Pheasants of India

AND THEIR AVICULTURE

KUNWAR RAGHAVENDRA SINGH DR. KUNWAR SURESH SINGH

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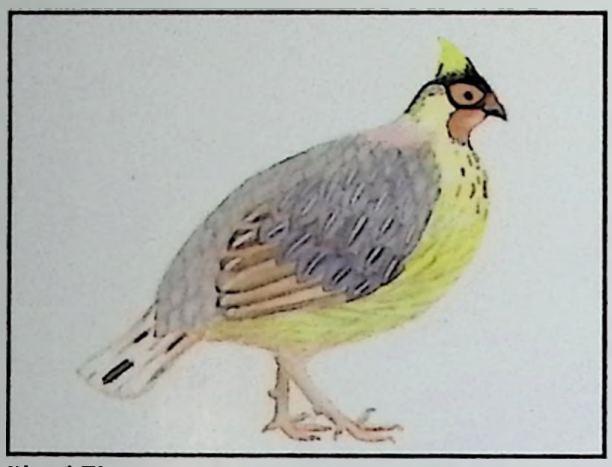
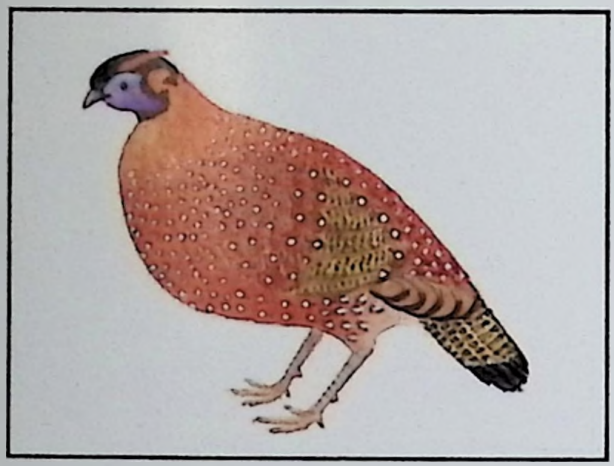


Blood Pheasant

Western Horned Tragopan



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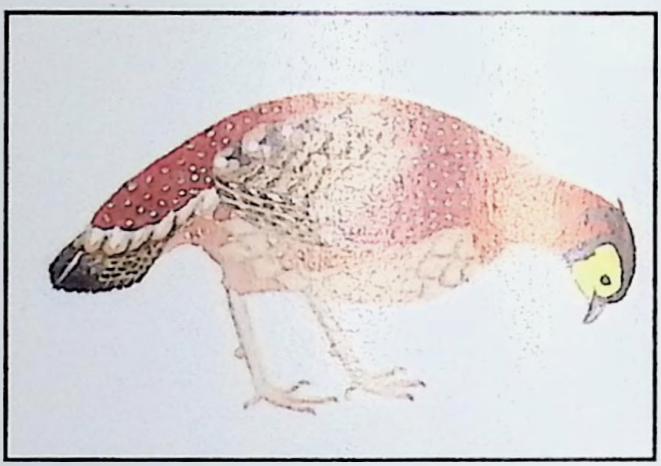

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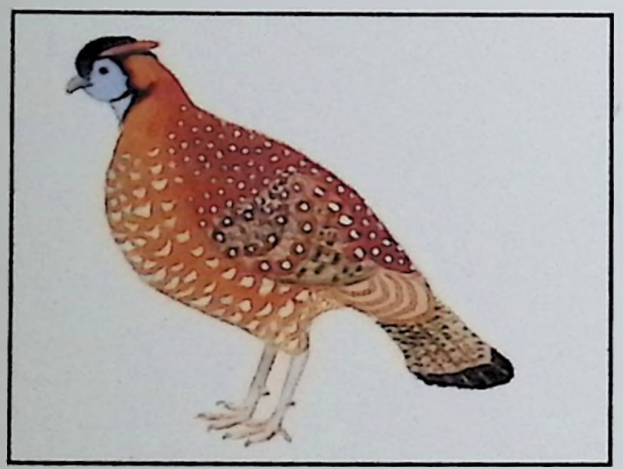

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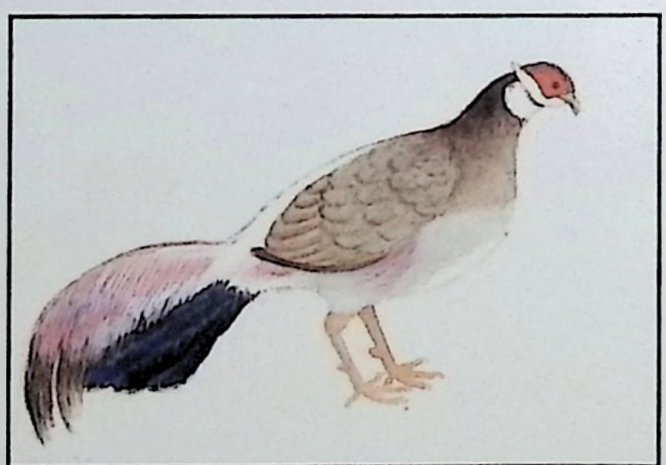
Himalayan Monal Pheasant

Sclater's Monal Pheasant



Elwes' Eared Pheasant

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Illustrations by the authors

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To the sacred memory of

PREM

How can you buy or sell the sky, the warmth of the land? The idea is strange to us. There is no quiet place in the white man's cities. No place to hear the unfurling of the leaves in spring or the rustle of insect's wings... And what is there to life if a man cannot hear the whippoorwill or the arguments of the frogs around a pond at night? I have seen a thousand rotting buffaloes on the prairie, left by the white man who shot them from a passing train. I am a savage and I do not understand how the smoking iron horse can be more important than the buffalo that we kill only to stay alive. This we know, the earth does not belong to man; man belongs to the earth.

—SEATTLE, Chief of Suquamish Tribe (1854)

In no country is life valued in theory so much as in India, and many people would even hesitate to destroy the meanest or the most harmful of animals. But in practice we ignore the animal world.

—JAWAHARLAL NEHRU

By ethical conduct toward all creatures, we enter into a spiritual relationship with the Universe.

—ALBERT SCHWEITZER

Our ignorance of nature, our apathy, our greed, our avarice and our increasing numbers have already exterminated or severely depleted the populations of many living organisms—our fellow crew-members on 'Spaceship Earth'.

—SIR PETER SCOTT

But the fundamental threat to all wildlife and indeed all life on earth is, of course, the combination of the human population explosion and the unbridled excess of modern technology.

—GUY MOUNTFORT

Now, though my primary concern is with the conservation of animal life, I am fully aware that you must also conserve the places in which they live, for you can exterminate an animal just as successfully by destroying its environment as with gun or trap or poison.

—GERALD DURRELL

A country's fauna is a sacred trust and I appeal to you not to betray this trust... If we do not bestir ourselves now it will be to our discredit that the fauna of our province was exterminated in our generation, and under our very eyes, while we looked on and never raised a finger to prevent it.

—JIM CORBETT

Contents

About the Authors

Kunwar Raghavendra Singh has an M.Sc. (Bot) from Lucknow University, an M.Sc. (Zool) from Agra University and a Diploma in Pheasant Breeding and Management awarded by the World Pheasant Association (WPA).He is very active in the conservation of wildlife movement. He has written several popular articles and two books on pheasants.

Kunwar Suresh Singh has an M.Sc., Ph.D. and D.Sc. from Lucknow University, and has worked (researched) as Nuffield Foundation Fellow at the Liverpool School of Tropical Medicine (UK) and as a Research Fellow (Dept of Microbiology) at the University of Chicago, Chicago, USA. He has taught at Lucknow University, the P.G. College of Animal Sciences and Tribhuvan University, Kathmandu. He was Principal of the P.G. College and Joint Director, Indian Veterinary Research Institute. He has written about 150 research papers and is the author of two books on pheasants and three on helminthology. He founded the Indian chapter of the WPA and was its administrator and guiding spirit during its formative years.

Foreword

Devastation of nature and degradation of the natural habitat of all species, including that of *Homo sapiens*, is a curse of modern times. We have threatened our planet in a thousand foolish little ways, most if not all, due to ignorance and insensitivity. With each one of us chipping away at the planet and its environment all the time, there might not be much of a wholesome target left for a nuclear weapon to destroy!

Fortunately, we are waking up. We are getting conscious of the hazard of a world full of grime, poison and acid rain, a world "where no birds sing!" Environmental movements are becoming increasingly powerful as they successfully confront established interests. The Rio Conference on sustainable development gave the whole world's collective support to the concern of enlightened humanity.

While the larger canvas begins to appear more hopeful we need to take a look at the matter of detail as well. Take the Himalaya and the Indian countryside, once replete with the brilliant flashes of amazing colours as pheasants burst from the undergrowth as if to celebrate the bounty of nature: Tragopans, Koklass, Monal, Red Junglefowl, Kaleej, Cheer, Hume's Bartailed, and the majestic Peafowl. Such was the wealth of India which we have unwisely drained. Now the time has come to replenish it. We need to breed pheasants for the charm of living in close association with these beautiful birds as also to bring back to health the breeding stocks in the wild.

I am delighted that to the select library of books on pheasants is being added this latest work of devoted aviculturists. Raghavendra Singh after his training in the UK, has devoted himself totally to the breeding of pheasants. He has one of the best collections of this family of birds in Asia. His father, Dr Kr Suresh Singh, is a committed pheasant aviculturist. Sadly, he has in recent years become handicapped in hearing, but this has turned him with a greater passion towards pheasants—breeding them, writing about them, painting them in oil and watercolour, and photographing them. He was largely responsible for founding the Indian Chapter of the World Pheasant Association.

This book is undoubtedly a milestone in the aviculture and conservation of pheasants in India. Nothing comparable has been produced in Asia, the home of almost all the pheasants of the world. It is my sanguine expectation that it will be read widely throughout Asia, where its message and contents will be as relevant and rewarding as in India.

The chapter on 'Census' is particularly valuable. It will, I hope, encourage interested people to keep notes of sightings and distributions. In particular it is important to note any decline in populations and, when this takes place, to advise the authorities or the World Pheasant Association–India. Similarly, nutrition and diseases of pheasants have not been discussed at such length in any other book so far. The text clearly reflects the scientific training and immense experience of the authors.

The real heart of this book lies in its rich store of avicultural knowledge gained from extensive personal experience under Indian conditions. In this respect also it is unique since the earlier books on the subject were all based on experience in the vastly different conditions of Europe or the United States. This book will be particularly topical for Wildlife Department officials throughout Asia, as also for those concerned with zoos and bird gardens, and private collections.

The publication of this excellent book is a tribute to the authors' devotion and to the farsightedness of the newly-created Department of Environment, Government of India, for encouraging them to write it.

I have been privileged to know the authors over the past several years. I have shared their dreams and disappointments. Today, I am delighted to see a healthy 'chick' hatch.

SALMAN KHURSHID
Minister of State
Ministry of External Affairs

Preface

> There is the greatest benefit in making a few failures early in life.
>
> —T.H. HUXLEY

When you come to think of it, it is really amazing how the average man in India takes birds for granted, mostly because every day he comes in contact with such birds as house-sparrows, crows, blue rock pigeons, mynas, which have learnt to live with man. And yet, he knows little about the life of birds, even those which are to be found near human habitation, leave alone the shy ones. His almost total indifference to them is hard to understand. Even educated people do not realise how rich in avifauna India is. Today, about 8,600 species of birds are recognised, from all over the world; if the sub-species and races are counted, the number will go up to about 30,000. According to Salim Ali (1979) there are about 1,200 species, comprising 2,061 forms, found in India (and Pakistan), of which only about 300 are winter visitors. It is not only in sheer numbers that Indian birds excel. It is generally conceded that the Indian Grackle or Hill Myna (*Gracula religiosa*) is the best 'talking' bird of the world; the Indian Whistling Thrush (*Myiophoneus caeruleus*), commonly called the Whistling Schoolboy, the best whistling bird; the Indian Peafowl (*Pavo cristatus*) the most beautiful and resplendent bird. For song, Salim Ali (1979) considers the Grey-winged Blackbird (*Turdus boulboul*) the best among the Indian birds. Finally, all breeds of the world's most economically important bird, the domestic chicken, are descended from the Indian Red Junglefowl (*Gallus gallus murghi*).

Thus, one would think that, with such a rich avifauna, Indians would show much more interest in aviculture than they do. It is true that the systematics have been pretty well worked out and we have some very good ornithologists. Still, where we have fallen short are field studies, specially concerning food preferences, reproduction, behaviour and aviculture. Thanks largely to bodies like the Bombay Natural History Society and, lately, to the Worldwide Fund for Nature—India, a number of small regional clubs have come up which are trying to generate an interest in the study of wildlife in general and birds in particular. However, the members of such clubs

go out in a group to a preselected area, spot a few birds through binoculars, put down their names in a list and subsequently are satisfied by publishing a check-list of birds for a particular area. In our opinion, this is just not enough. If you go through the current literature on Indian birds, you will find hardly a paper which precisely describes the food preference of any particular bird. As a result, our knowledge of this very important aspect of a bird's life continues to be very meagre. All that are to be found are delightfully vague statements like, 'feeds mainly on weed seeds, grain, shoots of grass and crop plants, berries, insects, etc.' Similarly, our knowledge of a bird's reproductive potential is usually limited to the number of eggs in a clutch. But how many of these eggs hatch, how many chicks are reared up to fledgling stage, and what is the extent of predation, etc. are just not known for most of our birds.

Tremendous changes have taken place during the last four decades in India, all connected with the exploding human population. To meet the demand for more land for agricultural use, for more timber, wood-fuel and pulp for paper, large areas of forests have been cleared. According to B.B. Vohra, out of 305 m. hectares of land available for utilisation in the early eighties, 83 m.ha. are classified as forests and permanent pastures and, of this area, only 35 m.ha. are under good tree or grass. According to Government of India figures, 4.3 m.ha. of forests have been cleared during the last 30 years. In 1985, the Inspector-General of Forests, India, said that instead of the stipulated 33 per cent of the country that should be under forests, India has barely 22 per cent, and, further, not all of it under *effective* vegetal cover. Obviously, such radical changes will bring about distressingly heavy destruction and/or shifting of wildlife, including pheasants. It is, therefore, very necessary that we have a fresh look at the distribution and status of pheasants. A small beginning has been made in this direction in recent years by A.J. Gaston (Canada), Peter Garson (UK) and B.S. Lamba (India) and their colleagues.

In India, aviculture has never caught the eye of even the very few people who keep birds as pets. Even those that do, keep only a limited range of species such as the Rose-ringed Parakeet (*Psittacula krameri*), Red Munia (*Estrilda amandava*), and Grackle (*Gracula religiosa*), in addition to some foreign species like the Budgerigar (*Melopsittacus undulatus*), Java Sparrow (*Padda oryzivora*) and Zebra Finch (*Poephila castanotis*). Not many people bothered to breed even these, for there were always more where they came from. Our zoos,

with rare exceptions, just do not go to any trouble to breed any animals in their custody—most often it is a case of an animal breeding on its own, in spite of being neglected.

Today, the conservation of wildlife is in the hands of forest officers, both as Wardens and Directors of the various wildlife sanctuaries, parks and zoos, who have been trained in the various practices of forestry but have received almost no or only superficial training in wildlife management. For most of these officers, 'conservation' is another term for 'protection'. It is generally not fully appreciated in this country, even by those who are responsible for it, that wildlife management is both a highly specialised scientific discipline and an art. It would be unrealistic to expect a person who has neither received any specialised training in the management of wildlife nor has had any previous field experience, and who, anyway, can expect to hold charge for only 2–3 years to be able to handle so complex a task adequately. The sooner we have a specialised cadre of officers trained in wildlife management, the better the country will be served, since all steps taken for the welfare of wildlife will be directly and indirectly beneficial to mankind also. Unfortunately, the reverse is not always true.

Today, we have a number of youth clubs and nature clubs in the country but there is not even one avicultural club. In the UK even small towns have an avicultural club or a bird society, many of them being specialist societies. As a result, avicultural expertise is available there for most groups of birds and the recent restrictions on export and import of birds have not affected them much. The same cannot be said for India.

A word regarding the movement for conservation of pheasants. Though some pheasants have long been kept as aviary birds in Europe, UK and USA, and at least one form (Ring-necked Pheasant, *Phasianus colchicus*) has been bred on a large scale, all such activities have been motivated by a desire to please humans. The first attempt to orient such activities towards conservation through reintroduction to the wild was made when the Pheasant Trust was established in UK in 1959, largely through the efforts of P. Wayre. After a few years, some people in UK and elsewhere wanted to widen the scope and the range of their activities, and hence the World Pheasant Association (WPA) was established in 1975 when a meeting of a few lovers of pheasants was called at 'Ashmere', the residence of Keith Howman in UK. Very soon, the WPA established some overseas chapters and the one in India was formed in 1979. Since then, we

go out in a group to a preselected area, spot a few birds through binoculars, put down their names in a list and subsequently are satisfied by publishing a check-list of birds for a particular area. In our opinion, this is just not enough. If you go through the current literature on Indian birds, you will find hardly a paper which precisely describes the food preference of any particular bird. As a result, our knowledge of this very important aspect of a bird's life continues to be very meagre. All that are to be found are delightfully vague statements like, 'feeds mainly on weed seeds, grain, shoots of grass and crop plants, berries, insects, etc.' Similarly, our knowledge of a bird's reproductive potential is usually limited to the number of eggs in a clutch. But how many of these eggs hatch, how many chicks are reared up to fledgling stage, and what is the extent of predation, etc. are just not known for most of our birds.

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have been trying to focus the attention of the various government and non-government agencies, as well as the general public, on the sad plight of pheasants. The cost of pheasant conservation activities is small, specially when one considers what we are spending on other animals. We will take just three species as examples—the crocodile, the tiger and the Great Indian Bustard. We hasten to add that we are not against this expenditure, and we also agree that the tiger should get the lion's share, if we can put it that way, but surely some money can be spent on saving pheasants. We feel that if we spend just about 0.1 per cent of the money spent on Project Tiger on pheasant conservation, we can do a lot to save the nine or ten species of pheasants in India that are facing extinction. We still have time, but not much, before the population of these pheasant species falls below the critical level, and the situation is rendered irretrievable.

In recent years, some very good books on pheasants have appeared, and there would have been little or no justification to add one more, except for two reasons. Even though all the pheasants except one are inhabitants of Asia, the practices of aviculture have been developed mainly in continental Europe, UK and USA. Understandably, these practices are better adapted to their temperate climate and easy availability of sophisticated materials and facilities. As far as we are aware, methods that would be more suitable for a country like India have never been described.

The second justification for this book is the need to bring up to date the information in respect of distribution and status of the Indian forms. In view of the tremendous changes that have taken place in the coverts preferred by Indian pheasants, it is reasonable to assume that there must have been corresponding changes in the distribution and status of the various species since they were last reported on.

An additional reason for the appearance of this book is that, as the earlier books had been written mainly for the benefit of individual fanciers and aviculturists, they did not deal with the subject of censusing and determination of status. Also, the various aspects of nutrition and diseases had not received enough attention. We have tried to cover all aspects of the life of pheasants in which a breeder or an official responsible for the welfare and conservation of pheasants, both in captivity and in the wild, would be interested.

Over the years we have received much help from people in India and abroad in various ways and special mention must be made of Dr C.M. Singh (President, WPA-I), Mr Samar Singh, Dr M.K. Ranjit-

sinhji, Dr B. Biswas, Dr M.S. Sastry and Dr R.L. Sah, all of India, Colonel J.O.M. Roberts of Nepal, Professor M.L. Scott, Dr A.E. Woodard and Mr C. Sivelle of USA, Mr G. Durrell, Mrs L. Arnold, Dr F.G. Clegg, Dr T.B. Blandford, Dr Peter Garson and Dr G.R. Potts of UK; Mr Francy Hermans and Mr I. Roels of Belgium; and Mr Wolfgang Weise of Germany. We owe a great deal to Mr Keith Howman who, over the past several years, has gifted us many fertilised eggs of pheasants to get us going, and for imparting practical training to one of us (K.R.S.) at his extensive aviaries. We are very grateful to Mr H.S. Panwar (Director) and to the Wildlife Institute of India for their keen interest in the publication of this book. Our thanks are also due to Dr A.J.T. Johnsingh, Mr Rabi N. Acharya and Mr Samuel Israel for their help in many ways.

It is presumed that anybody who is either going to study pheasants, or to keep them, will need to refer to the literature. From time to time, we have consulted the books listed at the end of this manual, and one should attempt to own as many of these as possible, while the rest can be consulted in libraries.

Probably the first comprehensive work published which was devoted to pheasants solely was Elliot's monograph on Phasianidae. It was published in 1872 in two volumes and contained 79 plates. Since the edition was confined to a mere 50 copies, these have become collector's items, being valued at about Rs 320,000 each. Recently, twelve of the plates have been reproduced with notes and comments by A. Thorpe. We have not seen either of these two volumes.

About half a century had to lapse before the next work appeared when W. Beebe (1918–22) published his monumental work in four volumes.* It was the outcome of Beebe's seventeen-month journey through the various countries of Asia where pheasants were found. The volumes are very well illustrated with some accurate colour paintings by several artists and contain very detailed accounts of the distribution and habits of various pheasants. The book is perhaps unique in being largely based on information collected first hand by the author. The edition was limited to 600 copies and the book has become rare though it can be found in many libraries.

That grand old man of Indian ornithology (and political life), A.O. Hume, published two very comprehensive works. The first was *The*

* This work has now been reprinted (1990) by Dover Publications, Inc., New York, the original four volumes bound as two.

Game Birds of India, Burmah, and Ceylon (1878–80) in three volumes (with C.H.T. Marshall as co-author), and the second *Nests and Eggs of Indian Birds* (1889–90), again in three volumes (co-author, E. Oates). After about a century, these works are still being cited as authoritative! It is interesting to recall here that Hume was largely responsible for founding the chief political party of India, the Indian National Congress.

The first edition of 'Birds' in the *Fauna of British India, including Ceylon and Burma* series of volumes was written by Blanford in 1889 and was revised by Stuart Baker in 1928. This revised edition gives most detailed descriptions of the plumage and distribution of then known pheasants (and other Galliformes). Apparently, later works like those of Delacour and Ali & Ripley have drawn very heavily on this work. Stuart Baker is also author of the well-known *Game Birds of India, Burma and Ceylon* (1930), which was meant mostly for the sportsman.

The doyen of pheasant aviculturists, Jean Delacour, in 1951 published his exhaustive and authoritative work, *The Pheasants of the World*, covering in detail, for the first time, all known species of pheasants. A revised and updated second edition was published in 1977 and is today considered the standard work on the subject. Avicultural methods were described by Delacour in the very much smaller book, *Pheasant Breeding and Care* (1973).

P. Wayre, who founded the Pheasant Trust in UK in 1959, published *A Guide to the Pheasants of the World* in 1969 which gave a good general account of pheasants and their management.

Ali & Ripley, in 1969, produced the exhaustive series called *Handbook of the Birds of India and Pakistan* dealing with all the birds found in this geographical area. The second volume deals with the order Galliformes (and others) and describes every Indian form in great detail and almost every species is illustrated in colour, although the illustrations are rather small. This volume contains most of the information known till then. It has recently been revised (1980). This volume is written by ornithologists for ornithologists and hence does not cover the fields of management, care, captive breeding, etc.

Gerrits wrote a small book, *Pheasants including their Care in the Aviary* (1974), which provides a good introduction and will be found quite useful by those who do not have access to, say, Delacour's book.

Grenville Roles, who worked at the Jersey Wild Life Preservation Trust, wrote an interesting book, *Rare Pheasants of the World* (1976), dealing with the rare species only, and his experiences with them.

Keith Howman, who probably today has the finest collection of pheasants in the world, wrote a small book, *Pheasants—Their Breeding and Management* (1979), which largely described the avicultural methods of care and breeding practised by him. It gives much information about individual species in a concise form. It is illustrated by some very good colour photographs taken by his talented wife, Jean. Howman's other booklet, *Introduction to Pheasants in Captivity* (1982), introduces the subject with the beginner particularly in mind. It is illustrated with four beautiful reproductions of paintings and five photographs of birds, as also a reproduction of the poster showing both the sexes of 52 species of pheasants—all in colour. Howman's latest book, *Pheasants of the World—Their Breeding and Management* (1993), has many coloured photographs.*

Johnsgard (1986) wrote a book, *Pheasants of the World*, dealing mainly with the field biology and distribution of all the species of pheasants. It is illustrated with 51 full-colour plates showing both the sexes of all the known pheasants made originally in water-colour by Henry Jones and by two plates from Timothy Greenwood's paintings. This book very ably complements the book by Delacour.

Hayes & Hayes (1987) have published a book dealing chiefly with their practices for raising game birds, including pheasants.

Singh, Howman & Singh (1982) have written a small book, *A Guide to Pheasants*, introducing Indian pheasants. In 1988, Singh & Singh published *A Pocketbook of Indian Pheasants*, describing all the Indian pheasants with notes on field biology and status, both in the wild and in captivity. The males of all the species are illustrated in colour.

A good account of the members of Galliformes, including pheasants, is to be found in the second volume of *The Orbis Encyclopaedia of Birds of Britain and Europe—Birds of Mountain and Moorland*, edited by Gooders. It also includes an account of the work of the Pheasant Trust for the conservation of pheasants.

The aphorism, 'Do not count your chicks before they are hatched', is even more true for pheasants than for poultry. Over the years, we have had our share of failures with the incubation and hatching of eggs and, most of the time, we lived in blissful ignorance. Then came *The Incubation Book* (1979) by Anderson Brown, till then the one and

* This is a revised version of his older (1979) book. Also see Woodard, Vohra & Denton (1993).

only book of its kind.* If we had not hatched a few eggs before reading the book, we would have perhaps not set the eggs in incubators thinking that we would never be able to meet all the requirements. This book should be made compulsory reading for anybody who is going to breed pheasants.

Another work that we wish to mention is not mainly concerned with pheasants but with smaller cage and aviary birds like the canary, budgerigar and finch. It is *Diseases of Cage and Aviary Birds* (1982) edited by Margaret Petrak. The book is divided into two parts: 'Non-Clinical Aspects' and 'Clinical Considerations', and it is the latter which is of great interest to a pheasant breeder.

Those who are concerned with management of wildlife will find *Wildlife Management* by Trippensee and *Wildlife Management Techniques* (1971) edited by Giles, and *Wildlife Ecology and Management* (1984) by Robinson & Bolen to be very useful.

In addition, short articles regularly appear in journals like the *World Pheasant Association Journal, American Pheasant & Waterfowl Society Magazine, Avicultural Magazine,* and *Cage & Aviary Birds.* Original research papers appear in the various scientific journals but these may be too technical for an amateur breeder. However, references to these can be found in the various abstracting journals, specially in *Wildlife Review* published by the Fish and Wildlife Service of USA.

Most of our knowledge regarding pheasants, specially concerning their nutritional requirements and diseases has come to us through studies on domestic chicken, turkey, Japanese quail and game pheasants. Today, breeding of these birds is big business. World production of chicken and turkey for the year 1970 was 6,705,934,000 and 110,971,000 units, respectively. In the same year, UK produced some 7,000,000 game pheasants, 17,000,000 turkeys and over 300,000,000 chickens, while France was producing 2,000,000 Japanese quails per week. Today, in the UK, about 15 million poults of game pheasant (*Phasianus colchicus*) are released every year to be shot by sportsmen. Understandably, the industry spends large sums on research, mainly on nutrition and on disease control. A breeder of pheasants benefits much *en passant* from all the research work being done on poultry and game birds. Those interested in nutrition, will find much information in *Nutrition of the Chicken* by Scott, Nesheim & Young (1976), *The Scientific Feeding of Chickens* by Titus & Fritz (1971) and *Poultry Nutrition* by Bolton & Blair (1974).

* Another book on the subject is *Practical Incubation* (1990) by R. Harvey but we have revised edition of Anderson Brown is expected shortly.

Plate 1
Blood Pheasant

Plate 2
Western Horned
Tragopan

Plate 3
Satyr Tragopan

Plate 4
Blyth's Tragopan

Plate 5
Temminck's Tragopan

Plate 6
Himalayan Monal
Pheasant

Plate 7
Sclater's Monal
Pheasant

Plate 8
Elwes' Eared
Pheasant

Plate 9
White-crested Kaleej Pheasant

Plate 10
Indian Red
Junglefowl

Plate 11
Grey Junglefowl

Plate 12
Koklass Pheasant

Plate 13
Cheer Pheasant

Plate 14
Mrs Hume's Barred-Back Pheasant

Plate 15
Bhutan Peacock-Pheasant

Plate 16
Indian Peafowl

Chapter 1

Systematics

> If in the last few years you haven't discarded a major opinion or acquired a new one, check your pulse. You may be dead.
>
> —GELETT BURGESS

All the pheasants belong to the subfamily Phasianinae, of the family Phasianidae and order Galliformes. They are characterised by the male having highly specialised ornamental plumage and their large bodies. Thus, they are easily distinguished from their close relatives, the various partridges, francolins, quails, snowcocks, spurfowls and the American quails. The family Phasianidae is usually divided into three subfamilies—Phasianinae, comprising pheasants, junglefowls and peafowls; Perdicinae, comprising Old World quails and partridges; and Odontophorinae, comprising American quails. The subfamily Phasianinae includes 16 genera and 49 species of which only 5 genera are not resident in India. Sibly & Monroe (1990), however, accept 51 species as valid. The Indian forms are usually classified into 16 species and about 32 subspecies.

Only a short description of each form is given here since the details of plumage are to be found in such standard works as Stuart Baker, Delacour, and Ali & Ripley.

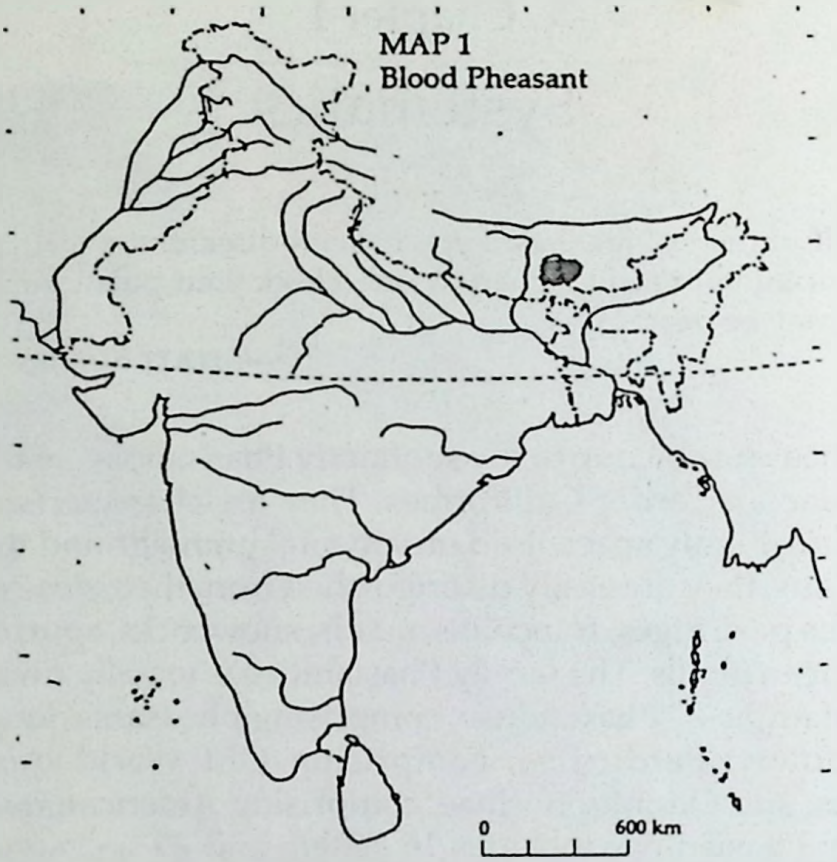
BLOOD PHEASANT

Ithaginis cruentus (Hardwicke, 1821)

Ithaginis: ithys (Gk)—erect, straight; *genos* (Gk)—race, kind; *cruentus* (*cruentatus*) (L)—stained with blood. (The name should strictly have been *Ithagenes*.)

LOCAL NAME: *Chilme* (Nepali)
DISTRIBUTION: See Map 1

A large (46 cm) partridge-like bird. Male brightly coloured; upper-parts generally grey with back and sides of neck darker and streaked all over with pale yellow. Under-parts bright apple green with pale yellow streaks. Top of head with a crown. Forehead black; eye-patch bright red bordered with black like a spectacle frame; chin and throat crimson



All maps in this chapter are based upon Survey of India Outline Map printed in 1987. The territorial waters of India extend into the sea to a distance of twelve nautical miles,measured from the appropriate base line. Responsibility for correctness of internal details shown on the map rests with the publisher. © Government of India copyright 1987.

and upper breast with crimson patches like blood-stains and hence the name. Wings, shoulders, upper and lower tail-coverts and tail have splashes of crimson. Legs and feet red, with one, two or more spurs. Female generally clear rufous-brown, finely vermiculated; forehead, face and throat light ochre; crest and nape ashy-grey.

A gregarious bird, found in coveys, anything from 5 to 30 strong, on steep hillsides with pine, rhododendron, ringal bamboo, etc. at 3,000–4,300 m elevation. Feeds on moss, fern and lichen. Nests on ground but in captivity will lay eggs in baskets, 1–2 m above the ground; breeding season April–May; eggs 5–12, buff with brown splotches but very variable in colour; incubation period 29 days. During courtship cock puffs out feathers and with crest erect struts in front of hen. In captivity, becomes very tame.

The species has four forms: Nepal Blood Pheasant, *I.c. cruentus* (Hardwicke) found in Nepal; Sikkim Blood Pheasant, *I.c. affinis* (Beebe) (*affinis* [L]—related) found in Sikkim, Bhutan and North

Bengal; Tibetan Blood Pheasant, *I.c. tibetanus* (Baker) (the name derives from its geographical distribution) found in Bhutan, Arunachal Pradesh, etc.; and Mishmi Blood Pheasant, *I.c. kuseri* (Beebe) (named after Col. A.R. Kuser who sponsored Beebe's expedition) found in Arunachal Pradesh. These forms are distinguished mainly by colour of forehead, tail feathers and ear-coverts.

Still plentiful and tame where not harassed by man. Has been successfully bred by Grahame in UK but even so the world captive population in 1982 was only 18, out of which only three were in Asia. In captivity, the birds show a marked liking for apple which must be fed diced.

CAPTIVE POPULATION: 12 (1976), 18 (1979), 18 (1982), 5 (1991).*

WESTERN HORNED PHEASANT

Tragopan melanocephalus (Gray, 1829)

Tragopan: tragos (Gk), diminutive of *tragulus*—a he-goat; *Pan* (Gk), rural god of Arcadia; *melanocephalus: melaina* (Gk)—black; *kephale* (Gk)—head.

LOCAL NAME: *Jewar* (Garhwal), Jijurana (Himachal).
DISTRIBUTION: See Map 2

About the size of a hen (71 cm). Male brilliantly coloured—blue, red, yellow and black, with white spots, looking like a big partridge. Top of head black with red-tipped occipital crest; face naked, bright red. Upper-parts finely vermiculated grey and black with round, black-bordered white spots; neck red all round; tail buff and black with irregular black bars. Throat naked and deep blue; fore-neck and upper breast bright red; rest of under-body black with white spots and irregular red splashes; flanks and abdomen mottled brown and black. Female largely grey; head and neck tinged with rufous, rest of upper-body streaked and spotted with black and white; under-body grey and dark brown, spotted on throat, abdomen and flanks, streaked with white.

Found singly or in pairs, or in small parties at 1,350–3,600 m elevation in Kashmir, HP, Garhwal and Kumaon. Very shy, but is said

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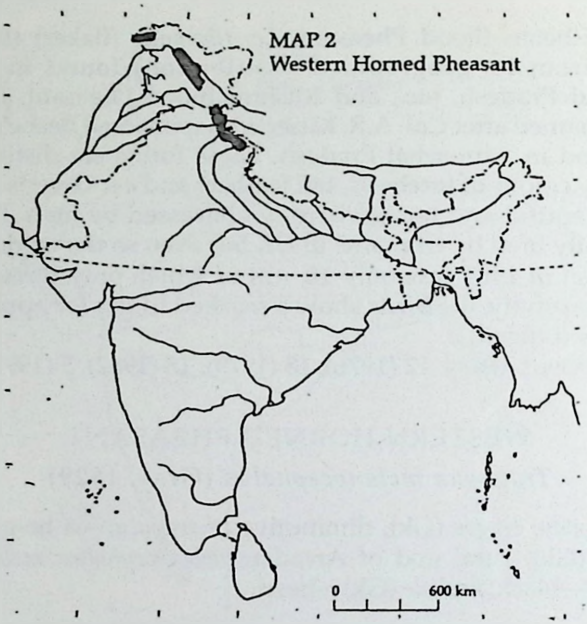
* The captive population figures are taken from the census carried out by WPA at three-year intervals. It can safely be assumed that all captive birds have not been censused for many aviculturists do not submit figures. The figures can therefore be taken as indicating the minimum of each species held captive all over the world.



to breed freely in captivity. Cock displays in typical cock fashion. Feeds on leaves, shoots, seeds, acorns, fruits and insects. In May–June, the Cabot's Tragopan's food consists of fruits (48.2 per cent), seeds (37.13 per cent), leaves (12.56 per cent) and animals (2.11 per cent). It is thus largely a vegetarian (Zheng *et al.*, 1986). Alarm call, a wailing cry, as also the call in the breeding season (?June). Nest on ground, or in a tree; eggs 3–6; incubation period, *c.* 28 days.

It is said to be difficult to maintain and to breed (see above). Very rare in nature and in captivity (probably none).* In recent years it has been reported from Kashmir (Howman; Bates & Lowther), Upper Beas and Ravi Valley in HP (Gaston) and UP (Garhwal, near Kulni Rest House; (Bland, personal communication, 1983). According to Gaston, the total population is less than 5,000. It is interesting to note that though Ali & Ripley had written that this pheasant 'breeds freely given adequate care and facilities', today perhaps not a single specimen is to be found in captivity. According to Delacour (1977), it disappeared from Europe around 1900 and was not re-imported. A few years ago, a male specimen was reported in captivity in

* Possibly four birds in capitivity with H.P. Forest Dept., and two chicks hatched (? in 1994) of which one survived.

Pakistan, which was probably trapped in Kashmir. Apparently one or two other specimens that were taken to Europe in recent years died in quarantine. Gaston *et al.* (1983) estimated a world population of 1,600–4,800 birds, all in the upper reaches of the '5 rivers of Panjab', at between 1,800 and 3,600 m altitude.

The Western Tragopan reportedly prefers a habitat with short shrubs and trees and avoids areas with tall trees and shrubs.

CAPTIVE POPULATION: 2 (1976), none reported (1979, 1982), 4 (1993).

CRIMSON HORNED PHEASANT (SATYR TRAGOPAN)

Tragopan satyra (Linnaeus, 1758)

satyra: satyros (Gk)—sylvan Greek deity, represented as part goat.

LOCAL NAMES: *Lungi* (Hindi, Garhwal, Kumaon); *Monal* (Nepali)

DISTRIBUTION: See Map 3

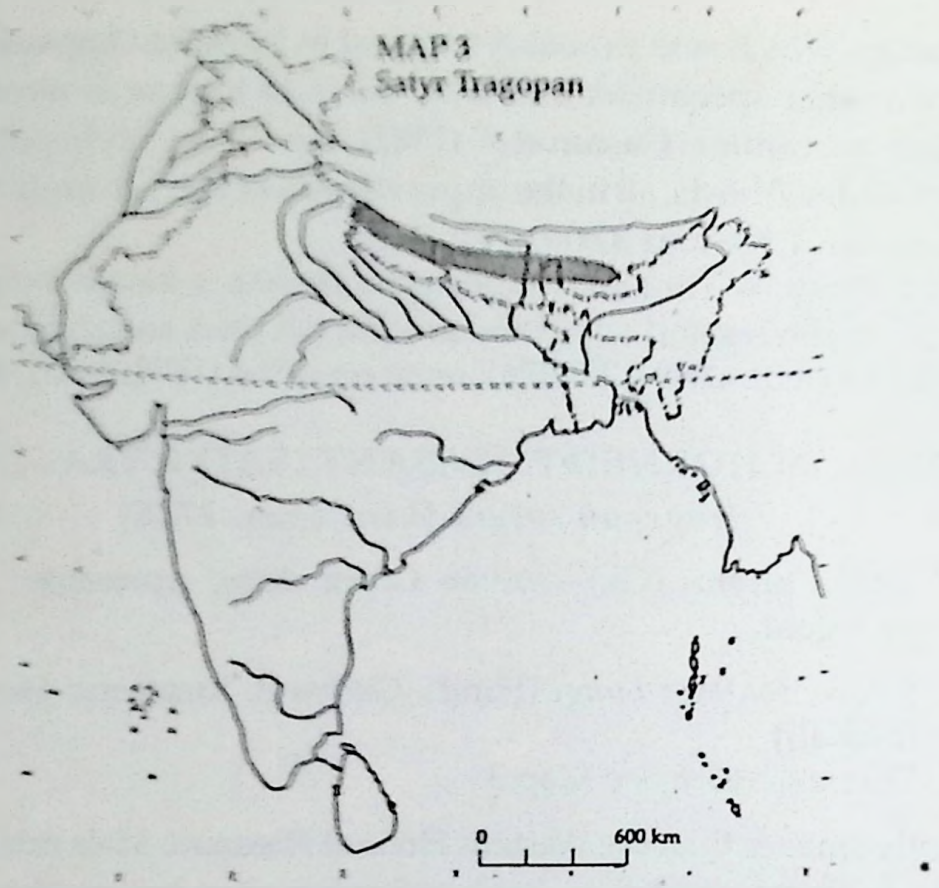
Slightly smaller than the Western Horned Pheasant. Male rich orange-crimson above and below, back and rump olive brown; shoulder of wing crimson and the rest of wing dark brown with buff; tail black. All over the body, white spots bordered by black are present. Head largely black with a deep blue, semi-naked patch on throat and below eye; crest black and recumbent with a crimson streak on either side. Female rufous or ochreous-brown, vermiculated, blotched with black and buff; shoulder of wing tinged with crimson; chin and throat whitish; breast and abdomen like back but lighter with large whitish shaft-spots; tail rufous-brown, barred with black and buff.

Shy and wary. Found singly, or in pairs, sometimes in larger family groups in oak and rhododendron forests on steep hillsides in Garhwal, Nepal, Sikkim, Bhutan, and Arunachal Pradesh at 2,400–4,250 m elevation. They like to roost in trees and are markedly arboreal. One male used the same tree for roosting on 38 consecutive nights (Lelliott & Yonzon, 1980, WPAJ, V). Food, call and breeding as in the case of Western Horned Pheasant.

Young males one year old develop red colour on neck and breast.

Still found in reasonably good numbers in Nepal and Garhwal. It breeds freely in captivity when it becomes very tame.

CAPTIVE POPULATION: 351 (1976), 395 (1979), 791 (1982), 583 (1991).



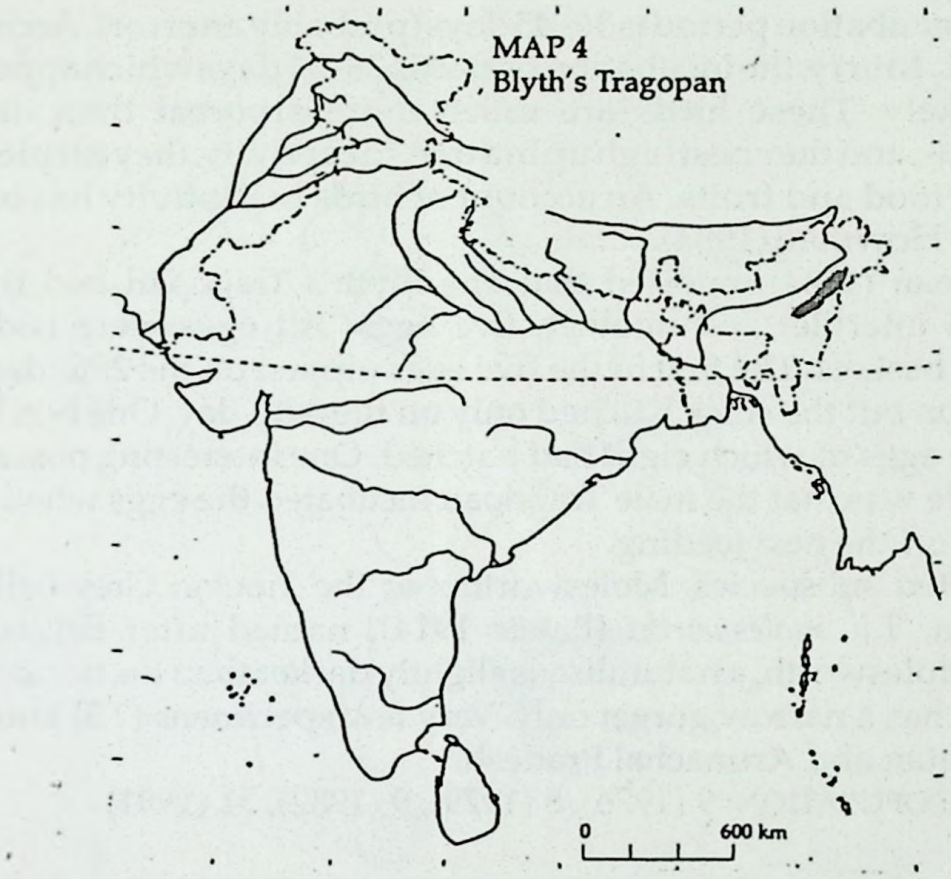
GREY-BELLIED OR BLYTH'S TRAGOPAN

Tragopan blythi (Jerdon, 1870)

blythi: named after E. Blyth, a naturalist and Curator, Natural History Museum, Calcutta.

LOCAL NAME: *Har Huria, San Sorai, Gnu, Aghah, Agoho, Chingtho, Ngou, Paura Rein.*
DISTRIBUTION: See Map 4

About the size of a Satyr. Lores, forehead, crown and side of head and neck black; bare skin of face orange-yellow; sides and tip of crest, neck, upper breast and shoulder deep orange-red to bright crimson, upper-parts brown and each feather has a whitish ocellus edged with brown and black and two deep maroon ocelli. Rectrices black with irregular bar near base. Primaries brownish black with buff bars. Lower breast and abdomen smoky-grey, the centre of feathers being paler. Thigh, flank, under tail-coverts mottled black and buff with crimson tips. Female black barred and marked with rufous and buff. Iris brown, bill horny brown, legs pink or reddish. Bare face golden-yellow, horns light blue, lappet yellow, bordered with blue.



Found in Assam, Nagaland and Manipur, in thick and damp forests at 1,800–2,600 m. Breeding season March–April.

This species has apparently died out in Europe and USA and till recently the only captive population known was in Kohima Zoo in Nagaland. Recently, two pairs were sent to Keith Howman by the Nagaland Government for captive breeding and eight chicks were hatched and reared in 1984. According to Zeliang (1980) the species is confined to the Barrail and Patkoi Ranges of Nagaland and in 1979 there were an estimated 400 birds in the wild there. The captive breeding centre trapped 30 birds of this species between 1973 and 1979, of which only 8 survived. From these 29 chicks were hatched out of which 10 survived. According to the latest census (1982), there were 9 birds of this species in captivity, presumably all at Kohima. There are probably only 2 pairs now left.* According to Zeliang, each female lays 2–6 eggs,

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* In WPA News (No 3, Aug. 1983), L.L. Murry stated that there were 15 individuals. According to the stud book (1988) prepared by the WPA, there are 36 individuals in all in Canada, USA and UK. In 1991, about 40 birds were in captivity. The *Stud Book* (WPA News, 43, Feb. 1994) mentions 29 males and 31 females.

and the incubation period is 36–45 days (probably an error). According to L.L. Murry, the incubation period is 28–31 days which appears more likely. These birds are much more arboreal than other pheasants, and they nest high up in a tree. In captivity, they eat plenty of green food and fruits. An account of birds in captivity has been given by Howman (1984).

Howman (1984) reported that one Blyth's Tragopan laid three eggs (all infertile) and another, five eggs. All eggs were laid in elevated baskets. The first of the five eggs pipped on the 28th day of incubation but the chick hatched only on the 30th day. One hen had laid nine eggs of which eight had hatched. One interesting observation made was that the male Tragopan incubated the eggs when the hen was off the nest feeding.

A related subspecies, Molesworth's or the Tibetan Grey-bellied Tragopan, *T.b. molesworthi* (Baker 1914), named after Brigadier A.L.M. Molesworth, a naturalist, is slightly darker than the nominate race and has a narrow gorget only. Very few specimens (? 3) known from Bhutan and Arunachal Pradesh.

CAPTIVE POPULATION: 9 (1976), 8 (1979), 9 (1982), 31 (1991).

TEMMINCK'S TRAGOPAN (CHINESE CRIMSON HORNED PHEASANT)

Tragopan temmincki (Gray, 1831)

Named after C.J. Temminck, ornithologist.

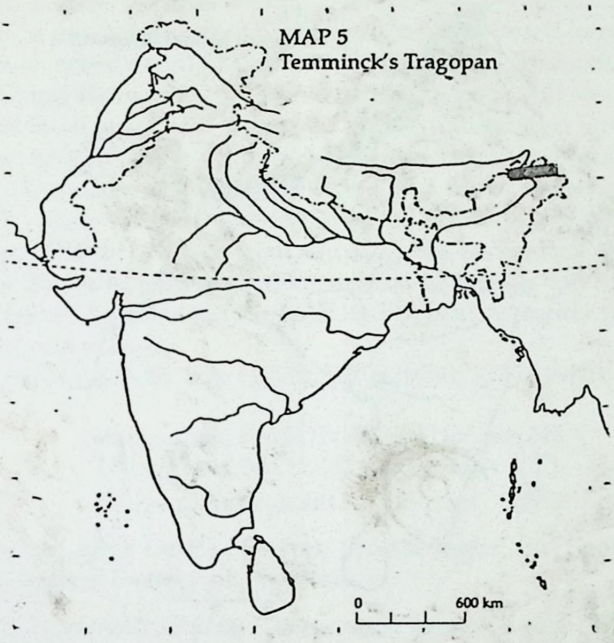
LOCAL NAME: *Bop.*
DISTRIBUTION: See Map 5

Slightly smaller than the Satyr, which it resembles superficially and like which it is bright crimson, both above and below, but differing in having pearl-grey ocelli on the upper-parts and not white as in the Satyr. Both face and throat patch are bright blue, and the under-part has large, triangular, pearl-grey spots.

It occurs in thick evergreen forests in North-East Assam and Arunachal Pradesh, and like Blyth's is very arboreal, living usually singly or in a party of 2–3 only.

This species is a prolific breeder in captivity and many rate it the most beautiful of all Tragopans. They readily hybridise with Satyr. More than half the world's captive population is in USA.

Rimlinger (1984) has described in detail the nature of various displays in Temminck's Tragopan. It is believed that essentially all



five species of Tragopans have a similar display which is both frontal and lateral.
CAPTIVE POPULATION: 193 (1976), 137 (1979), 340 (1982), 562 (1991).

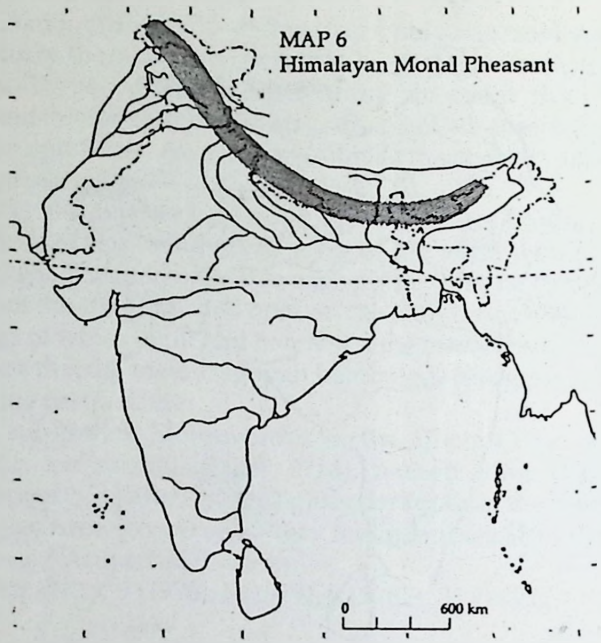
HIMALAYAN MONAL PHEASANT (IMPEYAN PHEASANT)

Lophophorus impejanus (Latham, 1790)

Lophophorus: lophos (Gk)—crest; *phoros* (Gk)—a bearing; *impejanus* (Impeyan), named after Lady Impey, wife of Judge, Supreme Court, Bengal.

LOCAL NAMES: *Sunal, Nilgur* (Chamba), *Munal* (Chamba, Hindi), *Datiya* (Garhwal, Kumaon), *Danfe* (Nepali), *Sona Chichur* (Kashmir)
DISTRIBUTION: See Map 6

Much larger (72 cm) than a domestic hen, stout and brilliantly coloured. In the male, upper-parts are a metallic bronze-green and purple; neck appears crimson and yellow; shoulder of wing and edges of wing feathers are green; rump white; tail bright cinnamon-



rufous, short, broad and cut square; eye surrounded by blue skin; crest consists of 7–8 metallic green spatulate feathers. Under-parts black. Female is brown; short tuft on head, throat white.

Very wary, flushing at a great distance. Found singly, or a male with 2–3 hens, in oak or rhododendron forests on steep hillsides and open glades in Afghanistan, Pakistan, Kashmir, HP, UP, Nepal, Sikkim and Bhutan at 2,600–5,000 m elevation. Feeds on seeds, roots, tubers, fruits, insects, etc. Gives a regular call at dawn. Alarm call, a wild, ringing whistle. Breeds from April to June; nest on ground, usually well hidden; eggs 4–6, pale yellowish or reddish buff, freckled with reddish brown; incubation period 27–28 days. Cock displays both on the ground and in the air. During display flight, the white rump and the cinnamon tail become very striking. The display has been described by Gaston *et al.* (1982, WPAJ, VII), Catlow (1982, WPAJ, VII) and Roberts (1991).

The beak and legs are sturdy and are very efficient in digging up underground roots, tubers, bulbs, small invertebrates, etc.

The bird is still found in good numbers in the wild and during a recent survey in HP, A.J. Gaston saw as many as 52 birds in a day. He estimated that the entire Upper Beas Valley, 600 km^2, will have 1,000–5,000 pairs of Monal. In a limited survey in four areas of

Kashmir, Lamba and his colleagues reported about 120 specimens. Similarly, a good number of birds have been reported in recent times from other areas of HP, Nanda Devi Sanctuary and other areas of Garhwal and Kumaon. Apparently, the species is still found in good numbers in all areas which are suitable as habitat and which are not too close to human habitations. It is amazing that about a century ago, Wilson alone was taking 1,000–1,500 birds (almost all males) annually, year after year for trade in feathers. This is another demonstration of how resilient the birds are in the face of predation and that they will survive if their habitat is not destroyed.

The species breeds well in captivity but is very poorly represented in collections in Asia.

CAPTIVE POPULATION: 1238 (1976), 1170 (1979), 1374 (1982), 798 (1991).

SCLATER'S MONAL PHEASANT (MISHMI MONAL PHEASANT)

Lophophorus sclateri Jerdon, 1870

Named after Dr P.L. Sclater, ornithologist and Secretary, Zoological Society of London.

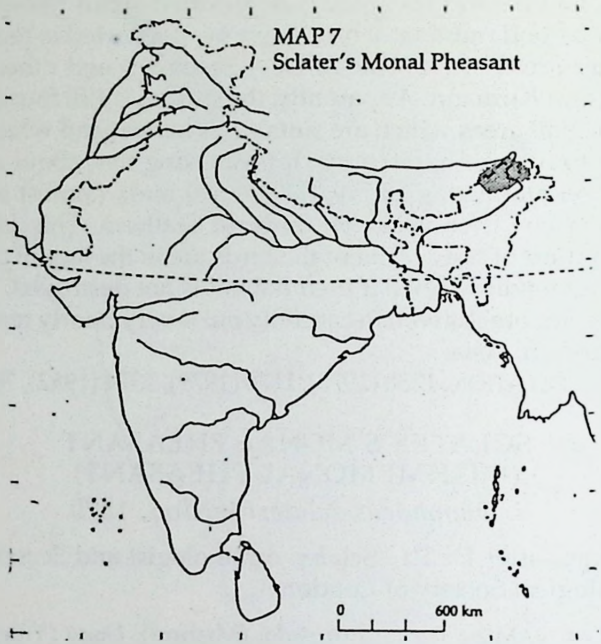
LOCAL NAMES: *Tratta, Poa padoi* (Mishmi), *Dong* (Tibetan, Po Ba dialect), *Pui-di* (or *de*).
DISTRIBUTION: See Map 7

Similar to the Himalayan Monal though not as brilliantly coloured. Crown with characteristic curly feathers of metallic blue-green, no crest; whole mantle deep purple blue-green, more purple on shoulders; lower back, rump and upper tail-coverts white; tail with a rich rufous central portion and a broad white terminal band.

It is found in Arunachal Pradesh, Upper Assam, N.E. Burma (Myanmar) and China at 3,000–4,000 m, usually in thick, steep areas with rhododendron, oak and silver fir.

Not much is known about this species in the wild except that it does not move around much and is very reluctant to flush. It has always been regarded as a rare bird and today there is probably none in captivity.

CAPTIVE POPULATION: None reported (1976, 1979, 1982, 1991).



ELWES' EARED PHEASANT (HARMAN'S EARED PHEASANT)

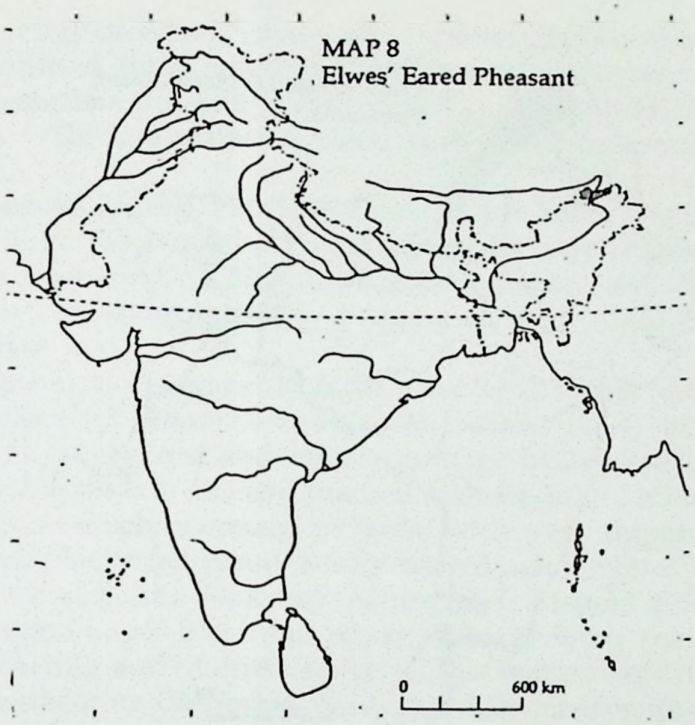
Crossoptilon crossoptilon harmani (Elwes, 1881)

Crossoptilon: krossoi (Gk)—a fringe, tassels; *ptilon* (Gk)—like feather, wing; *harmani*, named after Capt. H.J. Harman, R.E., who surveyed eastern Himalaya.

LOCAL NAME: *Cha-nga* (Tibet).
DISTRIBUTION: See Map 8

A fairly large bird, mainly ashy-grey with a broad laterally compressed tail. Crown black; chin, throat, fore-neck, ear-coverts and nape white; above, ashy-grey; inner secondaries partly purple-blue; tail metallic blue-black, glossed with green and blue, the central feathers arching and disintegrated like an ostrich feather (and hence the name). Under-parts largely ashy-grey and white. Bill light reddish; iris brown; legs and feet scarlet or reddish-brown. Unique among pheasants in having sexes alike (like other eared pheasants).

Found in Arunachal Pradesh and Upper Assam (?), at 3,000–5,000 m in thick forests. It is very reluctant to fly and moves about in parties



of 5–10. It is said to be very noisy. In the past it was reported to be very common and plentiful but there have been no recent reports, perhaps because nobody has looked for it in that area.

Apparently, it is not present in captivity. Recently, R. Mukherjee saw 6–7 brown birds near Ghoom (Bengal), which he said were eared pheasants. The Brown Pheasant, however, is confined to China.
CAPTIVE POPULATION: None reported (1976, 1979, 1982, 1991).

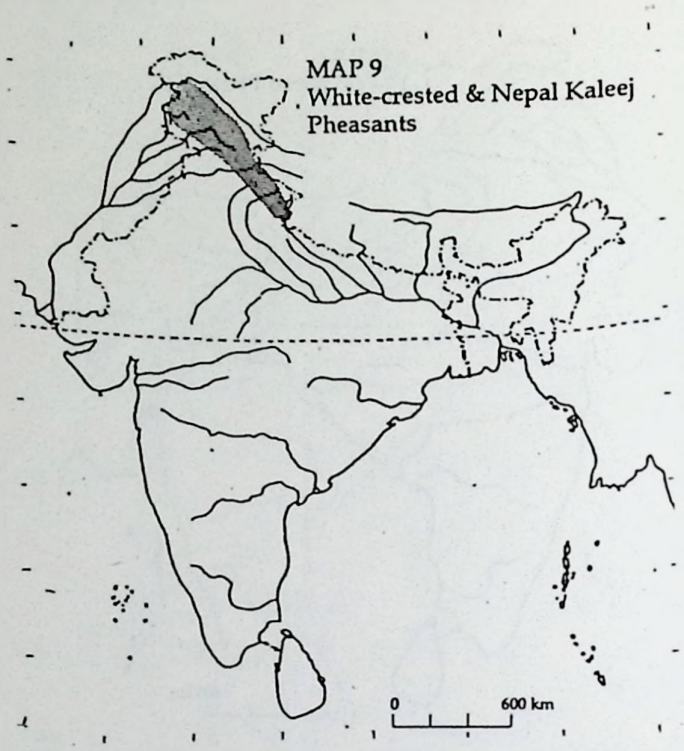
WHITE-CRESTED KALEEJ PHEASANT*

Lophura leucomelana hamiltoni (Gray, 1829)

Lophura: lophouros (Gk)—with tufted (bushy) tail; *hamiltoni*, named after Dr F. Buchanan Hamilton, FRS, a medical officer, who also worked as Superintendent, Botanical Gardens, near Calcutta; *leucomelana*: *leukos* (Gk)—white; *melaina* (Gk)—black.

LOCAL NAMES: *Kaleej, Kalij* (Hindi), *Kala murgha* (in the hills).
DISTRIBUTION: See Map 9

* The name is spelled in three ways in English—Kaleej, Kalij, and, rarely, Kalege.



About the size of a domestic fowl (65–73 cm). In the male, upperparts black, glossed with shiny steel-blue; feathers on rump broadly edged with white; tail shiny black and brown, arching like a sickle. Crest white and recumbent. Orbital region naked and red. Underparts chiefly brown and grey with pale markings. Female is mainly reddish-brown with brown crest and a scarlet eye-patch. Tail black with brown central feathers. Bill greenish-white, darker at tip; legs and feet whitish or brown. Found in small parties (up to 12), or in pairs in breeding season, in southern Kashmir, Punjab, HP, UP and up to central Nepal at an altitude of 300 to 3,000 m. Prefers to live near water, particularly hill streams. In habits much like the Red Junglefowl but gives no crow call. Strong flier. Feeds on seeds, grain, berries, roots, and small invertebrates. Breeds from March to June; nest a scrape on ground, usually with 6–9 eggs, incubated only by hen for 24–25 days. Courtship is in the usually pheasant fashion.

Since the bird is more commonly found at lower altitudes where walking is easy, it is much hunted by sportsmen and poachers. Because of the colour, the female is often confused with Cheer by the uninitiated.

It will freely breed with many other species of pheasants. Like the Red Junglefowl, it has learnt to live with man and in spite of rather heavy predation, it is still quite common in UP and HP. The birds regularly walk to a watering place, both in the forenoon and the evening.

The various Kaleejs, because of their rather sober colour, are not much favoured as aviary birds and apparently only 225 are found in captivity, mostly in USA and only 2 recorded from Asia. We find the birds very attractive, specially because of their slight build and dainty walk.

The other Kaleejs found in India are Nepal Kaleej (q.v.), Black-backed Kaleej (*L. leucomelana melanota* [*melaina* (Gk)—black; *notes* (Gk)—back] with crest and upper plumage black; Black-breasted Kaleej (*L. leucomelana lathami*) (named after Dr John Latham, FRS, a medical man much interested in birds) with crest, upper plumage and breast black and rump boldly barred with white; William's Kaleej (*L. leucomelana williamsi*) (named after Major F.T. Williams) with crest and breast black and upper plumage finely marked with black and white, and Moffitt's Kaleej (*L. leucomelana moffitti*) (named after James Moffitt, California Academy of Sciences) with crest and upper and lower plumage entirely black. Except for the White-crested and Nepal Kaleej, the others are few in captivity.

CAPTIVE POPULATION:

White-crested: 498(1976), 302(1979), 224(1982), 292 (1991)
Nepal: 431(1976), 359(1979), 454(1982), 352 (1991)
Black-breasted: 89(1987), 40(1979), 67(1982), 36 (1991)
Moffitt's: 15(1976), 13(1979), 26(1982), 34 (1991).

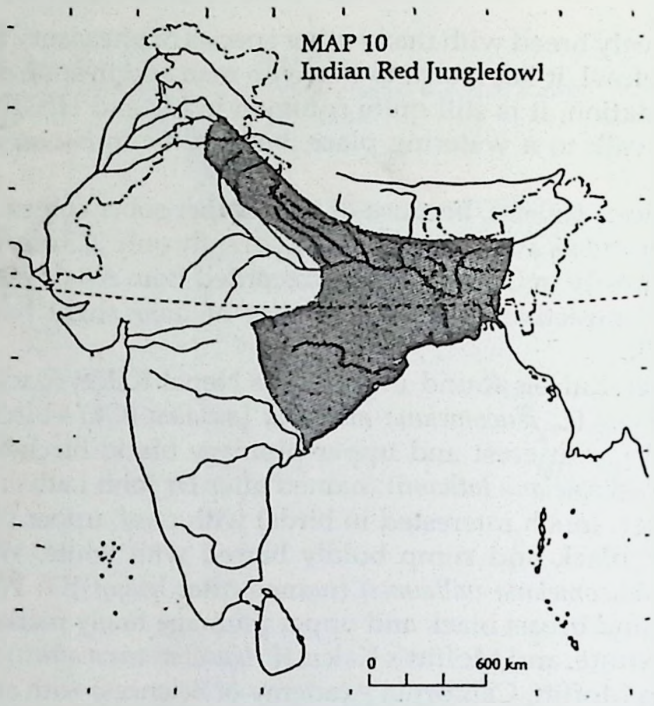
NEPAL KALEEJ PHEASANT

Lophura leucomelana leucomelana (Latham, 1790)

LOCAL NAMES: *Kalik Kaleej* (Parbattia), *Pechabo* (Nepal).
DISTRIBUTION: See Map 9

Slightly smaller (60–68 cm) than the closely related White-crested Kaleej, the male differing mainly in having a glossy blue-black crest and feathers on the upper-body with narrow white edges, and wing-coverts being more white, chin and forehead darker and more glossy and under-parts more white. Female comparatively brightly coloured. It is mainly confined to Nepal.

This form is more common than the White-crested one.



INDIAN RED JUNGLEFOWL

Gallus gallus murghi Robinson & Kloss, 1920

Gallus: gallus (L)—a cock; *murghi* (Hindi)—chicken.

LOCAL NAME: *Jangali Murgha/Murghi* (Hindi).
DISTRIBUTION: See Map 10

Size about that of a small domestic chicken, about 66 cm in male and 43 cm in female. Male gorgeously coloured; upper-parts being mainly glossy and bright orange-red; feathers on neck (hackle) and rump bright yellow and lanceolate; tail broad, laterally compressed, glossy black with characteristic long central feathers carried like a sickle; comb and wattle crimson; lappets white or pinkish; iris reddish. Female has a rufous crown; forehead bright chestnut; upper-parts mainly reddish-brown, patterned with buff and black; under-parts dull brown. Compared to male, it is very soberly coloured. Comb crimson. Legs in both sexes brown, in males with well developed spurs.

Found in small parties, a male with four to five hens, in moist forests, chiefly of sal trees (*Shorea robusta*), bamboo thickets and lantana bushes. Widely distributed in the plains of North India and

its foothills. In UP, specially well distributed in the reserved forests of districts Gonda, Bahraich, Lakhimpur-Kheri, Naini Tal and Dehra Dun. Feeds on grains, fruits, berries and insects. Found frequenting cart tracks and camp sites in search of grain which pass out with the dung of cattle, buffalo and equines. By preference, it remains in the heavy undergrowth. It is a fast flyer and affords excellent sport to guns, being also considered to be very good eating. Cocks vociferous, specially early in the morning and late in the evening. The birds roost in trees. Courtship display is in typical pheasant fashion. Breeding season mainly March to May. Nest a hollow in the ground, sparsely lined with dry grass; clutch of 5–6 eggs. (A wild hen kept in captivity by the authors laid ten eggs before starting incubating them. Of these seven hatched on one day and the eighth on the next—a very close sitter.) Incubation period 20–21 days.

This pheasant is widely accepted as the ancestor of all extant breeds of domestic chicken and was already domesticated by 2500 BC.

In the post-breeding season, the cock undergoes moulting and feathers on neck and hackle are lost and not replaced for many weeks.

Like the White-crested Kaleej, this bird has learnt to live with man and is still quite common in suitable areas in spite of heavy predation by man. The only factor that seems to affect its breeding is heavy rain when the eggs are being incubated.

Another subspecies, the Burmese Red Junglefowl, *G.g. spadiceus* (Bonnaterre, 1791) (*spadiceus* (New Latin)—date-brown, nut-brown) differs from the Indian Red Junglefowl in having neck-hackles less pointed and deeper golden-red on the terminal third. It has been reported from Arunachal Pradesh.

CAPTIVE POPULATION: 788(1976), 872(1979), 1,072(1982), 651 (1991).

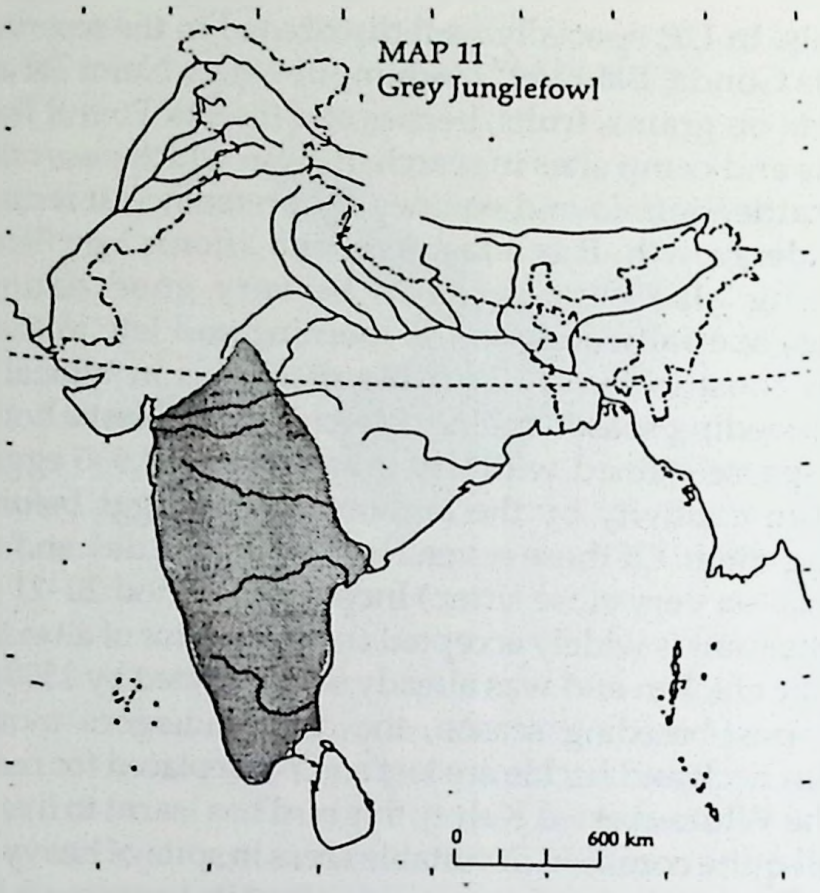
GREY JUNGLEFOWL

Gallus sonnerati Temminck, 1813

sonnerati: named after P. Sonnerat, Naturalist, French Naval Commissary.

LOCAL NAMES: *Jangli Murgha/Murghi, Komri* (Mt Abu), *Geera pur* (Maria gond), *Katu Kozti* (Malayalam, Tamil), *Parda Komri* (Gondi, Chanda Dist.), *Rakhi ran Kombada* (Marathi), *Jangli Murgho* (Gujarati), *Raan Kombdi* (Deccan), *Kattu Koshi* (Tamil), *Tella adavi Kodi* (Telugu), *Loli, Kad Koli* (Kannad).

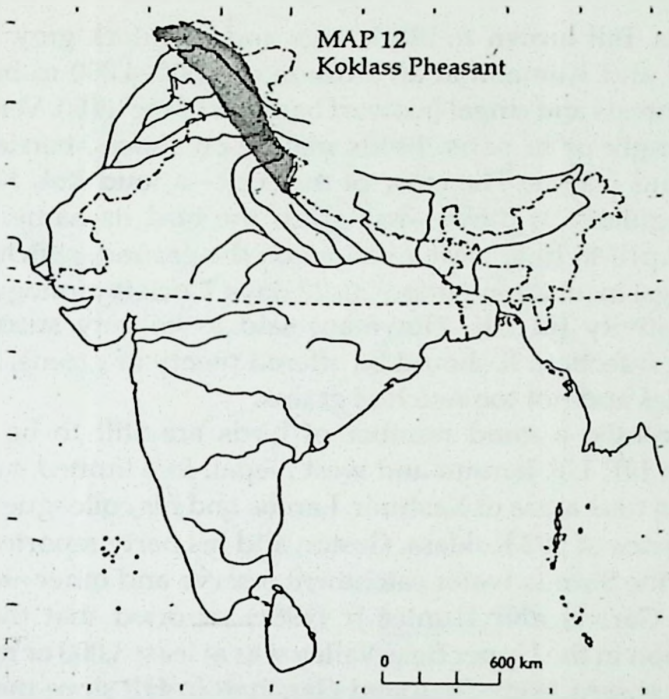
DISTRIBUTION: See Map 11



In size, like a domestic fowl. Head, neck and hackles of extreme upper back black with grey fringes and with numerous spots of golden-yellow on nape, neck and shoulders and pure white on back; back, rump and wing-coverts black, fringed with grey. Elongated lanceolate plumes absent from rump. Below, blackish-grey, with broad white streaks on breast, uniformly grey on abdomen and tinged with rusty-brown on flanks. In non-breeding plumage, neck-hackles and sickle-shaped rectrices are replaced by shorter, dull blackish feathers. Female largely speckled brown, the feathers streaked and scalloped. Chin and throat whitish, upper breast scalloped black. Bill yellowish, iris yellow to bright red, legs and feet yellow, claws black.

Eggs 4–7 (up to 10), incubation period 20–21 days. Found all over peninsular India, specially in mixed bamboo jungle and abandoned cultivated areas.

This species is under very great pressure as the spangled neck-hackles are much favoured for fly tying. However, it is a prolific breeder, both in the wild and in captivity. In one UK establishment



alone there are 226 of these birds (165 male) to meet the demand for feathers, which will hopefully mean less smuggling from India.
CAPTIVE POPULATION: 403 (1976), 374 (1979), 432 (1982), 231 (1991).

KOKLASS/KOKLAS PHEASANT

Pucrasia macrolopha macrolopha (Lesson, 1829)

Pucrasia, Koklass (Hindi-Nepali), onomatopoeic name. *macrolopha—makros* (Gk)—long, large; *lophos* (Gk)—crest.

LOCAL NAMES: *Koklas, Kokla, Pokras* (Hindi-Nepali), *Ptas* (Kashmir), *Kukrola* (Chamba).
DISTRIBUTION: See Map 12

As big as a domestic fowl (52–61 cm), with a medium-sized tail. In male, head fully feathered and metallic green; occipital crest brown with very characteristic long and metallic green tufts on either side. Tail chestnut-brown and straight. Under-parts bright chestnut. In female crown chestnut-buff with a short crest and no ear tufts. Upper-parts mottled black and brown; throat creamy-white; under-parts pale buff, streaked with black, narrowly on breast and broadly

on flanks. Bill brown to black; legs and feet dark grey. Found in Garhwal and Kumaon at an altitude of 1,500–4,000 m in oak and conifer forests and ringal (a dwarf bamboo of the hills). Very shy and found singly or in pairs. Feeds mainly on shoots, berries, tubers, acorns and insects. The crow of the cock—a loud *Kok, Kok, Kokras* given regularly at dawn—has given the bird its name. Breeding season April to June; nest a hollow on the ground; clutch of 5–7 or more eggs; incubation period 20–27 days. Cock is monogynous.

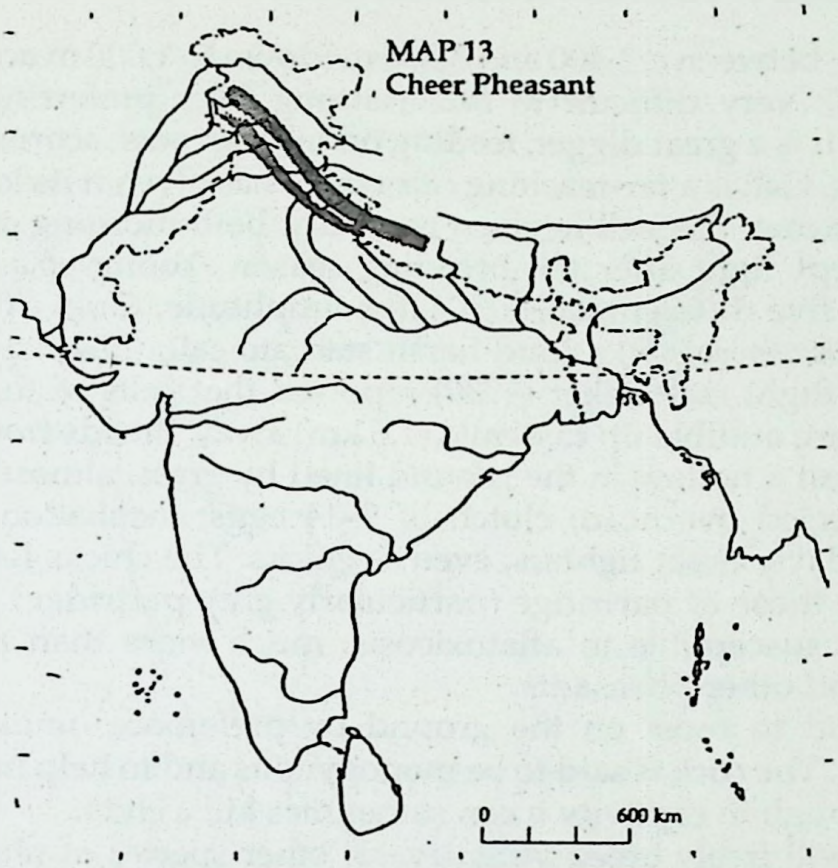
In captivity (in UK, Howman) said to be very susceptible to parasitic infection. It should be offered plenty of greens, fruits and vegetables and not too much of grains.

Apparently, a good number of birds are still to be found in Kashmir, HP, UP, Jammu and west Nepal. In a limited survey conducted in four areas of Kashmir, Lamba and his colleagues reported the presence of 582 Koklass. Gaston and his party reported 170–250 pairs in the Shimla water catchment reserve and other areas of HP. Gaston, Garson and Hunter Jr (1981) reported that the Koklass population in the Upper Beas Valley was at least 3,000 or more pairs, but was absent from Chail and Ganahati in HP since these have a lower altitude (1,600–1,800 m) Ban oak forests. However, Lamba and his colleagues and we ourselves have found Koklass near the Indian Veterinary Research Institute campus at Mukteswar (UP) at about 1,600 m with much oak and rhododendron and not much of understorey. In fact, one of us was able to take a colour photograph of a male Koklass sitting on a tree trunk at a distance of 25 m. In this area, seven males were heard calling on a single morning.

Another three subspecies are also found in the Indian region: the Chestnut-mantled Koklass (*P.m. castanea* Gould, 1855) (*castanea* (New Latin)—of chestnut colour) with sides and flanks mainly chestnut coloured and found in Afghanistan and N.W. Pakistan; the Kashmir Koklass (*P.m. biddulphi* Marshall, 1879) (named after Major J. Biddulph, its discoverer) which is similar to the nominate race but with a red nuchal collar and found in Kashmir, Chamba and Kulu (HP); and the Nepal Koklass (*P.m. nipalensis* Gould, 1855) (*nipal*—Nepal;—*ensis* (L)—belonging to) with sides and flanks mainly black, and found in Nepal.

An account of the Chestnut-mantled Koklass in Pakistan has been given by Severinghaus (1979, WPAJ, IV).

CAPTIVE POPULATION: 78(1976), 262(1979), 509(1982), 207 (1991).



CHEER/CHIR PHEASANT

Catraeus wallichi (Hardwicke, 1827)

Catraeus: catraeus (Gk)—a peacock-like bird; *wallichi*, named after Dr N. Wallich, botanist and Superintendent of East India Company's Garden at Calcutta; common name is onomatopoeic.

LOCAL NAMES: *Chir* or *Cheer, Riar* (Kashmir), *Cheerwa* (Kumaon).
DISTRIBUTION: See Map 13

Size, about that of a large domestic fowl, male 90–118 cm and female 61–76 cm. It is the most soberly feathered Indian pheasant but has a long tail. In male, top of head and the long crest blackish-brown; orbital patch crimson; upper-parts buffy-white and light rust-brown with black bars. Long and pointed tail, prominently marked with black and grey bands. Under-parts mainly buff-white, barred on lower breast and flanks. Female is similar except that it is smaller with a red orbital patch, duller in colour and without occipital crest. Neck feathers have more black which in male form a broad light grey collar. Found in small parties on steep hillsides which are rather open and very much

broken up, between *c.* 1,400 and 3,500 m (down to 1,000 m according to Gaston); very difficult to flush; strong flyer preferring to go downhill. It is a great digger, feeding on tubers, roots, acorns, seeds, insects, etc. Call is a far-reaching *chir* which has given it its local and common name. The call is given regularly, both morning and evening, except right after the breeding season. Young *et al.* (1987) identified five different calls: (*i*) a low amplitude, *Chut*, (*ii*) a loud whistle, *Chewewoo*, (*iii*) a loud harsh staccato call, (*iv*) a soft *Cluck*, and (*v*) a flight call. Baker (1930) reported that calls of the Cheer pheasant are audible up to a mile (1.6 km) away. Breeds from April to June; nest a hollow in the ground lined by grass, almost always well protected overhead; clutch of 9–14 eggs; incubation period about 26 days. Great fighters, even as chicks. The chicks look very much like those of partridge (particularly grey partridge) and are extremely susceptible to aflatoxicosis, much more than those of poultry and other pheasants.

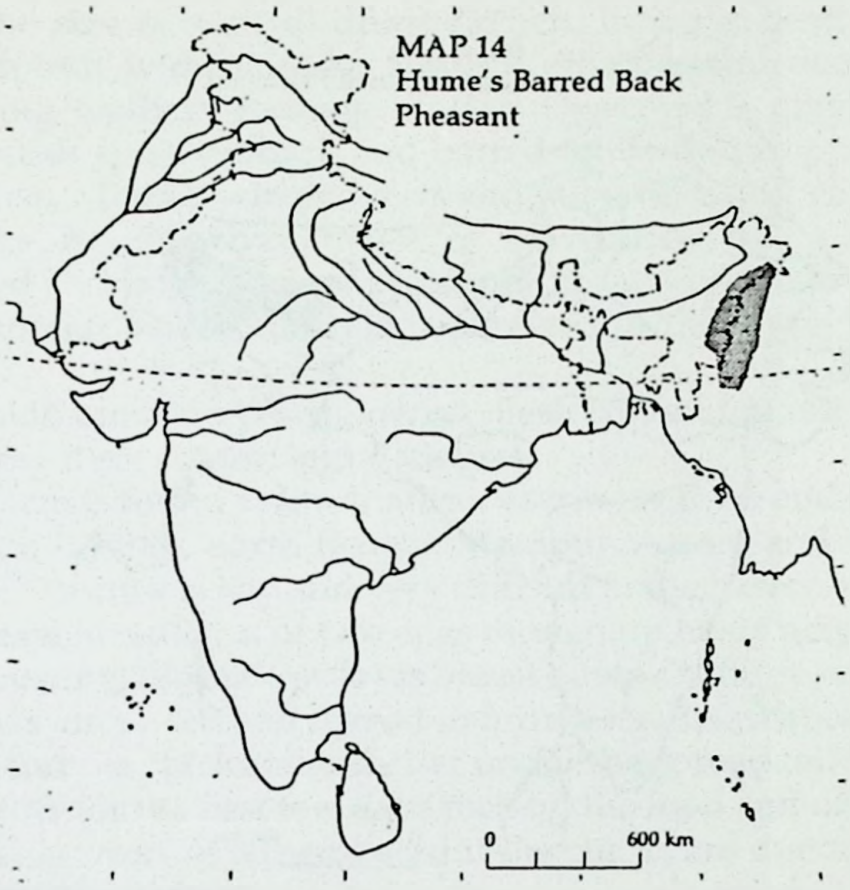
It is said to roost on the ground by preference, unlike most pheasants. The cock is said to be monogynous and to help in raising chicks, though in captivity it can sometimes kill a chick.

Cheer will freely breed with several other species of pheasants, but producing confirmed fertile hybrids only with Elliot's Pheasant. Records concerning other hybrids are of doubtful authenticity.

For some reason, the Cheer is found in very localised pockets, and apparently equally good habitats even nearby do not hold any. It has also been observed even by earlier workers that Cheer have never been plentiful in any locality. Whether these two factors are correlated, and whether one is the cause and the other the result is not very clear. It would also be interesting to determine whether small local populations would eventually lead to too close inbreeding.

Because of its sober colours, the species is not very popular with aviculturists, though we find the autumn colours very pleasing. At one time, efforts were made, both in India and Pakistan, with the help of WPA, to breed them in captivity for reintroduction in suitable areas. According to Gaston *et al.*, it is 'tolerably well distributed' in HP and viable populations are found in several areas (1981, WPAJ, VI), totalling perhaps 1,000 pairs in the state. Recently, Garson (1983) has reviewed the status of Cheer in Chail Sanctuary, Majathal Sanctuary and two areas of Upper Beas in HP. He is of the opinion that, on present knowledge, the density of the bird in Majathal (24 pr/km^2) is the highest in the world, and that the population in Chail Sanctuary was halved during the last four years.

CAPTIVE POPULATION: 838(1976), 705(1979), 463(1982), 363 (1991).



MRS HUME'S BARRED-BACK PHEASANT (HUME'S BAR-TAILED PHEASANT)

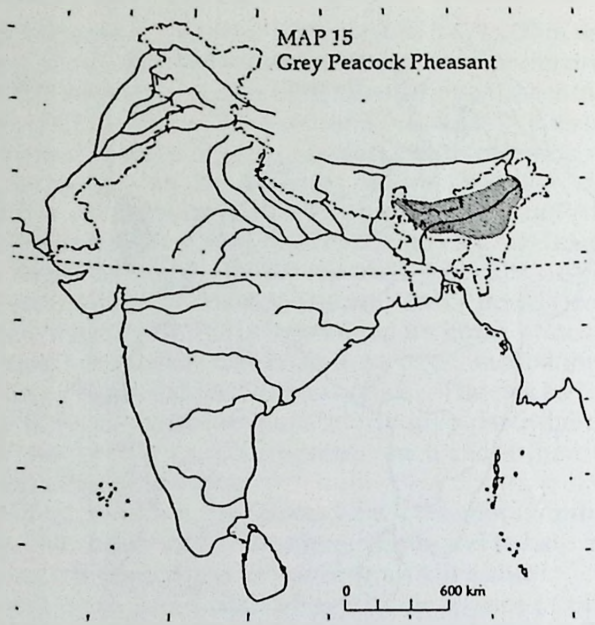
Syrmaticus humiae humiae (Hume, 1881)

Syrmaticus: syrmatikos (Gk)—trailing, dragging; *humiae*, named after Mrs A.O. Hume.

LOCAL NAMES: *Loiningkoi* (Manipur), *Nongin*.
DISTRIBUTION: See Map 14

Male about the size of a large domestic fowl but with a long and straight tail. Head, neck and rump steel-blue, the latter scalloped with white; chin and upper throat black, edged steel-blue; tail vermiculated grey with black bars and chestnut spots; greater wing-coverts deep chestnut edged white; primaries brown, edged chestnut; secondaries chestnut; three white bands and one blue band on wings and wing-coverts and all are very prominent; lower breast like back; abdomen and flanks deep chestnut.

Female with reddish-brown head, crown streaked with black, and neck sandy-brown barred with black. Orbital skin small and deep



crimson; bill greenish horny; iris brown to orange; legs and feet dull light brown.

Found in Manipur and Nagaland and distributed patchily, at 900–1,800 m in thin, steep forests with much grass and scattered trees.

CAPTIVE POPULATION: 876(1976), 626(1979), 527(1982), 340 (1991).

BHUTAN GREY PEACOCK-PHEASANT

Polyplectron bicalcaratum bakeri Lowe, 1925

Polyplectron: poly (Gk)—much, many; *plektron* (Gk)—a cock's spur; *bi* (L)—two; *calcar* (L)—a spur; *bakeri*, named after E.C. Stuart Baker, ornithologist.

LOCAL NAMES: *Monnower, Deyodahuk, Deoderick* (Assam), *Deo-durrug* (Garo), *Dao dip, Dao-dai-dip, Mejoor* (Cachar), *Burruminrui* (Kacha Naga), *Katmor* (Bangladesh, Chittagong).

DISTRIBUTION: See Map 15

About the size of a small domestic hen. In male, head and neck brownish-buff with hair-like feathers, finely vermiculated, a few upstanding feathers forming a crest. Upper-parts greyish-brown with whitish spots on back and barred white on rump and upper tail-coverts. Mantle, wing-coverts and tail with many violet green-blue 'eyes' ringed white, the 'eyes' on rectrices being somewhat elongated and larger. Below, chin and throat whitish; lower breast and abdomen barred. Female is similar but the 'eyes' are not so distinct.

Bare skin around eyes yellowish, flesh colour; iris white to grey; bill creamy flesh colour; legs dark grey.

This form is found at lower altitudes in very thick and hot forests of Sikkim, Bhutan, north Bengal, Manipur, Assam and Arunachal Pradesh. The bird is shy and very difficult to flush even with a dog.

The normal clutch is of two eggs though up to six may be found. When courting, the male puts his breast down on the ground, the tail and wings are raised and spread to form a fan. Incubation period is 21 days and the chicks take shelter under the spread tail of parents. The parents for the first few days pick up the food and offer it to the chicks. This must be remembered if the chicks are due to be raised away from the parents.

This form is under very heavy predation from man. It has been successfully bred abroad and most of the captive birds are in Europe and USA.

The Burmese Peacock-Pheasant, *P.b. bicalcaratum* (Linnaeus, 1758) is very similar but is more buffy-brown and not as grey. It is interesting to note that this is one of the three pheasants known to Linnaeus, the other two being Satyr Tragopan and Indian Peafowl.

Display by captive birds has been described by Cees Stapel (1976, WPAJ, I).

CAPTIVE POPULATION: 356(1976), 479(1979), 853(1982), 729 (1991).

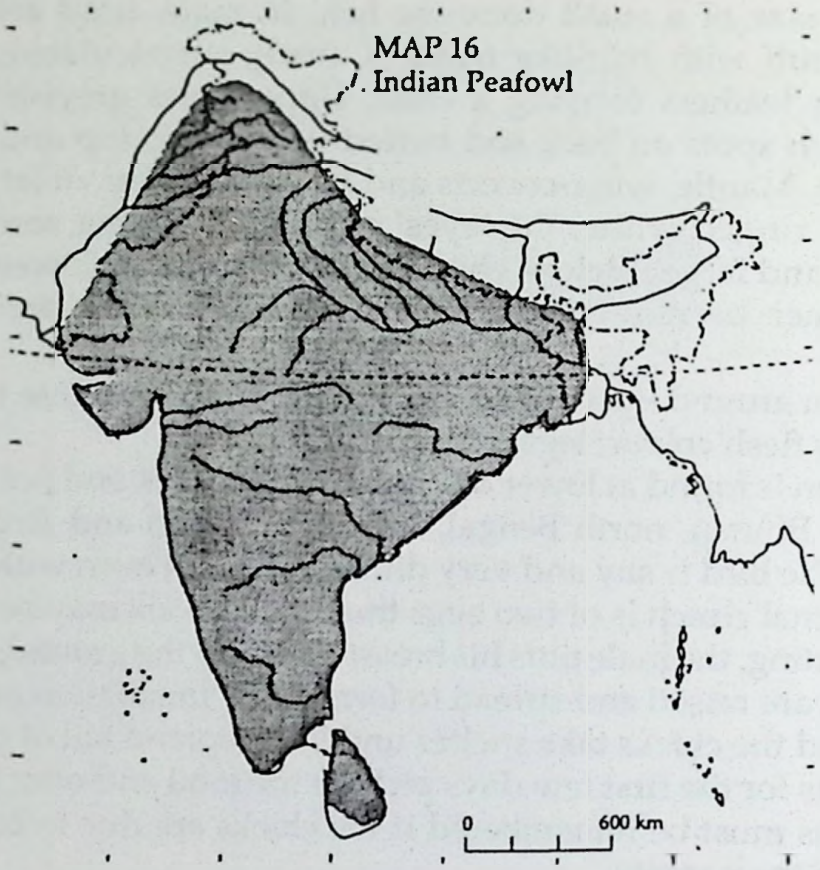
INDIAN PEAFOWL

Pavo cristatus Linnaeus, 1758

Pavo: pavo (L)—a peacock; *cristatus: crista* (L)—a crest

LOCAL NAMES: *Mor, Mayur* (Hindi).
DISTRIBUTION: See Map 16

In size of body, like the domestic turkey, the male being 92–122 cm, the full train being 2–2.25 m long; female about 86 cm long. The male



has a characteristic and prominent crest of wire-like feathers with broadened ends. Neck and breast brilliant and shining blue. Upper tail-coverts form the unique train, metallic bronze-green, with conspicuous eye-spots with purplish black-centred coppery discs; lower back light bronze-green with black bars. Wings black and buff, barred, with prominent chestnut coloured primaries and their coverts. Female much more soberly coloured and lacking a train.

Found in small parties, usually in open forests and agricultural fields, mostly in the plains but going up to about 1,800 m. It is not shy where unmolested but is extremely wary of predators and hunters. It is a swift runner and takes to wing readily and easily, the male, notwithstanding a long train, can fly swiftly through and in between trees. Once well airborne, they glide on outstretched wings for long distances. Their call is very loud, far-reaching and rather harsh. They feed on all kinds of vegetable matter and small animals. During the well known dance, the train is held upright and the chestnut-coloured wings drop to the sides and the bird keeps moving its feet slowly, and occasionally a shiver goes through the body and the train. Hillgarth (1984) has reported that wild peafowl

males during the breeding season hold territories from which intruding males are expelled. However, young males if accompanied by females are tolerated. A small clearing in the bushes is used as a display area. The females in groups of 3–5 visit several territories and apparently there is no pair bonding or harem system. Ridley *et al.* (1984) described the display in a feral population. Breeding season is June to September; the nest being usually well concealed under a bush; eggs 4–6; incubation period about 28 days.

The bird is very destructive of crops but even so is not molested in any way by rural Hindus because of their religious sentiments. It was declared the national bird of India in 1963 and hence is protected under law throughout India.

The White (recessive) and the Black-winged varieties are mutants and often piebald specimens (Harlequins) are also found. A hybrid of *P. cristatus* (Blue Peafowl) and *P. muticus spicifer* (Burmese or Green Peafowl) is called a Spalding.

The Burmese peafowl was once found in Manipur but Ali and Ripley think that it may be extinct in that area. There seem to be no recent reports of it in India, except of its presence in Mizoram (Biswas, personal communication).

When unmolested, the bird becomes very tame and confiding, as in certain parts of Rajasthan, Haryana and western UP. People in these areas have been known to take to arms in defence of these birds. In the forests, it is a very vigilant bird, often the first to give an alarm call when a carnivore is sighted. It will also respond (like the Koklass) to a sharp and loud sound, like gunfire or thunder. Hence it is heard very frequently during the monsoon season and Sanskrit and Hindi poets have from ancient times associated this bird with the onset of the monsoon and its heavy, dark clouds.

CAPTIVE POPULATION: 4,061(1976), 4,696(1979), 3,267(1982), 3422 (1991).

A LIST OF NON-INDIAN PHEASANTS

	Common name	*Scientific name*	*Distribution*
1.	Blood Pheasant	*Ithaginis cruentus* 3 forms in India, 11 ex-Indian	Nepal, Tibet, China
2.	Cabot's Tragopan	*Tragopan caboti*	S.E. China
3.	Koklass	*Pucrasia macrolopha* 3 forms in India, 7 ex-Indian	Afghanistan, Pakistan, Nepal, Tibet, China
4.	Chinese Monal	*Lophophorus lhuysi*	S.W. China
5.	Red Junglefowl	*Gallus gallus* 1 form in India, 4 ex-Indian	Burma, Laos, Thailand, Kampuchea, Malaysia, Sumatra, Java, Bali, Nepal, S. China
6.	La Fayette's Junglefowl	*Gallus lafayetti*	Sri Lanka
7.	Green Junglefowl	*Gallus varius*	Java, Bali, other islands
8.	Kaleej	*Lophura leucomelana* 5 forms in India, 1 ex-Indian	Burma, Thailand
9.	Silver Pheasant	*Lophura nycthemera* 13 forms	Kampuchea, Thailand, Laos, Vietnam, Burma, China
10.	Imperial Pheasant	*Lophura imperialis*	Annam, Laos
11.	Edward's Pheasant	*Lophura edwardsi*	Annam
12.	Swinhoe's Pheasant	*Lophura swinhoei*	Taiwan
13.	Salvadori's Pheasant	*Lophura inornata*	Sumatra
14.	Malay Crestless Fireback	*Lophura erythrophthalma erythrophthalma*	Malaysia
	Bornean Crestless Fireback	*L.e. pyronota*	Borneo
15.	Crested Fireback	*Lophura ignita*, 4 forms	Malaysia, Sumatra, Borneo
16.	Siamese Fireback	*Lophura diardi*	Thailand
17.	Bulwer's Wattled Pheasant	*Lophura bulweri*	Borneo
18.	Eared Pheasant	*Crossoptilon crossoptilon* 1 form in India, 4 ex-Indian	Tibet, China, Burma
19.	Brown Eared Pheasant	*Crossoptilon mantchuricum*	W. China
20.	Blue Eared Pheasant	*Crossoptilon auritum*	W. China
21.	Elliot's Pheasant	*Syrmaticus ellioti*	E. China
22.	Bar-tailed Pheasant	*Syrmaticus humiae* 1 form in India, 1 ex-Indian	Burma
23.	Mikado Pheasant	*Syrmaticus mikado*	Taiwan
24.	Copper Pheasant	*Syrmaticus soemmeringi* 5 forms	Japan
25.	Reeves's Pheasant	*Syrmaticus reevesi*	North Central China

26.	Game Pheasant	*Phasianus colchicus* 31 forms	China, Korea, Mongolia, Taiwan, Burma, Thailand, Afghanistan, Iran, etc.
27.	Green Pheasant	*Phasianus versicolor*	Japan
28.	Golden Pheasant	*Chrysolophus pictus*	China
29.	Lady Amherst's Pheasant	*Chrysolophus amherstiae*	China, Burma, Tibet
30.	Bronze-tailed Peacock-Pheasant	*Polyplectron chalcurum* 2 forms	Sumatra
31.	Rothschild's Peacock-Pheasant	*Polyplectron inopinatum*	Malaysia
32.	Germain's Peacock-Pheasant	*Polyplectron germaini*	Annam, Kampuchea, Thailand
33.	Grey Peacock-Pheasant	*Polyplectron bicalcaratum* 2 forms in India, 3 ex-Indian	Burma, Laos, Hainan
34.	Malay Peacock-Pheasant	*Polyplectron malacense* 2 forms	Malaysia, Thailand, Sumatra, Borneo
35.	Palawan Peacock-Pheasant	*Polyplectron emphanum*	Palawan
36.	Rheinart's Crested Argus Malay Crested Argus	*Rheinartia ocellata* 2 forms	Annam, Laos, Malaysia, Vietnam
37.	Malay Great Argus Bornean Great Argus	*Argusianus argus* 2 forms	Malaysia, Borneo, Sumatra
38.	Double-banded Argus	*Argusianus bipunctatus*	Not known (only a feather known)
39.	Green Peafowl	*Pavo muticus* 3 forms	Burma, Thailand, Vietnam, Malaysia, Java
40.	Congo Peacock	*Afropavo congensis*	Zaire (Africa)

In the list above, exclusively Indian species have been omitted.

Chapter 2

Census

> One of the most untruthful things possible, you know, is a collection of facts, because they can be made to appear in so many different ways.
>
> —K. MENNINGER

There was a time when the various pheasants were so plentiful in the wild in India that no thought was ever given to their number. If anybody did care about this it was either a sportsman who shot them for pleasure, or a poacher who trapped them for profit. And it were such persons who best knew which species was plentiful in which area and hence which areas were worth a visit.

It is generally agreed that sportsmen have never taken enough birds to have any long lasting effect on the wild pheasant population. Also, it seems that, in recent times, there have been no trappers of the calibre of the notorious Wilson who boasted of having taken 1,000–1,500 specimens of Himalayan Monal every year, over several years, for the feather trade. Today, comparatively few birds are taken, either for table or for commerce, legally or illegally, and yet the numbers of the various species in the wild have fallen very low. It is not necessary to elaborate here on the reasons for this beyond mentioning that the main one is habitat destruction. Given suitable habitat, it is believed that all species of pheasants will successfully hold their own against natural predation as well as a certain amount of predation by man. But, for obvious reasons, they are unable to cope with habitat destruction. This is the one factor which today is responsible for destruction of wildlife, including pheasants, in India. Wherever the greedy and unprincipled hands of man have reached, there we find destruction of plant and animal life. Today, there is much awareness, albeit among a small minority, of the havoc caused by insensate human activities, and some of us therefore hope that perhaps tomorrow will be safe for our plants and animals. It is in this context that it has become very necessary to know how many individuals of each species exist today and in which areas. Armed with this knowledge, we can take adequate steps to preserve what we have and to augment the numbers where needed.

That wild-animal populations are not static and are always in a state of flux is obvious. It is not our intention to identify the factors which govern the dynamics of a population; what we are interested in is knowing the total number of individuals of each species from year to year in particular areas.

Most pheasants nest on the ground, and though the hen is a close sitter and well camouflaged, nest losses are quite high. We have no figures for such losses in the wild in India, but the figures obtained for the Ring-necked Pheasant, *Phasianus colchicus*, under almost natural conditions in USA are very revealing. Over several years and in four states, the losses ranged from 42 to 82 per cent with an average of 63 per cent. Even so, 70–80 per cent of the females did manage to raise one or two broods. The losses are due to the elements, mainly snow and rain, and predation by birds and mammals, including man. Here again, we do not know for sure the quantitative effects of the various factors but once again we can turn to a study made in USA, in an area where no hunting was allowed. Of the 100 pheasants banded and released, 30 per cent survived to the second year, 9 per cent to the third year, 2 per cent to the fourth year and none to the fifth year.

These two experiments show that, in spite of such heavy mortality, pheasants do manage to survive mainly because of the comparatively large size of clutches and their being multi-brooded. The operation of these two factors would indicate that, in the same area, the population would fluctuate within certain limits and thus a cyclical pattern would emerge. Generally, this is true for most wild populations where the hand of man does not interfere too much.

A periodical census is a very important index of the health of a wild population and thus indirectly of the habitat. However, the true picture would emerge only when such censuses are carried out regularly for a few years over the same area and preferably about the same time of the year. A census is usually carried out with either of two objectives: *first*, to find out the total number of animals that are held in that particular area and whether their number has increased or decreased significantly, and if the saturation point has been reached; and *secondly*, to know the total world population of a particular species. The latter becomes very significant in the case of animals whose population has dropped to a dangerously low level. Though we do not have the exact figures for many areas in India, it is generally believed that, due to extensive deforestation, many of the Indian pheasants are so threatened.

Before 1979, only five Indian species of pheasant were included in the *Red Data Book* of the International Union for Conservation of Nature and Natural Resources (IUCN). These were Cheer (*Catraeus wallichi*), Sclater's Monal (*Lophophorus sclateri*), Blyth's Tragopan (*Tragopan blythi*), Mrs. Hume's Bar-tailed Pheasant (*Syrmaticus humiae*), and Western Horned Tragopan (*Tragopan melanocephalus*). When the 3rd meeting of the Convention of International Trade in Endangered Species (CITES) was held in Delhi in February 1981, some of us proposed that some additional Indian species should be listed. In consequence, the Himalayan Monal (*Lophophorus impejanus*) has been added in Appendix I, the Grey Junglefowl (*Gallus sonnerati*), Blood Pheasant (*Ithaginis cruentus*), and Grey Peacock-Pheasant (*Polyplectron bicalcaratum*) in Appendix II, and Satyr Tragopan (*Tragopan satyra*) in Appendix III.

At this point we would like to distinguish between two terms which are sometimes wrongly used interchangeably—*census* and *status survey*. Census implies a complete tally of an animal in a particular area (spatial) and at a particular time (temporal). Obviously, this cannot always be attempted or achieved and, in the majority of cases, we have only an approximation, usually derived through extrapolation and which we would prefer to call a status survey. The two procedures are also distinguished as the Absolute Method and the Comparative or Index Method, respectively.

Estimating absolute numbers of pheasants in the wild involves more work and the resulting data are prone to wide margins of error. However obtaining absolute numbers may be necessary for species that are highly endangered. Comparative methods have the advantage of being easier to carry out and will suffice for the management of most species.

A number of methods have been evolved for carrying out a census or a status survey, each suited either to a particular animal or to a particular area with its characteristic topography, nature of vegetation, and so on. An investigator would do well to be familiar both with the ecology of the animal being studied and the selected area of its habitat before actually carrying out the study with the eclectic method. These will greatly affect the accuracy and the precision of the investigator (or estimator). Some of the methods generally used are described below.

Distribution Surveys: This is a simple exercise which involves establishing the presence or absence of pheasants in a particular area. The exercise should be area-specific i.e., this ridge, this nullah, this forest path and so on. Areas can be administrative units such

as Forest Division, Range, Block, Compartment, etc. Before starting work in a new area, the investigator should examine old records (if they exist) and make enquiries from forest officials, field personnel and villagers. For obvious reasons professional poachers would be a very good source.

Abundance Surveys: The baseline data collected through Distribution Surveys can be upgraded by estimating or counting of numbers through sightings and monitoring calls and then classified as rare, common and abundant.

Territory-mapping Method: This method takes advantage of the fact that most animals have a territory, a home range, a core area, in which they live during a particular part of the year. In the case of galliform birds, which (except for some quails) do not undergo seasonal migration, this home range is quite small provided the covert provides all the necessities—food, water, shelter, juxtaposition and interspersion being the prerequisites of a suitable niche. The individuals in such an area are counted using one of the several methods available. This procedure is suitable for quails and partridges which usually form coveys, but will not be rewarding in the case of pheasants. Obviously, this method can be used only if visibility is high, either by direct sighting of birds or the tracks made by them either in snow or on earth covered by fine dust which are easily seen.

Drive Counts: This is a method which requires a large number of people to help drive the animals in a desired direction and is best suited for large animals, specially mammals. In fact, driving was commonly used for shooting game, both birds and mammals. An area to be driven or beaten, as the sportsmen used to term it, should be small enough to be adequately covered by the line of beaters. The number of beaters required would depend upon the breadth of the area as well as the thickness of the ground cover. Since quails, partridges, and pheasants are great skulkers, a large number of beaters is necessary. Another essential requirement is that there should be a sufficiently wide break in the ground cover on which the monitors can take their stand. The beaters form a line, which should preferably be in the shape of a wide U, with the men at the two ends being slightly ahead of those in the centre. This is to prevent the animals from breaking back through the sides before they come to the strip on which the monitors are positioned. All the monitors should face in the same direction and each should identify and count only the bird (or mammal) between himself and the next monitor.

This method can be used effectively in areas where the ground is reasonably level for it would be rather difficult for the beaters to maintain a line in a hilly area. Thus, this method is suitable for junglefowl, peafowl and the kaleejs which inhabit more or less level areas. Of course, if a sufficient number of men can be mobilised, this method can be used in the hills also. In the reserved forests of the plains, the blocks are divided into several smaller compartments and each compartment has several motor roads, cart roads and fire lines which are very suitable as breaks (strips) at which monitors could be stationed.

Aerial Counts: Small airplanes and helicopters have been used to count animals but for this method to be successful the animal should be big enough to be easily spotted from a low-flying and slow airplane and the ground cover should be minimal. This method cannot be used for pheasants.

Temporal Censuses: This method can be used only if a number of animals are due to pass through a small area within a comparatively short period of time. This is usually possible when the animals adopt a particular route during migration or when birds use a communal roosting tree. This method is not applicable to pheasants.

Extermination or Total Capture: As the terms indicate, in this method all the animals are trapped or killed in a particular area. Obviously, the extermination method is used only if the animals have become a pest, or have to be destroyed for some other compelling reason. The alternative—trapping all the animals in the area and then releasing them—is not practicable for pheasants.

Roadside Counts: In this method, an investigator covers a road, either in an automobile, or on horseback, or on a bicycle, and counts the animals seen on the road. This method has only one point in its favour, and that is, a large area can be covered by each investigator in a comparatively short time. However, the method suffers from several disadvantages. Firstly, it is confined to areas which have many roads. Secondly, there are too many variable factors which are difficult to take into account while arriving at a figure. Some of these factors are weather, time of the day, time of the year, availability of food and water in the vicinity, etc.

Strip Census: O.E. Frye devised this method for counting quails along permanent transects with the aid of dogs. It has been used with slight modifications by many investigators.*

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* Frye's method is somewhat similar to that of King as described in the literature. See Leopold (1933), Giles (1971), and Robinson & Bolen (1984).

In Frye's method, the investigator walks along a permanent transect which may be a man-made road, or a trail, or even a well-defined game path. Unlike a wild animal, a man walking makes a considerable amount of noise and all animals (including pheasants) will either freeze or flush, depending upon their nature and the thickness of the cover. Most paths or game trails will have a zone of varying width by its side which may not be as thickly covered as the rest of the forest and it is in this area of inadequate cover that animals flush. Those under better cover usually freeze. Pheasants are not easy to flush, specially if a man is passing quietly; they would, however, try to slip away on their legs into thick cover without being seen, when a skilled observer could detect their presence. It is obvious that some investigators would be better at this job than others and the ability to spot a bird, either on the ground or in a bush or tree, improves with practice. Also, it must be remembered that some persons have better peripheral vision than others. Most observers will succeed in spotting an animal mainly because of some movement and it is only an experienced man who can 'see' an animal that has frozen in order to blend with its surroundings and thus escape notice.

In this method, a few assumptions are made and the accuracy of the census depends upon certain factors which are more or less beyond the control of the investigator. It is assumed that the animals are evenly distributed in the whole area under study and, therefore, the number of animals seen on the transect is a true index. As will be obvious, it is wholly a matter of chance as to how many pheasants would be sighted in a given walk and thus, the larger the number of readings taken, the more accurate would be the count. In other words, it can at best be taken to be a random sampling. Also, if the transect lies in the path of birds going to a particular good feeding area, or a watering place, the count may yield too high a figure. Similarly, since the time of day decides the level of activity of birds, account must be taken of the fact that they are more active in the early morning and evening and will be mostly resting around noon. Further, there is always a chance that a bird that has been flushed once, and has been counted, may move ahead and be counted again.

In carrying out a strip census, a dog can prove to be very useful and may increase sightings by at least three times. There are many recognised breeds of dogs and each one is almost tailored to certain specific qualities and abilities. For animal census work, the most useful are those with flushing and pointing abilities. Some of the best breeds from this point of view are Pointers, Collies, Retrievers,

Setters, and some breeds of Spaniels and Terriers. However, within each breed, certain individuals would be better than others. Whatever type of dog is used, it is most essential that it must be well trained and should be under the full control of the handler, even when the dog is off the leash and some distance away from the handler. It must instantly obey such basic commands as 'Come', 'Sit', 'Down', 'Stay', 'Go', 'Heel' and 'No'. Better still, all such commands should be obeyed even when given by hand signal and not necessarily by word of mouth. A dog that gets excited at seeing an animal, or goes into the bush chasing it, is absolutely useless for our purpose and is best done without for its antics will seriously vitiate the results of the census.

Strip census methods have been perfected and used by Bennett & Hendrickson (1938, ring-necked pheasant), Einarsen* (1945, pheasants), Hayne* (1949, general), Howell* (1951, birds), Overton* (1953, 1954, includes Frye's method), Greely *et al.* (1962, pheasants), Jones (1982, capercaillie), Moss *et al.* (1979, capercaillie), Davison (1981, Crested Fireback), Steadman *et al.* (1979, turkey) and Lamba and his colleagues (1980, pheasants).

A good account of the censusing methods for pheasants has been given by Gaston (1980) who in recent years has done much work in India. Davison (1980) has used a combination of the crow count (described below) and transect method in the thick tropical forests of Malaysia. This method is specially good for Koklass, Cheer and Satyr Tragopan.

Lastly, one word of caution: many of the areas where pheasants live will have large game, including leopard, and a dog rates very high on its menu. Before a dog is taken into the forest, specially early in the morning and late in the evening, enquiries should be made locally whether the area contains a leopard or not.

Animal Signs as Censusing Methods

Various animal signs have been used for counting animals in a particular area and each method suits a particular type of animal. Further, these methods are very variable and should be regarded more as an index for showing a trend in animal population rather than an exact count which a census actually implies. Some of these methods are briefly described here.

* References marked with an asterisk have been cited in Trippensee (1948) and Giles (1971).

(*i*) *Track:* When animals move on soft ground, or ground covered by finely powdered soil, they leave very clean tracks. A good tracker can tell a lot from these tracks but the method is not suitable for pheasants.

(*ii*) *Excavations, Lodges, Dens, etc.:* Not suitable for pheasants but see Pellets, Droppings, below.

(*iii*) *Pellets, Droppings:* Many species of animals will deposit their pellets or droppings at a particular place. Many species of pheasants (not all) will roost up in a tree and occupy a favoured tree trunk or branch night after night. At least one Satyr Tragopan was known to have roosted in the same spot for 38 consecutive nights. Underneath such spots will be found a heap of faeces. Looking for such spots is a rather time-consuming method but a trained dog will be very helpful. This method is also useful if the pheasant has to be caught since a roosting pheasant will keep sitting, specially on a dark night, even when torchlight falls on it and thus can be captured either by hand or by net.

(*iv*) *Marked Animals:* The animals marked in one way or another can be released and captured at a later date. This method is best used for some special projects and is not very suitable for pheasants.

(*v*) *Nests:* Nests, whether containing eggs or terminated, can be counted in a particular area, and a reasonably good estimate of the population can be made. Once again, a good dog of a breed which has a good nose, like a Labrador Retriever, will come in very useful. The dog is likely to locate the nests of all species of birds, either on the ground or in a bush near the ground.

(*vi*) *Call or Crow:* This, like the strip transect method, is a most useful one for counting pheasants, and is probably the most popular. Fortuitously, the calls of the various species are very distinctive and even if individuals of two species are present in a particular area and are giving a call, the calls can be distinguished. For those who have never before heard the call, there are two options: (*a*) to be in the company of an experienced person who can be either a field worker or a local man who can identify the call. Usually, just one or two exposures are enough; (*b*) to listen to a recorded call. A number of agencies like the BBC, WPA and Cornell University, to name a few, have sound recordings of various birds, including pheasants. They would be willing to supply a copy if this is needed for field work.

Most species of pheasants will give a loud call (crow) early in the morning before leaving the roost, and again late in the evening, just before going to roost, and it is these calls that are monitored. For

obvious reasons, this method cannot be used for species which are more or less silent or give infrequent low calls. However, there are some species which are very vocal and are thus very suitable for this method. Some such species are Peafowl, Red Junglefowl, Satyr Tragopan, Himalayan Monal, Koklass and Cheer. On the other hand, the Blood Pheasant is an indifferent caller. Also, it has been observed that it is usually only the male that will give the crow call though both the sexes will sound the alarm call which is very different. One exception is the Himalayan Monal in which both sexes give the crow call. There are many factors which govern the frequency and volume of a call—chiefly, the onset of the breeding season and weather conditions, even a light rain being a damper, though cloudiness does not make much difference (see also Gaston, 1980; Ridley, 1987; Young *et al.*, 1987). This method is specially useful in the hills where the strip transect method has limited use because of the laborious and time-consuming walking involved.

When it is proposed to use the crow call method for a status survey, the procedure to be adopted is something like this: First of all, it must be ensured that the area to be studied is one that is known to contain a population of a particular species of pheasant in the recent past (unless it is the intention to study an area which apparently looks suitable though there may be no records of the presence of pheasants). In any case, enquiries should be made from local people and forest officers holding charge of the block in question. If the area is not well known to any of the investigators, then a quick preliminary survey of the topography, vegetation, covert, water source, food supply, etc. should be carried out for this will save much time when the actual survey is carried out. Once this has been done, the investigators should be able to choose a transect, road, game trail, etc. on which the estimators will stand during the actual survey. In the hills, most areas will have ridges with intervening valleys and, normally, the wind will blow from the valley up the face of the ridge. Thus the ridge is the most advantageous place to station the estimators. Once the ridge has been selected, a plan of the area is made which should show the important features like a prominent rock-face, a tree in bloom, a large dead tree, etc. and the four points of the compass. On this map are then marked the places at which each investigator will be placed and around this epicentre a circle is drawn with 12 segments, like the face of a clock. Each investigator is provided with a copy of the area plan so that the landmarks present will serve as points of reference, and on which he will mark the calls heard by him.

Though one single person *can* carry out a survey, since crow calls can be heard only from within a limited distance, several persons working together will be able to cover a proportionately larger area on a single day, resulting in a more reliable count, since the chances of a bird being counted more than once are far greater in a survey spread over more than one day than if the whole area is coverd simultaneously. If only one person is counting, moving from segment to segment each day, a duplicate count is possible even if a bird has moved slightly from the previous day's position. The distance from which a crow call can be heard will depend upon the particular species of the pheasant, the nature of terrain and vegetation, and very significantly on the direction and velocity of the prevailing wind, and the time of the year. For our purposes, the year can be divided into three seasons—pre-breeding, breeding and post-breeding, and both the frequency and volume of calls will vary during these three periods. The period immediately before the beginning of the breeding season should be the period of choice for a count.

Once all the preparations have been made, the party is ready to go to work. The pheasants will call very early in the morning, well before sunrise, and then at dusk, these periods coinciding with their leaving the roost and getting back to it. The members of the working party should synchronise their watches just before leaving camp. Since the calling period is usually short, generally no more than 30 minutes from the first to the last call, it is important that all the investigators are in position well before the first call is expected.

The estimators are placed in such positions as would enable them to cover the largest area possible but with the certainty that each and every call is heard at least by one investigator. Each person when he hears a call should mark the position from which the call came as also the time on the map provided. Once the calls are over, all the maps are immediately studied together to add up the tally. It is more than likely that a particular call has been recorded by more than one person and this should be taken into account. If the same area is studied on two consecutive days, it will give a more reliable figure.

This method is very suitable both for a flat area with not much vegetation in the form of large trees with broad leaves, and on the higher and middle altitude hills which usually have well-marked gullies and sharp ridges. The latter is an almost ideal condition with the investigators all being placed on the same ridge and thus able to monitor calls in the gullies or the valleys on both sides.

As in other methods, it is very desirable that the investigators be familiar with the biology of the species under study as well as the topography of the area being censused.

The method, in its simplest form, as described above is not only the most practicable but also reasonably good for estimating the number of males in a particular area. Its only fault or limitation is the unavoidable extrapolation involved—if six males are heard in one hectare, then there are 12 birds (six males and six females) in one hectare and 120 birds in 10 hectares. Also this method does not take into consideration the possibility of unattached males also giving a call. Some workers, because of this drawback, consider it to be rather unreliable, but since this is the only practicable method available for enumerating pheasants, apart from the strip transect method (q.v.), the crow call method is very largely used in India. For greater accuracy, several small areas selected at random should be studied before accepting the extrapolated figures as a true index for the whole. Obviously, a good investigator will take all factors into account, using great caution, before arriving at final figures. Even so, the final figure should be taken more as an index, or as indicating a trend in increasing or decreasing population in a particular area if such counts are taken over a period of several years and not as census figures *sensu stricto*. It is not possible to make a head count of pheasants and, fortunately, it is not necessary either.

While studying Cheer, Young *et al.* (1987) found that censusing through calls is beset with many problems and population or breeding densities cannot be determined with confidence.

The modification adopted by Amman* (1940) improves the accuracy of the method. He first determined by direct observation the number of calls given by a cock on an average in an hour and also the distance from which he could hear them. These two indices are used in adjusting the final figures. If time permits, and there is an opportunity to determine these two indices, then this modification should be adopted.

In the case of pheasants, the call of the male is a challenge and declaration to other males within hearing distance and is, therefore, contagious—a call by one male is quickly answered by another and so on. Advantage of this can be taken by playing back the call of a male on a cassette recorder-player and if there are any males of that particular species of pheasant in that area, they will almost certainly respond by calling. This can be very useful to an investigator in an area with which he is not familiar and will help determine whether

there are individuals of a particular species in the area. It must be borne in mind, however, that the sound produced by a portable recorder-player will not carry as far as the sound or crow produced by the bird. There are a few species of pheasants, like Peafowl and Koklass notably, which will respond to any sharp sound like gunfire, thunder, loud hand-clapping, etc.

The crow call method has been much used by Stoddard* (1932, quail), Amman* (1940, Ring-necked Pheasant), McClure* (1944, 1945, Ring-necked Pheasant), Kimball* (1949, Ring-necked Pheasant), Kozicky* (1952, Ring-necked Pheasant), Williams* (1961, Chukar), Smith & Gallizioli (1965, Gambel Quail), Gaston & Singh (1980, pheasants), Severinghaus (1979, pheasants), Young *et al.* (1987, Cheer), and Lamba and his associates (1980, pheasants).

* See footnote on page 36.

Chapter 3

Aviculture

> It is, after all, only the humans who worry about the expensive part of the cage design; the aesthetic side. The animals only want a place that feels right as a home, and if you give them this, you get your rewards.
>
> — G. DURRELL

The aviculture of pheasants has been very popular in continental Europe and UK for at least several hundred years, as also in China and Japan. In recent years much work has been done on large-scale breeding of game pheasants in UK and USA. The species bred is *Phasianus colchicus torquatus*, though some other subspecies may have also been used. As a result of this, most of the literature today deals with practices and methods evolved in Europe, UK and USA and only very limited information is available regarding countries like India. For one thing, extremely few persons (even today) in India keep pheasants and whatever captive pheasants are found, will be in the various zoos. For some reason most of the species displayed are non-Indian, the most common perhaps being Golden (*Chrysolophus pictus*), Silver (*Lophura nycthemera*), Ring-necked Pheasants (*Phasianus colchicus*) and the ubiquitous Indian Peafowl (*Pavo cristatus*). Even such commonplace Indian species as Indian Red Junglefowl (*Gallus gallus murghi*) and White-crested Kaleej (*Lophura leucomelana hamiltoni*) are rarely to be seen. Thus, it will be obvious that the standard management and breeding practices of colder (and more advanced) countries will have to be modified and adapted to local conditions. The science and art of aviculture in India are not well developed for they have rarely been practised in a systematic way. Unfortunately, the situation in our zoos leaves much to be desired and most of the time, if pheasants breed in our zoos, it is not because of any special efforts being made but in spite of the benevolent neglect that they receive.

India being such a large country and hence having greatly varying climatic conditions from one place to another, no single account will cover all the conditions. To simplify matters and for all practical purposes, we can classify the conditions under three types, those prevailing in (*i*) the plains, (*ii*) the higher hill-stations, and (*iii*) the

medium to lower hill-stations. In the plains, at stations like Delhi, Calcutta, Bombay, Lucknow etc., the winters are comparatively mild, the summers are hot (and often dry) and the monsoon rains can be moderate to heavy. In the higher hill-stations in the Himalaya, say, at altitudes above 1,800 to 2,000m, winters will be moderately harsh (though not excessively so), with light to medium snowfall; the summers will be very pleasant and comparatively dry, with the monsoon from light to heavy, depending upon the location. It must be borne in mind that the farther north the station is, the colder it would be and the farther west it is, the less rainfall it would get during the monsoon. For example, Naini Tal in UP is at an altitude of about 1,935 m and gets an annual precipitation of 150–230 (up to 280) cm, mostly as rain in the monsoon months, and rarely gets even very light snowfall; while Srinagar, in Kashmir, at an altitude of about 1,575 m annually gets 66.4 cm precipitation, most of it as snow and spring rain. The average monthly temperature of Naini Tal is 2.8–26.7°C and that of Srinagar 1.1–24.6°C. The medium to lower hill-stations in the Himalaya, like Darjeeling, Naini Tal, Almora, Mussoorie, etc., have a cold winter but little or almost no snow, pleasant summers which are moderately dry, and medium to heavy rain during the monsoons. We would like to mention here that our own experience of keeping pheasants is confined to Lucknow and Izatnagar, both in the plains, and partly at Mukteswar (Dist. Naini Tal), the last being at an altitude of 2,350 m above sea-level, all in UP. The first two stations belong to the first category and the third to the second category mentioned above.

After several years of experience of breeding pheasants under captive conditions, we have come to the conclusion that the ideal location for a breeding centre would be under category three mentioned above—say, a place about 1,800 to 2,000m above sea-level. Such a place would be neither too cold for the birds of the plains like Red Junglefowl, Grey Peacock-Pheasant and Peafowl, nor would it be too hot for high altitude birds like Himalayan Monal and Blood Pheasant. Also, not much protection would be required against the hot sun or the snow and hence the cost of each pen would be much reduced. All in all, it would be a good compromise, though a compromise it will be.

PEN

Pens can be of two kinds, one, designed for display only, and the other, for breeding or breeding and display. The requirements and specifications are somewhat different in each case and, accordingly, the cost of construction.

Pheasants are very adaptable and most of them very quickly get used to living in captivity and survive for a reasonable length of time, provided most of their requirements are met. Whichever type of pen is made to accommodate them, a few basic requirements are essential. Most pheasants live in subdued light and hence the pens should be well shaded. Though they can tolerate a lot of rain and snow, they do not like wet feet. Accordingly, the floor should be such that water runs off quickly even after a heavy shower. The soil should be light and sandy rather than heavy and clayey. Also, the birds do not like being exposed either to hot winds or to cold and draughty conditions. The pen should therefore be well-shaded, airy but free from draughts, and with comparatively dry soil. Unless absolutely necessary, pens should not have cemented or brick floors. A floor of light soil will allow all kinds of plants, bushes, grasses and weeds to grow in the pen and also permit the birds to dig and scratch. If for some unavoidable reasons a cemented or brick floor has to be used, then in one corner either sand or very light soil should be spread about ten centimetres deep to provide them with a dust bath.

The site of the pen should be carefully selected. It is highly desirable that the birds get the benefit of the morning sun. It would be best if it is on slightly raised ground, with a light loam or sandy soil, so that it drains well. In case there is a possibility of the ground getting waterlogged it would be advantageous to first dig up the area and lay down permanent drains. Admittedly, this would be expensive, but in the long run, the initial cost will be more than recouped in terms of healthier birds with good breeding results. It will also be very helpful if the site has a gentle slope so that water runs off. If necessary, a gentle slope can be created by adding some light soil at the end which will have the shelter (see below). In selecting a site, advantage should be taken of any large shade-giving trees in the plains and of a natural barrier or break against cold penetrating rain and wind in the hills.

The pens can be of almost any shape but the two most economical, and perhaps also most efficient designs, are a series of rectangular pens and a cart-wheel or polygonal pen. In the case of the rectangular

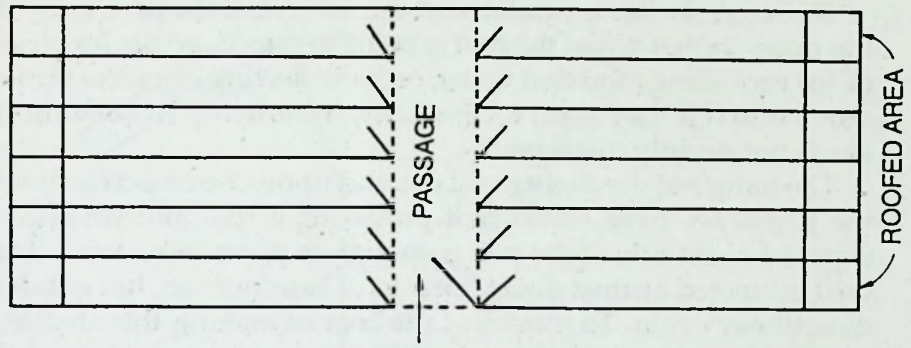


Fig. 1: Plan for a double (parallel) series of pens.

shape, two parallel series of pens are erected with a corridor in the middle for servicing and also for moving birds from one pen to another without having to catch them, which almost always puts a bird under a certain amount of stress, never mind how tame and docile the bird is. Each pen should be some four to six times longer than its breadth since this gives the bird a longer path to cover before it has to turn back on reaching the end of its 'territory' or 'home range'. It is believed that this gives the bird an enhanced idea of the size of its home range (Fig. 1).

The corridor is provided with a door at one end only and should be only wide enough to let the keeper move around freely. From the corridor a full size door gives access to the run portion of each pen. This door can open either into the corridor or the pen. In the latter case no bushes or trees can be planted in the area over which the door would swing when opened. Nearer the opposite end, a pop hole big enough to allow a bird to pass through easily is provided in the wire-mesh partition of the adjacent pen. This pop hole should have a removable cover so that a bird may be conveniently moved to the adjacent pen without having to catch it. If the bird is to be moved to a distant pen of the unit, it should be moved through the corridor. In either case, to move a bird all that is needed is to walk behind it slowly and the bird will continue to walk a few steps ahead. Under no circumstances should the bird be pressed hard for, under the stress of feeling cornered, the bird may strike hard against either the partition or the roof and hurt itself.

Shelter: A shelter is provided at the far end of the pen, away from the door, so that when the pen is being serviced, either for cleaning or for providing food and water, or for collecting eggs, the birds can move into it if they want to. Similarly, if the hen is incubating eggs, she is not unduly disturbed.

The nature of the shelter will depend upon climatic conditions. In the plains we have found that providing a roof and covering the exposed short side of the pen is enough to provide an area which is well protected against direct hot rays of summer sun, hot winds and direct heavy rain. To minimise the cost of making this shelter, the pens should run east to west with the corridor running north to south. Under such conditions, the covering for shelter need be provided only for part of the roof and on the east or west side wall of each pen. This shelter has no door and no covering on the sides which separate it from adjacent pens.

Any light-weight material which will keep out direct sunlight and the rain would be suitable for the roof. We have tried materials like straw thatching, reed curtains (*sirki pal*), straw matting and palm-leaf matting, but did not find any of them entirely satisfactory. For one thing, during the hot and dry summer they become tinder dry and highly flammable and the risk from accidental fire is always there. Then, being of plant material they are always subjected to the ravages of all kinds of invertebrates, specially termites, and thus do not last more than a season. At present we are using asphaltene sheets which seem to be quite satisfactory—they are easy to fix, are readily available, give full protection against direct rays of the sun and rain, and are light enough not to require a heavy framework.

In the hills, the shelter would be more like a small cubicle which is enclosed on all sides by a more substantial material than asphaltene. Probably the best material would be some kind of wood though galvanised-iron sheets could also be used, as also brickwork. It is usually not necessary to provide a door but an entrance big enough for a man to enter to service the cubicle is necessary. It would be desirable to slope the roof of the shelter away from the run side of the pen so that snow can drop off outside the pen.

The size of the pen and shelter is an important consideration and it will depend upon several factors—the amount of land available, the number of birds, and the single most important factor—the depth of your pocket. As some pheasants, like Monal, Eared Pheasants and Cheer are active diggers, they require a larger pen as compared to others like Peacock-Pheasants, Golden and Ring-necked Pheasants

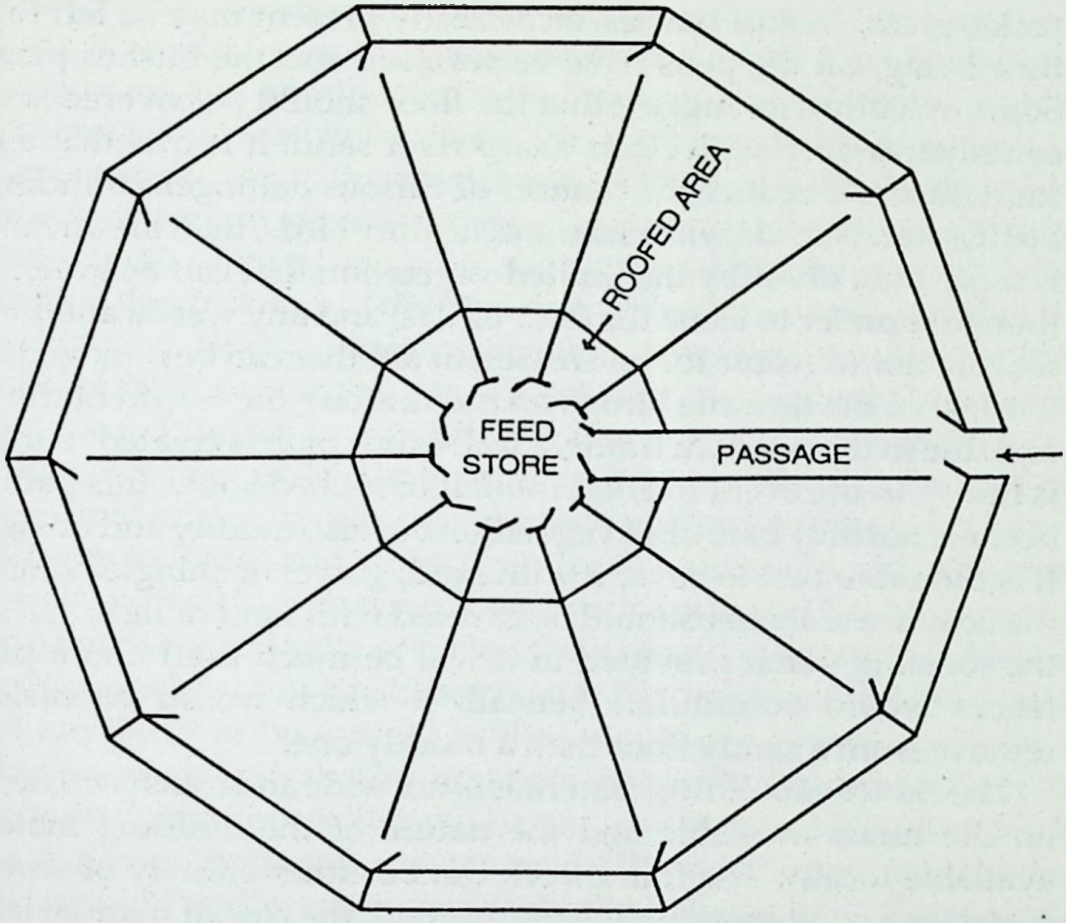


Fig. 2: Pens arranged in cart-wheel pattern.

which can be happy in a smaller pen. As it is true for many things in life, so it is for pens, a big good one will always beat a small good one. It is true that many a bird can be kept in a pen of modest size, but for satisfactory breeding results, the bigger the pen, within reasonable limits, the better the results. We can classify pens, according to size, into three groups—about 37 m^2 as large, 18.6 m^2 as medium, and 9.3 m^2 as small. The roof should be high enough to let a man stand in the pen with comfort and a roof 2–2.3 m high is good enough. Our pens, each lodging a breeding pair of Cheer, measure about 2.3 m wide, 8.75 m long and 2 m high; the corridor is 1.75 m wide.

The pens can also be arranged in cart-wheel pattern (Fig. 2). A good description of pens specially suited to cold climates has been given by G. Roles (1976).

The floor of a breeding pen should preferably be of earth. If it is a light soil, nothing needs to be done except to level it, dig up very big

trees and give it a slight slope away from the shelter side. Any stones, rocks, grass, weeds, bushes, etc. already present may be left for the time being, till the pens have been raised and the bushes planted. Some aviculturists suggest that the floor should be covered several centimetres deep with clean, sharp river sand. It is true that a pure sand floor will reduce the chances of various pathogens building up but if a start is made with clean and healthy birds, then the advantage is more than offset by the limited vegetation that can be grown. We therefore prefer to leave the floor as it is, and any weeds and bushes that are not welcome for one reason or another can be removed later.

Most of the time the birds will move along the length of the pen, and due to the constant traffic, a well-worn path is created. If the soil is heavy, in the event of good rainfall or melted snow, this path will become not only bare of all vegetation but also muddy and unsightly. It is therefore best to cover it with sand, gravel or shingle. Similarly, the area in the shelter should be covered with sand or light soil since the roosting perch provided in it will be much used and a pile of faeces would accumulate beneath it which would be easier to remove from a sandy floor than a muddy one.

The choice of building materials is not wide and much will depend on the funds available and the nature of the building materials available locally. The framework can be either entirely of wood or metal, or a combination of them. Abroad, the cost of manual labour is so high that many aviculturists are compelled to put up pens themselves. Fortunately for them, a lot of building kits and components are available which do not need much labour or skill on the part of a do-it-yourself buff to assemble. In India, the services of a carpenter, a mason and a metal-worker are still available at affordable prices and they can be depended on to do a good job of it. For the framework, only three types of material can be considered—bamboo poles, wooden poles (*balli*) and iron. The last could be flat, tubular or angled. In the plains the best results are obtained using 12.5 mm (½") angle-iron. Once pieces of suitable length have been cut, they are welded to give a very neat and lasting framework. Lengths of angle-iron can also be bolted together, which would permit easy dismantling when desired.

Those who prefer a rustic look for the pens can use either bamboo or wooden poles, but it is rather difficult to get these in sufficient lengths of desirable strength which are not very heavy, both in weight and looks. The framework should not look very obtrusive which it would if it is heavy. Though all these materials would have

to be given a protective coating (bituminous paint is cheap and good), it would be more difficult to protect wood from the ravages of dampness and termites. So, in the long run, a metal frame would be most suitable, at least in the plains. The extra cost of freight involved in carrying angle-iron to the interior of the hills may make the thought of using wood more attractive there. The amount of snow expected to collect on the roof of the pens should be taken into account when selecting the thickness of the material for the framework, whether it is iron or wood. The thickness and spacing of the upright posts should be such that they can bear the extra weight and drag produced by accumulated snow. Where no snow falls, the framework can be lighter.

For covering, usually only wire mesh is used though the roof can be covered with agricultural nylon net, especially if the birds have a tendency to fly up and strike their heads against the roof. You must make sure that the nylon mesh is of such a size that the birds cannot hang themselves. While selecting the size and the gauge of the wire mesh, consideration should be given to the predators and the vermin that are likely to be present in the area. In the plains, specially in urban areas, only stray dogs and domesticated cats gone feral are the likely predators, in addition to hawks, crows, and such other birds. The major predators, for instance in UK and Europe, are the fox, stoat, weasel and grey squirrel (actually only vermin). Fortunately, none of these are a problem in India. It is our experience that 12.5 mm (½") wire mesh of 24 or 20 SWG is very appropriate for all the sides as well as the roof. Even 18.75 mm (¾") mesh can be used if mice, snakes, and other such animals are not a problem. If it is necessary to provide protection against stray dogs and cats, the bottom 75 cm all along the perimeter of the block of pens should be reinforced by adding another layer of wire mesh of a much heavier gauge (16 SWG) or even welded mesh. Admittedly, this will add to the cost of the pens but in the long run it would mean almost total protection to the birds and peace of mind to the owner. Alternatively, the bottom 75 cm can be boarded up using wooden planks about 2 cm thick, or it can be made of brickwork. We have used all three alternatives and are now very strongly in favour of brickwork, which should be about 30–35 cm below and about 25 cm above the ground-level (Fig. 3). Small gaps protected with heavy-gauge wire mesh should be provided at ground-level to allow rain water to drain off freely. The extra protection is needed only along the perimeter. Abroad, most aviculturists advise having an overhang along the perimeter to prevent predators (fox, cat) from climbing up and over

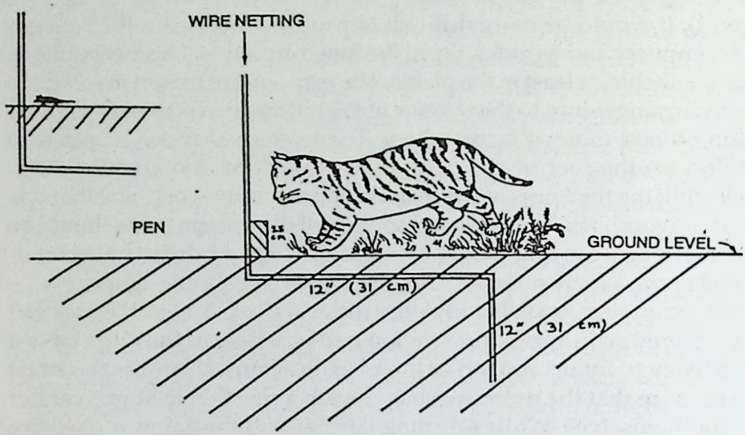


Fig. 3: Fixing wire mesh to prevent entry of vermin into the pen.

the roof. This is certainly desirable if predators are a problem. At least at Lucknow and Izatnagar we have not found this necessary.

In the hills, the pens will certainly need extra protection, specially if they are near forested areas from which a leopard, wild cat, langur, or pine marten is sure to visit the pen one day or another. All along the perimeter, wire mesh of heavier gauge would be necessary as also an overhang. Should the pens be near human habitation the chances of langur visiting the pens would be negligible and would also reduce, though not eliminate, the chances of night predators visiting. As an additional precaution, a few strands of barbed wire or cattle- and deer-proof fencing can be used around the pen complex.

It is imperative that the problem of predators should be well considered and appropriate material selected, both for posts and covering. It would certainly be prudent to spend a little more at the beginning rather than suffer a loss of birds and subsequently have to reinforce the pens.

The main vermin are the various species of rats that will visit the pens in search of food given to the birds. Rats are great diggers and active tunnellers and will dig their way underneath the sides of the pens unless special precautions are taken. Once they have gained entry into the runs and the shelters, it is an extremely tiresome job to get rid of them. Hence, all efforts should be made to prevent their

entry. All along the perimeter, the brickwork should go 30–35 cm down into the earth (like a foundation) and then about 30 cm out, or the dimensions may reversed (the former course is to be preferred). Similarly, wire mesh of a heavier gauge, and well covered with bituminised paint, can be dug in. However, we have found that even protected wire mesh does not last long. It rusts away quickly making it necessary to carry out periodical checks and repairs. As mentioned before, because of its permanency, we prefer brickwork to wire mesh for this purpose, even though aesthetically, it is not as good, since it prevents you from watching the birds from a distance.

Another device that has been recommended (though we have not used it) is soaking the soil all along the perimeter with waste oil from various types of engines. It is claimed that rats hate to dirty their fur with oil and hence avoid oil contaminated soil. However, there would be the risk of oil finding its way into the pen.

In the unfortunate event of rats finding their way into pen, they should be got rid of as early as possible, for not only will they eat a lot of feed, but worse, spread disease among the birds. There are several types of traps and rodenticides available (Warfarin, Roban, zinc phosphide, etc), but whatever means is used should not pose a hazard for the birds. If necessary, the birds should be shifted from the infested pen while the rodents are got rid of. If poisoned bait is to be offered, it is best to make small pills out of wheat flour mixed with the selected rodenticide and place them deep in a tube of appropriate size within the infested pen. Thus, while the poisoned food is not accessible to the birds it can be reached by the rats which are always attracted by narrow passages like that presented by the tube. A device following the design illustrated in Fig. 4, will ensure that the poisoned pills cannot fall out accidentally even if the device is rolled or turned over in any direction.

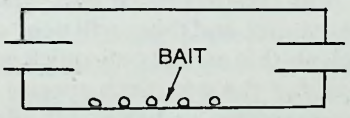


Fig. 4: A device for offering poisoned bait to rodents.

The aesthetic value and practical utility of a pen are very much enhanced by judicious use of plant material and it is in this field that the inherent flair of the aviculturist can best be brought into play. The

plants will perform many functions—providing food and shade, shelter for a female hard pressed by an overzealous male, a screen for a timid or shy bird against the proximity of man, and a suitable backdrop to show off the beauty and colours of the birds. As a bonus, many plants will produce flowers of great beauty and fragrance. The plant material should be selected with great care, taking into consideration the needs of the birds and then balancing the same against the plant species which are available and which will do well in that particular area. We are much in favour of using local plants, many of which might be growing wild in the area, and using exotics only when necessary. Many grasses and weeds will seed by themselves and these can be removed or trimmed if they grow too rampant. Such plants will provide food by way of green leaves (a good source of vitamin A) as well as seeds and berries in season, and also attract some invertebrate animals.

There are many plants which are quick growing, broad-leaved and not very tall and such plants are eminently suited for placing at strategic points to provide shade against direct sunlight. Many of these plants will tolerate pruning, which may be carried out to give shape to the plant. A list of some useful plants has been given in Appendix G, which is by no means an exhaustive one.

It is suggested that each pen should have up to only three or four plants that grow big. These should not be allowed to have more than one stem growing up from the ground up to about 60 cm or so, after which they may be encouraged to branch out, to form an umbrella-like canopy. This is a very good way of providing shade to the birds without taking up too much space near ground level. Such a plant is known as a standard or semi-standard to horticulturists. Plants that are eminently suited to such treatment are lantana, bougainvillea, *Chandni* and *Kamini* (Box tree). Many plants, though they will give plenty of shade, are likely to throw out too many branches from near the base and thus take too much floor area. Such plants are champa, ixora, lantana, etc., and these will need careful attention.

There are some plants that are not only quick growing but may go right through the roof of the pen. Such species can either be pollarded, as and when necessary, or, better still, one single trunk may be allowed to pass through the roof of the pen taking care to see that not too much space is left between the wire mesh and the tree trunk. Two such trees that we prefer to others are poplar and mulberry, but others like peach may also be used, though peach has a tendency to produce too many side branches too low down.

There are quite a few species of plants that can be grown outside the pen to provide shade and to act as a wind-break. Species suitable for the plains are poplar, ashok (*Polyalthia longifolia*), *Pongamia glabra*, pakar (*Ficus infectoria*), shisham (*Dalbergia sissoo*), etc. Some quick growing species that will form a low hedge are *Pithecelobium dulce*, hibiscus, neelkanta, bougainvillea, duranta, lantana, *Carissa carandus*, *Dedonea*, etc. *Euphorbia splendens* is a succulent with thorns and can be planted along the periphery and rather close to the pen walls. In time it will grow so thickly that it will form an effective barrier against small predators like cats and dogs, as also man. Similarly, cacti of various types and other succulents can also be used to form a barrier.

Plants that can be grown inside the pens in the plains are lantana, *Hamelia patens*, mulberry, ixora, kamini (*Murraya exotica*), champa (*Artabotrys odoratissima*), peach, fig, *Meyenia erecta*, chandni, croton, *Bambusa*, frangipani, etc. All of these can be pruned as and when required to give the desired shape.

There are some plants that can be made to run over and along the sides as well as the roof to provide dappled shade. Suitable plants for the plains are railway creeper, coral vine, grape vine, passion flower, *Bignonia venusta*, *Clerodendrum splendens*, *Clitoria*, *Quamoclit lobata*, etc.

In the hills, plants would be needed more for their aesthetic value and as a screen rather than for shade and protection against the weather. Species that are suitable for planting outside the pens are chiefly the oaks, rhododendrons, *Kaphal*, pines, deodar, etc. Inside the pens, smaller plants like magnolia, araucaria, azalea, camellia, hydrangea, persimmon, juniperus, etc. can be grown. For screening purposes plants like kniphofia, ferns, geranium, golden rod, osmunda, rex begonia, are suitable. Good climbers to go on the pen are wistaria, passion flower, honeysuckle, rose, and so on, which grow rather quickly.

If the aviculturist is not very familiar and knowledgeable about plants himself, he should consult some horticulturist who is familiar with the region. There are a number of books dealing with horticulture and gardening in general which will be found to be very useful. Also a nurseryman in the region would not only be a source of plants but of much practical information.

There are a number of plants whose leaves, fruits, tubers, seeds, etc. are toxic and it is best to avoid them even though by instinct the birds are likely to avoid them. Lantana, for instance, is very common

in the terai region and the areas covered by them are one of the favourite places for Red Junglefowl, White-crested Kaleej and Peafowl and yet the leaves, flowers and drupes (presumably only green ones) are all toxic to livestock. However, the ripe fruits, which turn purple or almost black, are avidly eaten by many wild birds like the various bulbuls. We have used lantana in our pens for many years without any problems. Amaltas (Indian Laburnum, golden shower, *Cassia fistula*) produces beautiful flowers and the fruit pulp is a purgative as also the bark and the twigs. The seeds of datura, several species of which are found in India, are poisonous as are its leaves, though not to the same extent. Similarly, the seeds of Mexican (prickly) poppy (*Argemone mexicana*), which is a common weed in the plains, are poisonous. Any specimens of this species growing near the pens must be removed before they seed. Other poisonous plants are crotons, dieffenbachia, *Clitoria*, pongamia, *Begonia rex*, rhododendron, plumeria, ipomoea and agave. We hasten to add, however, that normally none of these plants, even if grown inside or around the aviary will cause any fatalities, but every aviculturist should know of their hazard. Some aviculturists keep other cage and aviary birds with the pheasants and some of these seed eaters and psittacines are likely to damage leaves and twigs and, in the process, may get poisoned.

The shelter, as well as the run of the pen should be provided with suitable perches which should be from the trunks or thicker branches of any non-poisonous tree, though the pheasants are not likely to eat the bark. Care should be taken to select branches of correct thickness. Two uprights 60–120 cm long with Y-shaped ends should be firmly fixed in the ground and a cross-bar placed in the Ys and firmly secured either with nails or binding wire, with no nails or cut ends of wire exposed which may injure the birds, specially in the legs. The birds should be able to hop up to the perch comfortably. For adult birds the perch should be about 5 cm in diameter, or even more, but for younger birds a slightly slender perch would be preferable.

Alternatively, a pole may be suspended from the framework, fixing the binding wire at the ends of the pole which are wedged against the wire mesh so that there is no possibility of a flying bird coming in contact with the binding wire.

In addition to providing the perch in the shelter, a place must be made where the bird can make a nest. Pheasants do not, as a rule, make an elaborate nest—it is usually just a scrape in the ground. In the hills, a wooden platform about 45 cm off the ground is provided

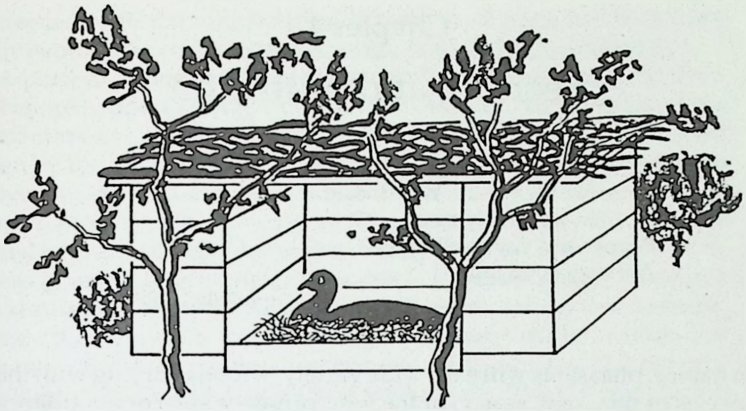


Fig. 5: Plan for a nesting site inside a pen.

and this is covered either with wheat- or paddy-straw, or, better still, dead pine leaves (needles). The birds usually like to rest on this platform and the hen will make a depression in the leaves to deposit her eggs.

In the plains, a bed of straw can be provided on the ground under the shelter and then two stacks of bricks placed 100–200 cm apart over which are placed some bamboo splits, making a kind of platform over which paddy- or wheat-straw, or even dried coarse grass is placed (Fig. 5). Most species of pheasant will use the platform for resting or roosting and only a few species will make a nest on it, whereas others will nest on the ground. If a low-growing bush, like *Ixora*, or a row of plants like *Sansevieria* is grown in front of this platform, it will provide a sense of privacy and security to the birds.

As mentioned earlier, the size of a pen depends upon several factors—area of land available, availability of funds, body and tail size of the birds, their propensity for digging and their need for greens being the main considerations. Accordingly, the suggestions made here should be taken only as a guide.

Small-sized pen (9.3m^2): Junglefowl, Grey Peacock-Pheasant

Medium-sized pen (18.6 m^2): Cheer, Kaleej, Barred-back, Eared

Large-sized pen (37 m^2): Monal, Tragopan, Koklass, Eared, Peafowl

Chapter 4

Feeding and Nutrition

'A loaf of bread,' the Walrus said,
'Is what we chiefly need
Pepper and vinegar besides
Are very good indeed.'

—LEWIS CARROLL

In nature, pheasants will eat a wide variety of foods varying with the species of pheasant, season of the year, presence and/or abundance of a particular food item in the area (home range) and age of the bird. Each group of birds is adapted to a particular type of food article and its collection. The various members of Galliformes, as adults, eat food of mainly vegetable origin, which they collect with their powerful beaks and strong legs—picking up seeds, grains, berries and other fruits, grazing on leaves and digging for fleshy tubers, corms, bulbs, insect larvae and other invertebrates. The chicks of all pheasants are nidifugous and self-feeding, that is, shortly after birth and once the yolk sac has been fully absorbed, they leave the nest and are able to run about and pick up their own food, though the parent (or foster parent) may call them to food. In a few cases, the parent will pick up the food in its beak and offer it to the chick directly but this stage lasts only a few days.

Our knowledge of the actual nutritive requirements of most groups of birds is still far from complete. Such as it is, it is derived mainly from direct observation of birds feeding in the wild, examination of food items present in the gizzard and the stomach of the birds that had fed in the wild, examination of the faeces, and the hit-and-miss methods adopted in feeding captive birds. It must be emphasised that, in nature, a wide variety of food of varying chemical nature is usually available. The choice of a particular food is dependent upon habit, which is largely influenced by the nature of the food that was fed to the bird as a chick; its appearance, since the birds have good eyesight but a poor sense of smell and taste (and are always afraid of experimenting with unknown articles for fear of getting poisoned); and finally due to idiosyncrasy or personality of an individual in a group of the same species. It is fortunate for pheasant aviculturists that the maximum amount of work

concerned with the nutritional requirements of birds has been done with two closely related species—domestic chicken and turkey.

A perusal of the earlier literature will show that many field ornithologists upon killing a bird would examine the contents of the alimentary canal with a view to identifying the nature of the food eaten by the bird. Obviously, the chances for such examination were rather limited and the data collected were confined to a particular season. However, in the case of Ring-necked Pheasant, which are raised by the million every year in Europe and USA for game farms, it was possible to examine the contents of the alimentary canal in a good number of birds during different ages and various seasons. Thus, some very interesting observations were made in USA. For instance, it was found that insects made up as much as 87.3 per cent of total food taken during the first week of life, 63.2 per cent during the second, 50.6 per cent in the third, 19.8 per cent in the fourth and thereafter it tapered off. The next important kind of food was cultivated grains and as the ratio of animal food fell, the ratio of grain increased and the levelling-off of both these items occurred at about the end of the fifth week. Further, according to one report, the 'pheasants ate 100 different species of insects, seeds of domestic grains, and wild plants'; according to another, 62 species of plants and 39 species of animals were eaten. It must be borne in mind that in these studies, the pheasants were living as ferals but in areas farmed and cultivated extensively by man.

In nature a bird will eat a wide range of food articles which will vary much from season to season; birds kept in captivity have, however, by necessity, a limited choice of foods. It is, therefore, up to the aviculturist to provide as balanced a diet as demanded by a particular species, since any deficiency for any period of time will surely bring about diseases directly correlated with an insufficient or unbalanced diet. The birds need an adequate diet to meet the demands of normal growth and development, for producing eggs with good hatchability and healthy chicks, and for a normal span of life during which resistance to diseases and parasites is developed. An adequate diet is important at all stages of life, but specially for a young chick, say up to the age of 12–16 weeks, and also for breeding birds. Not all aviculturists realise that only what is fed to breeding birds can be incorporated in their eggs, and thus their hatchability and the chicks' early growth, even their survival, are dependent on how well the breeders are fed. Many of the early losses in chicks, or their unthriftiness, can be directly attributed to nutritional deficiency

of the parent stock, mainly the hen, since the male does not contribute to the food reserve of the egg.

Nutritional requirements are met by various items which can be divided into six groups: (*i*) carbohydrates, (*ii*) proteins (and amino acids), (*iii*) fats, (*iv*) vitamins, (*v*) essential inorganic elements (minerals), and (*vi*) water.

CARBOHYDRATES

The important source for this group of foods for pheasants is starch which is easily digested by the birds and converted to glucose. Milk and milk-products are not such a good source because of the limited amount of lactase present in the bird and, therefore, only small amounts should be offered. There is no disease specifically associated with the deficiency of carbohydrates and under normal conditions there will be no shortage of carbohydrates in the feed.

PROTEINS

These are very important for proper nutrition of any animal and though, chemically, they have a complicated structure they are made up of simpler constituents called amino acids. Protein, when digested, breaks down into various amino acids—arginine, valine, histidine, phenylalanine, isoleucine, leucine, lysine, methionine, tryptophan and threonine. The amino acids tyrosine, cystine and hydroxylysine can be synthesised by the birds from other constituents of food supplied. These are alanine, aspartic acid, asparagine, glutamic acid, glutamine, hydroxyproline, glycine, serine and proline. Usually, plant proteins are deficient in such essential amino acids as lysine, methionine and tryptophan. Since no naturally occurring protein will contain all essential amino acids, several kinds of proteins are mixed in the feed.

Inasmuch as the proteins are essentially concerned with the formation of muscles, feathers, skin, beak and claw and the yellow of the egg, the protein requirement varies with age, and, usually, three categories are recognised: *starters* (or starting chicks) of age 0–8 weeks; *growers* (or growing chicks) of age 8–22 weeks, and *breeders* or *layers* of age 22 weeks onwards. Since the pheasants do not breed before the following breeding season at the earliest, the last category applicable to domestic chicken should be called maintenance and breeders. The pheasant aviculturists therefore recognise and use three types of rations—chick crumbs up to about 8 weeks of age, a

maintenance ration up to a little before the next breeding season, say the middle of February, and then a breeder ration during the breeding season.

The nutritive value of protein is dependent on its content of the 10 essential amino acids listed above and an adequate diet will provide all these. In addition, there should be sufficient nitrogen available from which other amino acids can be synthesised by the body of the bird. The biologic value of the protein depends upon the amino acid content and usually four categories are recognised—'high' like egg, dairy products, kidney and liver, 'good' like shellfish, soybean, peanut, potato, and muscle of meat, poultry and fish; 'fair' like cereals and root vegetables; and 'poor' like various nuts and legumes. When two or more 'poor' or 'fair' sources are mixed they may add up to 'good' as the deficiency of a particular amino acid in one may be made up by the others. This is why several sources of proteins are used to make up a diet. The proteins thus provide the essential and non-essential amino acids, nitrogen, sulphur and phosphorus to the body.

Pheasants could be fed on proteins of plant origin only, like corn, soybean and alfalfa meal. Optimum growth in one study was obtained with 24 per cent dietary protein and those fed 20 per cent or less developed at a slower rate, though by about 20 weeks they had about the same weight. However, the mortality rate was higher in chicks fed a low protein diet. According to this study, the chicks should be given diets containing about 24 per cent protein for the first eight weeks, 20 per cent for the next eight weeks and thereafter 10–12 per cent. A diet containing plant proteins only would reduce the chances of infection, specially with pathogens like *Salmonella*.

Soybean meal is available in raw, solvent-extracted form from soybean processing plants. In this form it contains a factor which inhibits trypsin and urease and therefore retards growth. The soybean meal should therefore be heated in the presence of moisture before being incorporated in the feed. In the presence of 25 per cent moisture, cooking at 50°C for three hours is adequate. Alternatively, with 12–16 per cent added moisture, 45–60 minutes cooking at 120°C and 1.02 atmospheres in an autoclave is recommended. Too much moisture and overcooking will reduce the lysine content.

There are two factors that have to be borne in mind. There is no single source of protein that will by itself provide *all* the essential amino acids needed in the right proportion. However rich the animal protein may be, if a single amino acid is missing, the biological value

of protein is nil. No single amino acid should be present in excess for this will be toxic and will retard growth. This is one more reason why several sources of protein, both of vegetable and animal origin, are mixed together to give a well balanced diet.

The staple diet for adult pheasants is said to be grains, specially the cultivated species—wheat, maize, milo, barley, paddy, etc. In some studies carried out with game pheasants in USA, it was determined that 91 per cent plant materials and 9 per cent animal matter formed the food. On an annual basis, the food comprised wild seeds 32 per cent, cultivated grains 26 per cent, insects 20 per cent, vegetable matter (other than seed) 12 per cent, and fleshy fruits 10 per cent. In this context, two things have to be borne in mind. Firstly, that these studies were restricted to game pheasants (*Phasianus colchicus* and *P. versicolor*), and secondly, the pheasants were living in cultivated areas and not in forests that were not manipulated and altered by man. There is no reason to believe that these data will apply closely to other species of pheasants and specially to those living in the wild, unaffected by man. As has been mentioned before, a pheasant will eat whatever is available and this is specially true of birds in captivity.

Almost every pheasant aviculturist has his own formula for feeding his birds during the breeding and non-breeding seasons. Unfortunately, not enough work has been done on the nutritive requirements of the various species of pheasants and the current feed formula, which is essentially based on work done on domestic chicken and turkey, is a kind of universal diet. It is inconceivable that what is good for, say, Blood Pheasant is equally good for Peacock-Pheasant and yet every breeder and aviculturist uses only one type of ration for all of his birds. Probably the only choice that we offer to the birds is in the comparative amount of greens.

What should be the percentage of crude protein in the feed? The recommendations differ widely from one authority to another. In the European countries and USA most aviculturists depend upon the commercially available feeds meant for domestic chicken and turkey. It is usually pelleted for adult birds and this is certainly a very convenient and economical way of feeding. In India, though the ready-made feed is available, it is not in pellet form. If you propose to buy ready-made feed, make sure of the quality and quantity of the ingredients, specially the proteins and the vitamins. These are the most expensive items in the feed and a substandard feed is likely to be deficient in these two items. It has been a popular aphorism

among poultry-men that what goes on the tag is not necessarily in the bag. If you buy commercially available feed then you are obliged to feed your birds with a particular level of crude protein. Some breeders (Howman, Murray, Hayes) will choose turkey pellets since these contain about 5 per cent more protein than chicken pellets. Most people prefer a feed with 18–20 per cent crude protein for the breeders but Howman prefers pellets with 23 per cent protein. For maintenance feed, the figure can be as low as 20 per cent, or even 18 per cent and as high as 24 per cent. To combat heat stress 15 per cent protein is better for egg production in chickens, and addition of ascorbic acid at 100 mg/kg and aspirin at 0.05 per cent of diet have been reported to be beneficial.

It is regarding the feeding of chicks, say, from zero to eight weeks, that we find greatest dissension. There is no doubt that in nature the young chicks will largely feed on insects and other small invertebrates and this is true even in the case of those species that, as adults, will be almost exclusively vegetarian. It is, therefore, quite reasonable to feed chicks on a high protein diet. Since the early growth period is the most critical part of an individual's life, we quote the figures recommended by various authorities—Delacour 24 per cent, Grenville Roles 24–29 per cent, Gerrits 25 per cent, Howman 28 per cent, Scott *et al.* and Hayes & Hayes 30 per cent. According to Scott, the optimum growth and feathering took place with a diet having 30 per cent crude protein, or with 26.5 per cent protein to which was added 0.1 per cent methionine. However, Scott (1983, personal communication) now prefers lower protein, stressing that '... when animals consume too much protein, it causes an increase in Specific Dynamic Action of the diet (also called a Heat Increment). This causes serious problem[s] in a hot climate—perhaps even mortality.' This view is reflected in the formula developed by him where the crude protein level is brought down to 22.5 per cent. In the past, we have used a diet with 24.8 per cent protein for the chicks. However, Mrs L. Arnold of the Jersey Wildlife Preservation Trust has, in a personal communication stated that the starter crumbs that contained 29 per cent crude protein were no longer used by the Trust since such high protein content caused problems related to leg deformities. (See also under Phosphorus, below). Accordingly, she prefers a diet containing 19 per cent protein. We have as yet not used such low levels of crude protein, which, as stated earlier, may lead to higher chick mortality. However, using a higher level of protein we have observed leg deformities in some of the chicks.

We very strongly recommend that you yourself mix the feed according to one of the formulas given in Appendix H to this book, from ingredients that are easily available on the market. Not only will you know what you are feeding to your birds, but also then, and only then, will you be sure that the feed is free from aflatoxin. Our greatest losses have been due to aflatoxin, directly or indirectly, specially in chicks.

For those who are interested in the details of nutritional requirements of birds, there are several very good books (Scott *et al.*, Bolton & Blair, Titus & Fritz, to name a few) but these deal mostly with domestic chicken and turkey. However, papers by Murray (1977), Woodard *et al.* (1979) and Scott (1978) deal specifically with the pheasants.

A disease due to protein deficiency is usually traceable to low levels of the essential amino acids and since the bulk of the usual feed contains maize, groundnut cake and soybean, and would therefore be adequate in all amino acids except, possibly, methionine, its addition is advisable. Casein is an important source of this amino acid, but since it contains a very large amount (85 per cent) of protein, methionine is best added as a pure chemical.

Protein deficiency may result in poor feathering, feather plucking, tail picking, and cannibalism.

FATS

Fats are an important source of heat and energy as also some essential fatty acids. The latter are important for they ensure the activity of vitamins E and A present in the feed. Fats are subject to oxidation in storage, turning rancid and producing a characteristic smell (and taste to man). Rancidity not only reduces their value as a source of energy but also their power to stimulate the activity of the two vitamins. A stock of feed, if it has to be stored for long, therefore, must incorporate a synthetic antioxidant.

The excess fat which is not used up by the bird (quite common in captive birds which get very little exercise) is deposited as such in the body, which is certainly useful during a severe winter. In wild birds, this fat is used during a lean period or during migration when there is little food intake and an excess of energy is needed. The aviculturist has to be very careful to see that the birds do not get fat specially just prior to the breeding season for excess of fat is one of the important factors responsible for poor breeding results.

VITAMINS

There are a number of vitamins known which are chemically unrelated to each other, and almost all of them, with the possible exception of vitamin C, are essentially required by birds, including pheasants, characteristically in very small quantities. Each one of them is required to help in a particular metabolic process of the body, and, therefore, the lack, or even a deficiency (avitaminosis) of a particular vitamin will seriously disrupt the particular metabolic process with which it is associated, producing characteristic signs and symptoms. These vitamins, needed in very minute quantities by a bird in normal health, are provided through a balanced diet. However, when necessary, extra vitamins can be given mixed with the feed or in drinking water, and in an emergency, as an injection.

Wilgus (1980) has reviewed the role of vitamins in diseases caused by viruses, bacteria and parasites, and has presented evidence of positive interactions. Hulan *et al.* (1980) have shown that Acute Death Syndrome (ADS) or 'flip over' can be reduced with greater intake of biotin, pyridoxine and thiamine.

Feeds usually contain the various vitamins in the required quantities but it is possible that during the processing of the feed or through long storage, a particular vitamin may be partly, or wholly, lost even though most millers will add excess vitamins anticipating such losses. Since the vitamins are so easily available, and not very expensive, some aviculturists are inclined to provide more vitamins than needed. A bird in good health would be able to take care of excess intake of any vitamins within reasonable limits, but beyond a certain level, excess of vitamins may also cause disease (hypervitaminosis).

The various vitamins are traditionally classified according to their solubility in either fat or water. Vitamins A,D,E, and K are fat-soluble and vitamins B complex and C are water-soluble. It naturally follows that fat-soluble vitamins cannot be utilised by the body even though they may be present in the feed in the absence of fat in the feed or, if fat absorption is impaired.

Vitamin A: This is important for the normal physiological functioning of epithelial tissues and the eyes and its deficiency will affect the epithelial tissues of the alimentary, urogenital and respiratory tracts as well as those of the eye. Consequently, the resistance of tissues to invasion by pathogens is much reduced and the birds become very

susceptible to infections, specially of the respiratory system and the sinus. In severe cases blindness may occur. The eggs produced by birds fed on low vitamin A diet show much lowered hatchability and high chick mortality.

The pigmented (specially yellow) fruits and vegetables, as also maize, contain carotene (provitamin A) and it is this carotene that is converted into vitamin A by the body. Pheasants are able to store a large amount of vitamin A and transfer it to the chick through the egg. If the egg does not contain enough vitamin A, the chick will show signs of deficiency within one week of hatching. If the hen pheasant had enough vitamin A in its feed, enough vitamin would be transferred to the chick to last for 4–5 weeks even though it may not be getting the vitamin through the crumbs it feeds on. Birds can obtain carotene through grasses. Birds suffering from deficiency respond quickly to treatment. Vitamin A @ 19,000–22,000 i.u./kg feed increased egg production and hatchability but more than 22,000 i.u. produced hypervitaminosis.

Vitamin D: These compounds are essential for the absorption of calcium and phosphorus from the intestine and are also connected directly with calcification of bones and with the functioning of organs like the kidney. While vitamin D_2 (calciferol, activated or irradiated ergosterol) is more active in man (and rats), in chicks it is only 1–2 per cent as potent as D_3 (cholecalciferol, activated 7-dehydrocholesterol). Deficiency contributes towards rickets, osteomalacia, kidney dysfunction, soft-shelled eggs, etc. Recent work has shown that vitamin D acts more like a hormone than as a vitamin. In animals that are exposed to strong sunlight containing enough ultraviolet light, the provitamin present in the skin or fur is changed to vitamin D_3. In the case of birds, the secretion of uropygial glands is spread on to feathers during preening and this is converted into vitamin D_3. Thus, during preening small but significant amounts of vitamin D are absorbed by the bird.

Hypervitaminosis causes soft tissue calcification and kidney damage.

The only natural sources of active vitamin D are liver and viscera of fish and the liver of those animals that feed on fish.

Vitamin E: This is present in three forms—*alpha-*, *beta-*, and *gamma-*tocopherol, and they are characterised by their anti-oxidant property. A deficiency produces muscular dystrophy, hepatic necrosis (spe-

cially along with lack of factor 3-selenium), sterility (in rats, at least, and hence the names antisterility vitamin and profecundin) and encephalomalacia in chicks. In the last case, the chicks suffer from what is known as 'crazy chick' disease. If the hen had been fed on a diet deficient in vitamin E, the chick hatched from its egg will show signs of encephalomalacia within a week of hatching. There are a number of conditions which are usually associated with the deficiency of vitamin E but which may be partly or wholly due to lack of factor 3-selenium. Apparently, many conditions respond to treatment with vitamin E and extremely small amounts of selenium (which in higher quantities is extremely toxic), the two apparently acting synergistically.

This vitamin is largely found in plant material and wheat (specially wheat germ oil); lettuce and alfalfa are specially rich. We feel that many aviculturists do not feed enough wheat for fear of getting the birds too fat and just prior to the beginning of the breeding season it is completely withdrawn. We would suggest that half of the maize in the diet should be replaced with wheat which contains more of protein, calcium, phosphorus, manganese, and vitamin E than maize. It is only copper that is more in maize (10.8 ppm) than in wheat (8.1 ppm), also carotene (source of vitamin A).

Vitamin K: This vitamin is known in about six forms, all having similar action. It is essentially concerned with the normal clotting of blood and is found in green plants and is also synthesised by the normal microflora in the alimentary canal. Accordingly, it is not necessary to include this vitamin in the feed unless the bird has been given antibiotics which may have removed the intestinal microorganisms. However, if sulphaquinoxaline has been added to the feed as a coccidiostat, then a stable form of vitamin K, or K_3 (menadione) should be added. This vitamin decomposes in sunlight though it is stable to air and moisture.

Vitamin B_1 (Thiamine): There are several salts available, but usually thiamine hydrochloride is used. It is needed for the metabolism of carbohydrates and acts as a coenzyme. Its deficiency results in loss of appetite, poor growth, leg weakness and ataxia, and nervous derangements. The birds become very susceptible to aspergillosis which proves fatal. Apparently, very little vitamin B_1 is stored in the body and hence a regular intake (as part of feed) is required. It occurs widely both in animal and vegetable materials and the cereals are

particularly rich. If a bird is suffering from thiamine deficiency, oral administration becomes necessary in view of the almost total loss of appetite.

Vitamin B_2 (Riboflavin): This acts as a coenzyme and is actively associated with the electron transport system and cell respiration. Its deficiency causes 'curly toe paralysis' and the chick walks only when forced to, and then too on the dorsal side of the toes and on the hock. The wings droop and are not carried up normally. When laying hens do not get enough of this vitamin, egg production falls and hatchability is reduced and there is abnormally high chick mortality. Good sources of vitamin B_2 are liver, kidney, heart, egg, milk, malted barley and yeast.

The condition 'curly toe paralysis' should not be confused with another deformity in which the toes are turned inwards, towards the inside but only laterally.

Vitamin B_5 (Pantothenic acid): This is also called the chick antidermatitis factor. It is very commonly found in many animal and vegetable materials, specially liver, kidney, egg yolk, rice bran and molasses. It acts as a coenzyme and is actively associated with metabolic processes. Its deficiency produces such diverse conditions as gastritis, enteritis, skin conditions, haemorrhage, etc. If the hen is fed a diet lacking this vitamin, embryonic mortality is high, specially during the last 2–3 days of incubation.

Niacin (Nicotinic Acid): This is the vitamin constituent of coenzymes concerned with the metabolism of protein, fats and carbohydrates. It is widely distributed, specially in liver, milk, white meat, yeast, alfalfa, legumes, whole cereals, maize, etc. Its deficiency produces enlargement of the hock joint, diarrhoea, inflammation of the mouth, and poor feathering. However, if the protein being given is rich in tryptophan, it will meet the needs of the body for niacin. Bacterial activity in the intestine also produces niacin.

Nicotinamide (Niacinamide): This is another constituent of the coenzymes and it is similar to niacin in action. Also called vitamin B_3.

Vitamin B_6 (Pyridoxine): This is one of the B complex vitamins and has three constituents. It is present in yeast, wheat, maize, liver, and also in milk, egg and leafy vegetables. Probably some of the needs

of the body are met by bacterial synthesis in the intestine. Normally, there should be no deficiency of this constituent in the feed. Deficiency may be caused by malabsorption or due to drugs and may result in poor growth, anaemia, skin problems, poor feathering, muscular weakness and convulsive seizures. The last mentioned condition should be distinguished from encephalomalacia due to vitamin E deficiency.

Biotin (also known as vitamin H): Acts as a coenzyme and is concerned with the synthesis of fatty acids. It combines with a constituent of raw egg white, avidin, and then becomes inactive. Its deficiency produces dermatitis around the beak and eyes, toes and foot pad, perosis (slipped tendon, hock disease), etc. It is found in liver, kidney, pancreas, milk, egg yolk and yeast. The hatchability of an egg is much reduced due to its deficiency.

Choline: Strictly speaking, this may not be a vitamin since it can be synthesised by the body and unlike other vitamins, it is needed in a much larger quantity. It is concerned with fat metabolism. It is found in many animal organs and plants and is a basic constituent of lecithin. Its deficiency produces perosis, haemorrhage in the eyeball and other organs, degeneration of kidney, cirrhosis, etc.

Folic Acid (Folacin, Pteroylglutamic Acid, PGA): Composed of three constituents, this coenzyme is concerned with the utilisation of single carbon moiety. Because of its physiological role, it has been called the antianaemia factor. However, it must be borne in mind that, though folic acid will correct the anaemia due to B_{12} deficiency, it will not prevent neurologic damage. It is found in fresh, green, leafy vegetables, cauliflower, mushroom, yeast, grasses, liver and kidney. Its deficiency causes poor growth, poor feathering, perosis, anaemia, depigmentation of feathers and cervical paralysis. (Cheer chicks appear to be rather prone to depigmentation of primaries.) Apparently, in the presence of a small amount of folic acid, much less choline is needed to prevent perosis.

Vitamin B_{12}: There are at least five B_{12} coenzymes associated with the synthesis of nucleic acids, amino acids and methyl groups. Probably the only known original source of vitamin B_{12} is microbial synthesis and hence the liver of ruminants contains more of this vitamin than that of other animals. Its deficiency produces poor hatchability of

eggs, retarded growth, bone abnormalities, etc., and is probably a contributory factor in perosis. The deficiency in a bird becomes apparent specially after antibiotics have largely destroyed the intestinal microflora and the bird may restore normalcy through coprophagy. It is notable that coprophagy is much more common in young chicks than in poults or pullets.

Vitamin C (Ascorbic Acid): This is much needed for proper metabolism and for maintaining intercellular material. It is found in large quantities in all citrus fruits, berries, tomato and leafy green vegetables and, usually, a bird is able to get all its requirements without the vitamin as such being added to the feed. There is some evidence supporting the use of this vitamin for better egg production and eggshell quality in poultry under continued heat stress (see also under Protein, above). No information is available specifically in respect of pheasants concerning this vitamin.

ESSENTIAL INORGANIC ELEMENTS (MINERALS)

Although the minerals form a comparatively small portion of the total body tissues yet they are as essential as the other classes of food. They provide the skeletal system and are absolutely vital in such metabolic functions as regulation of osmotic activity, pH regulation, transport of oxygen, activation of body enzymes, and water metabolism. They are incorporated in the various soft tissues of the body, and as iodine in thyroxine, iron in haemoglobin, zinc in insulin and as cobalt and sulphur in some vitamins and coenzymes.

The minerals are divided into two groups depending upon the amount required. Thus, we have the essential or principal minerals which form 60–80 per cent of all the inorganic material contained in the body, and these are calcium, phosphorus, sodium, potassium, magnesium, chlorine and sulphur. In addition, some nine minerals, called trace elements, are required in very small quantities. These are copper, manganese, iron, zinc, iodine, molybdenum, cobalt, selenium and fluorine. The animal body also contains minerals like aluminium, boron, cadmium and chromium whose function is not yet well understood. In chickens, at least, most of the calcium, magnesium, phosphorus and zinc is present in the bones, and the other minerals in the softer tissues and the body fluids.

Calcium: Most of the body calcium is in the bones and the rest in body fluids, regulating blood coagulation, the normal beating of the heart, the functioning of the muscles and the nerves, the permeability of the membranes, and acid–base equilibrium. It is present in many vegetables, lentils, beans, egg yolk, milk and cheese. Usually, in the diet of pheasants, it is provided as dicalcium phosphate. In laying hens, it is mainly used to form eggshell, and in chicks, the bones. The body may not be able to utilise all the calcium present in the feed due to several factors, the two main ones being deficiency of vitamin D_3 and an improper calcium:phosphorus ratio. Deficiency is largely shown as rickets in young birds; in laying hens it manifests in reduced laying, thin eggshells (with egg binding) and, ultimately, depletion of calcium from the layers' bones, making them very fragile and liable to spontaneous fracture. However, very high intake of calcium will also lead to trouble.

Phosphorus: Like calcium, most body phosphorus is present in the bones and its metabolism is very closely bound with that of calcium and vitamin D_3. Phosphorus is found in all body cells and is vitally connected with a number of physiological and biochemical reactions. Usually, the feed for pheasants should contain three parts of calcium to two parts of phosphorus. According to Woodard *et al.* (1979) calcium should be 3 per cent and available phosphorus 0.6 per cent. Protein can be 15.28 per cent, but at 0.3 per cent phosphorus, specially with high protein, mortality and paralysis of legs are greatly increased.

Magnesium: About 60–70 per cent of body magnesium is combined with the calcium and phosphorus and deposited in the bones; the rest is found in soft tissues, serum, blood cells, cerebrospinal fluid, etc. It is also needed for carbohydrate metabolism and the working of the body enzymes. Among the various types of food given to pheasants, soybean and whole grains are rich in magnesium. Deficiency produces retarded growth and convulsions.

Sodium: In the body, this element occurs mostly as chloride and bicarbonate, also as phosphate. It is found mainly in the extracellular fluids of the body. The mineral plays an important role in the maintenance of acid–base equilibrium, osmotic pressure of body fluids, and working of the heart. Its deficiency results in a large number of conditions, including retarded growth and lowered

reproductive performance. It is usually added as common salt (sodium chloride) to the feed.

Chlorine: As part of common salt, it is concerned with water balance, osmotic pressure and acid–base equilibrium. Its deficiency causes nervous signs, leg paralysis, high mortality, poor growth, and dehydration. However, excess of common salt in the diet can be very toxic, specially to chicks.

Potassium: This element is widely distributed within the cells of the body and is concerned with the regulation of osmosis and pH, metabolism of protein and carbohydrate, and heart activity. It is found in many types of food articles, both of animal and plant origin. Its deficiency causes weakness in muscles, and dysfunction or improper functioning of intestine and heart.

Manganese: Vitally required for a variety of bodily functions, manganese deficiency causes perosis, slowed growth, drop in egg production, and reduced hatchability.

Iron: Essentially required in the formation of haemoglobin and myoglobin, iron deficiency produces anaemia and lowered capacity to provide oxygen to the body cells.

Copper: Together with iron, copper is necessary for the formation of haemoglobin and is also concerned with the working of several enzymes and proper functioning of the central nervous system.

Zinc: Basically concerned with several enzymes and the mobilisation of vitamin A, zinc deficiency leads to retarded growth, poor feathering, delayed sexual maturity and inadequate immune response.

Iodine: Required for the proper working of the thyroid gland, iodine deficiency causes enlargement of the gland. The necessary amount is usually present in soil or water, but in deficient areas, fish meal or iodised salt will provide enough iodine.

Molybdenum: This element is required for maintaining normal levels of a certain enzyme but its necessity has not been proved for pheasants.

Cobalt: This is needed for the formation of vitamin B_{12} synthesised by microflora present in the intestine.

Selenium: This is required in very small quantities (see vitamin E, above). In higher quantities it is highly toxic.

Fluorine: This is required in very small quantities for the formation of teeth and bones in man, for proper growth of rats, and fertility in mice, but its necessity for birds has not been demonstrated.

Anderson & Stewart (1969) investigated the role of macro- and micro-nutrients in the soil on the density of ring-necked pheasants. They reported that low levels of calcium, magnesium and potassium may mean fewer birds while higher levels of metals like chromium, lead and nickel are toxic and deleterious.

There are two more items that may conveniently be considered here though they are not food articles.

Grit: This is necessary for grinding food articles like seeds, grains, grass, etc. in the gizzard and even omnivorous birds will ingest pieces of gravel or small stones. Due to the muscular movements of the walls of the gizzard, the seeds, grains and blades of grass and larger pieces of food are comminuted and made into a kind of thick paste so that they may be properly digested in the other parts of the gastrointestinal tract. If the pen has small pieces of stone or gravel as part of the soil, the birds will pick up these. Grit is provided in two varieties: either in the variously occurring natural forms of silica called granite, flint, quartz, coarse sand etc. or as oyster-shell, which is mainly calcium carbonate. The ideal grit should be such that it has sharp edges which will more easily break down the larger food items and be hard and not easily soluble. In any case, whatever be the chemical nature of the grit, over a period of time it will get dissolved and hence add to the intake of certain chemicals, which in excess (as it would if mineralised grit is given) may prove harmful. At the same time, many aviculturists are opposed to the use of oyster-shell which may lead to many complications. We use broken-up marble chips of suitable size. Charcoal should not be given since it will absorb certain vitamins, specially A, B_2 and K.

The size of grit used depends upon the size of the bird, the chicks being given smaller pieces, about the size of sugar crystals. The larger

birds can be given pieces 2–3 mm in size. If the bird picks up too many pieces of grit of very small size, it may lead to impaction of the gizzard.

Grit should not be considered as a nutritional source for any particular mineral but only as a mechanical help in the digestion of food, since birds lack teeth.

Water: Water is absolutely indispensable for the proper functioning of the body. Because of their characteristic physiology of excretion resulting in the formation of insoluble uric acid, birds do not lose much water and are certainly not as dependent on it as are mammals. In fact, in the wild, many of the pheasants can go without a drink of water for many days, their small requirement being met by the juices of plant and animal matter taken as food, supplemented by dew drops on the vegetation. However, for birds in captivity, fresh water must be made available at all times in a clean vessel, either enamelled or made of hard-baked earth. Very cold water should not be given to chicks. Though birds are rather reluctant to drink water to which medicines have been added, water-soluble vitamins and some antibiotics are readily accepted by pheasants.

FEED FORMULAS

There are many feed formulas available in the literature and some of these may be available commercially as feed for poultry. However, in Appendix H to this book, we give three sets of formulas. Usually, up to about ten ingredients are used and all of these are freely available in the market. We therefore very strongly recommend that you compound feed yourself to make sure that it contains what it should. There is no denying that adulteration of food, whether it is meant for human or animal use, is very common. Commercially available feed may well be substandard and its use may have serious consequences. Also, it is possible to get the various ingredients tested in a qualified laboratory, specially if its quality and purity are suspect.

In these formulas, yellow maize has been used but we are now of the opinion that yellow maize and wheat grain should be almost equal in proportions since wheat is richer in all constituents, except for copper and carotene (a source for vitamin A), which are supplied through the vitamin-mineral supplement anyway. Wheat is rich in vitamin E which we now believe is usually not given in sufficient

quantity, specially to a breeding hen. Also, maize is more susceptible to infection with *Aspergillus flavus*, the source of aflatoxin.

It is traditional in India to use groundnut cake for many animal feeds. One year we lost many chicks and poults. The post-mortem examination did not reveal any specific disease or cause. The main finding was debility and a poor condition of the carcass. Many of these birds, when alive, did not show any distinctive signs except that they were very lethargic in movement and would sometimes peck at food without actually picking it up, and their keel bone stood out as a ridge. A well-fed poult is plump in the breast—after all, there is a saying, 'As fat as a partridge'. An analysis of the feed showed it to contain 0.4–0.5 ppm of aflatoxin, a toxin produced by the fungus, *Aspergillus flavus*. This fungus is commonly found in stored feed and the two ingredients that are commonly involved are groundnut cake and maize, though other ingredients may also get infected. There is evidence that ducklings are very susceptible to this toxin and that there is variation in the susceptibility of the various breeds of chicken. We have found to our cost that the susceptibility of the various species of pheasants also varies. The LD_{50} for day-old ducklings is 20 mcg (μg). It is possible that the amount of aflatoxin present in the feed may not be lethal immediately, but given over a period of time, it depresses the appetite and therefore the chicks die due to starvation. Aflatoxicosis also increases the susceptibility of birds to candidiasis, pasteurellosis, salmonellosis, coccidiosis, Marek's disease and possibly others. It will also bring about anaemia and immunosuppression, and is a predisposing factor for carcinogenesis. It is also significant that the effect of aflatoxin is cumulative, thus even very low levels given over some time will cause serious trouble, even death. Linoleic acid @ 3.52 per cent improves feed intake in the presence of aflatoxin.

Since we were not in a position to scientifically test the toxicity in our pheasant chicks, we immediately changed the feed to one which contained soybean meal in place of groundnut cake. Nutritionally, soybean is undeniably better than groundnut cake though more expensive. Since each pheasant chick is expensive in India, the high cost of soybean meal is economic and the expenditure on it fully justified. Feeds containing soybean meal as the chief source of protein will need extra methionine and lysine.

If you are going to mix the feed yourself, and we cannot be emphatic enough in urging you to do so, there are certain precautions to be observed. For one thing, groundnut cake should be

avoided at all costs. If necessary it can be replaced with cottonseed meal which contains more choline, vitamin E, riboflavin and folic acid but less of nicotinic acid and biotin. Like most vegetable sources of protein, cottonseed meal contains a toxic principle and has to be suitably treated to make it safe. The maize, wheat and soybean meal have to be tested for the presence of aflatoxin and if even traces are present, the particular sample should be discarded. Meat meal and fish meal are usually prepared with an unspecified amount of bone and common salt and hence these should be analysed for the amounts of calcium, sodium, chlorine and protein content. If necessary, slight modifications will have to be made in the formulas given in Appendix H or any other that you may be using. Both meat meal and fish meal are usually prepared under unsatisfactory sanitary conditions and are hence likely to carry some pathogens, specially *Salmonella*.

Taking all factors into consideration, we suggest the following procedure. First of all, the various ingredients should be tested for their nutritional values (chiefly protein, calcium, sodium, and chlorine) and for the presence of aflatoxin and pathogens. Of all the ingredients, DL-Methionine is the most expensive, the chemically pure product selling for about Rs 200 per 500 g. However, the feed grade of this amino acid is available at about Rs 110 per kg. Since so much labour is involved in testing the various ingredients, feed required for the whole year may be prepared, preferably during the winter months, when both humidity and temperatures are low. A chick will eat about 1.7 kg of feed during the first eight weeks of its life while an adult pheasant will need about 70 g of feed per day, which would include wheat grains also. Thus, for each adult bird you should provide about 2.1 kg of feed each month, out of which 16.5 parts would be the compounded feed and 4.5 parts of wheat grain, the latter being offered after soaking it overnight.

All the ingredients should be mixed together, except for the vegetable oil and vitamin-mineral mixture and methionine, and packed in polythene bags which should be sealed and placed in a plastic or metal container. Depending upon the number of birds that you have, the quantity packed in each bag should be such that you use up the contents within two months or less during the non-monsoon months, and over three to four weeks during the monsoon months. This procedure will eliminate, or at least greatly reduce, the chances of growth of *Aspergillus flavus* as also the oxidation of the ingredients. When a bag is opened, the requisite amount of vegetable

oil and vitamin-mineral mixture and methionine are added and thoroughly mixed.

Pheasants, like other gallinaceous birds, scratch the feed and thus quite an amount of feed is spilled from the container, and this feed has to be periodically removed, lest the stale food is subsequently eaten by the birds. There are several types of containers in use which prevent the birds from scratching. The one that we prefer over the other is of a box type with an opening at the top as shown in Fig. 7. On the inside of the box, a level mark is made either by painting a line or by a beading and the food is put in up to this level only (Fig. 7). The use of such a container reduces wastage to a minimum and enables you to know if the birds are consuming the normal amount of food, often a very good index of good health.

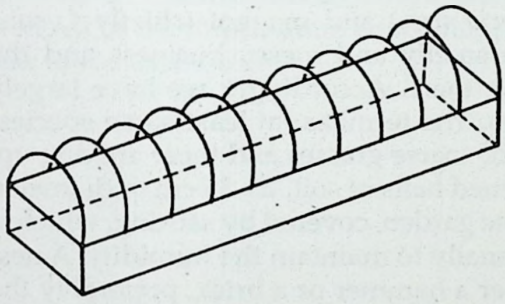


Fig. 6: Feeding trough when many birds are kept together.

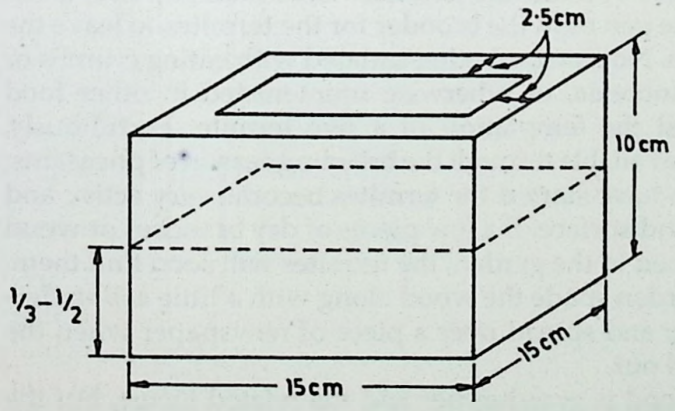


Fig. 7: Food container to prevent waste of food.

Hayes & Hayes (1987) recommend the use of bird cornbread, as an extra. To prepare this, take three cups of small birdseed (like millet); two cups each of whole wheat flour, soya meal, and corn meal; one cup Vionate (a vitamins supplement); one cup baking powder; four teaspoonfuls of salt. Mix the ingredients and make a

'well' and add five cupfuls of white and yolk of eggs with their ground shells, one cup of milk, and one-half cup of wheat germ oil (or cooking oil) and bake till firm to the touch. Cut up into small pieces or crumble over the regular feed.

LIVE FOOD

The importance of live animal food in the feeding of birds, specially the chicks, cannot be overemphasised. In temperate countries it is customary to use maggots, locust and mealworm. These are generally raised in large numbers under reasonably clean conditions and can safely be offered to the birds. However, maggots can, and do bring disease to birds, specially botulism. In India, these animal foods are not raised commercially and the aviculturist will have to raise the mealworms (*Tenebrio* spp.) and maggot (chiefly *Luculia* spp.). Raising maggots is a smelly and messy business and the danger of botulism is always there. Accordingly, we have largely depended upon live termites. The termites (at least some species) make their nests at the base of coarse grasses and these are dug up. These nests, which are hardened balls of soil, 20–35 cm in diameter, can be stored in a corner of the garden, covered by sacking, which is sprinkled with water occasionally to maintain the humidity. A nest ball is broken up, using either a hammer or a brick, preferably the latter since it does not crush the termites. The broken up nest is left on the floor of the pen or in the brooder for the termites to leave the nest on their own. No chick, whether satiated with eating crumbs or suffering from anorexia, or otherwise uninterested in other food articles can resist the temptation of a live termite. Fortuitously, termite nests are available through the breeding season of pheasants.

Once the rains have started the termites become very active and come to the ground surface. If a few pieces of dry branches or wood are left undisturbed in the garden, the termites will soon find them. Using a small garden spade the wood along with a little soil underneath are dug up and spread over a piece of newspaper when the termites will spill out.

Another live food is grasshopper and the related locust, but the latter are not available everywhere. However, because of the size of the body and the hardness of their chitin, only the smaller grasshoppers are suitable and these too for bigger chicks and poults. The grasshoppers can be collected by sweeping grassy areas with a butterfly-net or from agricultural fields, specially maize fields.

We do not trap the insects which are attracted to a lamp at night for some of them may be poisonous. House-crickets are also readily eaten though these are not available in any numbers.

All arthropods should be collected only from those fields or areas where no insecticide or weedicide has been used for many animals will continue to live while having the poisonous chemicals accumulated in their bodies.

Another live food that is often used for many cage and aviary birds is the larva of the honey-bee (*Apis mellifera*). There is no reason why it should not be suitable for pheasants but we have never used it, mainly because it was just not readily available to us.

For details of composition of various ingredients used as food for poultry (and pheasants), see Bolton and Blair (1977), Kearl (1982), National Research Council (1971) and Scott *et al.* (1976). Unfortunately much of the information concerning Indian samples is not available in the literature.

Chapter 5

Stock and Breeding

> You know there are two things that make all conservationists as hysterical as maiden aunts when they are suggested. One is captive breeding and the other is translocation of species.
>
> —G. DURRELL

Now that you have erected your pens, planted them with grass and shrubs and have laid a supply of suitable feed, you are ready to introduce the pheasants into the pens. The many available species can be divided into groups according to the criterion you choose but we would very strongly urge you to consider the year round climate of your place before making your choice. Thus, there are high altitude species like Monals, Tragopans, Blood Pheasants, etc. which are likely to do well in cold climates, and even though you may be able to keep them alive for some time in the hot plains, the heat stress year after year results in reduced breeding performance and heavy and premature deaths. Similarly, the species of the plains like Peacock-Pheasants, Peafowl and Junglefowl, are better adapted to the heat of the plains rather than the cold of the higher hills. However, it is very much easier to provide protection against cold through well constructed and insulated shelters, which may not even need artificial heating than to provide protection against extreme heat. Also, the birds can be made to roost on the platforms, rather than on the perches to prevent their toes from freezing.

Then you may decide to have both Indian and non-Indian species in your collection. We have not given here descriptions of the non-Indian species but only a list, and descriptions can found in the literature (Beebe, 1918 – 22; Wayre, 1969; Roles, 1976; Delacour, 1977; Howman, 1979; Johnsgard, 1986). Some of the very showy species like Golden, Silver, Reeves's, Lady Amherst's, Ring-necked, Firebacks, etc. are non-Indian and these are rather easy to take care of, and comparatively cheap, at least in Europe, UK and USA.

Once the choice has been made, the next problem is from where to get the stock. In this context it must be remembered that many of the species are listed as endangered and therefore protected under law. You would do well to consult either the Chief Wildlife Warden

of your state, or the Department of Environment or the Wildlife Section, Government of India, before buying and keeping any birds. The possession, without due permission, of live or dead birds, feathers, eggs or any other product of all the species that may be notified from time to time, which will include all endangered species, is prohibited and punishable under law. This applies to trade within the country and to export or import.

You can stock your pens either with captive-bred or wild-caught birds. You can buy the captive-bred birds within the country or import them. In case you can locate a source of birds within the country (unfortunately there are not many) you would do well to buy from it for several reasons. For one thing, the stock has already been within the country for one or more generations and is therefore likely to be acclimatised. Secondly, so many permits and licences and certificates are today required to export/import a live bird, that not many breeders outside the country will agree to supply. Also, the cost of various health certificates and air-freight would be very heavy. Therefore, import should be thought of only for some very pressing reasons, like making up of a pair for an individual that you may already have. While importing, you would do well to make enquiries whether the bird would be subject to quarantine, facilities for which may not be available at all airports. Quarantine space has to be booked in advance and you have to pay all the charges.

Whether you import a bird or buy it within the country, you should not only try to buy stock which is healthy but also ensure that the two birds making the pair are not closely related. It must be appreciated that, today, captive stock all over the world of several species is very limited and, since it is not always possible to introduce new blood, the individuals of such species are very close-bred. In consequence, they either do not breed or lay few eggs, or the eggs laid do not produce healthy chicks, or they are infertile. This is a problem that aviculturists all over the world are facing today and are trying to solve as best they can under the circumstances.

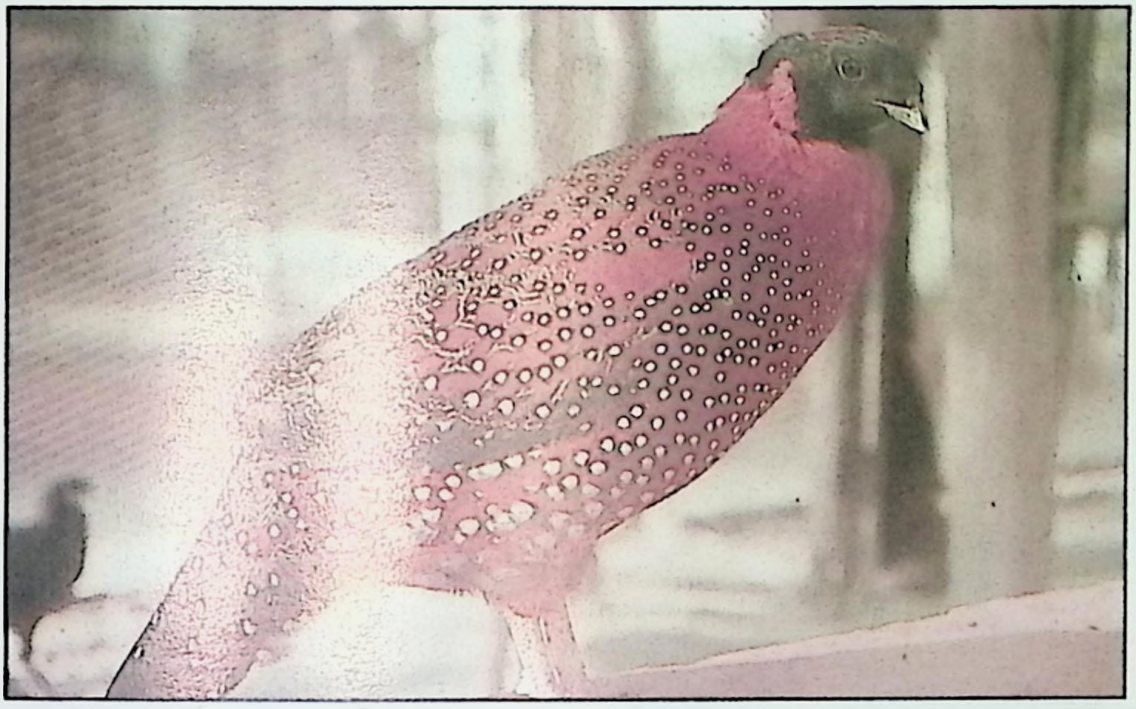
An aviculturist may have only one breeding pair of a particular species and if you buy both a male and female from him, you would be opting for a brother-sister mating. Perhaps one such close mating may be acceptable but for good results this must be avoided. If possible, the male and female that you buy should be from entirely different parentage. If the seller insists on selling both a male and a female as a package deal, then you should buy another pair from another party and mix the two pairs, keeping either both the pairs

or selling off one pair. When you have only one strain ('blood') of a particular species, you are forced to practise close in-breeding and opinion is divided between aviculturists and geneticists as to which mating is less evil—brother and sister, or parent and progeny. Apparently, many geneticists prefer a father-daughter or mother-son mating to a full brother-sister mating.

The other way to get stock is to obtain eggs either from a foreign source or from within the country. For importing eggs, an import licence from the Chief Controller of Imports & Exports, Government of India, is needed, as also a permit from the Department of Environment or the Wildlife Section, Government of India, in the case of eggs of any protected species. This is certainly the cheaper way of adding to your collection but the main problem is that not many aviculturists abroad, or even in India, would be willing to sell eggs. In the case of sources abroad, the reluctance is mostly because of the long, difficult and tedious procedure involved. Also, an aviculturist may be reluctant to sell eggs because there is no knowing which would be fertile and would hatch, and he would therefore be disinclined to expose himself to unmerited criticism. Even so, if fertilised eggs are obtained, they can be hatched though, understandably, the results would not be as good as with fresh eggs which did not have to travel. We have imported eggs from UK and Europe and hatched a fair number of them. Here again, it must be remembered that the eggs obtained from one source of any one species are likely to be from one set of parents and hence the chicks would be siblings.

Since all pheasants breed in spring and summer months, it is very desirable that the pair should be introduced into the pen as early as possible, definitely by November or so. This will enable the birds to settle down in the pen before the breeding season and also allow them to know each other and to form a bond. This will also give you a chance to make sure that the pair is compatible and that they are acceptable to each other. Instances are known where a particular bird was not acceptable as a mate and no breeding took place and when the partner was changed, breeding was immediately initiated.

In case of loss of a bird a replacement has to be found. In such a case, a female is not introduced into a pen with a resident male which may resent its introduction and may injure or kill it. At least in the case of Cheer, even a male when introduced to a pen with a resident female may have to defend itself. Usually, such skirmishes do not result in any serious injury but the birds must remain under close observation for a day or so. In difficult cases, both the male and the



Satyr, male

Temminck's male

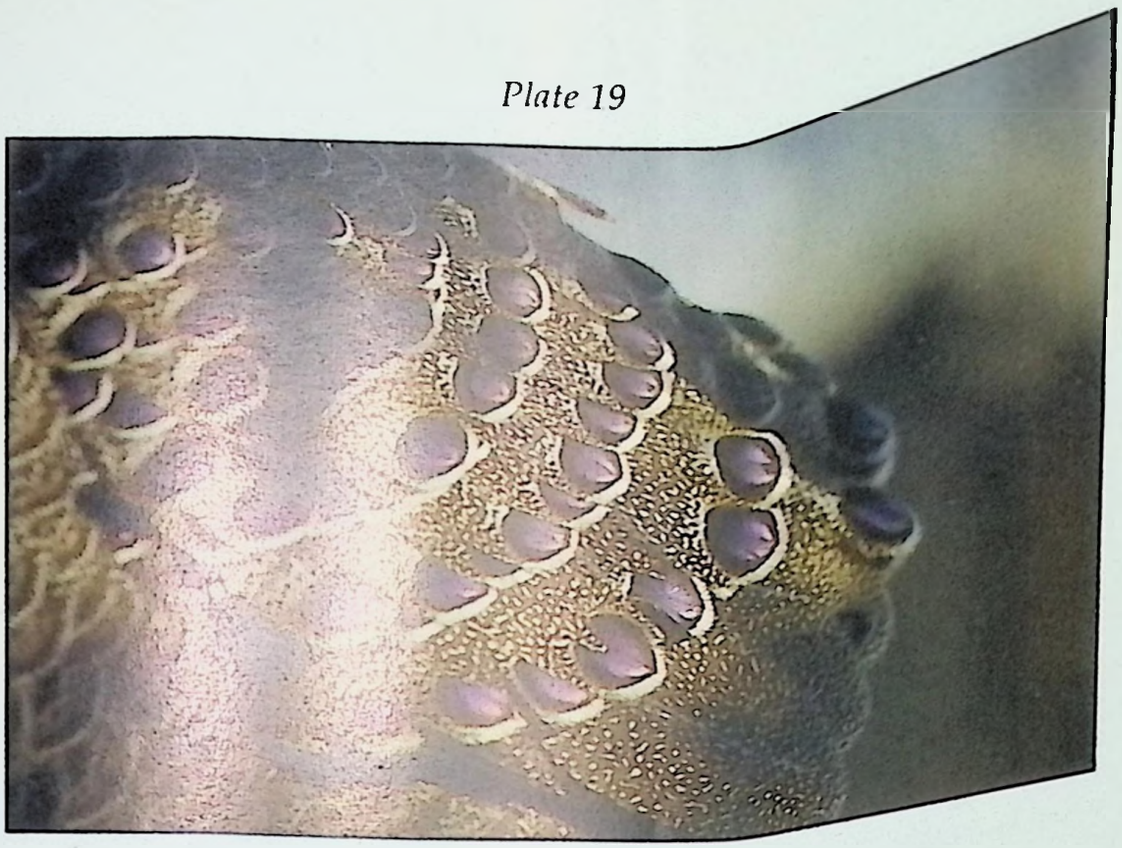
Kaleej, male

Cheer, male

Cheer, male, lateral display

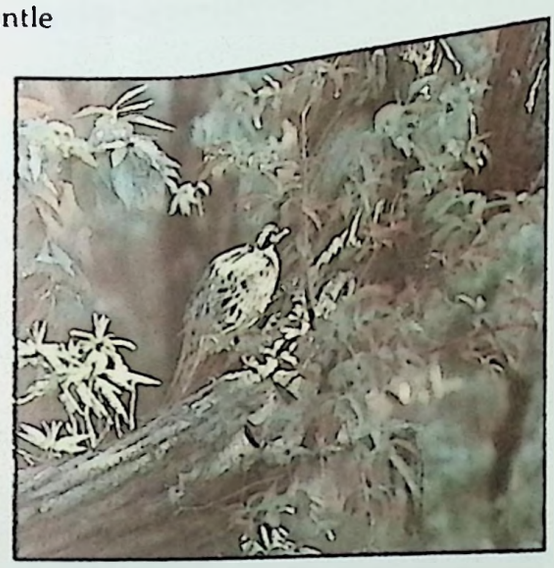
Grey peacock-pheasant, male

Plate 19

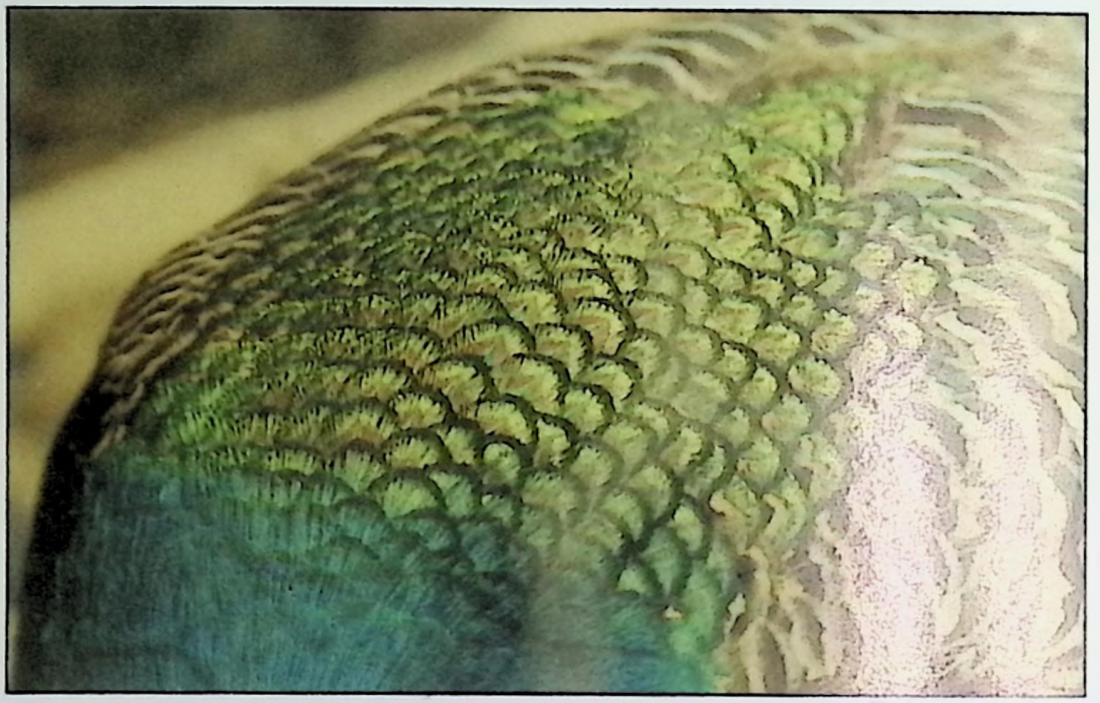


Grey peacock-pheasant, patterns on mantle

Grey peacock-pheasant, male, rectrices



Koklass, male; the only known photo taken in the wild



Peafowl, male, feathers on upper back

Peafowl, male, feathers on lower back

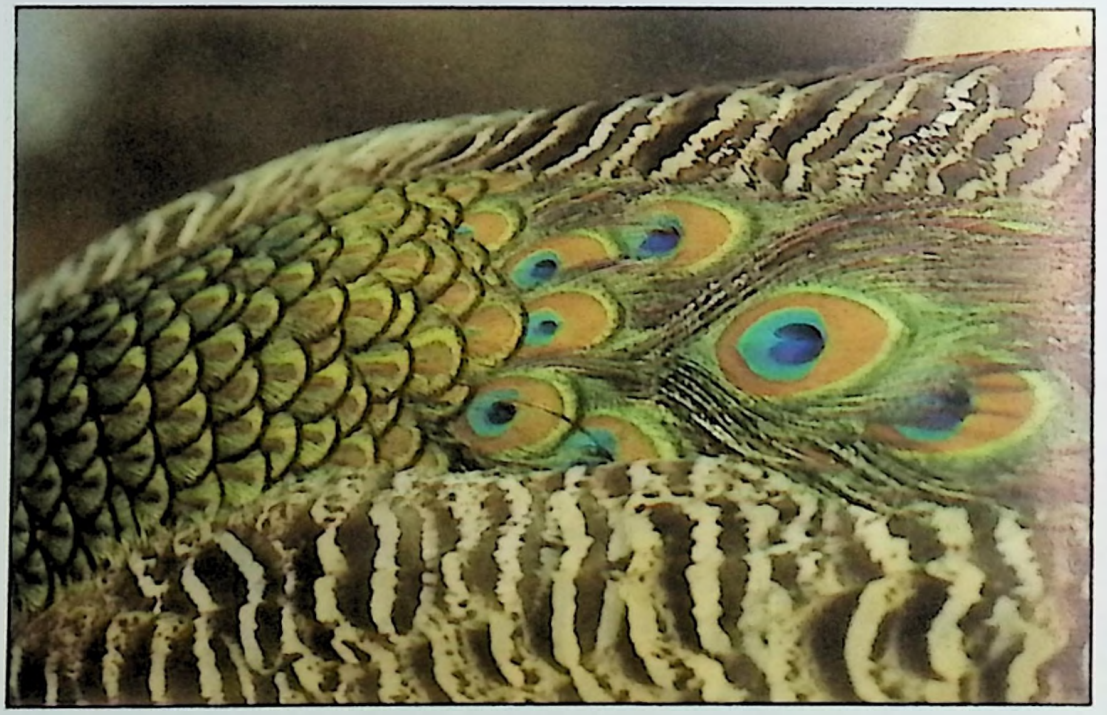
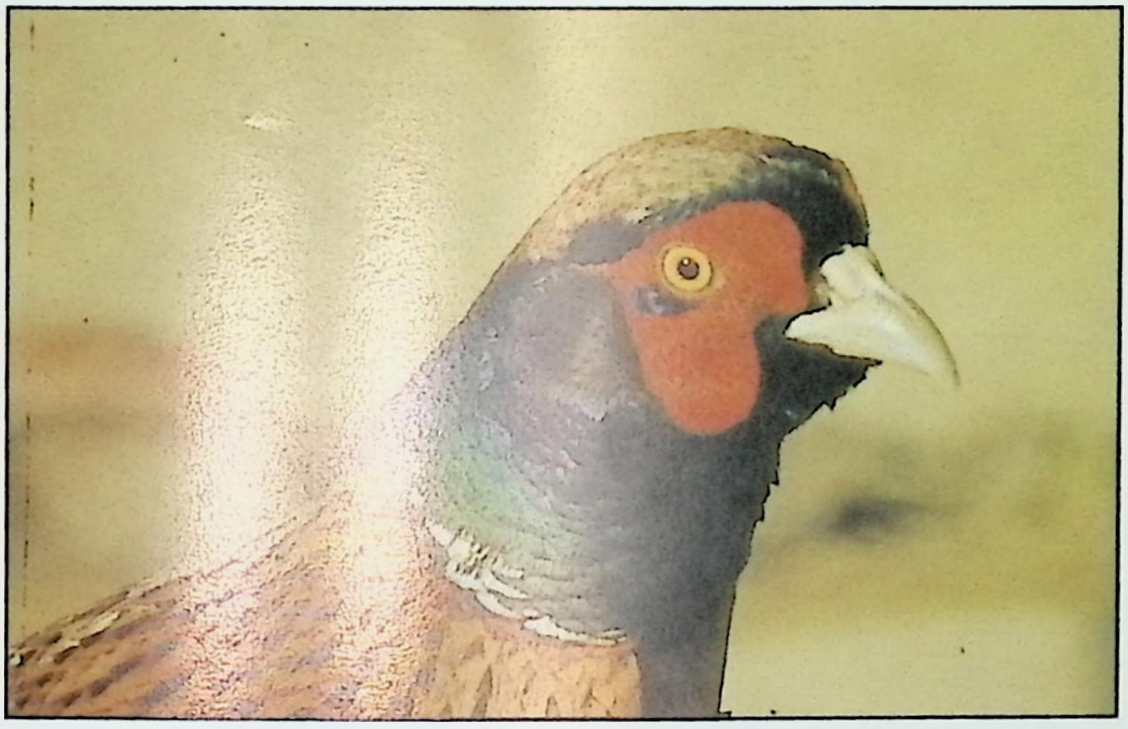


Plate 21



Ringnecked, male

Golden, male

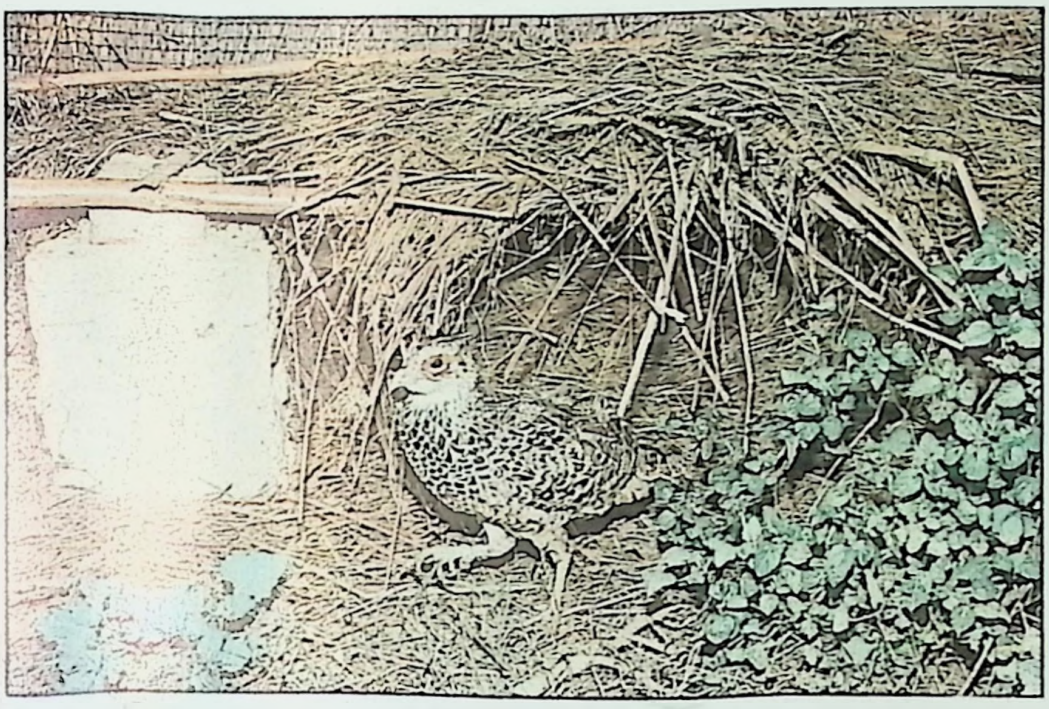
Bornean Crested Fireback—feathers on back

Swinhoe male, frontal display (wing flapp

Swinhoe, male

Authors' aviary in their garden

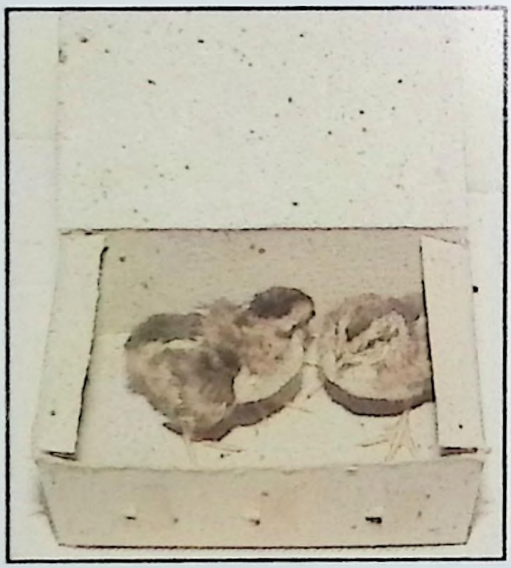
Cheer, female, leaving the nest in the pen



Cheer, female, on nest

Bantam broodies, on eggs

Chicks feeding on live termites



Newly-hatched chicks in cardboard box

Bantam broody with pheasant chicks, feeding on termites

female may be introduced together to a pen which is new to both. The principle is well known and is specially well demonstrated in zoo animals of various kinds where an animal has marked out its territory which will be defended against all intruders, including man.

When a bird is obtained from another source the food to which it is accustomed should be continued initially, for most birds are very conservative about sampling a food which is unknown to them. New foods should be introduced only gradually.

Once the birds have been acquired, which preferably should be poults of the same year, and the purchases made, say in October or November, they should be introduced to the breeding pen. We do not recommend buying adult birds unless their breeding performance is assured, for many a bird is sold for far from altruistic reasons. It is true that a poult is not in full plumage which may be disappointing if the bird is needed for immediate display. Members of many species will be in full colour in 9–10 months and also be ready to breed the first year. Even in those species which normally come into breeding condition in two years, many specimens will be found in colour and ready to breed earlier, probably because in captivity they are raised on a high protein diet and thus they mature earlier.

The pheasants are single-brooded. They will lay one clutch of eggs and incubate them, and the chicks hatched will be brooded by the hen or both parents for several weeks. Thus, if this lot is not totally lost, this will be the only one produced that year. Only in the event of complete loss of eggs, or of chicks soon after their hatching, will the hen lay another clutch. Many aviculturists take advantage of this since, by continually removing eggs as they are laid, the hen is induced to lay a much larger number of eggs than its normal complement. It is, however, desirable that at least one egg, either of the pheasant or of a bantam, is left in the nest as a hint to the hen where we want her to lay more eggs.

Just before the egg laying starts, the hen makes a cup-like depression, either in the soil or in the pile of straw provided. Some hens will make more than one nest, though usually only one will be subsequently used. Most hens will lay eggs in an area which is well sheltered from above but it may not necessarily be in the nest. In case a hen has the habit of laying eggs while sitting on a perch, all perches should be removed.

Most pheasant species will start breeding in March or April and we have observed that the season in Northern India (Lucknow, Izatnagar, Mukteswar) starts about the same time as in UK. A particular species will start laying eggs on a particular date, year after year, the variation being no more than 2–3 days on either side. On the face of it, this may appear rather strange because of the great difference in temperature but the onset of breeding is decided by the length of daylight and not by temperature. Also, the intensity of light is not as important as the ratio between periods of light and darkness in each 24-hour cycle. Light stimulates the pituitary gland which then secretes the three hormones—thyrotrophin, gonadotrophin and adrenotrophin—which are responsible for an accelerated metabolic rate and reproduction. This is one factor which can be suitably manipulated to either advance or retard the onset of the breeding season.

Though we have not carried out any controlled experiments, we feel that due to great heat in late April and May in the plains, many more infertile eggs are produced. It is a well-known fact that extremes of temperature decrease libido in most animals. A study of domestic chicken has shown that the volume of ejaculate in males at 17°C and the proportion of live sperms it contains (92.23 per cent) is higher than in males maintained at about 32°C; the volume of ejaculate in the latter case being much smaller and the proportion of live sperms in it dropping to 36.68 per cent. This may be the reason for poor fertility in pheasants reared in the plains in India. It would be worth trying to see if the breeding can be started earlier in the plains by giving the birds more light hours every day by switching on an electric light, say from the beginning of February (see also under Elective Breeding).

An alternative source to captive-bred stock is wild-caught birds, and if you are lucky enough to get a permit for trapping a few birds from the wild, then it is certainly the best stock for breeding. Here again, you can trap either adult or near adult birds, or collect eggs from a nest. In the case of birds, these should be trapped well before the beginning of the breeding season and any time between November and January would be fine. However, trapping is a specialised job and a professional trapper will do it best. The trapper must be firmly and very clearly told that absolutely no injury should be caused to the birds, more so because injured wild birds are difficult to treat. Once trapped, the birds should be lodged in a pen which has a roof made of either nylon netting or sacking, for these birds are

easily panicked when they are likely to shoot up (*rocketing* is the word) and hit the roof with their heads. This usually leads to a scalped bird which may die within a few days. Another precaution that can be taken is to cut away all the flight feathers (primaries) of one wing only. In this condition the bird cannot fly much and will use its legs to get around. The flight feathers will grow back at the next moult.

It is always preferable to keep newly caught birds in a comparatively small pen whose roof would be easier to make safe, and this pen should be well planted with small shrubs where the birds can hide and feel safe. Alternatively, a small screen made out of grasses or reeds may be used. Also, when approaching such pens, the caretaker should move slowly while whistling softly to give warning to the birds which will move away without panicking. It is usually when somebody comes up to them suddenly, or they feel cornered that the birds panic. If the skin on the head is broken, it must be stitched properly and the wound treated, otherwise the head will remain bald.

When freshly trapped, birds should be placed in their travelling basket, one bird to a compartment which is only big enough for the bird to be able to stand up and move a few steps. The side as well as the roof should be of sacking except for one side which can be of wood with a small door for putting in food and water. If the entire box is made of wood or any other hard material, the inside of the box, or at least the roof, must be covered with foam rubber. The box should be kept in a quiet corner, away from direct sun, and nothing should be done to disturb the bird unnecessarily.

Getting a wild-caught bird to start eating food provided by man is sometimes a problem since most birds are notorious for refusing all foods to which they are not accustomed. In the beginning some green leaves, grains, berries, and live food, if available, should be offered. A newly caught bird should never be released in a big pen till it has got somewhat used to captivity and has started feeding. If released in a big pen prematurely it will spend almost all its time trying to find a way to escape. It very soon gets exhausted due to starvation and high expenditure of energy.

By choice, only young birds hatched a few months earlier should be trapped. Such birds can be distinguished by not having full colours and by being smaller. In males, the size of the spurs is a good indicator of age.

Another way to get wild stock is to collect the eggs from the wild. This is certainly the best way since a hen pheasant that has been

robbed of its clutch will lay another and you would not be depleting the wild stock. This method has only one drawback: that you need to spend a considerable amount of time in the forest trying to locate a nest which is usually well hidden, either under a bush or at the base of a large tree. The hen is a close sitter and will not flush unless almost stepped upon. A local man or a well trained dog, like a labrador or one of the retrievers, would be very useful in locating a nest. The dog must remain under the full control of the handler and should not be allowed to range far and wide lest it destroys some eggs.

Once the nest with the eggs has been located, make sure whether the full clutch (clutch size for each species is known) has been laid or not, and whether the hen has been sitting on the eggs and incubating. If the eggs have been regularly incubated, which a hen will do only when the clutch is complete, they will feel warm when touched with the back of the hand and that would mean that the development of the embryo has already started. If the eggs feel cool, then the eggs have not been incubated. In the latter case the eggs can be removed and a few eggs of domestic chicken can be left in their place to induce the hen to keep on laying, though the substitution is essential only in the case of removal of eggs from an incomplete clutch. Every day the nest should be visited quietly and any fresh eggs laid removed. The hen pheasant cannot distinguish her own eggs from those of domestic chicken in spite of differences in size, colour and markings. In fact, the hens of most species have such a strong instinct to incubate that they will happily sit over a piece of rounded stone, many times bigger than its own egg. Once the required number of eggs has been collected, remove the chicken eggs and leave the nest alone so that the hen can get along with its job.

If the eggs have not been incubated in the wild, they can be just stored till they can be set. Partly incubated eggs need very different handling since, at no time, should they be allowed to get chilled. It is therefore necessary to carry a steady and broody bantam in a basket to the site of the nest, and as soon as the eggs of the pheasant are collected they must be placed under the brooding hen. It will be obvious that a broody bantam cannot be transported long distances and therefore your base has to be near the breeding sites of the pheasants. If the eggs have not been incubated, they can be stored for up to seven to ten days and transported long distances before they are set.

Once again a word of caution: before the birds are imported, or bought within the country, or trapped, or the eggs collected, you

must contact the Chief Wildlife Warden of your state and/or the Department of Environment or Wildlife Section, Government of India, for the necessary permits and licences. As a conservationist, you should not encourage illegal trade.

We believe portable cases which will maintain the right temperature using a thermostat and current supplied by dry batteries are available. We have not used these but if such a case can be devised which will accommodate even a dozen eggs it would be very useful in transporting partly incubated eggs from the field to the base. Alternatively, the eggs can be packed in a thermos flask partly filled with wheat grains heated to the right temperature.

Once the chicks have grown into poults, say 8–10 weeks of age, they are put on a maintenance ration which is continued during the winter and early spring. If the winter is severe the birds should be given more grains, specially wheat, which will put some fat on to the birds. However, one has to be careful that the birds do not put on too much fat for that would result in indifferent breeding performance. It has been truly said that in captivity no pheasant has died due to starvation but many have died due to being overfed, specially with high energy foods containing much carbohydrate, fats, oils, etc. Accordingly, during early spring the diet is changed from maintenance to breeder ration and the wheat and other grains drastically reduced or altogether withdrawn except for what forms part of the ration. Some aviculturists do not appreciate that in the wild a bird spends at least 10 to 12 hours every day either searching for food or avoiding predators, or looking for a mate. In captivity we provide them with food that they finish within a few minutes and there are no predators to avoid, or mates to look for, and thus they get very little exercise.

ARTIFICIAL INSEMINATION

Though artificial insemination has long been used extensively in many farm animals, including domestic chicken and turkey, it is of comparatively recent introduction in pheasants. Many aviculturists have experienced a comparatively large number of infertile eggs due to one of several reasons. In some species (specially the Copper Pheasant of Japan), the male is so aggressive that it may seriously injure the female or even kill it, sometimes after having mated with it. This necessitated the use of unusually large breeding pens which had to be heavily planted. In others like the Eared Pheasants there is

a behaviour problem resulting in high infertility. In a few species the number of individuals is so small that almost every fertilised egg counts. It has been the experience of aviculturists that artificial insemination greatly increases the percentage of fertilised eggs.

This method also allows the maximum use of the limited amount of good semen that may be available due to shortage of males in breeding condition and in good semen production. Also, it is not necessary for the male and female to be compatible, i.e., a bonded pair is no longer essential. It also happens that sometimes a male has a defective leg and is no longer able to tread the female satisfactorily, and fortuitously, such a male is usually a good donor. The procedure, can, of course, be used for hybridisation if there are some compelling reasons. It must, however, be borne in mind that artificial insemination is possible only when the male is able to produce an adequate quantity of good quality semen and the female is producing ova.

It is very desirable that the male and female that are to be used for artificial insemination are separated from each other well before the onset of the breeding season and are given the breeder diet to bring them into top breeding condition. For natural mating the birds are housed in as big a pen as is available but a small pen is preferable for birds meant to be used for artificial insemination. The birds have to be caught very frequently to carry out the procedure and a big pen means so much more chasing before the birds are caught. This stress results in very poor semen production. Also, a small pen allows the birds to get used to having a man at close quarters without getting into a panic. If there are several individuals of each sex of a particular species, then it is preferable to have a series of small pens so that the males and females are in vocal and visual contact with each other. In addition to other factors like proper nutrition and increase in light period, the stimulation between the sexes is necessary to bring individuals of both the sexes to breeding condition simultaneously. Normally, a male should be in good semen production at least a week before the first egg is laid. This is nature's way of ensuring fertilised eggs.

It is preferable to wait for the first egg to be laid before artificial insemination is carried out just to make sure that precious semen is not wasted. Also, the artificial insemination should be carried out as soon as possible after the hen has laid an egg to make sure that the passage of the oviduct is clear and not blocked by a descending egg. Most hens will lay an egg either early in the morning or late in the evening, usually at one- or two-day intervals. Thus, the schedule for artificial insemination can be anticipated.

The bird, specially the male, should get used to the person who is going to catch and handle it during the semen collection and it is very important that the handler should not cause unnecessary stress either because of rough handling or because he looks strange to the bird. Semen collection is easier if the feathers near the cloaca are trimmed. Once the male is caught it should be gently cradled and the back of the saddle gently massaged towards the tail. Many handlers prefer to handle the male a few times to 'train' it to produce the semen later when wanted. One person can hold the male with one hand and evert the phallus with the other while a second person collects the semen with the help of a small capillary tube or a modified syringe. Good semen should look milky but sometimes only a little clear fluid which is only lymph is produced, or the semen is contaminated with faeces. Such semen is to be rejected. Some males would be found to be better donors than others and if a male has produced about 0.1 ml of semen, it should be considered satisfactory.

Once the semen has been collected, the female should be promptly caught and inseminated as quickly as possible. The vent of the hen is everted by applying a little pressure around it and the semen introduced using the same pipette that was used for collecting it. Normally, the ejaculate from one male is used to inseminate one hen but if necessary it can be diluted with five times its volume of Ringer's solution and two hens can be inseminated.

The problem of artificially inseminating a female without causing injury has been solved by Lai (1985) by the use of a specially designed retractor for opening the cloacal vent and exposing the ostium.

It is usual to inseminate each hen once a week though some investigators have reported that fertilised eggs are produced for a longer period of time.

It must be borne in mind that our knowledge of artificial insemination in pheasants is still very inadequate and a lot of work has still to be done before we can hope to achieve as good results as are routinely achieved with turkey and domestic chicken.

Many workers use a micropipette or a glass straw for collection the semen and insemination. Howe & Howe (1981) have described the modified equipment that they have used with great success. All investigators who have used this method have reported a much higher percentage of fertile eggs than were obtained using the normal procedure and therefore this procedure is much to be recommended when it is necessary to obtain an increased supply of fertile eggs.

Chapter 6

Elective Breeding

People learn something everyday, and a lot of time it's that what you learnt the day before was wrong.

—B.V.

The normal breeding season for all gallinaceous species is early spring to summer and the physiological and biological functions of their bodies are well adapted to this. In the case of middle- and high-altitude species of the Himalaya, this schedule works well in the temperate climates but in the plains of Northern India, the season is certainly not suitable since, during this period, the ambient temperature is so high that both the breeding birds and the chicks are subjected to great heat stress and its logical sequelae. It is amazing, but nevertheless true, that a species will keep to its schedule of breeding season unless it has artificially been cycled for a change. Thus, Cheer's breeding season in the wild is said to be late April to early June and captive birds in UK and in the plains in Northern India start laying by about 20 April. This is because the breeding season is dependent upon the stimulation of the sex organs by increasing hours of daylight following a period of longer hours of darkness during the winter months. It is, thus, theoretically possible to manipulate the period of greater light (stimulatory light) alternating with less light (non-stimulatory light) to have the birds breed during any part of the year irrespective of ambient temperature.

That this approach is not only possible but practicable has been shown by work on quails, partridges and Ring-necked Pheasants. All that is necessary is to have the birds under eight hours of light and 16 hours of darkness (under three lux of intensity) for 12 weeks and then to reverse this pattern, i.e., to have the birds under eight hours of darkness and 16 hours of light (10–50 lux of intensity). About three weeks subsequent to the change in light schedule the hens will start laying, which phase will last for about 16 weeks. At the end of this laying period the birds are subjected once again to longer non-stimulatory periods, i.e., 16 hours of darkness and eight hours of light.

To ensure that the male is sufficiently sexually stimulated to produce enough semen for good fertility, it should be exposed to a

stimulatory period of light two weeks in advance of the female. In one experiment it was observed that the number of eggs produced by birds whose laying season coincided with the onset of spring was slightly higher than the others which started laying in July.

Once the 16 weeks of laying are over and the birds have been rested through the non-stimulatory period of 12 weeks, they can again be switched over to the stimulatory period and a second cycle of breeding will ensue. During the second cycle the egg production is slightly less than during the first cycle. Woodard, Abplanalp & Wilson (1970) induced Chukar Partridge (*Alectoris graeca chukar*) to lay eggs in four 10-week periods alternating with 6-week periods of rest during a span of 71 weeks. Woodard & Snyder (1978), working with the Ring-necked Pheasant (*Phasianus colchicus torquatus*), got, on an average, 87.3 and 69.8 eggs per hen, in the two groups. Hayes & Hayes (1987) have used this method very successfully.

The cycling of breeding cannot be utilised only for the production of a larger number of eggs but, using two groups, the eggs and chicks can be had almost throughout the year. This method is likely to be of very great use in the successful breeding of pheasants in the plains of India since the birds can be held under the non-stimulatory period during the hottest months of the year, say May, June and July. However, the problem of designing a suitable house which will not allow much light to reach the birds without overheating them will have to be solved.

It seems to us that, unless elaborate arrangements can be made for housing, it would be better to have only one cycle per year. In such a case the schedule can be thus: non-stimulatory period: 10 July to 10 October; stimulatory period for male: 10 October to 24 February; pairing: 1 November; laying expected, 14 November till 8 March; hatching to start at the beginning of December lasting up to the end of March. With this schedule the breeding would be at lower temperatures (which in the plains of Northern India are not too low) which is very desirable since it has been shown for turkey and domestic chicken that the best results are obtained at 10°C. Obviously, the approach needs a fair trial and may need adjustment.

Dr Allen Woodard (personal communication, 1983) has said that he failed to get fertile eggs from Golden Pheasants during winter months, probably due to low temperatures. In pheasants, the hen responds to increased light in 2.5 weeks or more and the male in four weeks or more but the response to decreased light is the same in both the sexes, viz., two weeks. He very kindly suggested a schedule for

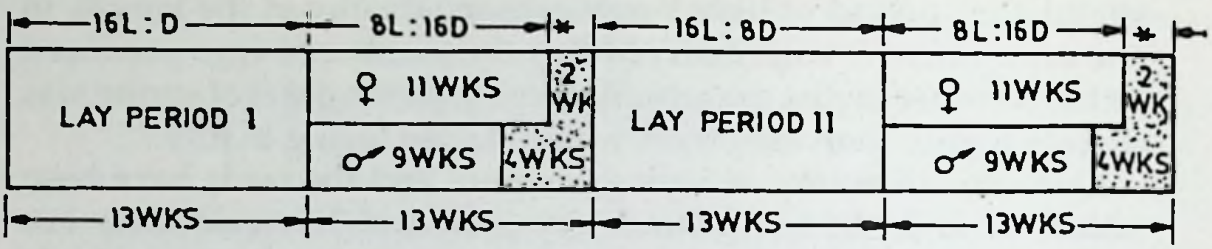


Fig. 8: Plan for programming for elective breeding.

pheasants and partridges which is represented diagrammatically here (Fig. 8).

Lux is a unit of illumination equal to a luminous flux of one lumen per square metre and one lux is equivalent to 0.0929 foot-candle. You can use the exposure meter of your camera to determine the level of illumination (light) by using the table given below:

Lux ca.	*Candles/sq. ft.* (approx)	*Exposure value* (approx)	*Reading*
2.8	0.26	6	f2, 1/15 sec
11	1	8	f2, 1/60 sec
44	4	10	f2, 1/250 sec

The film rating on the meter is set at 200 ASA.

Chapter 7

Incubation

> Opinions should be formed with great caution—and changed with greater.
>
> —JOSH BILLINGS

Incubation is the term used to describe the process of applying heat to an egg so that the embryo contained within develops into a chick. In nature, in the very large majority of birds, this is done by the hen, or both the parents sitting on the eggs alternately and thus transferring their body heat to the eggs. By choice, eggs can be incubated artificially in an incubator. Thus, we have two major methods of incubation which are possible because the chicks of Galliformes are not only nidifugous but self-feeders. This means that soon after the chicks are hatched and get dried, they are able to walk around and start feeding on their own.

The aviculturist has three options regarding the incubation of eggs and the procedure accordingly differs somewhat in each case. Each option has some advantages and some disadvantages as compared to the other two. The options are: (*i*) incubation and hatching by the hen pheasant, (*ii*) incubation and hatching by a broody domestic hen, and (*iii*) incubation and hatching by artificial means. Many aviculturists combine two of these options. If either a domestic hen or an incubator is to be used the eggs from the pen have to be removed regularly and promptly and then stored properly till they are set.

There is no denying that a freshly laid egg which has not been stored for any length of time before being set gives the best results. In fact, some aviculturists (notably C. Sivelle) as also ourselves make it a point to set an egg for incubation within five hours of its being laid. However, for all practical purposes an egg can be stored under the right conditions for up to one week without an appreciable loss of hatchability (Fig. 9). For proper storage the eggs should preferably be set on sand with the narrow end down in a box which should be placed in a cool, damp room, ideally at a temperature of 10–15°C (50–60°F) (Fig. 10). The relative humidity is also important for eggshell is porous and the only way that an egg can maintain temperature is by losing water. If too much water has been lost, the

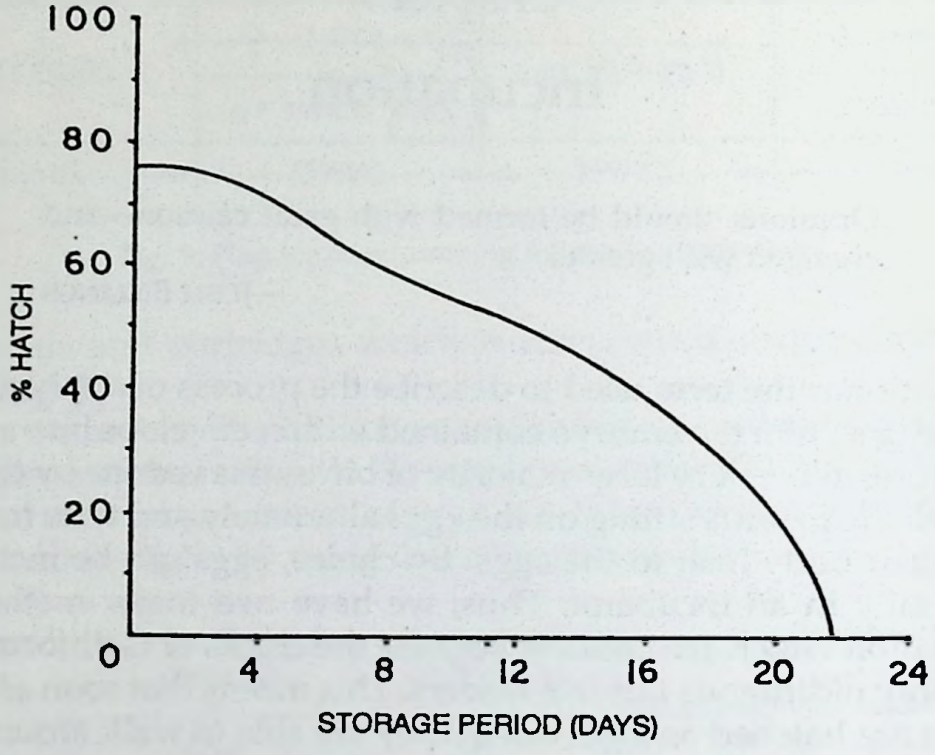


Fig. 9: Hatchability of eggs stored under ideal conditions.

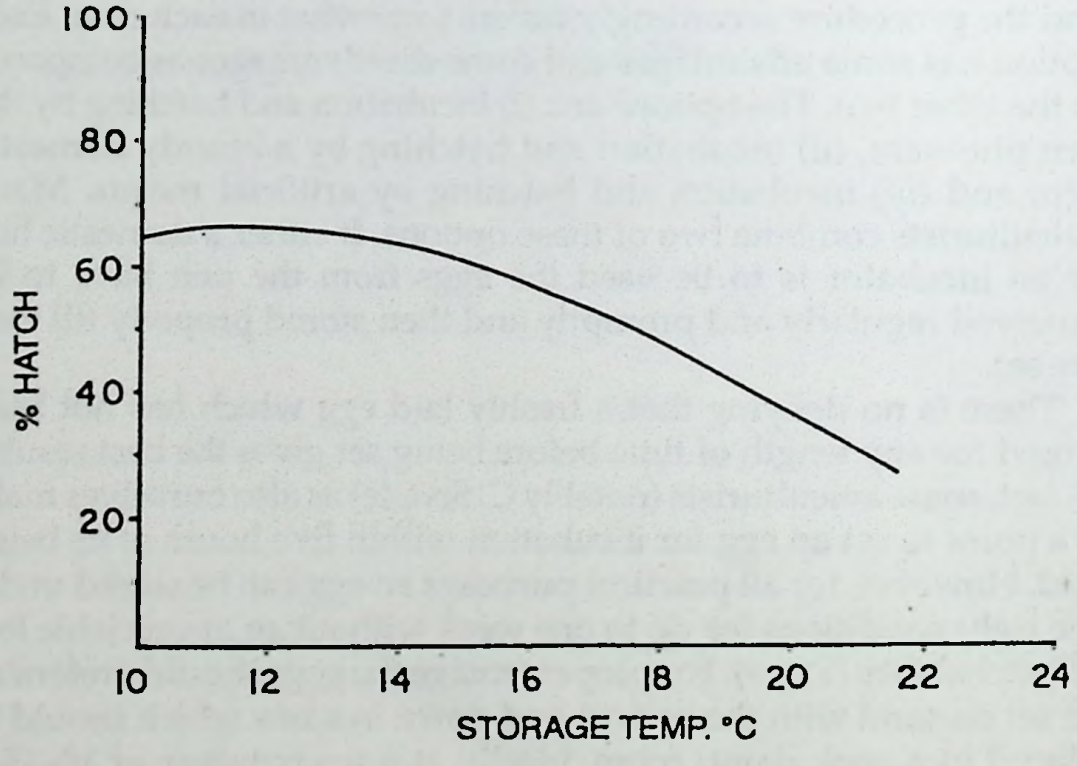


Fig. 10: The effect of storage temperature on pheasant egg hatchability. Eggs stored for one week.

hatchability will certainly be reduced and many of the eggs will fail to hatch. At 10–15°C, the ideal level of humidity around the eggs is 75–85 per cent R.H. Once the temperature of an egg is raised to 21°C (about 70°F), development of the embryo starts, but at this temperature development is very slow, and if this rate is maintained for some time, the embryo soon dies.

It has been shown that if eggs have been stored under ideal conditions of temperature and humidity for up to one week, there is no advantage in turning the eggs. However, if the temperature is higher than the ideal, or the eggs have to be stored for longer than a week, it is certainly desirable that they be turned once or twice every day. Traditionally, eggs are stored with the pointed end down but they can also be stored with the pointed end up, or even on their sides. After all, in nature eggs are stored on their sides.

On the egg itself, you can either put down just the serial number (and the details in a diary), preferably on the broad or the pointed end, with a soft pencil or a felt pen with indelible ink, or you can give additional information like the species of the pheasant, date laid, and, later, when set and when due to hatch, on the egg itself. On the side put a ↑ mark with an arrow pointing in one direction and on the opposite side a mark with the arrow pointing in the reverse direction thus ↓. This will guide you in turning the egg in the correct sequence during storage. Eggs should never be turned in the same direction a second (and subsequent) time, i.e., if you have turned an egg clockwise once, then it should be turned anticlockwise the next time and so on. The arrow will tell you in which direction the egg is to be turned.

In India the ambient temperature in the plains is so high that an egg should never be left in the pen for any length of time. We, as a routine, collect eggs two or three times a day. Most hens will lay on alternate days and thus the arrival of the egg can be anticipated. Though most hens will lay in the nest, or at any rate at the same place every day, some eggs will be laid just about anywhere in the pen, though usually in some protected place. If the egg is left for some time in an exposed place with the direct rays of the sun on it, it may literally be cooked. If an egg of a bantam is left in the nest, the hen is likely to lay in the same place.

Some hens develop the habit of laying while sitting on a perch, thus smashing the egg on the floor. In such cases, the perch must be removed and replaced by a platform, preferably with a raised

periphery, covered with dried grass or straw. Some birds have a habit of eating their own eggs. If ipecac syrup, a well-known emetic, is coated on the eggs, the bird will soon give up this bad habit.

For good hatching results, it is necessary to obtain, store and set the eggs under proper hygienic conditions. The breeding season in India, both in the plains and the hills, is comparatively dry, which means fewer pathogens like viruses, bacteria and fungi are likely to grow in the pens. Most hens will keep their nest clean, but if it gets soiled with faeces, the nest lining should be replaced. Once in a while an egg may be found which has come in contact with faeces, either while being laid or in the nest. If the faeces are still partly wet, they should be wiped off (taking care not to spread them on the shell) with a piece of cotton wool or clean cloth. The small amount of faeces still attached to the shell, should be removed with the help of a piece of fine sand-paper. Wetted cloth or cotton wool should never be used since wetness of the shell helps pathogens to penetrate it. If the egg shows any traces of dew or moisture, it should be wiped dry with a piece of cloth, using a fresh wad for each egg. It is a good practice to store and set contaminated or dirty eggs separately to avoid spreading the pathogens to clean eggs.

A number of liquids have been recommended for washing eggs like hot water, detergents, disinfectants, sanitants, antibiotic solutions, etc., but we have never had to use them. These have generally been developed for use with domestic chicken and turkey and methods of their use are described in all standard poultry husbandry books.

The vapours of formaldehyde can be used to sterilise the shell either before storage or after one or two weeks of incubation, if the latter is found necessary. For sterilisation prior to storage, place the eggs in any container which can be made airtight. Then take a glass or earthenware (or pottery) vessel and put in 0.84 g of potassium permanganate crystals *first*, then gently add 1.35 ml of formalin, and close the container for 30 minutes at room temperature. These amounts of chemicals are sufficient to produce vapours for a container with a volume of 0.028 m^3 (one cubic foot). The release of vapour is accompanied by much bubbling and heat and the vessel should therefore have a capacity 8–10 times the volume of the chemicals that will go into it. After the sterilisation is completed, the container should be opened in a room with good ventilation and a table fan used to quickly disperse the formalin vapours which, incidentally, are very irritating to skin, nose, lungs and eyes, causing much lachrymation.

If the eggs have been incubated for one or two weeks, then use 0.5 ml of formalin and 0.2 g of potassium permanganate for every 0.028 m^3 (one cubic foot) of space in the incubator. Needless to say, formalin sterilisation midway is practicable only when the eggs are in an incubator or in a closed container.

Ultraviolet lamps can also be used to sterilise eggshell. A word of warning—U.V. light can seriously damage eyes, even causing total blindness and, therefore, all proper precautions should be taken.

The ideal storage temperature can be had only by using a special piece of equipment like a Biochemical Oxygen Demand (B.O.D.) incubator which is much used in laboratories. In the hills, any room away from direct sun rays would be suitable but in the plains the ambient temperature would be too high. If nothing else is available then the eggs can be stored in the bottom compartment of a domestic refrigerator, taking care that the eggshells are not moistened by vapour condensation.

If eggs have to be stored for long, best results are obtained if the stored eggs are gently warmed up to 26.6°C (80°F) for a few minutes every day and turned. This is quite understandable since this is what happens in nature. A hen pheasant living in the hills (as most of them do) will certainly take more than a week to lay her full clutch, perhaps laying an egg every alternate day. This means that, by the time the last egg is laid, the first laid egg may be anything up to 12–14 days old. Every day the hen is said to sit on the eggs for a while and to turn the eggs and this continues till the clutch is complete and the hen starts incubating tightly. Since the mechanics of incubation have been perfected over millions of years, we cannot go wrong in just duplicating them.

Once the eggs have been stored for some days at a lower temperature it is advisable that they should be left at room temperature for some time before setting them either in an incubator or under a broody bantam. Similarly, if the eggs have travelled (e.g., as in the case of imports), they should be rested on their sides for 12–24 hours. For some reason, not well understood, stored eggs hatch better under a broody than in an incubator.

As mentioned earlier, there are three options open for the incubation and hatching of eggs and we shall examine each for its merits and demerits under Indian conditions, both in the plains and in the hills.

The hen pheasant can be left with the job of incubation and hatching the eggs, and subsequently brooding them also. Most hens

will do a very satisfactory job since their instincts for these processes have not yet been erased due to domestication as has happened in many poultry breeds and Japanese Quail. The main advantage is that you do not have to worry about the correct temperature and relative humidity, turning of the eggs and preservation of the instincts in the succeeding generations. Also, there is less contact with man and hence the chances of being adversely imprinted are reduced. The chicks are called to food by the hen and they start feeding without any problems. The preservation of the instincts including those related to breeding and the natural fear of and vigilance against man are factors which may be of importance if the progeny are to be released in the wild subsequently.

And now to the disadvantages. Firstly, in view of the high ambient temperatures in late April and May in the plains, we have our doubts whether it would be wise to leave eggs in outdoor pens for so many days, albeit in the shade, before the clutch is complete and the hen starts sitting closely. We have never left the eggs in the pens in the plains but in the hills (Mukteswar), working with Cheer, we got very good results. Secondly, only a limited number of eggs from each hen are obtained, for once the clutch is complete, she will stop laying and start incubating. The incubation period is so long that it is probable that a second clutch will not be laid even if the chicks are removed soon after hatching. Occasionally a hen may foul the eggs with her faeces or may not turn all the eggs properly, and/or crush some eggs or newly hatched chicks. The eggs can, of course, be removed two or three days prior to hatching and placed in an artificial hatcher. In such a case, the hen will perhaps lay a few more eggs but we have no experience of this.

One year when we had set some eggs under bantam broodies in an outdoor pen, two or three pipped eggs were invaded by a large number of small red ants. Evidently, the chicks had taken a longer time than usual to hatch and the ants were attracted by the smell of blood, and these chicks were lost. Since it is not advisable to use any insecticide, the eggs should be removed to a hatcher. Perhaps our experience was an exceptional one and need not preclude us from hatching eggs in outdoor pens.

The second alternative is to remove all the eggs as they are laid, store them for a while, and set them under bantam broodies. Considering the local conditions, this is the best method and the method of choice with us. Having said so, let us examine the various implications of this method, which are more or less the same both for the

hills and the plains. Firstly, this method allows you to get many more eggs than contained in a normal pheasant clutch and this is a distinct advantage. The eggs can be hatched by the bantam, or removed two or three days before they are due to hatch to an electric hatcher. Bantams are good foster mothers, taking good care of the pheasant chicks, leading them to food and brooding them under their wings or breast in cold weather. Unfortunately, there are some disadvantages also.

A good number of hens have to be maintained throughout the year to ensure having a sufficient number of broodies when needed. This naturally requires more space for housing them, a higher feed bill and more hired labour to feed and water them. In exchange, they will give enough eggs to pay for themselves and incubate and hatch pheasant eggs as a bonus.

Some aviculturists object to the use of bantam broodies mainly due to the possibility of their transmitting diseases to the pheasant chicks. This is not a very valid objection, since with a little care, a small flock free from diseases can be maintained. All birds should be vaccinated against Ranikhet disease virus (Newcastle disease virus), Marek's disease virus, and fowl pox, and given a course of antibiotics as a routine in February and again in early April. The birds should be dusted with an insecticide once every three months, particularly in March and April to kill all the ectoparasites, specially lice. We prefer 5 per cent Sevin dust which is safe and effective. Similarly, the birds should be given anthelmintic drugs periodically, specially against nematode parasites of the alimentary canal and the cestodes. All the normal precautions of preventing the introduction of disease in the poultry pen should be taken, which preferably should be some distance away from the pheasant pens.

Only some of the hens in a flock would be sitting on eggs at any one time, and of these only those broodies which are steady and have a strong brooding instinct should be given pheasant eggs. When such a bird is approached, she will partly rise in the nest, fluff out her feathers to look bigger, and will try to, or actually peck at your hand. She is the one to be trusted with the pheasant eggs, and should get good care for she is very valuable to an aviculturist. A plastic or metal ring can be placed on the leg of a good broody for identification and for receiving good care.

Among the many breeds of bantam, Silkie is generally considered to be the best for our purpose becaue of its good and gentle nature, and its strong instinct for broodiness starting at an early age. Most

people, however, prefer to cross the Silkie with other breeds which will bring about certain changes in the nature of feathers, lessening of feathers on the legs and a slight increase in body weight. The size of the hen will determine how many eggs she will be able to cover, and, accordingly, for eggs of larger pheasants like Monal, Koklass, Eared, and even Silver, some larger breeds like Rhode Island Red, Wyandotte and Plymouth can be used. Admittedly, the larger the broody, the more eggs she can cover but at the same time the chances of breaking eggs, or crushing a newly hatched chick are also increased. It is far better to give fewer eggs to a smaller broody than a few more to a larger one. A small broody should be given only 3–5 large eggs so that she is able to turn the eggs properly.

As far as possible, a broody should be given eggs of a single species of pheasant to hatch each time. If they are of mixed species they should be similar in size. This will allow all the eggs to be turned adequately and the body of the broody will be in actual contact with each egg. When placing eggs of two or more species under a single broody, the difference in the incubation periods of various species has also to be borne in mind as a broody hen is inclined to abandon the nest soon after the first batch of chicks have hatched. Hence the eggs of a mixed batch should be set on different days, species by species, so that all of them hatch almost simultaneously, and certainly within 12–18 hours of each other. For example, Golden Pheasant eggs hatch in 22 days, those of Reeves's in 25, and Hume's in 27. (They are all of almost the same size.) So, the eggs of Hume's Pheasant are set first, those of Reeves's two days later, and finally those of Golden after another three days, to ensure that almost all of them hatch simultaneously and the rest soon after.

The bantam hens should be sitting on their own eggs before the pheasants are due to start laying, and this will give you an opportunity to judge how good and steady each bantam broody is. The person who has been looking after the broodies should gently lift each broody from the nest, take away her eggs with the other hand and gently replace these with the pheasant eggs. While holding the pheasant eggs, the palm of the hand should be face downwards since some broodies have the habit of pecking at the hand and the eggs. Depending upon the steadiness of the broody, the eggs can be replaced at any time of the day, but it is best done either first thing in the morning, so that an eye can be kept on the broody during the first day of incubation, or late in the evening, when the hen has a tendency to keep still even if she is not brooding.

It is extremely desirable that records are kept regularly and as completely as possible so that the performance of the pheasants and the bantam broodies, as well as management practices can be checked. For egg production, incubation and hatching, we use reference cards where all the information goes like this on one side.

Egg No. 293		*Species:* Cheer *Origin:* IZN Pen No. 7 B.O.D. Inc.
Laid: 28/4		*Stored:* 28/4
Set: 3/5	*Broody No:* 36;	*Due:* 29/5
First Candling: 10/5 Good;		*Second Candling:* 17/5 Good
To Hatcher: 27/5;	*Pipped:* 29/5;	*Hatched:* 29/5–Quick
Applied Betadine while still wet		

On the reverse side goes the information regarding the chick, the serial number of which remains the same as that of the egg from which it hatched.

It is of some importance that the place where the broodies are housed is selected with care, keeping in mind the weather at the station during the season. In the hills, the broodies will need protection against cold winds at night and occasional showers. In the plains, they will need protection against hot sun, hot wind and wind- and rain-storms. Accordingly, both in the hills and the plains, we prefer to keep the broodies in a small room or a well-protected shed which does not admit too much light. The broodies prefer a semi-darkened and quiet area, free from not only human activity and predators but also from vermin, specially mongoose, rat and musk shrew. The room should be such that it does not allow these animals to enter through pipes, drainage holes and such openings. It is necessary to fix a strip of galvanised iron at the bottom of the door to prevent mice and rats from gnawing away the wood and gaining entry.

The nature of the floor is of some importance since it will to some extent decide the level of humidity inside the room. If it is a turf or dirt floor, it will be easy to keep it slightly dampened to maintain enough humidity. If it is of brickwork or cemented then either a tub of water or frequent sprinkling of water will keep the humidity up

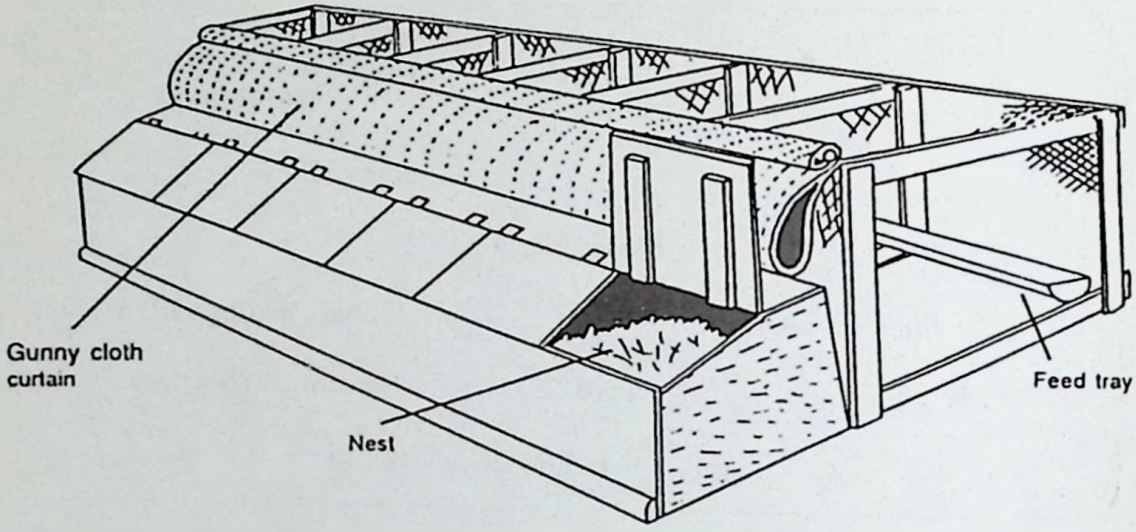


Fig. 11: Plan for a coop for brooding hens with a run containing feed at the back.

if, for most of the time the door and window(s) are kept closed, and opened only occasionally to allow for ventilation. A wet-and-dry-bulb thermometer hanging on the wall, about 45 cm above the floor, will indicate when more humidity is needed.

The broody will have to be provided with a nest and this can be done in two ways. It could be a traditional nest box made of wood and wire mesh, which may be placed directly on the floor or off it (Fig. 11). For most broodies, a cube, each side being 35–40 cm, is adequate. In any case, the box should be big enough to accommodate a nest with a broody sitting in it comfortably and to allow it to turn around. The base should be covered with turf or sand or light soil in which a cup-like depression is made and lined with either dried grass or straw. In colder climates it is the practice to shut in the broody in the box and to lift it out once each day for 10–15 minutes to allow it to feed, to drink water and to defecate in the run. It will then go back to the nest on its own or may have to be gently guided back to it. Alternatively, a sliding door may be provided in each nest box which can be pulled up so that the broody can go to the run on its own. Each nest box could have its own run or several boxes can open to common ground where the broodies can be allowed in

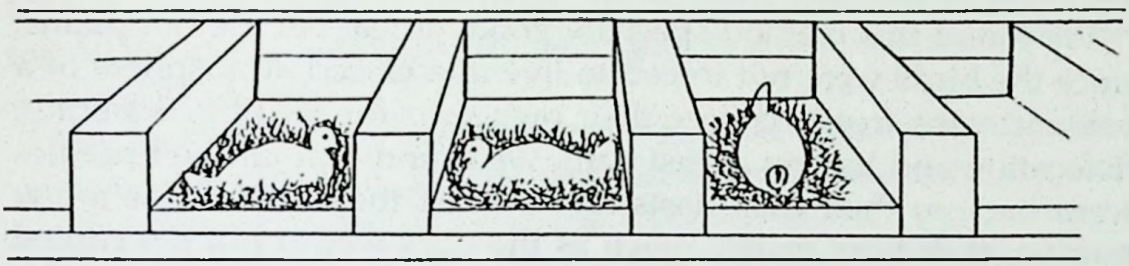


Fig. 12: Plan for a series of nests for broodies.

singly, by turn, or all together. The run should have some dry soil or sand for the broodies to have a dust bath.

Whichever method is adopted, it involves a considerable amount of work feeding, watering, cleaning the run and so on, including supervising the return of the broodies, each to her own nest. We have tried a number of nest boxes in a room and a run common to all the broodies, in which food, water, and a sandpit were placed. Even so, the operation required quite a lot of time and hence we have now slightly modified the system.

In rooms measuring 3 × 3 × 2.4 m high, the nesting areas were made by placing loose bricks so that there were rows of nesting sites along the three sides (leaving the door side free), each nesting site measuring 24 × 24 cm on the inside and being open both on the top and the front (Fig. 12). In each nesting site light garden soil was placed about 8–10 cm deep, shaped into a small depression and then lined with dry grass or straw to give it a rounded shape. The central area of the room was covered with rice husk and food and water were placed at one side and a sandpit was made in another. In December, into each room were introduced eight or nine bantam hens and a cock bird, and this became their permanent home. In due course, each hen laid eggs in its own nest and was allowed to incubate and hatch them. By about the end of March and the beginning of April, we had a fairly good idea as to which broody was a good sitter. By the beginning of April, the bantams were not allowed to hatch any of their own eggs, which were taken away and hatched in an electric hatcher/incubator and unfertilised eggs of domestic chicken were given to them. When the pheasant eggs were available, the chicken eggs were removed and the pheasant eggs set in their place. At this time any hens that were not sitting on eggs and the cock bird were removed to another room.

We found this method specially good, at least in the hot plains, since the birds were not forced to live in a closed atmosphere of a box and were free to choose their own time for feeding, watering, defecation and having a dust bath. We found that all the broodies went back to their own nests and even if they dallied for a few minutes it did not matter much as the eggs would not get chilled because of the high ambient temperature. There was no conflict or breaking of eggs and the eggs were not soiled with faeces. It also meant that a man could service each room in about 15 minutes or so, and thus the system was very economical. While the broodies were incubating they were given maintenance feed as well as some crushed maize and wheat grains.

Some aviculturists believe that a good broody will show much better results than an electric incubator, specially with eggs that have been stored for some time. It is also said that the first 7–10 days are critical and it is during this stage that the broody does better than an incubator. Accordingly, if enough broodies are not available, pheasant eggs from under a broody are removed after 10 days of incubation, transferred to an incubator and the broody given a fresh lot of eggs to incubate. However, some aviculturists will have nothing to do with a broody maintaining that risk of disease cannot always be eliminated. One would think that with today's technological advances and the range of electric gadgets available, it should not be difficult to design an incubator which will always give better results than a broody. After all, the critical factors that a broody can control and provide are heat, humidity, mechanical turning and lysozyme, the last working as an antibiotic. Even so, many of us do prefer a good broody at least for incubation though not necessarily for hatching and subsequent brooding of the chicks.

The third option of incubation is through the use of an incubator. There are several types available. The heat may be provided by a kerosene burner, or a gas burner or electricity and today since electric mains are available almost everywhere, it is more common in use mainly because of convenience of operation and more precise regulation of both temperature and humidity. There is at least one model available in UK which uses a six volt battery for heating. The incubator can be either of the still-air type or may have forced air circulation, the latter being preferable since a small fan works continuously and keeps the air circulating throughout the cabinet, resulting in more uniform temperature. However, in such a machine the eggs lose more water and hence a higher humidity has to be

maintained. Incubators usually have a fan that revolves at a very high speed and hence a regulator should be fitted. The body of the incubator may be of wood or metal but in either case it should be well insulated.

The level of humidity inside the cabinet can be maintained automatically by the use of a humidistat which controls a valve regulating the flow of water over a coarse cloth screen, or by providing a vessel with water. In either case, a wet-and-dry-bulb thermometer is placed inside the cabinet which will help monitor the level of humidity. The humidistat will have a calibrated scale but the humidity must be checked regularly with the help of a wet-and-dry-bulb thermometer. The humidity can be regulated manually quite easily with a tray of water. If the tray is tilted to one side, the surface of water exposed is reduced and hence less water evaporates and the humidity level is lowered. When the tray is kept flat the maximum amount of water evaporates under the existing conditions of surface area exposed, temperature, and water vapour pressure. We have used a much simpler method with success. Small petri dishes, about 50 mm in diameter and 18 mm in depth are filled with water and the desired level of humidity is maintained by the number of such dishes kept inside the cabinet. Once the number of dishes required is determined by trial, all that is required is to keep the dishes topped up with water. As a routine the level of humidity is checked several times a day but without opening the door of the incubator. For ready reference a small card giving the wet-bulb readings for different levels of relative humidity at approximately 38°C (100°F) is fixed near the observation window of the thermometer. These readings are:

R.H.	50%	60%	80%	100%
Wet-bulb temp.	29°C 84°F	31°C 88°F	34°C 93°F	38°C 100°F

The above-mentioned figures are approximate for Izatnagar and Lucknow but slight variations will not make any material difference.

Pheasant eggs need more frequent turnings than domestic chicken eggs. In nature, the hen pheasant is said to turn her eggs once every 25–30 minutes. Most incubators provided with an automatic turning device will turn the eggs once every hour. However, for all practical purposes, turning the eggs three times a day is enough as the embryo

takes about eight hours to travel from one side to the other when the egg is turned and it is quite practicable to do this manually, either turning each egg individually or, better still, by tilting the egg tray itself through 90° each time. Most incubators will have a handle outside the cabinet by turning which the tray can be tilted through 45° from the vertical in either direction. Alternatively, a block of wood is placed under the tray at one end to tilt the tray and when the block is shifted on the other end all the eggs are turned without being handled. We normally turn the eggs five or seven times every day using a handle provided on the outside of the cabinet. It is important that the eggs are not left on the same side two nights running and hence the eggs must always be turned an odd number of times each day. Of course, when the number of turnings exceeds, say, 12 times, the odd or even turnings do not matter.

When the egg trays are turned by hand, it is necessary to paste a piece of paper at one side with UP EVEN and on the other UP ODD to serve as a reminder for the last turning at night. The EVEN and ODD refer to the respective dates.

One word of caution. Small incubators with a capacity of 300–400 eggs are likely to be provided with a turning device which is so rough as to either kill the embryos or to bring about very serious malformations. The first year that we used such an incubator we lost many embryos before we realised what was going wrong. We then started turning the egg trays by hand, using the handle on the outside. It is unnecessary to have an automatic turning device for which one has to pay so much with the added risk of rough turning.

The one most important factor that makes for success or failure in incubation is temperature control. Several types of thermostat are incorporated in incubators, but mostly they are either of the capsule type or the solid state switch called triac. It is most necessary that the thermostat should be as sensitive as possible and can be relied upon to give satisfactory service. The capsule type, unfortunately, does not meet the strict demands of a good incubator for it is at best no more sensitive than $\pm$ 1°C and very often does not work properly. It is, therefore, always better to have an electronic device (solid state) which is very sensitive. The ideal temperature setting for pheasant eggs is 37.5°C (99.0°F) and many incubators (at least in UK and USA) will have a thermoregulatory device sensitive to $\pm$ 0.25°F. The more sensitive the device, the better would be the results. In India, big incubators are easily available which work well enough for domestic chicken eggs but small incubators, say with a capacity of 300 eggs,

which are accurate enough for the more demanding pheasant eggs are just not available. Some firms may agree to modify an incubator to specifications, and of these, a reliable and sensitive thermoregulatory device is the most important. The rest of the physical conditions are not so critical and to a very large extent can be controlled without much difficulty. The control switch which regulates the temperature should be so mounted that is cannot be disturbed accidentally and the switch itself should be so sensitive that it has to be turned in a positive way before the thermostat setting is changed.

Most thermostats will have a device to warn both for a very low or high temperature, either through a warning light or a bell, sometimes both. But in either case an operator has to be near the machine to rectify the situation. Since pheasant embryos are very sensitive to a variation of temperature of more than +0.5°C (+1°F), it is extremely useful to have an additional thermostat in the circuit which can override the faulting first thermostat and cut off the heater positively at 38.3°C (101°F). Any temperatures above this level are speedily fatal to pheasant embryos which may become apparent only much later. A second thermostat which can cut off the faulting main thermostat would cost a little more money but it would certainly be worth it.

Another factor that may affect the maintenance of correct temperature is proper and steady voltage of the mains supply and very low and very high voltages will affect both capsule type and electronic thermostats. This may seem incredible at first (as it did to us) since one would expect that the thermostat would cut off or restore electric current only when a particular temperature level is reached. Not so. If a variable resistance (rheostat) is introduced between the mains supply and the incubator, by varying the resistance you can switch off and on the heater without there being any change in temperature of the cabinet. Unfortunately, in India the voltage fluctuation can be very great (we have measured anything from 100 to 300 volts) and, therefore, all sensitive electrical appliances have to be used with a voltage stabiliser. The ordinary domestic voltage stabiliser is sensitive to about 10 per cent and this is not good enough. It is therefore desirable that a servo type of stabiliser which is sensitive to 0.5 or 1 per cent is used. Such pieces are available in India but are quite expensive. Which type of stabiliser you use will depend upon the stability of the voltage in your area.

At present we are using a Marsh Roll-X Automatic Incubator with highly satisfactory results. This is a portable table-top model with a very sensitive thermostat (which is not affected by voltage fluctuation) and a very smooth turning device. It has a capacity for about 75 pheasant eggs. (Unfortunately, is has to be imported from USA or UK.) When the ambient temperature nears 29°C, the heat produced by the fan is likely to push up the temperature inside the incubator above 38°C. A fan regulator connected with the incubator fan and set at speed I solved the problem.

One other problem that we have to take into account, both in the hills and the plains, is the disruption of electric supply. If you are incubating and hatching eggs of several species of pheasants, the incubator and hatcher would be operating from, say, the middle of April (or even earlier) up to the end of July when the ambient temperature is very high, being 43–44°C (100.4–111.2°F) or even higher in the shade. Thus, in the plains a disruption of electric supply for some minutes would not matter if you do not open the door of the incubator. During the breeding season disruptions are very frequent due to heavy demand, tripping, rostering and wind-storms and thunderstorms. Since the temperature of the incubator should not be allowed to fall below 36.5°C even for a short period of time, it is almost impossible to incubate and hatch eggs without recourse to a standby generator.

Till a few years ago, only medium-sized generators running on diesel were available and these were priced too high for an aviculturist. Fortunately, now a portable standby generator is available in India which can operate on petrol, diesel or kerosene. This too is somewhat expensive but, considering the cost of pheasants in India, the investment is worthwhile, more so as without it you cannot expect to hatch even 10 per cent of the eggs.

Many aviculturists abroad use an electric incubator exclusively for incubating and hatching since, with their advanced technology they have things under better control than we do. There is no doubt that an electric incubator will not break an egg, nor trample a chick and that control of disease is very much easier with its use than in the case of broody incubation. But our experience is that, for a country like India, it is better to trust broodies to incubate eggs which are then hatched in an electric hatcher. For a hatcher, the temperature is not so very critical and exacting. Also, for the purchase of a small incubator with manual turning, a voltage stabiliser and a portable standby generator, an aviculturist will need to invest approximately

Rs 25,000. Thus, from the purely economic point of view, the broody is much to be preferred, both in the plains and in the hills.

The incubator should be placed in a room which is well protected against the direct rays of the sun and does not show much fluctuation of temperature. This would be no problem in the hills but in the plains the room has to be selected with due care. It should have good ventilation but should be protected against hot and dry winds, and the ambient temperature should not rise over 28°C. In the plains the relative humidity is likely to be very low and it may be necessary to raise it. A desert cooler during the day will not only raise the humidity but will also lower the ambient temperature. A khas-khas screen would also work very well. As a last resort, some water can be sprinkled on the floor and a table or ceiling fan switched on.

It must be borne in mind that in the plains, the ambient temperature even in the shade (say in a veranda) can be several degrees higher than the incubation temperature suitable for the eggs but inside a room whose walls do not get direct sun at any part of the day, the temperature is marginally lower. Every time the incubator is opened, there is a slight drop in the temperature as well as humidity. When the door is closed again the temperature is soon regained but it takes much longer for the humidity to be made up. Fortunately, the eggs can both lose and gain water depending upon the level of humidity in the incubator and can make adjustments within limits. Therefore, an incubator should be opened only when necessary and for the shortest time possible.

In addition to factors like temperature, humidity and the turning of eggs discussed above, there are some factors of lesser importance, like the extent of ventilation, carbon dioxide pressure, number and age of eggs, etc. which also have a bearing on incubation. If the incubator has been made by a company of repute and experience, all that is needed is to follow the instructions closely. A copy of these should be placed near the incubator for ready reference.

Most incubators will give best results if they are carrying their full capacity of eggs. If the number of eggs is less than two-thirds of the capacity, ventilation should be slightly reduced within the incubator so as to maintain carbon dioxide concentration.

Incubators can also be used as hatchers. Normally, the fresh eggs are placed in the top tray and when more eggs are set, the top tray is shifted down and fresh eggs go in the top tray and so on. The eggs meant for hatching are placed in a tray on the floor. Though the combined incubator-hatcher machines work reasonably well, it is

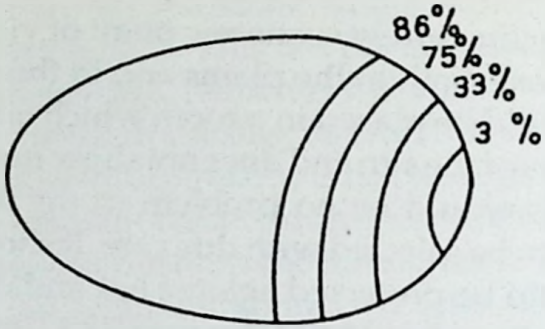


Fig. 13: Development of the air cell (after Anderson Brown).

certainly advantageous to have a separate hatcher since the temperature and humidity requirements are slightly different for hatching.

The progress of the development of the embryo can be determined by candling, the term having been coined when a candle was used as a source of light. If an egg is held against light, the developing embryo, with its blood vessels and the air cell at the broader end are seen. The examination becomes easier if a small light-box, made of either wood or metal carrying a 40–60 watt electric bulb and a small window appropriate to the size of the egg is used in a semi-darkened room. The bulb should be 30–40 mm away from the shell of the egg. The egg is placed on the window (which may carry a collar of foam rubber glued to the box) and the light switched on. The blood vessels can be seen as thin red lines after about 72 hours of incubation, though the egg is usually candled after seven days. The egg is gently but swiftly rotated along its long axis when the embryo appearing as a dark shadow should be seen to rotate. If it does not, then the embryo is sticking to one side of the eggshell due to improper turning. All infertile eggs would appear clear and should be removed from the incubator, as also eggs with cracked shells. A second candling is done a week later when eggs with dead embryos are removed.

The size of the air cell at the broader end is a reasonably good index of the development of the embryo as also for any change required in the level of humidity (Fig. 13). If the air cell is too large for the stage of development, the level of humidity should be raised and if the cell is too small, the humidity should be lowered. Many more chicks are drowned in the early stages due to very high humidity than are lost due to very low humidity. As stated before, the egg is capable of adjusting to high or low levels of humidity

within certain limits and this is done by losing or gaining more water as found necessary.

If no electricity is available a small electric torch can be used. Experienced men can hold an egg in the palm of their hand, enclose it with forefinger and thumb and look at it against a lightened window and be able to check the growth.

If it is difficult to observe the details inside an egg using a 40 or 60 watt bulb, do not use a more powerful bulb which would give off too much heat and may damage the developing embryo. A tube of cardboard or stiff paper about 22 cm long and 2 cm in diameter makes the examination of the egg easier as it cuts out extraneous light in a moderately lighted room.

A more precise method of monitoring the development of the embryo is by weighing the egg. As the development proceeds the egg loses weight and the minimum, maximum and average weight loss at different periods of development are as mentioned below:

Incubation time		25%	50%	75%	100%
Loss in weight (approx.)	Min.	1%	4%	7%	10%
	Av.	3%	6%	9%	12.5%
	Max.	5%	8%	11%	14.5%

Any egg that loses weight below the minimum or above the maximum is not likely to hatch (Fig. 14). Admittedly, this method involves more work but if many eggs of the same species have been set at the same time, a few representative eggs can be weighed. At various stages, too much weight would indicate too much water still in the egg due to a high level of humidity and vice versa. In such a case the necessary correction in the level of humidity should be made so that the developing embryo can make the adjustment. Of course, this is possible only within certain limits, beyond which the readjustment would be beyond the capacity of the egg.

For the eggs of most species of pheasants, 50–60 per cent relative humidity inside the incubator would be all right. Some aviculturists, however, prefer to have a slightly lower humidity at the beginning and at the end of the incubation period and a slightly higher level during the middle stage.

However, candling is more an art than a science and much can be learnt from experience.

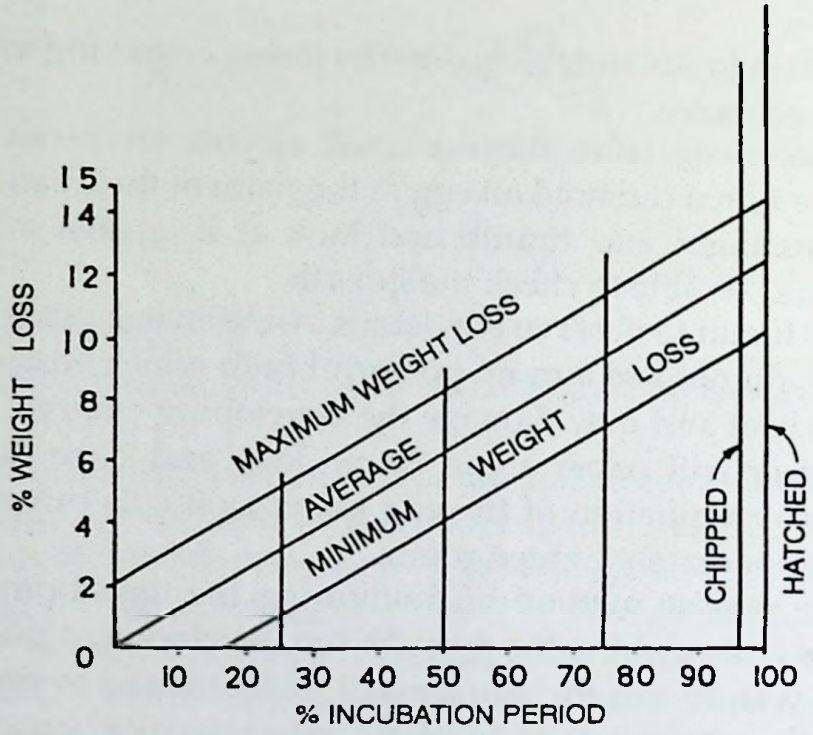


Fig. 14: Weight loss in eggs during incubation (after Anderson Brown).

For greater details about incubation and hatching Anderson Brown (1979) may be consulted.

The incubation period (in days) for various species of pheasants is given here, as reported in the literature. Often, variation would be found and hence the time given here should be taken only as a guide.

THE INCUBATION PERIOD (DAYS) FOR EGGS OF VARIOUS SPECIES OF PHEASANTS

Argus 25
Blood 28–29
Blue Eared 26–28
Blyth's Tragopan 27–28
Bornean Crested Fireback 24–25
Brown Eared 26–28
Bulwer's Wattled 25
Cabot's Tragopan 27–28
Ceylon Junglefowl 18
Cheer 26–28
Chinese Monal 27–28
Congo Peacock 28
Copper 24–25
Edward's 21–25
Elliot's 24–25
Germain's 20–22
Golden 22–24
Green Junglefowl 21
Grey Junglefowl 21–22
Grey Peacock-Pheasant 21–22
Himalayan Monal 27–28
Hume's 27
Imperial 25
Kaleej 23–27
Koklass 26–27 (? 21–22)
Lady Amherst's 22–24
Malay Crestless 24–25
Malay Peacock-Pheasant 20–22
Mikado 26–28
Palawan Peacock-Pheasant 18
Peafowl 28
Red Junglefowl 19–21
Reeves's 24–25
Ring-necked 24–25
Rothschild's Peacock-Pheasant 20–22
Salvadori's 22
Satyr Tragopan 27–28
Sclater's Monal ? 27–28
Siamese Fireback 24–25
Silver 25–27
Swinhoe's 24–26
Temminck's Tragopan 27–28
Western Tragopan 27–28
White Eared 24

Chapter 8

Hatching and Rearing

A hen is only an egg's way of making another egg.
—SAMUEL BUTLER

Keith Howman (1979) has said, 'The hatching stage is the moment of truth—and always an exciting one.' We fully agree with this apophthegm. Though over the years we have hatched many eggs of many species, even now we do not tire of just watching a chick bravely coming out into a strange world, full of all kinds of hazards, leaving the safe haven behind.

Hatching can be carried out naturally under a hen pheasant or a bantam broody, or artificially in an electric incubator-hatcher or a hatcher. The most natural way to hatch eggs is under a hen pheasant when there would be no problems of imprinting. With a bantam broody the process is similar. In both cases, there is some chance that a newly hatched chick may be crushed by a heavy and clumsy brooding hen. For obvious reasons, the chances of a foster parent doing it are greater if it happens to be much heavier than the natural parent. Accordingly, it is only prudent to select a bantam broody which is about the same size as the natural parent. As has been mentioned before, there is some chance of a chick getting infected, either directly from the broody or from the nest and the environment. It is difficult to ensure the same level of sanitation and duplicate almost aseptic conditions that can be achieved in an electric incubator. If you do not mind losing a chick occasionally, and specially if you do not have either a good hatcher or the time, then natural hatching is the thing for you. Not only will a broody hatch a good number of eggs, but she will keep the chicks warm and lead them to food and also encourage them to eat it. The chicks of some species, specially those of Peacock-Pheasants, are rather difficult to initiate into eating since in nature the hen will not only call the chicks to food, but will actually pick up an insect in her beak and offer it to the chick which will accept it.

Some aviculturists will hatch the chicks under a hen but remove them after about 24 hours to rear them artificially. We do not see much merit in this procedure since by then all the attendant risks have already been taken. Also, if this is done, the bantam will go off

broodiness and it is very doubtful if she will accept and incubate another set of eggs. So, if the eggs have been hatched under a broody, the chicks may as well be left with her for two to three weeks, unless there are some compelling reasons for removing the chicks. With this system the broody will share the food meant for the chicks.

The second alternative is to hatch the eggs in an incubator-hatcher combined or, still better, in a hatcher. The eggs that have been incubated by a hen pheasant, or a bantam broody, can be removed two or three days before they are due to hatch and placed in a hatcher.

The majority of incubators have forced air circulation and, during the incubation period, the relative humidity is maintained between 50 per cent and 60 per cent. Both these conditions are not very conducive to good hatching and a problem arises when some eggs need the optimum conditions for hatching. Under such conditions, the eggs which are due to hatch within the next two or three days are placed in the hatching tray on the floor and the incubator run for incubating conditions. Some aviculturists prefer to lower the temperature for eggs due to hatch but this is not possible with a combined incubator-hatcher which has forced air circulation. Even so, we have achieved a reasonably good hatch in an incubator-hatcher unit. One point to remember in this context is that so long as a pipped egg is in the hatching tray the door of the incubator should not be opened. Once the egg has pipped, the membranes of the egg are exposed to air and the classical stand is that, at this stage, the pipped egg requires 90–100 per cent relative humidity. This is the main reason why a separate still-air hatcher is preferred by some. It is generally held that once the membranes are exposed to comparatively dry air, they become so tough that the chick is unable to break them and emerge. In fact, some aviculturists add so much humidity to the hatcher that water droplets can be seen running down the glass door. Only when all the chicks have hatched is the hatcher opened and the chicks allowed to dry out in a much drier atmosphere.

Once an egg has pipped the chick may leave the shell within a few minutes or it may take as long as 12–24 hours to do so. It is not clear why one chick should take such a long time while another takes a mere five minutes for the same job. There is a great temptation for an aviculturist to lend a helping hand, fearing that, without his immediate aid, the chick will not hatch. We have known some cases where a chick, after pipping and cutting through a considerable portion of the shell, has eventually died. We have, on occasion, successfully helped a chick out by gently removing a part of the shell

and the tough white opaque membrane with a pair of fine forceps. During this manipulation very great care has to be taken not to break any of the blood vessels but only to open a way for the chick to kick its way out of the shell on its own. Under no circumstances should a chick be pulled out of its shell for, if this is done, some blood vessels will surely break and the haemorrhage will in most cases prove fatal. In case a blood vessel breaks, application of Betadine will stanch it.

It is difficult for us to say categorically which is the right procedure—whether to leave a chick to its own devices in the belief that a good healthy chick will need no assistance and that it is imperfect or weak chicks that die after pipping; or to lend nature a helping hand and save at least some of the weaker chicks. We have no hard and fast rule to suggest on this and we adopt the procedure in each case that we think is best in the light of our experience. In this we are mainly guided by the time taken by the chick to emerge and how vigorous are its attempts to leave the egg shell.

Hatching is a messy process. The chick leaves the shell wet and exhausted, trailing some of the membranes and, in rare cases, the eggshell is also dragged along for some distance. The chick should be left in the tray till it has got rid of the membranes. At this stage, a very simple and yet important operation should be carried out. Before the chick dries up, it is picked up by hand (hands must be washed with soap and water and dried first) and a little Betadine applied to the scar of the navel. This will help dry it up and seal the skin against the entry of pathogens. The chick is then replaced in the tray. We prefer to transfer the chick to a small cardboard box, measuring 15 × 10 × 7 cm with two holes, each 15 mm in diameter, cut in the side, and lined with sterile cotton wool. One chick goes into each box but if necessary, a second can also be put in. The chick remains in this box which is placed on the bottom tray of an incubator for 18–24 hours to dry out and for the yolk sac to be absorbed. It is then ready to be transferred to a brooder. However, there is some evidence that, at least in domestic chicken, chicks placed in rearing facilities four hours after hatching gain more weight than those removed after 24 hours.

'Betadine' is the trade name of a microbicidal solution containing 5 per cent solution of povidone-iodine which is active against both gram-positive and gram-negative bacteria, and also against fungi, viruses, protozoa and yeasts. In earlier years we encountered considerable mortality in young chicks due to omphalitis caused by infection of the umbilicus. As an alternative to Betadine, an antibiotic

spray like Terramycin Aerosol Spray—Oxytetracycline (Pfizer) may be used.

We feel that under tropical conditions chicks are very much under heat stress and many of the microorganisms that are normally present in the body, without causing any pathogenicity or morbidity, flare up and cause disease. The chick being small does not have enough body reserves and stamina to stand up to this and, since it goes off feed, it readily succumbs. Therefore, it is extremely important that all precautions are taken to prevent infection, for once a chick shows signs of disease, and by the time a proper diagnosis is made, it is already too late for medication to do any good. There is just not enough time for the medicines to control the infection and save life.

Since we have started treating the scar on the navel we have found that early mortality (up to seven days) has been completely eliminated. It is for this very reason that we prefer to hatch chicks in an incubator, or hatcher, in which we can keep an eye on the process. We have often waited for long in the night for a chick to hatch so that the umbilicus could be treated but, even so, some of the chicks cannot be given this treatment as by the time a check is made in the morning, the chick is already dry and then this treatment is not likely to do any good—unless of course the navel is still open.

Once a batch of chicks has hatched, the incubator or at least the hatching tray, should be sterilised. The tray is first thoroughly wiped with a piece of cloth dampened with Dettol, followed by a scrub with 90 per cent alcohol. The tray is then left in the direct sunlight for a few hours before being replaced in the incubator.

Any aviculturist would be happy to tell you that there are only two ways to rear a chick—his way and the wrong way. While it is a fact that no two experienced aviculturists will adopt precisely the same procedure, there are certain basic requirements which are very essential and should be common to all the methods. These are (*i*) protection against inclement weather and safe living quarters without overcrowding, (*ii*) adequate heat, (*iii*) enough food, and (*iv*) sufficient water. So long as these conditions are met, any changes to suit the local weather conditions and the funds available may be made.

As has been mentioned earlier, there are two basic ways of rearing chicks, either with a hen pheasant (or a bantam hen) or independently of a parent or foster mother. If chicks are to be left with the hen pheasant then it is better to leave them in the outdoor pen in

which the pheasant had laid and hatched the eggs, for it is more than likely that catching the hen pheasant and removing it to a smaller coop will greatly upset her and she may refuse to brood the chicks. The outdoor pen should be checked for any small breaks in the wire mesh, specially near the ground and for the presence or likely entrance of any small predators or vermin. One has to be very careful about rats, mongooses, and snakes which may not harm the adult bird but will almost certainly kill and remove chicks.

A bantam broody may be left in an outdoor pen though she will not mind being moved to a smaller pen or shed along with the chicks. Outdoor pens in the hills will be subject to rainstorms and, occasionally, hailstorms, while in the plains, rainstorms and duststorms can be expected. The area under the shelter should be raised by 15–20 cm by adding more soil, or a pile of pine leaves or hay, so that the broody can go up with the chicks in case of heavy rain which might wet the pen floor thoroughly. Also, it would be prudent in the plains to provide plenty of shade against the hot sun. The broody will provide all the heat needed to the chicks and will lead them to food and encourage them to feed by making the characteristic call. The sides of the utensil containing the food should not be very high though the chicks, within a day or two, will be able to use their wings to flutter in and out of the container. It is with the water vessel that more care has to be taken, for pheasant chicks have a tendency to drown even in very shallow water. The usual procedure is to place stones or round pebbles of suitable size in the container so that the chicks have to deal with very shallow waters. Even so, a chick can get its leg jammed between two pebbles and drown. For the first week the water should nowhere be more than 5 mm deep. Under this system, the food provided for the chicks will be shared by the adult bird.

If a bantam is being used, then it is best placed in a shed or a combined coop and run, which may have also been used for the incubation and the hatching of the eggs. The basic idea is to provide a small box in which the hen is confined and this is separated from a small run by a wire-mesh screen which leaves enough space at the bottom for the chicks to get through without difficulty but not the broody. The food meant for chicks alone can be placed in the run and the chicks after feeding and watering will be called by the broody every once in a while to be brooded. The broody can be given food either in the coop or outside. Such coop and run units can be placed in a room or a shed and must be well protected against inclement

weather and predators. Alternatively, a small run about 1 × 0.5 m can be used to lodge a bantam with the chicks without any partition.

Today, a majority of chicks are raised artificially, away from a pheasant hen or a bantam. This method has certainly many advantages, the main being the greater control over the surroundings of the chicks and the greatly reduced chances of a disease being transmitted. Basically, all that is needed is a box or cage of appropriate size with a heat source. It is rather unexpected, but all the same true, that even in the plains, where the ambient temperature is so high, chicks are attracted to a heat source. This can be either an infra-red lamp or a simple light bulb with an enamelled shade. In either case, the heat source should be suspended over the floor and its height so adjusted that the temperature at floor level at the centre is about 37.3°C (about 100°F), and at the extreme periphery, not much below 35°C (95°F). Between these two extremes there will be a gradient formed and the chicks will stay at the place where the temperature suits them. The food and water are placed a little away from the heat source. The chicks will seek greater warmth when they are resting and sleeping. As the chicks grow, they need less and less artificial heat and the general rule is to lower the temperature by 1°F for each day, though if the chicks have the choice of moving away from heat, the monitoring of reducing heat is not very important.

In earlier years we had used small cages, each about 1.5 × 1 × 1 m with a floor of galvanised iron sheet covered with newspaper, sand, rice husk, etc. Each cage was provided with a lamp at one corner and up to 15 newly hatched chicks were placed in each cage at a time. We did not find such cages satisfactory. Newspaper was too smooth and the young chicks had some difficulty in getting a proper grip on it with their toes. Also, it was not as absorbent as we would have liked to it to be, and the faeces which are rather thin in the early stages anyway, remained as such for a long time. Also, the chicks would put their feet in the drinking water and then wet the surrounding newspaper. Sand or sandy soil too was not satisfactory since the chicks were inclined to ingest the soil along with the feed. It was also rather difficult to remove the faeces and stale food satisfactorily. The rice husk did not allow a good grip and was likely to be mistaken for food or ingested accidentally. Chicks at this stage have a strong tendency towards coprophagy. You can actually see a few chicks expectantly awaiting the moment any chick makes that initial movement that precedes defecation. Coprophagy, which is practised only in the early stages, is probably nature's way of augmenting nitrogen

and the bacterial flora in the intestine of the chick which play an important role in the synthesis of vitamins and breaking down of certain ingested food articles. Unfortunately, this is a mixed blessing for it can greatly help in the spread of diseases.

The rearing of several chicks together has both advantages and disadvantages. The advantages are that a smaller investment is needed for providing brooders with a heat source, less time is required to clean the brooder and to feed and water the chicks and the chicks are not wrongly imprinted. Also, in a group, specially if they are of several species, a few chicks are always more ready to start feeding and thus set an example for the others to follow. There are mainly two disadvantages. There is bound to be some aggressive play which may even result in injury. We have observed that the cere and the legs, specially the toes, are attacked and mostly the victim will not even run away leave alone retaliate. Most such injuries are of a superficial nature and are easily treated by topical application of antibiotic cream or other medications and the affected chicks are best isolated for a few days. On occasion, we have lost a few chicks due to such injuries, and one of the most amazing things that we have seen is the complete removal of the upper mandible in a group of chicks about two weeks old. Many chicks have suffered serious injuries to toes and legs.

We have now come to the conclusion that even though it means a little more investment (which is marginal) and more labour, it is preferable to keep each chick in its own compartment and we have now adopted the procedure described below in some detail.

Each unit of brooder is divided into five compartments, each measuring about 25 × 25 × 25 cm. Each compartment has its own roof which is removable as also are the partitions between the compartments. By removing two or more partitions, compartments can be joined to make a bigger one (Fig. 15). The whole unit stands about 7.5 cm off the floor of the room and, since the base of the compartment is nothing but wire mesh, the faeces and the food drop through it on to a piece of newspaper spread underneath. For the first two days we place one to three chicks in each compartment depending upon the number of chicks and the brooders available. A 12.5 mm wire mesh can be used on all the sides and the top but the bottom and the partitions should preferably be of a finer mesh so that the toes of the chicks do not get caught, which they would in larger sized mesh and the chicks in adjacent compartments cannot peck at each other. Light-weight galvanised iron sheeting is used to make the

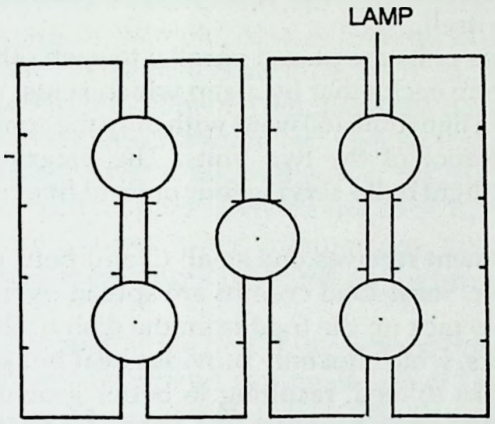


Fig. 15: Four brooder units each with five compartments heated by top lamps. Top view.

joints and the edging. For the first two or three days we prefer to line the floor with a thick, woven, rough cloth (*khadi*) which may be either dark green or dark blue. This type of cloth allows the chicks to get a good purchase with their toes, prevents cooler air from coming into contact with their bellies when they are resting, allows the chicks to see the food due to good colour contrast, and absorbs the faeces and water. The cloth is changed once a day.

If all the compartments are occupied, they have to be serviced with the chicks inside them. However, if one compartment is left vacant at one end, its partition is removed and the chick shifted without handling it and the compartment serviced before shifting another chick into it, and so on. Alternatively, each unit should have six compartments so that for each of the three groups of chicks there are two compartments and hence no chick uses a compartment that has been used by another group of chicks. The whole unit should be light enough to be picked up with ease.

After two or three days the piece of cloth can be removed if desired, though with its use, it is much easier to keep the whole compartment clear of faecal matter and stale food. The cloth should be edged with piping so that there are no loose strands of cotton for a chick to pull out and eat. (One chick just managed to do this, which we realised only when some 5 cm of thread was seen projecting out of its cloaca. When pulled another 4 cm or so of thread came out.) The piece of cloth should spread right up to

the side walls and some distance up the sides so that all solid matter falls on the cloth itself.

Several of these units are placed parallel to each other in a room and separated from each other by a gap which is just wide enough to accommodate a light bulb (60 watt) with only the enamelled shade resting over the roof of the two units. The diagram shows the placement of five light bulbs serving four units of five compartments each.

Each compartment receives one small (5 cm) petri dish for food and one for water. Some food crumbs are spread over the cloth till the chicks learn to pick up the food from the dish itself. The light is left on all 24 hours, which not only provides heat but gives a longer time for the chicks to feed, resulting in better growth. Before the chicks are placed in these brooders, the lights are switched on and the temperature checked since both very high and very low temperatures cause stress.

With this method, the chances of disease spreading from one group of chicks to the other are very much reduced and yet the chicks are in visual and auditory contact with each other. If so desired, all the partitions can be removed to make a long unit in which all the chicks can mix together. If a chick is sick it can be easily isolated and treated. Similarly, if any particular chick needs extra vitamins or minerals it is isolated and given the extras without the others having to share the extras unnecessarily.

Even in the plains some heat is necessary for young chicks and some back-up arrangement should be available in case the electric supply is disrupted. On one occasion we had just shifted the chicks when the electric supply was disrupted. To further aggravate the situation, one chick got thoroughly wet when it blundered into the water vessel in the semi-darkness. The only thing that we could think of was to provide a hot-water bottle for the chick to rest on and it did the trick.

Too much heat not only produces stress but induces feather picking. This can be checked by either debeaking in which the tip (about 2–5 mm) of the upper mandible is removed or a plastic 'bit' is fixed over it. In the latter case make sure that the chick can feed properly. However, we prefer to reduce the heat slightly or to remove the offending chick to isolation. Feather picking can also be caused by lack of protein, overcrowding, and very bright light.

Within about 24 hours of hatching a chick should be willing to eat, but some start earlier than others. In difficult cases a slightly older

chick, or a bantam chick which is only too ready to start eating, is all that is required to set an example. Also, at first chicks do not always realise that the water in the dish is meant to be drunk. If a few drops of water are placed in the palm of a hand and the beak of the chick dipped in it, it gets enough water. In fact, for the first two days we do not put in a dish of water for, at this age, the chicks are rather unsteady on their legs and are likely to wet their feathers or even drown even in very shallow water. Alternatively, the dish of water is left in the compartment only during the day, when an occasional check is possible.

As a first meal probably the best thing is hard-boiled yellow of chicken egg which can be offered in a small dish or spread on cloth of contrasting colour so as to be easily seen. The crumbs should be fine and large pieces must be avoided. For the first two or three weeks, the need for protein is high, and in nature, during this initial period chicks will largely feed on live food, mostly insects. The value of live food at this stage cannot be overrated since the chicks become very active when they have to chase the live insects. There are several types of live food that are traditionally offered by the aviculturists and these have been discussed under 'Live Food', above.

Some aviculturists offer milk both as food and as a source of water. It must be freshly boiled and not left for long in the brooder for it will turn sour very quickly. It is better to offer a little at a time and to replace it often.

Chicken egg can be given hard-boiled (yolk only), scrambled or as a custard made of milk and egg. The custard should be on the dry side and crumbly. Some aviculturists advise giving curd but we have not used it.

The chicks may be offered green food right from the beginning and any kind of leafy vegetable may by used. It must, however, be thoroughly washed for it may well be contaminated with some toxic chemical and pathogens. During the summer months there is no shortage of leafy vegetables in India and spinach, lettuce, alfalfa, *chaulai, methi,* etc. are freely available. Clippings from the lawn and weeds can be given provided no chemicals have been used on them. Some soft fruits like apple, tomato, pear, cucumber, etc. can be chopped up and offered. Some aviculturists think that lettuce is not good for chicks since it contains some alkaloids.

If a chick is passing very thin faeces, or showing signs of enteritis, green food should be withheld for a few days.

The various types of millets can be offered but in small quantities and that too not too early, perhaps at one week age. Similarly, in the first week when the chick is being given rather soft food it should not be given any grit for it is possible that very fine grains of grit may get impacted in the gizzard.

Each chick can be marked either by putting a metal tag on the wing or by an open plastic or metal leg-band. We do not favour either of these ways—wing tagging because it breaks the skin and can lead to infection and leg-banding since it attracts the attention of other chicks and invites pecking. However, if for some reason it is necessary to identify the chicks, wing-bands or leg-bands can be purchased with numbers or letters marked on them. A permanent leg band can be fitted at about 16 weeks age.

In spite of all the precautions taken to prevent disease, specially bacterial disease, it is more than likely that one or two chicks will pick up an infection which may spread to the others. Sooner or later, every aviculturist is faced with the question: should he give some antibiotic to the chicks as a prophylactic measure or not. Opinions seem to be equally divided; the group which favours its use sees no harm in using it in addition to the usual preventive hygienic measures; the other group, equally partisan, would never do so, holding that indiscriminate use of antibiotics does more harm than good. There are two main objections to the use of antibiotics as a prophylactic. Firstly, that it removes the normal microflora from the intestine which play such an important part in the synthesis of vitamins, digestion and absorption of food matter. This does not appear to be such a problem for extra vitamins can be given either in food or water and subsequently the normal microflora can be restored using the faeces from healthy chicks. The second objection is that the use of antibiotics leads to the creation of strains of bacteria which are resistant to them. This, of course, is a much more serious matter as also seen in human medicine today. Another objection to the use of antibiotics is the belief that it interferes with the immune response of the chick. There is, at least, some evidence that this is not so.

We have always resisted the temptation to use antibiotics as a prophylactic, as an easy way to keep bacterial infections down. In a temperate climate (which would include that of hill-stations in India), provided the necessary precautions are taken, chicks are safe and the bacterial infections encountered would be few. However, in the plains, in spite of all precautions taken, there are always some

cases of bacterial infection resulting in much morbidity and mortality. Though we have ourselves no scientific data to prove it, our belief is that many pathogens are present in the environment and the majority of the chicks, if reasonably well nourished, are able to resist infection. The picture changes drastically if the chicks are under any kind of stress, when they become very susceptible to any and all pathogens. For all practical purposes, this means that a chick, on its own, will not be able to fight even low-grade infections and would need support by way of antibiotics. Perhaps only a carefully controlled experiment will show whether, all things considered, antibiotics as a prophylactic should be given or not. And if so, for how long.

A perusal of the literature shows that not all who give antibiotics have given very precise details. The antibiotics commonly used are streptomycin with penicillin and oxytetracycline. Some workers think that addition of Aurofac–2A (aureomycin, chlortetracycline 8 mg/g) or T.M. –5 (oxytetracycline 10 mg/g) to feed from day-0 to day-21 increases feed efficiency and reduces mortality in chickens, and probably would do so in pheasants also. According to Twining Jr *et al.* (1978) chickens gain more weight if for the first 72 hours they are given water with added vitamins and antibiotics. To one litre of water are added vitamin A 4227 USP units, vitamin D_3 2642 IC units, vitamin E 1.85 I units, vitamin B_{12} activity 31.7 mcg, pyridoxine hydrochloride 1.32 mg, menadione sodium bisulphite 2.51 mg, folic acid 0.32 mg, choline bitartrate 12 mg, procaine penicillin 15.85 mg, and streptomycin sulphate 79.25 mg. In Bobwhite Quail, addition of 1 g of oxytetracycline per kg of feed during the first week of life very considerably brought down the rate of mortality.

Once the chicks are about three weeks old they need more space and a number of chicks can be reared together either out in an open pen, if the weather permits, or in a room. We prefer to keep them in a room for another three weeks because the weather at this time of the year is still not favourable and remains uncertain. The strong sun in May and June can bring about heatstroke if the chick is stupid enough (It is!) to keep in the sun for any length of time. Also, during this part of the year we get some very violent thunderstorms with quite heavy showers, which may be enough to either chill the chicks or to drown them.

The chicks can be set free in a small room and on one wall a small electric bulb may be fixed to be switched on at night to give a little warmth. If the room is too big a few bricks are laid (mortar not necessary) to make an enclosure which is then covered by agricul-

tural nylon net of suitable mesh size. The floor in the enclosure is covered with sand, or very light garden soil which should be raked once a day. At least one Indian firm (Garware) makes nylon nets. This is a very handy arrangement and costs very little.

Anyone who attends to chicks must wash his hands with soap and water to minimise the chances of transmitting disease. *Escherichia coli* is normally present in human faeces and, if accidentally transmitted to chicks, will cause enteritis, which is usually fatal.

Once the weather improves the chicks can be transferred to open pens and since by this time they can be sexed, the poults can be paired and given their permanent pens. However, a number of poults can be raised together up to the next breeding season but overcrowding will almost always lead to some aggression and injuries, specially in the head and the rump.

Chapter 9

Reintroduction and Release

> Conservation is a bird that flies faster than the shot we aim at it.
>
> —ALDO LEOPOLD

In India, at least during historical times, no large animal, except the Indian cheetah (*Acinonyx jubatus venaticus*) is known to have become extinct, though the numbers of individuals of several species are precariously low. Even if a particular species has a large number of individuals, there is no guarantee that it will not be extirpated by man. Two examples can be cited, both from North America. In 1860 there were an estimated 60 million bison (*Bison bison*) there and within 30 years only 150 were left outside the reserves. Still more bizarre is the case of the passenger pigeon (*Ectopistes migratorius*) which was perhaps the most numerous bird in the world. One flock alone in the mid 19th century was estimated to have two billion individuals. And the last passenger pigeon died in 1914. As many as 173 species and subspecies of birds have become extinct within historical times and today about 400 species are threatened. Fossil records tell us that it is the law of nature that a particular species, after living its normal span of life on earth (2 million years for birds and 600,000 for mammals) will become extinct and will be replaced by newly evolved species. Today, the rate of extinction has become 40 to 400 times faster, almost entirely due to the short-sightedness of man, the so-called Supreme Creation of God. It is in this context that captive breeding and reintroduction become so very significant.

One of the major objectives of captive breeding of a pheasant, specially one belonging to an endangered species, is for reintroduction to the wild. In the majority of cases the reintroduction becomes necessary if the wild population of a species has fallen to a dangerously low level and it is feared that, unless a helping hand of man is extended, and extended in time, the species may disappear from this world altogether. As mentioned above there are many examples of animals having become extinct during the memory of man and there is no need to labour the point here. However, it must be remembered that there are many possible factors responsible for the decline in the population of a species and it is absolutely essential

that the factor(s) responsible should be identified and suitable remedial measures taken before reintroduction is given effect to. Some of the more important factors to be considered are: (*i*) loss of habitat, (*ii*) predation, (*iii*) loss of food, (*iv*) epiornitics, and (*v*) change in climate. For the first three factors man is certainly responsible, directly or indirectly, and for the last two, man's activities may have been a contributory factor.

For pheasants, as for the majority of other animals, loss of habitat is the major factor. This can be brought about by the clear felling of trees, flooding of an area due to the construction of dams, excessive use of insecticides and other poisonous chemicals, drainage of swamps and lakes, too much disturbance due to activities of man, etc. Obviously, the area should be restored fully, either by way of planting and or regeneration if the trees have been felled or otherwise destroyed. There is little point in reintroduction unless the habitat meets all the essential requirements of the animal concerned. Perhaps equally important, at least for the pheasants, is control of predation, specially by man. Most people who have studied pheasants for some time are convinced that, given a suitable habitat, most species of pheasants can withstand predation from all kinds of animals, including man. We have only to look at two examples to judge the veracity of this statement. Firstly, the two species of pheasants that are under greatest pressure due to predation from man are the Red Junglefowl, and the Kaleej, and yet both have learnt to live with man and are able to survive well. The second example is provided by the large-scale trapping carried out by Wilson* in the Garhwal Himalaya. He used to collect 1,000–1,500 skins (ostensibly Himalayan Monal males only) every year for a number of years. And yet nobody reported that this species was declining in numbers, leave alone getting to the point of extinction. But habitat destruction with the additional pressure of predation by man is usually a fatal combination. Pheasants, like other prey animals, are able to survive predation from other animals, chiefly because these predators turn

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* Even among adventurers of that age, Wilson appears to have been a remarkable man. He had settled in Harsil (Garhwal Himalaya) around the early 1840s and had married a local woman. Apart from indulging in all kinds of business ventures, in which he made and lost several fortunes, he had introduced his own coinage—the Wilson rupee. An account of his life by Mady Martyn, entitled 'Raja Wilson' appeared in *Imprint*, vol. 16, 45–49, 1976. This article mentions his shooting Golden Pheasants, which is obviously incorrect.

their attention to other animals and other areas once the number of a particular prey species falls below a certain level. But man with a permanent homestead remains anchored to an area and has a much wider choice of food and thus makes a clean sweep of the animals.

Of the other three factors, viz., loss of food, epiornitics and a drastic change in climate, the first two are of minor importance to pheasants, and usually are of a transient nature, and the last brings about changes over a very long period of time and hence can be ignored for all practical purposes.

Once the chicks have been raised in captivity, they have to be released in an area which was formerly either occupied by the species in question, or is judged to be wholly suitable in all aspects. Unfortunately, this is not as easy as it appears to be, and a few attempts that have been made on a modest scale in the past in several countries have not been very successful. It is true that large-scale captive breeding of the game pheasant (*Phasianus colchicus torquatus* mainly) in UK, Europe and USA and their release by the million have been successfully carried out but the ecological conditions in India are so different that a comparison is incongruous.

It is absolutely essential that the area for release should be selected after a careful study to ensure that it meets the minimum requirements for the five essentials to both the sexes of all ages and in all seasons (King, 1938): (*i*) coverts, (*ii*) food, (*iii*) water, (*iv*) juxtaposition, and (*v*) interspersion. Further, we would like to stress one obvious factor: if the area has been denuded of pheasants due to predation by man, this must be checked. It is true that we have all kinds of laws to prevent illegal shooting and trapping of birds but this is very largely on paper and there is at present no very effective agency to enforce these laws, though slowly some progress is being made. Admittedly, with our present resources not much can be expected. Accordingly, some areas should be found where illegal shooting and trapping are likely to be at a minimum, either because they are far from human habitation or they are covered by a national park or sanctuary where some kind of surveillance is possible. It is in such areas that the first releases should be made.

Another factor that has to be taken into consideration is that pheasants are no great travellers. If they find a suitable habitat in the area where they have been released, they will not move out of it beyond one or two kilometres in the initial stages. It is in this context that two factors, viz., juxtaposition and interspersion, become so very important. In a suitable area, pheasants will breed very

quickly and then some of them will have to move out because of the intraspecific struggle and competition which are always most vigorous and relentless. It is therefore perhaps a good policy that a few individuals should be released in each of several areas rather than many in one single area. There is always a temptation to accept that a single area is easier to monitor but in practice this is not valid.

One more aspect that we have to consider is the expected behaviour of the released birds. It is well known that if the birds have been bred in captivity, specially in an incubator, the chicks get imprinted on man and subsequently they come to associate man with food and do not regard him as a predator to be shunned. In some cases it has been seen that released birds very quickly revert to their natural instincts, specially in finding food for themselves, going up in a tree to roost at night to escape nocturnal land predators, and recognising their natural enemies, most of all man.

Basically, there are three possible approaches to the problem, each with its own limitations. The first is to take grown up poults and release them in the forest without any preparations. For obvious reasons this is the easiest approach since it involves very little investment by way of men and material. However, once released the birds may have difficulty in recognising and obtaining food of plant origin which is wholesome since this process is at least partly learnt from parents and is not wholly instinctive. Secondly, the birds have a tendency to wander away individually and may not be able to form bonded pairs though it seems reasonable to presume that, during the next breeding season, the males and females which are still unattached will get together one way or another. This method, we believe, is adopted for the release of game birds (Ring-necked Pheasant) in areas which are provided with food by man and which are closely monitored by gamekeepers. Nobody knows for sure as to what would happen to birds, like Cheer say, if they are released in an area which has only naturally growing food and carries the normal complement of predators. Telemetry, which has so successfully been used with larger animals, has yet to prove its value in pheasants. Hill & Robertson (1987) mention that the radio transmitters should not weigh more than 3–5 per cent of the body weight of the bird and should preferably be glued to its back. For determining the home range, three radio-locations per day for ten consecutive days should suffice. They have also provided a list of sources for radio-telemetry equipment.

The second method is to place the eggs of the rare pheasant laid in the aviary in the nest of an established pheasant in the wild (say Red Junglefowl or the Kaleej), if necessary by removing a few eggs of these, so that the latter serve as surrogate mothers. In theory, this is almost flawless but for the fact that it is not easy to find enough nests in the wild even of a common pheasant. Another drawback is that an area in which a particular species has to be reintroduced may not have an established species to serve as a surrogate. This method can, therefore, be used only on a very limited scale and cannot have much impact on meaningful reintroduction.

The third method, which has been used more often than the others, requires placing the poults first in a release pen. The basic idea is to have a holding area in the forest to which the poults are confined for a period of time so that gradually they learn to roost in higher branches of trees, out of reach of nocturnal predators, to find some natural food for themselves and, hopefully, over a period of time, to move away when man approaches. For this, a pen using chicken wire mesh is made, commonly with an open top. Usually the sides are 1.5–2 m high, supported by posts made of either wood or angle-iron. The gauge of the wire mesh would depend upon the predators that are expected to be present in the area. In our hills, the two most serious and likely predators would be the yellow-throated or pine marten and the leopard and the wire mesh (commonly called deer-proof or cattle-proof) used should be able to withstand attempts by these animals to get at the birds. If the pen has sufficient cover by way of tall grass, bushes and small trees, most of the birds would not easily be visible to birds of prey. However, if these are likely to be a problem, a roof of nylon agricultural netting should cover the area where food and water are provided. The overhang of the side walls becomes necessary where a predator is likely to climb over the fence.

In a few instances where release has been tried, the space allowed per bird varied from about 2 m^2 to 12 m^2. Obviously, more space per bird means lesser chances of cannibalism. The perimeter allowed per bird varied from one to two metres.

With an open top the poults are expected to flutter out and in on their own initiative. With the top in place, it is necessary to provide entrance and exit tunnels or pop holes to allow the birds to leave the pen or to return to it but not allow entry to predators.

In the initial stages both food and water should be provided, though as infrequently as possible but with the assurance that

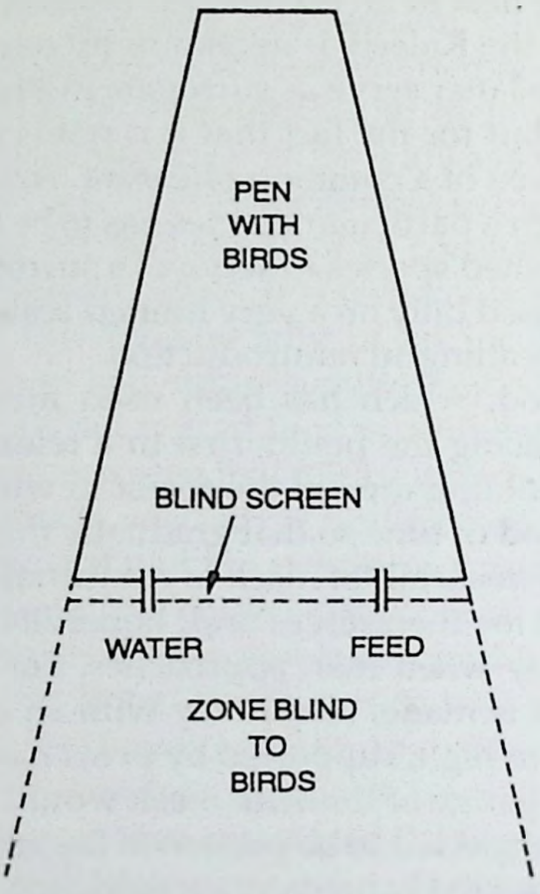

Fig. 16: A plan for holding young birds prior to their release.

enough of both are always present. The idea is to keep contact between the birds and man to the barest minimum. Accordingly, a large food bin requiring infrequent topping up is better than a man walking in with a bucket of feed every morning and evening. The latter course will certainly fix the image of the presence of man with food and consequently the pheasants will end up as food for man. Similarly, water should be piped in without a man having to fill the pot in the pen. If there is a natural source of water present in the area, so much the better.

Admittedly, we have not constructed any release pens as yet but even so we would like to suggest the following plan for feeding and watering the birds with almost no visual contact with man. Instead of having a rectangular or square pen, it should be trapezoidal with one parallel side very much shorter than the other (Fig. 16). A thick screen made out of reeds or thatching should cover the entire longer parallel side through which should pass one or two chutes for passing in feed and water pipes. The keeper approaches carefully through the area not visible to the birds and passes on the feed through

the chute and allows the water to flow by opening a tap outside the pen. Perhaps it would be better if a slow-running tap is allowed to run all the time with the water passing along a defined channel.

Gradually the amount of food provided is reduced to force the birds to look for their natural food in and outside the pen. Hence the pen should be sited at a place where there is an adequate amount of food already present. Even when all the birds have left the pen, the food and water should be provided for some time longer just in case any bird is unable to find these outside the pen.

In a very well reasoned article, Thomas (1986) has shown that chicks raised on commercial feeds will have gastrointestinal tracts which are ill-suited to the high-fibre food that they will encounter once they are released in the wild. In such cases the mortality in the released birds would be high due to partial starvation. Thomas advocates the use of insect larvae, cracked cereal grains dispersed throughout a thin straw substrate, fresh green vegetation, and coarse root crops to bring about desirable changes in foraging behaviour and the nature of the gastrointestinal tract.

It has been reported that most poults, when they come to the wire-mesh barrier, have a tendency to run up and down the entire barrier looking for a gap to get through. Most members of Galliformes will use only their legs to go from here to there without making use of their wings, which they do only when pressed by a potential predator. In fact, most galliform birds are trapped by taking advantage of this tendency. However, some workers who have released some birds maintain that the poults do flutter out and in.

It is possible that some predators (usually mammals) which are unable to break into the pen, will remain in the vicinity waiting hopefully for their dinners to come out. There is nothing much that can be done about this problem.

A perusal of the account given by some workers who have released pheasants convinces us that there is a great need to gain more knowledge about the mode of release, as also to find out the fate of the birds that have got out one way or another. Obviously, a few carefully monitored experiments will provide the right answers. Once again we would like to stress that all factors must be studied in depth before reintroduction is carried out and extreme caution should be exercised if a non-resident or a foreign species is to be introduced.

Several attempts have been made to release pheasants in the wild but success has been achieved only in the case of the Ring-necked

Pheasant which has been established in several countries of Europe, UK and USA. It is interesting to note that many attempts to establish this species in USA failed till birds were obtained directly from China. Robinson & Bolen (1984) while citing the work of Bump, mentioned four reasons for the failures: (*i*) failure to evaluate the characteristics of the exotic species like food habits, breeding biology and climatic and habitat requirements, (*ii*) failure to release sufficient numbers of healthy birds (some 200–300 wild-trapped individuals or about 1,000 hand-reared individuals should be released in a single area for each of at least three years); (*iii*) failure to condition hand-reared individuals properly before their release; and (*iv*) failure to manage the exotic population, including method of release, and necessary follow-up actions. Release is a long-term commitment, perhaps continued for 20 years before it can be judged a success or a failure.

Young *et al.* (1986) have reviewed the work done on reintroduction of Cheer pheasants in Pakistan between the years 1978 and 1985. They have analysed the various factors responsible for the poor results and, based on these, have made specific recommendations. Ridley (1986) in a well-thought-out paper, has made some astute remarks regarding the reintroduction of pheasants. He has stressed the obvious need to ensure that the habitat has been restored in case this was responsible for the decimation of an earlier population, which is usually the case, and to introduce only those individuals which are free from all pathogens lest, as carriers, they endanger the existing population.

Chapter 10

Diseases

> There is no subject, however complex, which—if studied with patience and intelligence—will not become more complex.
>
> —*New Speakers Handbook*

The word disease has been defined by *Dorland's Medical Dictionary* thus: 'A definite morbid process having a characteristic train of symptoms; it may affect the whole body or any of its parts, and its etiology, pathology, and prognosis may be known or unknown.' However, a simpler interpretation would be 'a state in which the body is not at ease'. By and large, our knowledge of only those diseases is advanced which affect either man directly, or his domesticated animals. Because of the economic importance of poultry (including domestic chicken, turkey, duck, etc.) considerable work has been done on their diseases. Fortuitously, both the domestic chicken and turkey are related to the pheasants and the work done on them can form a basis for the control of diseases of pheasants. However, it must be stressed that our knowledge of diseases of pheasants living in the wild is inadequate and most of our knowledge comes from study of captive birds.

Pheasants suffer from many diseases which can be serious during the first three or four months of their life, after which they are remarkably resistant to infectious diseases. As stated before, chicks in the plains are under a certain amount of heat stress and many of the microorganisms that in milder conditions live as harmless 'symbionts' or 'commensals' become pathogenic. If a chick becomes infected, there is usually not enough time to diagnose the disease and to medicate it. Once it is sick it goes off feed and since it has very little body reserve it virtually starves. Also, if many chicks are being kept together, a particular chick which is off feed may go unnoticed. Early and correct diagnosis is a big problem since with most conditions, at least in the early stages, the signs would be of a generalised nature—going off feed, ruffled feathers, huddling in a corner, not walking briskly, wings neither carried high enough nor close to the body, and so on. If a chick shows any of these signs it must be isolated at once, provided with warmth and watched. If available, a

veterinary surgeon should be asked to examine the chick, although the surgeon is likely to be familiar with diseases of poultry only. As a rule, medication should start only after a proper diagnosis has been made though in some cases this delay may prove to be fatal. If it is a viral disease, there is nothing very much that can be done except to provide warmth and quiet and, of course, food and water, the latter with added extra vitamins. The chick will either die or get over the infection on its own.

If the chick is suffering from some bacterial infection, the standard procedure is to collect blood, body secretions and faeces, subject them to laboratory tests to identify the pathogen, and carry out the sensitivity test with the various antibiotics available. This will naturally take quite a few days even if a diagnostic laboratory is readily available. If many chicks are being reared together, the sensitivity test will indicate the antibiotic of choice for the other chicks though the chick initially infected is not likely to benefit from this information. If a valuable chick is suspected to be infected with some bacterium, it is better to give it some broad-spectrum antibiotic straight away without waiting for a laboratory diagnosis. The excessive and indiscriminate use of drugs, specially antibiotics, can be harmful and a qualified veterinarian should be consulted.

It is also possible that a chick shows signs of disease because of some nutritional deficiency, usually that of some vitamins and/or minerals. If so, it is readily remedied and the chick will recover very quickly unless some irreversible changes have already taken place due to delayed diagnosis and remedial measures. The diseases caused by nutritional deficiency have been dealt with under Nutrition.

Coccidiosis is a very serious disease of domestic chicken, turkey and pheasants and the signs would be quite obvious as described below. It is usually possible to treat and cure an infected chick unless it has picked up a very heavy infection or the treatment has been much delayed.

We would like to stress the importance of the time-honoured saying, 'Prevention is better than cure', and it is more true for pheasants than for many other birds. All efforts should be made to prevent disease from entering the pheasantry but, even so, some birds will be lost due to various diseases. Since pheasants share many pathogens with domestic chicken and turkey a pheasantry should not be sited near a poultry house. Infection can be airborne, or can be introduced by wild birds, and can be carried on the limbs and

clothing of men entering a pen, or through dogs and rodents. Feed for pheasants must be stored in tightly closed containers so that rodents and insects cannot have access to it and, in the process, contaminate it.

Since laboratory diagnosis, clinical examination and postmortem examination are not likely to be undertaken by an aviculturist, information on these aspects will be omitted here. However, some references on these subjects are given at the end of this work.

The dosage of most drugs is decided by the weight of the body. It is seldom necessary to weigh every chick that has to be treated and the following can be used as a guide: Day-old 20g, 14 days 50g, 30 days 125g, 45 days 250g, 60 days 400g, adult 1.2–2 kg.

The drugs can be given in several ways. They can be mixed with food provided the bird is continuing to feed. They can be mixed with water but the water intake may vary greatly according to weather, extra moisture available through greens, dew, etc. If it is to be given orally forcibly, then great caution has to be exercised to see that the fluid does not enter the trachea which will suffocate the bird. Normally, if the beak is opened and the drug placed, a drop at a time, on the tip of the lower mandible, the bird will swallow it in the normal way. But even this method can lead to trouble. A sure way is to attach a short length of plastic or rubber tubing in place of a needle in a hypodermic syringe and, after gently passing down the tubing into the oesophagus, gradually push the liquid down.

Even at the cost of sounding repetitive, we would like to mention that omphalitis and aflatoxicosis were almost exclusively responsible for early deaths in our pens. Now that we have controlled these two conditions, we rear many more chicks than ever before.

NUTRITIONAL DEFICIENCY DISEASES

These have already been dealt with under Nutrition and Feeding.

BACTERIAL DISEASES

Salmonella group: There are 900 to 1,500 different serotypes of *Salmonella* recognised, depending upon the authority consulted. However, only three species are of major importance: *S. typhimurium*, *S. pullorum* and *S. gallinarum*. Earlier, it was said that *S. pullorum* was the pathogen affecting chicks and *S. gallinarum* that affecting adults. Of these three, *S. typhimurium* is certainly the most common. It causes paratyphoid in pheasants and other animals. The signs are similar

to those of pullorum disease and a definite diagnosis can be made only on laboratory test which takes 48–72 hours. This is usually a disease of young birds which when stricken tend to remain in one place, head down and eyes closed, feathers ruffled, wings carried low. Loss of appetite and thin and watery diarrhoea with soiling of the cloacal region are other characteristic signs. The chicks are infected either through the egg, both by direct ovarian transmission and shell penetration, or from the incubator, usually through the navel. The loss may start as early as two days post-infection and may continue for up to two weeks. Adult birds which have recovered act as carriers and the infection remains viable for several months, specially on vegetation and soil. Rodents (rats, mice) are commonly infected and spread the infection through their faeces if these get mixed up with the feed of the birds. Many domesticated animals and man can also carry the infection and spread it to pheasants. In severe outbreaks the mortality can be as high as 80 per cent.

Sulphamethazine and sulphamerazine have been used to reduce mortality in chicken and turkey, though the turkey seems to be rather sensitive to their toxicity. Excessive use of sulpha drugs may produce harmful after-effects including the haemorrhagic syndrome. Sulphamerazine at the rate of 0.3–0.5 per cent in the mash or 0.4 per cent of sodium sulphamerazine in drinking water was used for poultry chicks though not always successfully as a prophylactic. For pheasants, chlortetracycline (Aureomycin) at the rate of 250 g per ton of feed, or soluble terramycin at the rate of 100 ppm in drinking water can be given. Tetracycline (Steclin), oxytetracycline (Terramycin) and streptomycin have also been recommended. Tetracycline is best given in drinking water to 1–4 weeks old chicks at the rate of 40 g in 45 litres of water for one week and then half the dosage for the next four weeks. Steclin, containing tetracycline and several vitamins, is a broad-spectrum antibiotic and is effective both against primary pathogens and secondary invaders. It is similar to Terramycin in range against gram-positive and gram-negative cocci and bacilli, certain viruses (probably against secondary invaders), protozoa and parasites. Oxytetracycline is used at the rate of 110 g per ton of feed, or 55–110 mg orally per kg body weight. Streptomycin is effective against many gram-negative and some gram-positive bacteria. The therapeutic dose in poultry is 55 mg per kg body weight as intramuscular injection. A syrup for oral use in man is marketed as Comycin (Allenbury), and can be used for pheasants.

Certain nitrofurans like Furazolidone (NF-180) and Tiafur have largely been used to control paratyphoid in several species of birds. For pheasants, Furazolidone is used at the rate of 0.011–0.022 per cent in the feed as a prophylactic. Some workers think that nitrofurans are more toxic to pheasants than to chicken and turkey. Chloramphenicol at 2 mg/day for five days in drinking water is an efficacious curative.

Birds that have been cured or have got over the infection remain carriers for life and may transmit infection either through their eggs or faeces or other parts. Once the pens have been seeded with the bacterium, it is extremely difficult to eradicate it. The various antibiotics serve as bacteriostats only if they are given before the chick is exposed to infection.

S. pullorum causes the pullorum or bacillary white diarrhoea mainly in chicken but also affects turkey and pheasants and many others like quail, duck, etc. and some mammals. The infection is usually spread through hatching eggs, incubators, hatchers and contamination of feed and water with faeces. This is a disease mainly of the chicks and poults which appear sleepy, weak, and off their feed. Their faeces are chalky white, often soiling the pericloacal region. Both morbidity and mortality can be high, the greatest losses occurring during the second week after hatching.

Treatment and prevention are largely as for paratyphoid.

S. gallinarum causes fowl typhoid, a septicaemic disease, mainly of chicken and turkey though other species of birds like peafowl and pheasants can be infected. There seems to be little age susceptibility, the young and old birds both getting infected equally easily. The signs are similar to those of pullorum disease. Prevention, control and treatment are as in other *Salmonella* infections.

Avian Pasteurellosis: Several pathogens belonging to the Pasteurella group of bacteria cause diseases called fowl cholera, pseudotuberculosis and infectious serositis.

Pasteurella multocida: This causes fowl cholera (avian pasteurellosis, avian haemorrhagic septicaemia) which is a septicaemic disease with high mortality and morbidity though these depend upon the virulence of the strain and the resistance of the various hosts, these two factors being variable. The infection is through the mucous membranes of the pharynx and the upper air passages, conjunctiva and broken skin. Turkeys, chickens, geese, pheasants and many other species of birds are susceptible to infection. The infected birds (usually older than four months) show fever, loss of appetite, ruffled

feathers, mucous discharge from the mouth, and diarrhoea, but the signs are usually seen only a few hours before death. The drugs used for treating chicken and turkey are sulphamethazine and sodium sulphamethazine at the rate of 0.5–1 per cent in the mash or 0.1 per cent in drinking water, 0.4–0.5 per cent sulphamerazine in the mash or 0.1 per cent in drinking water. As a prophylactic, 0.04–0.1 per cent sulphaquinoxaline in water is effective. This drug is also used as a prophylactic and curative for coccidiosis but at a lower dosage. Some antibiotics like chlortetracycline and streptomycin, when given promptly as intramuscular injection to chicken, have been found to be of value, but not so much in pheasants.

Some recovered cases serve as carriers and these have to be removed to prevent spread of infection. Fortunately, this is not a disease of the hatchery and the incubators. Vaccination is recommended for chickens but apparently has not been used in pheasants.

Pasteurella (=Yersinia) pseudotuberculosis: Avian pseudotuberculosis is a contagious disease of chicken, turkey, goose, etc. and many mammals. There seems to be no authentic record of pheasants being affected, and perhaps only one case has been recorded from India. In turkey, chloramphenicol (0.6 g) and streptomycin sulphate (0.5 g/litre) in drinking water for two days and thereafter tetracycline (0.5 g/litre) for four days reduced mortality and prevented relapse.

Pasteurella anatipestifer (=P. septicaemiae) causes infectious serositis mainly in ducks and may cause accidental infection in pheasants if these are nearby.

Tuberculosis: This is caused by *Mycobacterium avium* and the avian variant of *M. tuberculosis*. This is a contagious disease which is chronic in nature and is specially prevalent in captive birds kept in crowded, cold, damp and ill-ventilated aviaries and zoos. The infected birds lose weight and appetite gradually and respiratory signs are seen only in later stages. The infection is usually transmitted through faeces of infected birds, both wild and captive, and through cannibalism. Under practical conditions, a definite diagnosis can be made only on postmortem examination supported by isolation and typing of the bacterium. If tuberculosis has been diagnosed in a particular aviary, then all birds and mammals that could have been exposed should be tested with tuberculin or using other serodiagnostic methods. This is a job for a qualified veterinarian and a proper laboratory.

It is almost certain that parrots are the only birds that can be infected with the human tubercle bacilli and conversely only (though not certain) children can pick up the infection from parrots.

The treatment though probably possible using streptomycin and isoniazid is not recommended unless the individual bird is extremely valuable.

The soil of the pen seeded by tubercle bacilli will remain a source of infection for several years and should be discarded altogether. The pens should be such that wild birds, specially sparrows, cannot enter them to share the food. The disposal of the carcass of an infected bird should be through burning since burying it in earth will keep the infection viable for several years.

Infectious Coryza: This is an acute upper respiratory tract disease, specially in chicken but also in pheasants. It is caused by *Haemophilus gallinarum*, a gram-negative bacterium, and usually results in very low mortality. The upper respiratory passages are involved and there is nasal discharge, oedema of the face, conjunctivitis, and loss of appetite. The infection causes trouble if the infected bird is under some other stress also. Chicks up to about five days are resistant and older birds suffer more. In most infected birds the facial swelling will be present only on one side. Some of the sulpha drugs tried have not given very good results and antibiotics like streptomycin (at 200 mg/bird) can be used as a curative. Erythromycin and Spectinomycin (1 mg/750 ml of water) can be used as a prophylactic for seven days. The recovered birds serve as carriers but the infection does not last more than a week on soil.

Avian Mycoplasmosis: Up to 20 serotypes belonging to several genera and species have been recognised which are associated with infraorbital sinusitis and are also probably involved in other diseases. In fact, it is still uncertain whether *Mycoplasma* is important as a primary pathogen or as a secondary infection. Earlier, it was thought that chronic respiratory disease (C.R.D.) was caused by pleuropneumonia-like organisms (P.P.L.O.) which were regarded as mycoplasmata, but there is some evidence that these coccobacilliform bodies are true bacteria and do not belong to Mycoplasmataceae, the members of the latter being commensals in air sacs of birds.

Mycoplasma gallisepticum: It is said to be the cause of chronic respiratory disease (C.R.D.) in chicken and infectious sinusitis in turkey. Infected birds when breathing produce a sound (tracheal rale) accompanied by coughing and inflammation of the sinuses. The

infection is spread by direct contact, airborne dust and through the egg. The disease is common in chicks 4–8 weeks of age. Normally, the feed intake is reduced only when the eyes are partially or totally closed due to inflammation of the surrounding area. In very young chicks this starvation for a few days can have serious repercussions and may even cause death. There is very strong evidence that pneumonia is probably not caused by *Mycoplasma* but by certain viruses, and bacteria like *Escherichia coli, Klebsiella (Pneumobacillus), Corynebacterium pyogenes, Pseudomonas aeruginosa* and some *Staphylococcus*.

Various antibiotics like streptomycin, oxytetracycline, chlortetracycline, erythromycin, tylosin, etc. are given either in feed or water or as injectables. Since more than one pathogen may be involved the results following treatment are not always similar and success may vary. Oxytetracycline or chlortetracycline is given at the rate of 1 g per kg of feed for several days. Tylosin, an antibiotic prepared from *Streptomyces fradiae,* is much favoured in UK and USA. It is given at the rate of 8–10 mg per kg body weight subcutaneously, or about 1 g in 375 ml of drinking water for 3–5 days.

If the eyelids of the chick have got stuck together they should be gently washed with lukewarm boric acid solution (1 per cent solution in water) and fomented, and antibiotic eye-drops put in.

Mycoplasma meleagridis causes arthritis and lameness in chicken, turkey and pheasants, the disease being called infectious synovitis. Apparently, it does not occur naturally in pheasants.

Erysipelas is a contagious, infectious disease of skin and subcutaneous tissue caused by *Erysipelothrix insidiosa* (*E. rhusiopahiae*) which affects a very large number of species of animals of all kinds—fish, reptiles, birds and mammals, including man. The transmission is probably mainly through broken skin or mucous membrane. The infected birds become weak and depressed, and may suffer from diarrhoea and lameness, and usually there is sudden death. Chicks 8–16 weeks of age are very susceptible. The antibiotics penicillin, chloramphenicol and tetracycline have proved very effective. Procaine penicillin at the rate of 20,000 units per kg body weight has been recommended but a fast-acting penicillin with streptomycin is better. Antibiotics given in water alone will not control the infection. It is also recommended that all birds that may have been exposed should be treated. Vaccination is possible in turkey.

Ulcerative Enteritis was earlier called Quail Disease since it was first reported from this host. Though chiefly many of the quails are

affected, the pheasants are also susceptible. The disease is caused by a gram-positive bacterium *Corynebacterium perdicum* (? *Clostridium colinum*). In acute form, the disease is not evident till death occurs and the carcass will show a well-muscled and fat body. In others, the birds appear listless and unthrifty with ruffled feathers and there may be watery white diarrhoea. In quails, the morbidity and mortality are high, the latter may go up to 100 per cent but is not as high in other birds. The transmission in nature is either through faeces or cannibalism. The diagnosis is made on clinical signs initially but should be confirmed on postmortem examination and laboratory tests.

The treatment is known in quails in which various antibiotics like streptomycin, chloromycetin and chlortetracycline have given good results. These can be used as prophylactics given as an injection, or orally through feed or water. Chloromycetin at the rate of 0.5 g or 0.06 g of streptomycin per kg of feed given as a prophylactic has proved very satisfactory. Streptomycin at the rate of 1 g per 750 ml of water on the first day, 200 mg per 750 ml for the subsequent days in drinking water reduces mortality.

Botulism is caused by the toxins of *Clostridium botulinum*, usually of type C, though other types may also be involved. The disease is not produced by the bacterium itself but under anaerobic conditions it liberates a toxin which causes the disease. This neurotoxin is one of the most toxic substances known. When an animal having the bacterium in its intestine dies, the bacteria invade the muscles and there they produce the toxin under anaerobic conditions. If such a carcass is infested by the larvae of flies (maggots), they collect the toxin in and on their bodies. The bluebottle, *Luculia* sp. is most commonly associated. Most birds, specially members of Galliformes, avidly feed on these maggots and it has been established that ingestion of as few as eight maggots is enough to kill a pheasant.

The afflicted birds appear sleepy and drowsy, have difficulty in flying and walking, and are unable to keep their neck in the normal position (limberneck). Since this is a neurotoxin the bird goes into a coma and shows other signs of paralysis before dying. If the amount of toxin ingested is small, the bird makes a recovery eventually. The affected birds should be given some laxative (castor oil, Epsom salts) to flush out the toxins from the alimentary canal. Antitoxin type C, if available, should be injected.

Once we lost four adult pheasants very quickly due to botulism. It so happened that a wild bird had died outside the pen and the bluebottle maggots, after feeding on the carcass, had crawled into

the pheasant pens and the pheasants had fed on them. All the pens were vacated and the maggots removed and the pens were not re-occupied for the next three months.

The spores of *Cl. botulinum* are extremely resistant, requiring boiling for five hours or autoclaving for 30 minutes at 7 kg pressure to inactivate them. Both animal and vegetable matter (vegetables, fruits, corn, aquatic leaves) may carry the toxin which can be destroyed if heated at 80°C for 6 minutes.

Staphylococcosis due to infection with *Staphylococcus aureus* results in omphalitis, arthritis, osteomyelitis, 'bumble-foot', etc. The infected birds show fever, abscess, inflammation, lameness, etc. It is generally believed that the bacteria get through small wounds and broken skin. The infection can be treated by giving any one of the antibiotics, specially streptomycin or novobiocin, either orally or by injection. If necessary, the caseous mass from the wound should be removed surgically. The prevention of omphalitis is easy and has been described under Hatching and Rearing.

Colibacillosis: Escherichia coli (B. coli) which is very commonly present in the intestine of many birds and other animals, is responsible for many conditions.

Air sac disease is caused by the invasion of the respiratory tract by *E. coli*, often along with other pathogens like viruses, *Mycoplasma*, *Klebsiella* and *Staphylococcus*. Even the vaccine strains of viruses like infectious bronchitis virus (I.B.V.) and Ranikhet Disease Virus (R.D.V.) increase susceptibility to *E. coli* infection. In most cases of pneumonia, more than one pathogen is involved. The bacteria are specially common under dry conditions and the fresh host is infected by inhaling contaminated dust particles.

The infection is very commonly transmitted through the egg. If the shell of the egg is contaminated with faeces, the bacteria penetrate through the shell and the membranes to infect the embryo. Wetness of the shell facilitates penetration by the bacteria.

Formerly, *E. coli* in birds was of little importance but now not only have certain pathogenic strains appeared but many of these are resistant to some of the antibiotics following their indiscriminate use in feeds. Accordingly, many cases of enteritis are now associated with the presence of *E. coli*. In one survey, 347 isolates of *E. coli* were tested in India for drug resistance: 98.8 per cent were resistant to erythromycin, 93.3 per cent to streptomycin, 76 per cent to chlortetracyclines, 46.6 per cent to oxytetracyclines, and none to ampicillin and chloramphenicol. In another test, kanamycin, nalidixic acid

and neomycin also gave good results. Gentamycin sulphate ('Garasol', Schering) is also said to be effective. Many strains are also resistant to triple sulphonamides.

If the eye is infected, the whole organ becomes inflamed, resulting in a condition called panophthalmitis and the bird becomes blind due to the accumulation of pus in the anterior chamber of the eyeball. Most infected birds die though some recover. Other organs that can be seriously affected are the heart (pericarditis), oviduct (salpingitis), liver (perihepatitis), joints (synovitis), and other visceral organs. An acute infectious condition resulting from septicaemia may also be seen.

A definite diagnosis for *E. coli* can be made only after laboratory tests since the signs are not characteristic. The treatment is by one of the antibiotics, preferably either ampicillin or neomycin, usually after doing a sensitivity test.

Chlamydiosis (ornithosis) caused by *Chlamydia psittaci* is of low virulence in pheasants and not common either. This disease, formerly called psittacosis or parrot fever, can affect a number of species of birds and mammals including man. The infected birds lose appetite and condition, and pass yellow-green gelatinous faeces. Very often there is concurrent infection with *Salmonella*. Antibiotics given in feed or water will control the infection.

VIRAL DISEASES

Infectious Bronchitis is caused by a filterable virus and chicken is the only natural host.

Infectious Laryngotracheitis is caused by a virus which belongs to the herpes group of viruses and affects chicken, peafowl and other pheasants. The birds are infected through the upper respiratory tract and the eye. The infected bird shows coughing, moist rales, sneezing, gasping, difficult breathing, and when the infection is severe, there is discharge of blood-tinged mucus through the nostrils. There is no treatment available. Recovered birds and the vaccinates should be kept separate from susceptible birds.

Ranikhet Disease (Newcastle Disease) is caused by a virus which belongs to the para-influenza group (paramyxovirus). It is an infectious and highly contagious disease, usually seen in the acute form. A large number of species of birds are susceptible and, of all, members of Galliformes are the most susceptible. At least in the chicken the severity of the disease depends upon the strain of the virus, the dose of infection, route of infection, age of the host and some environ-

mental factors. The natural routes of infection are through the nostrils, the eyes and the mouth, and the virus is carried as an aerosol.

The virus can be transmitted not only by contact or aerosol but mechanically also through the clothing and shoes of handlers, offal, contaminated feed or water, vehicles, chick boxes, etc.

The infected birds become dull and listless, show increased respiration and reluctance to move and to feed. Usually, there is profuse watery and greenish diarrhoea and there may be respiratory and nervous signs and partial paralysis of wing and leg muscles. The mortality can be very high and at times death may come without the bird showing any signs of disease. Since the signs are not characteristic of the disease, a firm diagnosis can be made only on laboratory tests.

Since no treatment is possible, prevention through vaccination is the only control measure. The susceptible birds should not be exposed to infection till they are vaccinated. The vaccine may be composed of either inactivated virus or living virus, and it is necessary to revaccinate to raise the level of immunity. The vaccine can be given in several ways and should be given by a qualified veterinarian and following the instructions of the manufacturer of the vaccine.

Avian Encephalomyelitis is caused by an enterovirus which is transmitted through the egg and is prevalent in chicken, quail and pheasants. Young (1–2 weeks) susceptible chicks can be infected orally and the virus leaves the body with the faeces. The infected chicks show dull eyes, incoordination of gait and ataxia; they tend to sit on their haunches; and tremors may be marked in head and neck. Very often they refuse to move, or lie on their pen-mates. The morbidity may be moderate to high as also the mortality. A firm diagnosis requires laboratory tests and this disease has to be distinguished from Ranikhet Disease. Since no treatment is known measures should be adopted towards prevention of disease, including vaccination.

Equine Encephalomyelitis is produced by the Western Equine Encephalomyelitis virus (WEEV) and Eastern Equine Encephalomyelitis virus (EEEV) which are classified as arboviruses since they are transmitted through bloodsucking arthropods (mosquitoes in this case). The infected birds show signs of involvement of the central nervous system, paralysis of leg, tremors and twisting of neck in an unnatural position (torticollis). Usually, there is very high mortality. It is normally the young chicks which are more susceptible and the disease spreads through mosquito bite, can-

nibalism and feather plucking. The signs are those of nervous involvement, which are also seen in other conditions and hence only laboratory tests can confirm the initial diagnosis. Apparently, the disease has not been reported from India. Since no treatment is possible, raising young chicks in mosquito-proof brooders and pens is recommended. The pheasants can be vaccinated using the vaccine meant for equines after dilution, following the instructions of the manufacturer.

Avian Pox is caused by one of the largest viruses (*Avipoxvirus*) and transmission may be through broken skin or mosquitoes. The disease is seen in three different forms: (*i*) diphtheritic, characterised by white and opaque lesions in the mouth (the most common in pheasants), (*ii*) cutaneous, when the lesions appear in the bare parts of the head, legs, toes and vent, and (*iii*) oculonasal, typified by lesions in the nasal chambers and eyes which produce signs of a cold in the head. The mortality is higher in the diphtheritic form. If the periorbital area is much inflamed it will greatly impair the sight of the chick, resulting in much reduced feed intake and starvation. Topical application of antibiotic creams on the affected skin area will prevent secondary infections, and fomentation of the eyes with lukewarm boric acid solution will also be helpful in keeping the eyes open and working.

A diagnosis based on clinical signs resulting from the lesions is usually reliable unless there are some complicating factors. Only a laboratory test, however, can confirm the presence of the virus.

Two types of vaccines, both having live virus, are available—fowlpox vaccine and pigeon-pox vaccine. These, if used improperly, can cause undesirable effects and should therefore be used under strict technical supervision.

Marble Spleen Disease has only recently been investigated and not much is known about it. No definite clinical signs except for loss of appetite have been reported, and the affected birds die suddenly. Postmortem examination shows a characteristic mottled appearance of the spleen along with congestion and oedema of the lungs. Apparently, the disease has not been reported from India so far.

Neoplastic Diseases are caused by several factors in which new tissues are formed, resulting in a tumour. Of these, perhaps the most important is Marek's Disease caused by a herpes virus which is of great economic importance to the poultry industry, being chiefly a disease of chicken, though pheasant, turkey and perhaps quail may also be affected. It is a highly contagious disease and the infection

can spread either by direct or indirect contact. Faeces, contaminated litter, feathers and dander from infected birds, and airborne particles seeded with the virus can spread the infection. The virus produces lesions in the nerves which bring about partial or total paralysis of the organ involved, and mostly the clinical signs become obvious if the wings, legs and neck are involved. The muscles may also show lesions resulting in tumour formation and degeneration. Usually young chicks 8–9 weeks old are affected though younger chicks have been involved in epiornitics. The older birds seem to be resistant.

Though the mechanism of immunity is not known, three types of vaccines have been developed: (*i*) a nonpathogenic or slightly pathogenic strain of virus, (*ii*) an attenuated strain of virus, and (*iii*) herpes virus of turkey (HVT). In all these a live virus is used and though the vaccinated bird is 'infected' it does not develop the disease since tumours are not formed. However, the vaccinated bird will act as a carrier and will be a potential source of infection to susceptible chicks. Turkey herpes virus (HVT) is effective both as aerosol and subcutaneous injection.

Tumours of various organs and tissues are caused by certain other viruses and are generally grouped under leucosis and sarcomas. Pheasants are rarely involved.

MYCOTIC DISEASES

There are several disease conditions of birds and other animals caused by infection with fungi. Of these, only one disease—aspergillosis caused by *Aspergillus fumigatus*, is of interest though other fungi can also be found in the lungs and air sacs. The infection spreads through fungal spores which are almost ubiquitous; damp, shady, ill-ventilated, over-crowded pens providing ideal conditions for the growth of fungi. Fungus will readily grow on any rotting piece of vegetation. It gains entry through the respiratory passages but infection through ingestion, broken skin and penetration through the egg shell (of the embryo) is also possible. However, bird to bird infection is not possible. The clinical signs are generalised and not diagnostic. It is usually very young chicks, 1–5 days old, which are infected either in the hatchery or the brooder. The infected chick shows difficulty in breathing, listlessness, loss of appetite, etc. Very often there is secondary infection with *Escherichia coli* and possibly also *Mycobacterium avium*. It is only on postmortem and histopathological examination that a definite diagnosis can be made.

For treatment several drugs have been employed. Nystatin (Mycostatin) when given at the rate of 625 units intra-abdominally to young chicks for six days reduced mortality. (The chicks were artificially infected intra-abdominally.) Each unit is equivalent to 0.001 mg of the drug. It can also be given as aerosol in a nebulizer, for 15 minutes twice a day. Amphotericin B has to be given intravenously or intratracheally and very slowly as it is likely to produce side reactions. Drugs that can be given orally are hamycin (20 mg/ml in drinking water) for seven days, and Ancobon (5-fluorocytosine, Roche) 120 mg per kg body weight three times daily (in raptors; not known in pheasants), potassium iodide 150 mg in 60 ml of drinking water daily or on alternate days (suggested for parrots), and Griseofulvin 1 mg per 100 g body weight for 7–10 days. However, Griseofulvin does not check the growth of the fungus in *in vitro* cultures. Copper sulphate 0.002 per cent in drinking water has also been found useful. In conclusion, it can be said that the treatment at present is not satisfactory.

Infection can be prevented by keeping chicks on a dry surface, with good ventilation, without excessive humidity and removing stale food and decaying vegetation. The vessels used to feed and water should be cleaned every day.

It appears that fungus can thrive in the lungs and air sacs of a bird without doing any harm but if the bird is put under stress, the infection flares up suddenly and becomes fatal. This is specially true for adult birds. Also, the indiscriminate use of antibiotics may predispose a bird to fungal infections.

PARASITIC DISEASES

Parasitic diseases can be due to external parasites like ticks, lice, mites, etc. or internal parasites like coccidia and helminths.

Helminths: There are four types of helminth parasites which live inside the body of a host—trematodes (flatworms), nematodes (roundworms or threadworms), cestodes (tapeworms) and acanthocephala (thornyheaded worms). Of these, trematodes are of little importance in pheasants. Our knowledge of nematodes and cestodes of pheasants in the wild is almost non-existent. However, almost all the records of parasites of pheasants are from captive birds and most of the parasites of chicken, if given a chance, will infect pheasants.

Nematodes have a cylindrical, elongated body looking like a tube or a piece of thread. A very large number of nematode parasites are

known and many species have been described from chicken and pheasants and other galliform birds. Here only that information will be given as is of direct importance to an aviculturist.

Gapeworm infection due to *Syngamus trachea* is very common in many wild and captive birds including pheasants. The parasites live in the trachea of the host and the male and female parasites are found in permanent copulation. Infected birds show signs of lobar pneumonia ('syngamus pneumonia'), coughing, open gape, extension of neck, jerking of head, suffocation due to blocking of trachea, etc. In the early stages of infection, the migrating parasites cause much damage in the lungs due to haemorrhage and, if the infection is heavy, the bird dies. The diagnosis is made on finding the characteristic eggs of the parasite either in the expectorated matter or in the faeces of the host.

Earlier, the usual treatment was to make the bird inhale finely powdered barium antimonyl tartrate, by placing the bird and the drug in a suitable box; when this box was tilted or disturbed, the bird flapped its wings and thus raised the drug as dust. Thiabendazole at 0.05 per cent or 0.5 per cent in the feed for 10–16 days or as a single dose of 0.3–1.5 g per kg body weight may be given. Mebendazole at 120 mg per kg of feed for three days is very effective. Both can be used prophylactically. Some other drugs have been used successfully abroad but these are as yet not available within the country.

The eggs of the parasite leave the body of the host with the mucus from the trachea or with the faeces and embryonation is completed on the soil. This infective egg is ingested, either directly or along with a transport host like earthworm, slug or snail which had ingested the eggs earlier. Since in a transport host a number of infective juveniles may have got collected, the ingestion of even one or two individuals may lead to a heavy infection. The prevention of infection depends upon excluding wild birds, earthworms, slugs and snails from the aviary. In an aviary with an earthen floor the transport hosts can be eliminated by having a sandy floor and no vegetation.

It is possible to vaccinate the birds using a live and irradiated vaccine though this vaccine may not be available commercially anywhere. Fortunately, this parasite is not a problem in India (as it is in UK), being of rare occurrence here.

Caecal worms: A few species of *Heterakis* are found in the caecum of pheasants and other gallinaceous birds. These are medium-sized worms and, when present in large numbers, produce petechial haemorrhages and thickening of the caecal wall. They are by themselves considered to be of little importance since the presence of a

few worms is well tolerated by a host. The eggs of the parasite pass out with the faeces, develop to the infective stage on soil and when these embryonated eggs are accidentally ingested, they produce the infection.

The importance of *Heterakis* infection lies in the fact that it helps transmit a protozoan parasite, *Histomonas meleagridis* which causes enterohepatitis or 'blackhead disease', it being of much importance in turkey.

Treatment is usually not necessary. However, methyridine, phenothiazine, piperazine adipate and levamisole hydrochloride are all very effective.

Infection can be controlled by regular removal of faeces and periodical anthelmintic treatment.

Ascaridiasis in chicken, pheasant and other avian species is caused by the presence of *Ascaridia galli* which inhabits the intestine of the host. These parasites are larger than *Heterakis* spp., both in length and breadth and the life history is similar. The larvae do more damage, specially in chicks, than the adult parasite. The latter are usually well tolerated unless present in such large numbers that they partly or completely block the lumen of the intestine. Infected chicks show diarrhoea, constipation and ruffled feathers. Morbidity and mortality increase in ill-nourished chicks, specially due to avitaminosis. Treatment and control are as in *Heterakis*.

Capillariasis is caused by the presence of various species of *Capillaria* which are usually present in the oesophagus and the crop. They do not cause any discomfort unless present in very large numbers. The parasites have an elongated and very slender body. The life history is direct. Treatment and control are as in *Heterakis*.

Cestodes are flat, ribbon-like parasites living in the intestine of the host. Their body is divided into many segments. Several species are found in chicken and all are potential parasites of pheasants. They are usually well tolerated unless they are so numerous as to block the intestine. The eggs of the parasites pass out with the faeces and several species of invertebrates act as intermediate hosts (vectors) in which further development takes place. When one of the vectors with the infective larvae is eaten by the bird, the infective larvae are released in the intestine and develop to the adult stage.

Davainea proglottina is a small parasite and uses slugs as a vector. These parasites are usually present in large numbers and hence cause considerable damage resulting in enteritis and haemorrhage. Di-n-butyl tin dilaurate (DBT) at 500 mg/kg feed and piperazine dithiocarbamate at 2 g/kg of feed are very effective.

Cotugnia digonopora, Raillietina tetragona, R. echinobothrida and *R. cesticillus* are medium-sized parasites, usually of chicken. They are not considered to be very pathogenic. Their vectors are house-fly, ants and beetles. Dichlorophen (200–300 mg/kg body weight) with phenothiazine (300 mg/kg body weight) will control the infection.

Other cestodes like *Amoebotaenia sphenoides, Choanotaenia infundibulum* and *Southwellia gallinarum* may occasionally be found but they are of little importance.

The hosts will pass out gravid segments and/or eggs of the parasites with the faeces and the diagnosis is made on the microscopic examination of the segments and the eggs.

Protozoa are unicellular organisms, usually of microscopic size and some of these are parasitic in pheasants and other animals. Here again not much is known about the diseases caused by them in pheasants but a parasite of chicken and turkey can be regarded as a potential parasite of pheasants.

Trichomoniasis is caused by two species, *Trichomonas gallinae* and *T. gallinarum. T. gallinae* is found in the crop, oesophagus and pharynx and seldom in the mouth; the lesions are therefore formed in these organs which produce a foul-smelling greenish fluid. The infected birds become listless, lose appetite, have ruffled feathers and diarrhoea and lose condition. Diagnosis is obtained by finding the parasite in the scrapings collected from the lesions. *T. gallinarum* is found in the lower intestine of the host where it produces the lesions, causing a disease similar to enterohepatitis. The birds can be treated with 2-amino-5-nitrothiazole (Enheptin-T, Entramin) at 30–45 mg/kg body weight or 1:1,000 aqueous solution as the only source of drinking water. Furazolidone (Furoxone, Nifulidone, Tricofuron) at 25–30 mg (in gelatin capsule) per day for seven days is also effective. This drug is also effective against salmonellosis, coccidiosis, hexamitiasis and blackhead. The drug may be slightly toxic to pheasants and hence should be given under the supervision of a veterinarian.

Histomoniasis is caused by the presence of *Histomonas meleagridis* in the caeca and liver, chiefly of turkey. The infection is transmitted through the eggs of the nematode parasite, *Heterakis gallinarum* and this may be helped by the intervention of an earthworm. The infected chick loses appetite, walks unsteadily, passes faeces tinged with yellow, has droopy wings and appears listless. In turkey poults, mortality can be very high.

Enheptin -T (Entramin, 2-amino-5-nitrothiazole) at 0.1 per cent either in the feed or drinking water as a curative and half this amount

for prophylaxis may be given. A related drug, 2-acetylamino-5-nitrothiazole (Enheptin-A, Entramin-A) is given in the feed at 0.025 per cent. Nithiazide at 0.025 per cent in the feed or water or Furazolidone (NF-180) at 0.01–0.02 per cent in the feed are also effective.

In addition to the treatment of the birds for histomoniasis, anthelmintic treatment against *H. gallinarum* would also help control the parasite.

Hexamitiasis is caused by the presence of *Hexamita meleagridis* which is essentially a disease of turkey but it also affects other birds, including pheasants. It is found in the small intestine and duodenum and causes catarrhal enteritis resulting in foamy watery diarrhoea. The chickens, up to eight weeks in age, are more susceptible and the mortality can be high. Treatment is as in histomoniasis. In both these diseases the older birds serve as carriers.

Avian Malaria is caused by several species of *Plasmodium* and the species affecting galliform birds are *P. gallinaceum, P. juxtanucleare, P. durae, P. relictum* and *P. lophurae.* The infection is transmitted through various mosquitoes. The infected birds show fluctuating temperature, become anaemic and emaciated. Since all drugs meant for treatment of human malaria are first tested against avian malaria, all such drugs can be used in birds. Quinacrine (mepacrine) hydrochloride (atabrine dihydrochloride) at 0.24 mg/kg body weight has been recommended.

Leucocytozoonosis is caused by *Leucocytozoon caulleryi* and *L. smithi* and both are blood parasites and transmitted by *Culicoides* sp. and *Simulium* sp. As in malaria, the diagnosis is based on microscopic examination of a blood film. Apparently, no treatment is known.

Piroplasmosis is caused by the presence of *Aegyptianella pullorum* and *A. moshkovskii* which are transmitted through ticks. The infected birds show high temperature, diarrhoea, anaemia, loss of appetite, and paralysis, and there may be high mortality. No treatment is known.

Coccidiosis is a disease of great economic importance specially to the poultry industry as it causes very heavy losses in chicken, turkey and other birds. There are only a few genera belonging to this group and of these, *Eimeria* contains almost all the species of economic importance. There are many species of this parasite described from various birds and, fortunately, they show a rigid host specificity, i.e., a particular species of *Eimeria* will affect only a particular species of host and not others, even under experimental conditions. Further, each species has its own site of predilection in the intestinal tract.

Another fortunate aspect of this parasite is that an infection results in a strong active immunity which means that if an animal has recovered from a coccidial infection, it will become resistant and even immune to subsequent infection though with the same species of parasite, and not against others.

The species reported from pheasants are *E. bhutanensis, E. colchici, E. dispersa, E. gennaesscus, E. langeroni, E. lophurae, E. megalostomata, E. pacifica* and *E. phasiani*. Experimentally pheasant chicks have been infected with chicken coccidia—*E. tenella, E. acervulina, E. maxima* and *E. necatrix*. The organisms live as intracellular parasites in various parts of the alimentary canal and undergo both sexual and asexual reproduction. The stage known as oocyst passes out with the host's faeces and, after some development on soil, becomes infective. The whole life cycle is usually completed in 6–7 days. The infected chicks show loss of appetite, diarrhoea with mucus and blood, anaemia and moderate to high mortality. Infected chicks have ruffled feathers and huddle in a corner, trying to keep themselves warm. The diagnosis is usually made on the presence of oocysts in the faeces though the chick may become sick even before the oocysts appear there. A careful postmortem examination should be made of the whole alimentary canal to detect lesions. It is not always easy to identify a species from oocysts alone but the presence of sporocysts of any species should be treated with respect.

Several drugs are available which can be used both as preventives as well as curatives. Some of these drugs are Amprolium, sulphaquinoxaline, Zoalene and Nitrofurazone. These are given either in feed or drinking water and the instructions of the manufacturers should be strictly followed. At least in chickens, the drugs given in water are more effective.

Drug	*Preventive*		*Curative*	
	Water	Feed	Water	Feed
Sulphaquinoxaline	0.077–0.013%	0.015–0.025%	0.04% followed by 0.025%	0.1% followed by 0.05%
Amprolium (Amprol)		0.0125%		
Zoalene (Zoamix)		0.0125%		
Nitrofurazone		0.0055–0.011%		0.0165% for 7–14 days

Duocoxin (Amprolium + sulphaquinoxaline) and Saquadil (sulphaquinoxaline + diaveridine) were better than Amprolium (against *E. maxima*) and Duocoxin is considered to be the ideal drug, followed by Amprolsol, Saquadil and Bifuran.

Coccidiosis is considered to be a man-made disease since it is when animals are kept under crowded and insanitary conditions that the infection builds up to epidemic proportions. In nature, usually a very light infection is seen which is good since it confers immunity upon the host without it suffering from the disease. In fact, an acceptable protocol is to give a very light infection (of course, under the full control of the operator) and then to treat it with drugs. Even otherwise, the drug is given on an on-off basis which allows good immunity to develop which is beneficial for that individual host. The older birds serve as carriers and are a source of infection for chicks which should always be reared separately. The older birds may carry the infection with impunity but if they are put under additional stress, they may show signs of disease.

As a routine, a coccidiostat is now added to the feed of poultry and if sulphaquinoxaline is the drug, then extra (five-fold) vitamin K has to be provided.

Ectoparasites for our purposes can be divided into two groups—one, those that attack the host only for the purpose and duration of feeding, like mosquitoes, gnats, midges, etc. and, the second group comprising those that remain more or less permanently attached to the body of the host like ticks, fleas, mites, etc. Here we will consider the parasites of pathologic importance belonging to the second group. The inclusion of a parasite here does not necessarily mean that it has been recorded from a pheasant in India. All the species of parasites found on chicken and turkey are potentially parasites of pheasants.

Fleas: There are only two species, *Echidnophaga gallinacea* (sticktight flea) and *Ceratophyllus gallinae* (European chicken flea) found on pheasants, though the cat flea, *Ctenocephalides felis*, and human flea, *Pulex irritans*, have also been reported, but the latter two are accidental parasites. These are blood-sucking parasites and cause much irritation and annoyance. The eggs are deposited on surrounding litter and need dampness for further development.

Lice: The chewing lice (Mallophaga) are dorso-ventrally flattened insects with a much flattened head and without wings. Many species of lice have been reported from poultry and the more important of these are *Eomenacanthus stramineus* (body louse), *Goniodes gigas* (large

body louse), *Menopon gallinae* (shaft louse), *Gallilipeurus* (*Cuclotogaster*) *heterographa* (head louse), *Lipeurus caponis* (wing louse), *L. tropicalis* (tropical wing louse) and *Goniocotes gallinae*. All these lice feed almost exclusively on feather and its products except for *E. stramineus* which punctures the base of soft quills to feed on the oozing fluids. The presence of lice results in increased preening by the bird and it is not definite how much trouble they cause, though it is certain that heavy infestation results in a drop in egg production. Also, an infested bird sitting on eggs may become restless and may not incubate the eggs properly. The eggs of lice are deposited on the feathers and the whole life cycle is completed on the body of the host. Heavy infestation of chicks is certainly pathogenic and causes more harm than in adult birds.

Fleas and lice can be controlled by 5 per cent DDT or 1–1.5 per cent *gamma* BHC dust, though recently 4–5 per cent malathion or 5 per cent Sevin have been much used. All birds and the poultry houses or pens should be treated at the same time. For lice, 0.125 per cent spray of Sumithion has been found very effective for poultry.

Ticks: The soft tick, *Argas persicus* is the most important tick of poultry and some other birds. The male is much smaller than the female, the latter varying very much in size, depending upon the amount of blood ingested. They are oval in shape and reddish brown in colour and are large enough to be seen easily with the naked eye. Ticks are certainly very serious parasites for they not only suck blood, causing anaemia, retarded growth and emaciation, specially in chicks, but also introduce toxins into the hosts' body and the worst is that they transmit several pathogens like *Borrelia, Aegyptianella, Pasteurella, Salmonella*, etc. Paralysis in birds may be due to either the toxins or a virus introduced by the tick. The engorged female tick drops off the host to deposit eggs in litter, woodwork, the bark of trees and other sheltered spots. Then in succession larvae and nymphs are produced which feed on the hosts till they reach maturity. The male dies after mating and the female after laying eggs.

The ticks on the body of the host can be controlled by the use of 5 per cent Sevin dust or 5 per cent Malathion dust or Dalf dust or Alugan dust.

In heavy infestations it may be necessary to treat the pens, woodwork, hatcher, etc., though it will mean much labour and cost. There are several chemicals available for the purpose, but probably the best are 2 per cent Sevin and 1–2 per cent malathion sprays. If the hatcher and brooder (only metallic parts) are infested, a blow-torch will be

found useful as it will kill not only the ticks but also coccidia and other pathogens.

Mites are closely related to ticks but are usually much smaller in size. *Knemidocoptes mutans* causes scaly-leg as it affects the bare parts of skin of legs and wattle. The mites burrow in the skin and scales are formed by the exudate. The infection spreads through direct contact. For treatment, the scales are first softened using soft paraffin (petrolatum) and gently removed. The affected part is then treated with 0.2 per cent *gamma* BHC in soft paraffin. A 10 per cent solution of Dettol (50 drops in 30 ml of water) is applied with a cotton swab, gently removing the scales, for 7–10 days.

Knemidocoptes gallinae is the depluming mite. It burrows in the skin at the base of the feathers, specially of the back and the wings, causing itching and inflammation when the birds pull out the feather. Treatment with pure sulphur dust and Dettol is recommended.

Dermanyssis gallinae (red mite, roost mite) is usually found in large numbers and therefore they remove a large amount of blood which can result in anaemia, specially in young or small birds. They feed only at night and withdraw to dark and sheltered places during the day and are difficult to spot. They also prefer dry conditions. They may also be responsible for transmitting some viruses. Infected birds should be dusted with carbaryl (Sevin) or *gamma* BHC. The mites deposit a very large number of eggs in the crevices of cages and other sheltered places of the woodwork, nests, etc. and it may be necessary to remove the birds to another pen before the infested pen can be thoroughly cleaned using insecticide.

Ornithonyssus bursa (tropical fowl mite, feather mite) remains on the feathers of the bird permanently and is found mostly on the fluffy feathers around the vent. The mite sucks blood and causes anaemia and much irritation and annoyance. It has also been incriminated as a vector for some viruses. The whole life cycle of the mite is completed on the bird itself.

Rivoltasia bifurcata is a skin and feather mite but probably of no importance.

Syringophilus bipectinatus (quill mite) lives inside the quill of the feather and causes partial or complete loss of feathers, and the stump of the remaining quill becomes powdery. No specific treatment has been recommended for these two mites but *gamma* BHC or Sevin may be tried.

Cytodites nudus (air sac mite) is found in the bronchi, lungs, air sacs and bone cavities. This mite is probably harmless and not much is known about its life history, pathology and pathogenicity.

Laminosioptes cysticola is found in the subcutis of the skin and is apparently harmless.

CANNIBALISM

It is well known that pheasants, specially the males, are very pugnacious and surprisingly the tendency to fight starts very early, sometimes only a few days after hatching. The chicks of a few species have a reputation for being more pugnacious than others but, in our experience, almost all species can behave in this way. It is usually the cere (the fleshy part at the base of the upper mandible) and the toes that are attacked. In such cases the victim must be isolated immediately and the wound dressed with some antibiotic. We have used terramycin solution and Betadine topically. Usually two or three applications in a day would be enough, and when the wound has healed over, the chick should be returned to the group. If necesary, a chick which persistently bullies others should be isolated and reared separately. The problem of cannibalism can partly be solved by giving enough space to chicks and overcrowding and mixing chicks of very different ages should be avoided.

CROOKED TOES

Very often it is found that a chick is either born with, or soon develops, crooked toes. In this condition, the toes, usually the inner and the middle, are slightly turned towards the middle of the body and the toes of either one or both the legs may be affected. This condition should not be confused with that of curly toes which is due to deficiency of vitamin B_2 (riboflavin). A bird with crooked toes will breed normally and it is only aesthetically that it is not acceptable. Several reasons have been held responsible for this condition—faulty and wrong incubation temperature, stress of any kind, lack of suitable perches, too close inbreeding, etc. We have seen this condition in several species of pheasants and grey partridge. The photograph by George Archibald* of a Siberian crane chick,

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* This photograph appears on page 29 of *The Cranes* compiled by J.C. Sawhney and edited by J.C. Sawhney & K. Mulla for WWF-India: 1–32.

'Gandhi', shows probably what is a similar condition. Some aviculturists have observed that this condition occurs when the eggs are incubated in an incubator and we have little doubt in our mind that the problem arises due to improper temperature. Even during the last two days of incubation the temperature should be absolutely right since we found this condition in a chick which was incubated under a broody but transferred to an incubator two days before it was due to hatch.

Appendices

Science at best is not wisdom; it is knowledge. Wisdom is knowledge tempered with judgement.

—LORD RITCHIE-CALDER

Appendix A: COMMON NAMES OF PHEASANTS

Bar-tailed Pheasant
Bhutan Peacock-Pheasant
Black-breasted Kaleej Pheasant
Black (Moffitt's) Kaleej Pheasant
Blood Pheasant
Blue Eared Pheasant
Blue Peafowl
Blyth's Tragopan
Bornean Crestless Fireback
Bornean Great Argus
Bronze-tailed Peacock-Pheasant
Brown Eared Pheasant
Bulwer's Wattled Pheasant
Burmese Peacock-Pheasant
Burmese Peafowl
Burmese Red Junglefowl
Cabot's Tragopan
Cheer Pheasant
Chestnut-mantled Koklass Pheasant
Chinese Monal
Congo Peacock
Copper Pheasant
Crested Fireback
Crimson Horned Pheasant
Doublebanded Argus
Eared Pheasant
Edward's Pheasant
Elwes's Eared Pheasant
Elliot's Pheasant
Game Pheasant
Germain's Peacock-Pheasant
Golden Pheasant
Green Junglefowl
Green Peafowl
Green Pheasant
Grey-bellied Tragopan
Grey Junglefowl
Grey Peacock-Pheasant
Himalayan Monal Pheasant
Hume's Barred-back Pheasant
Imperial Pheasant
Impeyan Pheasant
Indian Peafowl
Indian Red Junglefowl
Kashmir Koklass Pheasant
Koklass Pheasant
Lady Amherst's Pheasant
La Fayette's Junglefowl
Malay Crested Argus
Malay Crestless Fireback
Malay Great Argus
Malay Peacock-Pheasant
Mikado Pheasant
Moffitt's Kaleej Pheasant
Molesworth's Tragopan
Nepal Kaleej Pheasant
Nepal Koklass Pheasant
Palawan Peacock-Pheasant
Red Junglefowl
Reeves's Pheasant
Rheinart's Crested Argus
Rothschild's Pheasant
Salvadori's Pheasant
Satyr Tragopan
Sclater's Monal Pheasant
Siamese Fireback
Silver Pheasant
Spalding Peafowl
Swinhoe's Pheasant
Temminck's Tragopan
Tibetan Grey-bellied Tragopan
Western Horned Tragopan
White-crested Kaleej Pheasant
William's Kaleej Pheasant

Appendix B: SCIENTIFIC NAMES OF PHEASANTS

Afropavo congensis
Argusianus argus
A. bipunctatum
Catraeus wallichi
Chrysolophus pictus
C. amherstiae
Crossoptilon auritum
C. crossoptilon
C. c. harmani
C. mantchuricum
Gallus gallus murghi
G. g. spadiceus
G. lafayetti
G. sonnerati
Ithaginis cruentus
I. c. affinis
I. c. kuseri
I. c. tibetanus
Lophophorus impejanus
L. lhuysi
L. sclateri
Lophura bulweri
L. diardi
L. edwardsi
L. erythrophthalma erythrophthalma
L. e. pyronota
L. ignita
L. imperialis
L. inornata
L. leucomelana hamiltoni
L. l. lathami
L. l. leucomelana
L. l. melanota
L. l. moffitti
Lophura leucomelana williamsi
L. nycthemera
L. swinhoei
Pavo cristatus
P. muticus
P. m. spicifer
Phasianus colchicus
P. versicolor
Polyplectron bicalcaratum
P. b. bakeri
P. b. bicalcaratum
P. chalcurum
P. emphanum
P. germaini
P. inopinatum
P. malacense
Pucrasia macrolopha biddulphi
P. m. castanea
P. m. macrolopha
P. m. nipalensis
Rheinartia ocellata
Syrmaticus ellioti
S. humiae
S. h. humiae
S. mikado
S. reevesi
S. soemmeringi
Tragopan blythi blythi
T. b. molesworthi
T. caboti
T. melanocephalus
T. satyra
T. temmincki

Appendix C: VITAMIN PREPARATIONS

Complex B. (Glaxo): Liquid, vit B_{12} - B Complex
Floxaid Antibiotic - Vitamin Mixture (Merck, Sharpe & Dohme)
Rovimix (Roche): vit A, B_2 and D_3.
Nuvimin Forte (Sarabhai): vit. A, D_3, B_2, E, K, Cal. pantothenate nicotinamide, B_{12}, choline and minerals Ca, Mn, I, Fe, Zn, Cu, Co
Steclin (Sarabhai): vit A, D_3, E, K, Nicotinamide, B_{12}, B_2, Cal. pantothenate and tetracycline
Vi-Daylin (Abbott): vit A, D_3, thiamine hydrochloride, riboflavin, pyridoxine hydrochloride, ascorbic acid, nicotinamide

Vimeral (Glaxo): vit A, D_3, E, B_{12}
Vitablend Forte (Glaxo): vit A, water miscible

Appendix D: MINERAL SUPPLEMENTS

Mindif
Nuvimin Forte: see under vitamin, above.

Appendix E: ANTIBIOTICS AND ANTIBACTERIAL DRUGS

Ampicillin (Amfipen): Used as antibacterial agent; can be given orally. Not suitable for staphylococcal infections. Usual dosage 4-12 mg/kg body wt., twice daily. For injections use Ampicillin Sodium.

Betadine (Wockhardt, Mundipharma): Multipurpose microbicidal iodine solution (Povidone-Iodine). used to prevent omphalitis, and for cuts in skin.

Chloramphenicol: (Chloromycetin and others): Antibiotic with bacteriostatic action, similar to tetracycline hydrochloride but including also *Salmonella*. Usually given orally as palmitate.

Chlortetracycline (Aureomycin, Biomycin, Aureocina, etc.): Active against many gram-positive and gram-negative bacteria, (?) large viruses. Also used as growth stimulant @ 12-15g/ton of feed. May produce side effects—loss of appetite, vomiting, diarrhoea, vitamin deficiencies, enteritis at average or large doses.

Comycin (Streptomycin syrup, Allenbury): see under *Streptomycin*.

Erythromycin (Erythrocin, Erycin, etc.): Active against many gram-positive bacteria, specially penicillin-resistant staphylococci. May be used orally, intravenously or topically as different preparations.

Furazolidone (Furoxone, Tricofuron, etc.): Active against *Salmonella*, coccidiosis, hexamitiasis and blackhead (histomoniasis). Curative 0.011%; prophylaxis 0.0055%, both in feed. May be toxic for pheasants when given as preventive.

Isoniazid (Isonicotinic acid hydrazide, many trade names): Active against tuberculosis; given orally or intramuscularly. Many side effects reported in man.

Gentamycin sulphate (Garasol, Schering): Prevents early mortality when given to 1-3 days old poults (turkey); may be effective against *E. coli* infections.

Neomycin (Neomin, Nivemycin, etc.) (Flavomycin, Roseomycin): Broad-spectrum antibiotic active against *M. tuberculosis* and many gram-positive and gram-negative bacteria.

Novobiocin (Albamycin, Spheromycin, etc.): Usually sodium salt is used orally which is active against many gram-positive organisms, specially *Staphylococcus aureus*

Nystatin (Mycostatin): Antifungal antibiotic but has no action against bacteria and viruses. Used for treatment and prophylaxis of monilial infections, either orally or topically.

Oxytetracycline (Terramycin, Biostat, Riomycin, etc.): Active against gram-positive and gram-negative cocci and bacilli, certain viruses, protozoa and parasites. Anti-infective agent in many diseases including respiratory, enteric, skin and systemic disorders. Side-effects as in chlortetracycline. For poultry 100 g/ton of feed.

Penicillin: Available in various forms, usually potassium penicillin G (benzylpenicillin potassium) or sodium penicillin G are used. Active against streptococcus,

staphylococcus, certain clostridia infections, etc. Dosage at least 4,500 units/kg body wt. Penicillin V specially suitable for oral use. There are many resistant strains of bacteria now.

Soframycin (Framycetin sulphate): Like Tylosin, prepared from *Streptomyces fradiae*. Eye drops (Roussel). Antibiotic can be used against *E. coli* @ 10 mg/kg body wt., either orally or as intramuscular injection.

Spectinomycin: Used as an antimicrobial agent.

Streptomycin (usually as a hydrochloride): Active against tuberculosis, many gram-negative and some gram-positive bacteria, infectious sinusitis, chronic respiratory disease and infectious synovitis. For poultry, 60 mg/kg body wt., intramuscularly.

Sulphamerazine (Methylpyrimal, Pyrimal M, etc.): Action like that of sulphamethazine. Dosage for poultry 0.4-0.5% in feed, 0.1-0.2% in water.

Sulphamethazine (Dimezathine, Sulfadine, etc.): Active against certain streptococci, staphylococci, pasteurella, salmonella, coccidia. For poultry 0.4-0.5% in feed; water must be made available freely.

Tetracycline (Cyclomycin, Achromycin, Tetracyn, Hostacyclin, Steclin, etc.): Action like that of oxytetracycline and active against primary pathogens and secondary infections.

Tylosin: Much favoured in UK and USA against synovitis.

Appendix F: OTHER DRUGS, CHEMICALS, ETC.

Amphotericin B (Fungizone): Used against systemic mycotic infections. Must be administered very slowly, mixed with glucose intravenously. Has many side effects and can be very toxic.

Amprolium (Amprol, Pancoxin, Supacox): Used as coccidiostat as hydrochloride in feed @ 125 parts per million. For treatment 10-20 mg/kg body wt. daily for 4-5 days.

Amprolsol (Merck, Sharpe & Dohme): Coccidiostat, 20% sol. powder.

Ancobon (Flucytosine, Alcobon): Used as an antifungal drug, given orally @ 100-200 mg/kg body wt., usually with Amphotericin.

B.H.C. (Gammexane, Lorexane, Lindane, etc.): *Gamma* isomer is much used as an insecticide.

Bifuran (Smith, Kline & French): Mixture of nitrofurazone and furazolidone. Given as a preventive for coccidia @ 0.011% in feed.

Di-N-Butyl Tin Dilaurate: Very useful against tapeworms.

Carbaryl (Carbamyl, Sevin): 5% dust used as insecticide. Very safe.

Codrinal (Hoechst): Coccidiostat and antibacterial agent, given @ 0.1% in water. Not very good action.

Dettol (p-chloro-m-xylenol, 4-chloro-3, 5-xylenol): Antiseptic and germicide, used topically in surgery, cuts, wounds, etc. and also in mange caused by mites.

Dichlorophen (e) (Dicestal, Teniathane, Anthiphen, etc.): Used as agricultural fungicide, germicide in soaps, shampoos, etc.; active against many cestodes.

Duocoxin (Merck, Sharpe & Dohme): Coccidiostat, Amprolium + sulphaquinoxaline @ 0.1% in water.

Enheptin (Entramin, 2-amino nitrothiazole, 2-acetamido-5-nitrothiazole): Used against histomoniasis (blackhead) in turkey and trichomoniasis in pigeon.

Griseofulvin (Fulvicin, Fulcin, Grifulvin): Active against superficial fungus infection. Of doubtful value against aspergillosis.

Hamycin (Primamycin): Used as an antifungal agent.

Levamisole (1-tetramisol, 2, 3, 5, 6, tetrahydro-6-phenyl-imidazol-(2, 1-b) thiazolin hydrochloride): Used as an anthelmintic; usual dosage 10-15 mg/kg body wt.

Malathion (Malathon): Insecticide of considerable veterinary use, specially because of its low toxicity to warm-blooded animals. Used as 5% dust or for spraying pens with water solution.

Mebendazole: Active against mature and immature nematodes; usual dosage 5-10 mg/kg body wt.

Methyridine (Promintic, I.C.I.): Anthelmintic usually given subcutaneously @ 200 mg/kg body wt. Very good for nematodes.

Neftin 50 (Smith, Kline & French): Veterinary Furazolidone (NF-180), 5% w/w. Not suitable as a preventive because of its toxicity for pheasants. May be tried at half the strength recommended for poultry.

Nithiazide (Hepzide): Used for treatment and prophylaxis against histomoniasis (blackhead) and hexamitiasis. For treatment 0.04% for 7-10 days, for prophylaxis 0.025-0.035% continuously.

Nitrofurazone (Furacin, Nitrofural, etc.): Used as topical antiseptic (0.2% soln., powder, ointment) and for prevention of avian coccidiosis; prevention 0.0055% in feed; for treatment 0.0165% in feed for 14 days.

Phenothiazine. (Phenovis, Phenoxur, Phenoverm, etc.): Active against many gastrointestinal worms; often combined with other drugs.

Piperazine (Antepar, many salts, with many trade names): Active against many gastrointestinal nematodes with a high margin of safety. Usually adipate or hexahydrate is used @ 100-200 mg/kg body wt., orally.

Piperex (Sarabhai): Piperazine hexahydrate 44%.

Quinacrine hydrochloride (Mepacrine, Atebrin, etc.): Used against malaria, 0.5-1% in drinking water. May produce side effects.

Saquadil (May & Baker): Coccidiostat; sulphaquinoxaline + diaveridine, 0.005% in drinking water.

Sulphaquinoxaline (Sulquin, Sulphabenzpyrazine): Used for prophylaxis against caecal and intestinal coccidiosis, reduction in immediate losses from acute fowl cholera and fowl typhoid. Coccidiosis: treatment 0.1% followed by 0.05% in feed; prevention 0.015-0.025% in feed or 0.0077-0.013% in drinking water; fowl cholera and fowl typhoid: 0.1% in feed or 0.04% in drinking water.

Thiabendazole (Thibenzole): Anthelmintic active against many nematodes. Normally mixed with feed @ 0.1% or 50-60 mg/kg body wt., orally.

Vermex (Pfizer): Anthelmintic against *A. galli* in poultry.

Zoalene (3, 5-dinitro-toluamide, 2-methyl-3, 5 dinitrobenzamide) (Dow): Coccidiostat.

NOTE: The drugs are sold under many trade names and this multiplicity may cause confusion. In case of doubt, *Merck Index, Encyclopaedia of Antibiotics, British Pharmacopoeia* (Veterinary), *Pharmaceutical Codex* and such books of reference should be consulted. The dosage given throughout this work is from the literature and a veterinarian should always be consulted.

Appendix G: LIST OF PLANTS

	Scientific Name	*Common Name*	*Local Name*
1.	*Adiantum* spp.	Maidenhair fern	
2.	*Agave americana*	American aloe, Century plant	Hathi sengar, Kantala
3.	*Alocasia* spp.	Alocasia	Mankanda
4.	*Andropogon citratus*	Lemon grass	Gandhatrina
5.	*Antigonon leptopus*	Coral vine	
6.	*Araucaria cooki*	Araucaria	
7.	*Argemone mexicana*	Mexican poppy	Pila dhatura, Farangi dhatura Shialkanta
8.	*Artabotrys odoratissima*	Champa	Hari Champa
9.	*Bambusa* spp.	Bamboo	Bans
10.	*Begonia rex*	Rex Begonia	
11.	*Camellia japonica*	Garden Camellia	
12.	*Canna indica*	Indian Shot	
13.	*Carissa carandus*	Bengal Currant	Karaunda
14.	*Cassia fistula*	Indian laburnum, Golden shower	Amaltas
15.	*Cedrus deodara*	Deodar	Deodar
16.	*Clerodendrum splendens*	Clerodendron	
17.	*Clitoria ternatea*	Butterfly-pea	Aparajit
18.	*Codiaeum variegatum*	Croton	Croton
19.	*Datura metel*	Datura	Dhatura
20.	*Datura straminium*	Datura	Dhatura
21.	*Diospyros kaki*	Persimmon, Chinese date plum	Kaku, Halwa tendu
22.	*Dieffenbachia*	Dumb cane	
23.	*Duranta plumieri*	Duranta	Neelkanta
24.	*Euphorbia antiquorum*	Euphorbia	Dudhi
25.	*Euphorbia splendens*	Euphorbia, Crown of thorns	Dudhi
26.	*Ficus carica*	Fig	Anjeer
27.	*Ficus infectoria*		Pilkan, Pakar
28.	*Gardenia florida*	Gardenia	
29.	*Hamelia patens*		
30.	*Hydrangea hortensis*	Hydrangea	
31.	*Ipomoea palmata*	Railway creeper	
32.	*Ixora coccinea*	Ixora	Rangan, Rukmini
33.	*Jacquiemontia violacea*		
34.	*Juniperus chinensis*	Juniper	
35.	*Kniphofia aloides*	Redhot poker, Flame flower	
36.	*Lantana aculeata* (*L. camara*)	Lantana	Lantana
37.	*Lonicera japonica*	Honeysuckle	
38.	*Magnolia grandiflora*	Magnolia	Hari Champa
39.	*Maranta arundanacea*	Arrowroot	Tikkor
40.	*Meyenia erecta*		
41.	*Michelia champaca*	Champa	Champa, Champaka
42.	*Morus alba*	Mulberry	Shahtoot

43.	*Morus indica*	Mulberry	Shahtoot
44.	*Morus nigra*	Mulberry	Shahtoot
45.	*Murraya exotica*	Box tree	Kamini, Marchula
46.	*Myrica nagi*		Kaphal
47.	*Nephrolepis* sp.	Sword fern	
48.	*Osmunda* sp.	Fern	
49.	*Passiflora caerulea*	Passion flower	
50.	*Pelargonium* sp.	Geranium	
51.	*Pinus* spp.	Pine (various)	Cheer
52.	*Pithecelobium dulce*	Madras thorn	Hinga dolchi, Belaiti imli
53.	*Platycerium* sp.	Staghorn fern	
54.	*Plumeria alba*	Pagoda tree, Frangipani	
55.	*Plumeria rubra*	Pagoda tree, Frangipani	
56.	*Pongamia glabra*		Karanj, Pongai
57.	*Prunus persica*	Peach	Addoo
58.	*Pteris* sp.	Ribbon or Brake fern	
59.	*Pyrostegia venusta*	Golden shower	
60.	*Quamoclit lobata*	Belgian flag creeper	
61.	*Quercus dilatata*	Maru or Green oak	Ban
62.	*Quercus incana*	Banj or Grey oak	Banj
63.	*Quercus semicarpifolia*	Karsu or Brown oak	Karshu
64.	*Rhododendron arboreum*	Rhododendron	Bras, Brus
65.	*Russelia juncea*	Coral fuschia, Weeping Mary	
66.	*Sansevieria zeylanica*	Mother-in-law's tongue	Murva
67.	*Solidago virga-aurea*	Golden rod	
68.	*Tabarnaemontana coronaria*		Tagar, Chandni
69.	*Vitis vinifera*	Grape vine	Angoor
70.	*Wistaria chinensis*	Wistaria	

NOTE: This is by no means an exhaustive list but only gives some suggestions. Plants must be selected taking local conditions into consideration.

Suitable for hills: 1, 2, 4, 6, 9, 10, 11, 15, 19, 20, 21, 28, 30, 34, 35, 37, 38, 41, 46, 47, 48, 49, 50, 51, 53, 57, 58, 61, 62, 63, 64, 67, 69, 70.

Suitable for plains: 2, 3, 4, 5, 8, 9, 12, 13, 14, 15, 16, 17, 18, 22, 23, 24, 25, 26, 27, 28, 29, 31, 32, 33, 36, 39, 40, 41, 42, 43, 44, 45, 49, 52, 54, 55, 56, 57, 59, 60, 65, 66, 68, 69.

For planting outside pens: 2, 5, 6, 8, 9, 11, 13, 14, 15, 16, 17, 21, 23, 24, 25, 27, 28, 31, 33, 37, 38, 41, 42, 43, 44, 45, 46, 49, 51, 52, 54, 55, 56, 57, 59, 60, 61, 62, 63, 64, 68, 69, 70.

For planting inside pens: 1, 3, 4, 8, 9, 10, 11, 12, 13, 18, 22, 26, 28, 29, 30, 32, 34, 35, 38, 39, 40, 41, 42, 43, 44, 45, 47, 48, 50, 53, 54, 55, 57, 58, 65, 66, 67, 68.

Climbers and creepers: 5, 16, 17, 31, 33, 37, 49, 59, 60, 69, 70.

Poisonous: 2, 7, 10, 14, 17, 18, 19, 20, 22, 36, 56, 64

Lantana is a good example to show the limitations of the above sugestions. When allowed to grow naturally, it will form an unsightly bush with many stems arising from the base. However, when grown as a standard or semi-standard, it becomes very desirable. Also, all parts of the plant (except for the ripe drupes) are poisonous to livestock but we have grown the bush inside the pens lodging Cheer pheasant and various partridges and have never lost a bird.

Appendix H: FEED FORMULAS

	Start (1)	*Grow* (2)	*Layer* (3)	*Start* (4)	*Grow* (5)	*Layer* (6)	*Start* (7)	*Grow* (8)	*Layer* (9)
Yellow maize	30	30	30	30	30	30	13	22	18.9
Wheat	30	40	34.4	30	40	34.4	49.1	50	50
Veg. oil	1.3	2	2	1.3	2	2	1.3	2	2
Meat Meal (45% prot.)	5	4.35	5.5	5	4.35	5.5	5	5.4	6
Fish meal (40% prot. + 10% salt)	4	2	2	6	3	3	6	4	4
Soybean meal 44%	24	16	15	27	20	19	25	16	13
Groundnut cake	5	5	5	0	0	0	0	0	0
Dl-meth.	0.2	0.15	0.1	0.2	0.15	0.1	0.1	0.1	0.1
Nuvim. forte	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Limestone	0	0	5.5	0	0	5.5	0	0	5.5
Prot: ME	22.52	18.84	18.30	20.83	18.60	18.05	23.16	19.37	18.03
Kcal/Kg	2959	3110	2924	2889.5	2998	2856.7	2968.5	3117	2957.7
Fat	4.486	5.049	5.043	4.444	5.117	4.958	3.714	4.634	4.534
Fibre	3.898	3.701	3.496	3.45	3.22	3.06	3.39	3.05	2.82
Ca	0.929	0.696	2.738	0.987	0.681	2.82	0.981	0.829	2.996
Av. P	0.490	0.411	0.464	0.497	0.422	0.457	0.565	0.493	0.506

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	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Na	0.222	0.143	0.147	0.157	0.124	0.126	0.162	0.132	0.129
				0.236	0.118	0.118	0.236	0.157	0.157
Methionine	0.546	0.432	0.375	0.607	0.482	0.420	0.506	0.434	0.414
Cystine	0.467	0.365	0.352	0.365	0.315	0.304	0.388	0.331	0.309
Lysine	1.2	0.926	0.901	1.321	1.14	1.125	1.381	1.055	0.979
Tryptophan	0.253	0.205	0.196	0.309	0.264	0.251	0.272	0.215	0.197
Linoleic A.	1.677	2.077	2.039	1.675	2.088	2.039	1.245	1.701	1.631
Xanth. mg/kg	7.5	7.5	7.5	7.5	7.5	7.5	3.25	5.5	4.63
Cost US$	0.022	0.019	0.019						
Ind. Rs.				3.03	3.03	2.89	3.02	2.92	2.76

NOTES:

1. Formulas 1 to 3 have been prepared by Prof M.L. Scott (USA).
2. Formulas 4 to 6 to be used if the maize is free from aflatoxin.
3. Formulas 7 to 9 to be used if the maize has traces of aflatoxin.
4. The lower figures for Na in formulas 4 to 9 show the amount of sodium expected from fish meal; may need adjustment.
5. The values of various ingredients are those as determined in UK and USA; similar figures for Indian products not available.
6. The cost of formulas 4 to 9 will be slightly lower if larger amount of feed is made, say 100 kg and above. The cost will vary from area to area and year to year.

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> Indeed, in the eyes of many, bibliographic research must be taken as seriously as research in the laboratory or field.
>
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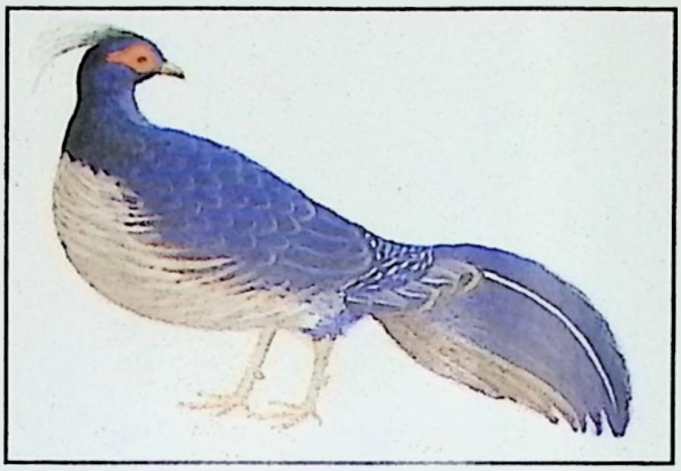
Index

1. For various infectious diseases of pheasants see sub-entries under *diseases*.
2. For various types of pheasants see separate PHEASANT INDEX, the lists on pp. 28-9 and Appendices A (p. 157) and B (p. 158).

Pheasant Index

Errata

p. xiv, line 9, *read* '1898' *for* '1889'.
p. 87, last para, line 1, *read* 'collecting' *for* 'collection'.
p. 171, line 3, *read* '158' and '159' *for* '157' and '158', respectively.
p. 175, column 1, lines 18–19, *read* '*Polyplectron bicalcaratum bicalcaratum*', *for* '*P. Polyplectron bicalcaratum bicalcaratum*'.
p. 175, column 2, line 5, *read* '42' and '46' *for* '41' and '45', respectively.



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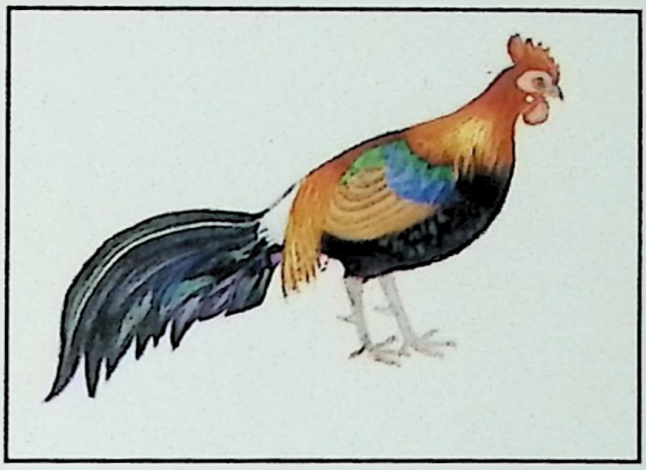

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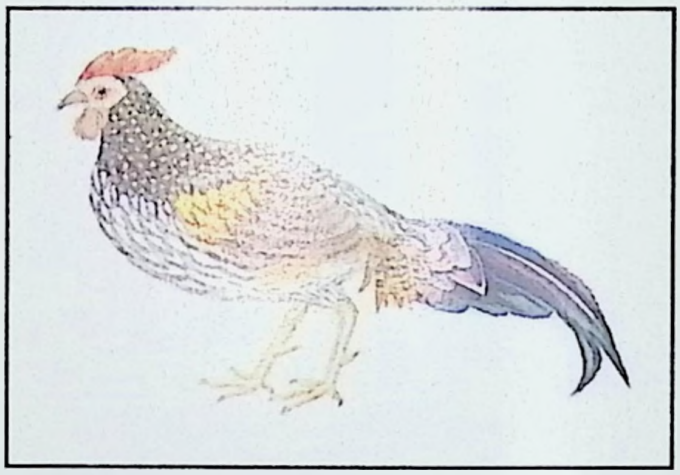

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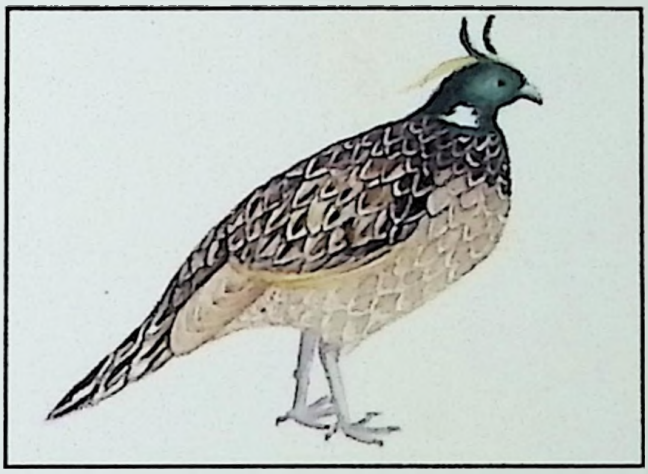

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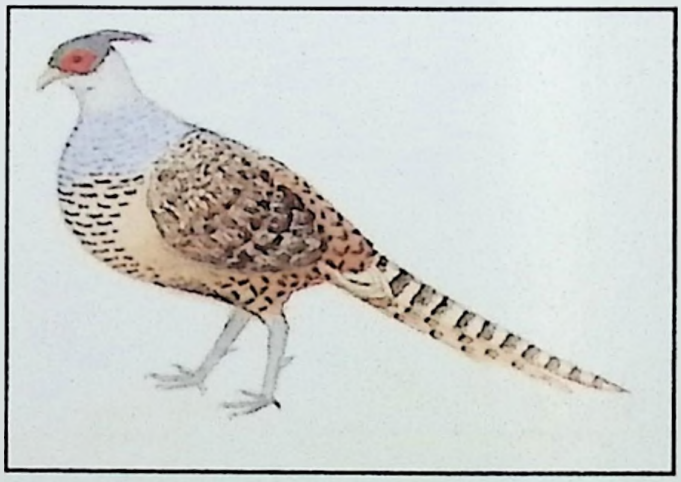

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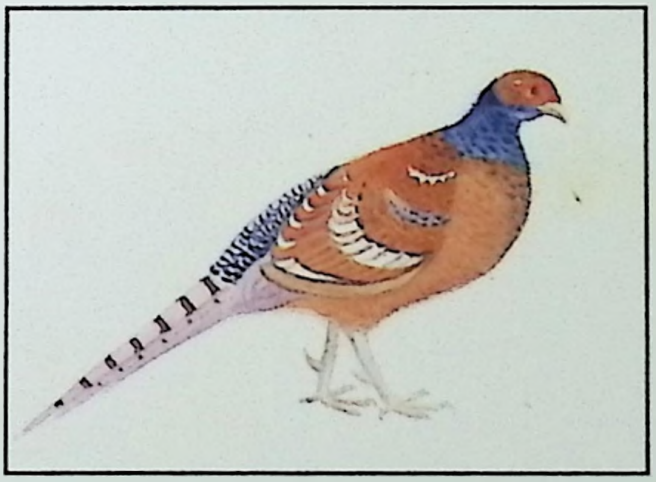

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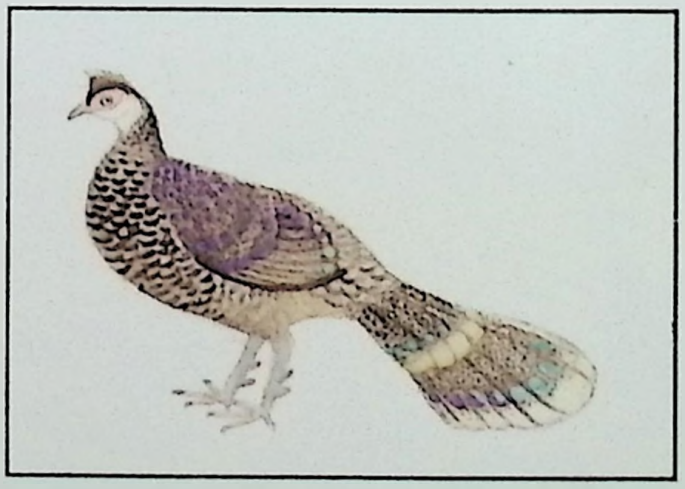

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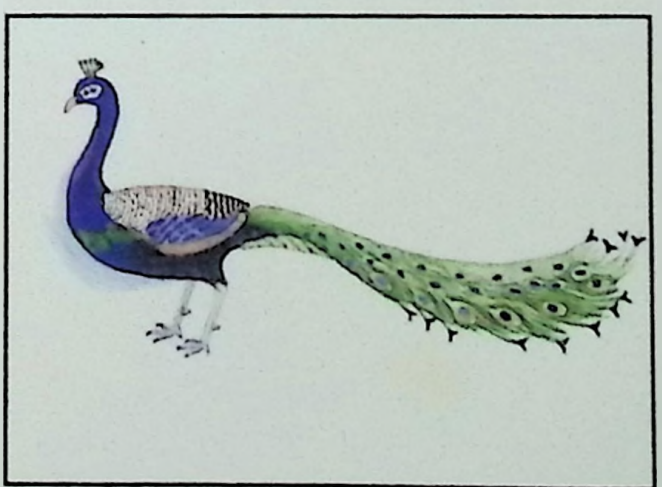

Indian Peafowl