.

It should, of course, be handled with great care and the pure cresol should not be allowed to come in contact with the skin. If it does so accidentally the spot should be immediately washed off with plenty of clean water. The price of commercial cresol varies with the drug market. It can be obtained through any druggist. On the day that this was written the quotation on cresol in the New York market is 24 cents per pound. In purchasing this article one should order simply "commercial cresol."

Measure out 3 to 5 quarts of raw linseed oil in a 4 or 5 gallon stone crock; then weigh out in a dish 1 lb. 6 oz. of commercial lye or "Rabbit's potash." Dissolve this lye in as little water as will completely dissolve it. Start with $\frac{1}{2}$ pint of water, and if this will not dissolve all the lye, add more water slowly. Let this stand for at least 3 hours until the lye is completely dissolved and the solution is cold; then add the *cold* lye solution very slowly to the linseed oil, stirring constantly. Not less than 5 minutes should be taken for the adding of this solution of lye to the oil. After the lye is added continue the stirring until the mixture is in the condition and has the texture of a smooth homogeneous liquid soap. This ought not to take more than a half hour. Then while the soap is in this liquid state, and before it has a chance to harden add, with constant stirring, $8\frac{1}{2}$ quarts of commercial cresol. The cresol will blend perfectly with the soap solution and make a clear, dark brown fluid. The resulting solution will mix in any proportion with water and yield a clear solution.

Cresol soap is an extremely powerful disinfectant. In the Station poultry plant for general purposes of disinfecting the houses, brooder houses, incubators, nests, and other wood work, it should be used in a 3 per cent solution with water. Two or 3 tablespoons full of the cresol soap to each gallon of water will make a satisfactory solution. This solution may be applied through any kind of spray pump or with a brush. Being a clear watery fluid it can be used in any spray pump without difficulty. For disinfecting brooders or incubators which there is reason to believe have been particularly liable to infection with the germs of white diarrhea or other diseases the cresol may be used in double the strength given above and applied with a scrub brush in addition to the spray.

B. Fresh Air and Light.—Too great stress cannot be laid on the importance of plenty of fresh air in the poultry house if the birds are to keep in good condition. And it must be remembered in this connection that "fresh" air, and cold stagnant air are two very different things. Too many of the types of curtain front and so-called "fresh air" houses now in use are without any provision other than an obliging southerly wind, to insure the circulation or changing of air within the house. Even with an open front house it is wise to provide for a *circulation* of air in such way that direct drafts cannot strike the birds. This applies not only to the housing of adult birds in laying houses, but also to the case of young stock in colony houses on the range.* Further a circulation of fresh air under the hover in artificial rearing is greatly to be desired and will have a marked effect on the health and vigor of the chicks.

Not only should the poultry house be such as to furnish plenty of fresh air, but it should also be *light*. The prime importance of sunlight in sanitation is universally recognized by medical authorities. Disease germs cannot stand prolonged exposure to the direct rays of the sun. Sunlight is Nature's great disinfectant. Its importance is no less in poultry than in human sanitation. The following statement made some years ago (1904) by a writer signing himself "M" in *Farm Poultry* (Vol. 15) brings home in a few words the importance of having plenty of light in the poultry house.

"Light in the poultry house has been found by a writer a *great help in keeping the house clean and keeping the fowls healthy*. Probably there is no greater assistance to the diseases of poultry than dark and damp houses, and dark houses are frequently damp. In recent years I have had both kinds of experience, those with the hens confined in a large, dry and light house, and with hens confined in a dark house in which a single window looking towards the setting sun furnished the only light. Being forced to use the latter building for an entire winter I found it impossible to get it thoroughly dried out after a rain had rendered the walls damp. By spring some of the fowls that had been confined there began to die of a mysterious

*See in this connection the modification of the Maine Station colony house to insure circulation of air, as given in U. S. Dept. Agr. Farmers' Bulletin 357.

disease and a post-mortem examination showed it to be liver disease. Later the roup broke out in the same house and this dread disease continued with the flock for months exacting a heavy toll in laying hens."

C. Avoid Dampness. Of all unfavorable environmental conditions into which poultry may, by bad management, be brought, a damp house is probably the worst. Nothing will diminish the productivity of a flock so quickly and surely as will dampness in the house, and nothing is so certain and speedy an excitant to roup and kindred ills. *The place where poultry are housed must be kept dry if the flock is to be productive and free from disease.*

D. Provide Clean and Dry Litter. Experience has demonstrated that the best way in which to give fowls exercise during the winter months in which, in northern climates at least, they must be housed the greater part if not all of the time, is by providing a deep litter in which the birds scratch for their dry grain ration. For this litter the Experiment Station uses pine planer shavings, with a layer of straw on top. Whatever the litter it should be changed as often as it gets damp or dirty.

II. HYGIENIC FEEDING.

Along with housing as a prime factor in poultry sanitation goes feeding. This is not the place to enter upon a detailed discussion of the compounding of rations and such topics, but there are certain basic principles of hygienic feeding which must always be looked after if one is to avoid diseases. There are:

A. Purity. It should be a rule of every poultryman never to feed any material which is not clean and wholesome. Musty and mouldy grain, tainted meat scraps or cut bone, table scraps which have spoiled, and decayed fruits or vegetables should never be fed. If this consideration were always kept in mind many cases of undiagnosed sickness and deaths, and low condition in the stock would be avoided. Keep all utensils in which food is placed *clean*.

B. Avoid Overfeeding. Intensive poultry keeping involves of necessity heavy feeding, but one should constantly be on the lookout to guard against overfeeding, which puts the bird into a state of lowered vitality in which its natural powers of resistance to all forms of infections and other diseases are reduced. The feeding of high protein concentrates like linseed or

cotton seed meal needs to be particularly carefully watched in this respect.

C. Provide Plenty of Green Food. Under natural conditions poultry are free eaters of green grass and other plants. Such green food supplies a definite need in metabolism, the place of which can be taken by no other sort of food material. It is not enough merely to supply *succulence* in the ration. Fowls need a certain amount of succulent food, but they also need *fresh green food*. The Station has found green sprouted oats, when properly prepared, to be an excellent source of winter green food. Full directions for sprouting oats are given in Bulletin 179 of the Maine Station, a copy of which may be had upon application to the Director of the Station.

D. Provide Fresh and Clean Drinking Water. The most sure and rapid method by which infectious diseases of all kinds are transmitted through a flock of birds is by means of the water pail from which they all drink in common. Furthermore the water itself may come from a contaminated source and be the origin of infection to the flock. Finally it is difficult to devise any satisfactory drinking fountain in which the water is not liable to contamination from litter, manure, etc. All these considerations indicate the advisability of adding to all drinking water which is given to poultry some substance which shall act as a harmless antiseptic. The best of all such substances yet discovered for use with poultry is potassium permanganate. This is a dark reddish-purple crystalline substance which can be bought of any druggist. It ought never to cost more than 20c-30c per pound and a pound will last for a long time. It should be used in the following way: In the bottom of a large mouthed jar, bottle or can, put a layer of potassium permanganate crystals an inch thick. Fill up the receptacle with water. This water will dissolve all of the crystals that it is able to. This will make a stock saturated solution. As this solution is used add more water and more crystals as needed, always aiming to keep a layer of undissolved crystals at the bottom. Keep a dish of stock solution like this alongside the faucet or pump where the water is drawn for the poultry. *Whenever any water is drawn for either chicks or adult fowls add enough of the stock solution to give the water a rather deep wine color.* This means 1 to 2 teaspoons of the stock solution to 10 quarts of

water. At the same time one should clean and disinfect the drinking pails and fountains regularly, just as he would if he were not using potassium permanganate. At the Station plant for some 2 years past no bird has ever had a drink of water from the time it was hatched which did not contain potassium permanganate, except such water as it got from mud puddles and the like.

Dr. G. B. Morse, the well known authority on poultry diseases of the Department of Agriculture, had the following to say regarding this point in a recent address (Rel. Poul. Jour. Oct. 1910). After describing the potassium permanganate method, as well as two others, directed to the same end, but in the opinion of the present writers not so desirable as this, he goes on to say: "Water-borne diseases are frequent in the poultry yard. Clean and disinfect your drinking-fountains (and you must) ever so well, if you are permitting, consciously or unwittingly, to run at large one bird sick with any of the contagious diseases of the head parts or with bowel diseases, you may count on that water supply being contaminated in less than one hour's time. In the case of a large flock affected with flagellate diarrhoea I have myself found the flagellates in less than one hour's time in the drinking water which had been sterilized and placed in thoroughly disinfected fountains. Do you not see where such a condition as this forces you? Right up against the principle of the individual drinking cup. Ridiculous, do you say? Not a bit. I did not say 'the individual drinking cup,' but the 'principle of the individual drinking cup.' Boards of health are recognizing that by means of the common, public drinking-cup foul and terrible diseases are being spread among people. It is just so with your poultry, and while you cannot adopt the individual cup you can incorporate the principle of it in your hygienic methods by adding * * * * * one of the antiseptics named. It is true, in the proportions named, these remedies do not disinfect the water, only act as antiseptics, that is, act to hinder the development of bacteria and other microbes. The water itself should be changed frequently. This hindering of microbial growth occurs not only in the fountain but is kept up in the intestinal tract."

III. THE LAND.

One of the most important considerations in poultry sanitation is to keep the ground on which the birds are to live both as chicks and as adults from becoming foul and contaminated. This is not a very difficult thing to do if one has enough land and practices a definite and systematic crop rotation in which poultry form one element. On the open range where chicks are raised a 3 year rotation is entirely feasible and serves its purpose well. Such a system of cropping would be something as follows: First year, chickens; second year, a hoed crop, like beets, cabbage, mangels or corn, the ground to be seeded down to timothy and clover after the crop is taken off; third year, in grass; fourth year, chickens again. Other cropping systems to serve the same purpose can easily be devised.

To maintain the runs connected with a permanent poultry house where adult birds are kept in a sweet and clean condition is a more difficult problem. About the best that one can do here is to arrange alternate sets of runs so that one set may be used one year and the other set the next, purifying the soil so far as may be by plowing and harrowing thoroughly annually, and planting exhaustive crops. Failing the possibility of alternating in this way, disinfection and frequent plowing are the only resources left.

The following excellent advice on this subject is given by the English poultry expert Mr. E. T. Brown (*Farm Poultry*, Vol. 18, p. 294): "Tainted ground is responsible for many of the diseases from which fowls suffer, and yet it is a question that rarely receives the attention it deserves. The chief danger of tainted soil arises when fowls are kept in confinement, but still we often find that even with those at liberty the land over which they are running is far from pure. So long as the grass can be kept growing strongly and vigorously there is small fear of foul ground, as the growth absorbs the manure; it is when the grass becomes worn away that the chief danger arises. The manure constantly falling upon the same small area, and there being nothing to use it up, the land is bound in a short space of time to become so permeated as to be thoroughly unfit for fowls. The question is very often asked in connection with this subject as to how many fowls a certain sized piece of land will accommodate the whole year through. Occasionally one may see in

some of the agricultural or poultry journals this question answered, but as a matter of fact to give any stated number is most misleading. It depends very largely upon the class of soil, as some can carry twice as many birds as others; it depends upon the breed of poultry, some being much more active than others, and thus requiring more space; it depends, too, upon the time of year, because during the spring and summer, when there is an abundance of vegetable growth in the soil, a considerably larger number of birds can be maintained than during the autumn or winter. The number must be varied according to these circumstances, and no hard and fast rule is applicable."

"The results of tainted ground are generally quickly noticeable, as the fowls have a sickly appearance, the feathers lose their brilliant lustre, and the wings begin to droop. Roup, gapes, and other ailments speedily show themselves, causing, if not death itself, considerable loss and unpleasantness. One of the greatest advantages to be derived from portable houses is that they so greatly reduce the risk of tainted ground, as they are being constantly moved from one place to another, thus evenly distributing the manure. When it is remembered that each adult fowl drops nearly a hundred weight of manure in the course of a year, the importance of this question will be immediately realized. It is quite possible, however, provided that suitable precautions are taken, to keep a comparatively small run pure for a long time. If the grass is short it should be occasionally swept, in this manner removing a good deal of the manure. Another important point is to always have around the house a space of gravel, upon which the birds should be fed, and if swept once or twice a week this will have a wonderful effect in preserving the purity of the grass portion. Anyone who has observed poultry will know how fond they are of constantly being near the house, and thus the greater portion of their droppings falls within its immediate vicinity. The shape of the run also has a great bearing upon the length of time it will remain untainted, a long narrow run being much superior to a square one. I have proved by my own experience how true this is, and probably a long and narrow run, containing the same amount of space will remain pure twice as long. It is unnecessary here to go into a full explanation of why this is so, but I may state the fact, which I am confident is quite correct. If the space at one's disposal

is very limited it is a good plan to divide it into two equal parts, placing the house in the middle. During one year one-half would be available for the fowls, the other being planted with some quickly growing vegetables, the order being reversed the year following. The vegetable growth has the effect of quickly using up the manure, and in this manner quite a small plot of land can be heavily stocked with poultry for an unlimited number of years. If the soil becomes at all foul it is a good plan to water it with a 1 per cent solution of sulphuric acid, or to apply a light dressing of gas lime."

IV. EXERCISE.

If poultry are to be in good condition, and maintain their normal resistance to disease *they must exercise*. As chicks they will do this on the range. As adults (in climates like that of Maine) the most feasible way to bring this about is to provide litter and make the birds scratch for their feed.

V. EXTERNAL PARASITES.

In hygienic poultry keeping the birds must be kept reasonably free at all times of lice, mites, and all other forms of external parasites. Directions for dealing with this matter are given in detail farther on in this book in the chapter on External Parasites. It is desired here merely to call attention to the matter as one of the general principles of hygienic poultry management.

VI. DISPOSAL OF DEAD BIRDS.

The poultry plant which does not have some dead birds to dispose of from time to time has yet to be started. Just in connection with the disposal of such dead birds is one of the weakest points in poultry sanitation as too commonly practiced. The number of poultry keepers who throw dead birds on the manure pile or out on a temporary unused field is much too large. This is a short sighted and dangerous procedure. Anyone who continues for a long enough time to dispose of his dead birds in such a way is tolerably sure, sooner or later, to be wiped out of business by an epidemic, with a thoroughness and despatch which will leave him wondering what in the world has happened.

The most sanitary method of disposal of dead bodies is cremation. Wherever it is possible every dead bird should be burned

just as soon as may be after death has occurred. In many cases, however, a farmer or poultryman is not so situated as to be able to burn dead animals without too great an expenditure of time or labor. In this event burial is about the only alternative, and here, as in the song, it is wise to dig the grave "both wide and deep," especially deep. Otherwise, through the aid of foxes, dogs, skunks, or other creatures, the dead may "rise again" in a literal and most insanitary manner.

VII. ISOLATION OF SICKNESS.

Whether one expects to treat the bird or to kill it, *every individual that shows signs of sickness should be removed from the general flock.* When the bird has been isolated a decision as to what will be done about the case can be reached at leisure, and in the meantime the flock is not subjected to the danger of infection. This is an important matter with young chickens as well as with adult stock.

THE ESSENTIALS OF POULTRY HYGIENE.

To summarize this discussion of poultry hygiene and sanitation it may be said that the essentials in the hygienic and sanitary management of poultry are

1. **CLEAN HOUSES.**
2. **CLEAN AIR.**
3. **CLEAN FOOD.**
4. **CLEAN WATER.**
5. **CLEAN YARDS AND CLEAN RANGE.**
6. **CLEAN INCUBATORS AND BROODERS.**
7. **CLEAN BIRDS, OUTSIDE AND INSIDE.**

CHAPTER III.

THE DIAGNOSIS OF THE DISEASES OF POULTRY.

The first thing that the poultry keeper whose birds are ill wants to know is: "*What ails my chickens?*" Before he can use this or any other book on poultry diseases effectively in getting advice for the treatment of disease he must diagnose the trouble. It is the purpose of this chapter to help him do this, and in this way make this book more useful to the practical poultryman. At the outstart it should be said that *the absolutely certain differential diagnosis of particular diseases of poultry, by the farmer or poultryman, either on the basis of external symptoms or post-mortem examination is in nearly every case impossible. The best that can be done practically is to determine into what general class of diseases a particular trouble falls.*

There are two general sources of information upon which to base a diagnosis of disease. These are:

- I. External symptoms.
- II. Post-mortem examination.

EXTERNAL SYMPTOMS, WITH A TABLE TO AID IN THE IDENTIFICATION OF THE CHIEF CLASSES OF POULTRY DISEASES.

There are certain external symptoms which are characteristic in a way of nearly all diseases. These symptoms merely indicate that the bird is *sick*; they are of *no value* for purposes of differential diagnosis.

These general symptoms of illness may be described as follows: A sick fowl is usually quiet, and does not move about unless disturbed. It stands or sits with the neck contracted so that the head is pulled well in to the body, giving the bird a "humped up" appearance. The eyes are often closed, entirely or partly, giving the bird a sleepy appearance. Often the feathers are roughened and stick out all over the body. The comb and wattles may be dark or, on the other hand, may be very pale.

When a bird shows these general symptoms of illness it should be picked up and isolated and an effort made to obtain a more precise diagnosis. In doing this the following table of the chief external symptoms may be found of use.

This table aims to direct one to the discussion of *general classes* of disease. The identification of special individual diseases should be attempted only after reading over the chapters covering the general class involved. In general it should be kept in mind that *this table is not intended to tell the reader what the disease he finds is, but solely to tell him what parts of this book to read in any given case in order to make a diagnosis.*

Table of External Symptoms which may be of Some Value in Differential Diagnosis.

The numbers in brackets denote the pages to be consulted.

SYMPTOM.	Diseases which the symptom named <i>may</i> indicate.
<i>Abdomen</i> swollen	Peritonitis (72). Dropsy (73). White diarrhea (181).
<i>Etching</i> of gas.....	Inflammation of crop (34).
<i>Breathing</i> abnormal (i. e.). Diseases of the respiratory system (85). too rapid, too slow, wheez- ing, whistling, snoring or Gapes (195). Air-sac mite (110). in any different from nor- mal.....	Arsenic poisoning (44). Pericarditis (112).
<i>Choking</i>	Arsenic poisoning (44).
<i>Comb</i> , pale.....	Tuberculosis (57). Dropsy (73). Air-sac mite (110). Infectious leukaemia (114). White diarrhea (181).
<i>Comb</i> , first pale, but later dark.....	Enteritis (39).
<i>Comb</i> , very dark.....	Liver disease (47). Blackhead (53). Congestion of lungs, (107). Pneumonia (108).
<i>Comb</i> , yellow.....	Liver diseases (47). Visceral gout (121).
<i>Comb</i> , with white, powdery scurf.....	White comb (150).
<i>Constipation</i>	Simple constipation (41). Indigestion (42). Inflammation of oviduct (165).
<i>Convulsions</i>	Arsenic poisoning (44). Copper, lead or zinc poisoning (44). Epilepsy (119). "Harvest-bug" (115).
<i>Cough</i>	Diseases of the respiratory system (85).
<i>Crop</i> , enlarged and hard....	Crop bound (32).
<i>Crop</i> , enlarged and soft....	Inflammation of crop (31). Enlarged crop (36). Gastritis (36).
<i>Diarrhea</i>	Diseases of the alimentary tract (32). Arsenic poisoning (44). Copper, lead or zinc poisoning (44). Blackhead (53). Tuberculosis (57). Cholera (66). Roup (99). White diarrhea (181).
<i>Nostrils</i> , discharge from....	Diseases of the respiratory system (85).
<i>Emaciation</i>	Tuberculosis (57). Aspergillosis (104). Visceral gout (121). Mites (132). White diarrhea (181).

Table of External Symptoms—Concluded.

The numbers in brackets denote the pages to be consulted.

SYMPTOM.	Diseases which the symptom named <i>may</i> indicate.
<i>Eye</i> , expansion of pupil.....	Arsenic poisoning (44).
<i>Eye</i> , sticky discharge from.....	Catarrh (87), Roup (90).
<i>Face</i> , swollen.....	Roup (90).
<i>Droppings</i> , bright emerald green.....	Cholera (66).
<i>Feet</i> , marked.....	Peritonitis (72), Aspergillosis (104), Infectious leucæmia (114), Inflammation of oviduct (165).
<i>Limbs</i>	Tuberculosis (57), Aspergillosis (104), Rheumatism (123), Scaly leg (135), Bumble foot (202).
<i>Legs</i> , roughened, with scales raised.....	Scaly leg (135).
<i>Mouth</i> , mucous discharge from.....	Congestion of the lungs (107), Pneumonia (108), Gapes (195).
<i>Mouth</i> , white, cheesy patches in.....	Roup (90), Canker (103).
<i>Nausea and Vomiting</i>	Inflammation of the crop (34), Copper, lead or zinc poisoning (44).
<i>Neck</i> , bent backward.....	Strychnine poisoning (15), Congestion of the brain (119), Wry neck (123).
<i>Neck</i> , limp.....	Limberneck (123).
<i>Paralysis</i>	Copper, lead or zinc poisoning (44), Strychnine poisoning (15), Apoplexy (118), Heat prostration (118).
<i>Saliva</i> , copious secretion.....	Arsenic poisoning (44).
<i>Skin</i> , pulled out in blisters.....	Emphysema (194).
<i>Skin</i> , scaly and incrusted.....	Body mange (144), Favus (147).
<i>Staggering</i>	Congestion of the brain (119), Leg weakness (192).
<i>Thirst</i> , excessive.....	Hypertrophy of the liver (50), Peritonitis (72), Aspergillosis (104), Tapeworms (76).
<i>Tongue</i> , hard and dry.....	Pip (162), Diseases of the respiratory system (85).
<i>Tumors</i> on head.....	Roup (90), Chicken pox (150).
<i>Vitals</i> , yellow.....	Cholera (66).
<i>Vent</i> , mass of inflamed tissue projecting from.....	Prolapse of oviduct (167).
<i>Vent</i> , skin inflamed.....	Vent gleet (175).

POST-MORTEM EXAMINATIONS.

Whenever a bird dies from a cause not entirely clear to the poultryman a post-mortem examination should be made in order to learn, if possible, from the condition of the internal organs what it was that caused death. The poultryman should familiarize himself with the appearance of the internal organs in a nor-

mal state of health, so that he may at once recognize any departure from these normal conditions.

The following directions and general advice regarding the making up of autopsies is taken from the English poultry journal "Poultry":

"How to make a post-mortem examination, so that these various organs can be seen and examined, and so that a general opinion can be formed as to their condition of health or otherwise. Let it be understood that a very large number of poultry which die are victims of some entirely simple complaint, such as enlargement of the liver, or tuberculosis in the lungs. These complaints are easily recognizable, and there is no reason at all why any farmer or amateur poultry keeper should not be able to form a general opinion as to whether his poultry are dying off from some such complaint as one or other of these. Take the dead bird and lay it on a wooden table or on a piece of strong board, breast uppermost. Spread out the wings and the legs, putting a small nail through the joint of each wing and through the center of each foot. It is not necessary for the bird to be entirely plucked; it will be enough to pluck the breast, and when this has been done pinch up the skin at the point of the breast bone, and cut it straight through from the vent to the crop. Having done this, draw back the skin on both sides so as to leave the flesh fully exposed, and then with a sharp knife cut through the flesh on both sides of the breast bone, and with a strong, blunt pointed pair of scissors, cut out the center of the breast bone entirely, taking particular care in doing so not to injure the heart, as a flow of blood from the heart will interfere with subsequent operations. When this has been done the principal organs will be seen clearly exposed."

"First of all examine the liver. To be perfectly healthy, it should be of a rich chocolate brown color, free from any specks, and free from any discoloration (although there are sometimes post-mortem discolorations at the edges, which are easily recognizable). If the liver contains any specks it is unhealthy, as it should not be what is known as pasty or rotten. Healthy and firm to the touch and of the proper color, is the general description to apply to the liver. The heart should then be looked at, and it should also be quite firm, free from any excessive covering of fat, and also quite free from little nodules of tubercu-

losis. Another thing about the heart is that it should be even lobed—that is to say, it should not be distended on one side and empty on the other; if it be so, the probability is that the bird has died from heart failure, and supposing it is known that the bird did die suddenly, this can at once be accepted as the cause—syncope, failure of the heart's action, which always ends in very sudden death, the bird simply dropping down dead without any warning. The lungs, which will be seen on either side at the back of the heart, are spongy looking bodies of a pink color. If a piece of one of the lungs can be cut off and be placed in a bowl of water it should float, not sink, or it will be unhealthy. Always look at the lungs for tuberculosis, which is usually to be detected there,* and is indicated by little cheesy nodules in the substance of the lungs, which cannot possibly be mistaken; sometimes the lungs and the heart will all be eaten by these tuberculous masses. If no disease has been found so far, proceed to examine the crop and the gullet, also the windpipe. With regard to the crop, it might almost be examined first if it is full of food, and apparently in a state of congestion, to see whether there be a stoppage in the opening from the crop to the proventricle. The gullet and windpipe can also be examined to see if there is anything unhealthy about them. Similarly an examination can then be made of the intestines, and in the case of a hen the egg organs can be carefully dissected to see whether there is a broken egg, or whether any egg substance has escaped into the cavity of the abdomen and set up inflammation."

"There is no difficulty about making an examination of the skull, and the amateur with a little practice will very easily be able to do this. The way to set about it is to start at one corner of the mouth, and with a pair of sharp pointed scissors cut around the skull to the other corner of the mouth; it will then be quite an easy matter to lift up the skull from the back, and the brain will be clearly seen. This should be perfectly clear, and if there be any trace of a slight effusion of blood, it will be positive evidence of an apoplectic seizure, and will confirm the symptoms of apoplexy, which are delirium, resulting, after a few hours or a few days helplessness, in death. These, then, are

* This is usually *not* the case (see below p. 62). This writer has probably mistaken aspergillois lesions of the lungs for those of tuberculosis. Note added by compiler.

the principal points, and any amateur can make a simple matter-of-fact examination such as has been described, very often with considerable satisfaction to himself."

In order to get the benefit of the descriptions given in this book of the post-mortem appearances of organs in various diseases, the poultryman should proceed as follows. If the liver, for example, of a dead bird appears to be abnormal, look up in the index of this book the entry "*Post-mortem appearance of.*" Under this will be found a heading "liver," followed by the page numbers 40, 47, 49 to 56, 61, 68, 113, 115, 121, 188, 194. This means that on each one of the pages listed will be found a description of the post-mortem condition of the liver in a bird dying of some particular disease. Similar entries are made for other organs. In this way the post-mortem examination may be made to aid directly and quickly in the diagnosis of disease.

CHAPTER IV.

POULTRY MATERIA MEDICA.

It is the purpose of this chapter to give an account of the drugs and remedies which the poultryman will find it well to be supplied with; directions for making various solutions; tables of weights and measures and the like.

THE MEDICINE CHEST.

The following drugs and medicines will be found useful to have at hand.

Calomel (subchloride of mercury).—“This is a very useful alterative medicine for fowls, 1 grain pills frequently having a good effect on the liver. When given it should be followed in two hours by a dose of castor oil. Some authorities oppose the use of mercury in any form for poultry, but there have been numerous cases when it has produced good results.” (Bradshaw.)

Cayenne.—“Is considered to be an excellent liver stimulant when given in small quantities. In cases of colds it is also useful, and forms one of the ingredients in the spices so much used to stimulate winter laying.” (Bradshaw.)

Catechu.—“In powder or tincture form, in combination with powdered chalk, is a good remedy for diarrhea. The average dose of powdered catechu is from 2 to 5 grains, and of the tincture from 2 to 5 drops.” (Bradshaw.)

Castor oil.—“Although apparently paradoxical, this is one of the best remedies for diarrhea. The latter is frequently due to some fetid matter in the intestines; a dose of oil will usually remove this, and often diminish the diarrhea. It is also used in cases of crop-bound fowls. A teaspoonful poured down the throat, and the mass kneaded with the fingers, and then warm water poured down will soften the matter, and frequently effect a cure.” (Bradshaw.)

Epsom salts (magnesium sulphate).—“Is one of the simplest, cheapest, and most effective poultry-yard drugs. It is useful in

liver disease, diarrhea, and many other complaints. Half a teaspoonful for a full-grown fowl is a standard dose. It can be mixed in the soft food, but is more effective by starving the fowl for a few hours, dissolving the salts in warm water, and pouring it down the bird's throat. Epsom salts always act best accompanied with a good quantity of water." (Bradshaw.)

The following table of doses of Epsom salts for young birds has been worked out by Gage and Opperman:

AGE OF BIRD.	AMOUNT PER BIRD IN GRAINS.	HOW ADMINISTERED.
1 to 5 weeks	10 grains	In feed
5 to 10 weeks	15 grains	In feed
10 to 15 weeks	20 grains	In feed
15 weeks to 6 months.	30 grains	} Two teaspoonful of water to every 30, 10 or 50 grains of salt.
6 months to 1 year	35 grains	
1 year and over	40-50 grains	

Cotton Seed Oil.—"Olive and salad oils are useful when hens are egg-bound, for diarrhea, and also for external use in dressing torn combs and other wounds. In eye troubles it takes the place of a simple lotion." (Bradshaw.)

Bichloride of mercury, 1 to 1000 solution.—To make this the simplest way is to buy of the druggist bichloride of mercury tablets, and ask him to label the box to show how much water a tablet must be dissolved in to make a 1 to 1000 solution. If one desires to mix it up for himself ask the druggist to make up some 1 gram (15½ grain) powders of bichloride of mercury. Dissolve 1 of these powders in a quart of water. Put in enough laundry bluing so that the color will be deep blue. Then the solution, which is highly poisonous, will never be mistaken for water.

"1 to 1000 bichloride" is a germicide and disinfectant for external use, cleansing wounds and the like.

Medicines in Tablet Form.—One of the most convenient forms in which medicines may be administered is in tablets. Wholesale and mail-order drug houses carry extensive lines of these graded as to dosage. They may be administered to poultry very easily and conveniently by holding the bird's mouth open with one hand and with the other thrusting the tablet far enough back in the throat so it will be swallowed.

The following list of tablets will be found useful to the poultryman. They fairly well cover the medicines recommended in

the body of this book. Any poultryman may get these either from his local druggist, or if he cannot furnish them, they can be purchased by mail at approximately the prices named from The Frank S. Betz Co., Hammond, Indiana.

	Price per 1000
Salicylic acid, 2½ gr.....	.70
(For use in rheumatism.)	
Aconite root, 1-10 gr.....	.50
(For use in fevers.)	
Antiseptic tablets, <i>Blue</i> , Corrosive sublimate, 7.3 grs.; Ammonium chloride, 7.7 gr.	
Price, 35c. per 100.	
(For making 1 to 1000 bichloride solu- tion. One tablet dissolved in 1 pint of water gives a solution of that strength.)	
Bismuth subnitrate, 1 gr.....	.80
(For intestinal irritation.)	
Calomel, ¼ gr.....	.40
Iron, Quinine and Strychnine.....	.80
(For use as a tonic, dose 3 per day.)	

In administering tablets in the manner suggested care should be taken to see that they are swallowed, and not coughed up.

AN ANTISEPTIC OINTMENT FOR USE ON CUTS AND WOUNDS OF ALL KINDS.

The following ointment may be made up by the poultryman and will be found useful in the treatment of cuts, sores and wounds of all kinds of poultry and stock in general.

Oil of origanum.....	1 oz.
Cresol	¾ oz.
Pine tar	1 oz.
Resin	1 oz.
Clean axle grease	8 oz.

Melt the axle grease and resin and stir in the other ingredients. Pour off in a tin box or can to cool. In making this, clean axle grease from a freshly opened can should be used.

TABLES OF APOTHECARIES WEIGHTS AND MEASURES AND THEIR
METRIC EQUIVALENTS.

APOTHECARIES WEIGHTS.

Pound	Ounces (Troy)	Drachms	Scruples	Grains	Grams.
1	= 12	= 96	= 288	= 5760	= 373.23
	1	= 8	= 24	= 480	= 31.10
		1	= 3	= 60	= 3.9
			1	= 20	= 1.30

APOTHECARIES MEASURE.

Gallon	Pints	Fluidounces	Fluidrachms	Minims	Cub. cm
1	= 8	= 128	= 1024	= 61140	= 3785.00
	1	= 16	= 128	= 7680	= 473.11
		1	= 8	= 480	= 29.57
			1	= 60	= 3.75

COMMON MEASURE.

A <i>teacup</i> is estimated to hold about 1 fluidounce, one gill.					
A <i>wineglass</i>	"	"	"	"	$\frac{2}{3}$ "
A <i>tablespoon</i>	"	"	"	"	$\frac{1}{2}$ "
A <i>teaspoon</i>	"	"	"	"	1 fluidrachm.

CHAPTER V.

DISEASES OF THE ALIMENTARY TRACT.

The arrangement of the digestive organs in birds differs from that in other domestic animals in that the mastication of the food does not take place in the mouth. The food of birds, consisting mainly of grains and seeds, is swallowed whole into the crop. It remains here until it is completely softened by the juices secreted by this organ. The food then passes into the stomach (proventriculus) where it is mixed with still other juices, and then into the gizzard. The muscular walls of the gizzard grind the softened food against the small pebbles (grit) which the bird picks up, until it becomes a paste. This paste is then passed into the intestines and mixed with the secretions from the liver, pancreas and the intestines themselves. The nutritive elements of the food are transferred through the intestinal walls, by means of the activity of the cells composing these walls, into the blood and are carried to various parts of the animal to be used in building up the tissues.

In the wild state birds are forced to hunt for their own food. They go about gathering in a few seeds here and there but probably at no time is the crop overloaded. Under conditions of domestication the birds are fed only once or twice a day and thus the crop is often gorged with a day's supply of food. Further the lack of sufficient grit, lack of exercise and the feeding of rich, soft mashes cause the birds to be predisposed towards indigestion. Under these conditions poultry are subject to a large number of disorders of the digestive system.

DISEASES OF THE CROP.

Impacted Crop (Crop Bound).

In general two immediate causes may be given for birds becoming crop bound. (1) The thin muscular walls may be paralyzed either through over-distention with dry grain or through some disease, as cholera and diphtheria. (2) The opening into

the lower portion of the cesophagus may become clogged by long straws, feathers or other substances. In either case the crop fails to empty itself while the bird continues to eat until the crop is greatly distended and packed solid.

Impacted crop is a common disease of poultry. A large number of things have been assigned as a cause for this trouble. It is probable that the real cause lies in low vitality due to improper feeding and indigestion. On this point Robinson says: "We say that the dry hay the fowl may take into the crop causes impaction, but the fact is that it is only in occasional instances that it does cause impaction. Far oftener the fowl eats dry hay or corn fodder till its crop is bulging, and is never seen to be at all the worse for it. I have seen this so often, that though an occasional case of impacted crop might properly be attributed directly to the overloading of the crop, the occurrence of a number of such cases in a flock at about the same time, would suggest that the real cause was indigestion, or weak digestion. I have repeatedly given fowls, which all their lives had been handled to make and keep digestive organs in first class condition, all other conditions for developing cases of impacted crops, but have never been able to get a case that way."

Treatment.—If a large number of crop bound birds occur in a flock, it should be taken as a sign that something is wrong in the management. Measures should be taken to correct errors in feeding and thus give the birds a more vigorous digestion. In such epidemics other evidences of indigestion are usually present and the particular treatment of the flock will depend largely on these other symptoms. In general the birds should not be fed too much at any one time and they should be encouraged to take as much exercise as possible, and should have plenty of green food.

When a crop bound bird is found it must be treated individually. Treatment in such individual cases is quite often successful. The profitableness of such treatment must be decided by every poultryman for himself. If the crop bound condition is discovered and treated at the *beginning* of the trouble the bird will usually recover quickly and may make a profitable fowl. On the other hand if the condition has become chronic the vitality of the bird is greatly lowered. In this latter case

it may recover but it will be a long time before it will repay the owner for his trouble and feed.

If swelled grain is the cause of the impaction the bird may often be successfully treated without an operation. In this case first give the bird a tablespoonful of castor oil. After allowing this a little time to work into the crop begin to knead the hard mass. After this mass has been softened hold the bird with head downward and attempt to work the grain out through the mouth. If unsuccessful in this or if the impaction is due to clogging with straw or other material it will be necessary to open the crop.

The following method for this operation is given by Sanborn (Farm Poultry Doctor): "If someone can hold the bird for you it will make the operation easier. Pluck out a few feathers and then cut through the skin over the crop a line about 1 inch long. This cut should be in the median line of the body. Then make an incision $\frac{3}{4}$ of an inch long through the crop. The distention of the crop will cause the opening to gape, and the mass will be in plain sight. With toothpicks, blunt pointed scissors, tweezers, or similar tools, take out the contents of the crop. This done run the finger into the crop and make sure that there is nothing remaining to obstruct the outlet to the organ. When sure all is right, take 3 or 4 stitches in the opening in the crop, making each stitch by itself and tying a knot that will not slip. Then do the same thing to the cut in the skin. For stitches use white silk (or if nothing better can be obtained) common cotton thread, number 60. Keep the bird by itself for a week, feeding soft food."

The above operation is not a difficult one and is usually successful. Care should be exercised to have the hands and instruments thoroughly clean. After the contents of the crop have been removed the wound and the empty crop itself should be *thoroughly* washed out with clean, warm (108° to 110° F.) water. The edges of the skin wound should be well greased with vaseline. It is well to feed the bird only milk for the first day or two.

Inflammation of the Crop.

Inflammation or catarrh of the crop usually accompanies more or less general disturbances of the digestive system. As a result of the irritated condition of the mucous membrane the functions

of the crop are disturbed or arrested. It is said to be caused by eating indigestible, decayed, or poisonous food. "The foods and substances specially mentioned as causing inflammation of the crop are: Decomposed meats and putrid foods of any kind, unslaked lime, paint skins, rat poison, excessive use of condiments and spices, milled by-products containing too large proportions of hulls or other indigestible fibrous particles. Salmon notes that it may result from the presence of worms in the crop, and that it occurs as a complication with thrush, diphtheria, and cholera. It also occurs frequently with gastritis." (Robinson.)

Diagnosis.—"The most prominent symptom is distention of the crop, and on examination the swelling is found to be soft and due to accumulated liquid or gas, mixed with more or less food. The birds are dull, indisposed to move, and there is belching of gas, loss of appetite and weakness. Sometimes there is nausea and the affected bird attempts to vomit. Pressure upon the crop causes the expulsion through the mouth of liquid and gas having an offensive odor due to fermentation." (Salmon.)

Treatment.—The first step in the treatment of this disease is to empty the crop as completely as possible. This can be done by holding the bird head downward and carefully pressing and kneading the crop. After most of the contents have been expelled in this way give the bird several spoonfuls of lukewarm water and then empty the crop as before. Give a slight purgative such as a small teaspoonful of castor oil. The bird should be kept without food for 12 to 20 hours and then fed sparingly on soft, easily digested material. Salmon recommends giving 2 grains of subnitrate of bismuth and $\frac{1}{2}$ grain of bicarbonate of soda in a teaspoonful of water to relieve irritation and to correct acidity. Salicylic acid, 1 grain to an ounce of water, is also recommended. The dose is 2 to 3 teaspoonfuls. Hill recommends the feeding of mucilaginous fluids such as barley-water, thin solution of gum, etc. If the inflammation is due to eating poisons antidotes as given farther on (Chapter VI) should be used.

If inflammation of the crop is at all general throughout the flock an effort should be made to remove the cause. It is well to change the feed and give the birds more exercise. The addition of fine charcoal (small chick size) to the mash will often be of service, as the birds eat more of it in this way than when the charcoal is in a box by itself.

Enlarged Crop.

"The crop sometimes becomes very much enlarged and prominent, but hanging loosely, not bulging and hard, as in impaction of the crop. This form of permanent enlargement and displacement is called enlarged crop, slack crop, or pendulous crop. It may exist with little inconvenience and detriment to the fowl." (Robinson.)

According to Sanborn the cause of this is irregular feeding resulting in overloading. Robinson, however, says that while "this may be the cause in a great many cases, yet it can hardly be the sole cause, for cases of slack crop are not infrequently found in fowls that have been well and regularly fed. If a fowl is fed heavily, and from any cause (as indigestion) the crop remains full and distended too long, though this condition may in time be relieved in the natural way without interference of the keeper, the effect on the crop is the same as if the overloading had occurred because of irregular feeding. If this condition is repeated several times the walls of the crop become in some degree permanently distended."

An enlarged crop and an enlarged or "baggy" abdomen are frequently associated in the same bird. These are probably due to too heavy feeding without sufficient intervals between meals and without sufficient exercise.

Treatment.—As stated above, a "baggy" crop often gives little or no apparent inconvenience to the fowl. In the case of a very valuable bird it might be worth while to operate. Sanborn states that this defect can be remedied by cutting out of the enlarged portion of the crop a diamond or oval shaped piece of tissue about 2 inches long and 1 inch wide. The edges should be sewed together and treated as directed for impacted crop. (Cf. p. 34). The general surgical methods described in the chapter on Poultry Surgery (Chapter XX) should be followed.

DISEASES OF THE STOMACH (PROVENTRICULUS).

Inflammation of the Stomach—Gastritis.

The stomach or proventriculus in fowls is a rather small organ. It is a thick, glandular walled section of the alimentary canal lying between the crop and the gizzard. Inflammation of this organ is usually associated with a similar disturbance of the

crop. In a few cases there appears to be inflammation of the stomach alone. Diagnosis in this case is very difficult.

The cause of gastritis is usually regarded as the same as that of inflammation of the crop (cf. p. 34).

Diagnosis.—In general the symptoms are very similar to those in cases of inflammation of the crop (see p. 34). The birds present the general appearance of being sick, viz., loss of appetite, indisposition to move and roughness of plumage. Constipation quite often accompanies gastritis. However, if the inflammation extends to the intestines there may be diarrhea.

Treatment.—"If the disease is identified in its early stages, seek for its cause and endeavor to overcome it by removing the cause. Change the ration and give more easily digested food with some meat. Feed regularly, often, and a small quantity at a time. Give some cooked food with barley water or milk for drink, or put 20 grains of bicarbonate of soda to a quart of drinking water. In severe cases give 2 grains of subnitrate of bismuth 3 times a day in a teaspoonful of water. Counteract constipation with Epsom salts (20 grains) or castor oil (one teaspoonful) once a day as long as may be necessary." (Salmon.)

"Give rice water for drink, soft mash made with the water in which clover hay has been cooked. Arsenite of copper, $\frac{1}{4}$ grain to each quart of the rice water (drink) will do for medicinal treatment." (Sanborn.)

As Robinson points out the important thing in treating this disease is to change the food in so far at least as to remove the cause of the trouble. Medical treatment without the removal of the original cause will be of little avail. The addition of fine (chick size) charcoal to the mash and the generous use of good green food are recommended.

DISEASES OF THE INTESTINES.

Simple Diarrhea.

In many fowls a condition of mild diarrhea is chronic throughout the life time of the bird. Again birds often acquire a slight diarrhea which will last for a longer or shorter time, but never becoming severe. In either of these cases the bird shows no symptoms of disease other than the watery droppings. No doubt such attacks are in some degree detrimental to the best

health of the bird. In most cases of this simple diarrhea the bird will recover without any treatment. Nevertheless the careful poultryman will watch his dropping boards for signs of "looseness." When such are found in any quantity the methods of feeding and housing should be carefully examined to see if the cause does not lie in them.

Concerning the normal droppings of fowls, Robinson says: "Normally the droppings of fowls are rather dry, retain the shape in which they are voided, and may readily be removed, leaving the spot on which they had fallen either slightly stained, or not at all."

Further, about 1-3 of the normal droppings consists of a whitish substance. This is the uric acid and urates excreted by the kidneys and is removed from the cloaca along with the feces.

"Without marked departure from the normal, droppings may be wet—watery—with a tendency to flatten on the surface on which they rest. On boards they moisten the surface for some distance around them. * * * It is perhaps most appropriately described as "looseness." It is not diarrhea, though fowls having it are probably more susceptible to intestinal diseases than others. Mere looseness of the bowels is not accompanied by any offensive odor.

"When the excrement becomes soft and pasty or liquid in consistency and whitish, yellowish, greenish or brownish in color, and has a more or less marked offensive odor, the condition is properly described as diarrhea. The evacuations in diarrhea are often of such consistency that the water in them is not readily taken up by absorbents with which they come in contact, and they are decidedly nasty, not only adhering to utensils used in removing them, and making ordinary cleaning difficult, but soiling the feathers of the fowls and sticking to roosts, nests and feed troughs." (Robinson.)

Diarrhea may result simply from an upsetting of the digestive organs due to improper feeding or it may be a symptom of some more serious disease. Simple diarrhea may arise from the presence of indigestible matter in the alimentary canal, it may be due to exposure to heavy rains or to draughts in the roosting house. In the latter cases a cold develops which affects the bowels rather than the head and lungs. Diarrhea from colds occurs much more frequently than is generally supposed. This

form of diarrhea can often be recognized by the greater amount of frothy mucus in the excrement. Young stock are much more susceptible to diarrhea from colds than are adult birds.

Among other common causes of simple diarrhea may be mentioned soured or decomposing food, too much green food at irregular times, too free use of animal food, allowing the birds access to water which has become soiled with excrement and allowed to stand in the hot sun until about putrid. Whatever may be the inducing factor the immediate cause is excessive bacterial fermentation in the alimentary canal.

Treatment—Simple diarrhea will usually require no treatment other than removing the original cause. This latter is by far the more important thing to be done. If neglected the condition may become chronic and may result in more serious disturbances of the alimentary system. It is often beneficial to replace part of the bran in the mash with middlings or low grade flour. Where in addition medical treatment seems desirable the first thing to do is to remove the fermenting material from the intestinal canal. This can be done with Epsom salts, using a small half teaspoonful to each bird. This should be dissolved in water and used to mix the mash. If more convenient a teaspoonful of castor oil may be given each bird. If the diarrhea is persistent Hill recommends 3 to 6 drops of chlorodyne as an unfailing cure.

Enteritis—Dysentery.

For practical purposes we may associate most of the severer forms of diarrhea with the above names. Simple diarrhea was defined as either a temporary or chronic affection of the intestines from which the bird appeared to suffer but little. Practically its only symptom is the watery or discolored discharge. Under the names of enteritis, dysentery or severe diarrhea there are listed several of the more serious infections of the intestines. From the medical standpoint enteritis is the name given to affections of the small intestines while dysentery is applied to the disease in the large intestine. The latter is usually accompanied by mucous and bloody discharges. In the diseases of poultry, however, it is hardly necessary for anyone other than a pathologist to distinguish between these different forms.

Etiology.—A variety of causes are responsible for these more acute forms of intestinal trouble. It may be a bacterial infec-

tion coming from filthy conditions. Foul drinking water, putrid meat or decaying food of any sort may be predisposing causes. Toxic enteritis or poisoning is caused by the birds eating such things as paint skins, lye, unslaked lime, salt, ergot of rye, arsenic and copper (in spraying mixtures) (cf. p. 44). Further simple diarrhea may develop into the more acute form. This latter is due to improper food, water or housing, and is probably closely associated with bacterial enteritis. Various intestinal parasites may cause severe diarrhea.

Diagnosis.—It is often very difficult to distinguish between the different infections of the intestines in the living birds. Woods (Reliable Poultry Journal) gives the following symptoms of enteritis: "The affected bird is inactive and dumpish. The comb is at first pale and limp, and later becomes dark and purplish. There is an abundant dark or greenish diarrhea. Diarrhea may become bloody. The bird appears sleepy and unwilling to walk around. The bird may be sick a week or several weeks before death takes place. Some birds recover without treatment. The appetite may be voracious, or the birds may refuse to take food. The crop may be full of food, or may contain only a little slimy fluid. When the bird dies, the comb is always dark. Often the bird may appear dumpish and sleepy, and show a bad diarrhea; the owner, picking the bird up to examine it, finds it has lost weight; holding it head downward, a stringy, dirty liquid runs from the mouth, and death of the bird soon follows. In such cases, the bird has been sick several weeks before it was noticed. Examination of the body after death shows the liver enlarged or shrunken, according to the duration of the disease. If of long duration the liver is shrunken. The spleen is usually enlarged. The intestines are inflamed and are full of mucus."

"The evacuations may show any or all of the color conditions commonly observed in cases of severe diarrhea, watery, mixed watery and solid, whitish, greenish, bluish green, brown, red, bloody. Particular colors or conditions may represent the degree to which different organs are affected, or indicate to an experienced eye the progress of the disease, but to the layman they have no special significance." (Robinson.)

Treatment.—If possible the cause of the trouble should be ascertained and removed. This is by all means the first and

most important step to take. It is useless to spend valuable time in doctoring sick birds while the conditions which gave rise to the trouble are still present. In bacterial enteritis sick birds should be removed from the flock as soon as noticed. Houses and runs should be cleaned up and disinfected. Drinking vessels and food troughs should be scalded daily. Potassium permanganate should be used in the drinking water (cf. p. 16). Mix powdered charcoal with the mash. Feed less bran and more middlings in the mash. Do not feed too heavily.

After attending to the above hygienic measures the birds should be given a good physic. A teaspoonful of Epsom salts to each fowl, dissolved in water and mixed in the mash, is the most convenient way of treating a large number of birds. For medical treatment Salmon recommends one of the following:

"Subnitrate of bismuth, 3 grains; powdered cinnamon or cloves, 1 grain; powdered willow charcoal, 3 grains. Give twice a day mixed with food or made into pills with flour and water.

"Subnitrate of bismuth, 3 grains; bicarbonate of soda, 1 grain; powdered cinchona bark, 2 grains; mix and give 3 times a day in a paste made with rice flour. When diarrhea is arrested, bismuth and soda are no longer needed. Give as a tonic: Powdered fennel, anise, coriander, and cinchona—each 30 grains; powdered gentian and ginger each 1 dram, powdered sulphate of iron, 15 grains. Mix and give in the feed so that each fowl will get 2 to 14 grains twice a day."

Constipation.

Constipation occurs in adult fowls far less often than diarrhea. It frequently passes unnoticed unless very severe. This trouble is much more common in young stock than in grown birds. In adult fowls it often occurs in connection with indigestion, gastritis, or peritonitis. "A not infrequent cause is obstruction of the vent by accumulations of excrement on the feathers about it. This is especially apt to occur following looseness of the bowels in fowls, which do not roost. Intestinal worms also may cause constipation by accumulating until their mass blocks the passage." (Robinson.)

Lack of exercise, or lack of green food are also occasional causes of constipation.

The *symptoms* are painful and ineffective efforts to evacuate the bowels. In the worst cases the vent becomes completely plugged with dry, hard feces. The birds appear dull, listless and without appetite.

Treatment.—"Adult fowls having constipation without obstruction of the intestines, that is merely difficult movements, should not require any treatment further than in correcting conditions and diet. When the passage is obstructed the treatment is according to the location of the obstruction. If it is at the vent with hard accumulation about the vent as well as in the intestine, the external accumulation must be removed first. This is accomplished by soaking in warm water, which loosens the attachment of the mass to the skin, and separates it enough to allow clipping the feathers about the vent to which the mass adheres. If the obstruction has filled the lower part of the intestine, there must be more soaking with warm water or softening with olive or sweet oil. Oil is applied between the accumulated excrement and the skin by using a small syringe or an oil can with very small nozzle. The process is a tedious one, and where the poultryman's time is valuable is unprofitable except in cases of valuable birds."

"When the obstruction cannot be reached in this way purgatives must be given. Those usually recommended for fowls, are castor oil, Epsom salts, and calomel." (Robinson.)

INDIGESTION.

Birds frequently suffer from disorders of the digestive system which are not easily classified under any of the diseases so far treated. Simple indigestion or dyspepsia most frequently results from overfeeding and the feeding of ground grains and meat without sufficient green food, are some of the causes usually given.

Symptoms.—The birds are dull and listless. They are inclined to sit on the roosts, and usually have but little appetite. Occasionally birds suffering from indigestion have an abnormal appetite and will eat ravenously quantities of foods which furnish but little nourishment, *c. g.*, grit. Indigestion is often accompanied by either constipation or diarrhea. In the latter case the symptoms are similar to those described under simple diarrhea (p. 37).

Treatment.—In treating indigestion it is important to observe the general rules of hygiene (cf. Chapter II). The house should be clean and as free from dust as possible. Sunshine should be able to reach every corner of the pens. The water dishes should be kept thoroughly clean and the supply of water should be kept pure and fresh. Use potassium permanganate in the drinking water as directed on p. 16. Use well balanced rations and feed at regular hours. Put fine (chick size) charcoal into the mash in considerable quantity. Enough should be used to make the mash decidedly black. This is a very important measure for the treatment of indigestion. Give the birds plenty of exercise. A small amount of a good stock tonic may help to bring the birds back into proper vigor. The following formula (from Me. Agr. Expt. Stat. Ann. Rpt. 1896) has frequently been used with good success.

Pulverized Gentian	1 lb.
Pulverized Ginger	$\frac{1}{4}$ lb.
Pulverized Saltpeter	$\frac{1}{4}$ lb.
Pulverized Iron Sulphate	$\frac{1}{2}$ lb.

These substances can be procured from any drug store and mixed by the poultryman. Use 2 to 3 tablespoonsful of the tonic to 10 quarts of dry mash.

Dr. N. W. Sanborn (Reliable Poultry Remedies) recommends the following treatment for indigestion: "If for 1 week at the beginning of the improved care you will add 1 teaspoonful of sulphate of magnesia to every quart of drinking water, and follow this for 2 weeks with $\frac{1}{8}$ of a grain of strychnine to each quart of water, you will hasten the time when the birds will be well."

CHAPTER VI.

POISONS.

Poultry on free range about farms and especially on small city lots often obtain poisonous substances. Most of the poisons obtained by fowls are the so-called mineral poisons. The chief symptom of poisoning by these substances is acute inflammation of the digestive tract. The narcotic or vegetable poisons on the other hand cause severe congestion of the blood vessels in the spinal cord and brain.

Among the principal poisons likely to affect poultry may be mentioned the following:

Common Salt, Nitrate of Soda, Concentrated Lye.—Common salt is most frequently obtained in excessive amount from eating salt meat or fish. Zürn says that 15-30 ($\frac{1}{2}$ to 1 oz.) grams of common salt will kill a healthy hen in from 8 to 12 hours. Nitrate of soda is used as a fertilizer and is eaten by hens along with worms, etc., which they scratch up. Lye is obtained only when carelessly left about the grounds. The treatment for such poisons according to Salmon is to give "abundant mucilaginous drinks such as infusion of flaxseed, together with stimulants, strong coffee and brandy being particularly useful."

Arsenic may be obtained either from rat poison or from various arsenical sprays used to kill insects. *Copper* is used in such spraying mixtures as Bordeaux. Where spraying has been done properly there should be no danger of the birds getting enough of the poison to injure them. Sometimes, however, the vessels containing the mixtures are emptied within range of the fowls or the substances are handled carelessly in other ways.

The symptoms of arsenic poisoning are given by Beeck (Die Federvieh-zucht 1908, p. 828) as follows: "Secretion of large quantities of saliva, choking, hiccoughing, great anxiety and nervousness, little or no appetite, thin, often bloody feces, slow and difficult breathing, unsteady walk, trembling and convulsions, expansion of the pupils. Death ordinarily occurs in a

very short time." Treatment should be with sulphate of iron, calcined magnesia, or large quantities of milk. Salmon also recommends white of egg and flaxseed mucilage.

The special symptoms of copper poisoning are vomiting and diarrhea, the copper giving a blue or green color to the vomited matter and the feces. Evidence of violent pain may follow with collapse, convulsions or paralysis. The circulation and respiration are weak. Usually fatal in a few hours. Large quantities of milk, white of egg, mucilage, and sugar water are recommended.

Lead and *zinc* poisoning occur chiefly from eating paint skins. The symptoms so far as they have been observed in poultry do not differ greatly from those seen in copper poisoning. The treatment recommended by Salmon is the same as for copper. With lead poisoning the sulphates of soda, potash or magnesia are recommended with the object of forming insoluble sulphate of lead.

Phosphorus may be obtained from rat poisons or from heads of matches. If large quantities of phosphorus are eaten by the bird severe inflammation of the stomach and intestine occurs and death results in from 1 to 2 hours. If only a small quantity is eaten the symptoms, according to Beeck, are weakness, languor, ruffled feathers, lack of appetite.

Strychnine is usually obtained by poultry from rat poisons. The distinctive symptoms here, according to Beeck, is the twisting of the spinal column and paralysis. The neck is twisted backward so that the head is often held over the rump. The treatment recommended by Beeck is to give "inhalations of chloroform or internally 1 to 3 grains of chloral hydrate dissolved in 2 tablespoonsful of water. The amount to be given depends on the size of the bird.

Ergot of Rye is one of the vegetable poisons which sometimes causes serious trouble among poultry. This is especially true in European countries. In this country so little rye is raised and fed to poultry that there is little chance for poisoning. The cause of the poisoning is a fungus which attacks the rye plants. The symptoms of ergot poisoning are trembling, intoxication, great weakness and gangrene of the comb, beak and tongue. The treatment is to give strong stimulants such as "brandy, coffee, camphor or quinine."

Fowls are occasionally injured by eating the leaves of poisonous plants. The sense of taste, however, protects the birds in most cases. Mr. H. B. Green (Illus. Poultry Record, Vol. I, p. 689) says in this connection: "Woodlands and fields abound in poisonous plants, and yet it is seldom, except in the case of birds that have been starved of green food and have become ravenous for it, that fowls ever succumb to vegetable poisons as thus obtained. Protection apparently lies in the fact that undesirable plants have repulsive flavors. Especially in suburban poultry keeping, danger arises when flower borders are weeded, seedlings thinned out, and plant rubbish swept up, if the resulting collection is thoughtlessly given to fowls in confined runs. Such birds are generally always ready for green food in any form and in their eagerness to satiate the craving the bad is often taken in with the good."

TREATMENT FOR POISONS IN GENERAL.

The above paragraphs have dealt with poisons rather more fully than is usual in treatises on poultry diseases. In the great majority of cases a poisoned bird is not discovered until too late for treatment. Even if found in time it is usually not worth the poultryman's time to treat individual birds. The symptoms of the different poisons have been given in some detail with the hope that they may enable the poultryman to distinguish the kind of poisoning which they may encounter and may thus be able to remove the source of the trouble before other birds are affected.

CHAPTER VII.

DISEASES OF THE LIVER.

“The annual losses of poultry due to liver trouble in various forms are numerous. These diseases seem to occur chiefly among adult fowls, and to be more prevalent in the latter part of the winter and through the spring. The reasons for their frequency then are easily found. The common forms of liver trouble result from improper feeding and lack of exercise. These causes operate most extensively during the winter, and they usually operate slowly, and the symptoms of liver troubles are generally obscure and not recognized until a post-mortem of fowls dying without special outward symptoms shows a diseased condition of the liver. Hence liver trouble may become general and reach advanced stages in a flock before their presence is suspected. Meantime, the conditions which cause them may be continued, the owner of a flock not infrequently supposing that the absence of sickness in it contradicts the teachings of those who advise methods designed to preserve health, while as a matter of fact many of his fowls are in a quite advanced stage of some liver complaint.” (Robinson.)

A large number of diseases of the liver are described by writers on this subject. In the great majority of these diseases there are no external symptoms by which one can be told from another. The most common diseases which affect the liver may, for the moment, be divided into two rough classes which it is highly important for the poultryman to distinguish. These again can only be distinguished in dead birds, but the occurrence of cases of either kind in any number gives the poultryman a clue as to what the trouble may be and a chance to correct it. In the first of these two classes a post-mortem examination shows the liver covered with nodules of a cheesy-like appearance when opened. These nodules occur not only in the liver but also in the spleen, intestine and other organs and sometimes in these latter regions without affecting the liver at all. With such symptoms

we may be fairly certain that the trouble is tuberculosis and for a further discussion of this the reader is referred to Chapter VIII.

In the second class of these diseases the liver shows great enlargement and this is often accompanied or followed by fatty degeneration. This hypertrophy of the liver is what is generally spoken of by poultrymen as "liver disease." "Liver disease" as popularly interpreted includes a number of different diseases distinguished by the pathologist. Of these the ones most commonly treated in the diseases of poultry are Congestion of the Liver, Inflammation of the Liver, Atrophy of the Liver, Hypertrophy or Enlargement of the Liver, Fatty Degeneration of the Liver and Jaundice.

The diagnosis of these different diseases is based entirely on the post-mortem appearances. In no one of them are there any outward symptoms which distinguish it from the others. "Vale says it is impossible for the most scientific observer to diagnose either inflammation or congestion of the liver with positive certainty. The symptoms are much the same and outwardly are the general symptoms of disease." (Robinson.)

Further not only the symptoms but also the causes and the treatments of these several diseases are essentially the same. The names of the diseases themselves indicate in a general way the post-mortem appearances.

For these reasons it seems best to give a brief discussion of the general causes of "liver disease" and the usual treatment. This will be followed by a brief account of each disease and its special symptoms and treatment, if any.

Cause of Liver Disease.—Lack of exercise and overfeeding, especially with rich albuminous foods, are the most common causes of diseases of the liver. In addition to these Salmon mentions the obstruction of the circulation of the blood by disease of the heart and lungs. Sanborn says that congestion of the liver may be caused by any disease of the crop, gizzard or bowels that obstructs the circulation of the blood. Robinson says: "By far the larger proportion of the cases of liver trouble coming to my notice are accounted for by bad feeding conditions."

Diagnosis of Liver Disease.—There are no special external symptoms. Sanborn mentions as early symptoms: "Rough plumage, watery diarrhea, first brownish, then yellow; lack of appe-

tite and indisposition to move. "The comb may be purplish at first, becoming dark and then quite black." These, however, are all merely symptoms of disease in general that might apply to any one of a dozen or more ailments. The only certain method of recognizing the disease is by post-mortem examination. Every poultryman should be familiar enough with the normal appearance of the more important internal organs of a fowl to recognize abnormal appearances. In general, when post-mortem examination shows the liver larger or smaller than normal or congested with blood or marbled or spotted, we may assume that the bird probably had some form of liver disease. Of course, a diseased condition of the liver is often associated with other diseases, especially of the alimentary canal. Other organs should be examined in all cases to see if they are normal. Special care should be taken to distinguish tuberculosis from other diseased conditions of the liver and intestines.

Treatment.—Since it is not possible to recognize diseases of the liver by external symptoms, the treatment of individual birds is out of the question. If, however, post-mortem examinations show that a number of the birds are dying with liver trouble it is necessary to take some remedial measures regarding the entire flock. In this connection Robinson gives the following remarks and advice:

"Just as soon as it is suspected that there is liver trouble in the flock one or more indisposed birds should be killed and examined. If examination confirms the suspicion prompt measures should be taken to counteract bad tendencies. These should look first to good diet. Make the mash, if mash is used, light and bulky; feed green and vegetable foods liberally; compel exercise in scratching for food. Then get the fowls out a little every day, and if sanitary conditions in the house are at all objectionable correct them. When the conditions to which a flock has been subjected are such that a number of bad cases of liver trouble develop, it cannot be expected that corrective measures will arrest development and restore to health in every case. On the contrary, a few cases may develop in spite of remedial measures, and the fowls exposed to the disease are likely to give a much larger proportion of cases of sickness of various kinds afterwards than fowls that as a flock had always been healthy.

This being the case, it is generally good policy to dispose of a flock that has been through such an experience as this as soon as it can be done to advantage, and replace with always healthy stock."

With regard to the special diseases already mentioned the one most commonly met with on intensive plants at least is

Hypertrophy or Enlargement of the Liver.

The cause of this trouble is chiefly concerned with food. In our climate it occurs most frequently towards the end of the winter. The birds have been confined to their houses most or all of the winter months. Very often they are overcrowded. The rich winter ration is continued after the weather begins to get warm and less heating food is needed. This combined with too little exercise and not enough green food favor indigestion and the accompanying sluggish action of gizzard and intestines. These are the immediate causes of trouble with the liver. It is said that feeding too much corn and barley is also responsible for much liver trouble.

Symptoms.—Mr. H. B. Green, M. R. C. S., gives the following symptoms of hypertrophy of the liver. He believes this to be only a stage in the fatty degeneration of this organ. (Illustrated Poultry Record 1909, p. 691.) "The first sign that a fowl is tending towards fatty disease of the liver is increase in weight. The comb wattles and face remain a bright red or take on a dull bluish tinge from congestion. This sign of sluggish circulation tells of full blood vessels, and explains how it is that apoplexy so frequently supervenes at this period. The excrement is an important symptom to note. It is generally at first semi-liquid, of a dark yellow color, and evacuations are frequent. Thirst is noticeable and a large quantity of water is drunk, especially after feeding. The appetite remains good, although the bird is capricious in what it eats. A post-mortem examination of a fowl in this phase of the disease will show a liver considerably enlarged, of a deep red color, engorged with blood, shining and greasy as though it had been soaked in oil, but fairly firm under the knife. The intestines are laden with masses of fat, so also are the mesentery—or as it is termed by butchers, 'the leaf,'—the ovary and oviduct."

In the next stage "Diarrhœa increases, the excrement being

perhaps bloodstained or blackened by congealed clots; the face, comb and wattles become a darker hue or if jaundice supervenes they may be pale or tinged with yellow bile; more fat is laid on internally and the liver will prove to be greatly enlarged. So large may this become by the deposit of fat globules between and in the substance of its cells that on one occasion I have removed from an Orpington cock a liver that turned the scale at a pound and a half. This stage is seldom passed and death usually takes place from syncope, or an accidental rupture of the softened liver."

Treatment.—Green says further: "Part of the treatment consists of a plentiful allowance of green food. Nothing in this way is better than freshly gathered dandelion leaves when procurable, for the taraxacum they contain is a valuable liver stimulant. It is not generally known that the sliced roots of the plants can be steeped in boiling water to make an infusion equally effective when the leaves are no longer obtainable. The roots should be gathered and stored in dry boxes. The infusion is conveniently mixed with the morning soft food and is always beneficial to birds in confinement as an occasional liver tonic."

Fatty Degeneration.

As noted in the above paragraphs, Green regards this disease as a later stage in the hypertrophy of the liver. Salmon, on the other hand, believes it to be a quite different disease. The latter author says: "On *post-mortem* examination the liver is found shrunken, hardened and marbled or spotted with areas of grayish or yellowish tissue. A microscopic examination shows the liver cells to contain droplets of fat and the liver tissue degenerated and largely replaced by yellow fat globules.

As the disease is not recognized during life, treatment is out of the question. If a number of cases occur in the same flock, give greater variety of food and a run on the grass. In addition, bicarbonate of soda may be given in the drinking water to the amount of 1 or 2 grains a day for each bird."

Atrophy or Wasting of the Liver.

This is very similar in many respects to the disease described by Salmon as fatty degeneration and probably arises from the same cause, *i. e.*, lack of variety in the food, especially lack of green food.

Symptoms.—Robinson says: "There are no special external symptoms. An examination of the fowl after death shows the liver shrunken and somewhat granular and sometimes of a yellowish cast."

Treatment.—See Salmon's treatment of fatty degeneration above. The flock should be given frequent (weekly) doses of Epsom salts.

Congestion and Inflammation of the Liver.

These are probably different stages of the same disease. The poultryman will find difficulty in distinguishing between this disease and that known as hypertrophy of the liver (*cf.* p. 50). The chief post-mortem difference is that in the latter disease the liver is more solid, not so easily torn or ruptured.

Diagnosis.—There are no external symptoms other than those of dullness and the general symptoms of disease. Salmon says: "It is difficult to make a diagnosis during the life of the bird. Post-mortem examination reveals a greatly enlarged liver engorged with blood, tender and easily torn or crushed."

Treatment.—Treatment of these diseases in individual birds is very rarely successful. The general treatment of the flock as recommended on p. 49 should be attended to. The chief medicinal treatment should probably be frequent doses of Epsom salts. Various authors recommend different medicinal treatments. For these see Robinson (pp. 71 to 74).

Jaundice.

Jaundice or biliary repletion is said by Megnin (*Medicine des Oiseaux*) to be due to long continued but moderate congestion of the liver. This leads to increased activity of this organ and is followed by the accumulation of a large quantity of bile in the gall bladder and ducts of the bird. This bile is absorbed by the blood vessels and causes poisoning which may lead to the death of the bird.

Diagnosis.—There are no specific external symptoms other

than that the wattles and comb may be yellowish. This also occurs in other liver diseases. Post-mortem examination shows the gall bladder greatly distended with bile.

Treatment.—Give greater variety of food, especially more green food. Give Epsom salts frequently. Meguin recommends $\frac{1}{2}$ to 1 grain of aloes.

This completes the list of the liver diseases most commonly treated as such by poultry veterinarians. There are a number of other diseases which especially affect the liver or are caused by deranged function of this organ. These may most conveniently be mentioned at this place.

Blackhead (Infectious Entero-Hepatitis).

Blackhead is essentially a disease of turkeys. It is not the intention of this work to treat diseases of poultry other than fowls. Consequently little will be said about this disease except as it applies to fowls. If further information is desired the reader is referred to the Rhode Island Experiment Station, Kingston, R. I., for bulletins relating to this disease. That station has been and still is studying this disease in a most thorough way.

Blackhead is a contagious disease affecting the liver and intestines, especially the blind pouches or ceca of the latter. The disease is very quickly fatal among turkeys. The turkey is apparently more susceptible than any other bird to this disease. In certain portions of this country where once turkey raising was a promising industry it has been practically annihilated. The disease is not usually as fatal to adult chickens but may cause very serious losses at times. It is now believed by several prominent investigators of this disease that white diarrhea, so destructive to young chicks, is caused by the same organism as blackhead. For further discussion of this see Chapter XIX.

The cause of blackhead disease according to Dr. Theobald Smith (Bur. An. Ind. Bul. No. 8) is a minute parasitic protozoan known as *Amoeba melagroidis*. More recently Drs. Cole and Hadley of the Rhode Island Experiment Station have claimed that the causative organism belongs to another group of protozoa known as *Coccidia*. Dr. Smith, however, still maintains that the former organism is concerned in the disease. The point to this discussion lies in the fact that the *Coccidium* has

a very different life history from the *Amoeba*, consequently it probably has a different method of dispersal and different means must be used in combatting it.

Diagnosis.—There are no special external symptoms of this disease until in an advanced stage. The victim then begins to mope, loses its appetite and is inclined to sit apart with drooped wings. The head and comb take on a dark color from which the disease takes its name "blackhead." One of the most conspicuous symptoms is the diarrhea. Post-mortem examination shows the liver enlarged and disfigured with whitish or yellowish spots. The ceca are inflamed and often clogged with pus and fecal matter.

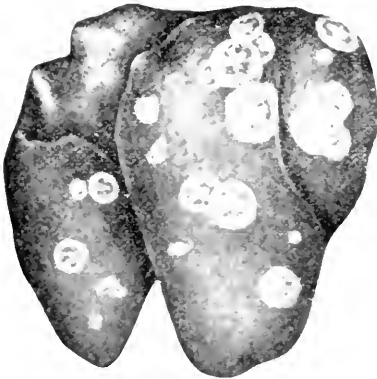


Fig. 1. Showing condition of liver in "blackhead." (Modified after Moore).

especially corn." The chief preventative measures are to keep the birds on fresh ground; to isolate any birds showing the least sign of disease, to destroy all dead birds and to protect the turkeys from contamination carried either by new stock or by other poultry or by wild birds as sparrows, crows, etc. Dr. Morse (B. A. I. Circ. 128) recommends for turkeys under 3 months old $\frac{1}{2}$ grain copperas in the morning and a $2\frac{1}{2}$ grain pill of salicylate of soda in the evening. Give Epsom salts every 3 or 4 days and keep the grounds and floors well sprinkled with lime.

With fowls the disease is not so virulent but it is still well to protect the flock from introduction of this disease. In this connection Dr. Cole (American Poultry World, 1910) says: "It is no uncommon thing for adult chickens and other poultry

Treatment.—Medical treatment of turkeys affected with blackhead is of little avail, at least in the present state of our knowledge. Cole and Hadley (Rhode Island Expt. Stat. Bul. 141) recommend the following: (1) Isolate the sick bird from the flock and place it in a dry, well lighted location free from cold and draughts. (2) Feed sparingly on soft, light, easily assimilable food, with little grain,

to die with all the pathological appearances of blackhead, which diagnosis has been confirmed with the microscope. Furthermore, infection there with this organism appears to be one of the principal causes of death of brooder chicks, which exhibit the symptoms of one form of the poultryman's greatest scourge, white diarrhea.' It has often been said of late: If you want to raise turkeys keep them away from chickens; it might be said with even greater emphasis: If you want to raise chickens, keep turkeys away from them."

Dr. G. B. Morse of the U. S. Department of Agriculture gives (Reliable Poultry Journ., Sept., 1910) a number of other diseases which affect the liver. Some of these which are not treated elsewhere in this circular will be mentioned in the following paragraphs.

Cercomoniasis.

This is frequently called "spotted liver." It, like many other liver diseases, is associated with intestinal trouble, especially severe diarrhea, that attacks poultry during the summer months. The disease is caused by a flagellate micro-organism known as *Monocercomonas gallinarum*. The post-mortem appearance of the liver in this disease shows usually slightly depressed yellowish necrotic areas or spots. This fact usually distinguished this disease from tuberculosis where there are prominent rounded cheesy nodules. In pigeons, however, this cercomonad is said to cause rounded prominent nodules about the size of a pea.

This same organism (*Monocercomonas gallinarum*) is also said to be responsible for other diseases. The most important of these is one form of roup. Canker in squabs and intestinal diarrhea in poultry are other diseases attributed to this parasite.

This disease can be held in check, it is said, by keeping the poultry plant well cleaned and disinfected and by giving the birds an occasional purgative, *c. g.*, Epsom salts.

In *aspergillosis*, the liver often presents the appearance of being "studded all over with minute, whitish or yellowish spots." This disease is discussed in Chapter XIX.

Sarcomatosis and Carcinomatosis.

In some cases the liver is affected with tumors or cancers. These are usually found in connection with similar developments on the ovaries.

Gout.

In cases of visceral gout the liver and adjoining organs are covered with a fine chalky sediment. This substance consists of crystals of urate of soda. See Chapter XV. for detailed description.

CHAPTER VIII.

TUBERCULOSIS.

Tuberculosis in fowls has long been a serious pest in Europe. Zürn in his "Krankheiten des Hausgefügel," published in 1882, devotes several pages to the description of this disease as it occurred in Germany. Its appearance in this country, however, seems to have been much more recent.

Salmon, whose book was published about 1888, says that the disease "is by no means rare in the United States if the statements of our professional men are to be accepted." However, at that time very little had been done in the way of bacteriological diagnosis and no doubt many of the early reports were unreliable.

The disease was first reported on the basis of bacteriological examination in 1900 by Pernot (Oregon Agr. Expt. Stat. Bull. 64). In 1903 Moore and Ward reported investigations on avian tuberculosis in California (Proc. Am. Vet. Med. Assoc. 1903). They found "a number of flocks in which the mortality from the disease was very high." Fowl tuberculosis was reported from western and central Canada in 1904 by Dr. C. H. Higgins (Dept. of Agr. Canada, 1905). In 1906 it was reported from New York and in 1907 from southern Michigan. The disease has been reported in many other places within the last few years. It thus seems certain that the disease is widespread throughout the United States and Canada and in the future must be reckoned with by American poultrymen.

Tuberculosis may exist extensively among fowls, especially in large flocks, and yet not kill enough birds to attract attention to it. Reports show that farmers often lose 1 or 2 birds a year from what appears to be tuberculosis. In many places the loss seems to be gradually increasing. The existence of the disease in the flock fails to attract the attention of the owner because the losses are so evenly distributed throughout the year. Moore and Ward report a flock of 1400 birds from which 250 had died during the first year. Another man lost 300 birds out

of a flock of 1400. Microscopic examination proved that these were dying of tuberculosis.

Tuberculosis is confined chiefly to adult or nearly adult fowls. Only very rarely, if ever, is it found in growing chicks. Further it is much more common in fowls than in other kinds of poultry. Two cases in wild geese were reported at the Ontario Agricultural College. Avian tuberculosis is said to be found in turkeys, pheasants, and especially in pigeons. Cage birds are particularly susceptible to this disease.

Etiology.—Tuberculosis is caused by a minute germ, the *Bacillus tuberculosis* of birds. These bacteria gain entrance to certain portions of the body and there multiply in vast numbers, causing the formation of small nodules or tubercles. The disease is highly contagious and is spread through the flock by the contact of healthy birds with the diseased ones, or with their discharges.

The relation of avian tuberculosis to that of man and other animals has attracted a great deal of attention. It is a subject of very great importance to the poultryman, not only on account of his flock but also on account of its relation to the health of himself and his family. In this connection, writing some years ago Salmon says: "Many outbreaks (of fowl tuberculosis) have been attributed to infection from eating the sputum of persons affected with consumption. The possibility of such infection is admitted by some authorities and denied by others. It is certain that poultry and pigeons are not easily infected experimentally with the tuberculosis of people, cattle and other animals which are classed together as mammals." On the other hand, "The bird or avian tuberculosis spreads rapidly from bird to bird and is easily transmitted experimentally to birds but it has little effect upon most mammals which are very susceptible to human tuberculosis. There is, consequently, a marked difference between avian and mammalian tuberculosis. The disease in the two cases does not appear to be absolutely distinct, but should rather be regarded as two varieties of the same malady."

In the last few years a great deal has been found out about tuberculosis in both birds and mammals. The results have been summarized and extended by Drs. Koch and Rabinowitsch in an extensive paper dealing with avian tubercenlosis and its

relation to mammalian tuberculosis (Virchow's Arch. f. Path. Anat. u. Phys., etc., Bd. 190, pp. 246-541, 1907). Their results may be briefly stated as follows: Attempts to infect fowls with mammalian tuberculosis, like the earlier negative results of other authors, have been fruitless. However, fowls are very easily infected with avian tuberculosis by feeding them parts of diseased birds. On the other hand, methods of infecting fowls other than feeding are not always successful even with avian tuberculosis. Other birds, especially cage birds, are very readily infected in various ways. Parrots, in particular, are susceptible not only to avian tuberculosis but also to mammalian and human tuberculosis. Also canary birds, sparrows, and various birds of prey were proven to be susceptible to both avian and mammalian tuberculosis. In these respects such birds differ materially from the domestic fowls.

On the other hand their later researches have made it apparent that a large number of mammals are susceptible to avian tuberculosis. These include not only the small laboratory animals as rabbits, mice and guinea pigs, but also cattle, hogs, horses, goats, and donkeys. Also avian tubercle bacilli have been found in cases of human tuberculosis. On the basis of such experiments and observations it appears that avian and mammalian tuberculosis are not caused by different species of bacteria but by different varieties of the same species. These varieties have developed because the bacilli have grown for a long period of time under different conditions. They are not so different, however, but that they may grow in the environment best suited to the other one.

It thus appears that while fowls are not very likely to contract tuberculosis from domestic animals or from man, yet fowls that have the disease are a serious menace to the other animals on the farm as well as to the poultryman and his family. (Cf. further on this point p. 64 below).

Diagnosis. Tuberculosis in mankind is so serious a disease chiefly because it is so difficult to recognize it in its earliest stages. The same is true with the disease in fowls. There are positively no external symptoms by which the disease can be recognized in fowls before the advanced stages. Morse (R. P. J. Sept. 1910) says on this point: "There is a combination of symptoms that might serve to arouse your suspicions; steadily



Fig. 2. Breast bone of a fowl showing excessive emaciation in tuberculosis. (After Ward).

outgrowths on the head and limbs of birds. Such forms of the disease are comparatively rare in poultry, however. Parrots are particularly affected with these external tubercles.

None of these symptoms, however, is more than an indication

advancing emaciation; anemia, shown by pallor of comb wattles and the skin about the head; general weakness; lameness, ruffling of the feathers and in many cases diarrhea. When combined with the foregoing you notice a bright eye and a ravenous appetite you may have very strong suspicions."

Emaciation is one of the best symptoms and in the last stages of the disease becomes very marked. Perrot cites the case of a Plymouth Rock hen weighing 4 pounds that was reduced to 22 ounces. The emaciation is very marked in the muscles covering the breast bone. Fig. 2 shows the breast bone of a tuberculous hen from which the skin only has been removed.

Lameness is another symptom often shown in the later stages of the disease. This is caused by tuberculosis of the joints as has been proven in many cases. Such cases are often called "rheumatism" by poultrymen. Tuberculosis may also form tumors or ulcers or various

of the possible presence of the disease. Morse says: "At the post-mortem examination you may have your suspicions strengthened by finding liver, spleen, intestines and membrane uniting the intestinal folds (mesenteries) studded with yellowish white cheesy nodules of various sizes." Outside of the bacteriological test these post-mortem findings are the best proof of the disease we have. The liver is affected in nearly every case of fowl tuberculosis. However, as has been pointed out many times in these pages, a spotted condition of the liver is no sure sign of tuberculosis. Most of the other liver diseases of fowls cause a simple blotching of the tissue in which the center of each spot is usually depressed or at least only slightly raised. (Cf. Fig. 1, p. 54). In tuberculosis the liver is covered with numerous raised nodules varying greatly in number and size as shown in fig. 3. A section of the liver shows these nodules or tubercles distributed throughout the tissue.

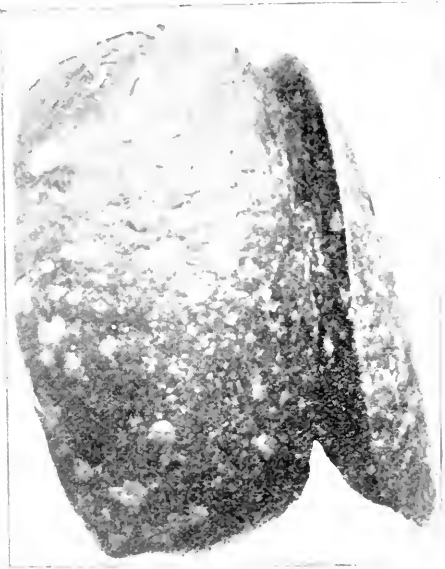


Fig. 3. Liver of fowl affected with tuberculosis. (After Ward).

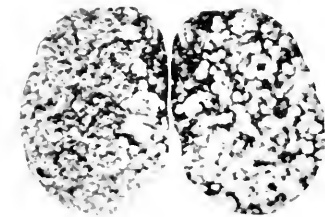


Fig. 4. Spleen from tuberculous fowl cut through the middle. (After Koch and Rabinowitsch).

Still more conclusive evidence is found if the spleen is covered with these same kind of nodules. The spleen in health is a small rounded purplish organ about $\frac{1}{2}$ inch in diameter. It lies just above the liver in the region of the gall bladder. In cases of tuberculosis it is very frequently greatly enlarged and is studded throughout with the yellowish-white tubercles as shown in fig. 4.

Still another very important piece of post-mortem evidence is found if the intestines and the mesenteries are dotted with these rounded nodules as shown in fig. 5.



Fig. 5. Intestine and mesenteries of a fowl affected with tuberculosis. (After Ward).

The lungs are *very rarely* affected and then usually by the infection spreading from the liver on to the adjoining lung tissue. All this agrees with the fact previously stated that fowls are most easily infected through the digestive tract. Alteration of the bones, joints or other organs occur much more rarely and usually only in the most advanced stages of the disease.

If the post-mortem findings agree in essentials with those given in the preceding paragraphs we may be practically certain that we are dealing with tuberculosis. It should not be forgotten, however, that the pathologist would not be willing to pronounce the disease tuberculosis until he had taken a small particle of the cheesy material and after staining this in a particular way had demonstrated by microscopical examination that the tubercle bacilli were present.

Moore and Ward have carried on some experiments in the use of tuberculin in detecting this disease. Ward (*loc. cit.*) gives the results of trials on 21 hens affected with tuberculosis. In very few cases did the tests give positive results and these were so slight and irregular as to be useless as a method of diagnosis. Apparently there is little hope of success in this direction with fowl tuberculosis.

Methods of Contagion. The spread of tuberculosis from fowl to fowl takes place only when the living bacteria are transferred from the diseased to the healthy birds. From the fact that tuberculous lesions are most commonly found in the internal organs of the digestive system we may conclude that the bacteria usually enter the body along with the food. Examination of the tubercles situated along the intestine shows that in many cases these communicate directly with the interior of the digestive tract. These are constantly emptying enormous numbers of bacteria which are carried to the outside by the feces of the bird. Without doubt the droppings of tuberculous fowls are the most important factor in the spread of this disease. This is especially true when in addition the birds are fed upon ground which is partly covered with these droppings. Besides, the infectious material may very easily be carried by the feet and thus mixed with the food.

Ward states that there is no evidence to indicate that tuberculosis is spread through the egg. He cites in support of this the fact that badly diseased birds do not lay and second the absence of tuberculosis among young stock. Koch and Rabinowitch, however, on the basis of later and more thorough work make the following statement (p. 431): "The possibility of the congenital origin of tuberculosis of fowls through the infection of the fertilized egg with bird tuberculosis is shown by our results. It is also demonstrated by our inoculation experiments on

eggs." Further they have given experimental proof of the transfer of the bacteria of mammalian tuberculosis from the *inoculated egg* to the chick. As noted before it was very difficult to do this by feeding the hens food infected with mammalian tuberculosis.

In this connection it is of interest to mention a case of the apparent transfer of fowl tuberculosis to man. In the Medical Record (Vol. 31, 1887) there is recorded a case of human tuberculosis in France which apparently came from eating tuberculous fowls which "were cooked very little before being eaten." The case occurred "in a little hamlet of 10 cottages isolated in the midst of a large forest." No other source of infection could be discovered.

Treatment. Fowl tuberculosis when it reaches the stage at which it can be diagnosed cannot be cured under our present knowledge. Treatment of individual cases should not be attempted. After it has been ascertained by post-mortem (and if possible bacteriological) examination that the disease exists in the flock all suspected birds should be removed at once. If the disease is to be controlled it must be by keeping the healthy and the affected birds apart. The most serious thing about tuberculosis is that there may be many birds in the flock that are in early stages of the disease but do not betray their condition. Long before these birds show recognizable symptoms they are throwing out millions of bacteria which become a menace to the remainder of the flock.

If only one or two cases of tuberculosis are found it may be sufficient to simply disinfect the houses, yards, feeding troughs and drinking vessels. This should be done with some good disinfectant. (See Chap. II). Morse recommends also the liberal application of lime referring to the fact that "lime workers seldom suffer with tuberculosis." The runs should be cultivated and the houses should be open to the sunshine and fresh air at all times.

If, however, the number of birds dying of tuberculosis in the flock is increasing even though the increase is very gradual, more strenuous measures must be taken. Under these conditions Dr. Morse says: "Kill everything in sight, disinfect, allow the poultry plant to lie fallow for several months, disinfect again and buy fresh stock that is known to be healthy." This no

doubt is the surest way to get rid of the disease and wherever possible it should be done. However, where the disease is found in large flocks of birds such measures would bankrupt the owner. Or a man may have a very fine strain of birds which he has spent many years in perfecting and which it would be impossible to replace. In such cases Morse proposes "Banging" out the tuberculosis according to the methods of new-herd-building in dairy cattle as proposed by Prof. Bang of Copenhagen. Morse's directions for "Banging" out tuberculosis are as follows: "Secure new or thoroughly disinfected ground, keeping it absolutely free from contact with the ground used by the infected flock. Erect new houses on this ground. Collect the eggs from the infected birds and wash them in 95 per cent alcohol or in a 4 per cent solution of some good coal tar disinfectant. Incubate these disinfected eggs in new incubators. When hatched, remove chicks to new brooder houses on the new ground. These growing chicks should be cared for by new men, that is to say, either different men from those that care for the old flock or if you are compelled to use the same men they should disinfect their hands and shoes and put on fresh overalls before handling the new stock. Have different feed bins and different pails for distributing it. As soon as you have built up a clean flock destroy the old and disinfect the ground occupied by them by the method outlined above."

This method is, no doubt, excellent in theory and if carried out with complete and *never-failing* attention to details might work. It is doubtful, however, whether in actual practice a poultryman would ever be able to carry it through successfully or profitably.

CHAPTER IX.

CHOLERA.

Fowl cholera is a virulent, usually fatal and highly infectious disease. It is entirely distinct from the ordinary forms of enteritis with which it is often confused by poultrymen. Fowl typhoid and infectious leukaemia are also often mistaken for cholera. Genuine fowl cholera is rather rare in this country but is much more common in Europe. This disease was first reported in this country about 1880 by Salmon (Rept. U. S. Comm. of Agric.). Owing to the lack of proper bacteriological methods at that time Salmon was not able with certainty to identify this disease with the European cholera. From certain experimental work he concluded that some of the symptoms exhibited by the disease in this country were different from those described by European writers. About 1894 Moore (U. S. Bur. An. Ind., Bul. 8) obtained material from several outbreaks of supposed cholera but found this disease to differ in several important respects from the European trouble. More recently Curtice (R. I. Expt. Stat. Bul. 87) has described a disease similar to that of Moore's under the name of fowl typhoid. What appears to be the genuine European fowl cholera has been reported several times within the last few years.

Fowl cholera attacks all varieties of poultry; also caged birds and many species of wild birds. "The infection generally occurs by taking food or drink contaminated with the excrement of sick birds. It is also possible for birds to be infected through wounds of the skin or by inhalation of the germs in the form of dust suspended in the air. They often take the germs into their bodies by consuming particles of flesh or blood from the carcasses of affected birds that have died or have been killed."

"The disease is generally introduced upon a farm or in a locality, with new birds, purchased for improving the flocks or

with eggs for hatching. When it exists in a district it may be disseminated by wild animals or wild birds." (Salmon).

Diagnosis: Salmon gives the following as external symptoms: "The earliest indication of the disease is a yellow coloration of the urates, or that part of the excrement which is excreted by the kidneys. This in health is a pure white, though it is frequently tinted with yellow as a result of other disorders than cholera. While therefore this yellowish coloration of the urates is not an absolutely certain proof of cholera, it is a valuable indication when the disease has appeared in a flock and an effort is being made to check its course by isolating birds as soon as affected. In a few cases the first symptom is diarrhea in which the excrement is passed in large quantities, and consists almost entirely of white urates mixed with colorless mucus. Generally the diarrhea is a prominent symptom. The excrement is voided frequently, and consists largely of urates suspended in a thin, transparent, sometimes frothy mucus. The urates have a deep yellow color, which in the later stages of the disease may change to greenish or even a deep green."

"Very soon after these first symptoms appear the bird separates itself from the flock, it no longer stands erect, the feathers are roughened or stand on end, the wings droop, the head is drawn down towards the body and the general outline of the bird becomes spherical or ball shaped. At this period there is great weakness, the affected bird becomes drowsy and may sink into a deep sleep which lasts during the last day or two of its life and from which it is almost impossible to arouse it. The crop is nearly always distended with food and apparently paralyzed. There is in most cases intense thirst. If the birds are aroused and caused to walk there is at first an abundant discharge of excrement followed at short intervals by scanty evacuations."

In regard to the yellow or green excreta Hadley* says:

"This is a very characteristic symptom. The excrement of normal fowls is not yellow; and when it is green it is a dark green, approaching black. In cholera both yellow and green are bright; the green is often an emerald green. These different colors may occur either alone or separately and both are

*Bulletin 144 R. I. Agr. Expt. Stat. (In press.) The manuscript of this bulletin was very kindly loaned by Dr. Hadley.

usually accompanied by diarrhea and thick mucus. In case it is known that cholera is in the neighborhood, it is well for a poultryman to examine, from day to day, the character of the droppings on the dropping board."

"The course of the disease may be rapid or slow in its progress through the flock. It may take all within a few days, or the fowls may drop off by twos and threes through a period of several weeks. After the first symptoms appear the development in individual cases is usually rapid. Forty cases investigated by Salmon averaged 3 days, but many birds die within a few hours after the diarrhea sets in. The time required to develop the disease after exposure or inoculation is given by Salmon as 4 to 20 days." (Robinson).

Examination of the dead birds shows inflammation of the digestive organs, kidneys and mesenteries in nearly all cases. According to Ward (Calif. Expt. Stat. Bul. 156) "punctiform hemorrhages are found upon the heart with almost absolute uniformity. The liver is very frequently marked with punctiform whitish areas." Sections show that the areas of necrotic tissue are present throughout the liver tissue. The blood vessels of the liver are congested. According to Ward the next most striking lesions are found in the reddened and bleeding mucosa of the first and second folds of the small intestine (next to the gizzard). These reddened areas can even be seen from the outside of the intestine. The intestinal contents are of either a cream colored pasty mass or may be brownish or even green in color. "Lesions are very rarely observed in other portions of the intestine. The ureters are noticeable in practically all cases by reason of the yellow-colored urates that they contain. The nasal cavity, pharynx and oral cavity frequently contain a viscous mucous fluid, probably regurgitated from the crop."

Etiology. Fowl cholera is caused by a bacterium known as *Bacterium bipolaris septicus*. It is closely related to the bacillus of rabbit septicaemia and the bacillus of swine plague. "Under the microscope the bacterium presents either a circular or oval outline. It is about 1 50-thousandth of an inch broad and 2 or 3 times as long. It grows best at from 85° to 105° F. It has no power of movement, does not form spores, and is easily destroyed by drying, by the ordinary disinfectants and by a temperature of 132° F. for 15 minutes." (Salmon).

Fowl cholera cannot be recognized with certainty except by a bacteriological examination. Practically, however, this makes but little difference to the poultryman. The methods of combating cholera are not radically different from those used against similar infectious diseases. The occurrence of a number of sudden deaths in a flock indicate the presence of an infectious disease and call for the inauguration of sanitary and remedial measures at once. At the same time a letter describing the symptoms should be sent to the Division of Pathology, Bureau of Animal Industry, Washington, D. C. In this way the name of the particular disease can be determined and advice as to any specific treatment will be received.

Treatment. "The best authorities on the subject regard genuine cholera as practically incurable. It is said that none of the alleged remedies have proved effective in cases known to be true cholera, and the presumption is that the persons supposing they had cured cholera with them were treating some other disease. While treatment of affected individuals is regarded as futile, the spread of the disease may be limited and the disease stamped out by disinfection to destroy the germs on the premises, and by proper measures to prevent their further distribution." (Robinson).

Dr. P. T. Woods, who several years ago while manager of a poultry ranch in New Jersey, had considerable experience with cholera gives the following method of dealing with the disease. (Reliable Poultry Remedies).

"As soon as the disease is discovered, establish a pest house remote from the other poultry buildings, a place that can be easily and thoroughly disinfected. Isolate all suspected cases in the pest house as soon as you can find them. Give these birds a few drops of creolin in their drinking water (just enough to turn it faintly milky), or give them drinking water in which has been dissolved one one-tenth of a grain tablet of corrosive sublimate to the quart of water. All birds which show marked symptoms of the disease had better be killed and cremated at once. This is safest and best. Kill them by strangling or by a sharp blow with a blunt club, breaking the neck. Do not draw blood, as the blood is infectious, and you do not want to spill it. If they bleed, scrape up all the blood and burn with the body, and disinfect the place where it fell. Rake

up and burn all litter used in houses or runs occupied by infected birds. Spray the runs and all parts of the buildings with a strong solution of creolin, or a 1 per cent solution of sulphuric acid in water. Do not use any litter until you are sure that the disease is eradicated. Thoroughly disinfect everything that could possibly be contaminated by the infected fowls, and repeat this as often as you find a new case. The runs or yards should be thoroughly disinfected and should be ploughed up often."

In connection with his work on an outbreak of fowl cholera in California, Ward points out the following important conclusion: "Cholera and other infectious diseases may exist in a fowl in a sort of inactive chronic condition and there is no doubt concerning the agency of such a case in spreading the disease. Thus, fowls not suspected of being diseased may have the disease smouldering among them. The fact that occasionally a single fowl dies of cholera means that a severe loss may occur at any time."

The practical recommendation for an outbreak of fowl cholera then is to kill and destroy all sick birds, confine all well birds to small runs. Disinfect these runs and the houses daily. After the outbreak is over and the birds have ceased dying it is best to market all flocks in which the cholera appeared. This latter precaution will often prevent a second outbreak some months later.

Methods of prevention are always the most satisfactory. The careful poultryman will guard his flock against all infectious diseases by methods of quarantine, disinfection and general cleanliness. At the same time the birds should be fed to keep them in the best of health. On these points read Chapter II.

Through the kindness of Dr. Philip B. Hadley the writers have had the opportunity to read the manuscript of Bulletin 144 of the Rhode Island Experiment Station dealing with fowl cholera. On the basis of his experimental work Dr. Hadley recommends subcutaneous injections of 5 per cent carbolic acid as a treatment for individual birds. In the summary of this bulletin Dr. Hadley says: "At the Rhode Island Station attempts have been made to prevent the development in fowls of cholera artificially produced by inoculation with the fowl cholera organism. The protective inoculations have involved

subcutaneous inoculations with a 5 per cent solution of carbolic acid in amounts of from 2 to 4 c. c. daily."

"The results thus far secured show that the inoculations as given protected artificially infected birds, and did no harm to birds that were in normal health. They therefore suggest that subcutaneous inoculations with carbolic acid have a protective and perhaps a therapeutic value in fowl cholera."

CHAPTER X.

DISEASES OF THE ABDOMINAL CAVITY.

Peritonitis.

The thin serous membrane which lines the abdominal cavity and covers the internal organs is called the peritoncum. Inflammation of this membrane may occur in connection with the inflammation of certain internal organs such as the intestines, liver, kidneys, etc. In these cases the inflammation extends from the diseased organs on to the wall of the body cavity. Peritonitis may also be caused by the entrance of foreign bodies into the abdominal cavity. It may further be caused by severe bruises or injuries of the abdominal wall.

Foreign bodies enter the abdominal cavity chiefly through perforation of the intestine. This may occur through severe inflammation, by sharp-pointed objects pushing through the intestinal wall or by parasitic round worms or other parasites puncturing the wall. In many cases mature eggs separate from the ovary but fail to enter the oviduct. Or, owing to rupture of the oviduct or a reversal of its peristalsis, the egg substance may enter the abdominal cavity. Usually these eggs are absorbed or walled off without very serious annoyance to the bird. In other cases they may cause severe peritonitis. Finally foreign bodies may enter the abdomen through such operations as caponizing.

Diagnosis.—The sick birds appear restless and lose their appetite. There is a high fever. The abdomen is swollen, hot and tender. Pressure on the abdomen produces evidence of sharp pain. Usually, but not always, a severe thirst accompanies peritonitis. As the disease progresses the bird becomes weaker, is unable to stand and the legs are drawn up close to the body often with convulsive movements.

Post-mortem examination shows the peritoneal membrane to be deep red in color (provided the bird has just died or has been freshly killed without bleeding). This membrane is usu-

ally covered with a thick opaque yellowish exudate. This gives it the appearance of being much thicker than usual. In some cases small lumps of whitish matter (pus) are found. The abdomen may contain more or less liquid which is usually yellowish and turbid and may have an offensive odor. If a mis-carried egg is the cause of the trouble portions of this will usually be found.

Treatment and Prognosis.—Only very seldom is treatment for peritonitis successful. The disease is not usually recognized until in an advanced age. Zürn recommends wrapping parts of the bird in wet cloths and to give internally tincture of aconite, 2 drops (at the most) with a teaspoonful of water 2 or 3 times a day. Sanborn recommends 1 grain opium pills twice a day to relieve pain, and warm liquid foods such as meat juice and milk in equal parts.

Abdominal Dropsy or Ascites.

Etiology.—This disease is sometimes called chronic peritonitis. It is characterized by the accumulation of a large quantity of liquid in the abdominal cavity. In some cases the abdomen becomes so distended that it nearly or quite touches the ground when the bird is standing. Salmon says: "If examined by slight pressure of the hand the swelling is found to be soft and fluctuating; it will yield in one place and cause greater distension at another. That is, it gives the sensation of a sac filled with liquid."

Abdominal dropsy may begin with a mild case of peritonitis which has continued for a long time without becoming serious. In young chicks it is said to be due to an anemic condition produced by bad feeding and insanitary conditions. In older birds it may also result from this same cause or may be due to some obstruction of the venous circulation either by a tumor or by some structural disease of the abdominal organs.

Diagnosis.—The most marked symptom, of course, is the enlarged, flabby abdomen. Salmon says: "Fowls affected in this way are dull, disinclined to move, generally feeble with pale comb and diminished appetite."

Treatment.—"Treatment of this condition is not profitable, but in special cases, stimulating diet with considerable animal food, tonics and diuretics, may be tried. Iodide of potassium

or iodide of iron in doses of 1 grain is particularly indicated." (Salmon.) Tapping with a hollow needle or trocar through the skin and muscles of the abdomen and allowing the fluid to escape is also recommended. It will usually be found more profitable to kill the bird.

CHAPTER XI.

INTERNAL PARASITES.

Fowls are often seriously infested with internal parasites. The most important of these are various worms living in the alimentary canal. In popular usage these are spoken of simply as "worms." Various other internal parasites as the gape worm, the air sac mite, etc., are described in other sections of this book. The present discussion will be confined to intestinal worms.

Regarding these Robinson says: "Worms in small quantities inhabit the digestive organs of all fowls and animals without causing them serious inconvenience. It is even maintained by some authorities that in limited numbers these parasites are beneficial, though in just what way they are beneficial I have never seen stated, and it seems more reasonable, in the present state of knowledge of the subject, to claim no more than that when not too numerous they do no perceptible harm. Worms are contagious in that they are transmitted from fowl to fowl, probably always indirectly by being deposited on the ground by one fowl and taken from it by another; but if it is true as stated that worms in small numbers are always present, contagion is not required to account for their increase to troublesome numbers in many members of a flock simultaneously. The more reasonable assumption in the premises is that all these fowls alike were in a condition favorable to an excessive development of the parasites. This is a phase of the question on which the literature of the subject has done nothing—yet it seems to be the all-important point to determine."

Diagnosis of Worms in General.—Accurate diagnosis of worms in the intestines can be made only by finding the worms in the droppings of the fowls. Fowls affected with worms to any great extent frequently show the general symptoms of dullness and depression. Birds that are suspected of being affected with worms should be shut up in a coop and given a dose of

some vermifuge or a purgative dose of Epsom salts. If careful observation of the droppings are made at frequent intervals the worms, if present, can usually be detected in this way. This is not, however, an infallible test. Regarding further measures Robinson says: "If efforts to secure evidence from the living fowls of the presence of worms fail, and the poultryman is at a loss to account for the trouble with his fowls, a suspected fowl should be killed and examined, and if this is still insufficient, the case should be taken to a competent veterinary. It is of greatest importance that the facts in such cases be learned and proper treatment given, for whether the worms cause the trouble or conditions exist which favor their increase, the situation is full of danger to the keeper of a flock in which serious trouble is associated with worms; and while I do not wish to unnecessarily alarm anyone, the fact that in recent years worms in epidemic form have put a number of poultry plants out of business, should be stated as a warning to poultrymen troubled with unidentified diseases presenting symptoms which might be associated with worms."

The principal parasitic worms which affect the digestive tract of fowls may be grouped into three classes as follows: Tape worms, round worms and flukes.

Tape Worms.

Tape worms have long been known to infest domestic poultry. Occasionally serious outbreaks of the tape worm disease occur in various parts of the country. These outbreaks are usually confined to comparatively small areas and are perhaps more common in the southern states.

Etiology.—The tape worms of poultry, like those which infest man and the domestic animals, are long, *flat, segmented* worms. (fig. 6.) The anterior end of the animal possesses a number of hooks or suckers by which it attaches itself to the walls of the intestine. Back of this head the entire animal consists of a long series of segments or proglottids. The segments nearest the head are the smallest and it is at this region that new segments are constantly being formed. The farther from the head they get the larger the segments become. Towards the posterior end of the worm the segments develop sexual organs and later become filled with eggs. As soon as the eggs are

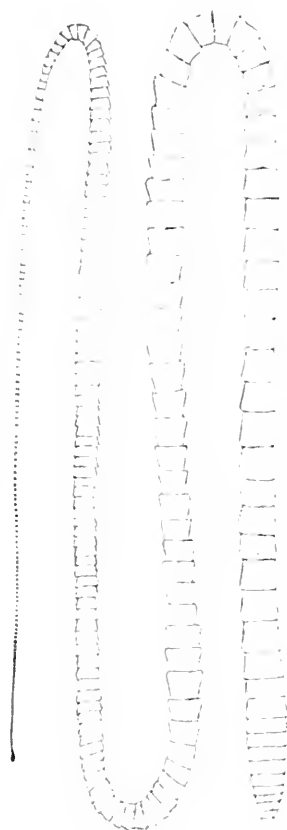


Fig. 6. *Drepanidotaenia fundibuliformis*, a tape worm of the fowl. (After Stiles).

fertilized and mature the segment containing them drops off and passes to the exterior with the feces of the host. Each segment of this kind contains thousands of eggs.

If these eggs are to develop farther they must be swallowed by some intermediate host (as a worm, snail or insect). The egg then hatches into a 6-hooked embryo which bores its way from the intestine into the body cavity of the intermediate host. It here develops into a larval form known as a *cysticercoid*. When the intermediate host (worm, snail, etc.) is eaten by a chicken this larva continues its development and forms an adult tape worm. Thus there are two stages in the life cycle of a tape worm: that in the adult host and that in the intermediate host. Each species of tape worm, of which there are a great many, has its particular host, both intermediate and final.

According to Stiles (Bur. An. Ind. Bul. 12) there were up to 1896, 33 species of tape worms recorded for poultry. Of these 11 are recorded as occurring in chickens.

The complete life history is known for only a few of these. Regarding the tape worms of chickens, Stiles (*loc. cit.*) says, p. 13: "(They) are known to become infected with one tape worm through eating slugs (*Limax*). They are supposed to become infected with a second through eating snails (*Helix*); by a third through eating flies and by a fourth through eating earth worms."

There seems but little need to give a description of the different species of tape worms found in chickens. The characters by which they are distinguished from each other are too minute and involved to be of use to the poultryman or farmer. If anyone is having trouble with tape worms in poultry the best thing

to do is to send a portion of the intestine containing the worms to the Zoological Division, Bureau of Animal Industry, U. S. Department of Agriculture, Washington, D. C. In this way the worms will be identified and any specific remedies will be recommended.

Nodular Tæniasis.

Stiles says, p. 15: "At least one species of tape worm (*Dactylna tetragona*) causes a serious nodular disease of the intestine of chickens which upon superficial examination may be easily mistaken for tuberculosis." Moore says (Bur. An. Ind. Circ. No. 3, 1895):

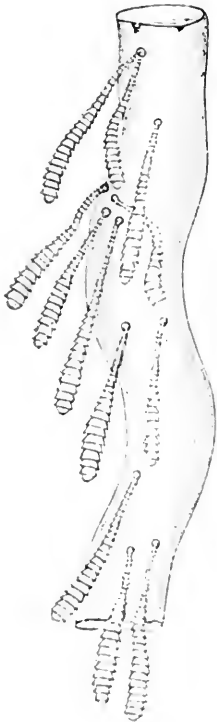


Fig. 7. Intestine of a fowl turned wrong side out to show tape worms in nodular tæniasis. After Pearson and Warren).

"Tuberculosis is the only known disease for which this affection is liable to be mistaken, and it is of much importance that the two diseases should not be confounded. The diagnosis has not in my experience been difficult, as in every case the attached tape worms were readily detected upon a close examination of the intestinal contents, or of the mucous membrane of the infected portion of the intestine. However, the worms are quite small and could easily be overlooked in a hurried or cursory examination. In case of doubt, if the affected intestine is opened and the mucous surface washed carefully in a gentle stream of water, the small worms will be observed hanging to the mucous membrane. This discovery, in the absence of lesions in the liver or other organs, would warrant the diagnosis of the tape worm disease."

Diagnosis.—The symptoms of tape worm disease are not specific. The general symptoms are similar to those of other worms (cf. p. 75). Regarding the symptoms of tape worms Stiles quotes the following from Zürn: "If numerous tape worms are present in the intestine of young or old fowls a more or less extensive intestinal catarrh develops, corresponding to the greater or less number of parasites present."

"The intestinal catarrh shows itself, especially in chickens and geese, as follows: The sick animals become emaciated, although the appetite is not especially disturbed. At times the appetite is even increased. The droppings are thin, contain considerable yellow slime, and are passed in small quantities but at short intervals. The poultry raiser must direct his attention to these thin, slimy, and often bloody droppings, for if any treatment against the tape worm is to be undertaken, this must be done as early as possible. In observing the droppings it should be noticed whether tape worm segments or eggs are present. The eggs can be seen, of course, only with the microscope."

"After a time other symptoms develop. The sick animals become dull and listless, remain apart from the rest of the flock—the feathers are ruffled and the wings droop, the appetite is lost and the birds allow themselves to be easily caught. Although it was stated that in the beginning of the trouble the appetite is not disturbed, the sick animals develop an intense thirst for cold water. When it rains they run under the eaves in order to catch water, and in winter are eager for ice water."

Since the examination of the feces for tape worm segments is rather unsatisfactory for the farmer or poultryman, Stiles says that "The best method for the farmer to follow is to kill one of the sick chickens when he suspects tape worms and to cut out the intestine. He should then open the intestinal tract from gizzard to anus in a bowl of warm water, and look for the parasites." (Cf. fig. 7). Finding the worms in the alimentary canal is the only certain diagnosis of the disease.

Treatment.—The chief drugs used for tape worms in fowls are: Extract of male fern, turpentine, areca nut, powdered kamala, pumpkin seed, pomegranate root bark and Epsom salts. The following extract from Salmon gives the principal methods of treatment and the doses: "One of the best methods of treating tape worms in fowls is to mix in the feed a teaspoonful of powdered pomegranate root bark for every 50 head of birds. In treating a few birds at a time it is well to follow this medicine with a purgative dose of castor oil (2 or 3 teaspoonsful). According to Zürn, powdered areca nut is the best tape worm remedy for fowls, but he states that turkeys are unfavorably affected by it. It may be given in doses of 30 to 45 grains mixed with butter and made into pills. Male fern is also a very effectual remedy and may be used in the form of powder (dose

30 grains to 1 dram) or of liquid extract (dose 15 to 30 drops). It should be given in the morning and evening, before feeding. Oil of turpentine is an excellent remedy for all worms which inhabit the digestive canal. It may be given in the dose of 1 to 3 teaspoonfuls, and is best administered by forcing it through a small flexible catheter that has been oiled and passed through the mouth and oesophagus to the crop. This medicine is less severe in its effects if diluted with an equal bulk of olive oil, but, if it fails to destroy the parasites when so diluted, it may be given pure. The method of administering medicine by depositing it directly in the crop can be advantageously used with many other liquid remedies, and should be adopted in all cases where it is important to have the full dose in the stomach in a short time. It does away with the uncertainty attending the giving of medicine in the feed or drinking water, and with a little practice is more expeditious than making and giving pills. The open end of the catheter may be inserted into a rubber bulb having one opening. Just sufficient air should be expelled from the bulb, so that the dose of medicine will be sucked up without

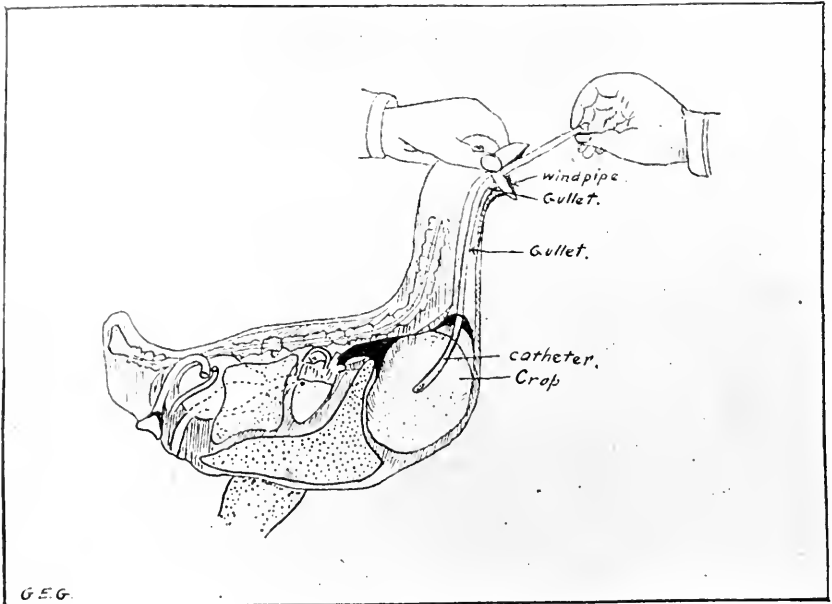


Fig. 8. Sketch showing method of introducing turpentine directly into crop. (From Gage and Opperman).

being followed by much air. The bird's head is then brought in a line with the neck, which is extended, the catheter is passed carefully to the crop, when a slight pressure on the bulb forces out the medicine, and the instrument is withdrawn. The operator should be sure that he avoids the trachea."

More recently Gage and Opperman* have found Epsom salts and turpentine a very effective remedy for Nodular Teniasis. After careful consideration of the data they conclude that "40 to 50 grains of Epsom salts is sufficient for an adult fowl in order to clean out the intestinal tract so that the birds may take food. Then the turpentine should be introduced" as directed above. For younger birds the dose of salts should be proportionately less. In fowls from 6 months to 2 years old the salts are best given by dissolving in water and giving each fowl this liquid. For younger chicks the salts may be dissolved in warm water and used to moisten the mash or feed.

Prevention.—The following statement by Salmon gives some of the chief preventative measures: "Parasitic infestation of the digestive tract should be guarded against by hygienic measures so far as possible. One of the most important of these measures is to move the fowls upon fresh ground every 2 or 3 years, or certainly in all cases where such parasites are frequently observed in the intestines of the birds. Another practical measure, which may be adopted at the same time, is to remove the excrement daily from the houses and destroy any parasites or their eggs which may be in it, by mixing it with quick lime or saturating it with a 10 per cent solution of sulphuric acid. The acid is cheap, but requires that great care be taken in diluting it, owing to danger of its splashing upon the clothing and flesh and causing severe burns. It should always be poured slowly into the water used for dilution, but on no account should water be poured into the acid as it will cause explosions and splashing."

"When treating diseased birds these should always be isolated and confined, and their droppings should either be burned or treated with lime or sulphuric acid as just recommended. Without these hygienic measures, medical treatment can only be partially successful."

Stiles says: "An extermination of slugs will insure immunity against *Davainca proglottina*, but no precise directions can be

*Md. Agric. Expt. Stat. Bul. 139, 1909.

given to prevent chickens from becoming infected with other tape worms until the life history of these parasites is better understood. It will be well, however, to keep the chickens housed in the morning until the sun is well up and the ground is dry, for they will thus be less likely to meet with the supposable intermediate hosts of other worms."

Round Worms.

Round worms can be found in the intestine and especially the ceca of almost any fowl. They are much more common than the tape worms. Normally the round worms cause no serious trouble to fowls. Under certain conditions, however, they may

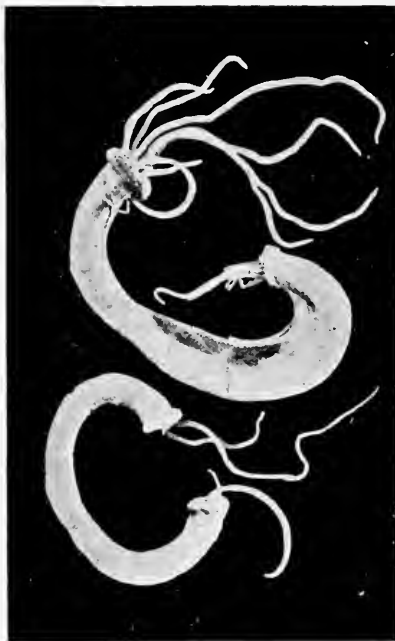


Fig. 9. Worms protruding from a section of the intestine of a fowl. (After Bradshaw).

become so numerous as to be a serious menace to the flock. At such times they have a decided effect on the digestion; the irritation often causes diarrhea. When in large numbers, they sometimes become rolled and matted into a ball which may cause complete stoppage of the intestine.

The round worms are white in color and vary in length from 1-3 inch to 5 inches. The head end is sharp pointed, while the tail end is more blunt. Round worms are seldom passed in the feces unless present in very large numbers. When a worm is passed it soon dies in the droppings or is eaten by another fowl.

Dispharagus spiralis, a small worm about 1-3 inch in length, is often found in the œsophagus and occasionally in the crop or intestine.

Dispharagus nasutus, about $\frac{1}{4}$ inch long, occurs in the walls of the gizzard of fowls. It sometimes becomes so numerous as to cause serious loss.

Heterakis perspicillum, from $1\frac{1}{2}$ to 3 inches long, is very common in the intestines of fowls. They sometimes become very numerous and may become rolled into rather large balls which obstruct the passage of the food.

Several other species of the genus *Heterakis* also infest fowls and other poultry.

Diagnosis.—The symptoms of round worms are similar to those of all worms (cf. p. 75). There is evidence of indigestion. The comb becomes pale and there may be diarrhea.

Treatment.—The remedies mentioned on p. 79 for tape worms are also useful for round worms. The remedy most commonly advised is to give 2 grains santonine for each bird. Dissolve this in water and use to mix the wash. As recommended on p. 79, all droppings should be collected and examined, also put out of reach of the birds.

Vale recommends the following: "Beat a new laid egg with 1 tablespoonful of oil of turpentine and mix thoroughly by shaking. Give a teaspoonful of the mixture night and morning for a few days; or divide $\frac{1}{4}$ of an ounce of areca nut in powder, into 4 parts, and give 1 part each morning, fasting, with a dessertspoonful of sweet oil 2 hours after each powder."

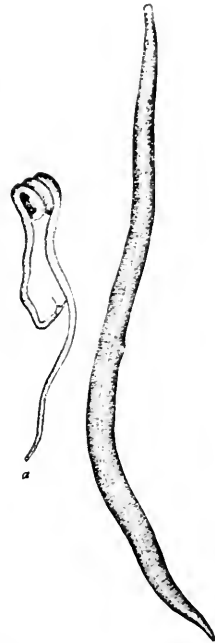


Fig. 10. *Heterakis perspicillum*.
a, male. b, female.
x2. (From Salmon).

Flukes.

Flukes or trematode worms are small, flat and usually oval-shaped. Fig. 11 gives a fair idea of the appearance of these parasites.

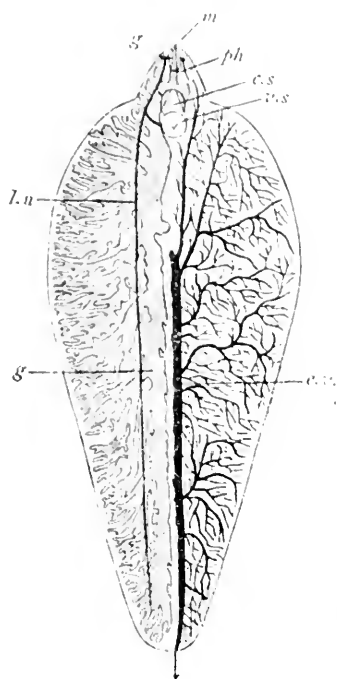


Fig. 11. Trematode worm or fluke showing internal structure. (From Thompson after Sommer).

Regarding these parasites in poultry, Theobald (*Parasitic Diseases of Poultry*, London) says: "The Trematode worms or Flukes found in the fowl are 3 in number. One is found in the egg (*Distoma ovatum*), the others in the œsophagus and intestines."

"The Fluke found in the œsophagus of the fowl is known as *Cephalogonimus pellucidus*, a transparent reddish fluke about 9 mm. long. These were found by Von Linstow and Railliet. In the intestines Neumann enumerates 7 species, namely, *Notocotyle triscialis*, *Distome orycephalum*, Rud., *D. dilatatum*, Miriam, *D. lineare*, Zeder, *D. ovatum*, *D. armatum*, Molin, and *Mesogonimus commutatus*, Sons. These, however, are not all distinct; *dilatatum* is undoubtedly the same as *orycephalum*; *armatum* is also probably the same."

"None of these Trematode worms are of any pathological importance, although, as is well known, they often cause serious maladies in other animals. All the Flukes that have two hosts undergo a complicated metamorphosis, the early stages always taking place in some water-mollusc. Those found in *Gallus domesticus* have not had their life-histories worked out."

CHAPTER XII.

DISEASES OF THE RESPIRATORY SYSTEM.

Anatomy and Physiology.

The respiratory organs of birds are the nasal passages, the pharynx, larynx, trachea, lungs and air sacs. The form and general appearance of the lungs and trachea are shown in fig. 12.

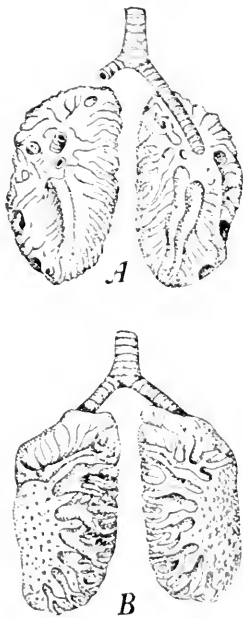


Fig. 12. Lungs of a bird. A, lower surface. B, upper surface. (After Salmon).



Fig. 13. Right lung of a goose. A, primary branches. b, and b', openings into abdominal and thoracic air sacs. c, c, secondary bronchi. (After Owen).

The respiratory apparatus differs somewhat in structure and function from that of mammals. As in mammals the trachea (wind-pipe) divides into the primary bronchi, one passing to each lung. In birds these bronchi do not divide and subdivide

as in mammals but each passes to the posterior end of its lung and where it opens into the abdominal air sac. This relation is shown in fig. 13.

In the lung the primary bronchus gives off branches (secondary bronchi) some of which end blindly (cf. fig. 13). The secondary branches give off branches (tertiary bronchi) all of which end blindly (cf. fig. 14). This tubular system makes up the air-containing portion of the lungs. It is imbedded in a net-work of almost naked blood vessels which make up the spongy tissue of the lungs (cf. fig. 14). The aeration of the blood takes place through the walls of these vessels. The relations of this tubular system of the lungs are shown in fig. 14.

The air sacs are very large, thin-walled sacs which open into the bronchial tubes as described. They function chiefly as reservoirs of air so that fresh air is supplied to the lungs twice during each breath. The air passes through the lungs into them during inspiration and during expiration the lungs are filled with the air forced back from the sacs. Some aeration of blood takes place in the sacs and they also help to reduce the relative weight of the body. In addition to aeration of the blood, the respiratory apparatus eliminates most of the waste moisture of the body and is, therefore, the temperature regulator. In mammals this function is performed by the sweat glands and the secretion of the kidneys. Birds have no sweat glands and the secretion of the kidneys contains relatively little moisture.

The air passages are lined with mucous membrane and this membrane is the seat of several diseases. Diseases are easily transferred from one part of the respiratory system to another, since the passages and also the lining membranes are continuous from the nostrils to the air sacs. There are also diseases of the vascular part of the lungs. Some of these diseases are caused by unfavorable conditions as exposure to cold, draughts of air, or moist air or to improper food. Others are due to specific organisms. Most of the latter are contagious. Exposure to unfavorable conditions also reduces the ability of the birds to resist infectious diseases.

Catarrh.—(*Simple Catarrh; Non-contagious Catarrh; Cold.*)

One of the most common diseases of the air passages is catarrh (cold). It is often hard to distinguish this disease from early stages of roup and diphtheria. The characteristic symptoms of the latter disease should be carefully looked for, lest the flock become infected with a dangerous contagious disease. In cases where there is a suspicion of either of these diseases it is better to isolate the sick birds. Catarrh is non-contagious. It usually affects only a few individuals in the flock, but in cases of exposure of the flock to the unfavorable conditions which cause the disease it may occur in quite a number of birds at the same time.

Diagnosis. Salmon gives the following description of the symptoms of this disease: "In simple, non-contagious catarrh, the affected birds are more or less dull, they are disinclined to move, their appetites are diminished, they sneeze and the mucous membrane is thickened, causing some obstruction to breathing through the nostrils. There soon appears a thin, water discharge which later becomes thicker and glutinous, the eyes are often watery, the eyelids swollen and sometimes held together by a thick, viscid secretion. In very severe cases, the birds are somnolent, the plumage is erect and roughened, the nostrils are completely obstructed by the thick secretion, the breathing is entirely through the mouth and is accompanied by a wheezing or snoring sound, the appetite is entirely lost, a thin liquid escapes from the mouth and the bird soon becomes exhausted and dies."



Fig. 14. A—Lobule of the lung of a bird represented in ideal longitudinal section: a, a, secondary bronchi; b, b, tertiary bronchi. B.—Plexus of blood vessels which chiefly compose the pulmonary tissue. (After Owen).

Etiology. The cause of catarrh is exposure to cold, to draughts of air, to damp atmosphere due to improper housing conditions, or to wet weather. Weak stock or improperly nourished birds are more likely to be affected by these conditions than strong, vigorous and well fed individuals.

Treatment. With strong, healthy stock it is usually only necessary to remove the cause. It is a good practice, however, to give red pepper (capsicum) with the food. Salmon gives the formula and dose of a tonic recommended by Megnin.

Gentian root	4 drams
Ginger	4 drams
Sulphate of iron	2 drams
Hyposulphite of sodium	1 dram
Salicylate of sodium	1 dram

These substances are to be pulverized and then thoroughly mixed. The dose is 3 to 4 grains a day for a medium-sized fowl. Its effects are stimulating and tonic."

In severe cases, the eyes, mouth, and nostrils may be washed once or twice a day with one of the following solutions which are given in order of preference:

1. Boracic acid 3 per cent solution.
2. Creolin 1 per cent solution.
3. Hydrogen dioxide mixed with equal parts of water.
4. Carbolic acid, 2 per cent solution.

Prognosis. A great majority of the birds recover in a few days if the cause is immediately removed. If the cause continues to act they may become worse and die, or the disease may become chronic and persist for a long time.

Bronchitis, Croup.

This disease may follow catarrh as a direct extension of the inflammatory processes in the membrane of the nasal cavities and throat to the mucous membrane of bronchial tubes.

Diagnosis. The symptoms of bronchitis are the symptoms of a hard cold (severe catarrh) with rapid breathing and cough. It may be distinguished from a cold by the peculiar sounds made in breathing. In the early stages of the disease this is a whistling sound made by the passage of the air over the dry, thickened membrane. As the disease advances mucus collects in the tubes and the breathing is accompanied by a rattling or bubbling sound. Under favorable conditions the symptoms do not usually pass

beyond this stage but soon disappear. In very severe cases the birds become very sleepy and refuse to eat. The wings droop. The feathers are roughened and breathing becomes more and more difficult, until finally the bird dies. The less severe forms of the disease may become chronic while the symptoms of rattling breath and coughing up mucus may persist for a long time. In this form of the disease the birds appear well except for the above symptoms.

Etiology. When it follows a hard cold, bronchitis may be caused by an extension of the inflammation of the mucosa of the throat to the mucosa of the bronchial tubes. It may also be caused directly by exposure to cold, draughts, and dampness; or it may result from irritation of the mucous membrane caused by inhaling irritating vapors, dust or foreign particles.

Treatment. Place the patient in a warm, dry, well ventilated but not draughty rooms. Feed bread or middlings moistened with milk, and add to this food 2 grains of black antimony twice a day. A demulcent drink is often beneficial. A very good one is made by steeping a little flax seed in water. Other demulcent drinks are made by dissolving honey or gum arabic in water. This treatment is sufficient for mild cases. Salmon recommends the following treatment for severe attacks: "If the attack promises to be severe, it may sometimes be checked in the early stages by giving 10 drops of spirits of turpentine in a teaspoonful of castor oil and repeating this dose after 5 or 6 hours. It should not be continued after there are signs of purging, for fear of exhausting the strength of the patient. In the very acute cases, where the whistling or snoring sounds with the respiration indicate a croupous form of inflammation, and where the gasping shows great obstruction of the air passage, relief may be obtained by giving from 3 to 6 drops of either the syrup or the wine of ipecac."

"Medicines should be administered very carefully in diseases affecting the trachea and bronchi, as otherwise they may enter the air passages and increase the irritation."

Prognosis. In the ordinary and chronic forms the birds usually recover. In the more severe forms a large per cent of the affected birds die.

Influenza (Epizootic, Grippe, Distemper).

This disease is mentioned by Woods as "a contagious germ

disease closely association with roup." Robinson gives a brief statement of the diagnosis, treatment and prognosis of this disease as follows: "Briefly stated, the symptoms are of a sudden and severe cold, with high fever, generally diarrhea, and extreme debility. In very severe cases death may ensue within a few hours after the fowl is observed to be sick. Usually the bad cases linger for a day or two, while those that recover run for a week or 10 days. Treatment the same as for bad colds."

Quite possibly this is not a separate disease but is either a severe form of cold occurring in many individuals of a flock which has been exposed to unfavorable, insanitary conditions, or is a mild form of roup.

Roup (Contagious Catarrh, Diphtheria, Diphtheritic Roup, Canker).

Veterinarians have distinguished two diseases belonging to this general class of troubles as follows: (a) roup or contagious catarrh when only catarrhal symptoms are present, and (b) diphtheria, diphtheritic roup and canker when diphtherial patches and false membranes are formed. The bacteriologists Moore, Harrison and Streit, consider these different stages of the same disease. Cary not only considers these as one disease but also believes that sorehead, chicken pox or *epithelioma contagiosum* is also a form of this disease. These questions cannot be settled with the present knowledge of the causes of these diseases. The evidence for considering roup and diphtheria as successive stages in the same disease seem much better than the evidence that sore-head is a form of this disease. In the present work sore-head is treated separately.

Roup is a disease of very great economic importance. It is widely distributed causing a large annual death rate, and also reducing the value and production of affected flocks since many birds contract the disease in a chronic form and become worthless for egg production or breeding. Such birds preserve the germs of the disease and this leads to fresh outbreaks whenever the flock is exposed to unfavorable conditions.

Diagnosis. Harrison and Streit* give a very good descrip-

*Harrison, F. C., and Streit, H., Roup. Ont. Agr. Coll. & Exp't. Farm. Bulletin 125, Dec. 1902, pp. 1-16.

tion of the symptoms of roup from early to late stages. The following account is quoted from their bulletin:

"The general condition of roup birds varies very much. After the first symptoms of the disease, which is usually a putrid catarrh from the nostrils, the affected fowl is generally restless, separates from other members of the flock, becomes dull, cowers in the corner of the coop or mopes in the corner of the pen, with its head drawn close to its body and often covered with its wings."

"If there is a severe discharge from the nostrils or eyes, then the feathers upon the wings or back are likely to be smeared with it, stuck together, and after some time fall out; and the eyes often shut, the lids being glued together by the sticky discharge from them."

"A fowl in a sleepy condition, or moping as described, frequently arouses itself for a time, takes food, and especially water, and then gradually returns to the apathetic condition."



Fig. 15. Showing appearance of a hen a day before death from roup. (From Harrison and Streit).

"Many fowls having the disease in a chronic form keep their normal appetite for a long time, and seem very little disturbed physically, whilst others, especially when the face or eyes become swollen, lose their appetite, grow thinner and thinner, and finally become too weak to stand or walk around, when they lie down and die in a few days. During the last stage diarrhoea, with offensive yellow or green discharge, often sets in and causes death in a short time."

"Many poultry keepers assert that roup birds show fever; and it is certain that the head is often very hot, but the body temperature is normal, or only very slightly higher than normal."

"*Special Symptoms of Roup.* By the term roup we generally understand a more or less putrid discharge from the nostrils, which lasts for weeks or even months. The disease often follows a common cold, to which fowls, especially young fowls and those of the more delicate breeds, are much predisposed."

"In the first stages of roup, the birds often cough or sneeze, and the breathing is noisy, caused by the partial closing of the air passages, which become blocked with the discharge from the nostrils. When the air passages are entirely closed by the discharged products, the fowl has to open its beak in order to breathe."

"Sometimes a yellowish cheese-like mass forms in the nostrils, growing quickly and pressing the upper walls of the nose upwards; and if this mass is removed, an uneven bleeding surface is left, which forms a new cheesy mass in from 24 to 48 hours."



Fig. 15. Showing swelling of head in severe roup. (From Harrison and Streit).

"Whilst many roup birds show only the above mentioned symptoms, others become more seriously diseased. The face of roup birds is very often swollen, especially between the

eyes and the nostrils; and this swelling, which is hot and sore, sometimes grows into a tumor as large as a walnut—generally firm and hard. (See fig. 16). A bird in this condition is frequently found scratching at the tumor with its claws or wings, as if endeavoring to remove it. If the tumor grows on the inner side, towards the nasal passage, it forces the roof of the mouth downward, and the upper and lower beak are slowly pressed out of their normal position, so that the bird cannot close its mouth."



Fig. 17. Head of a bird. The lower figure shows the maxillo-ocular sinus, which opens into the socket of the eye and communicates with the nasal cavities. The upper figure shows the roup tumor on the head caused by the filling of this cavity with cheesy pus. (From Megnin).

"On making an incision into the tumor, we find a solid, cheesy, yellowish matter, which may be pulled out like the root of a plant; but it usually has to be broken into small pieces in order to get it out. Around this mass, there is a more or less smooth, grey or brownish membrane that is capable of again forming a cheesy mass similar to what has been removed."

"The mass itself, when not attended to, often grows into the nasal canals, and blocks them up completely. Generally com-

bined with the formation of the tumor on the face, there is an affection of the eyes; or the eyes become diseased without the preliminary discharge from the nose, in which case poultry keepers speak of fowls as suffering from "roup of the eyes."

"Roup of the Eyes. The first symptom of the eyes is generally an inflammation of the eye-lids. These become red, swollen and hot; then the mucous membrane and glands of eyes become inflamed and begin to secrete a liquid—at first clear, and then of a grey, slimy, putrid character, which dries on the feathers at the side of the head, causing them to stick together or fall out. If the secretion is retained in the eye socket, it undergoes a change, becoming a yellowish, solid, cheesy mass of the same appearance as that found in the nasal tumor. This cheesy mass either forces the eye out of its socket, or the inflammation entirely destroys it. These cheese-like masses form in one or two days, and may reappear after many daily removals."

"All these affections, described above, may be localized on one side; but often both nasal passages and both eyes are affected at the same time."

"Combined with the symptoms of roup above described, there often are patches of a greyish yellow exudation firmly adherent to the mouth, throat, etc. These patches are called "false membranes," and on account of their somewhat close resemblance to the membrane which is formed in human diphtheria, it has been thought by some writers that the avian and human diseases are the same. Here, however, let it suffice to say that the weight of evidence is against this contention."



Fig. 18. Head of a fowl 22 days after inoculation with a culture of the roup bacillus. A.—False membrane. (From Harrison and Streit).

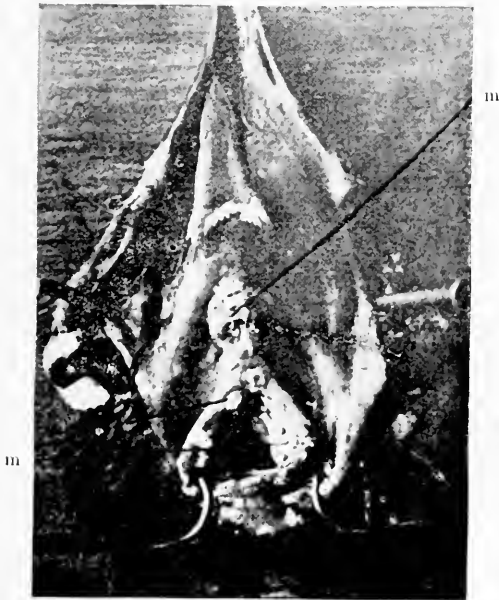


Fig. 19. Throat and bottom of mouth with false membrane (*m*) 14 days after inoculation. (From Harrison and Streit).

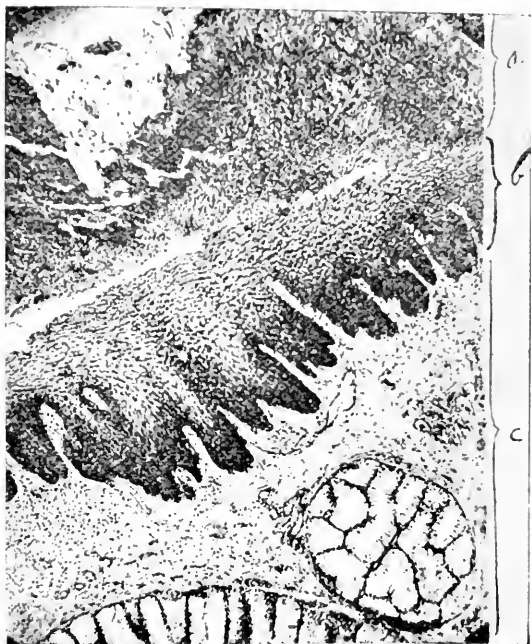


Fig. 20. A section of a false membrane of a rousy fowl. (a)—false membrane; (b), epithelium; (c), sub mucosa. (From Harrison and Streit).

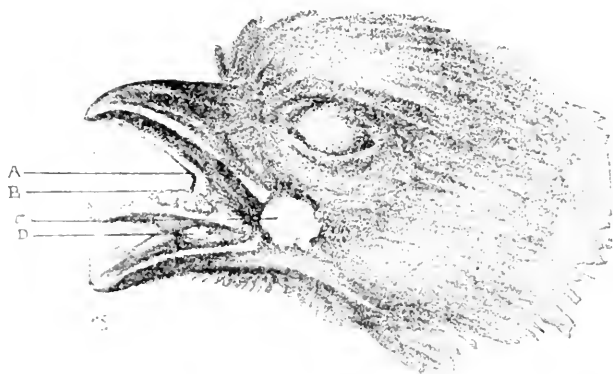


Fig. 21. Head of a bird with diphtheritic roup affecting the mouth and tongue. A, B, C and D.—False membranes. (From Megnin).

“We may also point out that many poultry keepers who notice the false membrane on the throat and mouth of their fowls,

regard the disease as quite different from the catarrhal form, and call it "canker," which is probably a popular form of the word "cancer."

"Whether the disease is characterized by false membranes, offensive discharges, or cheesy masses, the cause is the same, as we have many times experimentally demonstrated."

"At one or several places in the mouth or throat, these yellowish, smooth or uneven membranes appear, and either remain small and disappear after a few days or grow thicker, spread, and become firmly attached to the mucous membrane; and if they (the false membranes) are removed, an uneven, bleeding surface is exposed, which looks like a true cancer."

"After the appearance of the membranes the adjacent sub-mucous tissue sometimes becomes inflamed, and finally the growths are found to be similar to those so often seen at the side of the face—containing solid cheesy matter in the center."

"When the throat is blocked by these false membranes, the animal's breathing becomes abnormal, and the air passing through the throat produces loud noises. Gradually, the visible mucous membrane and the comb turn blue, and the fowl finally dies from suffocation."

The Course of the Disease. The course of roup is usually of long duration. A simple, putrid discharge from the nose may stop in 3 or 4 weeks, and similarly false membranes may soon disappear; but generally the symptoms last for months. When the eyelids become swollen and tumors appear, the case is usually chronic. Affected birds may be better for a few days or weeks, and then become very weak again. Damp, cold weather usually intensifies the disease.

"It is well known that fowls may be more or less sick from roup for one or even several years and these birds should have the greatest care and attention, for they are generally the cause of new outbreaks. Once introduced, roup may remain in a flock for many years. The first cold and moist nights of the fall and early winter cause all kinds of catarrhs, which in many instances are followed by roup. Roup spreads rapidly in the winter time and may attack from 10 to 90 per cent of the fowls in a flock. Towards spring, the disease gradually disappears; during the summer months, a few birds remain chronically affected; and then the first cold nights give the disease a fresh start."

"Young fowls and fowls of the fine breeds are especially liable to roup. While some poultrymen maintain that birds once having suffered from roup never take the disease again, most of the experimental evidence tends to show that no acquired immunity exists, as sometimes happens after other diseases. Some fowls are, however, naturally immune, and never take the disease. In the course of our own experiments, a white chicken which had never had roup, was inoculated with repeated and large doses of the roup germ, but without effect."

Etiology. Several organisms have been isolated from the lesions of birds suffering from roup. Four of these have some claim to be considered the cause of the disease. These include 3 species of bacteria and one protozoan. There is also some evidence that the cause of the disease is an invisible virus. While the specific organism or organisms which cause the disease are not certainly known its infectious nature is well established. It is probably carried from one individual to another in a flock, by the particles of dried secretion in the air or possibly by the food and drink contaminated by the diseased birds. It may be introduced into a flock by the bringing in of birds from an infected flock, or by birds that have contracted the disease at shows. Possibly it is sometimes carried on the shoes or clothing of persons coming from infected yards or houses. While a source of infection is necessary for the production of the disease it does not appear to attack birds when the mucous membrane is in a healthy condition. It is most apt to attack birds that are suffering with catarrh. When a flock once becomes infected the birds which develop a mild chronic form of the disease serve as sources of infection whenever exposure to cold and dampness causes catarrh in the unaffected birds. Thus in infected flocks an outbreak of roup usually follows catarrh caused by exposure and this fact has led some poultrymen to think that the disease may be caused directly by exposure. In some flocks it appears annually with the cold damp weather of late autumn and breaks out again at every radical change of temperature and moisture conditions throughout the winter. Vigorous and properly nourished birds are better able to resist catarrh and consequently roup than those that are delicate and improperly fed.

Treatment. The best treatment is prevention. The disease can be prevented by stopping all sources of infection. Some things to keep in mind are:

1. In introducing new birds always procure them from uninfected flocks.

2. Isolate all new birds and all birds that have been exhibited at shows for 2 or 3 weeks to make sure that they do not develop the disease.

3. Exclude from uninfected house and yards poultry and all other animals, including men, coming from those that are infected.

4. Do not use implements as hoes, shovels, etc., that have been used on infected premises.

5. Keep the birds in a good hygienic condition, well nourished and in dry well ventilated houses and roomy yards.

When the disease has been introduced into the flock careful precaution may prevent its spread.

1. Immediately separate from the flock any bird that shows symptoms of the disease.

2. Disinfect the yards and houses. A 5 per cent solution of carbolic acid may be used on the yards. Remove the litter from the houses and disinfect freely. This 5 per cent carbolic solution may also be followed by whitewash, or better use the cresol solution described in Chap. II.

3. Use potassium permanganate in all drinking water. (See Chap. II.)

4. Keep watch of the flock so that any new cases may be isolated at once.

5. *Burn or bury deep all birds that die.*

The disease is amenable to treatment but this treatment must be individual and requires a great deal of time. It must be continued once or twice a day for quite a long time. It is, therefore, very expensive and consequently impracticable for ordinary stock. Moreover birds apparently cured are likely to become the source of infection for later outbreaks.

Robinson well says: "I have cured many very bad cases, but quit treating them years ago, because I found that as long as I cured roup I had more roup to cure." No better advice than is implied in this could be given. If the stock is only of ordinary value it is better to kill all birds that develop the disease. If the flock is badly infected and the disease appears again and again when conditions favor its development, it is better to dispose of the flock and disinfect thoroughly, using new runs when

starting again. New stock may be obtained from uninfected flocks or from incubator chickens raised on a fresh range.

In the case of valuable show birds treatment may perhaps be advisable.

Harrison and Streit give the following methods of treating roup:

"The germs of roup are not very resistant; they can easily be destroyed when present in cultures, or somewhere outside the animal; but in the animal tissue, they are very difficult to kill, because they penetrate into the tissue; and unless this too is killed, the germs continue living for a long time."

"Roup may be cured by remedies, if the treatment is careful and judicious. Obstately reappearing false membranes can be successfully treated by burning the diseased tissue with a strong acid (hydrochloric acid 50 per cent to 75 per cent) or other caustic, such as silver nitrate. If the eyes and nose are attacked, they have to be carefully washed, at least twice a day, with an antiseptic solution, such as 2 per cent boracic acid in a decoction of chamomile flowers, or $\frac{1}{2}$ per cent solution of corrosive sublimate. Thus the micro-organisms are killed or at least, the diseased products which are discharged are removed, and the irritation caused by them; also the transformation into large cheesy masses is prevented."

"We had chickens badly affected with roup of the eyes, which were cured with boracic acid and chamomile. On account of the smallness of the nostrils and nasal canals, it is very difficult to get the antiseptic solutions into the nose and nasal cavities; but it can be done with a small syringe. If this treatment is too troublesome, then the nostrils, at least, should be washed and opened several times a day, to allow the secretions to pass away. We have treated chickens for 14 days by daily washing with a $2\frac{1}{2}$ per cent solution of creolin and glycerine. After the washings, small plugs of cotton wool, filled with mixture, were placed in the nostrils and lachrymal ducts. This remedy did not cure the roup, although the same mixture readily kills the roup bacillus in cultures in from 2 to 3 minutes. The greatest hindrance to a sure cure by remedies which have been used locally, is the ability of the germ to penetrate into the tissue and the many secondary cavities of the nostrils which cannot be reached by the antiseptic."

"Another method of treatment which gives excellent results,

especially in the early stages of roup, is the use of 1 to 2 per cent of permanganate of potash. Fowls are treated in the following manner: The nostrils are pressed together between thumb and forefinger in the direction of the beak two or three times. Pressure should also be applied between nostrils and eyes in an upward direction. This massage helps to loosen the discharge in the nostrils and eyes. The bird's head is then plunged into the solution of permanganate of potash for 20 or 30 seconds, in fact the head may be kept under the solution as long as the bird can tolerate it. The solution is thus distributed through the nostrils and other canals and has an astringent and slight disinfecting action. This treatment should be given twice a day and continued until all symptoms have disappeared."

"If there are solid tumors in the eyelids, they should be opened so that the skin may bleed freely. The cheesy matter should be removed and the surrounding membrane touched with a 5 per cent carbolic acid or silver nitrate solution, and then a cotton plug put in again to prevent the cavity from healing too quickly. We have cured chickens in this way in about a fortnight."

"As all these methods of treatment demand a good deal of time and care, they cannot well be used for whole flocks, but the more valuable fowls may be treated in this manner. Farmers and poultrymen should first try the permanganate of potash method of treatment as it is the easiest to employ."

"Food remedies influence roup only by strengthening the fowls and assisting nature to throw off or conquer the disease."

Sanborn (Reliable Poultry Remedies) recommends the use of an atomizer to apply the disinfecting solutions to the nasal passages and mouth.

He recommends the following solution for a spray for all the mucous surfaces:

Extract of witch hazel, 4 tablespoons.

Liquid carbolic acid, 3 drops.

Water, 2 tablespoons.

He applies the spray twice a day squeezing the bulb 5 times for each nostril and twice for the mouth.

Salmon recommends washing the cavities of the nose and throat with peroxide of hydrogen, diluted 1 to 3 times with water.

The birds which are being treated should be kept in a dry, warm, well ventilated room with good nourishing food. The drinking water should be frequently changed.

Prognosis. In infected flocks this disease caused a direct annual loss of 10 to 15 per cent of the flock. Also many birds contract a chronic form of the disease which affects them for months or years. Careful individual treatment will save the lives of many birds, but such treatment is economically inadvisable except in case of very valuable birds.

"Pip" (Inflammation of the Mouth).

Robinson describes "pip" as follows: " 'Pip' is a term in very common use among poultry keepers, and applied chiefly to a symptom occurring in many cases of cold or fever when the nostrils being obstructed and the fowls breathing through the mouth the skin of the mouth and tongue become hard and dry, and a bony tip may form on the tongue by the hardening and drying of the skin of that member, this condition being aggravated when catarrhal discharges adhere to the skin and dry and accumulate."

Etiology. It would appear to be the case that the symptoms above described originated from different causes in different cases. The trouble may be due to specific infection, though a particular organism has not yet been definitely isolated as the cause. In some cases the symptom is apparently purely physiological, arising from a failure of the mucus-secreting glands to function properly, owing to a lowered physiological condition.

Treatment. The essential points in the treatment of this diseased condition is first to treat the primary cause (cold, catarrh, etc.). In removing the scale or "pip" gentle measures are to be followed, otherwise a raw surface likely to ulcerate, will be left.

The following advice as to treatment, given by Salmon, is excellent.

"In case of simply drying of the mouth, it is sufficient to moisten the tongue with a few drops of a mixture of equal parts of glycerine and water. In case there is redness of the membrane, or if the epithelium is beginning to separate, or if a deposit has formed, add 20 grains of chlorate of potash to each ounce of this mixture. An excellent remedy for such cases is made by dissolving 15 grains of boric acid in an ounce of

water. Both of these solutions are harmless and may be freely and frequently applied. When the epithelium is separating, it should be kept moistened with the glycerine mixture and its detachment may be somewhat facilitated by loosening it with a pin or the point of a penknife, but great care should be exercised, the sensitive tissues should not be touched and no blood should be drawn."

Prognosis. In and of itself "pip" is not a serious matter. It is, however, usually associated with other disorders of the respiratory system, which may be very serious. Regarding this matter Salmon says: "The exaggerated idea prevalent as to the dangerous character of 'pip,' probably arises from its being associated with serious diseases of the respiratory organs and from the fatal results which follow the forcible tearing away of the dried epithelium, leaving a bleeding and ulcerating surface."

Canker.

Membranes formed in diphtheritic roup are sometimes called canker, but there are frequently found cheesy patches on the mucous membrane of the mouth or tongue which are not associated with roup. These growths are frequently, at least, the result of a traumatic injury to the membrane. Male birds frequently have canker where they have been picked in the mouth by other males when fighting. The growths are made up almost entirely of pus germs. These growths should probably be considered as suppurating wounds. An unhealthy condition of the mucous membrane of the mouth due to digestive disorders is sometimes accompanied by spots of canker.

A good treatment for canker is undiluted creolin applied with a cotton swab. The swab should be held against each sore for a short time. The whole surface of each patch should be treated. Another good treatment is to wash the sores with hydrogen peroxide 1 part and water 1 part.

Thrush.

This term is also sometimes incorrectly applied to the false membranes of diphtheria but there are at least two cases of true thrush on record. That is, in two cases microscopic examination has shown that the patches, which in both these cases were in the lower part of the oesophagus and crop, were made up of spores and filaments of the fungus *Saccharomyces albicans*.

This fungus causes thrush in children and calves. This disease may also occasionally affect the mouth. It is impossible to distinguish it from other diseases causing similar formations except by microscopic examination. The treatment is the same as for canker.

Aspergillosis (Mycosis of the Air Passages).

This is a very common disease of poultry, often mistaken for tuberculosis. In adult fowls it is frequent cause of the condition known as "going light," while in young chickens it probably ranks next to white diarrhoea as a lethal agent.

The discussion of this disease here relates primarily to adult fowls. Aspergillosis in young chicks is treated in Chap. XIX.

Diagnosis. Salmon gives the following account of the symptoms of this disease. "In the early stages of the disease no symptoms are noticed, and it is only after it has progressed considerably that these become apparent. The affected birds do not follow the flock; they are very weak, scarcely able to stand, and consequently remain by themselves and move about very little. They remain in a recumbent position, resting upon the sternum, are sleepy, and, if forced to run, soon fall from exhaustion. The plumage is dull and rough, the wings are pendant, the eyelids partly closed, the head depressed. The respiration is accelerated and accompanied by a rattling or snoring sound, particularly during the expiration, and becomes difficult and labored, the bird opening its beak from time to time, in order to take a long inspiration. The temperature of the body is elevated, the thirst increased and the appetite is diminished or disappears. There is more or less catarrh of the trachea and bronchi, with emaciation and diarrhea leading to death from exhaustion in from 1 to 8 weeks. When the disease is limited to the air-sacs of the interior of the body, emaciation may be the only symptom; but when it extends to the bones there may be lameness with swollen and painful joints."

"In examining the birds after death, the seat of the disease may be found in the trachea, bronchi, lungs, and various air-sacs, and other internal organs. It is sometimes, though rarely, found in the nostrils and in the air-sacs of the interior of the bones. Two kinds of lesions are found. There may be tubercles resembling those of tuberculosis. These are whitish or yel-

lowish nodules varying from the size of a pinhead to that of a pea. They may be isolated or joined together in masses of considerable proportions. These tubercles are generally found in the depth of the tissues, and even in the marrow of the bones. On the mucous membrane lining the air-tubes and air-sacs, the second form of disease process is seen. This consists of a membranous formation, $\frac{1}{8}$ of an inch or more in thickness, which bears upon its surface a growth of the fungus. These membranous patches are at first soft, but become firmer with age, and are yellowish or greenish in color, resembling a fibrino-purulent exudate. They adhere closely to the mucous membrane which is there thickened and inflamed. The air-sacs are sometimes obstructed by these growths which may in time become caseous or even calcareous. These changes may also be seen in the intestines, the mesentery, the liver and in other organs."

"The membrane lining the air-passages may, also, be found ulcerated, and the ulcers may be either naked or covered with a growth of the fungus."

"In the very acute and rapid cases, the lungs may simply show inflammation, or there may be formation of pus or abscesses in the lungs, kidneys, liver and spleen as in pyaemia or septic infection. In some of these cases there may be extensive hemorrhages, either locally or throughout the body, and these may constitute the only apparent alterations."

"A microscopic examination reveals the spores or filaments of the fungus in most of the lesions, whether these are acute or chronic. The nature of the disease may consequently be determined by a post-mortem examination, but the diagnosis is uncertain and difficult during the life of the bird."

Etiology. The disease is caused by moulds of the genus *Aspergillus* which grow on the mucous membrane of the air passage. The four parasitic species in order of their importance are *Aspergillus fumigatus*, *Aspergillus nigrescens*, *Aspergillus glaucus*, *Aspergillus candidus*. The appearance of one of these moulds, when greatly magnified is shown in fig. 22.



Fig. 22. *Aspergillus fumigatus*. Greatly enlarged. (After Mohler and Buckley).

These moulds and their spores occur on dead organic material like straw, grain, etc. They are inhaled in breathing or swallowed with the food. This being the case the importance of avoiding musty litter, and mouldy or musty grain of all kinds is apparent. As with most other diseases the resistance of the individual against infection is here an important matter. Some fowls will be able to stand musty litter and grain without any harm, while others will promptly develop aspergillosis. When once present in a flock aspergillosis is probably transmitted from generation to generation through the eggs.

Treatment. The disease is prevented by having clean, dry, well ventilated houses and avoiding the use of mouldy litter or grain. Vigorous birds under sanitary conditions are fairly re-

sistant. No medical treatment is known to be effective. Salmon gives a list of treatments which have been suggested and says "No form of treatment yet suggested, however, is very promising and the effort should be to prevent rather than cure." All birds that die should be burned or buried.

Prognosis. The disease in adult fowls is ordinarily not recognized as such until an affected bird comes to *post-mortem* at which time the prognosis is certainly extremely unfavorable. So far as concerns ridding a poultry plant of the disease, however, the outlook is favorable if energetic sanitary measures along the lines indicated above are applied.

Congestion of the Lungs.

Congestion of the lungs is a distension of the blood vessels which make up the vascular portion of those organs. The pressure of these distended vessels may close the smaller air passages, or a vessel may burst, filling the bronchi. In either case the patient soon suffocates.

Diagnosis.—The symptoms of this disease are difficult rapid breathing, sleepiness and an indisposition to move. A bloody mucus sometimes flows from the mouth. The comb is dark red or bluish from lack of oxygen in the blood. Symptoms appear suddenly and death occurs within a few hours.

Etiology.—This disease is caused by chilling the surface of the body. This contracts the surface vessels and a larger volume of blood is sent to the internal organs. The pressure on the small elastic vessels of the lungs is too great and they either close the air passages by pressing against them or the vessel walls are ruptured by the internal pressure and the air passages become filled with blood. This disease most often occurs in denuded birds (hens during moulting or young birds which have failed to feather out) or small chicks which have been exposed to cold or allowed to run out in cold, wet weather.

Treatment.—The rapid course of the disease makes treatment impracticable. Prevention is the only cure. Birds should be well nourished with plenty of green food and should be especially protected from cold and wet when moulting. Also chicks which are in a stage between down (chick) and juvenal feathers need special protection. This disease often attacks brooder chicks and indicates something wrong with the brooding. The cause should be immediately sought out and removed.

of considerable loss will follow from continued exposure of the flock.

Prognosis.—This disease is usually fatal in a few minutes or hours after its symptoms are noted. According to Salmon the patient sometimes develops pneumonia.

Pneumonia.

This disease is a step beyond congestion of the lungs. The vessels are not only distended but liquid escapes through their walls and coagulates in the air spaces. The lung of a chick dead of pneumonia is dark colored and firm and heavier than water. A normal lung floats but a lung filled with this coagulated serum sinks.

Diagnosis.—The symptoms resemble those of congestion of the lungs. Salmon gives the following symptoms: "The breathing is rapid, difficult and painful. There may be coughing with discharge from the mouth or nostrils of thick, adhesive mucus, grayish or yellowish in color or tinged with blood. The bird stands with ruffled plumage, drooping wings, head drawn in, and every appearance of severe illness. There is loss of appetite from the first, with thirst and constipation.

On examination of the lungs after death one or both of these organs are found dark in color, engorged with blood and solidified. The pneumonia may take either one of two forms. There may be what is known as broncho-pneumonia, in which case the inflammation affects more particularly the bronchi and the lung is not much solidified. The bronchial tubes in this case are more or less filled with thick mucus and exudate. In the other form, called croupous pneumonia, the tissue of the lung is principally affected. It is then that the lung is solidified by the filling up of the air-cells. A piece of lung so affected, if dropped into a bucket of water, sinks to the bottom, while healthy lung tissue will float. The bronchial tubes and air-sacs are also in some cases filled with a thick, yellowish fibrinous exudate which blocks up these air-passages and becomes partly solidified."

Etiology.—The cause of pneumonia in birds is not known. Salmon suggests that it may be caused in birds as the similar disease is known to be in some of the mammals and man. Robinson briefly summarizes Salmon's statement as follows: "He says it is supposed that to produce pneumonia there must be with the causes that produce congestion of the lungs the agency

of a germ, a species of bacteria, harmless when the lung is in normal condition, but harmful when conditions which cause congestion are present."

Treatment.—Ordinarily it will not be advisable to treat this disease. *A cure is unusual and involves such an amount of care and nursing as to make it a most unprofitable proposition.* The following treatments have been advised by different persons.

"1.—Keep the bird in a room of about 70 degrees, with steam from boiling water if possible. Give every 6 hours 1 grain phenacetin, and 1 grain sulpho-carbolate of zinc, mixed with bread crumbs enough to make a pill. Feed on raw eggs and milk. Tincture aconite in the drinking water, or 1 drop every 2 hours in the egg and milk, will help control the hard breathing. If successful in saving the bird, build up its strength with tonics such as nux vomica or quinine.' (Sanborn.)

"2.—The bird should be immediately housed and kept warm. Counter irritation must be applied over the region of the lungs by wetting the skin under the feathers on the back with tincture of iodine. Stimulants should be administered 3 or 4 times a day—2 drops of spirits of camphor and 10 drops of brandy in a teaspoonful of warm milk. Soft, nutritious diet, especially chopped beef, is necessary. Beaten egg and port wine is also useful. Three or 4 drops of chlorodyne may be given in a teaspoonful of linseed tea to relieve the more distressing symptoms; and ultimately, if the case progresses favorably, mineral tonics and cod liver oil are favorable in establishing convalescence.' (Hill.)

"3.—Place bird in a warm room and cover with a piece of blanket, leaving the head uncovered that it may have plenty of air. Give linseed tea frequently in small quantities. To make this tea: Pour a pint of boiling water on an ounce of flaxseed, and keep hot, but not boiling, for two hours. Strain to remove the seeds. The liquid may then be used as a drink, or medicines may be given in it. Dissolve enough nitrate of potash in the drink to give the bird about 1 grain 3 times a day. If the bird is failing and becomes sleepy, with comb turning dark, mix 15 drops of tincture of digitalis with 1 ounce of water, and give 10 drops of the mixture every 2 hours. To give medicine use a medicine dropper, and be careful to avoid getting it into the

air passages. When the bird begins to improve, give a grain of quinine, or 10 drops of cod liver oil twice a day.' (Salmon.)"

Tuberculosis.

This disease in birds does not usually affect the respiratory system, but is more commonly confined to the abdominal viscera, and is discussed with the diseases of the organs of alimentary tract (Chap. V).

The Air-Sac Mite.

A species of mite (*Cytodites nudus*) infects the air-sacs and bronchi of poultry.

Diagnosis.—When the birds are not badly infested there are no external symptoms. If badly infested the bird may become anemic and listless and finally die of exhaustion. Or, if the air passages are seriously obstructed by the collection of parasites and mucus there will be a rattling in the throat and coughing, and death may result from suffocation. The presence of the parasites is often found only on examination of dead birds. They appear as a yellow or white dust, each particle of which is a mite. If closely watched the particles may be seen to move.

Etiology.—The mite probably enters the air-sacs by crawling in the nostrils and finding its way down the trachea and bronchi to the sacs. The parasites are able to live only a short time outside the bird's body. The mouth parts of these mites are modified into sucking tubes. They attack the mucous membrane of the air-sacs and bronchi. When the number of parasites is small they cause no serious inconvenience to the bird.

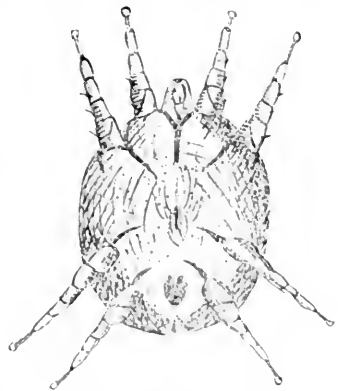


Fig. 23. *Cytodites nudus*. The air sac mite. Greatly enlarged. (After Theobald).

When there are a large number present they may cause inflammation of the membrane and secretion of mucus or they may seriously obstruct the air passages.

Treatment.—Treatment of infested birds is probably useless. Feeding sulphur with the food or compelling the birds to inhale

the fumes of burning sulphur or burning tar or the steam of boiling tar water has been recommended.

If a flock is infested with this parasite it is best when possible to start a new flock with incubator chicks raised on a new range and carefully protected from infection from the old flock. Or stock may be purchased from an uninfested flock. Birds with this parasite should not be bought or sold for breeding or laying purposes, as the flock into which they are introduced will become infested from them. Since this parasite can not live long outside the bird's body, the houses, runs, etc., do not remain infested long after all the diseased birds have been removed.

Prognosis.—A bird once infected is probably never free from the parasite but may live a long time little harmed by its presence.

CHAPTER XIII.

DISEASES OF THE CIRCULATORY SYSTEM.

Pericarditis (Inflammation of the Pericardium, Dropsy of the Heart Sac).

This disease is often found associated with other diseases of the circulatory system and with diseases of the lungs and air-sacs and also with soreness of the joints.

Diagnosis.—A differential diagnosis of this disease during life is not usually possible. Salmon gives the following symptoms: "There is great weakness, difficult breathing, the head being thrown backwards, and the breath drawn through the mouth in order to obtain sufficient air. If forced to run the bird soon falls. In a case observed by Hill there was tumultuous action of the heart and occasional spasms." Examination of a bird dead from this disease shows the heart sac full of serous liquid and sometimes the cavity is divided by false membranes which may attach to the heart as well as to the pericardium.

Etiology.—The causes of this inflammation are not known. It may result from exposure to cold or dampness.

Treatment.—Treatment is impossible since the disease can not be diagnosed until after death. Successive cases in the same flock indicate exposure of the flock to cold or wet weather or to confining the birds in insanitary houses. These conditions should be remedied. Salmon also recommends in such cases "2 to 4 grains of bicarbonate of soda to each bird daily in the drinking water."

Endocarditis (Inflammation of the Internal Membranes of the Heart).

In the examination of dead birds it is sometimes found that the membrane lining the heart is reddened and coagulated lymph may adhere to it. Little is known of this disease in fowls. It cannot be distinguished from pericarditis except by an examination of the heart. The cause and treatment suggested for that disease probably apply equally in these cases.

Myocarditis diphtherica.

According to Zürn, Bollinger has described a bacterial disease of the heart and blood vessels of fowls and pigeons. The disease is caused by a bacterium which resembles the bacterium of roup. The disease attacks the lining membrane of the heart and blood vessels, causing inflammation and the breaking down of the tissue. It especially affects the valves of the heart and aorta, where round or oval colonies of the bacteria are found on the membrane. In these patches fibrin and red and white corpuscles are mingled with the organisms. The walls of the small vessels of the lungs, liver, spleen, kidneys and intestines are also affected. The liver, spleen, and kidneys are enlarged. The bacteria are numerous in these organs as well as in the blood.

Little is known of the frequency of the occurrence of this disease and nothing of methods of treatment.

Enlargement of the Heart (Hypertrophy).

The heart of a fowl is sometimes enlarged. According to Cadeac this enlargement most frequently affects the right side of the heart. The muscle may be fatty and degenerate.

Diagnosis.—The distinctive symptom of this disease is a very rapid beating of the heart.

Etiology.—The cause of this hypertrophy of the heart muscle is not known, but it is probably due to some derangement in the nutrition of the muscle. The palpitations are increased by excitement or fright.

Treatment.—The disease is not usually recognized while the bird is alive. Treatment is therefore not possible.

Prognosis.—A hypertrophied heart may function for a long time. The violent beating may cause rupture of a blood vessel; sometimes several vessels are ruptured at the same time.

Rupture of the Heart and Large Blood Vessels.

Internal hemorrhage due to the rupture of the heart or large blood vessels often occurs in full blooded fowls.

Diagnosis.—The bird becomes weak and drowsy, passes into a comatose condition and dies with the characteristic appearance associated with bleeding to death.

Etiology.—In full blooded fowls any excitement or over-exertion which causes an increase in the rate of heart beat and an

increased blood pressure may result in a rupture of the heart or one of the large vessels.

Treatment.—The accident can not be predicted and treatment is impossible.

Prognosis.—The bird dies in a short time.

DISEASES OF THE BLOOD.

Various cases of an alteration in the number of white corpuscles in the blood of fowls have been described. Most of these descriptions are based on from one to three cases, and from the descriptions it appears that the investigators have found several different blood diseases. Most of these diseases when tested did not prove infectious. They are impossible to distinguish except by microscopic examination and most of them are probably quite rare. Only one of these diseases seems to be of any economic importance. This is *Infectious Leukæmia*, first described by Moore (Ann. Rep. Bur. An. Ind. 1895-1896).

Infectious Leukæmia.

This is a bacterial disease often mistaken for fowl cholera but caused by a different species of bacteria and the lesions produced are somewhat different.

Diagnosis.—The following symptomatology is quoted from Moore: "From the statement of the owners of the fowls in the different outbreaks and from the appearance of those in which the disease was artificially produced, little can be positively recorded concerning the distinctive or characteristic symptoms. The only fowl examined ante-mortem from the natural outbreaks was first seen only a few hours before death, when it was unable to stand. If held in an upright position, the head hung down. There was a marked anæmic condition of the mucosa of the head. It had an elevation of nearly 3 degrees of temperature. An examination of the blood showed a marked diminution in the number of red corpuscles and an increase in the number of white ones. In the disease produced artificially by feeding cultures of the specific organism there was in most cases a marked drowsiness and general debility manifested from 1 to 4 days before death occurred. The period during which the prostration was complete varied from a few hours to two days. The mucous membranes and skin about the head became pale. There was

an elevation of from 1 to 4 degrees of temperature. The fever was of a continuous type."

"Although the course of the disease in the different fowls was usually constant, there were many variations. In a few individuals the time required for fatal results was from 2 to 3 weeks, but ordinarily death occurred in about 8 days after feeding the virus, the rise in temperature being detected about the third day and external symptoms about the fifth or sixth, occasionally not until a few hours before death. The symptoms observed in the cases produced by feeding correspond with those described by the owners of affected flocks."

Dr. Moore found the only constant lesions to be in the blood and liver. The change in the blood as noted above was a decrease in the number of white cells. The change in the liver is described by Moore as follows:

"The liver was somewhat enlarged and dark colored, excepting in a few cases in which the disease was produced by intravenous injections. A close inspection showed the surface to be sprinkled with minute grayish areas. The microscopic examination showed the blood spaces to be distended. The hepatic cells were frequently changed, so that they stained very feebly, and not infrequently the cells were observed in which the liver cells appeared to be dead and the intervening spaces infiltrated with round cells. The changes in the hepatic tissue are presumably secondary to the engorgement of the organ with blood."

Dawson's diagnosis of the disease (An. Rep. Bur. An. Ind. 1898, p. 350) differs somewhat from the one given by Moore.

It is very difficult to distinguish this disease from fowl cholera except by identifying the bacteria which produce the diseases. Moore contrasts the characteristic lesions in the appended columns:

Fowl cholera

Infectious leukaemia.

- | | |
|-----------------------------------------------------------------|---------------------------------------------------------------------------------|
| 1. Duration of the disease from a few hours to several days. | 1. Duration of the disease from a few hours to several days. |
| 2. Elevation of temperature. | 2. Elevation of temperature. |
| 3. Diarrhea. | 3. Diarrhea very rare. |
| 4. Intestines deeply reddened. | 4. Intestines pale. |
| 5. Intestinal contents liquid, muco-purulent, or blood stained. | 5. Intestinal contents normal in consistency. |
| 6. Heart dotted with ecchymoses. | 6. Heart usually pale and dotted with grayish points, due to cell infiltration. |

<i>Fowl cholera</i>	<i>Infectious leukaemia</i>
7. Lungs affected, hyperaemic or pneumonic.	7. Lungs normal, excepting in modified cases.
8. Specific organisms appear in large numbers in the blood and organs.	8. Specific organisms comparatively few in the blood and organs.
9. Blood pale (cause not determined).	9. Blood pale, marked diminution in the number of red corpuscles.
10. Condition of leucocytes not determined.	10. Increase in the number of leucocytes.

Attention should be called to the fact that as yet there seems not to have been a careful study of the condition of the blood in fowl cholera. Dr. Salmon observed many changes in this fluid which may have been similar to or identical with those herein recorded.

On p. 201 of Dr. Moore's paper he gives the method of differentiating the two bacteria. This is, of course, dependent on microscopic examination and cultural tests. A full description of *Bacterium sanguinarium* is given by Moore on pp. 188-191 of the paper cited above.

Etiology.—The disease is caused by a non-motile, rod-shaped bacterium (*Bacterium sanguinarium*.) This bacterium causes the disease when injected into the blood or when fed. In a few cases fowls are known to have contracted the disease by picking up the droppings of infected fowls.

More recent work* indicates that there is at least one sort of transmissible fowl leukaemia which is dependent upon a filterable virus, rather than upon a visible organism.

Moore says: "This disease of fowls has not been found in flocks where a good sanitary regime has been enforced. It is highly probable that it is a filth disease, being dependent upon unfavorable environments quite as much as the specific organism for the ability to run a rapidly fatal course and of spreading to the entire flock."

Treatment.—Prevention is the only known treatment. A maintenance of generally sanitary conditions and the avoidance of the introduction of diseased birds are effectual. If the dis-

*Ellerman, V., and Bang, O., Cent. f. Bakt., Orig., 1908 xlvii, p. 595; Ztschr. f. Hyg. u. inf. Krankh., 1909, lxiii, p. 231.

Hirschfield, H., and Jacoby, M., Ztschr. f. klin. Med. 1909-10, lxix, p. 107.

case appears in the flock separate the diseased birds, disinfect the premises, and place the flock under sanitary conditions. The disease will probably disappear, as it is difficult experimentally to maintain an infection when the birds are kept under sanitary conditions.

Prognosis.—Diseased birds usually die in from a few hours to two weeks, but they may recover.

CHAPTER XIV.

DISEASES OF THE NERVOUS SYSTEM.

Apoplexy (Hemorrhage of the Brain).

In this disease the bird usually drops dead or paralyzed without showing any previous sign of illness. The only abnormality found on examination of the dead bird is clotted blood on the brain.

Etiology.—The cause of this disease is the rupture of a blood vessel in the brain and the pressure on the brain due to the blood which escapes. The cause of this rupture may be an unhealthy condition (usually a fatty degeneration) of the walls of the brain blood vessels. The immediate cause of the rupture is increased blood pressure due to fright, over-exertion, or strain in laying (hens often die on the nest). This disease is more apt to attack very fat birds and the degeneration of the vessels is supposed to be due to too rich food or to overfeeding.

Treatment.—Treatment of the affected birds is useless. So-called "apoplexy cures," of which there are some on the market, should be left strictly alone by the poultryman. Only *very rarely* can apoplexy be recognized till after the bird is dead, and then all the pills or potions ever invented for the purpose of swindling a gullible public will be of no avail. If *several successive* deaths from apoplexy occur, modify the ration, giving more green food and less meat and corn. See that the birds have plenty of range.

Prognosis.—The bird is usually found dead or dies in a little while.

Heat Prostrations.

In very warm weather heat prostrations may occur, especially among heavy fowls. This is sometimes considered to be the same thing as apoplexy. The birds suddenly drop insensible or paralyzed.

Etiology.—The cause is pressure on the brain, due to heat, but the blood vessels are not ruptured as in apoplexy.

Treatment.—Mild cases may be treated by applying cold water to the head and keeping the bird in a cool, quiet place.

Prognosis.—Mild cases may recover. Others usually result fatally in a short time. As a preventative avoid overcrowding in hot weather. If the range is not provided with natural shade, supply artificially shaded places in which the birds may find protection from the hot sun during the middle of the day.

Congestion of the Brain (Vertigo, Cerebral Hyperæmia).

A number of abnormal physiological conditions may lead to a congestion of blood in the brain. This is usually associated with a diseased condition of other organs, and hence often occurs as a complication with other diseases. It is sometimes due to injury of the head.

Diagnosis.—Pearson (Diseases of Poultry) gives the following diagnosis of this disease: "It is characterized by staggering, stupor, unusual movements such as walking backward or walking in a circle, unusual and irregular movements with the wings and feet and twisting the head backward or to the side. Sometimes the bird will fall on its side and make peculiar movements with its feet and wings as though attempting to run or fly."

Etiology.—The congestion of the brain is sometimes due to blows on the head or to fright or other intense excitement. Often it is associated with acute indigestion or with the presence of parasitic intestinal worms.

Treatment.—Apply cold water to the head. Administer a laxative (2 teaspoonful of castor oil, or 30 grains of Epsom salts given in water or $1\frac{1}{2}$ grains of calomel). Keep the fowl in a cool, quiet place. If this treatment is not efficient Salmon recommends 1 to 5 grains of bromide of potassium dissolved in 1 tablespoonful of water 3 times a day. If intestinal worms are found in the droppings after the laxative, treat for the removal of these parasites (p. 79).

Prognosis.—The bird may recover if the cause is removed.

Epilepsy.

This somewhat rare disease is characterized by occasional fits. Between these the birds appear normal.

Diagnosis.—Pearson (Diseases of Poultry) describes the behavior of the bird during the fit as follows: "The fowl will make beating movements with its wings, its legs will draw up and it will fall down, sometimes turn over on its back, or it may stand upright with its legs apart, head turned backward and mouth and eyes opening and closing spasmodically."

This spasm passes away after a time and leaves the bird in a normal condition.

Etiology.—It is often impossible to discover any cause of the disease. It is said to be sometimes caused by tumors on the brain and sometimes by intestinal worms.

Treatment.—The only cases that can be treated are those caused by the presence of intestinal worms. An affected bird should be put up and given a laxative and if intestinal worms are passed treat the patient for the removal of these parasites (p. 79).

The birds may live some time with occasional fits and may recover. Cases caused by intestinal worms are definitely cured by removing the parasites.

CHAPTER XV.

DISEASES OF THE KIDNEYS, RHEUMATISM AND LIMBERNECK.

Gout.

Gout is a rather common disease among fowls. It is due to a failure of the kidneys to eliminate the urates. The uric acid content of the blood is greatly increased and the urates are deposited on the surface of the visceral organs, in the tissues of the urinary apparatus and around the joints in the form of crystals of urate of soda. In fowls two forms of the disease occur; the visceral, and the articular.

Visceral Gout.

In visceral gout the only symptoms shown by an affected bird are a loss in weight or "going light" and a slight yellowish tinge to the skin, comb and wattles. The bird has a good and often abnormal appetite. Death occurs suddenly. An examination of the abdominal cavity shows that all the organs and serous membranes are covered with a chalky or talcum-like powder. This powder has a mother-of-pearl luster and on microscopic examination is seen to be composed of small needle-like crystals. These are crystals of urate of soda. These crystals are also found in the urinary organs. The ureter and collecting tubules are often filled with a mass of these crystals. Drs. Hebrant and Antoine give the following test for the urate of soda.

Dissolve the crystals in nitric acid and evaporate in a watch glass. This gives a red onion peel mass which turns purplish blue on the addition of a solution of caustic potash.

Articular Gout.

In this form of the disease the crystals of urate of soda are in nodules around the joints especially of the feet and toes. These nodules sometimes appear like strings of beads on the under side of the toes. They contain a white or creamy thick liquid composed mostly of the crystals. They are at first soft but later become very firm. The presence of the nodules causes stiffness and soreness of the joints and the birds become in lis-

posed to stand or walk. Sometimes the nodules ulcerate, discharging a stringy pus and exposing the cavities of the joints to the air. The development of fistulas cause the death of the bones. The disease is slow in its development and advanced stages are seen only in old birds. The birds lose weight and in advanced stages diarrhea sets in and death from exhaustion follows.

Early stages of this disease are often mistaken for rheumatism on account of the stiffness and soreness of the joints.

Etiology.—The cause of this disease is a disturbance of the normal physiology of excretion so that the uric acid which should be excreted by the kidneys is first retained in the blood and then deposited within the body as crystals of urate of soda. The disturbance is probably due to a diet which is too rich in proteids.

Treatment.—In case of articular gout Salmon recommends rubbing the affected joints with camphorated or carbolic ointment. In well developed cases it is more profitable to kill the birds than to treat them. Visceral gout is not usually recognized while the bird is alive. Prevention is the only reliable treatment for either form of gout. Birds should be kept under sanitary conditions and given plenty of green food. When several birds develop the disease it is well to give the whole flock Epsom salts ($\frac{1}{4}$ to $\frac{1}{2}$ teaspoonful per bird) and to reduce the amount of meat scrap and increase the quantity of green food.

Prognosis.—The disease, especially the articular form, is chronic and advanced cases are only found in old birds. Badly diseased birds may live a long time. Mild cases may recover on corrected diet.

Other Diseased Conditions of the Kidneys.

In the examination of dead birds cases are often observed where the kidneys are diseased. They are often enlarged. Sometimes they contain dark points caused by the rupture of small blood vessels, and in other cases they may contain abscesses. Micro-organisms have been obtained from some cases of diseased kidneys. Nothing is yet known of the causes of these specific diseased conditions in poultry. Some of the cases of under-development, especially of pullets, are apparently due to enlarged kidneys. In such cases the birds usually lose their appetite, become emaciated and their feathers are roughened. No dependable diagnosis of diseased kidneys can be made on

the living fowl. When several cases occur care should be taken to see that the flock receives a balanced ration with plenty of green food, as diseased kidneys may occur from too much protein in the food.

Rheumatism.

A lameness or stiffness is usually considered rheumatism. Many such cases are due to tuberculosis of the joints (p. 60), and others to articular gout (p. 121), but there are muscular and joint inflammations caused by exposure which are properly considered rheumatism. This disease is an inflammation of the connective tissues of the muscles and joints.

Etiology.—It is caused by exposure to cold or dampness. The occurrence of several cases in the flock indicates something wrong in the housing conditions.

Treatment.—The disease is prevented by keeping the fowls in dry, warm, well ventilated houses with well drained runs.

Prognosis.—Fowls protected from further exposure and given a good ration with plenty of green food usually recover.

Limberneck.

This is not properly a disease but a *symptom* which accompanies several diseased conditions. A fowl is said to have limberneck when partial or entire nervous control of the neck muscles is lost. The neck may hang limp so that the head falls on the ground between the feet. Sometimes the bird is able to raise the head from the ground by making a great effort.

A bird is sometimes said to have limberneck when the dorsal or lateral neck muscles are tense, the head drawn convulsively backward, but this is more often called "wry-neck."

Both limberneck and wry-neck are due to nervous disorders which arise from several different causes. "Wry-neck" is usually associated with direct brain or nerve irritation and occurs in epileptic spasms, but also sometimes occurs in rheumatism. Limberneck is usually associated with colic, acute indigestion, intestinal parasites, or ptomaine poisoning.

No treatment for limberneck *as such* can be advised. Effort should be made to ascertain and cure the diseased condition which is responsible for this symptom.

Cases due to rheumatism, colic, indigestion, intestinal parasites, and some of those due to poisoning may recover, if the real cause can be ascertained and treated soon enough.

CHAPTER XVI.

EXTERNAL PARASITES.

Vigilant and continuous attention is necessary to keep fowls free from external parasites. At least 32 species of arachnids and insects are known to be parasitic on fowls. Some of these like the red mites visit their host only to take food and spend the rest of the time on the under side of the roosts, in cracks and crevices and various other places of seclusion. Others like the lice normally stay on the birds, although occasionally some individuals crawl off, especially into the nest. Some of these parasites live upon the surface of the skin and upon the feathers, deriving their nourishment either by sucking the blood like the red mite, or by chewing the skin and feathers like the lice and some of the mites. Some of the mites, however, bore under the skin, causing skin diseases known as scabies or psoric diseases. The most common of these diseases are scabby or scaly leg and depluming scabies.

The economic importance of these external parasites is very great. Fowls infested with one or several of these species of parasites are not profitable. They make a smaller growth in the same time with the same food and their egg production is not equal to similar birds not so infested. Not only are they constantly robbed of some of their tissue and blood but their rest is disturbed. Sleep is as important to the normal physiology of a bird as it is to that of a man.

Keeping a Poultry Plant Free from External Parasites.

It is not necessary for a poultryman to be able to distinguish the 32 species of parasites or to know their life histories in order to keep his plant free from them. It is only necessary to know that some of them stay on the birds and can only be exterminated by treating the birds (usually with a powder) while others spend most of their time on the under sides of the roosts in cracks and can best be exterminated by contact sprays containing cresol or kerosene. A single application is not efficient in

either case but treatment must be repeated 2 or 3 times at intervals of a few days to destroy those that hatch after the treatment or are concealed beyond its reach. A routine procedure by which a poultry plant can be kept free from parasites is very useful. The following method has proven very successful at the Maine Experiment Station and is described in Circular 352 of that Station:

"The routine method which the Station uses in handling its stock with reference to the lice problem is as follows:

"All hatching and rearing of chickens is done in incubators and brooders. The growing chickens are never allowed to come into any contact whatever with old hens. Therefore, when the pullets are ready to go into the laying houses in the fall they are free from lice. Sometime in the later summer, usually in August or early in September, the laying houses are given a thorough cleaning. They are first scraped, scoured and washed out with water thrown on the walls and floor with as much pressure as possible from a hose. They are then given two thorough sprayings, with an interval of several days intervening, with a solution of cresol such as is described in Chap. II. Then the roosting boards, nests, floors and walls to a height of about 5 feet are thoroughly sprayed with the lice paint (kerosene oil and crude carbolic acid described on p. 135). Finally, any yearling, or older birds, whether male or female, which are to be kept over for the next year's work are given 2 or 3 successive dustings, at intervals of several days to a week between each application, with the lice powder described on p. 130, before they are put into the cleaned houses.

"As a result of these methods the Station's poultry plant is at all times of the year practically free of lice."

This method keeps the flock free from lice and the mites which live upon the surface of the skin, but would not destroy those mites which penetrate the skin and cause scabies. These and other more rare parasites should be destroyed when present by special methods. The description of, and treatment for each class of external parasite is given below.

A. LICE (MALLOPHAGA).

Lice are probably the most widely distributed parasite of poultry. They are so common that flocks of fowls that have not been treated to remove lice for a long time are almost sure

to have one or more species present. At least 8 species of hen lice have been found and 5 of these are common. Bird lice are quite different from those which affect man and mammals.

The popular notion that lice may be transmitted from poultry to other animals is quite erroneous. Theobald (*Parasitic Diseases of Poultry*) says: "So particular are bird-lice that it is quite the exception to find one species upon two distinct kinds of birds. Fowl-lice will not even attack the duck nor duck-lice the fowl. Nearly every bird has its own particular Mallophagan parasite or parasites. They may possibly pass to some strange host for a short time, but they will not live and breed. Moreover, . . . particular species attack restricted areas on the same host and are seldom found in other positions." Some of these lice are sluggish, nearly stationary, and confined to a restricted area of the body, while others are active and crawl over the entire body. The 8 known species are described in Theobald's "*Parasitic Diseases of Poultry*," pp. 23-29.

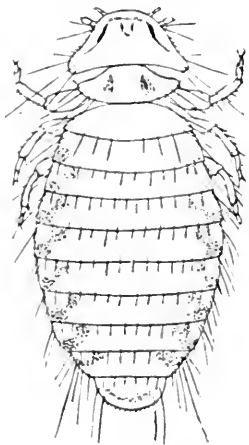


Fig. 24. The common hen louse (*Menopon pallidum*) Greatly enlarged. (From Banks).

The most common and widely distributed hen louse found in this country is *Menopon pallidum*. This louse is shown in fig. 24.

Another species of this genus (*Menopon biscriptum*), which closely resembles *M. pallidum*, is also sometimes found. These are active lice living on all parts of the body. They often crawl on to the hands when handling or plucking birds, and may sometimes be found in the nests.

There are several other lice which sometimes infest poultry. Each of these species is confined to a special region of the host. Although capable of crawling about, the lice of these species for the most part remain nearly stationary, often with their heads buried in the skin and their bodies erect. Two species, *Lipeurus variabilis* and *Lipeurus heterographus*, live among the barbs of the wing and tail feathers. *Goniodes dissimilis* is found under the wings and on the rump. The appearance of two of the species mentioned, viz.,

Lipcurus variabilis and *Goniodes dissimilis*, is shown in figs. 25 and 26 respectively.



Fig. 25. *Lipcurus variabilis*. A louse that infests poultry. Much enlarged. (From Banks after Denny).

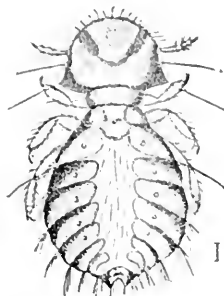


Fig. 26. *Goniodes dissimilis*, a louse that infests poultry. Much enlarged. (From Banks after Denny).

A short account of the mode of life; the conditions which favor their presence; their effect upon the birds; and the generalized life history of hen lice are given in Leaflet No. 57 of the English Board of Agriculture, pp. 3 and 4. From this source the following is quoted:

“These *Mallophaga* have not a piercing mouth, their mouth is simply used for biting. They subsist upon the productions of the skin and fragments of feathers. They cause violent itching, and bite sharply, and must produce considerable pain when present in large numbers, as is too often the case. The feathers, especially the saddle hackle, generally show notched edges with lice infestation. Eight distinct species of lice attack fowls. The presence of these lice is generally ascribed to too uniform or insufficient nutrition, or else to damp, dark, and dirty runs, especially those badly ventilated. Food, either when uniform or insufficient, has no effect upon their presence. Dark, damp places, however, when dirty, are sure to harbor all these pests, especially when badly ventilated. It is also said that breed affects their presence, but observation tends to show that all breeds are more or less subjected to infestation. In every case they set up severe irritation and inflammation of the skin, which often leads to stunted growth, and even death. Lice and other parasites flourish on unhealthy birds.”

Life-history of Lice.—All the lice breed fairly rapidly. The eggs or nits are laid upon the down feathers, as a rule; they are often beautifully sculptured objects, oval in form. In about 6 to 10 days they hatch into small, pale, active lice, which at once commence to irritate the birds. The adults are occasionally found in the nests. Some species are found copulating in the nests, others always on the birds. They live a considerable time. *Menopon pallidum* (Fig. 24) has been kept alive for months upon fresh feathers, the quill epidermis being especially eaten. Before reaching the full-grown state as many as 10 or 12 moults apparently take place, there being little difference in each stage, except the gradual darkening of the markings."

The eggs or nits of hen lice are shown in fig. 27.



Fig. 27. Feathers showing eggs or "nits" of the common hen louse. Enlarged (Original).

Methods of Introduction and Infestation.—It is generally agreed that lice and other parasites flourish best in insanitary surroundings. There must, however, be a source of infestation. Lice are brought to a new place by introducing infested birds. They spread from bird to bird (a) directly during copulation (an infested cock often infests the whole flock), or (b) when two hens occupy a nest together, or (c) from mother to chick. They also pass indirectly from bird to bird by crawling off one bird first on to the nesting material and later on to another bird which uses the same nest. Doctor Sharp has also

observed several lice clinging to the body of a fly parasitic upon chickens. Lice are so much more common than the parasitic fly that it is probable that this insect is of little real importance in the distribution of the lice.

All the lice breed very rapidly. In 8 weeks the third generation is mature and in this generation the estimated number of the offspring of a single pair is 125,000 individuals. It seems important to eradicate an infestation if possible as soon as discovered. However, if kept under sanitary conditions and furnished with plenty of attractive dust, vigorous birds will hold external parasites in check. With some attention to sick birds, setting hens and young chicks, the parasites will give little trouble on a plant conducted with due regard to the principles of hygiene and sanitation (cf. Chap. II).

Diagnosis.—"It should be remembered at all times that the external animal parasites are the most common and frequent cause of trouble in the poultry-yard and pigeon-cote. If the birds are not thriving and conducting themselves satisfactorily, look for these pests, take measures to repress them, and in most cases the results will be surprising and gratifying. When anything is the matter with a horse the maxim is *examine his feet*, and when anything is found wrong with poultry or other domesticated birds, the maxim should be *look for lice*." (Salmon.)

Adult hens may harbor quite a number of these parasites without showing any symptoms which indicate their presence. If they are unthrifty and broody hens leave their nests they should be examined for lice. The biting and digging of the claws of the lice may cause sores and the nervous irritation and loss of sleep may cause general debility and bowel trouble. Little chickens are very susceptible and often die. Lice are frequently found in large numbers on birds suffering from roup, gapes, etc. In some cases their presence has rendered the birds more susceptible to other disease, while in others it is probable that the birds lack sufficient energy to dust themselves.

The sure test for the presence of lice is, of course, finding the lice. Part the feathers under the wing, on the back and around the vent and examine the exposed skin. Examine the head and neck feathers and look between the large feathers of the wing. When present the parasites are easily found by anyone who is familiar with them. It seems incredible that serious infestations can escape the eye of any poultryman.

Treatment.—Sanitary surroundings and liberal range help the birds in their attempts to keep themselves free from lice. The dust bath is very efficient in holding the pests in check. It is doubtful, however, whether the dust boxes which used to be almost universally kept in the poultry house are of any real value. It is a noticeable fact that dust boxes are much less used now than formerly. This Station has not made use of them for a number of years. As commonly made these boxes are too small, and too shallow, and are not filled with the proper kind of material. Hens will use them, in most cases, only as a last resort if at all.

When possible, birds should be given access to dry, sandy ground, and they will provide their own dust bath. Some authors advise adding insect powder to the earth in dust boxes for bad infestations. It is doubtful whether under the best of circumstances this does anything but waste the insect powder. It is better to apply the powder directly to the bird and furnish clean earth for the dust bath.

When hens are used for incubating and brooding it is necessary to give some individual treatment to brooding hens and young chicks. It is also necessary to treat sick hens which are not able to use the dust bath. While it is theoretically possible to exterminate the pests and keep the flock free from them by avoiding the introduction of infected birds, this ideal condition prevails in very few poultry plants. In almost all flocks there are enough lice present to cause trouble if conditions favor their development. Robinson gives a very good method for preventing troublesome outbreaks in the following words:

“Treat with insect powder every sick fowl, every fowl that has been cooped for some days where it could not dust itself, every sitting hen when set, and at least twice again during the period of incubation, the last time just before the eggs are due to pip; treat the young chicks and hen when a brood is taken from the nest, and at intervals of a week until 3 weeks old.”

How to Make an Effective and Very Cheap Lice Powder.

When the treatment of individual birds for lice becomes necessary some kind of powder dusted into the feathers thoroughly, seems to be, on the whole, the most effective and advisable remedy. The powder used must be of such nature, however, that it will be *effective*. There are so-called “lice powders” on

the market which are no more effective than an equal quantity of any inert powdered substance would be. It is not only a waste of money but of time as well to use such powders. At the Maine Station no lice powder has been found that is so satisfactory as that originally invented by Mr. R. C. Lawry, formerly of the poultry department of Cornell University. The following matter regarding this powder (which can be made at a cost of 5 cents per pound) is quoted from a circular issued by the Maine Station:

"In using any kind of lice powder on poultry, whether the one described in this circular or some other, it should always be remembered that a single application of powder is not sufficient. When there are lice present on a bird there are always unhatched eggs of lice ('nits') present too. The proper procedure is to follow up a first application of powder with a second at an interval of 4 days to a week. If the birds are badly infested at the beginning it may be necessary to make still a third application.

"The *lice powder* which the Station uses is made *at a cost of only a few cents a pound* in the following way:

"Take 3 parts of gasoline,

1 part of crude carbolic acid;

"To get the proper results *only the 90-95 per cent. carbolic acid should be used for making lice powder.* Weaker acids are ineffective."

"Owing to the difficulty in getting the strong crude carbolic acid locally in this State at reasonable prices, the Station has experimented to see whether some other more readily obtainable substance could not be substituted for it. It has been found that *cresol* gives as good results as the highest grade crude carbolic."

"The directions for making the powder are now, therefore, modified as follows:

"Take 3 parts of gasoline, and

1 part of crude carbolic acid, 90-95 per cent. strength, or, if the 90-95 per cent. strength crude carbolic acid cannot be obtained take

3 parts of gasoline and

1 part of cresol."

"Mix these together and add gradually with stirring, enough plaster of paris to take up all the moisture. As a general rule it will take about 4 quarts of plaster of paris to 1 quart of

the liquid. The exact amount, however, must be determined by the condition of the powder in each case. The liquid and dry plaster should be thoroughly mixed and stirred so that the liquid will be uniformly distributed through the mass of plaster. When enough plaster has been added the resulting mixture should be a dry, pinkish brown powder having a fairly strong carbolic odor and a rather less pronounced gasoline odor."

"Do not use more plaster in mixing than is necessary to blot up the liquid. This powder is to be worked into the feathers of the birds affected with vermin. The bulk of the application should be in the fluff around the vent and on the ventral side of the body and in the fluff under the wings. Its efficiency, which is greater than that of any other lice powder known to the writer, can be very easily demonstrated by anyone to his own satisfaction. Take a bird that is covered with lice and apply the powder in the manner just described. After a lapse of about a minute, shake the bird, loosening its feathers with the fingers at the same time, over a clean piece of paper. Dead and dying lice will drop on the paper in great numbers. Anyone who will try this experiment will have no further doubt of the wonderful efficiency and value of this powder."

Next to the Lawry powder probably pure pyrethrum or Persian insect powder is as cheap and effective as anything to be had.

A time-honored and effective treatment for lice, especially for young chicks, is greasing. The grease most often used is lard or sometimes lard and sulphur. The latter should not be used for young chicks. The lard is applied with the finger to the head, neck, under the wings and around the vent. Greasing is a somewhat tedious but very effective treatment for lice, especially on young chicks, since lice usually attack them on the head and neck.

Prof. W. R. Graham, in conversation with one of the writers, has strongly recommended the use of blue ointment (*Unguentum hydrargyri*, U. S. P.) to rid birds of lice in cases where individual treatment was demanded.

B. MITES—ACARINA.

Eighteen species of mites are parasitic upon fowls. Only 4 of these are sufficiently injurious and widely distributed to be

of great economic importance. Occasionally one or another of the other species becomes sufficiently abundant to be of local importance. The mites are small 8-legged animals related to the spiders. Some of the mites parasitic on the fowl visit their host only to feed, as the common red mite; others remain on the surface of the skin or on the feathers, as in the case of depluming scabies. Others live under the skin, causing deep-seated skin diseases like scaly leg; still others find their way into the internal regions of the body, living either on mucous membranes like the air sac mite (p. 110) or upon the connective tissue like the connective tissue mite.

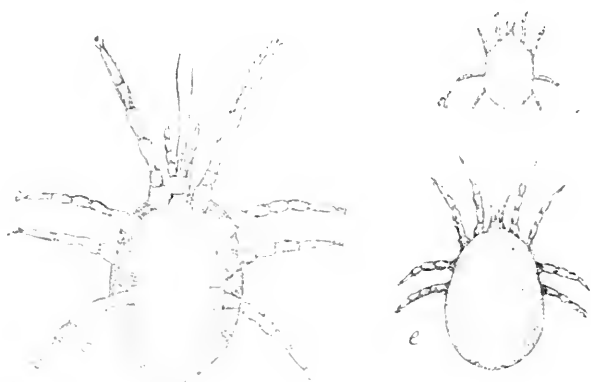


Fig. 28. The common "red mite" of poultry, *Dermanyssus gallinae*, a, adult. d and e, young. (After Osborn).

The most common and most injurious mite parasitic on fowls is the common fowl mite or red mite, *Dermanyssus gallinae*. These mites are present in almost every poultry house that is not kept very clean. When they are present in large numbers they are a serious pest. This mite is a little more than $\frac{1}{2}$ millimeter long. The female is a little larger than the male. When empty they are gray with dark spots, but usually they appear some shade from yellow to dark red according to the amount of fowl's blood they contain. They visit the fowls only to feed and spend the rest of the time on the under sides of the roosts, in cracks and crevices, under collections of droppings or other filth and in the nesting material, especially if such material is dirty straw. The mites breed in these places. They reproduce very rapidly, especially in spring and summer. The eggs are laid in con-

cealed places, usually in cracks containing filth or in dirty nesting material. The young mites are white and have only 6 legs. Their first food is probably filth or decayed wood. They moult several times and their cast skins are often seen as a white powder on the perches. After the first moult the larvæ have 8 legs. The mites are able to live and reproduce for months at least without animal food, but when they are associated with fowls the older larvæ and adults depend upon the blood of the fowls for food. They usually attack the birds at night but sometimes are found feeding on laying or brooding hens during the day. They pierce the skin with their needle-like jaws and suck the blood. The irritation due to the biting of a number of these creatures disturbs the rest of the bird and the loss of blood may be considerable. The mites thrive best in dark, damp, dirty houses and may be found in such houses for months after all fowls have been removed. They will bite man or other mammals, causing severe irritation, but do not remain on strange hosts for any length of time. Fowls should not be allowed to roost in sheds with other animals, as the sheds may become infested with the mites which will disturb the other animals as well as the fowls.

Diagnosis.—If the birds are not doing well, especially if they appear emaciated and dejected, they should be examined at night for mites. In the day time the ends and under sides of the roosts and the cracks in them should be examined. Numbers of the mites are often found by prying up a loose cleat or splitting off a wide loose sliver. They may often be found in old straw nests.

Treatment.—Clean, dry, well ventilated houses which get plenty of sunlight are seldom badly infested. The first step in eradicating or controlling the pest is thoroughly to clean the houses. Remove the droppings and all the old nesting material. Clean and when possible scrub or wash with a stream from the hose all the perches, nests, floors and walls. Spray or paint the perches, nests, walls and floors with a 5 per cent solution of cresol (see Chap. II for directions for making this). Prof. H. C. Pierce has tested various remedies for mites and finds none so effective as this. Use plenty of solution and make the spraying thorough. Every crack and crevice should be flooded.

Another spray successfully used is: 3 parts kerosene and 1 part crude carbolic acid. Still a third, kerosene emulsion is recommended by the United States Department of Agriculture. Their method of making this spray as given in Circular No. 92 is as follows: "To make this, shave $\frac{1}{2}$ pound of hard soap into 1 gallon of soft water and boil the mixture until the soap is dissolved. Then remove it to a safe distance from the fire and stir into it at once, while still hot, 2 gallons of kerosene or coal oil. The result is a thick, creamy emulsion. Dilute this stock mixture with 10 parts of soft water, and apply as a spray or with a brush, being careful to work it into all cracks, crevices, and joints of the building."

With any of these sprays it is necessary to make two or more applications at intervals of a few days to destroy the mites which hatch after the first application. The liquid may be put on with a hand spray pump or with a brush. Cleanliness, fresh air and sunlight are cheap and effective preventatives.

Scaly Leg.

A minute mite, *Knemidocoptes (Dermatoryctes) (Sarcoptes) mutans*, is the cause of a contagious disease affecting the legs of fowls, turkeys, pheasants, partridges and cage birds. According to some authorities it sometimes affects the comb and beak also. The mites excavate places under the skin where they live and breed. The most thorough study yet made of this parasite and its effect on birds is that of Haiduk.*

Diagnosis.—This very common disease is easily recognized by the enlarged roughened appearance it gives the foot and shank. This appearance is shown in fig. 29, with a normal leg for comparison.

The disease is present in most flocks unless especial care has been taken to exclude it. It is slightly contagious, but usually only a few birds in a flock appear to be infected. The scales on the foot and leg of an affected bird are raised by a crusty substance deposited beneath them. The lesions usually appear first near the joints between the toes and foot. The parts affected first appear to be enlarged and then the scales are raised, giving the roughened appearance shown in B fig. 29. In early

*Haiduk, T. Die Fussränder des Geflügels. Inaug. Diss. Giessen, 1909, pp. 1-58, Taf. I-VI.

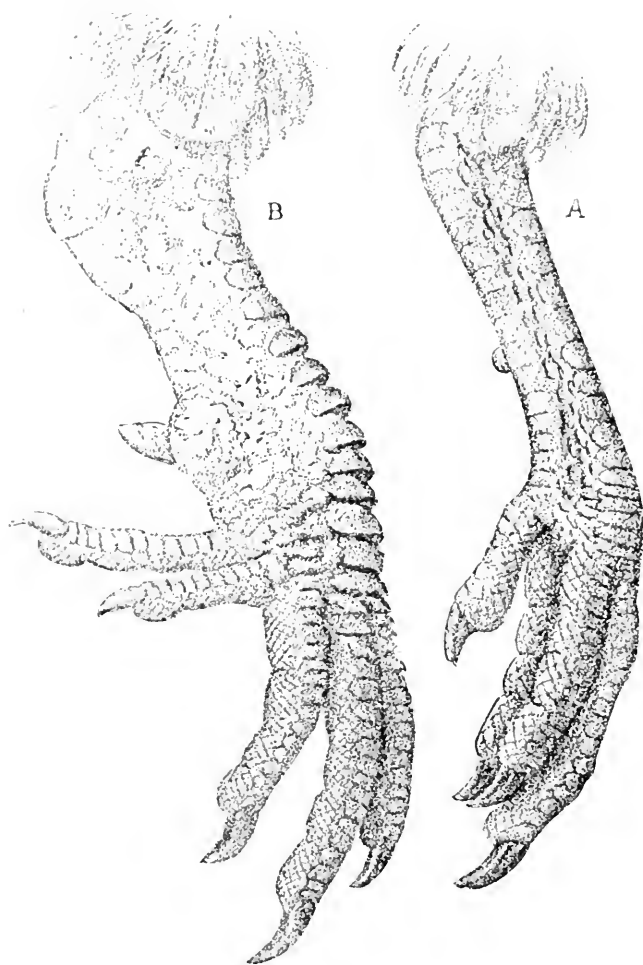


Fig. 29. A. Normal leg of hen. B. Leg of hen affected with scaly leg. (After Megnin).

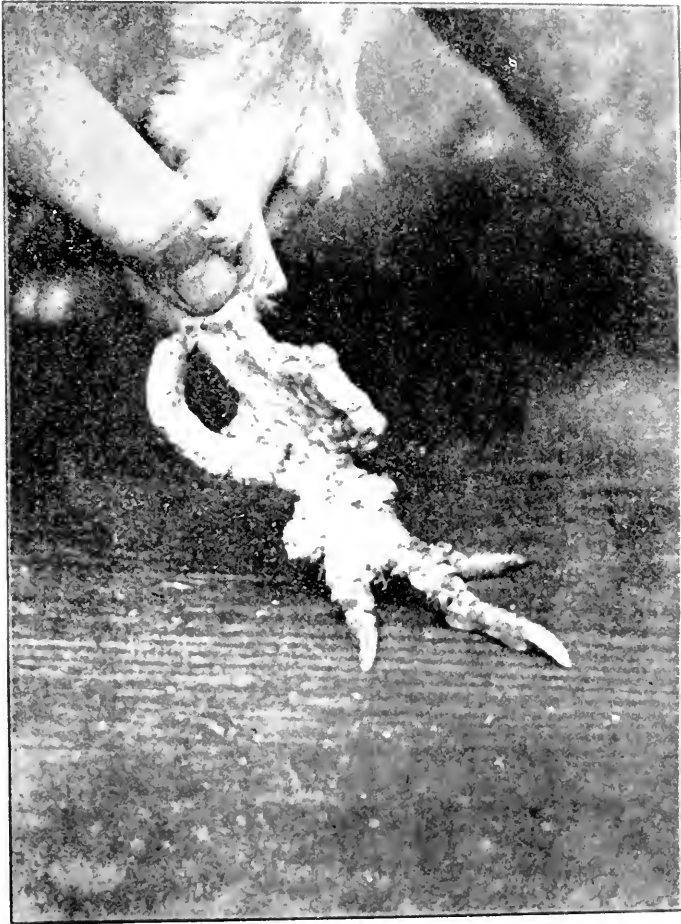


Fig. 30. Photograph of the leg of a hen affected with scaly leg.
(After Haiduk).

stages the disease does not appear to disturb the general health of the fowl. As it progresses the birds become lame and sometimes the foot becomes so badly diseased that joints or even whole toes drop off. The photograph of a badly affected leg is shown in fig. 30. The two legs are usually affected equally.

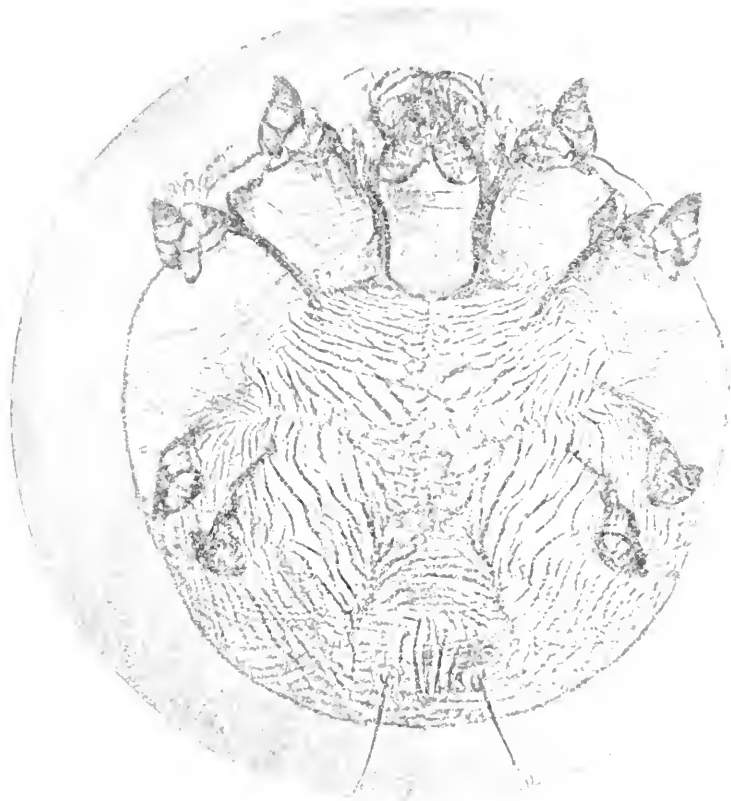


Fig. 31. Photograph of the adult female of the mite *Knemidocoptes (Dermatoryctes) mutans*. (After Haiduk).

Etiology.—The disease is caused by the minute parasitic mite *Knemidocoptes mutans* (figs. 31 and 32).



Fig. 32. Photograph of the six-legged larva of *Knemidocoptes (Dermatoryctes) mutans*. (After Haiduk).

The mites bore under the scales of the foot and leg and burrow deeper and deeper into the tissue. They set up an irritation which leads to multiplication of cells and the exudation of serum. This accumulation forms crusty deposits beneath the scales. These crusts contain many depressions in which are imbedded female mites containing eggs. The larvae and the males are usually found beneath the crusts. The relations just described are shown in fig. 33, which is a picture of a section of the skin of a "scaly" leg.



Fig. 33. Section of the skin of the leg of a fowl affected with scaly leg.

- a. Papilla with pigment cells.
- b. Lymphatic tissue in the papilla.
- c. Epidermis: stratum profundum.
- d. Epidermis: stratum corneum.
- e. Section through a mite.
- f. Young mite.
- g. Cavity excavated by mites.
- h. Excrement of mite.
- i. Horny layer between the mite excavations.

(From Haiduk, after Olt).

As the disease progresses the mites which are becoming constantly more numerous penetrate very deep into the tissues, causing lameness and sometimes the loss of some of the toes.

The infection from bird to bird probably takes place on the roosts or from mother to chick. Robinson believes that the birds most likely to be infected are those with a deficient supply of oil in the skin. The conditions which favor its spread in a flock are dry, barren runs, especially on alkaline soils or in yards filled with ashes or cinders. Foul roosting places also favor the spread of the disease. The disease is easily cured and it is worth the trouble of any poultryman to cure all the affected birds and to examine any birds purchased that infected ones may be treated before they are introduced into the flock.

Treatment.—Individual treatment is necessary to cure the disease. This treatment consists in the application of some penetrating oil to the diseased parts. A large number of oils and ointments have been used successfully. If the case is not far advanced and if there is no especial hurry about bringing about the cure the application of the oils or ointments at intervals of 2 or 3 days will soon do the work. If the birds must be cured quickly for show or sale purposes the cure is hastened by removing the scales and crusts before applying the medicine. This may be done by brushing with a stiff toothbrush before each treatment. Or the feet may be soaked for a few moments in warm soapy water and then brushed. When the disease is far advanced it is best to begin the treatment by the removal of the scales.

Haiduk's experiments show that one of the very best cures for scaly leg is *oil of caraway*. *This is best applied in an ointment made of 1 part of oil of caraway to 5 parts of white vaseline.* Oil of caraway is very penetrating and is not nearly as irritating as some of the treatments more usually advised. This ointment should be rubbed into the leg and foot every few days until signs of the disease disappear.

Hill recommends daily application of an ointment made of equal parts of vaseline and zinc ointment, or in severe cases of one made of 1 ounce of sulphur, $\frac{1}{2}$ ounce of oxide of zinc, 1 dram of oil of tar and 2 ounces of whale oil mixed together.

There are two common remedies used successfully by poultrymen. These are irritating and should be used with some caution. They have the advantage of being quickly applied. The best of these is probably a mixture of 1 part of coal oil or kero-

sene and 2 parts of raw linseed oil. If a quick cure is imperative a half-and-half mixture may be used. Robinson in *Farm Poultry*, May, 1907, recommends a quick and easy method of applying this. It is to take a tall quart measure of the liquid to the hen house at night and dip both legs of each infected bird into the measure of oil, holding them there for a moment and then allowing them to drip for a moment more and then replacing the hen on the roost. With any treatment which involves the use of kerosene care must be taken not to wet the feathers of the leg, as this causes irritation and sometimes burns the skin much as the human skin is burned when it is rubbed with kerosene and covered with flannel.

A second method of applying kerosene is to put a teaspoonful of the oil in a quart measure of water and treat the birds by the method given above. The same care should be taken not to wet the feathers.

The advantage of these treatments is their easy and rapid application to a number of birds.

Depluming Scabies.

The mite *Sarcoptes laevis* var. *gallinae* (fig. 34) is the cause

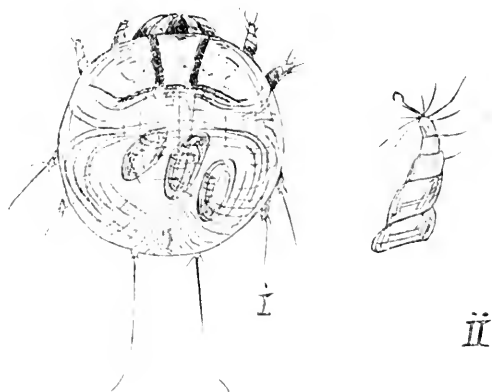


Fig. 34. Egg containing female *Sarcoptes laevis* var. *gallinae*. (After Theobald).

of a kind of scabies in fowls which causes the feathers to break off at the surface of the skin.

Symptoms.—This disease usually appears in spring and summer and is characterized by the dropping off of patches of

feathers on different parts of the body. It usually begins at the rump and spreads to the head and neck, back, thighs and breast. The large wing and tail feathers are not usually lost. The exposed skin is normal in appearance. Around the stumps of the lost feathers and at the end of the quills of feathers near the bare spots are masses of epidermal scales. On microscopic examination these scales are found to be composed of numerous mites and their debris. The irritation of the mites often causes the birds to pull their own feathers. Birds affected often pull each others' feathers. Some of the so-called feather eating is due to the presence of this parasite, but fowls sometimes pull each others' feathers when the parasite is not present. Salmon says this disease does not affect the general health of the bird and does not appear to disturb gain in flesh or egg production, but Theobald says that the disease checks egg laying in hens and affected cocks become emaciated and sometimes die.

Etiology.—The mite *Sarcoptes laevis* which causes this disease is smaller than the one which causes scaly leg. They live at the base of the feathers in the epidermal debris referred to above. A flock becomes infected by the introduction of one or more birds carrying the mites. The mites are spread from bird to bird by the male in copulation. The distribution is often very rapid so that the whole flock is soon affected.

Treatment.—The disease should be prevented by taking care not to introduce infested birds. If it appears all affected birds should at once be isolated. The mites yield easily to treatment. The infested areas may be rubbed with some of the less irritating ointments recommended for scaly legs (see p. 141).

The following list gives some ointments in the order of their desirability for use on the body.

Oil of caraway ointment (1 to 5).

Balsam of Peru.

Creolin treatment (1 to 10).

Helmerich's ointment.

Salmon gives a modification of the latter ointment which he considers an improvement for use in depluming scabies.

Flowers of sulphur, 1 dram,

Carbonate of potash, 20 grains,

Lard of vaseline, $\frac{1}{2}$ ounce.

Scabies may also be cured by liquid applications. The two following preparations are recommended by Salmon: A solu-

tion of balsam of Peru in alcohol (1 part of balsam to 3 of alcohol) or 1 dram of creolin, 2 ounces of glycerine, $\frac{1}{2}$ ounce of alcohol and $\frac{1}{2}$ ounce of water. Either of these liquids are applied by rubbing into the skin. The application should be repeated every 4 or 5 days until the disease is cured.

Other Mites Affecting Poultry.

Another form of *Body Mange* or scabies is found associated with the mites *Epidermoptes bilobatus* and *Epidermoptes bifurcatus*, but it has not been certainly demonstrated that they are the cause of the disease. Present evidence indicates that they are.

The disease closely resembles *favus* (p. 147) but usually does not affect the head. The regions commonly attacked are the neck, breast, the wings and the body under the wings. It sometimes affects the entire body, including the head. The skin becomes irritated and shows an accumulation of scales or crusts especially at the base of the feathers.



The mites live on the skin at the base of the feathers. Since the mites are sometimes found on birds which show no signs of scabies and since the disease so closely resembles *favus*, which is known to be caused by a fungus, it is sometimes supposed that this mange is also due to a fungus and that the mites are inoffensive.

Five species of mites have been recorded which live upon the feathers of fowls. These are fairly abundant but do no harm.

Two mites live within the body of fowls. One of these, the air sac mite, is described elsewhere (p. 110). The other the connective tissue mite, *Symplectoptes cysticola*, is found in the connective tissue of the fowls. They produce local irritations giving rise to tubercles but apparently do not affect the health of the bird.

The larvae of the so-called "harvest-bug" (which is not a bug at all) *Tetranychus (Thrombidium) (Leptus) autumnalis* sometimes attacks poultry. The appearance of this mite is shown in fig. 36.

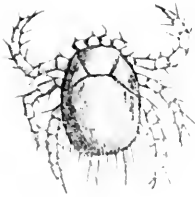


Fig. 36. "Harvest bug," *Tetranychus (Leptus) autumnalis*, larval form. (After Murray).

This small brick red mite, rarely visible to the naked eye, is bred upon berry and currant bushes, vegetables and grain, but when opportunity offers it bites almost any animal, often attacking man. It sometimes causes considerable mortality among late hatched chickens which frequent its breeding places. The parasites fasten themselves so firmly by their claws and palpi that they can only be detached by force. They produce intense irritation which often leads to epileptiform symptoms and death follows in a few days.

Theobald suggests dusting flowers of sulphur among the feathers when the parasites are present. Probably the Lawry lice powder (p. 130) would be more effective. When these parasites are abundant chickens should be kept away from the places where the mites breed.

Other External Parasites.

The *dove cot bug* or "bed-bug" of poultrymen, found in pigeon lofts, sometimes invades neighboring hen roosts. It probably sometimes attacks fowls. It resembles closely the bed bug found in dwelling houses and like this pest is hard to exterminate as it can live almost indefinitely on dead organic matter. This tick hides in cracks during the day and attacks its host only at night. Persistent repetition of the sprays recommended for hen roosts infected with red mites (p. 134) will destroy these parasites.

Leaflet No. 57 of the English Board of Agriculture gives the following brief account of the *hen flea*, *Pulex gallinae (or avium)*:

"The fleas, which are true insects, belong to the order of flies (*Diptera*). They feed upon the blood. One species only lives upon the fowl, namely the bird flea (*Pulex gallinae or avium*) which attacks also most other birds. The hen flea, as it is generally called, is abundant in dirty fowl runs, and especially in the nests where straw is used. The adult flea is dark in colour, and, as in all fleas, is devoid of wings. The fleas are provided with very sharp piercing mouths. They are what

are termed 'partial parasites'—parasites that only go to their hosts to feed. The fleas are not noticed on the birds because they generally attack them at night; then, however, they do much harm, causing constant irritation and loss of blood, and depriving them of rest."

Life-history of Hen Flea.—The female flea lays her eggs (nits) chiefly in the nests amongst dust and dirt and in the crevices of the walls and floor. These nits give rise to pearly white maggots, with brown horny heads, which can often be found in the bottom of the nests amongst the dust. These larvae are mature in 2 or 3 weeks, then they reach about 1-6 of an inch in length. In warm weather they may be full fed in even 10 days. They then spin a pale cocoon amongst the dirt, in which they pupate. The pupa is at first pale brown, then dark chestnut brown. In this condition the flea remains 10 to 21 days, when the pupa hatches into the adult. They breed all the year round, but chiefly in warm weather. It is well to remember that, whenever there are dark and dirty hen roosts, there are sure to be a number of *Pulex gallinae*."

Treatment. These parasites do not usually occur under sanitary housing conditions. When they occur the houses should be cleaned and sprayed as for red mites (p. 134). Theobald recommends the use of excelsior or shavings instead of straw for nesting material as the fleas do not breed as readily in this material.

CHAPTER XVII.

DISEASES OF THE SKIN.

Favus (Baldness or White Comb).

This disease of the skin attacks poultry as well as man and the domestic mammalia. In mammals it is called *tinca favosa* or *favus*.

Diagnosis. The disease usually appears first as small gray white spots on the comb, wattles, eye lids and around the ears, that is, on the unfeathered parts of the head. The spots enlarge and run together forming a scaly crust which becomes thicker until in 3 or 4 weeks it may be as much as 8 millimeters (1-3 inch) thick. The scales which make up the crust are often formed in concentric rings, the margins raised and the centers depressed, so that the scale is somewhat cup shaped. When the crust is removed the skin appears irritated and in places the surface is somewhat raw. The disease spreads to the feathered parts of the head, the neck, and the region around the vent. The base of the feathers becomes surrounded by concentric rings of the scaly material. The feathers become dry, erect, and brittle and finally break off or fall out leaving a disc-shaped scale with a depression at the bottom where the base of the feather was located. The bird's head and neck and patches around the vent become bare of feathers. The exposed skin is covered with the cup-shaped scales. Sometimes the disease spreads over the whole body until the bird becomes nearly naked. The diseased bird has a peculiar disagreeable odor, sometimes likened to the odor of a musty grain or to mouldy



Fig. 37. Head and neck of a fowl affected with generalized favus. (After Pearson).

cheese and sometimes to cat's urine or to macerating animal material. In early stages the general health does not appear to be affected but as the disease advances the bird loses its appetite, becomes poor and exhausted, and finally dies.

Etiology. The disease is caused by the fungus *Achorion schonleinii*

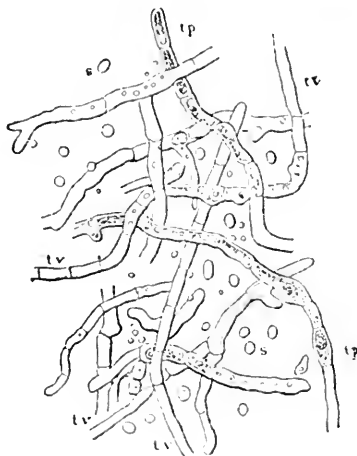


Fig. 38. The fungus *Achorion schonleinii* which causes favus in poultry. tv.—Empty tubes of mycelium. tp.—Tubes of the mycelium containing protoplasm and spores.

This fungus is found in the cup like scales on the skin and in the quills of the feathers of the diseased parts. If the favic cups or scales are moistened with weak acetic acid and examined under the microscope it will be seen that they are formed of branching, thread-like mycelial tubes of the fungus closely interwoven with one another, spores of the fungus, and epithelial scales from the skin of the host imbedded in a viscid substance secreted by the fungus. Some of the tubes of the mycelium contain spores. Many of the spores are found free among the filaments. They are usually found in groups of 3, 4 or 8.

Both the mycelium and spores of the fungus are found in the quills of the feathers of the diseased parts. The fungus sometimes penetrates even the barbs of the feathers.

Favus is a contagious disease and gets into a flock by the in-

roduction of an affected bird. It is less likely to attack strong, vigorous birds than those in poor condition. It usually starts at a point where the skin is broken. Young birds are more susceptible than old ones. The large Asiatic breeds are specially liable to take the disease. No breed is entirely immune.

Megnin and some other authors consider this disease distinct from the favus of man and other animals, but numerous recorded observations indicate that it is the same disease and may be communicated to man. In handling affected birds, therefore, care should be exercised to prevent infection of cuts or scratches.

Treatment. Diseased birds should not be introduced into a flock. If the disease has been accidentally introduced the affected birds should be isolated as soon as possible. The flocks should be watched in order to discover and isolate any new cases that appear.

In early stages the disease yields readily to treatment. Zürn considers treatment economically advisable only before the feathered parts of the body are attacked. The disease may sometimes be cured at a later stage. The value of the affected bird must determine whether or not it is worth treating.

As much of the crust as possible should be removed. This is best done by first softening the scabs with warm water or with oil or glycerine. Robinson recommends scraping with the back of a knife or a spoon handle. The parts should then be painted with tincture of iodine or should be bathed with corrosive sublimate solution, 1 part of the sublimate to 1000 parts of water, and then rubbing with the ointment described on p. 30. In using the corrosive sublimate solution it should be borne in mind that this solution which unless colored with some dye looks exactly like water is extremely poisonous to men and animals when taken internally. Dishes or bottles of corrosive sublimate should never be left where they can be accidentally mistaken for water.

Lard and sulphur are often used successfully in the treatment of favus. Use nearly as much sulphur as lard and work them into a smooth salve. In early stages the disease usually yields to application of lard or oil alone.

Prognosis. In early stages the favus may be cured at the expense of a small amount of attention. After the feathered parts become affected a cure requires considerable labor as the fungus is better protected from the applications.

White Comb.

This name is often used for favus, but some authorities (e. g., Vale) use it to designate a condition of the comb characterized by a white powdery scurf of the surface. The comb is light colored and the white scales or flakes are particles detached from the epidermis. This condition is thought to be due to anemia. Wright says that it "appears generally due to dirt, or overcrowding in small space, or want of green food." The only treatment advised is to place the birds under sanitary conditions and give them a good balanced ration.

Chicken Pox (Sore Head or Epithelioma Contagiosum).

This contagious disease of poultry, although widely distributed in the northern states, is less common and serious here than in the Gulf States and Hawaiian Islands. It is impossible at present to decide whether this is a distinct disease or a form of roup which affects the skin of the head. This can only be determined when further investigations have revealed the real cause of these diseases.

Diagnosis. The disease usually appears as warty nodules on the unfeathered parts of the head. They look like the tumors in the nasal passages and eye sockets of birds affected with roup.

Freidberger and Frohner* give a good description of these nodules on the skin of the head, as follows:

"Their favorite seats are those parts of the head that are not covered with feathers; root of the beak, neighborhood of the nostrils, angles of the mouth, lobes of the ear, parts adjacent to the auditory meatus, wattles, surface of the face, edges of the eye-lids, intermaxillary space, and especially the comb. They sometimes spread over the feathered parts of the head, throat and neck, and may occur on the outer surface of the thighs, abdomen, under the wings and in the vicinity of the cloaca. At first these epitheliomata appear in the skin, as flat nodules, which soon become prominent, and which vary in size from a poppy seed to a millet seed. Later on, they usually attain the size of a hemp seed. They are of a reddish-gray or yellowish-gray color, often show distinctly in their earlier stages of development a peculiar greasy, nacreous lustre; and are rather firm

*Freidberger and Frohner. *Veterinary Pathology* (Vol. I. Hayes trans.). Quoted from Cary.

to the touch. Their surface soon becomes covered with a dirty-gray, yellowish-brown or red-brown crust. They are discrete and disseminated in considerable numbers on the erectile tis-



Fig. 39. Sore-head crusts on comb, eye-lids and skin.
(After Cary).

sues, etc. They vary in size according to their age; and frequently lie rather close to one another, so that the affected parts look as if coarsely granulated; or they are crowded together in such a manner as to give the appearance of large warts with divisions through them, or mulberry-like hypertrophies. Even single nodules, to say nothing of the groups, may attain the size of a lentil, pea, cherry-stone, broad bean or larger object. The older they become the rougher, and more covered with knobs will be their incrustated surface."

"If the edges of the eye-lids be affected by these tumors, the lids will become nodular, swollen and closed. The conjunctiva in this case also suffers; it projects outwards because catarrhally inflamed; assumes a yellowish color at the seat of eruption; and its surface becomes covered with crusts. Purulent conjunctivitis may appear and the inflammation may spread to the sclerotic and cornea, with keratitis and panophthalmia as the result. If, as sometimes happens with pigeons, the eruption of nodules extends over the whole of the skin of the eye-lids and its neighborhood, the entire eye will become covered with mulberry-like proliferations of various sizes."

The presence of these nodules on the epithelium of the head is often (but apparently not always) accompanied with characteristic roup lesions of the nasal cavities, mouth and throat. As long as the disease is confined to the skin of the head the general health of the bird does not seem to be affected. Recovery may take place without treatment in from 10 to 20 days. The nodules in such cases dry up and fall off. Usually, however, the disease is not self-limited, but advances. The eyes may become closed so that the birds cannot see to eat. They get poor and die from exhaustion. When the mucous membrane of the mouth develops diphtheritic membranes death occurs earlier than in other forms.

Etiology. The lesions of this disease resemble the lesions of roup and many of the same micro-organisms are found in the two cases. The organisms isolated from the lesions of sore-head include several bacteria, a coccidium, a yeast and several moulds. The coccidium, one of the moulds, and one of the bacteria have each been considered the cause of the disease by different workers. The real cause of the disease and its relation to roup must be determined by further investigations. The following discussion of the etiology of sore-head is given by Cary (Chicken-Pox or Sore Head in Poultry. Alabama Agric. Expt. Stat. Bulletin 136):

Transmission and Dissemination. It is evidently infectious; because the disease in all its forms, spreads rather rapidly from one chicken or pigeon to another. Ward, Harrison and others have transmitted, in some cases quite readily by carrying small amount of diseased material (exudate and blood), from a sore-head chicken to healthy chickens. It is also quite certain that chicken pox and pigeon pox are identical or one and the same disease."

"Mosquitoes, gnat flies, chicken mites (ticks), chicken lice, chicken foot mites (*Sarcoptes mutans*) and possibly cock-roaches may sometimes be carriers of the real virus. It seems quite certain that mosquitoes can transmit the virus from water or some other source, under certain conditions. Warm and wet weather seem to increase the virulency of the virus and favor the rapid transmission of the disease. It is not impossible that ants may have a role to play in the transmission or cause of sore-head."

Pathological Anatomy. On the skin the small, greasy-like nodules, or hypertrophied nodules of the skin, contain epithelial

cells that have in them 'greasy' refractive bodies that stain yellow with picro-carmin and the nuclei of the epithelial cells become 'reddish brown' in color. Nearly all the epithelial cells in the nodule appear larger than normal and contain the refractive bodies. In the younger epithelial cells these bodies (young coccidia) are relatively small and occupy $\frac{1}{4}$ to $\frac{1}{3}$ of the epithelial cavity. In the older or outer or cast-off epithelial cells these refractive bodies are said by Freidberger and Frohner to occupy the entire cavities of the epithelial cells. The invaded or infested epithelial cells are unusually larger than the epidermal cells of the healthy neighboring skin. Among the cast-off mass of epithelial cells are found round refractive bodies and numerous nuclei of leucocytes or pus cells. The subcutaneous connective tissue is hyperaemic (congested) and is infiltrated with cells (leucocytes and nuclei of disintegrated cells). Possibly some of the small nuclei-like bodies among the cells in the subcutis may represent one stage in the development of coccidia. Many observers have, also, found various bacteria in the nodule and subcutis."

"In the diphtheritic membranes on the mucous surfaces of the mouth, pharynx, larynx and oesophagus, the epithelial cells are sometimes invaded by refractive bodies in the same manner as the epithelial cells of the skin and in the mass of diphtheritic exudate and cast-off cells on the mucous surface may be found the well formed coccidia * * * *. But the refractive bodies are not found in the epithelial cells of mucous exudates of skin nodules in every case. I have found them only in the early development of the nodule and the diphtheritic exudate, and have never found the mature coccidium in the nodules of the skin."

"When the exudate on the mucous surface or the crust of the nodule of the skin is torn off the raw surface bleeds rather freely and a fresh mount of this blood contains a short oval bacillus, numerous round bodies usually said to be nuclei of leucocytes; and a few polynuclear leucocytes. Repeated inoculations in the comb, wattles, skin and conjunctiva and oral mucosa of healthy chickens of various ages, with this blood, fresh from under a nodule or a diphtheritic exudate, has failed to produce positive infective results. I have also tested it on pigeons with like negative results."

"The exudates on the mucous membrane of the throat, mouth or larynx appear to be very much alike in all forms of the disease."

"The *period of incubation* is said to vary all the way from 2 to 20 days. In December I placed a newly-purchased barred Plymouth Rock cock (18 mos. old) in a yard with my chickens, many of which were recovering from sore-head, and in 24 hours this cock developed a good case of sore-head on the wattles, comb and eye-lids. There were mosquitoes in the roosting house. The period of incubation varies with mode of transmission, virulency of the virus, the weather (rapid in damp warm weather and slower in cool and dry weather), and the age and condition of the chicken or pigeon. Chicks from broiling size up to 7 or 8 months old seem to be most susceptible. Chickens with large combs seem to be more susceptible than birds with small combs and wattles."

Treatment. The introduction of diseased birds into healthy flocks should be avoided. The same precautions should be practised in the isolation of sick birds and disinfecting the houses as is advised for roup (p. 99). When the disease is localized a small amount of individual treatment cures many cases. The crust or nodules should be removed and the places treated with creolin (2 per cent solution) or corrosive sublimate (1-1000) (p. 29) and dusted with iodoform. The iodoform may be put into the eye. When the disease is not far advanced one such treatment may be followed by daily greasing with the ointment recommended on p. 30 or with vaseline or lard. In bad cases the iodoform should be used daily for a few days and then the ointment. When cases have roup or diphtheritic symptoms treat as recommended for roup (p. 100).

Prognosis. "The mortality is said to vary from 50 to 70 per cent of the affected birds. I judge this a low per cent of losses if birds are left to themselves with proper care or treatment. But if individual treatment is patiently and regularly applied the mortality can be cut down to less than 20 per cent. If only the skin of the head, and the comb and wattles are involved, one should lose less than 10 per cent. If the mouth and pharynx are also involved, less than 10 per cent should die. But if the nasal passages and trachea are involved, or the intestines become involved,—good care and treatment may save 50 to 80 per cent." (Cary).

CHAPTER XVIII.

DISEASES OF THE REPRODUCTIVE ORGANS.

The direct economic importance of poultry lies in the production of two things, viz., meat and eggs. For the production of the latter the poultryman is dependent upon the activity of the reproductive system of the hen. Under natural conditions in the wild state, the progenitors of the domestic fowl laid relatively few eggs. Judging by other species of wild birds of the present day, however, it is highly probable that the wild progenitors of poultry possessed the potential ability to lay much more than the usual number of eggs provided they were removed from the nest as fast as laid. Under domestication this practice of removing the eggs as fast as laid, together with the feeding of rich foods, and still other factors, lays heavy demands upon the reproductive system. It is not remarkable that an organ system which under conditions of nature produced from 12 to perhaps 30 units per annum, frequently breaks down under the strain of producing from 100 to 250 per annum of the same kind of units. It could only be expected that, as is actually the case, the egg producing organs would be particularly liable to disease.

ANATOMY AND PHYSIOLOGY.

In order that the discussion of the diseases of the reproductive organs may be intelligible it is desirable to preface it with a brief account of the anatomy and physiology of the organs of reproduction in the hen. Because of the fact that the corresponding organs in the male are less subject to disease, on the one hand, and are perhaps better understood by the poultryman, because of the prevalence of the practice of caponizing, on the other hand, it will not be necessary to discuss the male in detail in this connection.

The organs concerned in egg production in the hen are shown graphically in fig. 40. This picture and the accompanying ex-

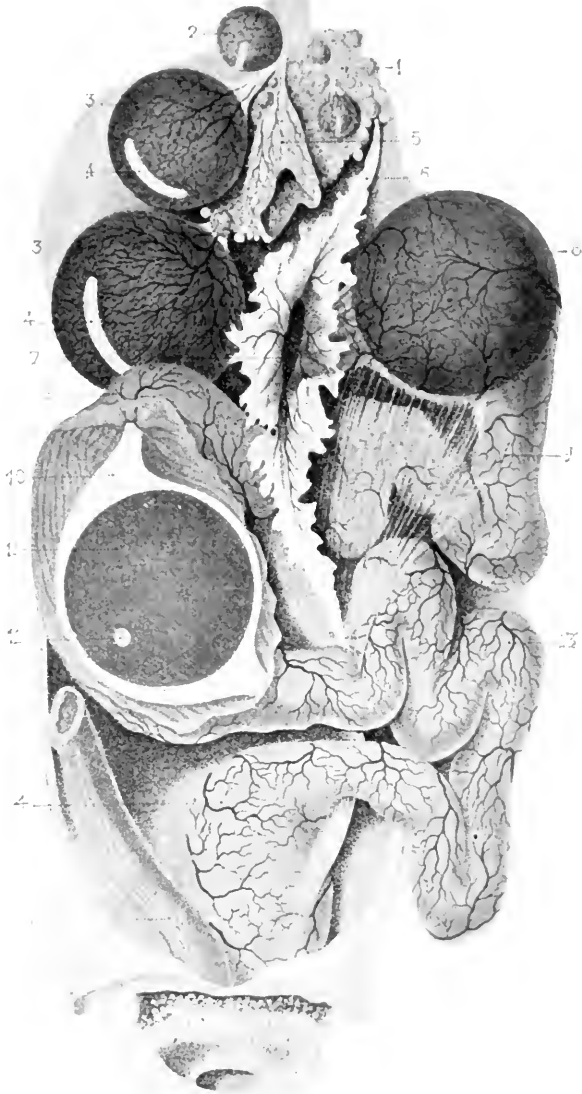


Fig. 40. The reproductive or egg producing organs of a hen. See text for explanation of figures. (After Duval).

planation of it will make clear the various parts of this organ system. All of the points shown in the figure may easily be demonstrated on a hen, killed during a period of laying activity. It should be noted that this picture is somewhat diagrammatic and not in accord with normal conditions in respect to at least two points. These are: (1) there are two eggs in the upper portion of the oviduct. Normally there would be but one there at a time. (2) The proportionate lengths of albumen portion, isthmus and uterus are not correctly indicated.

In this figure the various numerals have the following significance:

1. The *ovary*; region in which the ovules (later to become yolks) are still small in size.
2. An *ovule* in an intermediate stage of development, larger than those at 1, but still not ready to pass into the oviduct to be laid. It is contained in a very vascular capsule, known technically as the *follicle*.
3. Ovules still larger and containing more yolk. The lower one is nearly ready to leave the ovary and pass down the oviduct.
4. It will be noted that on all the larger follicles there is one region (forming a line) in which there are no blood vessels. This region (4, 4) is known as the *stigma*. Here the follicle wall breaks and allows the ovule (yolk) to leave the ovary preparatory to laying.
5. An empty *follicle* in which the *stigma* has opened and the yolk passed out.
6. Anterior end of the margin of the *funnel* (or *infundibulum*) of the *oviduct* or egg-tube. When an ovule is about to be discharged from the ovary these funnel lips or margins wrap around that portion of the ovary, so that the ovule may certainly pass into the oviduct and not into the abdominal cavity.
7. Opening of the *funnel*. Through this opening the yolk passes into the oviduct.
8. A yolk which has just passed through the funnel opening into the upper portion of the oviduct.
9. *Albumen secreting portion* of the oviduct in which the greater portion of the albumen or white of the egg, is secreted by glands in the walls of the oviduct in this region.
10. First layer of albumen, or white, secreted about the yolk.

From this layer are formed the *chalazae*, or cords of twisted, thickened albumen, at each pole of the yolk.

11. Yolk, around which albumen is being secreted.

12. The *germinal disc*. This is the living portion of the egg, from which the future chick develops, the main mass of yolk serving as food material for the developing embryo during the process.

13. Anterior end of the *isthmus* of the oviduct. The primary function of the isthmus is to secrete about the egg the *shell membrane*, the dense white membrane closely adherent to the inside of the shell of an egg.

14. The *uterus*, or *shell gland*, in which the shell is put on the egg.

15. The *rectum*.

16. The walls of the abdomen cut and folded back.

17. External opening of the *cloaca*, or common space into which open (a) the rectum, (b) the oviduct and (c) the ureters, or kidney ducts.

The processes concerned in the formation of an egg are thus summarized by Lillie (The Development of the Chick, New York, 1908, pp. 23-25):

"The formation of an egg takes place as follows: The yolk, or ovum proper, escaped by rupture of the follicle along a pre-formed band, the stigma (fig. 40), into the infundibulum, which swallows it, so to speak, and it is passed down by peristaltic contractions of the oviduct. The escape of the ovum from the follicle is known as the process of ovulation. During its passage down the oviduct it becomes surrounded by layers of albumen secreted by the oviducal glands. The shell-membrane is secreted in the isthmus and the shell in the uterus (fig. 40). The ovum is fertilized in the uppermost part of the oviduct and the cleavage and early stages of formation of the germ-layers take place before the egg is laid. The time occupied by the ovum in traversing the various sections of the oviduct is estimated by Kölliker as follows: Upper two-thirds of the oviduct about 3 hours (formation of albumen), isthmus about 3 hours (secretion of shell-membrane), uterus 12 to 24 hours (formation of shell and laying). These figures are only approximate and it is obvious that they are likely to vary considerably in different breeds of hens."

“Some of the details of these remarkable processes deserve attention: The observations of several naturalists demonstrate that the ripe follicle is embraced by the funnel of the oviduct before its rupture so that the ovum does not escape into the body-cavity, but into the oviduct itself. Coste describes the process in the following way: ‘In hens killed 17 to 20 hours after laying I have observed all the stages of this remarkable process. In some the follicle, still intact and enclosing its egg, had already been swallowed, and the mouth of the oviduct, contracted around the stalk of the capsule, seemed to exert some pressure on it, in other cases the ruptured capsule still partly enclosed the egg which projected from the opening; in others finally the empty capsule had just deposited the egg in the entrance of the oviduct.’”

“The existence of double-yolked eggs renders it probable that the oviduct can pick up eggs that have escaped into the body-cavity. But in some cases ova that escape into the body-cavity undergo resorption there.”

“Immediately after the ovum is received by the oviduct it appears to become softer and more flexible (Coste). The uppermost portion of the oviduct then secretes a special layer of albumen which adheres closely to the vitelline membrane and is prolonged in two strands, one extending up and the other down the oviduct; these strands become the chalazae; the layer to which they are attached may, therefore, be called the chalaziferous layer (Coste) of the albumen. The ovum then passes down the oviduct, rotating on the chalazal axis, and thus describing a spiral path; the albumen which is secreted abundantly in advance of the ovum is therefore wrapped around the chalaziferous layer and chalazae in successive spiral layers and the chalazae are revolved in spiral turns. The main factor in propulsion of the ovum along the oviduct appears to be the peristaltic movements of the latter; it is probable that the cilia which line the cavity have something to do with the rotation of the ovum on its chalazal axis.”

With this account of the anatomy and physiology of the female organs of reproduction in hand we may proceed to a consideration of their diseases. These diseases fall at once into two classes: (a) those affecting the ovary and (b) those affecting the oviduct.

DISEASES OF THE OVARY.

Atrophy of the Ovary.

By "atrophy" of the ovary is meant a diminution in size of that organ accompanied with a cessation of its physiological activity. It may shrink to the size and appearance which it has in a very young bird. The following sorts of atrophy of the ovary may be distinguished. The different sorts are separated from each other, not because of any difference in the end result, but because of the different etiological factors concerned.

1. Physiological atrophy.
 - a. Temporary.
 - b. Permanent.
2. Congenital atrophy (Pseudo-hermaphroditism).
3. "Black atrophy."

A physiological diminution in size or partial atrophy of the ovary occurs normally in fowls when after a period of laying they go into a more or less prolonged resting period. The condition of the ovary is usually (in fowls under 2 years old) only temporary. The organ resumes its normal size and activity after a time. In old birds (3 to 6 or more years of age) it not infrequently happens that the ovary passes into an atrophied condition, and remains permanently in that condition thereafter. In such cases the bird as a whole, and the ovary in particular, may be perfectly healthy, showing no sign of disease. Cases of permanent physiological atrophy of the ovary have been observed at this Station as follows:

One case in a White Crested Black Polish.

One case in a Cornish Indian Game.

Several cases in Barred Plymouth Rocks. All of the latter were birds of very high fecundity (200 or more eggs per annum) in their pullet years.

It should be noted that in what is here called permanent physiology atrophy of the ovary there is *no* associated change of the secondary sexual characters. That is, the hen does not assume cock plumage, spurs, enlarged comb and wattles, nor any other of the secondary sexual characters normal to the male. This indicates that in permanent physiological atrophy (just as is known to be the case in temporary) the only function of the ovary which is disturbed is that which is involved in egg formation. The activity of the organ in regard to producing an

internal secretion which in some way controls the secondary sexual characters remains unchanged.

As *congenital atrophy* of the *ovary* are to be classed cases of pseudo-hermaphroditism in fowls. In such cases a true, functioning ovary never develops. There may be a body which in gross features resembles an ovary, but it is inactive and does not take even the first steps in oogenesis (egg formation).

There may or may not be a testis like body present in these cases. Not only is the egg producing activity absent in such cases, but also in many of them at least, the internal secretion normally produced by the ovary is lacking also. The bird then takes on some or all of the secondary sexual characters of the male. The appearance of such a bird is shown in fig. 41.

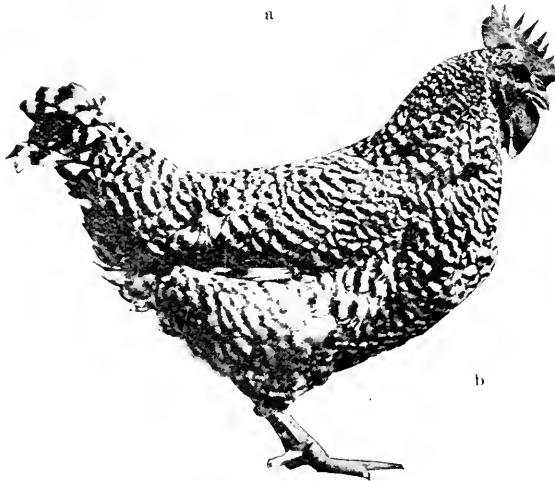


Fig. 41. Showing a case of incomplete hermaphroditism. In front of the line a-b the bird has the characters of the male, behind it the characters of the female. The ovary was not functional in this bird. (Original).

As "black atrophy" of the ovary is here designated the peculiar disease of the ovary first observed more than a century ago in England as occurring in pheasants. The striking feature of the disease is that under its influence the bird assumes the plumage appropriate to the male. The change in the ovary and oviduct induced by the disease appears to be an atrophy accompanied by a blackening which is probably a true melanosis. The following account of an outbreak of this disease about 50

years ago, written by Hamilton (Proc. Zool. Soc., London, 1862, p. 24) is of interest: "In the years 1858, 1859, and 1860 this peculiar alteration of structure in the female organs of generation in the Pheasants was particularly prevalent in some parts of England. I had the opportunity of examining many specimens, and was able completely to confirm Mr. Yarrell's views on this subject. Indeed, the majority of the birds were young females, many of them being birds of the year, some being in their first moult. I found also that the plumage varied and approached that of the male, not in accordance with the age of the bird, but with the amount of disease of the generative organs. The greater the destruction of the ovarium and oviduct, the nearer the plumage assimilated that of the male."

"For example, in birds with the hen-plumage predominating, the ovarium and oviduct exist as in the fecundating hen, the small ova lying in considerable numbers in the ovarium, the ovarium and oviduct showing dark lead-coloured masses of disease."

"In birds with the plumage of the male in a measure exceeding that of the female, the ovarium is considerably diminished in size, dark-coloured, and containing only a few blackened ova; the oviduct is spotted with dark patches, and considerably contracted."

"And thirdly, in birds with the male plumage predominating over that of the female, the ovarium is reduced to a small dark amorphous mass, resembling the coagulated blood, the presence of ova cannot be detected, and the oviduct is almost entirely obliterated at its junction with the ovarium. Thus it seems that there are 3 distinct phases in this peculiar abnormal state of the generative functions."

"I have also noticed that, in most cases where the male plumage is in excess of the female, the tail-feathers are particularly long, some being as much as 19 inches in length."

"Although Mr. Yarrell states that this condition of the female generative organs is not confined to the *Phasianidae*, and that it has occurred in the gold and silver pheasants, partridges, peafowls, common-fowl, common pigeon, king-fisher, and common duck, and that other classes of animals are liable to an influence similar in kind, particularly among insects and Crustacea, yet this disorganization is rarely observed except among the *Phasianidae*, and particularly when these birds are produced in a do-

mestic state, i. e., on the present system of breeding pheasants in preserves. Very few *battues* take place in which some of these birds (generally designated males) are not killed and mixed indiscriminately with the heaps of the slain."

"As to the cause of this disorganization, if it occurred only in the old female, or if it were a common occurrence among birds either of different genera or of the same genus, it could be easily accounted for; but when it is generally found existing among a class of birds which are bred in vast numbers in a particularly artificial manner, it leads one to suppose that the cause must be connected with this condition."

In regard to all sorts of atrophy of the ovary it should be said that there is no known way to treat them. Such cases when they appear must be accepted by the poultryman as one of the vicissitudes of the business.

Gangrene of the Ovary.

Salmon and other writers on poultry diseases following him have designated as gangrene a condition of the ovary relatively often found at post-mortem. Salmon's discussion of the matter is as follows: "This disease is quite common with all varieties of poultry. On examination of the ovary after death, the ova are found in different stages of development, but instead of being yellowish-pink in color, with the blood vessels well defined, they are brown or black, easily crushed and the contents broken down into a putrid liquid. Death is caused partly by peritonitis and partly by the absorption of the products of decomposition."

"The cause of this trouble is not well understood. It has been attributed to the birds being too fat thus compressing the ovary and hindering the evolution of the ova. As it may occur in birds which are not fat and as it is evidently accompanied by the penetration and multiplication of bacteria, it is possibly an infectious disease."

We have not been able to find anywhere in the literature that there has been a thorough investigation of this disease.

Ovarian Tumors.

Tumors and cancerous growths on the ovary are not uncommon. These include several sorts of interest to the pathologist, but not to the practical poultryman. From the literature it ap-

pears that at least the following (and probably other) kinds of new growths are found to occur on the ovary with greater or less frequency.

1. Benign tumors, of several types, including yolk tumors.
2. Carcinoma.
3. Dermoid cysts.

"Treatment is, of course, impossible in these cases as the nature of the disease is not determined until after the bird's death. If such abnormal conditions are frequently found, it is an indication that there is a predisposition in that direction in the strain of birds. The only way to correct this is to kill off the flock and obtain different blood." (Salmon).

Abortion of Eggs.

Regarding this matter Wright (New Book of Poultry, p. 574) has the following to say: "This is not to be confounded with the laying of soft eggs. These last are laid when mature, and usually by fat birds; but when violently driven or startled, or subject to violence of any kind, or even if suddenly and greatly terrified, immature yolks are sometimes detached from the ovary and expelled. This is most likely to happen with pullets not yet laying but about to lay, and being a real miscarriage or abortion, may wreck the constitution of a valuable bird unless attended to. It is distinguished from the other by not occurring as a rule in fat birds; by the immature and small size of the yolk or yolks; generally also by hemorrhage; and always by signs of illness of chicks afterwards. Any such bird should be placed for a few days in a quiet and comfortable but rather dark pen, with a nest in case of need, and fed on a little bread and milk. Quiet rest is the main thing, but 20 grains bromide of potassium may be dissolved in half a pint of drinking water. With such care the event may be entirely recovered from."

Yolk Hypertrophy.

There are a number of cases on record where the yolks formed by the ovary have been very much larger than normal. These "giant yolks" are due to a diseased condition of the organ, possibly contingent upon too much forcing for egg production. Such cases have been described by Gurlt (Mag. f. d. ges. Tierheilk, 1849) and more recently by von Durski (Die pathol.

Veränderungen des Eies und Eileiters bei den Vögeln. Berlin, 1907). When yolks become very large in this way they may break loose from the ovary without any rupture of the follicle wall along the stigma but a breaking or tearing loose of the stalk or pedicle of the follicle.

Failure of Follicle Wall to Rupture.

Closely connected with the last diseased condition is one discussed by von Durski in which the follicle wall fails to rupture and release the yolk. In consequence of this, in the case described by von Durski, the follicle wall became stretched and pulled out into a long and very much twisted stalk. This stalk held the hard, and decayed yolk fast to the ovary. In cases of this kind the stalk sometimes breaks, and the yolk enclosed in the follicle and with the end of the stalk attached, passes down the oviduct acquiring albumen, membranes and shell. In still other instances the stalk breaks and the follicle and contained yolk drops into the abdominal cavity.

DISEASES OF THE OVIDUCT.

Diseases of the oviduct are relatively common and cause a steady, and probably in the aggregate rather large loss to the poultryman. Fortunately some of the diseases of the oviduct are more amenable to treatment than are those of the ovary. Further these diseases in many cases show plain external symptoms at a relatively early stage. Then they may be recognized and treated while it is still possible to effect a cure. This is usually not the case with ovarian diseases.

The general external symptoms of the commoner diseases of the oviduct are very much like those of constipation. The poultryman watching his birds is indeed rather likely to confuse the two. But if so no harm is done. The thorough cleaning out of the alimentary tract, and stimulation of the liver indicated in the treatment of constipation is the very best thing to be done in cases of inflammation and similar disorders of the oviduct.

Inflammation of Oviduct.

This is one of the most important and common diseases of the oviduct. It may occur alone or in association with other morbid conditions of this organ.

Diagnosis. Hill (Diseases of Poultry) gives the following symptoms: "A bird affected with inflammation of the egg passage suffers acutely. At first there is a continual and violent straining (sometimes resulting in apoplexy). The wings are dropped and the feathers puffed out. The vent is usually hot and if a thermometer be inserted the temperature will be found high, frequently 105 to 107 degrees.* As the inflammation proceeds the bird becomes more and more moping and exhausted but does not strain so violently, pain and exhaustion acting as preventatives. Ultimately the temperature becomes lower, the body cold and with a few, convulsive gasps the sufferer dies."

To these symptoms Salmon adds the following, basing his account largely upon the statements given by Zürn: "The bird at first shows indications of a desire to lay without being able to produce eggs or it may lay eggs containing more or less blood or eggs without shells or small and misshaped eggs containing albumen but no yolk, or finally the yolk may be dropped without any covering of albumen or shell. As the inflammation increases there is high temperature, straining and an effort to rub the abdomen upon the ground. In later stages the bird becomes dull, indisposed to move, the comb is pale, the plumage rough and the temperature falls to normal or below."

Etiology. There are probably to be distinguished three classes of causes which lead to inflammation of the oviduct. These are:

1. Physiological; from irritation due to too frequent laying or from too stimulating foods or condiments.
2. Traumatic; from irritation due to too large eggs, or to the breaking of eggs within the oviduct, or similar causes.
3. Specific infection; it is probably that alone or in combination with the causes classed under 1 and 2 a specific infection of the lining membranes of the oviduct may occur.

In an inflamed oviduct there very often is a copious sero-fibrous exudate. This hardens about any foreign body (egg, broken egg, etc.) which may be in the oviduct, and by accretion causes this foreign body to increase in size. This, of course,

*There must be some mistake about this. 105° to 107° are not at all high temperatures for the domestic fowl. In fact in our experience at this station 105° would seem to be a slightly subnormal temperature rather than one indicating fever.

makes it still more irritating which in turn provokes further inflammation of the walls of the duct. One sometimes finds relatively enormous masses of material in a diseased oviduct, which have been built up in this way. There is an extensive literature on these "egg concretions" or "yolk tumors" built up either in the oviduct or in the abdominal cavity by hardened fibrous exudate, about an original basis of a broken, or miscarried, or aborted yolk or yolks. It is not necessary to review this literature here as it is only of interest to the specialist.

Treatment. If this disease is to be dealt with at all the treatment must be individual, since it is something which will never affect considerable numbers of the flock at the same time. If individual treatment is to be successful it must be begun at a relatively early stage of the disease. Therefore, it is important that a bird showing the symptoms which have been described above should be isolated at once and as a first step in the treatment given a purgative dose of Epsom salts (see p. 29). All stimulating foods such as meat, green cut bone, linseed meal and similar substances, as well as condiments like condition powders, pepper, etc., should be immediately taken away from the bird. A light ration and plenty of green food should be given. Salmon recommends following the purgative with $\frac{1}{2}$ drop of tincture of aconite root 3 times a day. Equally effective, and much easier to administer, will be found 1-10 gr. aconite root tablets (see p. 30).

Prolapse of the Oviduct (Eversion).

It not infrequently happens from one cause or another, that the lower portion of the oviduct becomes everted and projects from the vent as a mass of red or purplish tissue. This condition is known as *prolapsus* of the oviduct

Diagnosis. The diagnosis of this diseased condition is simple and consists merely in the observation of the prolapsed oviduct. If there is a mass of red or bloody tissue projecting from the vent one is safe in diagnosing prolapsus. The only point which needs particular attention in the diagnosis is as to the degree to which prolapsus has occurred when the bird is discovered. The importance of this lies in the fact that on it depends the treatment which it is advisable to give. Where the prolapse is only partial and is discovered early it is advisable to treat it by the methods outlined below. If, on the other hand, the prolapse is

extensive and has existed for some time before the bird is seen so that the mass of tissue has turned a blue or purplish color or has been pretty extensively picked and torn by the other birds in the pen, then it is useless to carry on any treatment and the proper thing to do is to kill the bird at once.

Etiology. Prolapse of the oviduct may be caused by a number of different things. It is observed not only in old hens, but, in our experience, quite as frequently in pullets. The fundamental cause of the condition is, of course, a weakness of the oviduct walls, and ligaments, chiefly in respect to their muscular portions, which makes the oviduct unable to stand the strains put upon it in egg production. The immediate cause may be either:

1. Straining to lay a very large (double yolked) egg. This is perhaps the most common cause.
2. Straining to lay when there is an obstruction in the oviduct (egg bound).
3. Constipation. The rectum full of hardened feces stimulates all organs in that region of the body to expulsive reflexes.
4. Zürn says that often times feces may become lodged in the cloaca in a sort of blind pocket, and then set up the same expulsive reflexes as an egg in the cloacal or vaginal regions normally does. In the effort to expel this foreign body the oviduct may become everted.

The most serious thing about prolapsus is that if not discovered very shortly after it occurs it is almost sure to result fatally, because the everted portion will become so badly infected as to cause blood poisoning, or the protruding mass of tissue will be picked and torn by the other birds in the pen until there is no hope of repair, whatever the treatment.

Treatment. As stated above, the advisability of treating prolapsus depends upon its degree and duration before discovery.

In treating this condition the first thing to endeavor to do is to remove the cause. That is, if the bird is constipated give it a rectal enema of warm soapy water, followed by $\frac{1}{4}$ teaspoon of Epsom salts by the mouth. If there is a lump of feces lodged in the cloaca this should be carefully removed. The protruding mass of tissue should be washed with warm 1 to 1000 bichloride of mercury solution, or a warm $\frac{1}{2}$ per cent cresol solution. After the protruding parts are thoroughly cleansed they should be well greased with vaseline, or with the ointment already recom-

mended (p. 30). Then with the fingers well greased an effort should be made to replace the protruding mass in the body. In doing this one should proceed with the greatest gentleness. In most cases with care and patience it is possible to reduce the prolapsus, that is, to get the extruded tissue back into the body in approximately its normal position.

After the parts have been carefully replaced in normal position the next point to be considered in the treatment is to insure that they shall stay there. That is to say, it is necessary some way to bring about a healthy degree of contraction of the muscular walls of the oviduct so as to hold the parts in place permanently. In order to do this Salmon recommends the use of ergot. Robinson follows Salmon in this recommendation. It should be said, however, that it is doubtful whether this treatment is advisable. Ergot is a rather violent poison for poultry. It seems likely that the treatment recommended by Salmon and Robinson is based on a theory that the action which ergot has on the mammalian uterus will be duplicated on the fowl's oviduct rather than upon actual experience in administering the drug to poultry. The measure recommended by Zürn to bring about a healthy contraction of the replaced oviduct in cases of prolapsus would seem to be simpler and on the whole more likely to yield desirable results than the ergot treatment. Zürn recommends that a lump of ice be placed in the cloaca after the prolapsed oviduct is returned to its place and that this treatment be followed up for some hours.

The bird should be kept in a small coop, partly darkened, where there will be every inducement for it to remain perfectly quiet. The success of the treatment depends very much on keeping the bird quiet for a few days. It should be fed only a light and unstimulating ration with plenty of green food.

Prognosis. If discovered early enough prolapsus is curable.

Obstruction of the Oviduct ("Egg Bound").

Perhaps the commonest of all diseased conditions of the oviduct is that which leads the poultryman to say that a bird is "egg bound." By this is meant that there is something in the oviduct which the bird is not able to pass to the outside and which in turn prevents the normal passage of eggs. In many cases this is not properly speaking a disease at all but rather an accident. Other cases, however, depend upon a true diseased condition of the oviduct.

Diagnosis. Salmon describes the following symptoms: "When fowls are egg bound they at first go frequently to the nest, making efforts to lay but are unable to accomplish this function. They are restless and evidently in more or less distress. Later they become dull, with rough plumage and are indisposed to move. On examining the bird by pressure of the finger about the vent, the egg can be distinguished as a hard body in the posterior part of the abdominal cavity. In case of prolapsus, the everted oviduct may be easily seen."

In this connection, however, it should be noted that these general symptoms which Salmon describes are observed in mild form in a great many cases with birds which subsequently lay the egg without trouble. In many instances the extrusion of an egg which is finally successfully laid is attended with a good deal of difficulty. There are all degrees of gradation between this somewhat difficult but still normal laying and the condition of complete obstruction of the oviduct where the egg cannot be passed at all. The practical consideration to which this leads is that one should not be too hasty in applying treatment for the egg-bound condition. A diagnosis of the trouble, in other words, should not be finally settled upon until there remains no doubt that the hen is not going to pass the egg without help from the outside.

It must also be remembered that in many cases of obstruction of the oviduct, the obstruction is so far up that it cannot be felt from the outside. In such cases the diagnosis must be made upon the general behavior of the hen, and in particular in regard to going frequently on the nest without laying.

Etiology. In considering the causes of obstruction of the oviduct it is necessary to distinguish between several different sorts or categories. This may be done as follows:

1. Simple "egg bound" condition, in which a normal egg is lodged in the uterus or vagina and cannot be expelled. This inability to expel the egg may be due to any one or a combination of the following causes acting together:

- a. Egg of too large size, so that it is mechanically difficult or impossible to force it through the natural passage. Robinson regards this as the most common cause.

- b. Exhaustion (true physiological fatigue) of the muscular walls of the oviduct. This condition results after long continued and unsuccessful attempts to expel the egg. It leads to

c. Atony and paralysis of the duct in which the muscular walls are incapable of making any effective contraction at all.

2. Complicated "egg bound" conditions in which the fundamental source of the trouble is not simply mechanical, and in which usually the portions of the oviduct anterior to the uterus are involved. In this general category the following sorts of cases are to be included.

a. Atony and paralysis of the upper portions of the oviduct. This condition may exist for a long time without being recognized.

b. Inflammation of the oviduct leading to the formation of fibrous exudate which accumulates in the duct, until it may form a mass of relatively enormous size (usually with one or more yolks as a nucleus) completely obstructing the duct, and eventually leading either to gangrene or rupture of the walls, or both.

c. Volvulus, or twisting of the oviduct about its own long axis, completely obliterating the cavity.

d. Stenosis or stricture of the oviduct. This may result from several causes. One frequent one is that in laying a very large egg the oviduct wall becomes torn to greater or less degree, and subsequently heals. The scar tissue contracts the cavity and a stricture is thus caused.

Treatment. Whether treatment is or is not likely to be effective depends upon which of the two main categories above defined any given case belongs to. Simple obstruction of the oviduct may be successfully treated. In cases of complicated obstruction treatment is not indicated, for a variety of reasons. These conditions are in the first place difficult to diagnose, and offer little prospect of successful cure even after a diagnosis has been made.

The best advice which has come to our attention for the treatment of the simple egg bound condition was published some years ago in the English Journal "Poultry" and is here quoted verbatim:

"It is a good plan to watch those birds that are about to lay. Should they visit the nest frequently during the course of the day and leave without depositing an egg, it is almost certain that something is wrong and when a pullet is in such a state there are three good remedies that may be tried. The first is: Take the bird up gently, and hold her so that her stern is over the mouth of a jug of boiling water, that the steam arising there-

from may get to the parts and help to relax and procure delivery of the egg. If this has not the desired effect after an hour's rest in a quiet coop, the vent should be oiled gently with a feather, and the hen given a powder composed of 1 grain of calomel and 1-12 grain of tartar emetic. The powder may be mixed in a bolus of food, and put into the bird's crop. If it be acting properly a marked improvement should be noticeable in the bird a few hours afterwards, while a second powder given two days subsequently will probably complete the cure. It is advisable for a while to feed the fowl sparingly on a somewhat low diet, withholding any fat forming food, and giving lime-water to drink, after the system is rid of the powder. The second remedy was advocated by Dr. H. B. Greene, * * * * * and is best applied when the egg can be felt. It is:—Let an assistant, seated on a chair, hold the bird firmly on his knees on its back, with the vent directed away from him. Seating yourself opposite, with the finger and thumb of the left hand outside the bird's body, push the egg firmly but carefully towards the vent, until it is plainly visible, and, keeping it in that position, with a bradawl in the right hand puncture the egg shell, evacuate the contents of the egg with an egg-spoon, and afterwards with a pair of tweezers break down and take out the shell piece by piece until assured by passing the finger into the vent, that the cloaca is empty. Special care must be taken to avoid injuring the bird with the point of the awl; and one's assistant must maintain a steady and firm hold on the fowl. A third method of relieving an egg bound hen was recommended by a correspondent in our issue of June 10, 1898, and has since been frequently tried by several poultry keepers, and found very efficacious. 'When a hen is in that state I hold her over some hot water, bathing the vent at the same time. After this I use a small penknife (blunt) in the following manner:—Placing the edge of the blade along the first finger so that the end is level with the finger end, I push the finger with the knife into the vent until they touch the egg; then I begin to scrape until I hear that I have scraped the rind or skin away from the egg (I mean outside the egg). The hen is then placed on the nest, and I will guarantee she will lay in 20 minutes, or in most cases even less than that. I got this advice from a man who has kept poultry on a small scale for 50 years. I have tried it several times, and have never known a hen to be egg bound a second

time. This method, it would appear, saves the egg. The great thing throughout is to keep the bird quiet, and in future to avoid extra fat forming food."

Prognosis. Good in cases of simple obstruction if taken in hand early; bad in all cases of complicated obstruction.

Rupture of the Oviduct.

In some cases of complicated obstruction, and in cases of severe inflammation the walls of the oviduct may break and allow the contents to escape into the abdominal cavity. In such cases death usually ensues in a relatively short time as a result of peritonitis. These cases are incurable; indeed the trouble is usually not known till after the bird dies. The lower portion of the oviduct (vagina) or the cloaca may be ruptured in passing a very large egg. If the wounds made in this way are relatively small they will usually heal without any trouble. If, on the other hand, such tears are extensive they may very easily become infected, and unless treated properly in accordance with the general directions given in Chapter XX for the treatment of wounds, the bird will die of blood poisoning. Regarding cases of this kind the following excellent discussion (presumably written by Mr. J. H. Robinson) appeared in *Farm Poultry* some 6 years ago (Vol. 16, p. 230). The writer says that this trouble of rupture of the oviduct near the vent he "used to have with Buff Leghorns, and to a lesser extent with other varieties of the Leghorn. Leghorn hens quite generally lay larger eggs in proportion to their size than others. Some of them lay eggs very much larger in proportion to their size than layers of large eggs in the larger breeds. As a result of this the difficulty of laying is correspondingly increased. When a pullet begins to lay she may lay small eggs, which are easily passed. As warm spring weather comes she lays more eggs, and also larger ones. Suppose one day there is a slight tear or a strain on a part of the oviduct in laying. The part is not badly damaged, but it is sore, a little inflamed, and cannot be stretched as it was before to permit the passage of the egg. But the egg is there and must be extruded. A larger tear in the parts is the result. There may be blood enough flow to make the egg quite bloody, but the injury be not yet serious. With the next egg conditions are still less favorable for a safe extru-

sion, and perhaps a very bad rupture results, ending in the course of a few days fatally."

"I don't think it profitable to attempt to treat such cases. Some cures may be effected, but it is not always easy to check laying without starving the hen, and even that treatment may not operate quickly enough to avoid a bad rupture. Every egg passed while the vent and adjacent parts of the passage are not in normal condition is a possible cause of fatal trouble."

"The best way to treat this trouble is to prevent it by selecting medium sized eggs for hatching. Select breeders of good size; select good but not excessively large eggs from these; use males from stock of the same characteristics, and avoid the use of males (and of hens too) that are narrow bodied."

Gangrene of Oviduct.

This may result from severe and complicated obstruction. What is meant by "gangrene" is that the walls of the oviduct die, and putrefy. This causes general blood poisoning from which the bird dies. Gangrene of the oviduct most frequently follows severe cases of complicated obstruction where there is a mass of fibrous exudate deposited in the oviduct. There is not the slightest hope of successfully treating such cases.

Breaking of Egg in Oviduct.

It sometimes happens that an egg in the upper portion of the oviduct, before it has acquired any shell, is by accident broken. There is a belief common amongst poultrymen that this is always immediately fatal. There is but little discussion of the subject in the literature but our experience here indicates that two sorts of results may follow the breaking of an egg in the oviduct. These are:

1. An inflammatory condition of the oviduct is induced leading to copious secretion from the glands of the albumen portion of the duct and the isthmus. There is also a copious fibrous exudate, and the final outcome is a severe case of complicated obstruction of the oviduct. Death in these cases may be delayed for a long time after the original accident. In the absence of inflammation recovery may possibly occur.

2. Death within a short time (2 to 3 hours) after the breaking of the egg, without visible lesion of any organ of the body. The oviduct is not even inflamed. Absolutely the only things

which are not normal in such cases are (a) the broken egg in the oviduct, and (b) the fact that the bird is dead. We have had several such cases come to autopsy. They are very puzzling. In them is to be found the basis for the poultryman's belief as to the fatal character of this accident. In reality it seems probable that in these cases the thing which caused the egg to be broken was also the cause of the death of the bird. That is, a blow, or any sort of sudden shock violent enough to break an egg in the oviduct might also very well be the cause of death. Such cases need further study.

Abnormal Eggs.

Owing to various diseased conditions of the oviduct many different kinds of abnormal eggs are produced by fowls. The explanation of the different types of such eggs is usually tolerably clear if one gets definitely in his mind the normal physiology of egg production as outlined above. We shall consider here only some of the more important general classes of such abnormal eggs. Such eggs are very interesting from the scientific standpoint but are of relatively little practical significance to the poultry keeper because of the rarity of their occurrence.

Soft-shelled Eggs. These are eggs laid without a sufficient amount of shell substance covering the shell membrane. The immediate cause lies in a failure of the uterus to function properly. Regarding this class of abnormal eggs Wright has the following to say: "Soft eggs may be caused by lack of shell-material, which, if discovered, points to the remedy, the most rapid being pounded raw oyster-shell. Or they may be caused by the fowls being driven or frightened, in which case they soon cease, and nothing need be done unless the injury has been so severe as to prematurely detach small and unripe yolks, when the case becomes a real *abortion*, or they may be caused by condiments and too much animal food, spices in particular leading frequently to all sorts of trouble with the egg-organs, particularly in the Mediterranean races of poultry. A few small doses of Epsom salts or jalap, and cessation of the extra stimulus, will remedy this. But far the most usual cause is simple over-feeding. A little careful investigation will find which is in fault, and that will indicate the appropriate remedy. Want of shell

material is far less common than it used to be; over-feeding or over-stimulation probably more so."

Small, Yolkless Eggs. These little eggs, variously called "wind-eggs," "cock eggs," "witch eggs," "luck eggs," etc., are familiar to every poultry keeper. They contain no definitely formed yolk, and to the casual observer seem to consist of nothing but a small shell filled with white. The laying of one of these eggs is popularly supposed to mark the end of a laying period. This belief is without foundation in fact. They may be produced at any time. Unpublished data collected over a period of years at this Station in regard to such eggs indicate that three factors are fundamentally concerned in their production. These are:—

1. The bird must be in an active laying condition; the more pronounced the degree of physiological activity of the oviduct the more likely are these eggs to be produced.

2. There must be some foreign body, however minute, to serve as the stimulus which shall start the albumen glands secreting. This foreign body may be either a minute piece of hardened albumen, a bit of coagulated blood, a small piece of yolk which has escaped from a ruptured yolk, etc.

3. It seems likely, though this is a point not yet definitely settled, that ovulation (i. e., the separation of a yolk from the ovary) must precede the secretion of albumen around the foreign body to form one of these eggs.

Double and Triple Yolked Eggs. Eggs with two yolks are, of course, quite common. They result from a disturbance of the time relations of ovulation, of such nature that two yolks

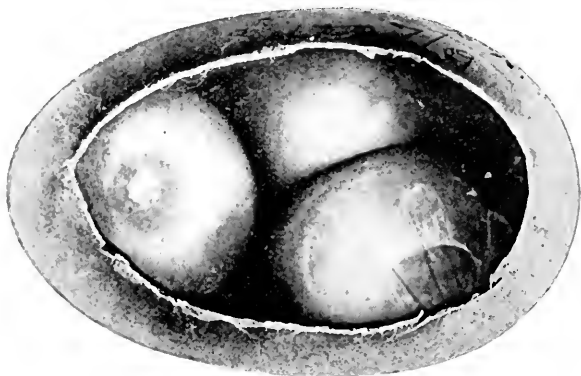


Fig. 42. Triple yolked egg. (Original).

get into the oviduct at nearly the same time and become surrounded by common layers of albumen.

Eggs with three yolks are very rare. An egg of this kind laid by a pullet at this Station is shown in fig. 42.

Inclusion in Eggs. The number of different foreign substances which at one time or another have been found enclosed in eggs is great. The list includes blood streaks or spots, blood clots of firm consistency and often considerable size, lumps of bacteria, worms, fecal matter, etc., etc.

From the practical standpoint the only inclusions which need consideration are blood spots. Many inquiries are annually received at this Station as to what causes these spots and what to do to get eggs which will be free from them. These inquiries are most frequent in the spring months. *The only thing which can be done in such cases is to candle the eggs, and sell only those which show no spots.* Hens which are perfectly normal often lay eggs with blood spots, especially in the spring of the year when laying is heavy. The blood which makes the spot probably comes in most cases from the ovarian follicle. When this ruptures a little blood escapes into the oviduct and is caught up in the albumen. The so-called "liver" or "meat" spots in eggs are in nearly every case thoroughly hardened, well packed together, blood clots. They may be of large size. These inclusions *do not* represent, as they are sometimes said to, portions of the oviduct wall which have been torn off and enclosed in the egg.

Eggs of Abnormal Shape. There are many other kinds of abnormal eggs besides those here discussed, but as they have no practical significance it is not desirable to devote further space to them. In closing this section we append some figures showing in outline some of the curiously shaped eggs which have been found.

Vent Gleet (Cloacitis).

This is a true venereal disease of poultry. It usually begins with a hen but is transmitted in copulation to the male, and by him to other birds in the flock.

Diagnosis. Salmon gives the following clear account of the symptoms: "The first symptom observed is the frequent passage of excrement which is voided in small quantities almost as rapidly as it reaches the cloaca. Often the bird endeavors

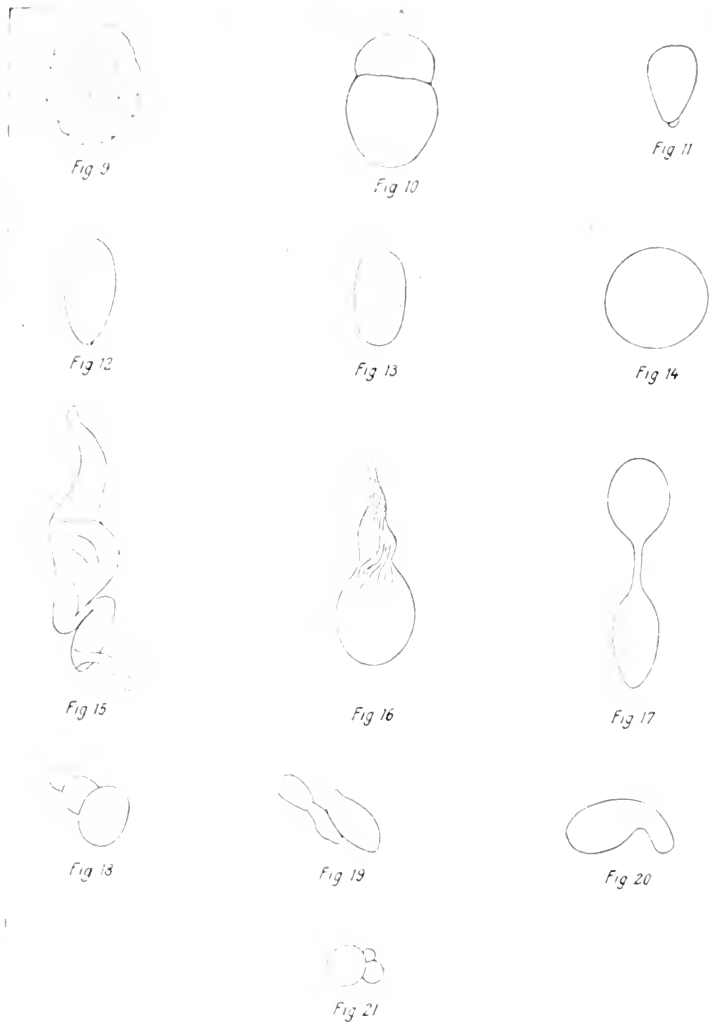


Fig. 43. Showing shapes of abnormal eggs sometimes found. (From von Durski after Landois).

to drop excrement when cloaca is entirely empty. This action is due to the tenderness and irritability of the cloaca which gives to the bird the sensation of fullness, and produces spasmodic contractions. If an examination is made the mucous membrane is found in the early stages to be red, dry, swollen and hot. In a day or two a discharge makes its appearance. It is, at first, thin and watery, but soon becomes white, purulent, and offensive. This discharge collects upon the skin and feathers about the vent, obstructs the passage and irritates the parts with which it comes in contact. The soiled skin becomes red and inflamed, it may be abraded by friction or by the bird picking at it, and thus sores or ulcers are started which may become quite troublesome."

Etiology. The cause of the disease has not yet been thoroughly worked out. Wright suspected it to be identical with human gonorrhoea because of the similarity of symptoms, infectiousness, etc. However, he has not been able to isolate the *Gonococcus*, or specific germ of gonorrhoea from affected birds.

Treatment. The following is the treatment outlined by Wright: "Any hen found with it should at once be isolated, and the male bird carefully examined, and if necessary also isolated. Give 30 grains Epsom salts, and twice a day inject first a 4 per cent solution of cocaine, and immediately afterwards a solution of nitrate of silver 4 grains to the ounce. The fifth day commence a small copaiba capsule daily, and inject acetate of lead, 1 drachm to the pint. Feed rather low meanwhile, and dust any sore places outside with iodoform or aristol. If not well after 2 or 3 weeks, we would kill the bird, as the disease is not quite free from danger; for if the operator should touch his eyes accidentally before he has cleansed his hands, the result might be a most violent inflammation."

"Break Down."

Sanborn (Farm Poultry Doctor) gives an account of this trouble, which, while brief, is to the point, and says all that really needs to be said about the matter. Especially to be commended is the last sentence.

"This is the 'baggy condition' often seen in old hens that have had too much corn. The rear part of the abdomen is crowded with fat and hangs down, sometimes to the ground, giving a very unhandsome appearance to the bird. The ceasing to feed corn

and other fat-producing foods will sometimes remedy this condition, but a bird that has been allowed to get into such a shape is spoiled for life both as a layer and breeder. "The hatchet and pot should be the fate of such a bird."

Diseases of the Male Reproductive Organs.

A number of diseases of the male reproductive organs have been described but they are all of no practical significance, for the reason that no poultryman ought ever to use as a breeder a male bird that ever had any disease of these organs, whether it had been "cured" or not.

CHAPTER XIX.

DISEASES OF CHICKENS.

White Diarrhea.

Of all the diseases which the poultryman is called upon to fight, there is probably none so destructive, year after year, as the disease (or diseases) known as "white diarrhea." The loss of chicks ascribed to this cause varies in different years and is different places from 10 to 90 per cent. It is perhaps not too much to say that more than 50 per cent of the chicks hatched throughout the country are lost from white diarrhea in its various forms. The number of inquiries concerning this disease which are annually received, and the amount of space devoted to it by the poultry press, lead one to believe that "white diarrhea" is perhaps the worst enemy with which the poultryman must contend.

White diarrhea is more common among artificially hatched and brooded chicks than among those which have been hatched and cared for by hens. However, it is by no means unknown among the latter. Many poultrymen report as heavy mortality from this disease among hen hatched and reared chicks as from those which were incubated and brooded by artificial methods.

Almost any chick that comes out of the shell apparently healthy on the 21st day will live for the first week. If white diarrhea is going to strike the brood they usually begin to show symptoms about the end of the first week or later. The heavy loss of chicks from this disease occurs between the ages of 1 and 3 weeks. Where the brood is badly affected chicks may continue to die until the fourth or fifth week. On the other hand if a brood goes through its first 3 weeks of life without being attacked by this disease it is practically safe from its ravages. White diarrhea then may be said to be limited to the first 3 weeks of the chick's life so far as serious mortality from it is concerned. The reason for this no doubt is that the digestive

system of chicks under 3 weeks old is so delicate that even a slight disturbance makes a very serious handicap for the chick.

Etiology. Within recent years a large number of studies concerning the cause, prevention and cure of white diarrhea have been conducted. Investigations have been carried on by state and national institutions as well as by many private individuals. Consequently a large number of alleged causes of the disease are given by different writers. Among these may be mentioned: Debilitated breeding stock, improper incubation, improper brooding, overheating, chilling, poor ventilation, over-crowding, poor or improper food and filth as well as specific bacteria, fungi or other parasitic organisms.

Dr. Geo. B. Morse in the *Reliable Poultry Journal* for July, 1909, classifies the causes of diarrhea in chicks as follows:

"First among these causes is the class of physical agents. Under this title I would place such agencies as heat or its lack, moisture or its lack, producing what we call in human medicine, the diarrhea of relaxation. Such a condition is produced in the intestinal tract that a large amount of serum is driven through the intestinal wall into the lumen of the intestine, and in doing so the cells are loosened, and thus we have the development of a catarrh. This condition may be brought about by the agencies just mentioned."

"Another class of agencies may be designated foreign bodies, and in this class I place such diarrheas as originate from improper feeding, too early feeding or feeding wrong material. We know, from analogy, that in mammals whether human or the lower animals, such a condition is possible."

"Then we have another large class of intestinal derangements or catarrhs or inflammatory conditions produced by what we call living agents or parasites. These produce what we may call parasitic inflammations. Now, we must subdivide this class into two, and we may get rid of one substance at once by placing in it those catarrhs or inflammations produced by the larger parasites, macroscopic parasites, such as worms."

"Thus we come to the other sub-class of parasites causing derangements in the intestines, the microscopic parasites or micro-organisms. This sub-class of diarrhoea-producing micro-organisms falls naturally into 3 groups. Having already referred to the animal kingdom in speaking of worms we shall take our first group of parasitic micro-organisms from that same king-

dom; these are the protozoa, the lowest animal forms. The other two groups of micro-organismal agents of enteritis are found in the plant kingdom; they are bacteria and molds. Hence, the 3 groups of microscopic agents of intestinal inflammation are protozoa, molds and bacteria."

It is doubtful if many of the cases of true *white diarrhea* are caused by the physical or mechanical agents mentioned in Dr. Morse's first two classes. In most cases true white diarrhea appears to be an infectious disease. Such disease we know is caused by some form of parasitic organism. Without doubt improper incubation, brooding and feeding, resulting in weakened chicks, very often lay the foundation for the attacks of parasitic organisms. In many cases these faulty methods of handling the eggs and chicks appear to be the real cause of the disease while they are really only indirect causes.

From this it should not be understood that such things as poor food, poor brooding and weakened breeding stock are of no importance in the study of white diarrhea. It is just exactly these predisposing factors which result in chicks with weak constitutions, easily overcome by disease germs. Without doubt the points at which most progress can be made in combatting such diseases are in the methods of incubation and in the care of the chicks for the first 3 weeks of their lives. Nevertheless it should not be forgotten that the death of the chick is caused by the ravages of some minute parasitic organism.

Within recent years several investigators have discovered organisms which they believe to be the specific cause of white diarrhea. Three of these may be mentioned at this place: (1) *Coccidium tenellum* or *cuniculi* producing the disease called "coccidiosis." (2) *Bacterium pullorum* producing "bactillary white diarrhea" and (3) *Aspergillus fumigatus* and allied species, producing aspergillosis or brooder pneumonia of chicks. Of these the first two diseases will be considered in some detail in the following paragraphs. Aspergillosis is treated in a separate section of this chapter (cf. p. 193).

Intestinal Coccidiosis.

In Circular 128 of the Bureau of Animal Industry, U. S. Department of Agriculture, Dr. G. B. Morse published a preliminary account of some investigations on the cause of white diarrhea. Microscopic examination of the intestines of chicks dying

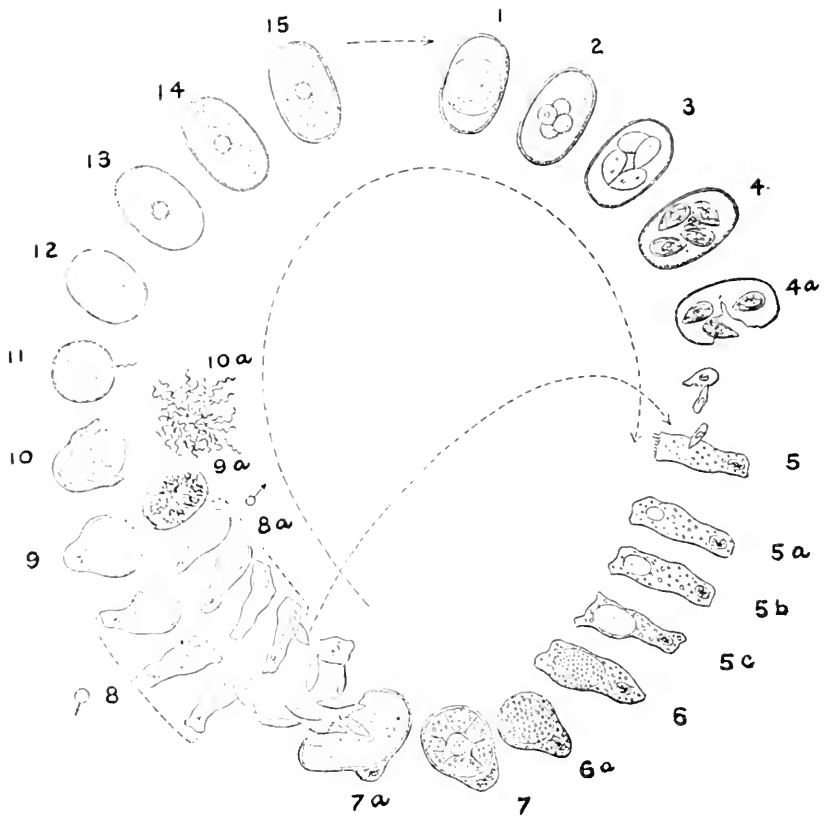


Fig. 44. Diagrammatic representation of the life history of a Coccidium. (After Cole and Hadley).

with this disease revealed the presence of large numbers of protozoan organisms which he identified as *Coccidium tenellum*. At practically the same time Drs. Cole and Hadley of the Rhode Island Experiment Station reported finding a similar organism in white diarrhea chicks. They identified it as *Coccidium cuniculi*. These two species of coccidium are so nearly alike that it is very difficult to distinguish them except by prolonged study of their life cycles. Various species of coccidia have long been known to infest many domestic animals. In all cases that have been studied they produce very serious diseases.

The life history of a coccidium is very complicated yet in order to combat this parasite most successfully it is necessary to know something of its life history. Fig. 44 represents the different stages in the life history of these parasites. If one should examine with a microscope the contents of one of the ceca of a chick which died with this form of white diarrhea he would find forms somewhat like No. 1 in the figure. These are the oöcysts or permanent cysts of the coccidium. The membrane around the outside of this cyst is very tough and will withstand almost all methods of disinfection. It will live and even grow in sulphuric acid. It can be killed, however, by drying. The size of these cysts is about 14-25000 inch and 21-25000 inch. If this cyst is placed under the right conditions for development the first step is for the protoplasm to divide into 4 spherical bodies which are called sporoblasts (fig. 44, 2). Each of these sporoblasts then divide into two sickle-shaped sporozoids (cf. fig. 44, 3 and 4). These sporozoids are then set free in the intestinal tract (4a) and each one penetrates with its pointed end an epithelial cell of the intestine as at No. 5. In the figure 5a, 5b, 5c, 6 and 6a, represent the succeeding stages of growth of the organism within the intestinal cell. As shown in 6a and 7 the parasite grows so large that it completely fills the cell and finally these cells are broken down and torn off the intestinal wall. The stage of the parasite shown at 6a and 7 is known as the schizont. The next step is for the schizont to break up into a larger number of sharp pointed bodies as shown at 7a. These escape and enter other epithelial cells just as the somewhat similar bodies did at 5. At this point the organism may do one of two things. The small sporozoids from 7a may develop exactly like the sporozoids did from 5 to 7. This part of the life

cycle, as shown by the shorter arrow from 7a to 5 may be repeated any number of times.

If, however, the conditions are not very good, *i. e.*, the bird is about to die the sporozoids undergo an entirely different development as shown at numbers 7 to 15 (fig. 44). Here the sporozoids enter the epithelial cells and some develop into very large (egg) cells (female element) as shown at 8, 9 and 10. Others go through the development shown in 8a, 9a and 10a, forming a very large number of minute motile zooids or sperms (male element) which unite with one or more of the large egg cells as shown at 11. After this sexual union there is developed the oöcyst like No. 1, with which we started. At all stages of this disease many of these cysts are carried to the outside with the feces and upon being picked up serve to infect other chicks. Death is caused by the parasite attacking so many of the intestinal cells that the chick is no longer able to digest its food. There are also secondary effects by which the kidneys are deranged and throw out a large amount of white urates, hence the name "white diarrhea."

Diagnosis. The symptoms of coccidiosis are similar to those of other forms of white diarrhea. (cf. p. 189). The only exception is that according to Morse the ceca are always distended with yellowish-white cheesy matter. In other forms of white diarrhea this may or may not be the case. These different forms of white diarrhea have been too little studied yet to permit of an exact differential diagnosis on external symptoms even supposing that ever to be possible. With the aid of a microscope the finding of coccidial cysts in the fecal matter would indicate that these were causing the disease.

Dr. Hadley has carried out some feeding experiments with these coccidia and has found that he is able to produce the disease in chicks more than two days old. As will be mentioned later (p. 188) it is said that infection with the bacterium of bacillary white diarrhea cannot take place after the chick is 48 hours old. It is possible that further work will show that these facts are of some importance in distinguishing these two forms of the disease.

Bacillary White Diarrhea.

In May, 1908, Dr. L. F. Rettger and Mr. S. C. Harvey published a paper on "Fatal Septicemia in Young Chickens or

'White Diarrhea.''' (Journ. Med. Research). From a large number of observations and experiments they came to the conclusion that white diarrhea was caused by a bacterium. A number of later papers by Dr. Rettger have appeared since then (e. g., Journ. Med. Research, July, 1909; Am. Poult. World, Vol. 1, Nos. 3 and 5; also Rettger and Stoneburn, Storrs Agr. Expt. Sta. Bul. 60). In all of these the fact has been clearly brought out that at least one form of white diarrhea is caused by a bacterium.

Dr. Rettger took chicks which had died with all the symptoms of white diarrhea and by the ordinary bacteriological methods obtained pure cultures of a bacterium which had certain definite reactions and habits of growth. By these methods this bacterium can be distinguished from other kinds. To this species of bacteria he gives the name *Bacterium pullorum*. Now if entirely healthy chicks were inoculated with the pure culture of this bacterium they almost invariably showed symptoms of white diarrhea and in many cases died. To cite only one case; at the Storrs Experiment Station (Bull. 60) 210 White Leghorn chicks were hatched from healthy stock. These were divided into several lots, some of which were infected by feeding bouillon cultures of *Bacterium pullorum*. Other lots were used as controls. The results were as follows: "During the first two weeks the comparative mortality was as follows:

Control lots (84 chicks) 5 deaths or 6 per cent.

Infected lots (126 chicks) 22 deaths or 18 per cent.

At this time the chicks in the control lots averaged 15 per cent more in weight than those in the infected lots and appear in every way greatly superior to them."

In many cases Dr. Rettger was able to find *Bacterium pullorum* pure in the artificially infected birds. Further he was able to obtain the same bacterium from a large number of different chicks gathered from widely different localities. Dr. Rettger says (Am. Poult. World, January, 1910): "From the blood of the liver, heart and lungs I have repeatedly found the organism—*Bacterium pullorum*. More recently I have been able to obtain the organism without difficulty, from the unabsorbed yolk and in some instances from the crop of the affected chicks. In some chicks that were quite young at the time of death (2 or 3 days) the same bacterium may be found in the

intestines. In older birds it is obscured by the common and rapidly growing intestinal organisms, particularly the colon bacillus."

Dr. Rettger has also been able to find this same organism "in (a) the ova in the ovaries of the hens, (b) the yolk of fresh laid eggs, (c) eggs incubated for varying lengths of time and (d) yolk sacs of fully developed chicks still within the shell." This, together with the evidence that the organism does produce white diarrhea, shows pretty conclusively that one source of infection is the hen. The feeding experiments with pure cultures of the bacillus apparently show that the infection must begin within the first 48 hours after the chicks are hatched. Several investigators have shown that it is impossible to infect chicks by feeding after they are two days old. It may be said that Dr. Rettger has proven that at least one form of white diarrhea is caused by a bacterium. The relation of this form of the disease to that caused by other organisms is still a subject for investigation.

Diagnosis. The external symptoms of bacillary white diarrhea are much the same as those given for the disease in general (cf. p. 189). The following post-mortem appearances are reported by Rettger and Stoneburn:—

"Crops—Empty or partially filled with slimy fluid or with food."

"Lungs—Apparently normal. (Tubercles not observed)."

"Liver—Pale, with streaks and patches of red. These apparently slightly congested areas are usually large in size."

"Kidney and Spleen—Apparently normal."

"Intestines—Pale, and for the greater part empty. A small amount of dark grayish or brownish matter frequently present."

"Ceca—With few exceptions but partially filled with a grayish soft material. Only occasionally cheesy or firm contents."

"Unabsorbed Yolk—Usually present varying in size from a pea to a full-sized yolk. The color may vary from yellow to brownish green or nearly black. In consistency there is also much variation. It may appear perfectly normal, distinctly gelatinous, or watery. Frequently it is observed in the character of custard and again more or less dry and firm. Unless the chick has been dead for some time the yolk is usually not found putrid, but merely stale."

"The chick as a whole appears more or less anaemic and emaciated. The muscles of the wings, breast and legs may be almost completely wasted away."



Fig. 45. Ten day White Leghorn chicks showing symptoms of bacillary white diarrhea. (After Rettger and Stoneburn).

The chief difference between this and coccidiosis appears to be in the contents of the ceca (cf. p. 186).

Diagnosis of White Diarrhea in General. The symptoms of white diarrhea are in general the same for the different forms of the disease. They may be briefly stated as follows: The affected chicks appear stupid and remain under the hover or hen much of the time. They isolate themselves from the rest of the flock and appear indifferent to what goes on about them. Their feathers become rough and the wings droop (cf. fig. 45). There is progressive loss of weight. The birds eat little or



Fig. 46. Normal ten day White Leghorn chicks. (After Rettger and Stoneburn).

nothing and appear unable to pick up their food. Their actions in this direction are chiefly mechanical. The characteristic whitish discharge from the vent very soon makes its appearance. The discharged matter may be creamy or sometimes

mixed with brown. The discharged matter is more or less sticky or glairy. In many cases it clings to the down in sufficient quantity to plug up the vent. This condition is known as "pasting up behind."

Many of the chicks chirp or peep constantly or will utter a shrill cry apparently of pain, when attempting to void the excreta. These sounds are often characteristic of the disease.

In many cases the chicks present the appearance of being "short backed" or "big bellied." Dr. Woods describes this as follows:

"The weakling is almost always big-bellied, the abdomen protruding to the rear so that it bunches out behind, well out of line with the vent, with the result that the chick looks as if the tail piece and backbone has been pushed forward and in just above the vent." (Cf. fig. 45).

In some cases the chicks die with but little warning and show few of the above symptoms. In other cases the sick chick will last a long time showing all the symptoms mentioned.

Post-mortem examination often reveals but few lesions. One of the most striking things is the loss of flesh if the disease has lasted for some time. The alimentary canal is usually nearly empty except for some slimy fluid. The organs are all very pale. The liver may have a few streaks showing congested areas. Some of the unabsorbed yolk may or may not be present. There is considerable variation in its appearance. It is not usually putrid unless the chick has been dead for some time.

The ceca are often filled with firm, cheesy or soft grayish material depending apparently to some extent upon the form of the disease (cf. pp. 186 and 188).

Treatment. The treatment of white diarrhea depends somewhat on the cause. If it is due to improper feeding or brooding of course the only treatment consists in removing the cause. This will prevent the trouble in the later flocks and will help those already affected. A small dose of a good purgative such as Epsom salts will probably help in bringing the chicks into better condition. Dr. P. T. Woods recommends giving the chicks scalded sweet milk with a little grated nutmeg 4 times a day. He also recommends boiled rice as food. They should have plenty of charcoal before them and in their mash. They should also have green food every day. If green food is not available raw vegetables may be substituted. Some good anti-

septic should be used in the drinking water. Potassium permanganate as recommended on p. 16 may be used. Dr. Morse recommends also bichloride of mercury, using 10 of the 1-1000 grain tablets to one quart of water. Also 10 grains of iron sulphate to the gallon of water is said by some to be good. It is the opinion of the writers that neither of the latter two is as desirable for use as an antiseptic for the water as permanganate.

These recommendations apply to any case of white diarrhea whatever its cause. In the forms of white diarrhea caused by parasitic organisms specific modes of treatment or of prevention may be recommended. In the case of coccidiosis Dr. Morse says that the eggs should be dipped in 95 per cent alcohol or a 4 per cent solution of a good coal tar disinfectant before they are placed in the incubator. The incubators and brooders should all be thoroughly disinfected every time they are used. The treatment of sick chicks should be as recommended above.

In the case of bacillary white diarrhea the same recommendations for disinfection of incubators, brooders and the premises should be followed. Dr. Rettger says that it is only during the first 48 hours that the chick can be infected. Consequently the very greatest care should be taken during those first two critical days. However, the fact that the bacterium has been found in the yolk of the unhatched—even of the unlaidd egg—indicates very clearly that something more than disinfection is necessary to stamp out the disease. Very great care should be exercised in picking out breeding stock. It is very likely that the hens which lay the eggs infected with the bacteria were chicks which recovered from white diarrhea. The bacteria still continue to live over in their bodies. Every effort should be made to locate and remove the source of infection. If there is widespread infection on the farm, eggs for hatching should be obtained from other places where there is little or no white diarrhea.

On methods of preventing and eliminating bacillary white diarrhea Rettger and Stoneburn give the following.

"If the disease makes its appearance among the flocks of chicks every effort should be made to ascertain the source of the infection. This may be (a) breeding stock upon the place, (b) eggs for hatching secured from other breeders, or (c) newly hatched chicks purchased from others."

"If the breeding stock proves infected there are two courses of procedure open; (a) market the entire flock or refrain from using their eggs for hatching, or (b) install trap nests in the breeding pens and by means of accurate pedigree records ascertain which individual hens are producing infected chicks, and remove such hens from the breeding flock."

"Since infection may be brought upon the place through purchased eggs or stock, such purchases should be made from farms where bacillary white diarrhea is not common."

"If bacillary white diarrhea is known to be present on the place steps should be taken to prevent the spread of the infection, and, if possible, to effect a cure. (As to the latter we do not feel justified in offering any suggestions at this time)."

Prevention. Since the disease cannot, apparently, be transmitted through the food supply after the chicks have reached the age of 3 or 4 days, every means should be pursued to prevent the spread of the infection during this critical period. We suggest:

The segregation of the chicks in small lots during this interval.

Perfect disinfection and cleanliness of brooders and brooder coops.

Food and water supplied in such a manner as to prevent contamination by the droppings."

"The use in the brooder of a liberal amount of fine, absorptive litter which will quickly cover and seal up the droppings."*

"Raise and maintain the vigor and vitality of the breeding stock and chicks by every reasonable means known to the poultryman."

Leg Weakness.

The term "leg weakness" is sometimes used by poultrymen to indicate the lameness due to rheumatism in adult birds. Regarding this form of the disease see p. 123. The more usual use of the term "leg weakness" is to denote a disease or ailment which is found in growing chicks, from 1 month to 6 months of age. It is said to be more common among cockerels than pullets and is more frequent in the heavier than the lighter breeds. The chief cause of the trouble seems to be that in birds growing rapidly and fed heavily the weight sometimes increases faster

*For this purpose we have used alfalfa meal with much satisfaction.

than the strength. This results in a weak kneed, wobbling bird. The disease is sometimes ascribed to other causes such as overcrowding, close, unventilated quarters, overheating, etc. Salmon says "It may develop in young chickens kept in brooders in which the heat is not properly distributed or where there is too much bottom heat, also in those which are kept constantly upon wooden floors." Regarding these cases Robinson says "Where such conditions are present the leg weakness is more likely to be an accompaniment of diseases which plainly show other symptoms."

Diagnosis. The symptoms are indicated in the name of the disease. It first appears as an unsteadiness in the walk. This may gradually become worse until the bird is unable to stand alone and is constantly tumbling over. The birds are found sitting while eating and are inclined to walk very little. When the trouble first appears there is little else wrong with the bird. The eye and comb are bright and healthy, the appetite is good. Later, however, the bird being weaker than the others gets less grain and becomes thin, feathers out poorly and is a distressed object. It is said that rheumatism can be distinguished from leg weakness by the swelling of the joints in the former disease.

Treatment. This consists chiefly, of course, in removing the cause. Since the most common cause is the overfeeding with fat producing foods, the amount of these should be reduced. The weak birds should be removed to a pen by themselves. Substitute bran, wheat and oatmeal for the corn and corn meal. Give skim milk, if possible, instead of water. *Feed plenty of green food.* This is one of the most important measures. Sanborn recommends rubbing the legs with tincture of arnica and adding $\frac{1}{2}$ teaspoonful of tincture of nux vomica to each quart of drinking water.

Aspergillosis or Pneumomycosis.

This disease, which is discussed on p. 1, not only occurs in hens but it is also a very common and fatal disease in young chicks. It often occurs with white diarrhea and the double disease was for a long time considered as one. Poultrymen designated the cases in which the lesions occurred in the lungs as "lungers." Investigation has shown that there are two diseases which may occur separately or together.

Diagnosis. This disease is characterized by a dumpish sleepy condition of the chick. The wings are pendulent. Breathing is rapid and sometimes accompanied by snoring sounds. A whitish diarrhea is present. A differential diagnosis between this and the coccidial white diarrhea is only possible by an examination of the dead birds. In aspergillosis, yellowish tubercles which closely resemble those of tuberculosis occur in the lungs and in the walls of the air sacs and often also in the intestines, mesentery, liver and other organs. In very acute cases the lungs are simply inflamed, death occurring before the formation of the tubercles. The mycelium and spores of the fungus may be found by microscopic examination of the tubercles and this fungus may be obtained by inoculating cultures from these tubercles.

Etiology. The disease is caused by the spores of an *Aspergillus* usually *A. fumigatus*, fig. 22. This is a very common fungus and the spores are widely distributed in nature. The spores are often found on the food or on the litter and are inhaled or taken in with the food. Incubator chickens are often infected from the incubators and brooders and hen hatched chickens from the straw or chaff in the nests. Sometimes the chicks get the disease from chick food not properly cared for. It is possible that this disease as well as the coccidial and bacillary white diarrhea is sometimes carried in the egg. The spores and mycelium are often found in the digestive tract of hens and it is not unlikely that they may work up the oviduct from the cloaca and infect an egg before it gets its shell.

Treatment. The treatment of diseased chicks is useless. When they are infected the spores develop on the membranes and new spores are formed which spread the infection throughout the respiratory system and also to the other organs. The only effective treatment is prevention. Keeping the flock under good hygienic conditions with clean food, litter and nesting material reduces the chance of infection and keeps the chicks in a vigorous condition in which they are able to resist the disease. The dead chicks should be burned or buried.

Prognosis. The disease is fatal so far as known.

Emphysema.

This name is applied by Robinson to a disease of young chicks in which the skin puffs out in the sides of the neck near its

junction with the body. The size of the puff varies somewhat. In mild cases it is about the size of a hickory nut. Sometimes there is one puff, sometimes several. A few cases have been reported "where the puffing covers nearly the whole body, the skin of the chick being so inflated that locomotion becomes difficult." (Robinson).

According to Vale the trouble generally occurs in growing chicks which have been confined in close quarters. It is often associated with some lung trouble. It seems to be due to obstruction of the air passages and the rupture of some of the air sacs. The air thus escapes into the tissues beneath the skin. While not common this disease does occur in Maine. Some cases were reported to the Station while this work was in preparation.

The treatment suggested by Vale is to puncture the skin with a needle and to give 2 grains nitrate of iron to each wine glassful of drinking water. Robinson, however, says: "It is rather to be recommended that no effort be made to treat such chicks. Even if cured of the trouble, they rarely develop satisfactorily."

Gapes.

Gapes is a disease which attacks domestic poultry and many species of wild birds. In fowls it is more frequently observed in young chicks. It occurs also in adult fowls but rarely causes enough inconvenience to attract attention. The disease is due to the presence of minute parasitic worms in the air passages.

Diagnosis. "The symptoms of gapes are frequent gaping, sneezing, a whistling cough with discharge of mucus and worms, dumpishness, weakness and drooping wings. When badly affected, the bird shakes its head frequently, gapes and coughs as if suffocating, droops and is not able to keep up with the rest of the flock, and stands in "dumpish" position with eyes closed, wings drooped, mouth open and tongue protruding." (Woods, Rel. Poultry Rem.)

The correctness of a diagnosis for gapes should be tested by determining whether or not the worms are present in the trachea. When chicks are dying from a disease supposed to be gapes the trachea of a dead bird may be examined. If the trouble is gapes the worms will be found attached in pairs to the mucous membrane of the trachea.

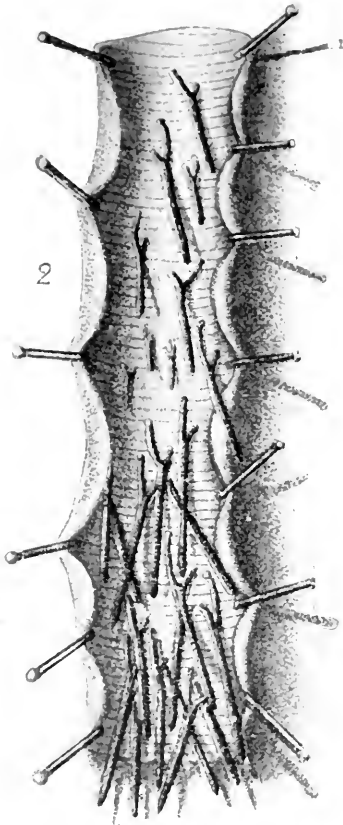


Fig. 47. Trachea (windpipe) of a pheasant showing gape worms (*Syngamus trachealis*) attached to the mucous membrane. (After Megnin).

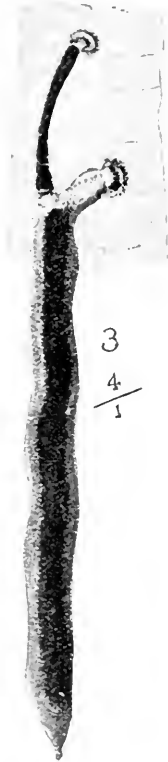


Fig. 48. A pair of *Syngamus trachealis*, attached. (After Megnin).

The two sexes are joined together in such a way that a pair looks like a double headed worm. The female is about $\frac{1}{2}$ inch long and the male about 1-5 inch. The worms are pale in color when empty but when they have been feeding they are red with the blood of the chick. The presence of the worms in the trachea of a living chick may be demonstrated by passing a gape worm extractor (a loop of horse hair or fine wire or a feather with the vane removed except at the tip) carefully down the trachea for some distance turning it around to loosen the worms and drawing it out. If the worms are present some will be removed with the extractor.

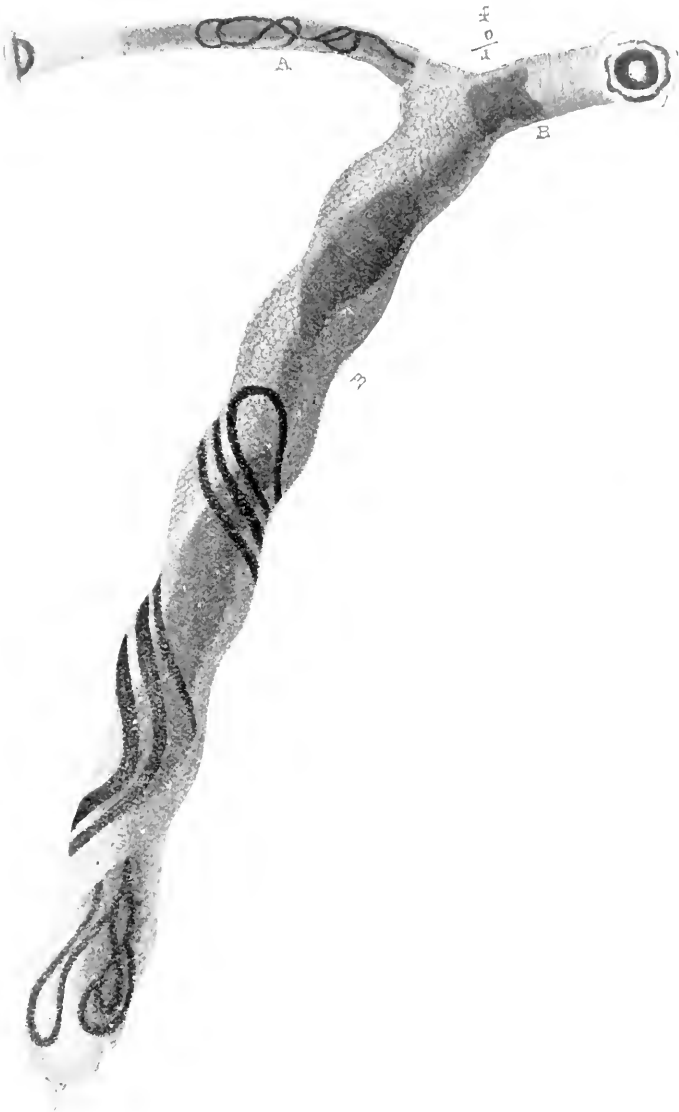


Fig. 29. A pair of *Syngamus trachealis*. A, male. B, female.
(After Megnin).

The presence of the worms causes an irritation and inflammation of the membrane and stimulates the secretion of mucus. Some of the accumulation of worms and mucus is expelled by coughing. Sometimes part of it is swallowed and expelled with the feces. The loosened material may be drawn into the deeper air passages during inspiration. Death may occur from suffocation due to the obstruction of the air passages with worms and mucus, or weak individuals may die from loss of blood.

Etiology. The only cause of the disease is the nematode or thread worm *Syngamus trachealis* Siebold, called the gape worm, red worm, or forked worm. (See figs. 47 to 49). These parasites obtain their nourishment by sucking the blood from the mucous membrane of the trachea. They are attached in pairs to the membrane by their sucker-like mouths. Beside bringing about a considerable loss of blood the worms cause irritation and inflammation of the membrane and a copious secretion of mucus. The two sexes are so closely attached to each other that they can not be separated without tearing. The body of an adult female is swollen with thousands of eggs and occasionally contains some embryos. The eggs are not laid but escape when the body of the female is ruptured. This may take place with the decomposition of the worm or the body may be torn by the coughing of the bird. The eggs may develop and grow to adult worms within the trachea of the same bird. The worms, eggs and embryos are often coughed up. Sometimes they are swallowed and then some of the eggs and embryos may be passed with the feces. The worms coughed up are eagerly eaten by the same or other birds and the ova and embryos are often taken with contaminated food and drink. Developing embryos have been found in earth worms living in infected poultry yards, and these will cause gapes if fed to chicks.

The eggs and embryos need only warmth and moisture to develop. Eggs may develop in the digestive organs. It is not known how the embryos reach the trachea from the digestive organs. A large number of those eaten never reach the trachea but are either digested or voided with the feces. Salmon says: "Although there are some thousands of eggs in the adult worms, 10 to 15 worms have been fed to a single chicken, and, as a result, not over 4 or 5 embryos would reach and develop in the trachea." According to Theobald, Ehler found copulated worms where several of the females were full of worms 10 days

after feeding ova to healthy chicks. Wet clay soils are especially favorable to the gape worms, and they thrive best in warm, wet weather.

Treatment. In eradicating the disease it is important to isolate all affected birds so that the worms and ova coughed up or voided with the excrement may not be eaten by the other chicks or contaminate the food, drink, and the ground of the runs. Burn the bodies or at least the heads and necks of all dead birds. The feed troughs and water dishes should be scalded and the houses, and coops disinfected. Use potassium permanganate in the drinking water. If possible provide fresh runs on which there has been no poultry for several years. The following paragraph from Robinson is much to the point:

"Preventive treatment to be fully effective, seems to require that fowls be kept away from infected ground for several seasons. It is said that ground from which poultry is kept for three years, the land meanwhile being sown to grass or cultivated, will be entirely free from the gape worm. To a poultry keeper whose area of land is small this means moving or keeping no poultry for several years. Where land is abundant gape worms can often be avoided by moving the poultry to a plot not recently occupied by them. Treatment to disinfect the soil by destroying the gape worms in it, the object being to continue the poultry on it, is not often profitable."

The following methods have been recommended for disinfecting the ground. It is doubtful if these are economically advisable.

Treating the ground with air slaked lime and spading.

Sprinkling with one of the following solutions:

1 per cent or 2 per cent sulphuric acid.

2 ounces of copperas dissolved in a pail of water.

1½ ounce of crystals of potassium permanganate to a barrel of water.

The lime or acid treatments are most often recommended. The infected birds should be kept in houses easily cleaned and disinfected and this should be done frequently to prevent re-infection of the recovering birds. Theobald advises an addition of 3 drams of salicylate of soda to each quart of drinking water to destroy eggs and embryos that may contaminate it.

The individual surgical method may be profitably practiced in some cases. It seems to be the only sure method yet ad-

vised of ridding an infested bird of the parasites. Wright gives the following description of the method:

"The old-fashioned cure was to strip a small quill-feather, all but a small tuft at the point, and (moistening it in turpentine or not) introduce it into the trachea, turn it round, and withdraw it with the worms. This is effectual, but requires care to prevent lacerating the wind-pipe or causing suffocation. In this way 30 worms have been successfully extracted from one chicken. A very much better method is to take two *straight* hairs from a horse's tail, laid together, tie a knot on the end of the pair, and cut off the ends close to the knot. This is passed straight (i. e., without twisting) down the windpipe as far as it will go without bending, then twisted between the finger and thumb and drawn out. A trial or two may miss, but usually 5 or 6 attempts will bring up 4 or 5 worms, and the hairs inserted in this way, without twisting, do not seem to hurt the chicks, and are used with the greatest facility. The bringing up of even from 4 to 10 worms, and the failure of more to come after a blank trial or two, may usually be reckoned as a cure."

Wire gape worm extractors may be bought from dealers in poultry supplies, or one can make one for himself by taking No. 30 wire, forming a loop at one end just big enough to go easily down the trachea, and then twisting together the ends of the wire to form a long handle. Worms removed should be burned.

Prognosis. This disease is often fatal in young chicks from one to four weeks old, especially in small weak birds. Young chicks and in most adult fowls it often causes little inconvenience. These fowls, however, are constant sources of infection. The removal of the worms from the trachea if skilfully done so that the delicate membrane is not injured usually effects a cure but this individual treatment requires considerable time and the value of the chicks must determine whether or not it is economically profitable.

CHAPTER XX.

POULTRY SURGERY.

It is proposed to consider in this section those pathological conditions of poultry which demand surgical treatment for their cure. At the outstart it should be said that poultry bear and recover from surgical operations very well. The common practice of caponizing, usually done without any aseptic precaution whatever and with small losses from infection, is sufficient evidence of this. Probably no mammal would bear opening the abdominal cavity (which is done in every caponizing operation) with such entire and nearly uniform freedom from ill effects as attends this operation with poultry. The reason why poultry make such excellent surgical subjects lies in their marked resistance to all pyogenic (pus producing) germs.

The Treatment of Cuts, Tears and All Open Wounds.

Very severe wounds may be successfully treated by adhering to the following procedure:

1. Thoroughly wash the hands in warm water, using plenty of soap, before handling the wounds at all. After the hands have been well scrubbed, rinse them thoroughly in a pan of 1 to 1000 bichloride of mercury solution (p. 29) and dry with a *clean* towel.

2. Pull out the feathers in the region around the wound, and thoroughly cleanse it, using first *warm water*, and follow this with *warm 1 to 1000 bichloride solution*. A piece of clean soft cloth may be used for this purpose, or absorbent cotton. Make sure that the wound is *thoroughly* clean. Do not be afraid of hurting the bird. A little pain at the start is preferable to a dead bird later.

3. If necessary sew up the wound, using a good sized sewing needle and silk. Both needle and silk should be soaked in alcohol for 15 minutes before using. Small wounds need not be sewed. Large ones will heal much quicker and more certainly if they are sewed. If the wound involves the muscles as well

as the skin sew it up in two layers; one set of stitches including only the muscles, the other set only the skin.

4. Paint the skin in the region about the wound, *but not the wound itself* with dilute tincture of iodine.

5. Powder the wound well with iodoform.

6. Smear a thick layer of the ointment already recommended (p. 30) over all.

7. If the wound is very severe bandage it with a clean cloth.

The above treatment is only necessary in its entirety in very severe cases. Depending upon the gravity of the condition the following items in the treatment may be omitted in the order named:

7 may be omitted except in most serious cases.

7 and 3 may be omitted in less severe cases.

7, 3 and 4 may be omitted in still less severe cases.

7, 3, 4, and 1 may be omitted in still less severe cases.

In case of slight wounds which appear still to demand some treatment 6 and 2 or even 6 alone will suffice.

Abscess.

Should an abscess appear lance it with a clean sharp knife, making sure to cut to the bottom. Squeeze out the pus and core if there is one, and then proceed to heal it by following the treatment above outlined for wounds in general.

Bumblefoot.

This is an abscess of the foot which may result from a variety of causes, e. g., too high roosts, too narrow roosts, undiscovered wounds caused by stepping on nails, splinters of glass, etc. It is usually not discovered until the bird becomes lame.

The best treatment to follow is first to tie a cord *tightly* about the leg above the foot to control the flow of blood; then with a *clean*, narrow bladed, *sharp* knife open up the abscess *thoroughly*. Go clear to the bottom and dig out the core. Then follow *in detail, omitting nothing except 3*, the treatment given above for wounds. Two days after the first treatment take off the bandages and repeat the treatment, going through in order steps, 1, 2, 4, 5, 6 and 7. In some cases a third treatment after a lapse of 2 or 3 days may be necessary, but usually not if the first treatment is thorough.

Of course the bird under treatment should be isolated and kept in a small pen with soft litter on the floor.

Broken Bones.

If a bird is sufficiently valuable to warrant the trouble it is possible to set fractures of the long bones of legs and wings, and get successful union. A splint should be made for the affected part and carefully and thoroughly bound into place. Healing is rapid, and it should be possible to remove the splints in three weeks from the time they are put on if not before. In our experience firm union has occurred in less time than this.

Frozen Combs and Wattles.

In northern parts of the country frozen wattles and combs, especially in male birds, are very common occurrences. The trouble is more apt to be with the wattles than the comb, because the former dip into the drinking water and then freeze at times when if dry, they would not do so.

The following brief but adequate directions for treating frozen combs and wattles are taken from *Farm Poultry*, Vol. 15, p. 41: "First thaw the wattles or combs out by manipulating with the fingers well smeared with vaseline. Keep the bird in a cool (not cold) place, and anoint the frozen parts with a mixture of vaseline, 5 tablespoonfuls; glycerine, 2 tablespoonfuls; turpentine, one tablespoonful, once or twice a day. If he is not very badly frosted it probably will make no difference with his breeding a few months from now—provided he is not again injured the same way."

Anesthetizing Poultry.

From time to time requests come to the Station for information regarding the most satisfactory method of anaesthetizing birds. On this account it seems desirable to republish the following material extracted from a paper written some time ago by R. Pearl and Frank M. Surface on this subject (*Jour. Amer. Med. Asso.*, Vol. 52, pp. 382 and 383).

"The difficulty which we have found to be inherent in anesthetizing the domestic fowl may be stated briefly in this way: If any anesthetic is pushed to the point at which the bird is in satisfactory condition for operative procedure in about 9 cases out of 10 the bird will die on the table from the effects of the

anesthesia before the operation, if extensive, can be completed. If, on the other hand, the anesthetic is given less freely the bird does not lose its reflex excitability. Every time a cut is made or a nerve is pinched with the forceps the bird will struggle. Our experience in anesthetizing birds, which has now covered a large number of individuals, leads us to believe that the only middle ground between these two extremes is afforded by those cases (unfortunately too few) in which the individual idiosyncrasy of the bird toward ether makes it take the anesthetic well.

While we have made no detailed physiologic study as to the fundamental reasons underlying this difficulty respecting anesthesia which has been described, it seems reasonably apparent what these reasons are. Connected with the respiratory organs proper of a bird are the relatively enormous air sacs. During anesthesia the ether or chloroform vapor gets into these air sacs either by diffusion or directly as a result of respiratory movements. There is reason to believe that the vapor, once in the air sacs, stays there until it is absorbed by the tissues; in other words, it appears to be the case that the great bulk of an inhaled anesthetic in the case of birds must be eliminated from the body by way of the urinary organs rather than the respiratory organs. Assuming this to be the case there is no difficulty in seeing why forcing an anesthetic in a bird leads to disastrous results. The relatively enormous area for absorption afforded by the air sacs insures that a correspondingly large amount of the anesthetic will be taken up very quickly. This almost immediately affects the vagus center, with the consequent cardiac inhibition, respiratory failure and death.

The exact method of procedure which we now follow in anesthetizing birds is as follows: Immediately before beginning the administration of the anesthetic a 1-200 grain atropin sulphate tablet is dissolved in 1 c. c. of warm normal saline solution. The salt solution with the dissolved atropin is then injected subcutaneously in the axilla. Ether is used as the anesthetic. It is administered from a small improvised mask which admits of the condition of the comb being seen during the operation. Depending on how hard the ether is pushed, the bird is ready for operation in from 15 to 20 minutes after the anesthesia is begun. The dosage of 1-200 grain atropin to a bird may seem large, but we have never been able to see the slightest bad effect from it, provided the administration of ether was begun immediately after the injection of the atropin."

GLOSSARY OF TECHNICAL TERMS.

- Abdomen*.—That portion of the body which contains the internal organs. Belly.
- Air sac*.—One of the membranous sacs filled with air in different parts of the body, especially in the abdominal region. They often extend into the cavities of the bones and connect with the lungs.
- Albumen portion of oviduct*.—See p. 157.
- Anæmia*.—A condition in which the blood is deficient either in quality or quantity. It is marked by paleness and loss of energy.
- Anus*.—The external opening of the intestine. Vent.
- Apathetic*.—Lacking in feeling or ambition. Indifferent.
- Arachnida*.—A class of invertebrate animals including among other groups the spiders, scorpions and mites.
- Articular*.—Pertaining to the joints.
- Astringent*.—Causing contraction and arresting discharges.
- Atony*.—Lack of normal tone or strength.
- Atrophy*.—A wasting or diminution of the size of a part.
- Auditory meatus*.—The opening into the ear.
- Avian*.—Pertaining to birds.
- Axilla*.—The region under the wing where the latter joins the body.
- Bile*.—The substance secreted by the liver. Gall.
- Bronchi*.—The tubes which lead from the end of the windpipe (trachea) to the two lungs. (cf. fig. 12).
- Carcinoma*.—A malignant tumor or cancer.
- Catheter*.—A tubular surgical instrument for discharging fluids from a cavity of the body or for distending a passage.
- Cecum (plural ceca)*.—A blind intestinal pouch of which there are two in the fowl.
- Cell*.—The smallest element of an organized body that manifests independent vital activities. A morphological or structural unit of an organism.
- Chronic*.—Long continued but not acute.
- Cleavage*.—The division of the cells of an embryo.
- Cloaca*.—The enlarged portion of the alimentary canal just before the vent. The intestine, the ureters (tubes from the kidneys) and the oviduct open into the cloaca.
- Conjunctiva*.—The delicate membrane that lines the eyelids and covers the eyeball in front.

Contagious. A disease which is communicable by direct contact.

Copulation.—Sexual intercourse. With fowls "treading."

Cornea.—The hard transparent structure forming the anterior part of the eyeball.

Creolin.—A thick black liquid coal tar preparation. It has antiseptic properties.

Cresol.—A coal tar product with antiseptic and germicidal properties.

Cyst.—A sac-like growth which usually contains a liquid or a semi-solid.

Demulcent.—A soothing mucilaginous or oily medicine.

Dermoid cyst.—A form of congenital cyst often containing skin-like structures.

Diuretic.—A medicine that increases the activity of the kidneys.

Echymoses (ek-kim-o-ses).—Discoloration of the skin caused by blood outside of the blood vessels as in a bruise.

Emaciated.—Very lean or wasted condition of the body.

Enema. A liquid injection in the rectum or cloaca.

Euteritis.—Inflammation of the intestine. In human medicine confined chiefly to the small intestine.

Epidemic.—A disease that is widely prevalent in a community or locality.

Epidermis.—The outer or non-vascular layer of the skin. The cuticle.

Ephelioma.—A cancer or malignant tumor consisting chiefly of cells derived from the skin or mucous membrane.

Epithelium.—The covering or outer layer of the skin and mucous membranes.

Ergot.—A fungus which affects and finally replaces the seed of a cereal grass. Used chiefly in connection with the ergot of rye which is poisonous to poultry. Ergot as a drug has the property of causing the mammalian uterus to contract.

Etiology.—The causation of any disease.

Exudate.—A substance thrown out of the body or deposited in a tissue by a vital process.

Feces.—The excrement or undigested residue of the food discharged from the intestines. Dung. Droppings.

Flagellate micro-organism.—Any minute microscopic organism which swims through the water by means of the lashing of one or more hair-like structures (flagella).

Follicle.—See p. 157.

Gall bladder.—The reservoir for the bile or gall secreted by the liver. It is readily seen on the upper side of the liver.

Gallus domesticus.—The scientific name for the domestic fowl.

Gangrene.—See p. 174. Gangrene of oviduct.

Gastritis.—Inflammation of the stomach.

Hermaphrodite.—An organism which has both male and female reproductive organs.

Hemorrhage.—Bleeding. A copious escape of blood from the vessels.

Hepatic.—Pertaining to the liver.

Hyperaemia. Excess of blood in any part of the body.

- Hypertrophy*.—The morbid enlargement or overgrowth of an organ or part.
- Immunity*.—Security against any particular disease.
- Infection*.—The transmission of disease from one animal to another usually through some intermediate agent.
- Infiltration*.—The accumulation in a tissue of substances not normally found in it.
- Inoculation*.—The insertion of a virus into a wound or abrasion in the skin in order to communicate a disease.
- Isthmus*.—See p. 158.
- Keratitis*.—Inflammation of the cornea of the eye.
- Larva*.—The first stage in development after leaving the egg. Used in connection with insects, worms, etc.
- Larynx*.—A muscular and cartilaginous structure situated at the base of the tongue and connecting with the windpipe (trachea). It is the organ of voice.
- Lesion*.—Any hurt, wound or local degeneration.
- Leucocytes*.—White blood corpuscles.
- Lymphatic*.—Pertaining to or containing lymph which is a transparent slightly yellow liquid which fills the lymphatic vessels. It corresponds in some respects to the serum or liquid portion of the blood.
- Mammal*.—Any vertebrate animal which suckles its young.
- Melanosis*.—Pertaining to an abnormal deposit of pigment.
- Mesentery*.—The fold of peritoneum attached to the intestines.
- Metamorphosis*.—In insects the change from larval to adult form as from caterpillar to butterfly.
- Micro-organism*.—Any minute (microscopic) animal or plant. Often used in referring to bacteria or germs.
- Mite*.—A small arthropod somewhat related to spiders. (Cf. fig. 31).
- Mucosa*.—The mucous membrane.
- Mucous membrane*.—The lining of the internal cavities of the body.
- Mucus*.—The viscid secretion of certain (mucous) glands.
- Mycelium*.—The thread-like portion of a fungus. (Cf. fig. 38).
- Nacreous*.—Resembling mother-of-pearl.
- Necrotic*.—Pertaining to dead or decaying tissue.
- Nucleus* (Pl. nuclei).—A spherical body within a cell. The nucleus is essential to the life of the cell.
- Oesophagus*.—That portion of the alimentary canal between the mouth (pharynx) and the crop.
- Oral*.—Pertaining to the mouth.
- Ovary*.—The female sexual organ in which the eggs develop.
- Oviduct*.—The tube through which the egg passes from the ovary to the cloaca.
- Ovum*. (plural ova).—The egg, particularly while on the ovary. (Cf. fig. 40).
- Panophthalmia*.—Inflammation of all the structures or tissue of the eye.
- Papilla*.—A small nipple shaped elevation.
- Pathology*.—That branch of medicine which treats especially of the tissue changes caused by disease.

- Pericardium.*—The membranous sac which contains the heart.
- Peristalsis.*—The worm-like movements of the intestine and oviduct by which the contents of these tubes are propelled.
- Peritonitis.*—Inflammation of the peritoneum or the membrane lining the abdominal cavity.
- Pharynx.*—That portion of the alimentary canal between the mouth and the oesophagus. It also communicates with the larynx and nasal passages at its upper end.
- Prognosis.*—The prospect as to recovery from a disease or a forecast as to the probable result of an attack of a disease.
- Protoplasm.*—A viscid granular material which forms the essential constituent of the living cell. Living substance.
- Protozoa.*—A class of unicellular animal micro-organisms.
- Proventriculus.*—That portion of a bird's alimentary canal lying between the crop and the gizzard. Often called the stomach.
- Punctiform hemorrhages.*—Presenting the appearance as if punctured by a large number of fine prickles or needle holes from which the blood oozes.
- Purgative.*—Causing evacuations of the bowels.
- Pyæmia.*—Blood poisoning due to a microbial origin.
- Sarcoma.*—A kind of tumor or cancer not always of a malignant nature.
- Scabies.*—A contagious skin disease caused by a mite.
- Sclerotic.*—Pertaining to the hard white fibrous membrane which with the cornea forms the outermost coats of the eyeball.
- Serum.*—The clear liquid which separates from the clot and the corpuscles in the clotting of blood.
- Spleen.*—An oval shaped organ normally about one-half inch in diameter and of a dark red color. It lies immediately above the liver and between that and the proventriculus.
- Spore.*—The reproductive cell of many protozoa and of many lower plants. It is usually enclosed in tough membranes and is difficult to kill.
- Stigma.*—See p. 157.
- Subcutaneous.*—Beneath the skin.
- Sub-mucosa.*—The layer of tissue situated beneath the mucous membrane.
- Syncope* (sin-ko-pe).—Fainting. Failure of the heart's action.
- Trachea.*—The wind-pipe.
- Traumatic.*—Caused by an injury.
- Therapeutic.*—Pertaining to the art and science of healing.
- Urate.*—A salt of uric acid. A product of the secretion of the kidneys. The white part of a fowl's droppings.
- Ureters.*—The tubes leading from the kidneys to the cloaca.
- Utricle.*—See p. 158.
- Vagina.*—That portion of the oviduct between the shell gland and the cloaca.
- Virulent.*—Extremely poisonous or dangerous.
- Virus.*—Any animal poison, especially one produced by and capable of transmitting a disease.
- Viscera.*—The internal organs of the body.

INDEX.

	PAGE
Abdomen, baggy	36
liquid in	73
Abdominal dropsy	73
Abnormal eggs	175
Abortion of eggs	164
Abscess	202
<i>Acarina</i>	132
Air	14
Air sacs	86
Air-sac mite	110
Alimentary tract	32
<i>Amoeba meleagridis</i>	53
Anæsthetizing poultry	203
Anatomy of reproductive organs	155
respiratory organs	85
Apoplexy	118
Apothecaries' weights and measures	31
Arsenic as poison	44
Articular gout	121
Ascites	73
Aspergillosis	53, 104
in chicks	193
Atrophy of liver	52
ovary	160
Autopsy	24
Bacillary white diarrhea	186
Bacillus tuberculosis	58
Baldness	147
"Bed bug" of poultry	145
Bichloride of mercury	29
Blackhead	53
Blood, diseases of	114
Blood vessels, rupture of	113
Bloody diarrhea	40, 44, 51, 79
Bloody spots in eggs	177
Body mange	144
Bones, broken	203

	PAGE
Books on poultry diseases	2
Brain congestion	119
hemorrhage of	118
postmortem appearance of.....	118
Breaking of egg in oviduct.....	174
"Break down"	179
Breeding, for health and vigor	6
Broken bones	203
Bronchitis	88
Bumblefoot	202
Calomel	28
Cancers	55, 163
Canker	90, 103
Castor oil	28
Carcinomatosis	55
Catarrh	87, 90
Catechu	28
Cayenne	28
Ceca, post-mortem appearance of.....	186, 188
Cercomoniasis	55
Chicken pox	150
Chickens, diseases of.....	181
Cholera	66
Circulatory system, diseases of.....	112
Cleanliness	10
Cloacitis	177
Coccidia	53, 185
Coccidiosis, intestinal	183
Coccidium, life history of.....	185
Cold	87
Comb, frozen	203
white	147
Congestion of lungs	107
Constipation	37, 41, 42
Constitution, breeding for.....	6
Contagious catarrh.....	90
Convulsions	44, 45
Copper poisoning	44
Cremation	20
Cresol disinfectant	12
Crop, enlarged	36
impacted	32
inflammation of	34
Cropping poultry ranges.....	18
Croup	88
Cuts, treatment of.....	201
<i>Cytodites nudus</i>	110

	PAGE
Dampness	15
Dandelion, for liver trouble.....	51
Dead birds, disposal of.....	20
Depluming scabies	142
<i>Dermanyssus gallinac</i>	133
Diagnosis of disease	22
Diarrhea	34, 40, 42, 44, 45, 48, 67
Diarrhea, white	181
Diphtheria	90
Diphtheritic roup	90
Disinfection	11
Dissection of bird.....	25
Distemper	89
Double and triple yolked eggs.....	176
Dove cote bug	145
<i>Drepanidotaenia</i>	77
Drinking water	16
Droppings, appearance of normal.....	38
green	67
Dropsy	73
Dysentery	39
Dyspepsia	42
Egg bound	169
breaking of in oviduct	174
laying, physiology of.....	159
Eggs, abnormal	175
abortion of	164
double and triple yolked.....	176
inclusions in	177
misshapen	177, 178
small	176
soft shelled	175
spots in	177
yolkless	176
<i>Emphysema</i>	194
Endocarditis	112
Enlargement of heart.....	113
liver	50
Enteritis	39
Enterohepatitis, infectious	53
Epilepsy	119
Epithelioma contagiosum	150
Epizootic	89
Epsom salts	28
Ergot as poison	45
Eversion of oviduct	167
Exercise	20

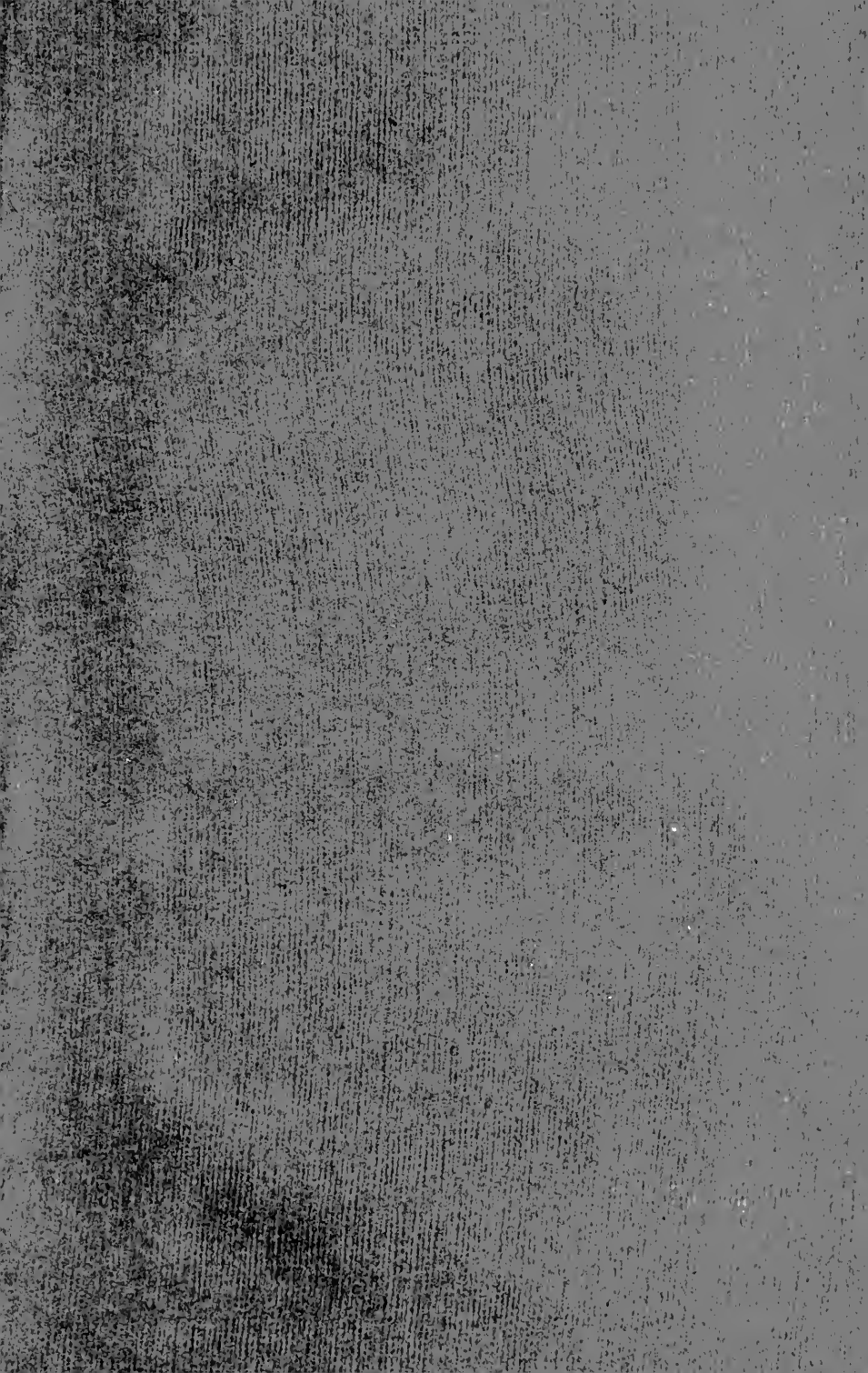
	PAGE
External parasites	124
Extractor, gape worm	200
Eyes, roup of	94, 100
Fatty degeneration of liver.....	51
Favus	147
Feeding, hygienic	15, 49
Flea, "hen"	145
Flukes	83
Follicle, failure to rupture	165
Formaldehyde disinfection	12
Frozen comb	203
Frozen wattle	203
Fungus	105
Gangrene of oviduct	174
Gapes	195
Gastritis	36
Gleet, vent	177
Glossary	205
<i>Goniodes dissimilis</i>	127
Gout	56, 121
articular	121
visceral	121
Green droppings	67
Green food	16
Grippe	89
Harvest bug	145
Health, breeding for	6
Health type	7
Heart, enlargement of.....	113
post-mortem appearance of	68, 112, 113, 115, 121
Heart sac, dropsy of	112
<i>Heterakis perspicillum</i>	83
Housing	10
Hygiene	8
essentials of	21
Hypertrophy of liver	50
yolk	164
Inclusions in eggs	177
Indigestion	42
Infectious enterohepatitis	53
leukaemia	114
Inflammation of mouth	102
oviduct	165
Influenza	89
Inoculation for cholera	70
Internal parasites	75
Intestinal coccidiosis	183

	PAGE
Intestines	37
post-mortem appearance of.....	40, 50, 62, 68, 79, 115, 121, 188, 194
Jaundice	52
Kidneys, diseases of	121
Kidneys, post-mortem appearance of.....	68, 113, 121, 188
<i>Kucmidocoptes mutans</i>	138
Land	18
Lead as poison	45
Leg weakness	192
Leukaemia, infectious	114
Lice	125
powder	130
Life history of coccidium	185
Light	14
Limberneck	123
<i>Lipeurus variabilis</i>	127
Litter	15
Liver, atrophy of	52
diseases	47
enlargement of	50
fatty degeneration of.....	51
hypertrophy of	50
post-mortem appearance of.....	40, 47, 49, 50, 51, 52, 53, 54, 55, 56, 61, 68, 113, 115, 121, 188, 194
Lungs	85
congestion of	107
post-mortem appearance of.....	104, 108, 113, 116, 188, 194
Lye as poison	44
Male reproductive organs, diseases of.....	180
Mallophaga	125
Mange, body	144
Measures	31
Medicines	28
<i>Menopon pallidum</i>	126
Mercury, bichloride of.....	29
Misshapen eggs	177
Mite, air sac	110
Mites	132
<i>Monocercomonas gallinarum</i>	55
Mouth, inflammation of	102
Mycosis of the air passages	104
Myocarditis diphtheritica	113
Nervous system, diseases of	118
Nitrate of soda as poison	44
Nits	128
Nodular taeniasis	78
Obstruction of oviduct	169
vent	41

	PAGE
Ointment	30
Operation, for "egg bound"	171
impacted drop	34
Ovarian tumors	163
Ovary, atrophy of	160
diseases of	160
gangrene of	163
post-mortem appearance of	160, 161, 162, 163, 164, 165
Overfeeding	15, 48
Oviduct, diseases of	165
gangrene of	174
inflammation of	165
obstruction of	169
prolapse of	167
rupture of	173
Pericarditis	112
Peritonitis	22
Permanganate, potassium	16
Phosphorus as poison	45
Physiology of reproductive organs	155
respiratory organs	85
Pip	102
Pneumomycosis, in chicks	193
Pneumonia	108
Poisons	44
Poisonous plants	46
Post mortem appearance of brain	118
ceca	186, 188
heart	68, 112, 113, 115, 121
intestines	40, 50, 62, 68, 79, 115, 121, 188, 194
kidneys	68, 113, 121, 188
liver	40, 47, 49 to 56, 61, 68, 113, 115, 121, 188, 194
lungs	104, 108, 113, 116, 188, 194
ovary	160 to 165
spleen	40, 61, 113, 121, 188
Post-mortems, how to make	24
Potassium permanganate	16
Poultry surgery	201
Powder, lice	130
Prevention of cholera	70
disease	5
Prolapse of oviduct	167
Purity of blood	15
Rotation, crops and chickens	18
Reproductive organs, anatomy and physiology of	155
diseases of	155

	PAGE
Respiratory system, anatomy	85
diseases of	85
Rheumatism	123
Round worms	82
Roup	90
Rule of treatment	5
Rupture of blood vessels	113
heart	113
oviduct	173
Salt as poison	44
Salts, epsom	28
Sanitation	8
Sarcomatosis	55
<i>Sarcoptes laevis</i>	142
Scabies, depilating	142
Scaly leg	135
Sickness, isolation	21
Skin, diseases of	147
Small eggs	176
Soft-shelled eggs	175
Sore head	150
Spleen, post-mortem appearance of.....	40, 61, 113, 121, 188
Spots in eggs	177
Stock tonic	43
Stomach, inflammation of	36
Strychnine	45
Surgery, poultry	201
<i>Symplectoptes cysticola</i>	144
Symptoms, table of	23
<i>Syngamus trachealis</i>	196, 197
Table of symptoms	23
Tablets	29
Taeniasis, nodular	78
Tainted ground	19
Tape worms	76
Tears, treatment of	201
Thrush	103
Tonic	43
Tuberculosis	57, 100
distribution of	57
Tumors	55, 93, 163
Vent gleet	177
Vertigo	119
Vigor, breeding for	6
Visceral gout	121
Vomiting	35, 45
Wasting of liver	52

	PAGE
Water, drinking	16
Wattles, frozen	203
Weights	31
White comb	147
White diarrhea	181
White diarrhea, bacillary	186
White diarrhea, diagnosis of	189
prevention of	192
treatment of	190
Worms	75
flukes	83
round	82
tape	76
trematode	83
Wounds, treatment of	201
Yolk hypertrophy	164
Yolkless eggs	176
Zinc poisoning	45







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