PARROT INCUBATION PROCEDURES

BY

RICK JORDAN

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A METHODICAL GUIDE TO INCUBATION, HATCHING, AND PROBLEM HATCHES FOR THE AVICULTURIST

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Foreword

As a practicing aviculturist for over forty years, I've had the opportunity to observe many changes and developments in the keeping and breeding of parrots. Within the last fifteen years, there have been increasing numbers of parrots bred in captivity each year. This increase has generally been the result of vastly improved avicultural techniques that have emerged as a more scientific approach to our avicultural pursuits has developed. Imagine for a moment the difficulty of breeding monomorphic species before the advent of surgical and cytological sexing; imagine the difficulty of treating birds for disease before avian medicine became an established field. Improved understanding of psittacine nutrition and a host of other innovative developments in husbandry have significantly increased the efficiency and successes of our avicultural endeavours.

An area of husbandry that has become increasingly important in the management of many psittacine collections is the use of artificial or surrogate incubation. Until now much of the information utilized in developing these programs has been extrapolated from incubation data on other groups of birds. While general incubation procedures are, indeed, very similar for most species, little, if any, specific information has been available as a result of the actual incubation of significant numbers of parrot eggs representing a broad range of species.

The data presented in Parrot Incubation Procedures (PIP) are the result of artificial incubation of an unprecedented number of parrot eggs. These have included a wide variety of psittacines ranging from common species such as Indian Ringneck Parakeets to such avicultural rarities as Palm Cockatoos and Blue-throated (Canindae) Macaws.

By virtue of his association with the Avicultural Breeding and Research Center in Florida, the author has undoubtedly had the

occasion to artificially incubate the greatest number of large psittacine eggs ever available to a single individual. The expertise he has gained from this in-depth marathon endeavour has provided much information that is available from no other source. This volume will undoubtedly go a long way in enhancing the artificial incubation of parrot eggs for many years to come.

Robert J. Berry
Former Curator of Birds
Houston Zoological Gardens

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If it were not for Mr. Schubot, I might very well still be incubating bird eggs with a quart jar and a light bulb.

Finally to Dale Thomspon for his generosity in supplying us with the images of the Red-vented Cockatoo chicks, Citron-crested Cockatoo chick, Scarlet Macaw chick and three Rose-breast chicks.

This book is dedicated to Mr. Robert (Bob) J. Berry, former Curator of Birds at the Houston Zoological Gardens in Houston, Texas and private aviculturist extraordinaire, and to Mr. Richard M. Schubot, founder of the Avicultural Breeding and Research Center in Loxahatchee, Florida.

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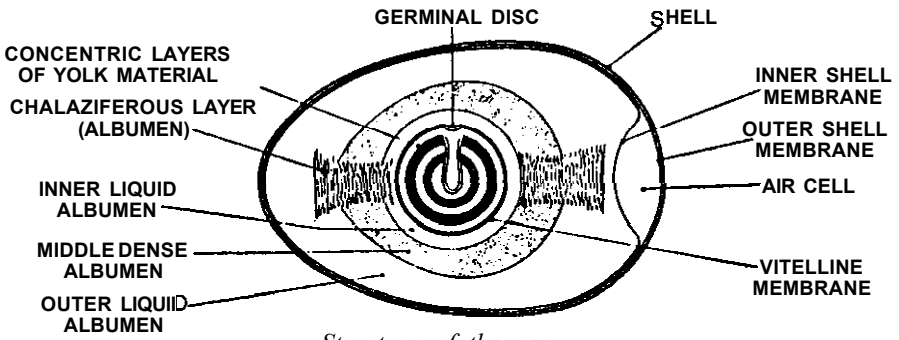
The Egg

THE EGG

The egg, although seemingly simple, is a very complex method of reproduction. If an egg is cracked into a bowl for inspection, it appears to be nothing more than a shell, yolk, and some eggwhite; however, each one of these parts contains less visible but crucial subparts, all of which must be in their proper place and perform their contributing function for a chick to be hatched. Malfunctions of any of the constituents may cause death to the embryo.

When the egg is formed, it must contain all of the nutritional requirements necessary to sustain the growing chick until after hatching. This is the main reason that birds fed inadequate diets have a history of *dead in shell* chicks.



Structure of the egg

(Courtesy: Nimrod Press Ltd.)

EGG COLOR

Parrots lay white eggs. Perhaps a better way to say it would be that parrots lay eggs that have no color in the shell or cuticle. White eggs are common in species of birds that nest in dark places because light colored or white eggs are easier seen by the hen when entering the nest.

THE EGGSHELL

Eggshells perform one very important function: protection. The shell is shaped and formed so that great pressure must be exerted on it before it will shatter from the outside, but it will crack easily if pushed from the inside. This physical phenomenon makes it easier for the chick to escape the shell when the time arrives. Shell thickness varies greatly among birds. Generally, the larger the bird, the thicker the shell. Eggs with thinner shells usually contain thicker shell membranes and vice versa.

The shell of an egg contains countless pores that allow the *transpiration* of moisture and gases from inside. In the same manner, bacteria or other microscopic organisms can be drawn into the egg through these pores if the eggshell is wet and subjected to cooling. The number of pores increases near the small end of the egg; however, this is usually not detectable without the aid of a magnifying glass.

The shell contains three separate layers. The outermost part is called the *cuticle* and consists of dried mucus laid down in the uterus. This dried mucus creates a shining luster in the eggs of some species of birds, but not in all of them. The main functions of this layer are to regulate evaporation of moisture through the shell and to protect the embryo from bacteria and other microorganisms.

Directly beneath this cuticle is a soft calcium carbonate layer sometimes referred to as the *testa.* It is this layer of shell that provides the growing embryo with the nutritional calcium it needs to produce a strong skeletal structure. This layer makes up most of the thickness of the shell.

The third and innermost layer of shell is called the mammillary layer which lies in contact with the shell membrane. This is the first layer of calcium that is laid down in the uterus and forms the foundation for the remaining two layers.

THE SHELL MEMBRANES

The egg contains two shell membranes, the inner shell membrane

and the outer shell membrane. Both of these membranes lie directly beneath the shell and in contact with each other except in the area of the air cell. At the large end of the egg these membranes separate as the egg cools and the air cell is formed between them. The outer shell membrane adheres to the shell while the inner shell membrane drops and rests on the liquid portion of the egg.

It is difficult to visualize the way these two membranes are situated inside of the egg. When assisting a hatch and the shell over the air cell is removed, the white canopy membrane that remains over the chick's head is the inner shell membrane. If the removed piece of shell is inspected, a portion of the outer shell membrane can be seen adhering to the inner surface of the shell.

THE ALBUMEN

The egg-white, called the albumen, consists of three proteins: mucins, globulin and albumen. The albumen has both a thick and a thin form and is deposited in three layers. The thin albumen engulfs the yolk and is surrounded by a layer of thick albumen and another layer of thin albumen. Thin albumen surrounds the thick albumen in all areas of the egg except the polar ends. This thinner albumen is said to contain anti-bacterial properties and is a source of nutrition for the embryo. (A.S.King/McLelland) The thick albumen is connected to the shell membranes at each end of the egg.

Two strands of thick albumen, called the chalazae, surround the yolk and yolk membranes. These strands connect to the shell membranes in the same area as the thick albumen and act as a stabilizer to keep the yolk in the center of the egg.

THE YOLK

The yolk contains solid proteins and fats which are the main source of nutrition for the growing embryo. Yolks of different eggs exhibit varying shades of yellow or white due to the amount of fats contained within. Eggs containing dark yellow or pale yellow yolks are equally hatchable when incubated properly.

There are four membranes that surround the yolk and keep it intact and separate from the albumen. During early embryonic development, a system of blood vessels develops in these membranes and encircles the yolk, carrying nutrients to the growing chick. As hatch time approaches, the remaining yolk is pulled into the abdomen where it is absorbed over the first few days of the chick's life outside of the egg. Close inspection of newly hatched chicks will reveal the yolk, with

its system of blood vessels, through the transparent skin on the chick's naval.

THE GERMINAL DISC

The term germinal disc refers to the nucleus of the female cell or ova. This disc appears on the surface of the yolk as a small white dot. If the egg is fertile, this dot is called a *blastoderm*; if it is infertile, the dot is called a *blastodisc.*

The blastoderm contains the genetic material necessary to create the offspring of the parent birds. The cells of the blastoderm begin to separate and grow before the egg has been laid. A fertilized germinal disc will often appear as a small donut shaped area when cracked out for inspection. In cases where infertility is suspected or where the sex of the pair is not certain, the presence of a fertilized germinal disc indicates other causes of nondevelopment.

FORMATION OF THE EGG

The reproductive system of the female bird includes a left ovary and left oviduct. Rarely does it include a functional right ovary as this usually remains small and dormant throughout the life of the bird. This adaptation may have occurred to help keep the bird's body lighter for the purpose of flight.

Birds of different species have different numbers of ova in the ovaries. These ova resemble a small cluster of grapes and usually only one ovum matures at a time. The mature ovum breaks away from the cluster of remaining immature ova and enters the reproductive tract of the hen.

The funnel shaped entrance to the oviduct is called the *infundibulum.* This entrance contains glands where some of the sperm from the male is stored. It is in this area that fertilization of the ovum takes place. The sperm cells can stay alive for several days; therefore, only one successful copulation may result in several fertile eggs.

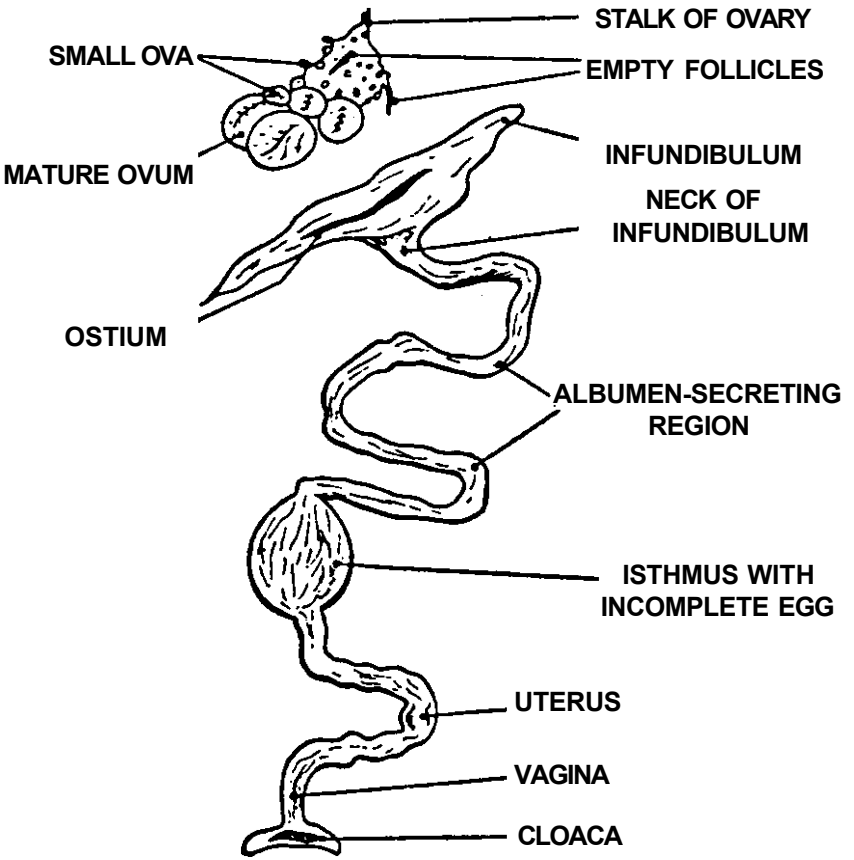
Once the egg moves through the infundibulum, it enters the second part of the tract called the *magnum.* The magnum is the longest portion of the oviduct and is where a majority of the albumen is added to the egg yolk.

As the yolk and albumen move out of the magnum, they enter the *isthmus.* It is here that the inner and outer shell membranes are placed around the albumen.

From the isthmus, the incomplete egg moves into the *uterus* or *shell gland.* The uterus is a thick walled, muscular area of the oviduct.

Water and salts are added through the membranes and the shell is formed around the egg. Lastly, the cuticle is deposited over the shell, and the egg is ready to be expelled from the oviduct.

The amount of time that the egg spends in each section of the oviduct varies from species to species and even among birds of the same species. It is believed that the majority of time is spent in the uterus during shell formation.



Female reproductive system

(Courtesy: Nimrod Press Ltd.)

EARLY EMBRYONIC DEVELOPMENT

The embryo begins to form before the egg is laid. Depending on the amount of time the egg spends in the uterus, fertility can be assessed through *candling* as early as day one. This advanced development is often a cause of early dead embryos if the egg is allowed to cool after development has commenced and progressed beyond a certain point. For this reason, it is not wise to store parrot eggs prior to incubation.

The yolk, inside of the egg, will float to the top and maintain contact with the shell membranes. The germinal disc will be in the upward position and can often be seen through *candling* of the egg. Proper turning must take place to keep this disc from becoming affixed to the shell membrane because this will cause damage to the young embryo and often will cause its death. After a few days of incubation, the growing embryo will become more apparent due to the visible system of blood vessels that are spreading out across the yolk.

RATE OF EMBRYONIC GROWTH

The rate of growth of an embryo varies from species to species. It is not true that larger eggs always require a longer incubation period than smaller eggs. Nor is it true that larger birds have a longer incubation period relative to their adult body size. The magnificent Hyacinth macaw and the medium sized African Grey parrot hatch in approximately the same amount of time. The archaic assumptions that larger eggs take longer may be a contributing factor to deaths in the egg; if the incubation period of the species being incubated is not known, hatching assistance may be critically needed but postponed through ignorance.

During the first few days of incubation, the fertile egg may be distinguished by the visible vessel structure of the developing cardiovascular system. The heart begins to pump in the first week of life and at this point, the vascular system begins to grow at a faster rate.

During the second week of incubation, the blood vessels that support the chick should be apparent throughout the membranes of the egg. As incubation progresses, the chick grows larger and candling becomes more difficult. At this stage of development, the egg may appear very dark toward the pointed end, and the only blood vessels that will be visible will be near the line of the air cell.

When hatching time is near, the chick will move its head toward the air cell. This movement causes the inner shell membrane to shift position and drawdown the side of the egg. This is the time when the chick takes its first breath of air.

Approximately 24 hours after the chick has penetrated the air cell, it should poke a small hole through the external shell using the tiny egg-tooth located near the tip of its beak. Sometime within the next 24 to 72 hours, the chick should emerge from the egg.

Incubation techniques and temperatures play a very important role in the timing associated with each developing egg. Lowered temperatures may bring about a delay in hatching and may often weaken the chick to the point that it no longer has the strength to hatch at all. Optimum temperatures that simulate those used by the natural parents will effect proper embryonic development and produce more healthy viable chicks.

chapter 2

Aviculture as a Prelude to Incubation

INTRODUCTION

What is *incubation*? The process of applying heat to eggs to effect embryonic development. It sounds as if it would be an easy task to simulate, but for many years aviculturists have failed to find the secret to this science and accomplish it as well as nature has. Thus, the search for a better way is not over.

There are many ways to incubate eggs of exotic species of birds. Most of these methods are successful in varying degrees. Subtle differences will emerge among the chicks produced by differing incubation processes which is evident if weight gain charts between incubator hatched chicks and chicks hatched by their natural parents are examined. These subtle differences are usually not enough to worry about, but they should remind us that we do not know it all and that nature still has the upper hand on a few of the sciences.

Raising parrots can be a rewarding and even profitable endeavor. There are, however, countless situations and problems that need to be solved before your efforts will yield maximum productivity. Proper management of your breeding stock is an important step to breeding and raising healthy chicks of any parrot species. The laying and hatching of fertile eggs is the only way to measure success of a flock. If eggs fail to hatch, very little has been accomplished for the time and effort expended.

This book was written in hopes that it will encourage more aviculturists to record incubation data and stimulate more avian research facilities. Purchasing expensive equipment is not necessary for the gathering of important incubation statistics. Recording and

sharing your notes will help reinforce the foundation of knowledge in which, as yet, so few parrot breeders participate. The data on the five or ten eggs that you might incubate could be the confirming bit of information needed so that we all may begin the breeding season next year with more insight and a higher success rate.

The following chapters may make your struggle for a better way a little easier because these methods do work. When developing your incubation system, however, keep in mind that you will not do as well as the natural parents in some cases and in others you may do better. These are the unwritten laws of incubation and nature. If you discover other methods that work well, share them with those of us who are interested so we may all better understand this phenomenon.

THE ADVANTAGES OF ARTIFICIAL INCUBATION

The advantages of artificially incubating eggs include an increase in productivity, a reduction in disease transmission, and the elimination of bad habits being learned from the parents, to name a few.

The potential increase in the number of young that can be hatched and reared is an obvious advantage. Some birds will not lay multiple clutches of eggs if allowed to raise their own young. By removing eggs for artificial incubation, birds can often be triggered into laying two, or even more, clutches of eggs in one season. This is particularly important in the case of single egg layers.

So little is known about most avian diseases and viruses and how these are transmitted. Artificial incubation may help reduce the risk. If exotic eggs follow the same disease transmission patterns as domestic poultry, there is a much higher risk of disease being transmitted from parent to live chick than would be from parent to an unhatched egg. I have seen evidence of this in the 1986 and 1987 breeding season when a fatal disease ran rampant in a nursery when some eggs were hatched and partially reared by parent birds before entering that nursery. The following year an artificial incubation program was followed and all eggs were hatched in machines and chicks were hand-reared from day one. As of the time of this writing, there has been no recurrence of the disease in the chicks that have come out of that nursery. In previous years, the signs of illness were prevalent in chicks at a very young age and most had to be sacrificed due to the lethality of the virus. Whether or not this improvement is due to a higher cleanliness standard rather than to artificial incubation has yet to be proven. I am inclined to think that eliminating contact with the parent birds prevented disease transmission and artificial incubation doubled production in 1988.

It appears that disease transmission to parrot chicks is lowered

considerably by artificially incubating the eggs. This could mean a lower incidence of viral diseases such as Papova virus, Feather and Beak disease, Pacheco's virus, and Psittacosis in the nursery.

How much of a bird's behavior is actually learned from the parents? Perhaps self-mutilation, mate harassment or annihilation, poor eating habits, or obnoxious screaming are all learned behaviors. This means it would be possible, through artificial incubation, to raise the almost perfectly behaved bird. This is of course just speculation but with the increase in numbers of people who artificially incubate eggs, it will not be long before we know if these traits are learned or inherited.

FLOCK MANAGEMENT

The propagation of parrots requires a male and a female. Many people take this situation for granted and continue to hope for fertile eggs from a pair of male or a pair of female birds. To complicate matters, most parrots are not *dimorphic*. This means that the boys look like the girls and vice versa.

The presence of two parrots in a cage, a nest box, a proper diet, fresh water, and privacy does not guarantee breeding results. They may exhibit compatible behavior and may even copulate but if these birds have not been *surgically sexed* by a competent avian veterinarian or *chromosome feather sexed*, they may be two birds of the same sex that have adapted their behavior to playing roles. Sometimes two females in a cage will set up housekeeping, lay eggs, and take turns incubating. To my knowledge there have been no chicks produced from these pairs. There is always the possibility that one of them may lay a fertile egg if she has been in the cage with a male previously. The continued laying of fertile eggs is out of the question. Quite often a breeder will allow pairs such as these to remain together based totally on their behavior; this is not a responsible approach to breeding parrots.

The number of avian veterinarians who are experienced at surgically sexing birds is growing every day. Engaging the services of such a veterinarian is a good way to get started with a breeding program. Once it is established that you do, in fact, own a male and a female of the same species, it is time to think about housing them properly.

There are numerous styles and sizes of cages used by breeders across the world. What has worked in the past for them will not necessarily work for you, but it is always worth a try.

Two basic types of cages are commonly used today. One style allows the birds access to the ground or floor. This is called a flight cage and is advisable for certain species of birds that tend to gain excessive

weight in captivity by providing sufficient space for flight or other exercise. Overweight birds are not the best breeders.

Another type of cage is a wire cube or rectangle that has a wire bottom. These cages are usually suspended in the air by means of legs or cables. Small pieces of food and feces will fall through the bottom of these cages allowing for easy cleaning.

The type of caging selected is a personal decision. Be sure, however, to allow enough room for the birds to fully stretch their wings and keep their tails from dragging on the wire bottom or ground. Protection from predators, rain, heavy wind, snow, and cold are important factors to keep in mind when constructing your cages. Try to design your cages with the birds in mind, but do not forget to allow for easy cleaning and feeding. Privacy is also important to some parrot species and should be taken into consideration. If housed and fed properly, a healthy compatible pair of parrots usually produce young.

INDOOR VERSUS OUTDOOR ACCOMMODATIONS

Birds kept indoors due to climate or convenience are afforded protections that outdoor collections are not. There are still important factors to consider with indoor housing of birds. Ventilation and full spectrum lighting are two of the most important things to keep in mind when building any indoor facility. Cleanliness and health will parallel each other in a closed environment; as the cleanliness standards decline, so will the health of the birds.

Outdoor aviaries are preferred by many, but are not always desirable in cold winter regions. Birds housed outdoors require protection from rain, scorching sunlight, wind, and predators. Food bowls should also be protected from rain because damp seed will grow many types of harmful molds and fungi.

In all types of aviaries, keeping the nesting area dry is very important. Dark, moist nest boxes are ideal areas for the growth of bacteria and fungi which may invade eggs or young chicks. Sometimes these contaminants may even invade the sitting hen by entering the *cloaca.*

NUTRITION

The subject of parrot nutrition is a never ending controversy. Many diets are available and when searching for the best diet, it is advisable to ask a few successful breeders what their daily staple includes. Avoid diets that rely heavily on seeds as the major component as these diets are high in fat and lead to calcium and other vitamin and mineral

deficiencies. Parrots in the wild eat a wide variety of foods from seeds and nuts, to flowers, buds, dirt, and insects.

Vegetables, fruits, dog food kibble, seeds, nuts, and a variety of people foods have been used to feed captive parrots. Most parrot diets are deficient in much needed vitamin A and the mineral calcium. These two important items need to be supplemented in most cases if the bird is to remain healthy and breed without undo stress. Some species require higher levels of some vitamins and minerals making an overall diet for an entire flock undesirable. It is always wise to investigate their specific dietary requirements.

Before purchasing certain birds, some dietary needs, if researched ahead of time, may cause you to change your mind about having to have a certain species in your care. Most people tend to shy away from birds that require a daily supply of different kinds of fruit rather than seed in their diet. Many more people will shy away from birds that savor the flavor of hairless pinkie mice that have to be chopped on the kitchen cutting board.

Needless to say, the birds will be hesitant to raise young if the diet does not provide them with what they need to feed their young. It is your job as the keeper of the flock to be sure that they receive a suitable diet.

Talk to successful breeders of different birds to see what they feed their birds. This may not be the best answer, but it is as good a place to begin as any. Always consult an experienced aviculturist or veterinarian prior to using vitamin and mineral supplementation.

NUTRITION AS IT RELATES TO INCUBATION

Why all this talk about nutrition in a book about incubation? The growing embryo inside the egg is a bird that needs sufficient nutrients to develop and it has no external means of acquiring this nutrition in the state it is in. The only possible way to get the required vitamins and minerals into the egg is via the diet fed to the parents. The diet provided to the parent birds has a direct relationship on the hatchability of the eggs. To go one step further, diet also influences fertility in the parent birds.

When calcium is discussed as an important dietary ingredient for strong egg shells, some do not realize that the embryo inside also receives some of that calcium from the egg shell. Without it developmental problems, such as *rickets*, or even death may result. Studies have been conducted with poultry where the breeding hens were fed diets that were inadequate in essential vitamins and minerals. These studies showed that the chicks produced by these hens had deformities,

deficiencies, and a higher mortality rate than chicks from hens fed adequate rations.

If the diet is inadequate, it may disguise itself as the result of improper incubation techniques. If you follow all the rules of proper incubation and your success rate is still marginal, it may be time to look at the nutrition of your breeding stock.

Nutritional deficiencies that manifest themselves as deformities in the chicks are heartbreaking. Birds with curved spines, deformed beaks, twisted legs and wings, or permanent organ damage are virtually useless as breeder stock and some are too unhappy to sell into the pet trade. These types of problems can be avoided by proper nutrition.

CALCIUM

Calcium is the primary ingredient of the skeleton and the eggshell. Insufficient amounts of calcium in a seed diet make it necessary to supplement this mineral in order to maintain a healthy flock. It is also believed that the high oil content of most parrot seed diets may contribute to calcium deficiencies by combining with the calcium and preventing its absorption into the bird's system. For this reason, it is recommended that an analysis of the diet be performed and if necessary, supplemented with a calcium and phosphorous product.

In the laying hen, calcium, phosphorous, and vitamin D_3 deficiencies may cause severe bone structure erosion as the body tries to maintain its blood calcium levels. When the egg is being formed, calcium is drawn from the intestines to use as calcium carbonate shell layers. If this calcium is not available from the diet, the body will utilize calcium from the skeletal structure and may severely weaken or cripple the hen (Petrak 1982). Furthermore, this condition may cause egg binding and eventually cause the death of the hen.

Parrots fed a diet that is deficient in calcium or vitamin D_3 often show signs of these deficiencies. Eggshells become soft, brittle, stressed, or may not be present at all. Chicks that are hatched and reared by the parents may develop calcium related disorders like brittle bones in the legs, wings, or the entire skeletal structure. Upon leaving the box these chicks may not be able to fly or to perch due to the weak conditions of the bones. Sometimes fledglings emerge with wing and leg deformities that will cause their death upon the first attempt at flight.

There is a proportional relationship among the dietary requirements of calcium, phosphorous, and vitamin D_3. Experimentation with different ratios fed to laying chickens established a normal ratio of 3:1 calcium to phosphorous requirement. Without vitamin D_3, however,

the calcium cannot be utilized in the bird's system and calcium supplementation will be futile.

Birds housed indoors require a vitamin D_3 supplementation because unfiltered sunlight is the main source of the production of this vitamin. Consultation with an avian veterinarian is suggested due to the danger of overdose with this vitamin. Too much vitamin D_3 can cause hypervitaminosis D_3 and the absorption of calcium in organs and soft tissue where it does not belong. In severe cases this causes death to the bird.

Once again, it is advisable to research the dietary requirements of certain species of birds that you plan to keep. Some of the commonly kept parrots have a higher requirement for calcium due to their metabolic usage of this mineral.

CUTTLEBONE AS A CALCIUM SOURCE

Eggshells consist of 85% calcium carbonate, 1.4% magnesium carbonate, 0.76% phosphate and 4% organic matter. This physical analysis is almost identical to that of the cuttlefish bone which is made up of 85% calcium carbonate, 4% protein, and about 1% magnesium with trace elements of silicon, titanium, iron, copper, nickel, chromium, vanadium, zinc, barium, lithium, zirconium, aluminum, and molybdenum (Petrak 1982).

For this reason, and also because it is readily accepted by most birds, *cuttlebone* is an excellent source of calcium in the diet. Cuttlebone can be purchased in bulk supply to be crushed into small pieces and fed with the daily diet. This is a convenient way to provide your birds with the calcium they need, but it does not ensure that they will eat it. If signs of nutritional calcium deficiencies are present, another form of supplementation, such as neocalglucon, is needed and should be obtained through your veterinarian.

PAIR BONDING

The bonding between a male and a female bird is very important for the production of young. Birds that are housed singly for a period of time, and are not bonded to their human keeper, often bond with the first bird of the same species and opposite sex that they encounter. This is a favorable situation for successful breeding. Bonding can, however, take place between birds of two different species or birds of the same sex. Adequate *pair bonding* can be almost instantaneous or take several years. By no means should an incompatible male and female be shoved together in a cage. This could result in a dead bird.

Pairs to be introduced should be placed in separate, side by side cages where they can see each other and vocalize to each other. When these birds begin to roost as close to each other as possible during the night, a bonding is taking place. After there is no doubt that they want to be together, they should be placed together in a cage that is foreign to both of them. This will reduce the chance of a dominant role evolving allowing possible injury to the subordinate bird. Avoid the rush to give them a nest box until they are familiar with each other. Sometimes the presence of a nest will cause one of the birds to become frustrated and impatient to breed. It is better that they both be ready before providing a place to nest. There are exceptions to this rule. Some species of birds sleep in a nest box and if not provided, may suffer from unnecessary stress.

Once pair bonding has taken place, it is difficult to dissolve. If a pair of bonded birds needs to be separated for some reason, the mate should be moved out of visual and audible range. The presence of the original mate may prevent a new pair bond from being established.

Bonding in birds can take place at a very young age. In some species it may be as early as weaning age. This often results in bonds between related birds or birds of the same sex. If possible, siblings should be separated and housed with birds from other bloodlines. A careful eye will tell you if pair bonds are being formed. If birds are feeding each other or playing sexual roles, it is time to put them with unrelated birds of the opposite sex.

PROBLEM PARENTS

The decision to pull eggs from a pair of birds is a difficult one. If you have no means to incubate and hand feed the chicks, however, there is no decision to make. This situation does not allow for any type of crisis management and limits your options to save chicks.

Many times first-time parents will not incubate eggs properly and if they do incubate, there is still no guarantee they will feed the chicks. The uncertainty of this situation warrants frequent checks of the nest box but this often will drive a new parent from the nest and cause her to abandon the eggs or chicks. After the loss of the first clutch the reliability of that pair of birds is suspect and the aviculturist may think it necessary to pull the eggs of future clutches. Many poor parental habits are reinforced by this type of mismanagement afforded first time layers.

Once poor parental habits are formed, they are difficult to break. The eggs of these pairs may require artificial incubation if chicks are to be hatched. If there is a doubt whether a hen will incubate eggs,

dummy eggs or eggs of another species, i.e., pigeons, can be substituted for the original clutch. Evaluation of the substituted eggs after a short period of time will provide an answer as to how well the hen is incubating. This information can be considered before another clutch of eggs is laid.

Parrots that refuse to enter the nestbox, but lay eggs off the perch onto the cage floor, can be managed by placing hay under the perch to catch the eggs. These eggs are hatchable depending on the amount of force with which they hit bottom. Be sure to pile the hay fairly high and retrieve the eggs as soon as you can so nothing else happens to them in the mean time.

If a pair of birds consistently break eggs, abandon them, or kill chicks, other means of incubation are necessary. Depending on which parent is causing the problem, re-pairing with another mate will frequently solve the problem. The birds with the bad habits can be sold (as problem breeders) or given to someone who has the means to deal with the situation.

Problem parents that are the most difficult of all to manage are the egg eaters. Birds that eat their own eggs make it very difficult to obtain them for incubation of any means. When these pairs go to nest, a close eye must be kept on the box for signs that she has laid the first egg. Sometimes substituting infertile eggs for the hen to devour will preoccupy her long enough for you to get to the nest box and rescue one of her eggs before it too, is consumed. If she eats both the infertile egg and her own egg, try putting two or three infertile eggs in at the same time. This usually confuses her and you may find one of her eggs still intact when you check the box.

Another method that is used quite frequently is to substitute false eggs to help curb the hen's obsession for eating eggs. Ceramic eggs can be purchased from your local ceramic shop to use as substituted eggs. Be sure there is no hole in the egg where the parrots can get their beak inside or they will destroy the glass egg and possibly injure themselves in the process. You will find that, in most cases, the hen surrenders the attempt to eat the ceramic eggs and will begin to incubate it.

SURROGATE SITTERS

In the absence of a good incubation system, proven surrogate sitters can be used to hatch eggs of problem parents. Hens chosen to hatch eggs of other birds should be carefully selected. Unproven surrogates should never be trusted. If a hen has raised young in the past, leaves the nest with no hassle, and returns promptly, she is probably a good

candidate for surrogate sitting. You can only place eggs under a hen that has laid eggs of her own and is actively incubating them. It is highly unlikely that a bird will sit eggs placed in her nest unless she is in a breeding cycle. Only eggs of approximately the same size should be substituted. Eggs that are too big or too small may not get the proper turning in the nest.

Using surrogates to sit other eggs also has its limitations. For one, what is to be done with the surrogate's eggs? If they are known to be infertile, this is no problem, but fertile eggs present both an incubation problem and a hand rearing problem if you are not equipped to handle the situation.

Another consideration is the ability of the surrogate to feed the fostered chicks once they have hatched. Different species of parrots have different feeding responses and often a surrogate will misinterpret this difference as a potentially ill or weak chick and refuse to feed it. The amount and color of down on newly hatched chicks may also trigger a negative response from the surrogate sitter. Some species may kill chicks that do not look like their own.

Last, but not least, there is also a timing factor to consider. The eggs to be placed under the surrogate should be due to hatch at approximately the same time as the surrogate's original clutch. Some hens will eat or destroy eggs they think are overdue, and they do it with remarkable timeliness. It is possible to substitute eggs under the surrogate for two weeks, move them to the incubator and substitute another set of eggs for her to incubate. Make sure that any eggs are removed from the nest before the due date of the original clutch.

If a pair of birds is maintained in the collection that consistently lays infertile eggs but incubates very well, they can be used to incubate fertile eggs of another pair of birds. The above considerations to size and timing still apply.

In the overall picture, if you are planning to hand feed the young, using parrot surrogates will not increase your production nearly as much as will a trustworthy artificial incubation program or a few good chickens to act as surrogate sitters.

WHEN ARE EGGS LAID?

There is controversy over this subject due to individual differences in each pair of birds. I feel it is important to discuss this subject in order to provide information for better management decisions when dealing with problem parents and artificial incubation.

In my experience, most parrots lay eggs in the late evening hours right before dark. This time period can extend into the dark hours

but rarely does it extend to the morning hours. Pairs that are known to damage or eat their eggs are checked just before dark and again immediately before daybreak. For the most part, I have found that eggs are laid shortly after dark. With a few exceptions, laying occurred so late that I had to retire before the eggs were laid and subsequently found before dawn the next morning. I have known of a few parrots that lay in the middle of the day. A few people that keep parrots have told me of instances where their birds did lay eggs other than the times mentioned above. Getting to know the laying habits of your birds will provide you with the insight that you need to better manage your incubation program.

The time of year that parrots lay their eggs is variable in every situation. Parrots that originally come from the southern hemisphere usually lay their eggs during the same time of year each year. When brought into captivity in the northern hemisphere, some of them will continue to lay in accordance with their natural instincts and often this time does not coincide with our natural breeding season. After a few years in captivity, they will often adjust to our seasons and lay accordingly. There are species of parrots commonly kept today that will lay eggs all year long and at any time of the year. This is the reason that an artificial incubation program should be on line and ready to go at any time. Eggs that are left in the nest box during the bitter cold winter have a very low chance for survival.

What makes a parrot enter the breeding cycle and begin to lay eggs is not fully understood. It used to be thought that parrots are influenced by the natural photo cycle just as the domestic chicken. This would be unexplainable in the case of parrots that come from the equatorial regions, as there is very little or no change in the light cycle of their natural habitat. Other suspicions include the change in barometric pressure as an influence on egg laying. Experimentation with photo cycles, food availability, nesting site choice, and weather changes yield some interesting facts, but very few solid conclusions.

Some parrots exhibit a dramatic change in their behavior when they are preparing to nest. This behavior change is usually in the form of aggression toward the keeper or anyone who might be near the cage. Other noticeable behavior changes may include a new-found affection for each other that was not noticed previously or attention paid to the nest box that they have yet to enter. There is usually a change in the birds as the breeding season rolls around. Although sometimes subtle, parrots do change their personality when nesting is inevitable.

A more obvious clue that nesting is going to take place would be a noticeable swelling in the lower abdomen of the female bird. This swelling is caused by an egg that is in the uterus and it is usually

noticeable within one or two days of the laying of the egg. It is this time period that a close eye must be kept on the hen to make sure that she does lay the egg so she does not become *eggbound.*

MULTIPLE CLUTCHES

In order to achieve maximum productivity from a pair of breeding birds, some breeders remove eggs or chicks from the nest in an attempt to encourage the pair to lay another clutch. Depending on the species and also the individuals, this may bring about another clutch of eggs. Some pairs may continue to replace clutches throughout the breeding season if eggs are pulled for incubation elsewhere.

To take this practice one step further, there is a way to increase the clutch size of some birds. If one or more of the eggs is removed from the nest during the laying cycle, some birds will replace these eggs before incubating the clutch. These birds are called *indeterminate layers.* A higher production is possible with species that lay an indeterminate number of eggs in each clutch.

There are also birds that will lay a set number of eggs in each clutch. Pulling eggs from these birds will not trigger their replacement and may or may not cause a new clutch to be laid. These birds are known as *determinate layers* and influencing the size of the clutch is virtually impossible (Pettingill 1970).

It is wise to do a little research on the different species of birds that you keep. This will result in better management techniques and reduce undue stress on your birds. Consult other breeders of certain species of birds to find out if they have laid a second clutch or replaced eggs that are removed for incubation. The results will be a better understanding of individual management techniques for each pair of birds in your care.

LAYING INTERVAL

Laying interval can be defined as the time period that passes between the laying of each egg in a clutch. This interval differs in each hen but seems to average about 48 to 72 hours, generally, the larger the parrot the longer the laying interval. Occasionally this interval extends even longer; I have an Amazon hen that will go seven to eleven days between each egg. Getting to know your birds is the key to figuring out their particular interval, however, sometimes they will fool you by changing the interval with each clutch or even with each egg in the clutch.

Special conditions or interruptions can cause a longer interval to

occur between the laying of eggs or clutches. If the weather turns cold before the clutch is complete, sometimes the hen will discontinue the laying of eggs. Depending on the severity and length of time the weather remains cold, the hen may resume laying when conditions return to normal. This often results in the hatching of chicks with age differences of a week or more. If not closely monitored, the younger chicks may not receive the parental care that they require to survive.

Disruptions in the nest or area of the nest can also cause a hen to delay or discontinue the laying of a clutch. Birds that object strongly to nest inspections seem to be more prone to this type of interval change. Once again, individual management techniques may need to be established for each breeding pair of birds in your care.

CLUTCH INTERVAL

As mentioned earlier, some parrots will lay another clutch of eggs when the first one is pulled away. To get an idea of when to expect the laying of the next clutch, calculate the number of days in the incubation period and add it to the date that you pulled the eggs. This usually gives you a good reference point to start looking for the next set of eggs. Some parrots will lay earlier than this (Eclectus Parrots are famous for this) but most will wait an entire incubation cycle before laying again. The fastest turn around time will occur if eggs are pulled as they are laid or immediately after the clutch is complete. If the birds are allowed to hatch and feed the young for a few days before they are pulled, the next clutch will take longer if one is laid at all. I call this time period between the laying of clutches: *clutch interval.*

THE EGGBOUND HEN

When is a hen officially eggbound? This is a difficult question to answer if you are not "in touch" with your birds. Every hen acts differently and every hen will give different indications that she is in need of help to lay an egg.

In mild cases of egg binding, where the hen shows no physical signs that she is having trouble but is overdue to lay an egg, it is difficult to decide when to intervene. Cold weather causes an increased incidence of egg binding. If weather conditions are colder than usual, taping a heating pad to the outside bottom of the nest box will sometimes help the hen to pass the egg. Monitor the hen closely for further signs of difficulty which may manifest themselves as loss of appetite, drooping head, watery eyes, loss of muscle control or inability to walk. These symptoms indicate a severely eggbound hen that requires further assistance.

Once any or all of these signs are noticed, it is time to act fast and hope that you are not too late; contact an avian veterinarian immediately. Some home remedies that help keep the hen comfortable are to keep her warm by use of a heating pad or heat lamp. If you are adept at veterinary assistance and no veterinarian is readily available, you could place small amounts of KY lubricating jelly into the cloaca and gently massage the vent area. I do not recommend that you help her to pass the egg unless you have done it before and you are confident that you know what you are doing. Breaking an egg inside of the bird's body will often claim her life.

Once in the veterinarian's office you can expect heat application, lubrication of the cloaca, *palpating* and manipulation of the egg, a calcium injection, or even the internal collapse of the egg by use of a syringe and a large needle. These are not procedures that I would recommend to the layman unless you have no choice in the matter. Egg binding is very serious and does mean death to the bird if not resolved. A diet evaluation is in order if egg binding becomes a frequent occurrence.

EGGS WITH NO YOLK

Besides the obvious zero hatchability of these eggs, it may be important to mention the possible indications involved with the laying of an egg of this sort. It is possible that a yolk was produced to be included in these eggs and it never entered the infundibulum of the hen. This means it could have "fallen" or entered the body cavity where it can cause severe physical ailments.

If an egg without a yolk is found, it is wise to keep a close eye on the hen that laid it. If in fact the yolk entered the body cavity instead of the reproductive tract, the hen may suffer *egg yolk peritonitis* or internal infection. This condition causes a range of problems which may include death of the bird.

Any symptoms that indicate the hen is feeling poorly also indicate she needs to visit an avian veterinarian as soon as possible. Since she is in a laying cycle, care must be taken when catching her in case there is another egg present in her body.

HYGIENE WHEN HANDLING EGGS

It is always a good practice to wash hands with soap and water prior to handling eggs. The less chance of bacteria or viruses reaching the shell surface, the less chance of possible contamination inside.

As eggs cool they can draw microscopic organisms through the

uncountable pores in the shell surface. If a harmful bacteria enters the egg this way, it will eventually multiply within the body of the chick and probably kill it. Mother nature has taken a lot of precautions against this by specially designing the shell to ward off infection, but slight cracks or breaks in the shell cuticle may allow infiltration of bacteria.

Sterile, disposable, rubber gloves can be worn when handling eggs. This type of glove is available from some surgical supply houses. Wearing gloves is ideal from the standpoint of hygiene but can often make it difficult to pick up or hold onto the eggs. If gloves are worn, be sure to cup a second hand under the egg to avoid dropping it. When handling newly hatched chicks, gloves are highly recommended. Always discard any glove that has been used to handle an egg or chick.

DIRTY EGGS OR NESTING MATERIAL

The inside of the nest box becomes a breeding ground for bacteria if not properly maintained. When dealing with aggressive parrots it may be too late once the eggs are laid. In cases where the hen voluntarily leaves the nest, eggs can be cleaned and new nesting material can be placed inside the box. This should be approached as a two person project to avoid any unnecessary jarring and cooling of the eggs. Some parrots will return to the box and destroy eggs or chicks if the nest is disturbed. Use your own judgement before cleaning nests and weigh the consequences against the benefits. Sometimes you can gradually change the nesting material by removing small quantities at a time and replacing it with clean material. This will often go unnoticed by the parents and may be a safer way to approach the situation.

If you do decide to replace nesting material, the eggs can be placed in a cushioned bowl or a bowl filled with clean nesting material. One person can replace nesting material while the other quickly wipes the eggs with gauze pads moistened with warm sterile water or sterile saline solution. Feces that are difficult to remove should be allowed to remain on the egg rather than risking damage in the cleaning process. After the nest is cleaned, the eggs are replaced for the hen to continue incubation. This is generally only necessary for species that tend to defecate or eat in the box rather than leave their eggs unattended.

Once chicks have hatched, this procedure should be repeated as necessary to provide clean nests for the chicks. Interruptions of this type could cause a hen to desert her nest. Always do a follow-up inspection to assure she has resumed her maternal duties.

NEST BOX DESIGN

The different sizes of nests used for each species of bird will not be discussed here. It is part of your job as an aviculturist to research species specific requirements for nesting. What does need to be addressed is design functions that make inspection and egg removal easier to avoid broken eggs or chewed off fingers.

When building or purchasing nest boxes for your birds, make sure that the inspection door is located in a convenient place, preferably on a sidewall rather than the top of the nest box. This door should also be large enough that you do not crush the eggs upon removal. Aggressive parrots make egg removal very difficult and for this reason many eggs are broken or cracked when removed from the nest. Designing doors large enough to accommodate a net or some type of protection is recommended.

NEST TYPES AND THEIR INFLUENCES ON INCUBATION

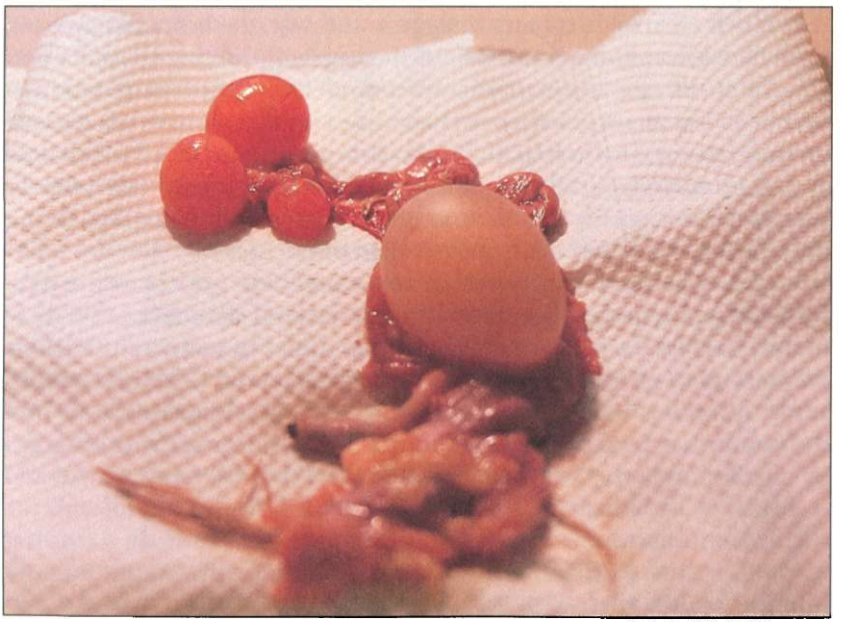
In the wild, different species of parrots nest in many different types of nests. The reasons for these variations in nest choice are not always explainable and therefore may harbor some of the secrets of artificial incubation that we all seek.

When a parrot incubates its eggs in the nest, the heat is transferred from her skin to the top portion of the eggshell, leaving the sides and bottom of the egg at a cooler temperature. This temperature gradient may be a vital secret to successful hatching, one that we have not learned to simulate in our artificial incubation programs. Most incubators available on today's market heat the eggs fairly evenly from top to bottom, thus ignoring this natural phenomenon and perhaps reducing the viability and survivability of the hatching chicks.

Nest construction of some parrots contribute greatly to the temperature gradient that is created through natural incubation. Nests of loosely arranged sticks, rocks, or dirt, are cooler in temperature where the bottom of the egg contacts the nesting material. These nests also act as humidity regulators by allowing rain and water to drain into the bottom sections of the nest and not come in contact with the eggs or incubating hen. As this water evaporates, the water vapor rises and is heated by the incubating bird, this adds significant humidity to the incubation environment. Rotting debris is often used as a nesting material in the wild and will also contribute significant amounts of humidity to the nest.

Suspended wooden nest boxes are common in aviculture today. In areas where weather can become cold after eggs are laid, it is very

Good nutrition is paramount in any successful breeding program. Variety and freshness are absolutely essential.



Reproductive system of hen after necropsy.

Slender-billed Cockatoo

important to maintain a deep foundation of nesting material to act as an insulator against the cold bottom of the box. If eggs are against the wooden bottom in extremely cold weather conditions, they can become chilled to a point where they can no longer survive. On the other hand, these boxes should be protected from direct sunlight to avoid high temperatures that are also fatal to the growing embryo. Nesting material of your choice should be added in sufficient amounts to avoid both of the temperature situations above and assure that the eggs have a soft secure place to rest.

TRANSPORTING EGGS FROM NEST TO INCUBATOR

Many eggs get jarred or damaged on the short trip from the nest to the incubator. Piling eggs in a basket or carrying them in your hands is risky business.

A dog food bowl with about an inch of small seeds in it will work well and keep the eggs in a natural position during transport. Remember to identify the eggs if more than one nest is being gathered at the same time. Eggs or even chicks may closely resemble each other and this may cause future problems if certain offspring require special treatment during hand rearing. Identification is easily accomplished with a standard #2 graphite pencil. Ink pens have been used with no apparent problem, but I prefer to use a pencil. Mark the small end of the egg as the chick will obliterate your marking on the large end when hatch time arrives.

ELEMENTS OF DANGER IN THE CAGE OR NEST BOX

It is very upsetting to enter your aviary in the morning to find one of your favorite birds hanging from its toy or bleeding to death with its foot caught on a loose wire. Stick your head inside of each cage occasionally to see if you can sight any potential threats to the health of your birds. Wires that stick out, screws, nails, points or wire ends of toys, etc. can be the death of your bird.

In the nest box, due to the chewing habits of most parrots, you will occasionally find nails or screws protruding in an unsafe manner. These nails can also be the end of the eggs in the box. Parrots sometimes have a habit of removing the nesting material and laying the eggs on the bare wooden bottom of the box. This is not a favorable condition as the eggs can be easily slammed against the side of the box. It is a good idea to inspect the boxes just prior to the breeding season to ensure that they are a safe place for the hen to lay.

PRIVACY

Earlier it was mentioned that birds require privacy for breeding. This is not true in all cases. Some species need close contact with pairs or singles of the same species in order to stimulate the proper breeding mechanisms. This is true of many flock type species that are very social during the pre-breeding season.

There are also birds that would prefer never to see or hear any other birds, let alone people or pets. These are the most difficult to accommodate if space is limited. Surrounding outdoor cages with trees and bushes can sometimes settle these pairs enough to breed, but often moving them to an area of least traffic is in order. If breeding success does not occur in a reasonable amount of time, try putting these nervous birds in a high traffic area. Sometimes the constant contact with humans will completely change their attitudes and breeding will follow shortly thereafter.

If enough time is allowed, most birds will acclimate to the daily feeding routine and even the presence of dogs or cats. Once a routine is established and the birds have grown accustomed to it, do not make drastic changes. The introduction of new birds into the flock may also cause a negative reaction. It is not wise to make these introductions during the breeding season.

The bonding between a male and a female bird is important for the production of young.

Eggs that are dropped from the perch are hatchable. This baby Caninde Macaw was hatched from an egg found on the bottom of the cage under the back perch.

Blue-eyed Cockatoo

chapter 3

Preparing for Incubation

ENGINEERING AN INCUBATION SYSTEM

Long before the eggs begin to arrive you should have a game plan in mind for managing them. Many things need to be considered and accomplished before the hens retreat to the nest boxes. Beginning the incubation season without a management plan could result in a disheartening season and lead to unnecessary frustration for you and the birds.

Before the season begins, it is wise to decide which eggs will be pulled for incubation and at what stage. Make a list of pairs that are known to be poor incubators and any additional pairs whose eggs you plan to pull. Allow for other unexpected problems that will surely arise and plan the accommodations for all of these eggs.

It is an undisputed fact that exotic eggs have a higher hatch rate if they receive at least ten days of natural incubation. Is this one of your goals? Can all of your eggs remain with their parents for ten days or is it necessary to plan a network of surrogate sitters? If you have not incorporated the use of chickens for natural incubation, you must rely on good timing when the egg shuffle begins. When your good sitters have not laid on a convenient schedule and in conjunction with your poor parents, mechanical incubator machines are your only hope. Parrots will not incubate eggs that are placed in their nests unless they have just laid eggs themselves. The act of incubating is triggered by hormone releases when a bird lays eggs.

By the time this situation arises, you should have had your incubators running and adjusted to the proper temperatures. It is a good idea to keep at least one operating year-round for untimely arrivals. The humidity setting is not as critical in an emergency plan, but it should level out to the desired percentage within a few days.

Dry bulb temperatures may take a few days to adjust to the desired levels, so it is best to begin before it is too late.

The use of two or even three incubator machines would be ideal. If chickens or surrogates are being used for the entire incubation period, one machine to function as a hatcher will suffice. The nice feature of having chickens available as incubators is their usefulness during long power failures. Eggs can be transferred to the chickens if electricity is not restored within a few hours. Consult the section on power failures for further suggestions.

Design an egg numbering system that is comfortable for you to help keep track of eggs that have been removed from the nest box. This may not sound important, until you lose track and a chick hatches in a place it is not welcome.

Depending on the number of eggs you are managing, a large calendar with room enough to write on will suffice for keeping track. Record, in ink, eggs that are found the day they are laid, and the eggs that you are not sure about, record in pencil. This will trigger you to check on the unknown eggs a few days prior to the day you recorded their expected hatch. It is also a good idea to keep an eye on all eggs placed under chickens or surrogates for the possibility of an early hatch. If you are not going to be around on hatch day, it is safe to place eggs in the hatcher unit 48 to 72 hours early. This timing usually coincides with internal pip and the chick may benefit from the lower temperature and higher humidity.

Planning an incubation system to be used during the breeding season is best accomplished with certain goals in mind. Goals could include pulling and incubating all eggs, pulling eggs of problem pairs only, using chickens for a given period of incubation, allowing eggs to remain with parents for two weeks, or incubating only eggs that have been neglected by the parents. Whatever the goals are that you set, gather the needed equipment and materials to allow a smooth system execution.

RECORD KEEPING

As previously mentioned, keeping accurate and complete records is a very important part of aviculture. Breeding statistics should be kept on all birds in captivity and passed on with the sale of every pair. These statistics could mean the difference between success and failure in a future captive breeding program. Records should be maintained on pairs even if you have not succeeded in your breeding attempts. This will provide a starting point, save a lot of time for the next person

and may answer important questions on the breeding of other species with similar breeding habits.

Incubation statistics, even today, are sketchy presentations that usually rely on the memory of bird keepers. This is not a responsible method of keeping information. If it were not for records and journals of past breedings, we all might be throwing away fertile hatchable eggs due totally to ignorance.

The time involved with record keeping is a main complaint from aviculturists. I say take the time to keep records and you will be amply rewarded in the long run. Many times I have gone back to review previous hatch data before making a decision to assist a struggling chick. Information revealing a history of weak chicks or trouble hatches in a certain pair may help you develop an incubation regime specifically designed for the eggs of that particular pair of birds. This could mean a higher hatch rate and a better understanding of captive breeding in general.

Useful information to be recorded on eggs could include weights, incubation periods, air cell, first signs of life, lengths, widths, and much more. Make charts that fit nicely into a standard three ring notebook and have them duplicated so they will be available. Keep statistics on each pair of birds and their eggs as well as any observations of courtship and habits. So often this information is unavailable when a pair of birds is acquired. How many times have you purchased a proven pair of birds that never laid again? Could it be that they are used to a different diet, nest box, nesting material, or something so subtle as a different feeding schedule? Accurate records passed on with the birds could alleviate a few of the variables.

Appendix IV consists of various forms and log sheets that can be copied and used in the different areas of your breeding facility. If any of these are suitable for use in your program, feel free to use them. Pass these records on if birds are sold and encourage new owners to continue these records. Perhaps there will be central record keeping systems one day to help provide some sort of uniformity in our record keeping, but until then we must do the best that we can to keep valuable information. (See Appendix IV.)

USING AND ANALYZING INCUBATION RECORDS

The importance of keeping records has already been stressed. It may be more convincing if I relay some actual experience where record keeping helped increase productivity.

A certain pair of Citron Crested Cockatoos laid fertile eggs each year but only hatched one out of four. The remaining three eggs died

in the early stages of life and when candled, a blood ring development was noticed. These statistics were recorded for future use along with the fact that the pair was very nervous and fled the nest box frantically whenever it was approached from behind.

The following year, the first egg was laid and left with the parents. On day ten of incubation it was pulled and candled to reveal another blood ring development had occurred. When the second egg arrived, it was moved to the incubator on day one and was successfully hatched. Meanwhile a third egg was laid and the parents resumed incubation. Once again the egg died early and a blood ring appeared. Two more eggs were laid and both were artificially incubated and hatched. All three chicks lived and grew up to be healthy beautiful birds.

Looking back on the breeding data of this pair indicates a need for artificial incubation if chicks are to be hatched and reared successfully. Total genetic incompatibility is ruled out since normal chicks were reared from three of their eggs. Could this pair be too rough when exiting the nest box in a frenzied manner? That would be my guess after analyzing all of the available data.

Keeping records like these has assisted me in more than doubling productivity on different species and even individual pairs of many birds. Important things like knowing that a certain pair throw eggs from the box, clean out all of their nesting material, defecate on eggs, stop incubating after ten days, or do not incubate at all, have helped tremendously in managing breeding and incubation. (See Appendix IV.)

CHOOSING AN INCUBATOR

With so many brands and types of incubators on the market it becomes very difficult to choose one. If you add in the horror stories of entire incubators full of eggs lost by aviculturists, you may not want to choose one at all. Do not be discouraged from purchasing an incubator because of one person's failures; there are just as many success stories associated with incubators. If a machine is capable of maintaining a set temperature without severe fluctuations, it can be used to incubate parrot eggs if certain procedural rules are followed.

Before buying an incubator it is important to make a few decisions pertaining to what you plan to use it for. You do not need to purchase an incubator with accommodations for 1000 chicken eggs if you only plan to use it for thirty parrot eggs. In many cases, incubators are designed to be operated at full capacity and you may find it difficult to regulate the internal environment if you only have a few eggs in it. Incubator manufacturers may claim that this is not true, but they

may also claim that you cannot hatch chicken eggs with a quart jar and a forty watt light bulb, which can be done. In any case, you can purchase heavy ceramic or aluminum eggs to place in the incubator to help keep the temperature uniform when it is not run at full capacity. Using infertile eggs or even eggs purchased at the grocery store is also possible. In the case of a power failure, these additional eggs will help to maintain the temperature until the power is restored.

I will not get elaborate at length on the types of incubators available as this information is printed in almost every bird book that I have ever read. There are, basically, two types available: forced air (using a fan), and still air or draft types (using natural convection). I am sure that both are fine for the different types of domesticated poultry for which they are designed, but I prefer to use the forced air models to incubate parrot eggs. This preference is only because I have trouble maintaining a steady temperature in the convection type models.

To add more confusion to the situation, the forced air incubator comes in many styles also. There are wooden cabinet models, plastic dome types, styrofoam box types, etc. I have chosen a Humidaire wooden cabinet model, with forced air, automatic turning, and special trays designed for parrot eggs. Then I add gauze pad cushions under the eggs to keep them from rocking in the tray. This works very well, perhaps soon, someone will invent the perfect parrot egg incubator which incorporates a more natural turning mechanism that gives the eggs a more complete turn.

The special trays that have been designed for exotics are merely a wire insert that fits in each of the incubator trays. These wire structures are bent in a W shaped pattern to allow the eggs to remain on their sides for incubation. The problems associated with these trays are that all exotic eggs are not the same size and shape which causes some of them to fit poorly in the grooves and rock back and forth. The gauze pads will support the large end of the egg and prevent this from occurring.

Prices on incubators vary a great deal. Do not assume that a more expensive model is better for parrots. If you are getting a more sensitive thermostat and better thermometer system, it may be true, but otherwise the price means very little. I have hatched Black Palm Cockatoo eggs in a $600 model while a friend of mine accomplished the same feat in a $47 incubator with no turning mechanism. If possible and time permits, request some literature from the manufacturer before buying an incubator. Do a little research to see which ones maintain a more constant and accurate temperature without frequent dives into the deadly zone of too low, or even worse, too high a temperature.

Your success with incubation is going to be based mainly on the

amount of time and attention to detail you put into it, not on the amount of money you spend on the machines. It is always a good idea to test the equipment by incubating cockatiel eggs or eggs of other parrot species that are easy to locate. Incubator manufacturers recommend testing the machines with quail or chicken eggs. Just because a machine can hatch a quail egg does not mean it can hatch a parrot egg.

WHEN THE POWER GOES OFF

Parrot breeding season tends to peak during the storm season. Unfortunately this also coincides with the time period that the electricity is interrupted on a frequent basis. This situation can cause panic if you are not prepared to deal with it.

The most efficient way to handle a power disruption is to purchase a gas powered generator. This is also the most expensive way to solve the problem. When choosing a generator, make sure it is capable of producing the proper current rate. If it is not, it may damage the thermostat in the incubators.

The following is a list of procedures to follow during power failures, when a generator is not available.

1. Turn the incubators off. Power surges are common during the restoration of electricity.
2. Close the incubator vents.
3. Cover incubators with a heavy blanket to slow the cooling of the internal temperature.
4. Call the power company to get an estimate of how long the power will be off. If incubators are indoors, they can retain most of their heat for a couple of hours if the above procedures are followed.

If the power is to be off for several hours, placing the eggs under chickens or surrogate parrots is advisable. When there are no birds to take care of the eggs, hot water bottles at a temperature of 99 or 100°F can be wrapped with a bath towel and used to keep the eggs alive. Wrap the hot water bottle once in the towel and lay the eggs on top in a nest-like depression. Cover the eggs with another dry towel or cloth and monitor the temperature with a thermometer. Try to keep the eggs as close to 99°F as possible until the power is restored. Keep movements and vibrations to a minimum to avoid damaging the eggs.

After the electricity is restored, remember to turn the incubator

back on and adjust vents to the normal operating position. Do not continue to use the blankets or the machines may overheat.

Eggs can withstand a remarkable amount of cooling after about twelve days of incubation. Any eggs that are younger than twelve days may need to be treated with the hot water bottle method after the first hour of the power failure, or when the machine has cooled to about 80°F.

THERMOSTAT TYPES

Generally speaking, thermostats are either solid-state or wafer-type in their design. There is a marked difference in the accuracy based on their use and the temperature zones that are desired. Temperature fluctuations of just a few degrees could be detrimental to very young embryos, so the most accurate thermostat is the most desirable.

Solid-state thermostats are highly accurate in temperature regulation, basically dependable, and have a much lower maintenance requirement than the wafer-type models. These mechanisms do, however, cost more. This is one area of incubator equipment where money does buy a better product. The only problems that I have encountered with a solid-state thermostat is their sensitivity to power fluctuations. If the power supply to these instruments is disrupted, it is advisable to turn the machine off until full power has been restored and is being supplied at a steady rate. This will eliminate the potential damage that could occur if a surge of electricity goes through the temperature controlling device. Another good idea would be to put all incubators on a surge protected and dedicated circuit.

Wafer-type thermostats can be less accurate than those of the solid-state design. They also have other associated problems that need to be addressed if they are to be used in incubators that are used to incubate parrot eggs.

Basically, wafer-type thermostats consist of two or three hollow round metal discs that are filled with liquid ether. As the temperature rises, the metal disc expands and presses against some type of on/off heater supply switch. This is how they regulate the heat flow into the machine. This system will work fine as long as the wafers are not acted upon by outside forces of atmospheric pressure changes or subjected to extremely high temperatures. Once a wafer has been heated enough to cause its expansion beyond the desired temperature of the machine, it may never be as accurate as it was before. The over-expansion may also cause cracks in the disc construction and eventual leakage of the liquid ether. If water thermostats are used, the incubator machines should be kept up to temperature all year to reduce the stress of

reheating. These wafers are best managed if they are replaced once a year.

VIBRATIONS IN THE INCUBATOR

When opening doors to service eggs or the incubator machine itself, observe the amount of movement the cabinet is making. Take whatever steps that are necessary to eliminate any vibration of the incubator. Sometimes placing a closed matchbook or piece of cardboard under one leg will suffice.

When choosing a spot for the incubator be sure you check to see if it is sitting firmly and on the level. Incubators that rock back and forth, even slightly, can jar the eggs and cause death to a chick in early development. This rocking action is also a suspect cause of some malpositions.

CHOOSING A HATCHER

Any incubator can serve as a hatcher. If you are fortunate enough to have two incubators, one can be used as a hatcher. When searching for a hatcher, I try to choose one that will not lose all of the humidity when the door is opened. This is ideal for me because I tend to visit the hatching eggs on a frequent basis.

Cabinet-type incubators make good hatchers because they rapidly regain the desired level of humidity after each entry. The dome type incubators lose their temperature and humidity very quickly each time you lift off the top. In most cases, your old incubator will become your hatcher when you buy a new incubator.

CLEANING THE INCUBATOR AND HATCHER

The temperature and humidity in the incubator or hatcher unit present ideal conditions for the growth of bacteria and fungi. These bacteria or fungi can cause many problems to the chicks if allowed to remain in these machines. When a chick hatches, it has a small unhealed area on the naval that is a prime target for the transmission of bacteria into the chick's body. For this reason many breeders treat the umbilicus of the newly hatched chick with betadine solution shortly after hatching.

About once a week it is a good idea to wipe all surfaces inside of the incubator and hatcher units with a disinfectant solution. I use a mixture of 20cc of Chlorhexidine diacetate, commonly known as Nolvasan solution, to one gallon of water for this purpose. Wipe all

surfaces and pay particular attention to the door seals and windows. This diluted mixture is virtually harmless to young chicks both in the liquid or evaporated form.

The water tanks or reservoir inside of the incubator and hatcher units are also prime areas for bacteria growth. The Nolvasan solution described above can be used in the place of plain water in these tanks. If this solution is used in the water tanks, it may be necessary to clean the tanks out about once a month as residue from the Nolvasan will accumulate on the metal and plastic surfaces, but it is easily removed.

If the incubator is not going to be used for a few days, it is also wise to spray all of the exposed surfaces with a disinfectant spray such as Staphene or Lysol. The diluted Nolvasan solution mentioned above can be placed into a misting bottle and used for the same purpose. When using the Staphene or Lysol, make sure there is no lingering smell from these preparations before placing eggs inside. The problem with these sprays is the high alcohol content that eventually evaporates into the air. It is not recommended that the chicks be allowed to breath this. It is sometimes helpful to open any available vents on the machines during cleaning to help clear the air inside.

Fumigation of the incubators and hatchers is a good idea but can be a real task. Follow the directions on these preparations carefully as they can be harmful to you as well as the eggs and chicks. I only fumigate my equipment about twice a year when I have a slow weekend or a few days where all eggs will fit in one incubator. Allow the incubator to air out for a few days before you put any eggs back inside. These procedures are best performed out-of-doors.

THE INCUBATOR ROOM

If possible, the incubators should be in a room that is not well traveled. This will cut down on the cleaning that is necessary to keep the incubator environment sanitary.

The room that houses the incubator and hatcher units should be air-conditioned to keep the temperature between 70 and 74°F. In high humidity areas it is necessary to run a dehumidifier to dry the air surrounding the machines. It is easier to add water to the machines to acquire the proper wet bulb reading than it is to try to dry the air after it is saturated and heated inside the machine. If the room is dehumidified to a point below the desired level in the machines, all that has to be done is to add water in the proper surface areas to bring the wet bulb temperature to where you want it. (See the section on humidity in the incubator.)

Sanitary practices in the incubator room should be enforced.

Bacteria, viruses, and fungi that are brought in on the shoes will get into the machines if allowed to remain in the room. Floors should be mopped with a good disinfectant at least once a week and all table tops and tops of the machines should be wiped down at least every other day. Any additional equipment should be disinfected before being brought into the room.

If there are ill birds in the aviary and you must also tend to them, do not wear the same clothing in the incubator room. It is wise to shower and change your clothing prior to tending to the eggs. Disinfectants can be poured into shallow containers to dip shoes into as you reenter the room.

Be sure to keep all hatching dishes, surgical equipment, and thermometers sanitized until needed. When cleaning, it is a good practice to use disposable paper towels or something similar to avoid contamination of the cleaned areas.

At first, these practices may be difficult to follow. If violations occur, these should be followed up with a mopping of the floor and a complete cleaning of the room. It is difficult to calculate the risks to the incubation environment, so pay close attention each time you enter the room and eventually good sanitary practices will become habitual.

EQUIPPING THE INCUBATOR ROOM

Besides the obvious equipment, an incubator and a hatcher, there are a few things that should be kept on hand in case of an emergency. During a problem hatch, things can go wrong and require equipment in a hurry to save the life of a chick.

The following is a list of items that could be useful if they are on hand in the incubator room. All items that have direct contact with an egg or chick should be sterile.

Tweezers
Q-tips
Cotton Balls
Syringes
Misting Can
Quik Stop
Silver Nitrate Sticks
Betadine Scrub
Saline Solution
Disinfectant Cleaner
Egg Candler
Hemostats
Gauze
Needles
Sterile Water
Paper Towels
Cornstarch
Lactated Ringers Solution
Betadine Solution 1%
Heat Lamp
Disinfectant Spray
Scales

A breakdown of uses for each item above is listed below. Read through the list and make a shopping list of your own for the things that you might need.

TWEEZERS - USED PRIMARILY TO ASSIST IN A PROBLEM HATCH. EGG SHELL IS EASILY CHIPPED AWAY BY USING A PAIR OF TWEEZERS. MAY ALSO COME IN HANDY TO PULL PIECES OF MEMBRANE FROM THE NEWLY HATCHED CHICKS.

HEMOSTATS - BE SURE TO BUY A SMALL ENOUGH PAIR TO CLAMP OFF THE UMBILICUS OF A BLEEDING CHICK. IF BLOOD IS DRIPPING FROM THE NAVAL, DO NOT HESITATE TO CLAMP IT OFF AS A CHICK CAN BLEED TO DEATH IN LESS THAN A MINUTE.

Q-TIPS - COME IN HANDY IF MEMBRANES NEED TO BE MOISTENED ON A HATCHING CHICK. ALSO USED IN THE CLEAN-UP OF MESSY HATCHES.

GAUZE - CAN BE USED TO PAD EGGS THAT ROCK BACK AND FORTH IN THE INCUBATOR TURNING TRAYS. USED TO CLEAN UP NEWLY HATCHED CHICKS. GENERAL CLEAN-UP.

NEEDLES - LARGE GAUGE NEEDLES WORK WELL FOR BREAKING THROUGH THE EGGSHELL WHEN ASSISTING A HATCH. VERY SMALL NEEDLES CAN BE USED IF SUBCUTANEOUS FLUIDS ARE NEEDED BY A DEHYDRATED CHICK.

SYRINGES - USED TO MOISTEN DRY MEMBRANES, FEED NEWLY HATCHED CHICKS, APPLY TOPICAL SOLUTIONS TO THE UMBILICUS ETC.

STERILE WATER - ANY WATER APPLIED TO EGGS OR CHICKS SHOULD BE STERILE WATER THAT IS WARMED TO ABOUT 99°F.

MISTING BOTTLE - CAN BE USED TO INCREASE HUMIDITY IN THE HATCHER OR IF STERILE WATER IS USED, CAN BE USED TO WET MEMBRANES OR MESSY CHICKS.

PAPER TOWELS - GENERAL CLEAN-UP. CUSHIONS FOR HATCHING DISHES.

QUIK-STOP® - IN AN EMERGENCY, USED TO STOP BLEEDING IN CHICKS OR EGGS. SILVER NITRATE IS PREFERRED.

CORNSTARCH - CAN BE USED TO STOP MILD CASES OF BLEEDING, NOT ALWAYS EFFECTIVE.

SILVER NITRATE STICKS - USED TO CAUTERIZE ACTIVE BLOOD VESSELS AND STOP BLEEDING.

LACTATED RINGERS SOLUTION - USED AS FIRST MEAL ON DEHYDRATED

CHICKS. CAN ALSO BE INJECTED SUBCUTANEOUSLY. DO NOT ATTEMPT THIS UNLESS YOU KNOW WHAT YOU ARE DOING.

BETADINE SOLUTION 1% - USED TO TREAT THE UMBILICUS ON NEWLY HATCHED CHICKS.

BETADINE SCRUB - THIS PRODUCT OR SOME OTHER TYPE OF DISINFECTANT SCRUB SHOULD BE USED PRIOR TO HANDLING EGGS OR CHICKS.

SALINE SOLUTION - EXCELLENT SOLUTION FOR CLEANING THE SKIN OF CHICKS.

HEAT LAMP - KEEPS CHICKS WARM WHILE YOU ARE CLEANING THEM OR HELPING THEM TO HATCH. BE CAREFUL NOT TO BURN THE CHICKS OR DRY THEM OUT EXCESSIVELY.

DISINFECTANT SPRAY/CLEANER - FOR ALL SURFACES IN THE INCUBATOR ROOM.

EGG CANDLER - USED TO VIEW THE GROWING EMBRYO INSIDE OF THE EGG.

SCALES - USED TO WEIGH EGGS AND MEASURE THEIR PROGRESS DURING THE INCUBATION PROCESS.

chapter 4

Candling and Repairing Eggs

CANDLING EGGS

The act of shining light through eggs to observe the interior portions is called candling. This is a useful practice in determining progress or developmental abnormalities.

Candling and handling eggs takes some practice if you are to realize what you are viewing inside. Eventually you will know if an egg is dehydrating too fast or if it is retaining too much fluid by analyzing the size of the air cell on a given day. After you candle a few eggs, you will begin to develop a feel for what is going on inside and you will be better able to judge if an embryo is following an abnormal development pattern or if it will become a problem at hatch time.

It is very important to candle eggs shortly after you pull them. The first candling can tell you if there are tiny cracks in the shell that need to be repaired or if you have an abnormally structured egg, such as a double yolk. If an egg is cracked and the embryo is dead, do not put it in the incubator because you may introduce bacterial problems into the incubator environment. A cracked egg with the embryo still alive should be repaired and watched closely to determine if it will continue to develop or if it has a bacterial problem and dies shortly thereafter. Dead eggs should be removed immediately from the incubator.

At the first candling, I record any abnormalities of the internal or external structures to help with decision-making in the later stages of development. During any subsequent candling, notes are continued as the embryo progresses. Care is taken not to burn the embryo inside with the candling light or to jar the growing embryo during handling.

All eggs are kept in the incubation position and slowly rotated to allow a complete internal picture. The procedure should be completed as quickly as possible on eggs with larger embryos inside because the chicks flinch from the bright light and in this process may rupture blood supplies and die. The cooling of eggs during candling does not seem to pose a great problem, as I candle eggs in an air conditioned room where the trays sit for up to five minutes and have not had any problem with this.

The shape of the air cell is the indicator used to determine if a chick is starting the hatching process. Throughout the majority of the incubation time the air cell will have a clean sharp edge appearing almost round in most cases. Within 24 to 48 hours of pip, the air cell will change shape and its perimeter will drop slightly or even a great deal on one side of the egg. This is called *drawdown* or *internal pip* and signifies that the chick is moving its head towards the air cell. Upon candling, the chick's body or head can sometimes be seen moving slightly in response to the bright light. At this point of incubation it is no longer necessary to turn the eggs. If the egg is on a tray controlled by an automatic turning device, it should be placed in the bottom of the incubator where it will not be turned or moved around. Draw down is observed in most eggs but not in all of them. Occasionally a chick will pip the shell prior to any indication that drawdown is occurring, but this is an exception. At the drawdown stage I candle eggs three or four times a day to ensure the chick does pip the shell for air. If it does not, consult the section on "Pinholes Into the Air Cell" in the hatching section of this book.

Never give up on an egg that still has active blood vessels in the internal membrane. Some eggs will hatch a few days late, depending on the temperature of incubation and how constant that temperature is maintained. Remember, once you open an egg and disrupt the developing embryo, there is no turning back.

CANDLING ABNORMALITIES

When candling eggs during the incubation process, you may see things that do not look normal; I caution you, do not give up if there are any traces of active blood supplies inside. Not very long before the writing of this book, I candled a Military Macaw egg on its twenty-first day of incubation and saw large areas of yellowish appearing spaces where no blood vessels appeared. There were blood vessels in approximately two-thirds of the area surrounding the air cell but most of the tissue appeared *necrotic*. Weight loss of the egg was in the acceptable range and it had received natural incubation for a majority of its term.

Two days after candling, the chick pipped the shell. Blood vessels were ruptured and yellow liquid was oozing out of the pip site. After another thirty-six hours I chipped some shell away and assisted the chick out to reveal that it had broken into the *allantoic membrane* and spilled fecal material all through the egg. The chick was covered with yellow and green feces from beak to toe but otherwise appeared normal. He was cleaned off with warmed saline solution and sterile gauze after hatching and cultured for bacteria. This chick is alive and doing well despite the fact that I considered it would be a *dead-in-shell* chick.

There are other similar situations that I have encountered in the past. Some eggs, depending on what is going on inside, appear to be dead and will surprising enough, hatch.

CANDLING EGGS IN THE NEST

Eggs are candled in the nest to determine fertility, damage, or development. Infertile clutches should be removed after ten days to allow the hen to lay again. The clear eggs removed from the box should be placed in an incubator to be certain the hen was incubating them and not just creating the illusion. If, after several days in the incubator, these eggs show no signs of fertility, they should be discarded.

In dark nest boxes, where the birds are not aggressive, a small flashlight can be held against the eggs without pulling them out. This is a quick and hassle free method of candling.

Another method that I use frequently is to cut a one-inch hole (a smaller hole may need to be used if small eggs are being candled) in the top and bottom of a small cardboard box. The egg can be placed inside the box over the hole in the bottom while a flashlight is shined through the egg. Close the top of the box and peer through the hole in the top. Care must be taken not to allow the egg to roll around inside and possibly jar the embryo.

AIR CELL SIZE AND SHAPE

The air cell of an egg can reveal much to the experienced egg handler. Displaced or movable air cells will result in a severely reduced hatch rate and each one of these must be dealt with in a different manner in order to increase the chance of successful hatching.

Many people that incubate the eggs of their exotic birds use the air cell size as an indicator to proper weight loss. When asked what they look for, they usually respond with many different measurements that they consider to be the normal size of the air cell by the time the hatch begins. This can be a useful bit of information to those who

have candled many eggs and do not have an egg weighing system, but it can also mislead a beginner. Depending on the original size of the air cell, these two target sizes could result in extremely over or underweight chicks at hatch time. I have candled eggs in the nest that have had air cells as large as one-half of the egg or more and they have hatched. If they were under my incubation control, I would have controlled their fluid loss and perhaps killed these chicks. The size of the air cell can also be influenced by climate. Eggs incubated in a dry climate area will often have larger air cells than those in the more humid areas.

AIR CELL SIZE WHEN LAID

The size of the air cell in freshly laid eggs varies greatly. In some cases the air cell is so small it is difficult to locate even with a candler. As the incubation process proceeds, the air cell will expand to a more recognizable size.

There are also cases where the air cell is very large in freshly laid eggs. In these cases, weight loss data could be very helpful in managing the egg. In either case, the proper weight loss should be the goal of the handler, not the estimated size of the air cell toward the end of the incubation cycle because this is often misleading to the inexperienced.

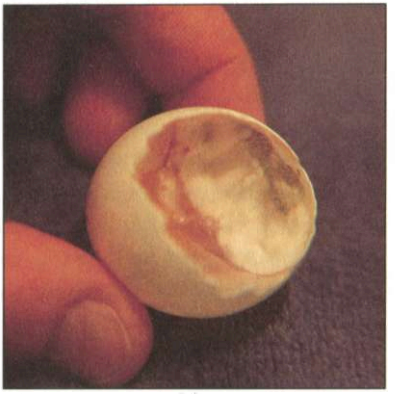
CRACKED EGGS IN THE NEST

Many times eggs are damaged in the nest box but are still potentially hatchable. If an incubator and hand rearing facility is available, the egg should be pulled, repaired as described in the "General Repair of Damaged Eggs" section, and incubated. If no incubator is available, the egg needs to be repaired while standing behind the nest box so the parents will not know that the egg has been removed. Elmer's glue is often sufficient if a few precautions are followed.

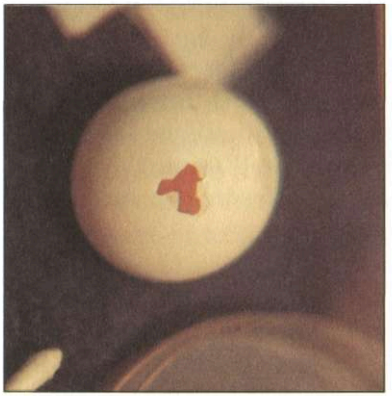
First, glue the damaged portion of the egg but do not place it back in the nest box while the glue is still wet. If the glue is not allowed to dry, the egg may adhere to the breast feathers of the hen and be carried out of the box to be found on the floor at a later time. Instead, the glue should be dry enough that when touched it does not leave a residue on the fingers. If nesting material becomes glued to the egg surface, it may be difficult for the chick to hatch.

Second, try to calculate when the chick is supposed to pip. At this time the glue should be removed if it is extending over the air cell

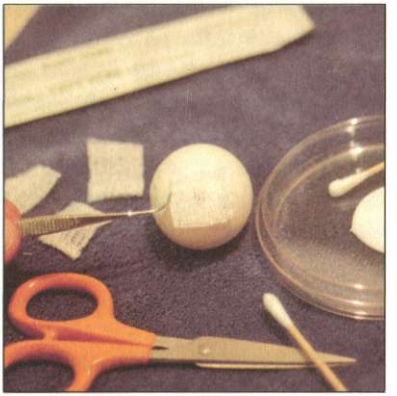
Cracked eggs that are not repaired are in danger of fungal or bacterial invasion. Fungus usually appears as black marks near the cracks in the shell.



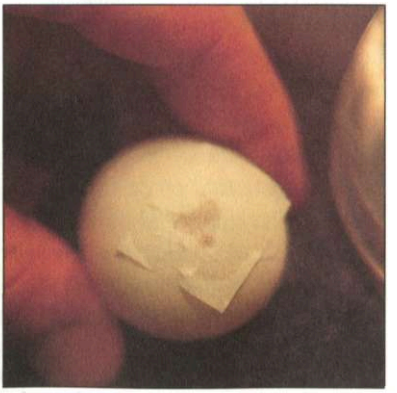
The same egg opened for inspection.



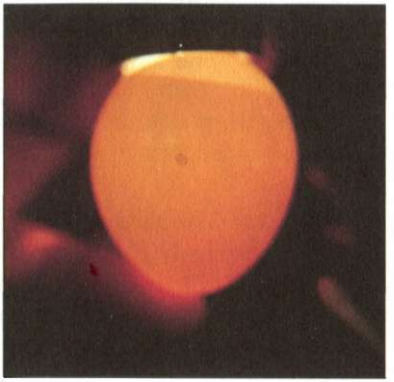
Gaping holes in the eggshell make it impossible to repair with glue alone.



The first step is to glue the shell around the hole and apply tissue or gauze as a cast-like filler.

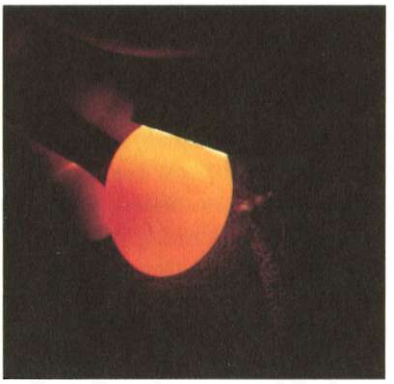


Continue glueing layers of gauze or tissue across the hole until the dehydration is stopped.



Even a small hole, such as a toenail hole, through the cuticle of the eggshell can cause dehydration death to an embryo.

Bite holes below the air cell will allow air inside of the membranes. Hatchability of these eggs is severely reduced as the air bubbles will disrupt the growing vascular system.



When two eggs collide, the indented marks must be repaired with glue.

area. A moist piece of gauze and tweezers will ease removal. Hold the gauze against the glue for about fifteen seconds then carefully peel the glue off with the tweezers. The egg can be returned to the box or pulled for hatching.

TOENAIL HOLES

Believe it or not, most small holes through the cuticle and shell of the eggs are created by excessively long toenails. This holds true in the chicken coup as well. A simple manicure before breeding season may help to alleviate the problem. Just one small spot where the shell is weak will allow the toenail to penetrate it. Eggs need to be mended if this occurs or they will dehydrate and die. See the section on "General Repair of Damaged Eggs".

BLOOD SMEARS ON THE EGG SHELL

This incident is rarely indicative of a severe problem. Usually blood on the eggshell is noticed on the shell of a first time layer or in the first clutch of the year. It is advisable to make a note of this condition and monitor diets and laying intervals to prevent the possibility of egg binding in the future.

Wiping these eggs with sterile water and gauze is a good idea due to the risk of bacterial infections developing with blood present in the incubator. There are, to the best of my knowledge, no incubation problems associated with this condition alone.

GENERAL REPAIR OF DAMAGED EGGS

Nervous or aggressive parrots will sometimes accidentally damage eggs in an attempt to escape you or keep you from pulling their eggs. These eggs are not always totally destroyed and, with a little repair, can be hatched.

The actual hatchability of a damaged egg depends on the extent to which it is broken. External shell cracks and breaks that do not extend through the membrane are usually still hatchable if they were not *addled* when the damage occurred. The main concern is to stop the dehydration that will probably occur since the shell is no longer regulating the *transpiration.*

Aviculturists have been repairing eggs for a long time. Many different mediums have been used for repair with various rates of success. I have seen eggs repaired with nail polish, paraffin wax, pieces of eggshell, and different types of glue. Before repairing any egg,

remember to clean it off and use sterile or at least clean repairing mediums. Fungi and bacteria rank very high in the causes of death in repaired eggs.

After repairing eggs, it is always a good idea to keep an eye on it as hatch time approaches. If you repaired it well, you may also have reinforced the chick's escape route and it could be trapped inside.

Repairing hairline cracks in the shell

Cracks that do not extend below the inner shell membrane are easily repaired. If these eggs have been pulled for artificial incubation, they can be candled to expose the extent of the damage.

A thin layer of white, water soluble, glue (like Elmer's glue) is usually enough to slow the evaporation and keep these eggs intact until hatch time. It may be necessary to add a second or third coat if cracks are serious.

Weight data could be very helpful in monitoring cracked or damaged eggs. If no egg weight system is employed, at least monitor the evaporation through frequent candling to be sure the problem has been corrected.

Repairing indented smash marks

When two eggs collide in the nest, one will crack or be dented from the impact. These dent marks are treated the same as hairline cracks unless the internal membrane is also damaged. Smoothing Elmer's glue over the entire damaged area is usually sufficient in most cases, but the situation may again require two or three coats.

If albumen is present, the internal membrane has been damaged. Repairing damage of this extent is explained in the next section, "Repairing eggshells where the membrane is damaged."

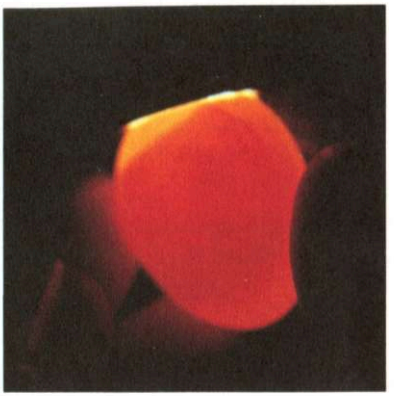
Repairing eggshells where the membrane is damaged

If a parent bird bites a hole in the eggshell, hopefully it will be in the area of the air cell. These holes can be repaired as described below and will usually hatch without too much trouble.

Where the bite holes are below the air cell line and have penetrated the liquid portion of the egg, hatchability is severely compromised. Depending on the degree of damage, these eggs can be cleaned off and repaired with a chance that they will hatch, perhaps with some assistance.

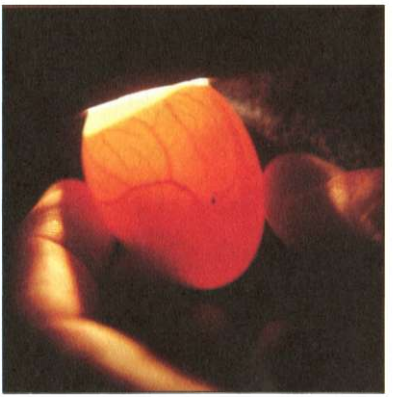
Whenever blood or albumen is present on a broken egg, the best that can be done is to repair the outside shell and hope that the

The first candling of an egg can tell you if there are abnormalities in its structure, like a double yolk.

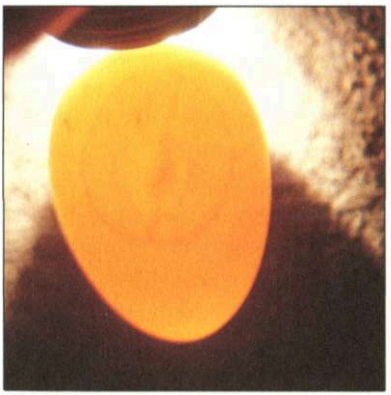


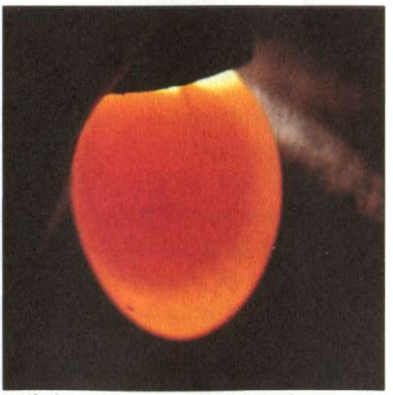
Congested-looking embryos such as this may need to be moved to a surrogate or a chicken for natural incubation if they are to be hatched.

An egg is in trouble and need of natural incubation if the vascular system supporting the chick is weak or patchy in development.

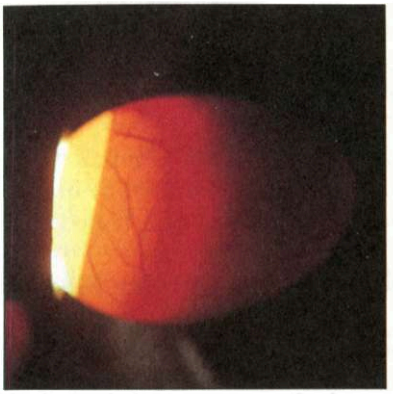


After two weeks of incubation, a normally-developing egg will reveal large red blood vessels throughout the membranes when candled.

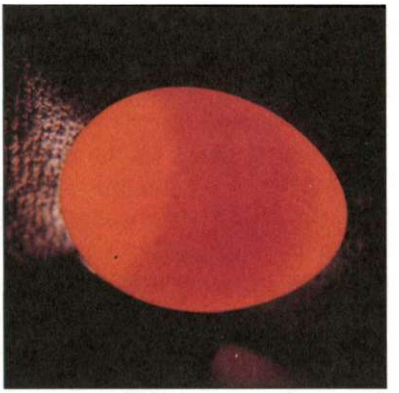




Fertility of parrot eggs is not always distinguishable until about day four or five of incubation.

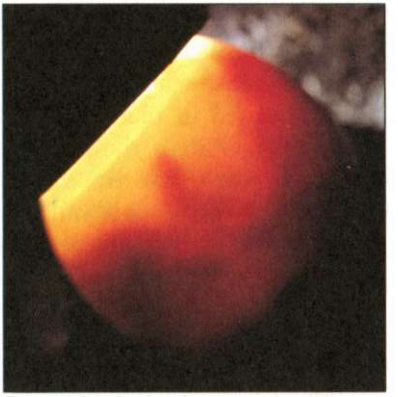


As the incubation process proceeds, the egg will begin to appear darker where the chick absorbs the light of the candler.

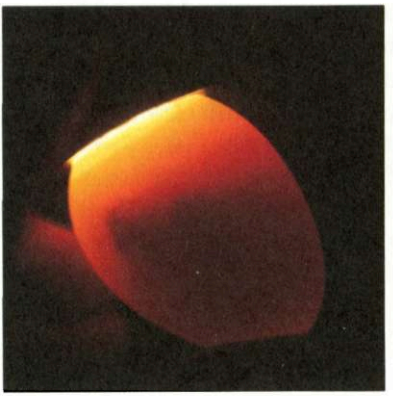


The air cell of freshly laid eggs is often so small it is not detectable even through candling.

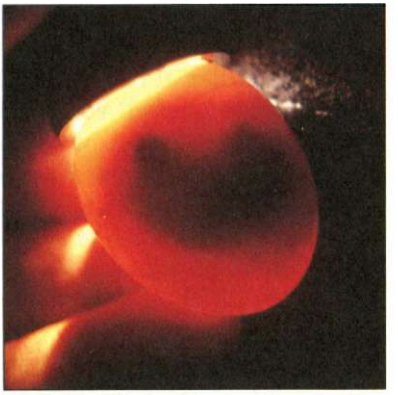
Recognizing dead embryos.



Recognizing dead embryos.



Recognizing dead embryos.



Recognizing dead embryos.

When the embryo has died, blood supplies will receed and the embryo will begin to darken in color.

membrane inside is still intact and can support the vascular system of the chick. I have hatched eggs that have had blood dripping from a hole in the shell. After cauterizing the torn membrane with silver nitrate and repairing the outside hole, these eggs continued to grow despite the disruption.

Gaping holes in the eggshell make it impossible to repair with glue alone. A reasonable substitute for shell has to be used to bridge the gap between the two sides. In the past I have accomplished this in one of three ways.

The first way is by using tissue or tissue paper and glue. Smooth glue all around the hole in the shell and place a piece of tissue over the cavity pressing the tissue into the glue. Numerous coats need to be applied so the egg is placed back in the incubator between each one to allow the glue to dry.

After the first coat is dry, it is possible to smooth glue over the first piece of tissue and apply another piece. Continue this procedure until you have created a shell-like covering over the hole. The second method is similar to the first except that single layer pieces of sterile gauze are used in place of the tissue paper. Cut these gauze patches slightly larger than the hole that is being repaired and apply them exactly as you would the tissue. After several applications, the patch will become very tough and will need to be softened and removed at hatch time if it is in the area of the air cell. The only advantage of using gauze over tissue is that it is more three dimensional and is more easily removed by moistening it with water and scraping or slicing it off with a razor blade. Gauze purchased in sterile packages would be preferred over tissue in all cases.

The last method of repair is the lazy way out and the least desirable of the three techniques. Instead of tissue or gauze, a piece of shell from an infertile egg can be used. This method is quick and easy but proposes a substantial risk of fungal or bacterial infection to the repaired egg.

If a piece of shell is used, it needs to be disinfected by dipping it in a mixture of 20cc of Nolvasan and one gallon of water. Let it soak in the mixture for at least fifteen minutes before removing it and rinsing it off for use. To use an unsterilized piece of shell will probably result in the death of the chick (depending on how long it must remain intact), therefore, tissue or gauze is recommended over this procedure.

TURNING OF REPAIRED EGGS

If an egg that has been repaired is to be artificially incubated, there are a few things that you need to consider about the handling of that egg.

Respiration through the shell is severely hampered or completely inhibited in areas where glue has been applied. Since the blastoderm on the yolk always floats to the top of the egg, it is easy to ensure that the growing embryo does not "suffocate" by limiting the amount of time that the glued portion of the egg remains on the top position. This is more important in the first ten or fifteen days and becomes less consequential or even irrelevant after the blood vessels of the inner membrane have completely spread throughout the egg. Once the allantois has thoroughly formed and closed around the albumen, it can draw nutrients and carry on respiration from all sections of the shell.

Hand turning of repaired eggs is often preferred and more advantageous than allowing the egg to be machine turned. Depending on the method and amount of repair that took place, these eggs may not turn smoothly or may even become stuck to turning trays of turning grids. Try calling on your avicultural instincts as to whether or not the egg can safely and efficiently be turned by the machine.

RECOGNIZING DEAD EMBRYOS

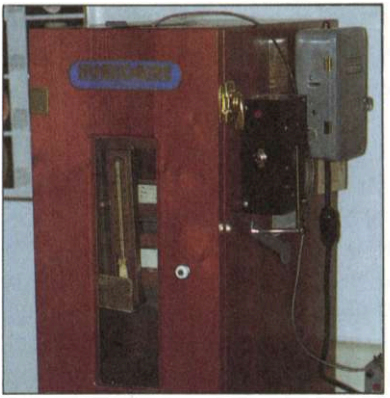
Early deaths are easily distinguished upon candling. The blood that was present in the young chick usually separates from the tissues and flows to the outer-most point of development. This formation is called a blood ring. The ring of blood can be longitudinal in the egg or may extend around the breadth of the egg. In either case, further development will not take place. Before breaking into an egg, be sure there is no embryo in the center of this circle that is still alive and growing.

Other easily distinguishable dead embryos are those that turn very dark upon death. Blood supplies recede into the chick's body and the only visible characteristic of the egg will be the darkened embryo. If no blood vessels are visible upon candling, and the chick is dark brown or black in color, it is most likely dead.

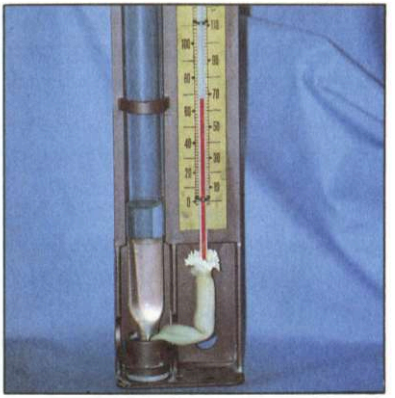
Eggs that die during incubation have one characteristic that is common to almost all of them: no visible active blood vessels. In the later stages of normal development the egg becomes very dark and candling is difficult. If the chick is still alive there should be a small line of blood vessels immediately below the line of the air cell. At this stage of incubation, it is very easy to mistake a live chick for one that has died. If there is doubt in your mind, do not crack the egg open. Place it back in the incubator until there is no doubt or until it is late to hatch.

Typical equipment required to repair eggs.

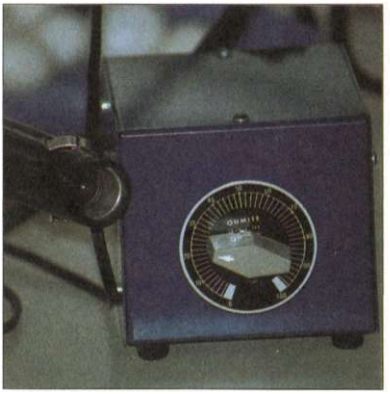
Hole being glued for repair



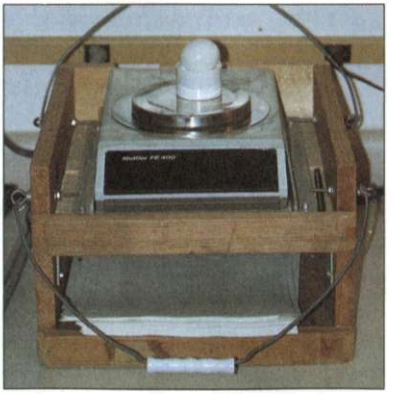
Typical incubator as used by author.



Accurate readings of temperature and humidity are extremely important.



View of a typical candler.



Extreme accuracy is required in keeping proper records of egg weight. Electronic scales provide such accuracy.

Thick Billed Parrot, range used to extend into southern U.S.

chapter **5**

Incubating Eggs

INCUBATION TEMPERATURE (Dry Bulb Temperature)

Many different temperatures are used to incubate parrot eggs. The success rate of your system will probably be due to the amount of work and attention afforded to it rather than the temperature used, if it is within limits. Different breeders use different settings on their incubators depending on what they are hatching and who they asked about it. I have tried several temperature settings from 98.5°F to 99.7°F and I find that I have fewer problems with the hatches and fewer deaths if I keep the incubator set just slightly above 99°F.

This setting works very well on Cockatoo, Macaw, and Eclectus Parrot eggs. Galahs and Australian parakeets seem to do better at 98.7°F for some reason. This is probably due to the use of a constant temperature rather than the variable temperature created by the rhythm of the parents. (See "Incubation Rhythm and Incubation Periods.")

Embryos begin to develop at a temperature of about 97°F and continue to develop up to a temperature of about 102°F. The higher the temperature, the faster the development, and vice versa. The optimum temperature will be the one that the chick develops at exactly the same rate that it would if incubated by the natural parents. If chicks develop too fast or too slow they tend to be weak at hatch time, if there is a hatch time at all.

Using a combination of natural incubation from the parents, a surrogate, or even a chicken, combined with the incubator, will give you the best overall hatch rate. I used this system in the 1988 breeding season on over 200 eggs and hatched all but two! The two that failed to hatch had damage that explained their deaths, so the final system hatch rate was 100% of the undamaged eggs. Next year the damaged eggs will be repaired and placed under the chickens as well. The few

damaged eggs that I repaired and placed under chickens did hatch, but most were kept in the machines to be observed over the incubation period. Depending on the extent of damage, it may be best to keep damaged eggs in the incubator so they can be observed closely.

All undamaged eggs received more than half of their incubation from a surrogate or chicken; this reduces the lethality of the incubation temperature in the machines. Eggs rarely die immediately in an improper environment; they slowly weaken and eventually die. This is not true, however, if temperatures are extreme. In this case, death is usually rapid.

HUMIDITY IN THE INCUBATOR (Wet Bulb Temperature)

The humidity in the incubator is the controlling factor of how much weight or fluid an egg will lose during incubation. Being in humid Florida at the time of this writing, it is rarely necessary for me to add water to the incubator tanks at all. The wet bulb temperature always stays between 80°F and 82°F which works very well. At certain times of the year, it is actually necessary to run a dehumidifier in the incubator room in order to keep the wet bulb reading at 82°F.

A vast majority of the parrot breeders that I have spoken with set their wet bulb temperatures at 84-86°F. I tried this setting and lost many chicks from excess fluids in the egg or other high humidity problems. After reduction to a wet bulb temperature of 82°F, the hatches returned to normal. Keep in mind that these settings worked well at sea level or slightly higher. If you are living in a high altitude area, it may be necessary to increase the wet bulb reading slightly to keep the eggs from losing too much weight.

If you are weighing eggs, it is easy to find the optimum setting by comparing daily weight losses to the wet bulb reading (see "Egg Weight Management").

THE HYGROMETER WICK

This little piece of material is the cause of much concern in an incubator or hatcher. **Keeping this wick wet is the only way to get an accurate reading from the hygrometer.** If the wick dries out by accident, the thermometer inside will climb to the dry bulb temperature of the machine.

It would be difficult to count the number of times that I have failed to check this wick and proceeded to add water to the water tanks in the machines, attempting to change the reading of the dry hygrometer. Furthermore, a more accurate reading will result if the water in

the hygrometer is allowed to warm up to the temperature of the air inside of the machines. Excessively cold or hot water in the hygrometer tube will yield an erroneous reading.

Replace the hygrometer wick often. Soiled or rusted material will also give false readings. Sometimes it is possible to wash these wicks but it is usually easier to replace them.

Be aware that the hygrometer will yield a slightly different reading if it is hanging near a glass or plexiglass window. The best way to assure an accurate reading is to insulate these windows with styrofoam or some other comparable material.

VARIABLE TEMPERATURE ZONES IN THE INCUBATOR

The fans in most incubators do an adequate job of distributing the heated air throughout the cabinet. Due to a few of the laws of physics such as, heat rising and the thermal insulation capabilities of glass, there may be temperature variations within your machines. It is a good idea to place a few thermometers in different areas of the machine and monitor all of these readings. Alternating these thermometers will help you to determine their accuracy. After you have recorded the temperature differences, there is one thing that can be done to try and correct this problem: insulate the glass windows.

If the incubator you are using has a glass or plastic window in it, chances are that the temperature is a few degrees lower in that area. Cut a piece of styrofoam to fit over the glass and tape it in place. This will help a great deal in regulating the different temperature zones.

Rotating eggs each time you open the machine to candle or service the incubator is also a good idea. This will ensure that no one egg will remain in the cooler or hotter zones for an entire incubation period.

A SEPARATE HIGH HUMIDITY ENVIRONMENT USING A PLASTIC BAG

In many of the different sections of this book, I will mention using a plastic bag for incubation or hatching. This procedure works very well for eggs that are in need of a higher humidity to incubate or hatch properly.

When an egg is placed inside a Ziplock plastic bag for incubation or hatching, it is in a smaller environment that is much easier to regulate. Heat will easily transfer through the plastic but the internal humidity becomes a function of the moisture inside that bag. If more humidity is needed for hatching or to slow weight loss of an egg, one or two gauze pads moistened with sterile water can be added to the

bag. Do not place wet gauze against the eggs because this will lower their temperature as the water evaporates from the shell surface.

Using plastic bags to incubate or hatch eggs also concentrates the gases given off by the eggs into a smaller area. This can be a potentially fatal problem if uncorrected. Opening bags daily or poking small holes in them are two ways to ventilate the inside space. Bags should be changed every three to five days to curb any possible fungal growth.

INCUBATION RHYTHM AND INCUBATION PERIODS

The amount of time it takes for the chick to grow and hatch varies among species of birds. To a lesser degree, this time period may even vary among pairs of the same species and between two eggs in the same clutch. This time variance is due partly to the *incubation rhythm* or periods of heating and cooling provided by the parents or artificial means.

This fact makes it very difficult to simulate natural incubation to exact perfection. The amount of time the parents spend sitting on the eggs or the *period of attentiveness* is often difficult to assess. Just because one or the other parent is in the nest does not mean that they are actively incubating. Often the incubating parent will sit beside the eggs and allow a certain amount of cooling time. Measuring these *periods of inattentiveness* is next to impossible and, therefore, difficult to simulate in the incubator.

Some species of parrots share the responsibility of egg incubation while in others, incubation is the sole duty of the hen. In species where it is common for the male to feed the female, the *periods of inattentiveness* are greatly reduced. These statistics become very helpful when artificial incubation becomes desirable or necessary. Applying these observations to your incubation system is very difficult if eggs of different species are being incubated in the same machine. If a number of incubators are available for use and set at slightly different temperatures, trays containing eggs of frequently inattentive species can be transferred to an incubator with a lower temperature setting for one or two hours, a few times a day. The hatcher unit can also be used for this as the humidity setting will be of no consequence for such short periods of time. After all, hens do go out and bathe once in a while and return to the eggs with wet feathers.

VENTILATION OF THE INCUBATOR

The importance of ventilation in the incubator and hatcher unit is sometimes underestimated. Most literature and instruction manuals

provided with incubators approach the use of the vents as a control of temperature or air flow for humidity in the incubator environment, but the respiration of the growing embryo should be addressed as well.

Studies have proven the existence of gas exchange through the shell of eggs. This gas exchange is necessary for the developing chick to continue to live and grow. In proving the necessity of this gas exchange, egg shells have been varnished to prevent it and caused the death of the growing chicks (Romanoff 1949).

As the chick develops, the eggs in the incubator give off carbon dioxide into the internal incubator environment. The amount of carbon dioxide emitted is minute and probably not of great consequence with the number of exotic eggs that are normally incubated by the hobbyist breeder. With an increase of eggs will come an increase in carbon dioxide and subsequently, the risk factor of asphyxiation will rise. Conditions created through average ventilation should render these gases harmless.

Of more importance would be the build-up of ammonia gas given off by the eggs when the chick has pipped the shell. If one incubator is being used for both incubating and hatching, a greater need for sufficient ventilation arises. Pay close attention to the temperature and humidity fluctuation when you adjust the vents on any incubator.

Oxygenation of the incubator air can be very beneficial to incubation and hatching (Cruz and Romanoff 1944). It has been proven with the use of chicken eggs that increased oxygen levels from the normal 19% or 20% up to between 31% and 41% will increase growth rate by 1.5 times and improve over-all hatchability. Do not run out and buy an oxygen tank for this purpose alone; consider that incubation was a little more crude in those days and the eggs were packed in the machines by the thousands. Oxygenating the environment of these incubators had to increase the over-all hatchability if you consider the number of chicks that suffocated in the crowded conditions they were incubated in. The important thing to keep in mind here is the fact that more oxygen in the air boosted the growth rate and viability of the hatched chicks. This information can become very important when dealing with problem eggs or weak hatches, and a tank of oxygen can be kept handy for the time you decide that a chick may benefit from it. Wet hatch chicks may need oxygen for a day or so to make breathing easier if they took in fluids and excess albumen upon hatching. Newly hatched chicks with bad color, pale or deep red skin, should also be given oxygen to help give them a stronger start in the nursery.

An analysis of oxygenation studies seems to imply that supplementation with 0_2 is not necessary if ventilation is adequate in the incubator. Be aware that oxygen supplies that are packaged in heavy

metal tanks can be very cold. Do not allow the gas to flow directly on the eggs or chicks as it could kill them.

POSITION OF THE EGG DURING INCUBATION

In large poultry production plants, eggs are incubated vertically with the large end containing the air cell at the top. This has worked well for poultry fanciers across the world but has caused many deaths for those that choose to raise waterfowl or exotic species of birds.

With the increase of breeders that practise some sort of artificial incubation, came the increase of upside down and other malpositioned chicks. The question of why these malpositions are on the rise, is, as of yet, unanswered. Speculation based on studies in the poultry industry may assist us in evaluating this problem.

Rol'nik (1970) states that a study conducted in 1933 by Byerly and Olsen yielded a 60-70% malposition rate in eggs that were incubated with the small end upward. This seems to indicate that a center of gravity mechanism does exist in the developing chick and guides the chick's head to the optimum hatching position.

In my experience incubating parrot eggs, a higher malposition rate occurs if I incubate eggs horizontally in trays where they can teeter back and forth from small end to large. I have observed a decrease in malposition by supporting the large end of the egg with gauze pads preventing its movement below that of the small end. The large end of the egg is only slightly elevated and supported by the gauze; it does not put the egg in the vertical position or anywhere close. This has not completely eliminated upside down chicks but there is definitely a positive effect on them. Eggs that were incubated under chickens showed only one incidence of malposition out of over 100 exotic eggs set. This egg also spent seven days in the incubator machine prior to being placed under the sitting hen.

Incubation position has proven detrimental to the posture and survivability of chicks in many species. Eggs are formed in such a way that they will naturally assume the proper incubation position when placed on a flat surface. Sometimes our newfangled incubator trays or turning grids hamper the eggs' natural resting position and cause hatch-related problems. I realize that this is not true of every egg and some are shaped irregularly enough to defy this rule, but for the most part, eggs will come to rest with the air cell slightly elevated when allowed to come to rest on their own.

Vertically incubating eggs of some species of birds, *i.e.,* geese and ducks, also caused developmental problems where the allantois failed to close around the albumen (V.V. Rol'nik). Because of the rarity and

expense of most exotic birds, tests like these may never be conducted on parrot eggs and we may never know if one species or another has a higher mortality rate when incubated under these conditions. This is another reason it is so important to keep good records on your incubation program and share your results with others that incubate exotics. If everyone who has incubated eggs kept records and a book was compiled of the results of different temperatures, humidities, and positions, we might have the answers to all our questions and solutions to all of our problems.

TURNING OF THE EGGS

The turning of the eggs during incubation is necessary for the normal development of the chick. Eggs that are not turned throughout the incubation period will not survive; embryos will adhere to the top portion of the eggshell and development will cease. Some aviculturists believe that turning of eggs came about because they became very warm against the brood patch of the hen and she turned them to the cool side for comfort. Over the evolution of time, turning became physiologically necessary for the development of the embryo inside. This theory can be partially substantiated if you consider optimum turning requirements of birds that sit on their eggs for great periods of time and birds that seldom or never sit on the eggs for incubation. There are birds that bury their eggs in rotting debris and do not turn them at all, if these eggs are incubated artificially, they cannot be turned or they will die.

Parrots, for the most part, turn their eggs frequently during incubation. This is necessary in order to prevent the blastoderm, and later the embryo itself, from adhering to the shell membranes, as the yolk will always float to the top of the egg and press against the inner membrane.

Incubators commonly available today often come equipped with some type of turning mechanism. In the cabinet type incubator, it is a tray that rotates 45 degrees in either direction of the middle position. This turning is automatically triggered once every hour unless otherwise modified. Through candling of the developing eggs in their first week, I've noticed that a more even distribution of blood vessels will take place if eggs are turned 180 degrees by hand once a day in addition to the mechanical action of the rotating tray. I have continued this extra turn until internal pip takes place and it does seem to aid the development of artificially incubated eggs. Hand turning of eggs is always preferred over the use of the automatic turning device because it is a more natural turn. Whenever possible, turning should be

accomplished by hand. A system of hand turning during the day and automatic at night is a reasonable compromise.

In machines that use a rotating grid, the eggs usually are turned through a 180 degree arc and back again. I have a definite aversion to these machines due to the embryo's extreme sensitivity to vibration during early development. Cabinet type, tilting trays should be observed closely for vibration also. Sometimes a small adjustment can eliminate vibration and decrease the number of early dead embryos.

In chickens, a 15% hatchability can be expected if eggs are not turned at all (V.V. Rol'nik). As the number of turns increases in each twenty-four hour period, so does the hatchability rate up to about forty-eight turns in one twenty-four hour period. In the experiments quoted by Rol'nik, hatchability decreased slightly with 96, 144, and 192 turns in each twenty-four hour period.

When turning eggs by hand, be careful not to spin them so fast that the yolk remains at the top of the egg. I have a definite feeling that hatchability will be severely reduced with such rough handling. Gently roll the eggs over one eighth or one quarter at a time being careful not to crack the shell or bump the egg while doing so. As the incubation cycle progresses, the shell becomes more brittle due to the utilization of shell calcium by the chick. It may be helpful to mention that turning eggs end over end may damage the air cell of the egg. Turning is accomplished by gently rolling eggs on their sides, as they would roll if placed on a flat surface.

Once chicks have internally pipped, it is not necessary to turn the eggs and turning may actually have a negative effect on hatchability. Eggs that have begun the hatching process should be placed in the hatcher, not turned, and monitored for any type of hatching difficulty.

When using a machine that is not equipped with an automatic turning device, it is advisable to turn eggs every two hours or so during a sixteen hour day. Try to turn them an odd number of times each day. It is believed that allowing eggs to incubate on the same side each night will decrease their hatchability. Turn the eggs one-fourth or one-third of a complete turn each time and this should be sufficient.

ACCIDENTAL COOLING OF INCUBATING EGGS

We have all been told that allowing eggs to get cold during incubation will surely kill them. Well, this is not necessarily true.

Depending on the stage of development that the embryo is in, it can withstand a great deal of cooling and still live to hatch. I discovered this quite by accident when a pair of Umbrella Cockatoos laid eggs and began to incubate. After five days I decided to candle these only

to find them cool to the touch. Since my chickens had not laid yet, I left the eggs with the parents. Three days later I returned to find the eggs warmed and development had begun. On four or five subsequent visits, these eggs were cool again but after 28 days, they both hatched. This experience, as well as other similar ones, has enlightened me and also reduced my stress attacks over worrying about eggs getting too cool during candling or handling.

Other events have caused eggs in my care to become very cool. One night after tending to the incubator, I forgot to turn it back on. When I returned the next day, the temperature was below 70°F. All of the eggs in that group hatched despite twelve hours of cooling. Eggs that are chilled in early development, or for very long periods of time, will probably not hatch. It is possible that, if they do, the chicks may die at a very young age.

Eggs that are tended by the parents go through many periods of slight cooling. Perhaps this is the big secret of successful incubation. As soon as we find out how to process and use this information in an artificial incubation program, we might all sleep a full night during the breeding season.

STORING EGGS PRIOR TO INCUBATION

This subject is not addressed in this publication because I cannot think of any reason why someone would want to store parrot eggs. The idea of a synchronized hatch is somewhat appealing, but certainly not worth the risk of reduced hatchability that may occur.

There has been a study done at the Department of Avian Sciences, University of California, Davis, on storing cockatiel eggs prior to incubation. These studies yielded a reduced hatchability in eggs stored more than three days before incubation. To the best of my knowledge, there have been no studies done on the larger parrot species and I personally am not willing to risk the chicks involved. If more information on the subject is desired, contact the University of California for a copy of the study.

TRANSPORTING EGGS VIA COMMERCIAL TRANSPORTATION

On two separate occasions I have had cause to send eggs to a satellite location for incubation. Both shipments included two Umbrella Cockatoo eggs, packed in plastic bags, protected by styrofoam, and positioned vertically in the container. All four eggs failed to hatch.

In another case, an individual who was afraid to hand-rear chicks

of a certain species sent eight eggs to someone else for hatching. They hatched but only one chick was reared. Due to the difficulty in rearing this particular species, the important fact is that the eggs did survive the flight and managed to hatch. If given a choice of sending eggs that were not incubated at all, or sending pipped eggs ready to hatch, I would try shipping the pipped eggs on a direct flight or wait until they hatch and send the chicks.

WHEN TO PULL EGGS FOR BEST HATCHABILITY

From the standpoint of hatchability, the best time to pull eggs from the parental nest is after ten to fifteen days of natural incubation. It may be possible to pull the older egg or eggs and leave the rest until they have received the desired amount of natural incubation. If other means of natural incubation (such as chickens) are available, the eggs can be pulled when it is convenient for the breeder. If you are comfortable with your artificial incubation system, the eggs can be pulled at your convenience.

SHELL ABNORMALITIES AND INCUBATION

Eggs that are abnormally shaped or sized tend to have incubation problems. If the normal look of an egg from a certain species is glossy and you find one with a dull finish, chances are there are abnormalities in the *cuticle* structure and a dehydration problem will follow. Frequently eggs are laid with many calcified bumps or a chalky, thick shell. These eggs tend to have problems quite the opposite by retaining too much fluid during incubation.

Many writings recommend lightly sanding an eggshell that is too thick and does not allow for the normal transpiration to occur. I have had very few occasions to practise this procedure and could not comment on it from experience. I have, however, experienced many situations where the egg was losing too much weight which I have controlled with certain repair techniques or high humidity settings. Successful hatching of these eggs requires great attention to detail and careful manipulation of the incubation environment.

Eggs that are unusually small but contain a yolk seem to exhibit the same fertility rate as normal-sized eggs. I have noticed that certain hens will lay these odd-sized eggs repeatedly from clutch to clutch with the larger egg almost always being laid first. Hatchability has not been reduced in my experience. I have tended pairs of birds which lay one very large egg and one very small egg in each clutch. These eggs had the same hatchability rate as normal-sized eggs. The chicks matured into perfectly healthy adult birds.

If an egg is laid that does not look normally structured and you have the facilities to artificially incubate it, I would strongly suggest it. This will give you the opportunity to monitor the progress of the development. Macaw eggs with no glossy cuticle on them tend to lose too much moisture during incubation and eggs with a pitted or porous shell often have a dehydration problem also. This is not always the case, but a closely monitored egg would have a better chance of hatching than one left totally to fate. Thin shelled eggs that appear almost transparent when first laid can create a problem with excessive weight loss. If monitored and manipulated correctly, these eggs produce healthy chicks.

The incubation techniques that I have adopted and used are explained under each particular problem heading. I have included all the commonly occurring egg abnormalities that I have treated in the past.

INCUBATING THIN SHELLED EGGS

During the breeding season nutritional deficiencies such as calcium are more easily noticed. If an insufficient amount of calcium is available, or the utilization of that calcium is hampered in any way, irregularly-shelled eggs or egg binding could occur in the laying hen. The latter being a potentially fatal problem which is covered in more detail in the section on "The Eggbound Hen".

Thin-shelled eggs can also be caused by excessive egg laying or be more prevalent in older hens. These eggs are another incubation nightmare. Leaving these eggs with the parents is almost certain death due to dehydration or damage to the delicate egg shell. In many cases these eggs, if fertile, can be hatched successfully with close attention. Handling thin shelled eggs for any reason demands the utmost of care.

Weight data is very helpful in incubating and hatching thin shelled eggs as the most common problem is the dehydration through the incubation process. An accurate hatchability percentage would be difficult to predict, but I estimate at least a 75% chance.

After weighing the egg and recording its original weight, place the egg in a Ziplock plastic sandwich bag for incubation. If your automatic turning device is one that rolls the eggs inside the incubator, it should not be used. Turning devices that rotate the whole tray back and forth can be used by wrapping the excess plastic bag around the egg and placing it in the rotating tray. Make sure the egg is resting in the natural position and does not shift during the automatic turning of the tray.

Remove the egg from the plastic bag once a day and weigh it. If you are not opening the bag to weigh eggs, you must replenish the

air supply in the plastic bag daily due to the gas exchange and the small amount of space inside of the bag. In most cases the plastic bag will retard weight loss enough to maintain the desired *transpiration.* If dehydration is still excessive, a moist *2″* x *2″* piece of gauze can be placed in the plastic bag with the egg but not touching it. This will increase the internal humidity of the plastic bag and slow weight loss. Change and discard the gauze and plastic bag every three or four days to reduce the risk of fungi development. If weight loss is erratic, it is probably due to the gauze pad drying and can be corrected by paying closer attention to this detail.

Sometimes incubating an egg in plastic will slow weight loss too much. An easy solution to this is to poke holes in the bag or leave the seal open far enough to correct the problem.

Eggs that are incubated in plastic bags can also be hatched in them. When drawdown occurs, place the egg and plastic bag in the hatcher unit. It may be helpful to add moistened gauze at this point if it has not been used thus far.

INCUBATING THICK SHELLED EGGS

This condition is difficult to diagnose even through candling. Sometimes during candling of these eggs the shell will be more difficult to see through and appear more gray than normal. Other symptoms of this condition could include a thick chalky-looking shell or daily weight losses that are much too low. These eggs are a definite problem as it is easier to prevent weight loss than it is to promote it. If multiple incubators are being used, these eggs should be placed in a very low humidity and monitored daily.

When it becomes apparent that insufficient weight losses are not being accurately resolved through humidity changes, lightly sanding the shell over the air cell with very fine sand paper may be helpful. This will usually correct the problem if done properly. If too much shell is sanded away, it may be necessary to follow the instructions for a thin shelled egg by finishing the incubation period using a plastic bag. Thin layers of Elmer's glue can also be used to build up the thickness of the shell and is sometimes a more convenient solution.

If you are willing to monitor the egg closely, a pinhole can be placed through the shell in the area of the air cell. This should be accomplished at about ten days of incubation and monitored very closely each day. Often the water loss will increase enough that a thin layer of glue can be smoothed over the hole after five or ten days. Be aware that you have technically opened the shell and may impose a potential bacterial or fungal problem to the growing embryo inside.

As hatch time grows near, a close eye should remain on eggs with thick shells. Frequently the chick has a hard time hatching and a rescue mission may be in order. In most cases of thick shelled eggs, I place a pinhole through the shell over the air cell, or reopen the one that was there previously, to ensure the chick can breath. After varying periods of time, the chick usually manages to hatch on its own, but sometimes it is necessary to help the chick remove the top portion of the eggshell. Care must be taken not to attempt this procedure too early in the hatching process. Consult the sections on assisting a hatch prior to opening the egg.

STRESS LINES ON EGGS

Grayish appearing lines or grooves that are usually located toward the pointed end of the egg are called *stress lines.* Calcium deficiencies or intrauterine irregularities can cause lines or thin shell on some eggs. These lines become very evident when the egg is candled. Some stress grooves are deep enough to expose the inner shell membrane. It is sometimes difficult to tell how deep these lines are; therefore, all of them should be repaired with glue to avoid any excess dehydration during incubation. If an egg weight system is being used, it is wise to weigh these eggs frequently and apply thin coats of glue to the shell until the problem is solved. Be cautious not to glue the entire eggshell. Place glue only where it is needed so as to allow for normal gas exchange of the embryo. If weight loss cannot be controlled in three or four days, consult the section on incubating thin shelled eggs.

In these cases a need to re-assess the daily diet is in order. Calcium deficient hens can easily become egg bound and die or the thin shelled eggs can rupture and lacerate the hen's reproductive system. Consultation with an avian veterinarian is recommended.

INCUBATING BROKEN AIR CELL EGGS

Shapes of air cells in general will vary a little. For the most part they appear as a perfect circle with a clean line of attachment in the large end of the egg. There are areas that drape down slightly in some eggs and even some that will change shape when the egg is rotated under the candler. This is no indication of a problem unless the membrane forming the air cell is broken allowing albumen into the air filled portion. This condition, if noticed early, can be dealt with by slightly elevating the large end of the egg during incubation to avoid any further spilling of albumen. If the tear in the membrane is very slight, it will often heal over and the chick will continue to grow.

Careful turning is required and must still be accomplished (perhaps by hand) to prevent the embryo from adhering to the shell.

The outlook for eggs with severe internal damage is not good. When development proceeds to the point of damage, the embryo usually dies.

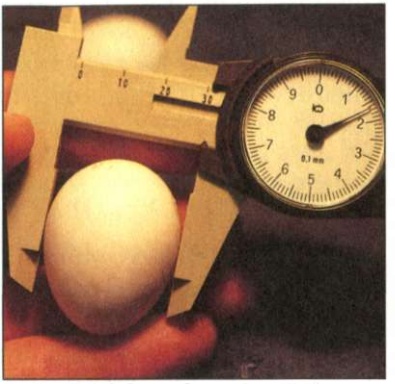
BLOOD RING DEVELOPMENTS

Very early in development, before a recognizable embryo exists, growth can cease and a ring of blood will appear around the yolk or the entire egg upon candling. This is called, quite logically, a blood ring development. This ring can continue to grow but it is no longer associated with the embryo and further embryonic development will not take place. Frequently a tiny embryo will be present but is not visible upon candling due to the lack of blood in the tissues.

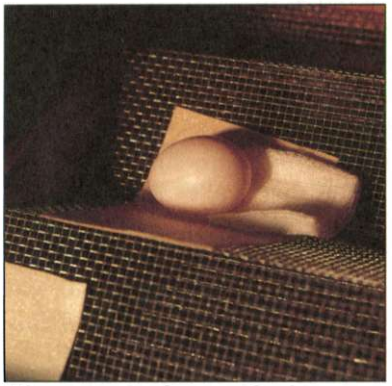
Causes for this early death cover a wide range of things. In my experience, almost any egg that begins to develop and dies very early on will appear as a blood ring when candled. Poor nutrition, incompatible genetics, improper turning, temperature extremes, and trauma are among the reasons given in other literature on this subject.

Many of the blood ring developments that I have cracked open for inspection yielded very little about their cause. A few eggs that have been known to have been jarred by parents or the handler eventually appeared as blood ring eggs. This is valuable information to record for future use. If a particular pair of birds produce numerous blood ring eggs, artificial incubation may assist in the production from that pair. Frequent occurrences of blood ring eggs in the incubator itself may indicate a severe temperature fluctuation or a turning mechanism in need of adjustment.

Extreme accuracy is required in keeping proper records of egg weight. Electronic scales provide such accuracy.

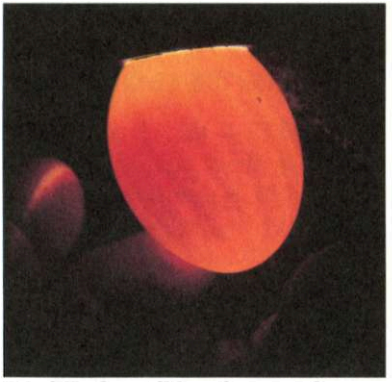


Proper detailed records require extreme accuracy in egg measurement.

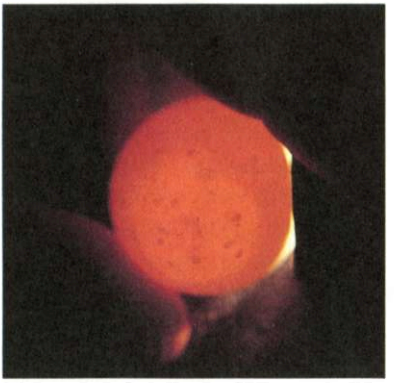


When using incubators with tilting trays, cushion the air cell end of the egg to keep it slightly elevated and keep it from teetering back and forth.

Turning-related problems are often noticed through candling. The blood vessels of the shell membranes fail to close around the albumen of the egg.



It is difficult to tell how deep stress lines are on the eggshell, therefore all of them should be repaired with glue.



Thin or pitted shells should be repaired by using a coat of glue over the breaks in the cuticle.

Scarlet Macaw chick.

Three Rose-breasted Cockatoo chicks.

Quick Reference
Problem Solving Guide
For the Incubator

This chart is to be used only if a trend has developed in the incubator. Adjustments should not be made based on one or two individual eggs.

Symptom of Trend	**Possible Problem**
1. Eggs do not develop or begin to develop and die.	Dry Bulb temperature too low Improper turning
2. Blood ring development.	Eggs jarred or damaged Dry Bulb temperature too high Vast temperature fluctuation
3. Died fully formed, chicks large, soft, and full of fluid.	Wet Bulb temperature too high
4. Unabsorbed yolk sac at normal hatch time	Dry Bulb temperature too high Wet Bulb temperature too high
5. Early hatch.	Dry Bulb temperature too high
6. Late hatch.	Dry Bulb temperature too low
7. Many upside down chicks	Improper turning Turning mechanism vibrates Improper incubation position Eggs teeter on trays Incubator not level
8. Many unexplained deaths	Possible bacteria or fungi Severe temperature fluctuations
9. Late to pip, chicks underdeveloped.	Dry Bulb temperature too low Wet bulb temperature too low

chapter 6

Egg Weight Management

GENERAL

I began weighing parrot eggs after reading *Falcon Propagation,* an excellent publication by the Peregrine Fund Inc. In an effort to compare average weight losses between parrots and other birds, I established a system incorporating methods quite similar to the ones used in this book.

Weight loss is really the only measurable change that takes place over the incubation period of an egg. If the egg shrank or expanded when incubated, it would be so much easier to assess. Using air cell size is much less accurate than weight loss and judgment is difficult due to the many shapes and sizes that can occur after drawdown; this method would be little more than an educated guess.

The equipment needed to carry out egg weighing in a responsible way will include some type of gram scale that is accurate to at least one decimal place (preferably two), a pair of scientific calipers, a hand-held calculator, and some type of log sheets or record keeping system. Sample egg weight data sheets are included in the appendices of this publication. Use them as they are or modify them to fit your needs, but be sure to include all of the important data.

After weighing and observing eggs for as little as one breeding season, you will develop a sixth sense about the eggs and soon be able to recognize a problem egg merely by candling it. This sixth sense could make a remarkable difference in the incubation system used and may boost hatchability considerably.

HUMIDITY AS A FUNCTION OF WEIGHT LOSS

The humidity or wet bulb temperature is the main regulating

element of weight loss in eggs. As the eggs develop, fluids evaporate through the shell pores, a process called *transpiration*. The amount of fluid that will evaporate is directly related to the humidity in the incubator and, to a lesser degree, the air circulation and altitude. If the humidity in the incubation environment is low (lower wet bulb reading), the fluid in the egg will evaporate faster, thus the egg will lose weight faster. The converse is also true, a higher wet bulb reading yields a lower fluid loss and subsequently, a lower weight loss.

These strange facts are due mainly to the natural physics involved. Humidity is a measurement of the amount of water in a given sample of air. As you heat air, in this case using an incubator, it can hold more water and will draw this water from any source available in the incubator. The two major sources of moisture that will be present in the incubator are the water tanks and the eggs. Once the heated air has absorbed as much moisture as it can, it is said to be saturated. As the air approaches this *saturation point*, the evaporation in the incubator is slowed and the transpiration or weight loss will also slow. It is easier to remember:

(Higher wet bulb = Lower weight loss)
(Lower wet bulb = Higher weight loss)

Weight loss of normal eggs remains fairly constant in each twenty-four hour period if the humidity remains constant. Furthermore, the weight of each individual egg will vary according to the amount of shell surface area exposed to the heated air and the number of pores in that shell. This means that smaller eggs incubated in the same humidity as larger eggs will lose approximately the same percentage of weight daily as the larger eggs.

This is a fortunate situation. If the smaller eggs lost the same amount of weight (in grams) as the larger eggs, they would dehydrate and die before pip time arrived.

ALTITUDE INFLUENCES ON WEIGHT LOSS

Even though humidity (measured by wet bulb temperature) is the main controlling influence of weight loss, it may be important to consider altitude influences as well. As the altitude of your location increases, the outside air pressure drops. This allows for more transpiration to occur due to the pressure inside the eggs.

To overcome this increase in fluid evaporation due to altitude, it may be necessary to increase the humidity in the incubator just a bit. Make this increase slowly and monitor the effect it has on the weight loss of the eggs. Unless you are hatching eggs on a mountain top ski

resort, you should not have to increase the wet bulb reading by more than a degree or two above recommended settings. Weighing eggs is very helpful when any adjustment is to be made in the incubation temperatures.

GETTING STARTED

If you have decided to pull eggs as soon as they are laid, keeping weight records will be a cinch. Monitoring the percentage of loss will be a simple matter of plugging the fresh laid weight into the equation below and calculating the amount of weight the egg should lose daily. The table in Appendix II and III contains incubation periods, desired percentage weight losses, and pip to hatch intervals for many of the commonly bred species. These numbers are averages of actual statistics compiled on eggs that were naturally incubated as well as artificially incubated. Numbers hatched range from 15 to 50 eggs in each group unless otherwise indicated. All weight loss percentages that appear are targets that I have established and used in my incubation program. The numbers will work for the species indicated; there is no indication, expressed or implied, that these numbers will work for any species other than the ones for which they have been established.

If natural incubation has been performed for a week or longer on the eggs, weight loss data becomes less important. Eggs that are naturally incubated will hatch with little trouble even if the weight losses are out of the normal boundaries. The more natural incubation an egg receives, the less important the weight loss becomes.

FINDING THE DAILY WEIGHT LOSS TARGET

Daily weight loss goals are computed by multiplying the fresh laid weight by the desired percentage weight loss to pip time and dividing this product by the number of days of incubation to the expected pip day, or:

$$\text{DAILY WEIGHT LOSS TARGET} = \frac{(\text{FRESH LAID WEIGHT}) \times (\text{DESIRED \% LOSS TO PIP})}{\text{NUMBER OF DAYS TO PIP}}$$

Example: A Major Mitchell's Cockatoo egg is pulled on day one. The egg weighs 21.25 grams and you would like a 14% weight loss over a 24 day incubation period before the chick is due to pip the shell.

So:

$$\frac{21.25\text{gms} \times .14}{24 \text{ days}} = .124 \text{ or } .12 \text{ grams daily}$$

Now you can use .12 grams as a daily weight loss goal over the twenty-four days that the egg will incubate. If the weight loss is too low, reduction in the humidity is necessary, but if it loses too much weight each day, the humidity needs to be increased.

Remember to multiply the actual weight loss by the number of days between weighings or you will panic when you see the erroneous weight difference. Incubators should not be adjusted based on one day's weight loss due to the normal humidity fluctuations that occur in the machines. An average daily weight loss over a three or five-day period would give a better picture of the trend that is occurring with each individual egg. It is important to evaluate all the eggs in the incubator before making any incubator adjustment.

EVALUATING THE CURRENT TREND OF WEIGHT LOSS

It is helpful to know what percentage of the total weight an egg will eventually lose if it continues on the trend it is on. This is a good way to double check target weights and to prepare yourself for a chick that may have a hatch problem.

The following equations will yield the final percentage of weight loss that an egg will lose by pip day. These equations are based on the average daily weight losses thus far, so any substantial difference in daily losses will yield an inaccurate estimation. If the egg continues to lose according to the trend already established, the final result will be accurate. If an extremely high or low percentage is calculated, an adjustment of the incubation procedure for that egg may be warranted.

To compute a trend percentage, first subtract the current weight from the fresh laid weight and divide by the number of days the egg has incubated up to now. This number will be the average daily weight loss that has been occurring.

Second, take this average daily weight loss and multiply it by the total number of days in the incubation period to expected pip time. Divide this number by the laid weight and the result will be the decimal percentage that the egg will lose if it continues on the trend it is on. If you prefer seeing this number in a straight percentage, multiply it by 100.

EQUATION:

STEP 1.

$$\frac{\text{(LAID WEIGHT - CURRENT WEIGHT)}}{\text{\# OF DAYS INCUBATED}} = \text{AVERAGE DAILY WEIGHT LOSS}$$

STEP 2.

$$\frac{\text{(AVG DAILY WT. LOSS)} \times \text{(TOTAL INC. PERIOD)}}{\text{LAID WEIGHT}} = \text{DECIMAL PERCENTAGE}$$

STEP 3.

$$\text{DECIMAL PERCENTAGE} \times 100 = \text{WEIGHT LOSS TREND TO PIP}$$

Example:

We want to know how much weight a Major Mitchell's Cockatoo egg will lose by pip time if it continues on the trend it is on.

On day one the egg weighed 14.48 grams It has been under a chicken for 15 days and now weighs 13.25 grams The total incubation period to pip is 24 days for a Major Mitchell's egg, so:

STEP 1.

$$\frac{14.48 - 13.25}{15} = .082 \text{ (average daily wt. loss)}$$

STEP 2.

$$\frac{.082 \times 24}{14.48} = .136 \text{ (decimal percentage)}$$

STEP 3.

$$.136 \times 100 = 13.6\% \text{ TOTAL WEIGHT LOSS}$$

If the egg continues on the same trend, it will lose 13.6% of its original weight by pip time. Check the table in Appendix II to see if the weight loss is in the acceptable range for this species.

TREAT EGGS INDIVIDUALLY

Manipulation of the humidity in the incubators affects all the eggs that are present. If one or two eggs are having a weight loss problem but the majority are doing well, it is not cause to adjust the total incubator environment and throw the remaining eggs out of line. The following lists will help to resolve weight problems on eggs that insist on expressing their individuality.

Losing too much weight

A. Continue incubation in a Ziplock plastic bag. If weight loss is not corrected, add a few pieces of moist gauze to the bag but not touching the egg.

B. Coat small portions of the shell with Elmer's glue. The plastic bag method is preferred as it does not have an effect on the egg's natural gas exchange.

C. Place the egg under a chicken or surrogate sitter for natural incubation.

Not losing enough weight

A. Using an emery board or nail file, lightly sand the shell over the air cell. Be cautious not to break through.

B. Place a small pinhole through the shell over the air cell.

C. Place the egg under a chicken or surrogate sitter for natural incubation.

WEIGHT LOSS GOALS ON EGGS NOT PULLED ON DAY ONE

If you did not pull an egg when it was first laid, you cannot use the formula previously mentioned to establish a daily weight loss goal. There are, however, a couple of ways to finish the incubation process using a daily target weight.

When dealing with parent birds that are calm, sometimes it is possible to obtain a weight on an egg and return it to the nest box for three or four days. This is a very valuable bit of information to obtain because it is the amount of weight loss the natural parent is allowing to occur. Merely return the egg to the nest and pull it again three days later. Weigh the egg again and subtract the second weight from the first. Divide the three day weight loss by three and use the result as a daily target for the artificial incubation regime on that egg. If the hen has not incubated the egg during the trial period, the reading will be false. Ensure the clutch is being incubated before using this method of estimation.

There is another way to estimate the weight of the egg when it was laid. I rarely use this method due to the questionable accuracy of the equation, but it is interesting to investigate the differences among species of birds. One of the variables in this equation is a coefficient for the particular species of bird that you are using it on. Very little

weight data has been collected, compiled, and reported about psittacine eggs, so in an attempt to establish some coefficients for this formula, I have measured, weighed, averaged, and recorded some that can be used if no other means of control are available. These numbers have yielded fresh laid weights to within one or two percent accuracy on any egg in the sample group. Any time you use a formula to obtain weights or target numbers, compare the results with other statistics known to be correct. This type of holistic approach will help keep an incubation program in a safety zone created by the data you have collected. If the estimated laid weight is less than the actual weight when you began computing, the equation obviously was incorrect. Eggs do not gain weight. Use some common sense when estimating any egg weights.

ESTIMATION EQUATIONS

Hoyt (1979) presented an equation to be used for estimating the fresh egg weights of avian eggs. Before using it you must first measure the egg's length and breadth using scientific calipers. Coefficients to be used are listed in Appendix I by species. If the species in question is not included in the table, it would be preferable to find another method of weight loss estimation than to substitute a number that could yield a potentially lethal result. A rendition of the equation is listed below:

$W = (CSS) \times (L \times B^2)$ WHERE...

W = FRESH LAID WEIGHT
CSS= SPECIES SPECIFIC COEFFICIENT
L= LENGTH OF EGG IN MILLIMETERS
B= BREADTH OF EGG IN MILLIMETERS^2

To explain this in more simple terms, work through the following example.

EXAMPLE: A Major Mitchell's Cockatoo egg is pulled at day six when the parents stopped incubating. The egg measured in at a length of 39.99 mm and a breadth of 27.10 mm. A species specific coefficient of .0005565 is taken from the table of coefficients in the appendix and the equation is worked as follows:

$W = (.0005565) \times (39.99 \times 27.10^2)$
AND $W= (.0005565) \times (39.99 \times 734.41)$
... $W = (.0005565) \times (29369.0559)$
W = 16.34 GRAMS

Due to variances in shape, shell thickness, and size of the air cell when the egg is laid, the number will not be the exact fresh laid weight, but it will be close. If the total percentage of weight loss to pip is around the midpoint of the acceptable range in the table in Appendix II, there should be no need for exact figures.

Now it is possible to calculate a daily weight loss target by using the equation in the section called "Finding the daily weight loss target."

As previously mentioned, natural incubation is always preferred over artificial means. By using weight loss as a guideline for artificial incubation, you will be better able to judge if an egg is staying within the range of hatchability.

WHEN TO WEIGH EGGS

Eggs should be weighed at the same time of day, everyday. This will provide some uniformity for your record keeping. You need only weigh eggs every other day or every third day unless you have a problem weight loss with some of them. These problem eggs should be weighed daily until weight loss reaches an acceptable range.

SURVIVABILITY OF WEIGHT LOSS EXTREMES

When I first began keeping weight data on incubating eggs, I did not control the weight losses in any way. Since no one seemed to know what weight losses were potentially fatal to the different species I was incubating, it made no sense to manipulate it. This is how the "Table of Desirable Egg Weight Losses" in Appendix II of this book was established.

Eggs were weighed and placed in the incubator for incubation. Many did not hatch due to too low or too high fluid loss. The extremes were finally beginning to establish themselves; all that needed to be done was to record them.

The statistics provided to you in the "Table of Desirable Egg Weight Losses" was prepared by analyzing the deaths and hatches at a certain weight loss for each species. I will admit that there is a certain amount of overlap in these numbers but it makes more sense to break them down by species rather than say hatchability is increased with a weight loss of between 9-20 percent for all exotic eggs. Due to the tremendous size difference, a 20 percent weight loss on a Hyacinth Macaw egg will certainly have a better hatchability than the same weight loss on a Major Mitchell's Cockatoo egg. There seems to be some correlation between desired weight loss and the size of the egg,

but since some birds lay different sized eggs, it is easier to approach weight loss by species.

Eggs have hatched under my supervision with as little as an eight percent weight loss. The chicks looked like small pink water balloons with beaks and feet. On the other end of the spectrum, I have hatched eggs that lost 29 percent of their weight at pip time. These babies were all wrinkled and dehydrated, but they did pull through and looked normal in a day or so. Hatchability will be the highest and yield healthier more viable chicks if the losses are in the mid to upper range of acceptable percentages for that species.

Given the choice of weight loss extremes, I would always choose a higher weight loss. Many eggs that fail to lose their desired weight will drown when pip time arrives. It is easier to assist a hatch on a slightly dehydrated chick than to discard the chick that never could free itself from the egg.

chapter 7

Hatching and Hatching Assistance

HATCHING (Temperature and humidity settings)

The hatcher unit should be set around 98.5°F or approximately one degree less than the incubator unit. Generally, chicks have a limited ability to regulate their own body temperature at the point when they should be placed in the hatcher and they no longer require such high temperature settings.

The humidity in the hatcher must be elevated enough to prevent the hatching chick from drying out and adhering to the inner membranes. I usually set the hatcher wet bulb temperature at 92 to 94°F or higher.

Humidity in the hatcher is measured with a *hygrometer.* This instrument is merely a thermometer with a wet wick or sock on the end of it. As the heated air dries the water from the wick, it reduces the temperature reading on the thermometer, this reading is called the wet bulb temperature and is the most common way to measure humidity in the hatcher or incubator units.

If you desire to know the actual percent relative humidity that corresponds to the wet bulb reading, see the "Relative Humidity Chart" in Appendix V.

Increasing the humidity

There are a few tricks to raising the humidity in the hatcher. Since the humidity in the unit is dependent on both the temperature and the amount of water surface area exposed, and the temperature is a constant setting, adding a bowl of water to the hatcher will usually

do the trick. If the humidity is still not high enough, add a bigger (wider, not deeper) bowl of water.

There are other ways to increase humidity, too, but these methods may change the temperature in the hatcher if you do not monitor them closely. You can close the vents just a touch as long as you make sure you do not close them completely and suffocate the hatching chicks. Changing the vent position should be a last resort after adding additional bowls of water.

Decreasing the humidity

To decrease the humidity in the hatcher or incubator, you must find a way to decrease the amount of water surface area exposed to the heated air. One way that is very efficient is to float pieces of styrofoam on top of the water in the main water tanks. Monitor the changes and increase or decrease the size of the styrofoam as needed.

You can also open the vents a little to allow more fresh air to enter the machine. As mentioned above, be sure to check the temperature frequently after adjustment of any vent.

WHEN TO MOVE EGGS TO THE HATCHER

Hatching usually begins approximately three or four days prior to the expected hatch date. At this point in time, the chick is making a delicate transition from a totally fluid environment to breathing air. The first signs of hatching can be noticed during candling. When the circular line of the air cell drops slightly on one side and movements can be seen as the chick works its head toward the air cell. The break in the circular line signifies that *internal pip* or *drawdown* is taking place. This is the time to move the egg into the hatcher and discontinue turning it.

If everything goes as scheduled, hatching should be uneventful. Often things do go wrong, however, and additional sections have been provided to help you deal with these situations on an individual basis.

WET HATCH VERSUS DRY HATCH

The amount of weight, or fluid, lost during incubation determines whether a hatch is wet or dry. Documentation of weight losses and the condition of chicks during hatching will assist in assessing the humidity control of your system for future hatches. If chicks are hatching successfully and not dying prior to hatching, any adjustments of humidity, if necessary, should be very gradual.

If weight losses of eggs were very low and the chicks hatch with excess fluids under the skin, or *edema*, this is called a wet hatch. Wet hatches are risky as often these overweight chicks will drown inside the eggs prior to hatching. If weight data is being monitored and the egg in question is a little heavy with excess fluids, it can remain in the low humidity incubator until external pip. These eggs should be moved to the bottom tray or off the turning grid surface so they no longer get turned. To take this situation one step further, if the egg is very over weight at external pip, it can remain in the low humidity incubator on the bottom tray for an additional 24 hours. This will help evaporate some of the excess fluid from the egg and free the movement of the struggling chick. Chicks that do manage to hatch may benefit from additional oxygen for a day or two while they absorb the fluids that might have entered the lungs or air sacs.

Wet hatch chicks will often be covered with thick mucous and appear irregularly shaped or distorted. If no irreversible internal damage has occurred these chicks should be normal in a few days.

Dry hatch chicks are those whose eggs lost an excessive amount of fluid and weight during incubation. Eggs with excess weight losses can be moved to the hatcher a few days early and hand turned three to five times a day until internal pip. The lower temperature in the hatcher unit should not affect the hatch time by more than a few hours.

Often the membrane surrounding these chicks becomes dry and adheres to the chick's skin. Loud vocalization and a lack of progress in hatching will sometimes alert you to this situation. Although a dry hatch is preferred to a wet hatch, there is a major risk that the membrane will dry over the chick's nares and beak causing suffocation. If it is known that an egg has lost excessive weight, the air cell of the egg can be opened to examine the chick after pip has taken place. Membranes that have dried to the chick need only to be moistened with sterile water to assist in free movement. The hatching process can be continued in a high humidity hatcher or plastic bag with moist gauze placed inside to increase the internal humidity. After hatching, these chicks will benefit from a liquid meal of *lactated ringers* or *Pedialyte*. Feeding can be accomplished as soon as the chick is free of the shell.

Severe weight loss problems in eggs indicate a need for adjustment in the humidity setting. Consult the index for information about humidity control.

HATCHING ASSISTANCE (General)

Hatching assistance is any attempt to help a chick escape the shell.

The reasons that a chick may need help to hatch are diverse but can usually be attributed to some type of incubation related control.

When to intervene and assist a chick to hatch is a difficult decision to make. If exact lay dates and incubation periods are recorded, the guess work is alleviated by knowing when an egg is overdue to hatch. The move to assist a chick is most commonly made when 48 hours have passed after pip and there seems to be no more progress made.

Candling these overdue eggs will aid in determining the condition of the chick. If the chick is active and seems to be moving about in the air cell, hatching assistance should be postponed an additional 24 hours. At this time, the shell can be slowly chipped away at the pip site until a better view of the chick is revealed.

There will be a white canopy membrane over the chick's head and body unless it has already pushed through the membrane and into the air cell. To make the chick more visible, moisten the membrane with a Q-tip dipped in sterile water. Blood vessels should be brown or not be present at all if the chick is ready to hatch. **If active blood vessels appear (pink or red lines), do not continue with this procedure.** Place the egg in a Ziplock plastic bag and back into the hatcher until it is safe to proceed. Check the egg frequently to see if the blood vessels have dried up and disappeared.

After the blood vessels are no longer active, the membrane can be gently peeled back starting at the hole already made by the chick. Work very slowly when peeling away this membrane in case a hidden blood vessel might still be active. If a blood vessel is accidentally torn and begins to bleed, cauterize it with Quik Stop or silver nitrate and place the egg back in the hatcher to warm up for a while.

CAUTIONS OF ASSISTING A HATCH

Many people claim that hatch time is one of the most vulnerable periods in the incubation process. I do not agree with this statement. If someone is having problems with eggs after the hatching process has begun, it is more than likely due to an improper incubation system from the beginning. It is very rare for me to find a dead in-shell chick once it has begun to hatch, but, this could be due to my aggressive nature toward hatching eggs. I monitor hatches closely and do not hesitate too long before assisting a struggling chick.

Hatching assistance is tedious nerve wracking work and is not recommended as a general everyday practice. The most common causes of death during an assisted hatch are listed below. Read them and try to keep them in mind when you grab your tweezers to help a chick hatch.

Common Causes of Death in Assisted Hatches

1. **Ruptured blood vessels**. in surrounding membranes. Chick will bleed to death in a few minutes if the rupture is in a major blood supply.

2. **Unabsorbed yolk sac**. The tendency to pull a chick out of the egg before it is ready should be avoided. Once the egg has been opened, the chick's head can often be gently lifted to provide a view of the naval area to check for an unabsorbed yolk sac. If an unabsorbed yolk sac is present, do not continue the assistance but place the egg back in the hatcher and check on it later.

3. **Bleeding naval**. Always have some type of blood clotting or cauterizing medicine close by when assisting a hatch. The naval area is very delicate at hatch time and may brush against the eggshell during the hatch, causing bleeding.

4. **Stabbing chicks with tweezers.** Don't laugh, when breaking into the egg for the first time, too much pressure may cause the shell to give away all at once and allow the tweezers to jab into the chick.

5. **Bacterial infections.** Use only sterile equipment and keep eggs in a plastic bag between help sessions. Open eggs are very vulnerable to bacterial and fungal infections.

PIP TIME

Approximately 24 to 48 hours after drawdown begins, the chick will push a small hole up in the outer shell by use of its *egg tooth.* This is called *pipping* or *external pip*. If the chick is positioned correctly, the pip mark should be in the air cell where the chick can breathe freely. If the mark is below the air cell, it may be necessary to open the pip site a little to allow fresh air to flow inside. Be cautious of active blood vessels and treat this as an assisted hatch.

Assuming that the pip is above the air cell line, the humidity is high enough, and the chick is strong, you should have a new baby parrot in another 24 to 72 hours. Decisions to intervene in the hatching process should be carefully thought out. If a chick is making progress and seems strong, there is usually no need to help.

OVERDUE TO PIP

If you have been candling the egg all along, you will have noticed whether or not drawdown has occurred. If it has, chances are the chick

has entered the air cell and either does not have the strength to pip or is in the wrong position to pip the shell. Place a pinhole in the shell over the air cell and return the egg to the hatcher for a day or two. Monitor the progress of the hatching and intervene when blood supplies have receded.

In the case where the chick has not internally pipped and has not even begun the hatching process, place the egg back in the incubator until drawdown or pip occurs. Little is understood about the transition from fluid respiration to breathing air and therefore little can be done to assist this transition.

VOCALIZATION FROM THE EGG

Listening to chicks in the egg as they hatch can tell you a lot about the condition they are in. Tapping lightly on the shell or whistling into the hatcher will almost always bring about a response from the hatching chicks. Vocalization from the egg tells you one important thing: the chick is breathing air and is probably strong enough to finish the hatching process.

There are a few other things that can be detected from the voice of a hatching chick. If it sounds like the chick is screaming frantically, there could be a problem. Candle any egg that sounds desperate for help. Sometimes a chick will be ready to hatch and will become disoriented in the process. Upon candling, the chick appears to be moving and thrashing around. There will be no attached membranes at this stage so it is safe to expand the pip site with a pair of tweezers so the chick can crawl out.

On the other hand, sometimes a little voice may sound faint and fading fast. It is best to assist the hatch of these eggs if all other conditions are favorable.

LATE OR NO INTERNAL PIP

Some eggs do not have noticeable drawdown before pipping the shell. This is not the rule as most will show signs of internal pip even if it is very slight.

Malpositioned chicks often will not internally pip. Since the head of the chick is not near the air cell, movement does not affect the air cell line. If external pip is due and there is no sign of drawdown, many times this will be the result of upside-down or slightly malpositioned chicks.

PINHOLES INTO THE AIR CELL

Many times it can be advantageous to place a pinhole in the shell over the egg's air cell. Generally, this is accomplished for one of three reasons: to provide the chick with fresh air; to relieve the internal pressure when hatching an upside-down chick: or to attain more weight loss. This last use is only performed toward the middle or end of the incubation cycle.

Chicks that have begun the hatching process and do not pip the shell within 36 to 48 hours after drawdown need to have air supplied to them if they are to live. Why these chicks begin to hatch and do not pip the shell is usually related to some slight malposition preventing the egg tooth from reaching the shell. If these chicks are vocalizing in the air cell but have not pipped, you must supply fresh air immediately or they will suffocate. After the pinhole is placed in the air cell, the chicks usually manage to pip and hatch.

Another common use of an air cell pinhole is in cases where the head of the chick is in the small end of the egg. For a detailed description of how this procedure is accomplished, see the section "Hatching Upside-Down Chicks".

Drilling a pinhole into the air cell is easy but does require some care not to puncture the chick inside. Candling the egg while rotating a 20 gauge needle on the shell above the air cell is the safest way to accomplish this. Be sure not to apply too much pressure as the needle will penetrate the shell fairly easily. Small drill bits are available from some hobby shops that will do the job and may be a bit safer.

AN EXERCISE IN HATCHING ASSISTANCE

Helping a chick to hatch is a nerve wracking experience if you have never opened an egg before. The exercise below is to help familiarize you with the basic structure of an egg in hope that you will be less nervous when the real event happens.

Materials needed

1 infertile parrot egg (or)
1 chicken egg (at room temp for a week)
1 pair of tweezers
1 small bowl
Flashlight or candler
Pencil
5-10 Q-tip
Warm water

1 towel
1 shot glass

STEP 1.

Wash your hands with soap and water. This is always a good practice before handling eggs.

STEP 2.

In a darkened room, hold the flashlight up to the egg to expose the location of the air cell. With the pencil, draw an outline of the air cell on the egg so you will know where the liquid portion of the egg begins.

STEP 3.

Position the egg with the larger end upward and the small end resting on a soft towel. Using the tweezers, gently poke a small hole in the center of the circle that you have drawn depicting the air cell. Be careful not to force the tweezers down into the egg too far or you will disrupt the membrane that encircles the liquid portion of the egg.

STEP 4.

Carefully pick very small pieces of shell from the perimeter of the hole you have created. Constantly observe the location of the membrane below and be cautious not to touch it. Continue picking shell until you have removed about three quarters of the shell covering the air cell.

Once the air cell is chipped away, observe the leather-like white membrane inside. Pay attention to how it connects to the shell. If this were a live chick, it would look basically the same except small three dimensional contours and blood vessels would be present.

STEP 5.

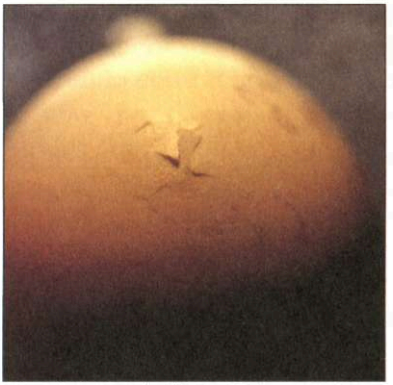
With a Q-tip or paint brush moistened with water, gently brush water across the membrane and observe how it becomes more translucent as the water penetrates it. If a chick were present, you would see blood vessels and the three dimensional outline of the chick. Tilt the egg back and forth to give you a feel of how delicate this membrane is. The weight of the liquid contents is enough to change the shape as it pushes against the membrane.

STEP 6.

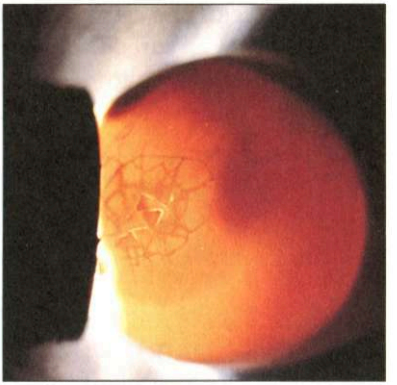
In order to see how thin the membrane is, it will be necessary to break it. If you were helping a chick, you would not do this unless there were no blood vessels apparent after wetting down the membrane. If you break a membrane containing blood vessels, the chick would probably bleed to death.

During drawdown or internal pip, the round line of the air cell changes shape.

Hatching eggs can he placed in cushioned bowls in the hatcher unit so they do not roll around.



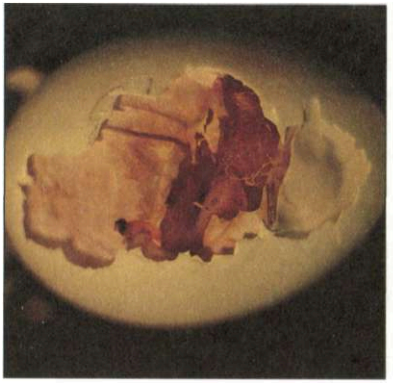
At approximately 72 to 48 hours prior to expected hatch, the chick pips the shell with its eggtooth.



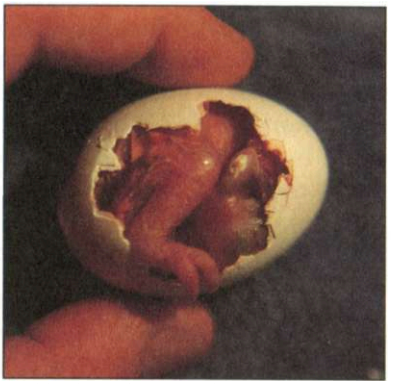
Candling the egg after pip has taken place will often reveal shadows of the chick as it works to escape the shell.

Apply Betadine solution to the naval area of newly hatched chicks.

When a chick pips in the small end of the egg, begin chipping away shell at the pip site and the original air cell.



The membrane can be peeled back near the pip site to allow fresh air to get to the chick.



As blood supplies receed, continue removing shell and membranes from the egg.

Before allowing the chick to crawl out, always inspect the naval area for an unabsorbed yolk sac.

When the time is right, the chick will usually push itself out of the remaining eggshell.

Supplies used to stop bleeding during an assisted hatch.

If blood vessels appear red, discontinue hatch assistance and place egg back in hatcher until vessels have receeded.

STEP 7.

Gently push the tweezers along the inside of the shell where the membrane connects to it. Continue all the way around until the membrane is disconnected and floats on top of the liquid. Pick the membrane up by pinching it in the tweezers and lifting it out of the shell. It may be helpful to balance the egg in a shot glass at this point so the contents do not spill.

STEP 8.

Slowly pour the contents of the egg into a bowl being careful not to break the yolk. Examine the egg shell cup that remains to see how the membrane forms along the shell in the entire egg. Try to remove the membrane with the tweezers. This is probably not possible if the egg is fresh. If this was a fertile egg in the middle or latter periods of incubation, the membrane would be filled with blood vessels.

STEP 9.

Try to locate the germinal disc on the egg yolk. The disc appears as a small white dot on the surface of the yolk and would be developing into a chick if fertilized. Notice also the different consistencies of the albumen and their proximity to the yolk. These are mostly water and nutrition sources for the chick embryo. The very thick twisted albumen connected to both ends of the yolk are called the *chalazae* and help stabilize the yolk in the center of the egg to keep it from settling or adhering to the shell membrane.

As you can see, an egg is more complex than it may appear from the outside. Damage to any of the important structural portions will reduce hatchability. Opening and assisting a fertilized egg is covered in more detail under each subheading in the hatching section.

MISTING EGGS WITH WATER

For some reason the practice of misting eggs with water during the hatching process has become a common practice. It is not advisable to do this because as the water evaporates off the eggshell, it cools the hatching chick considerably and may weaken it. If a chick needs to be moistened during a hatch, use a Q-tip with warm sterile water on it, do not spray the entire egg with water. If the intent is to increase the humidity in the hatcher unit, there are more efficient ways to accomplish this. Add a bowl of water to the bottom of the hatcher to increase the exposed water surface area and evaporation.

CAPPING OPEN EGGS

When assisting an egg to hatch, many aviculturists cap an open

air cell with a piece of shell from a previously hatched egg or an infertile egg. This is a potentially lethal procedure if the shell cap is infected with fungi spores or harmful bacteria. Rather than risk the health of the chick, I would recommend placing any opened egg in a Ziplock plastic bag (if it is being artificially incubated). This will serve the same purpose and is a substantially lower infection risk.

If an opened egg must be returned to the parental nest, capping with a piece of shell may be necessary. Soak the cap for 15 minutes in a solution of 20 cc of Nolvasan to one gallon of water before gluing it to the opened egg.

CAUTION: UNABSORBED YOLK SAC

Chicks that emerge from the egg with a large yolk sac extending from the naval need medical attention immediately. Surgical removal of the extended yolk sac is tedious work and needs to be accomplished by a veterinarian who has this experience. In some cases, the intestines are also extended and will need to be tucked inside of the chick's body. The procedure usually involves gently tucking the extended parts into the naval with a Q-tip dipped in mineral oil. Next, the naval is sutured shut using a cross hatch or X pattern.

If a protruding yolk sac is small (pea sized or smaller), treatment with Betadine solution (1%) and time in the hatcher or brooder will usually cure the problem. Keep the chick warm and pad the naval region to avoid any trauma to the extended area. Often the naval will close tight and pinch off the extended sac. Treat the area often with the Betadine solution and do not attempt to pull the sac off. After about three days, the sac will dry up and fall off much like the umbilicus on a human baby. By no means should you pull or cut at this sac; it could cause the chick to bleed to death.

During an assisted hatch, if an unabsorbed yolk sac is present and the chick has already defecated in the egg, the chick may have some type of physical problem. Chicks generally do not defecate until the yolk sac has been absorbed.

After hatching, some chicks maintain a large yolk sac in the abdominal region. If this sac remains large and conspicuous for several days, the chick may have a yolk sac infection and needs to see a veterinarian.

OPEN UMBILICUS

This condition resembles the "outee belly button" of a child. Treat this disorder as a premature hatch by applying Betadine solution to

the area and putting the chick in the hatcher for a few hours. Hopefully, the problem will cure itself and the most that will come of this, when it has healed, is a slightly protruding dried umbilical cord. In a few days it will drop off by itself and the problem will be solved.

In severe cases where the umbilicus is open a great deal, allow the chick to remain in the hatcher for a few hours. If the naval does not close after four to six hours, it is advisable to have an avian veterinarian suture it closed. This condition, left untreated, could result in a bacterial infection to the chick.

TREATMENT OF DEHYDRATED CHICKS

As previously mentioned, eggs that lose excessive amounts of weight during the incubation period often yield dehydrated chicks. These chicks need the lost fluids replaced in order to assume normal body functions. Pedialyte or Lactated Ringers solution are full of electrolytes and excellent preparations that can be fed to the chick upon hatching.

If the dehydration is severe and you fear for the life of the chick, you can inject warmed Lactated Ringers solution under the skin in the area of the inside leg webs or where the legs attach to the abdomen. This should only be done if you know what you are doing and the chick's life is in apparent danger. If you have never done subcutaneous injections before, this is not the time to practise. Newly hatched chicks are very delicate and they can bleed to death from a pin prick in the wrong place.

Most chicks will be fine if fed the Lactated Ringers solution on a frequent basis until the body fluid levels reach normal. When a healthy look has returned to the skin of the chick, the additional fluids can be discontinued. It may also be of some help to keep the chick in a high humidity brooder for a day until it regains its health and stamina.

FEEDING CHICKS IN THE EGG

When a chick is having a hard time hatching, it frequently tires and eventually stops trying completely. In an assisted hatch, after some of the shell is chipped away, the chick can be fed warmed drops of Lactated Ringers solution or Pedialyte while it is still in the egg. This will give the chick a boost of energy if it is dehydrated or just does not have the vigor to push the shell away. Caution should be exercised when feeding chicks in the egg because the position they are in makes it difficult for them to swallow. Do not force the fluid, allow the chick

to lick it from a small syringe or paintbrush. This will reduce the chance of the chick inhaling the fluid and aspirating.

Feeding chicks while they are still in the egg should only be done when it is thought to be necessary because this may cause the chick to defecate in the eggshell, posing a potential bacterial problem. Due to the nourishment provided by the yolk sac, chicks rarely need to be fed in the egg except in cases where they have dehydrated during the incubation process.

HATCHING UPSIDE-DOWN CHICKS

It is always disheartening to find that an egg you have attended for weeks has been pipped in the small end. Usually blood vessels have been ruptured and the outlook is grim. There are a few things you can do to help increase the chances of hatching. Successful hatching of upside-down, malpositioned chicks is about a 50/50 chance if unassisted.

The first step, once the chick has pipped the shell, is to ensure that the chick can get fresh air. Since the chick's head is in the wrong end of the egg, it will not be able to reach the air cell and, therefore, must rely on the air brought in by the pip mark. Candling the egg will tell you whether the chick has created its own air pocket by positioning itself longitudinally along one side of the egg. This is a favorable condition which allows air to come in the pip site and lie under the shell close to the head of the chick. To improve the situation by making the air supply larger, place a pin hole through the shell in the large end of the egg extending into the original air cell. This relieves the pressure inside and the chick can push the membrane farther into the bottom of the egg. If a plastic catheter or tube is available, air can be blown into the pip site causing the membrane to expand into the space of the original air cell. This gives the chick plenty of air and lessens the chance of it drowning. Be careful not to force the air in with such strength that you rupture the blood vessels in the membrane as it expands inside of the eggshell.

If candling reveals that there is sufficient air for the chick to breath, then the afore mentioned procedure is probably not necessary. Instead, chip away a small portion of the shell at the pip site and also place a pinhole into the shell over the natural air cell to relieve pressure. Place the egg, with the small end elevated slightly, in a hatching dish in the hatcher. In most cases the chick's body will shift downward and create a little more head room.

The majority of the upside-down chicks that I have observed have an unretracted yolk sac for an additional day. To prevent the chick

from rotating and rupturing this yolk sac, I often chip away the shell around the pip site and the entire small end of the egg. The membrane is left intact because it is filled with blood vessels, but most of the shell that lies on this membrane is removed so the chick cannot get a foothold and maneuver so easily inside of the egg.

When chipping shell away from the membrane, the procedure goes faster and easier if you do not add moisture. Using tweezers, lift slightly on the edges of the shell and it will usually break away in small triangle-shaped pieces. Keep the egg warm when working on it by using a heat lamp or a heating pad. If you accidentally tear or puncture the membrane, blood will appear on the surface. Small tears will usually heal themselves, but severe ruptures must be cauterized with silver nitrate sticks or Quik Stop to prevent the chick from bleeding to death or becoming very weak from blood loss. Any time blood is noticed during this procedure, the egg is placed back in the hatcher after the bleeding has been stopped. Give the chick an hour or so to warm up and proceed with the assistance.

There are two options when dealing with an upside-down or malpositioned chick. These are whether to put the opened egg in a plastic bag in the hatcher or leave it in the open air. If the chick is a wet hatch, or overweight chick, I have left the egg in the open air inside the hatcher and purposely let the membrane dry around the chick's body to restrict its movement in the egg. If this is the game plan, I always make sure that the shell membrane is peeled back past the nares where it cannot suffocate the chick. On every egg where I have allowed the membrane to dry, the chick is virtually stuck in the same position which prevents the yolk sac from being ruptured by the chick's feet or beak during the rotation of natural hatching movements.

This procedure will also take some additional weight off the chick and dry up any unabsorbed albumen still in the egg at pip time. Do not, however, use this method with a chick that has acquired the correct weight loss or it may dehydrate and become severely weakened.

When blood supplies have shut down in the membrane, the chick can be carefully rescued from the small end of the egg. Opening the shell and membrane above the chick's head will usually be enough for the chick to crawl out on its own free will. Do not force chicks out, they will exit when they are ready. Remember, it is common for malpositioned chicks to take an additional day to absorb their yolk sac. Be patient, keep the egg moist on a dry hatch, and dry on a wet hatch, and the chick should do the rest.

DISPLACED AIR CELLS (Hatching Procedures)

Occasionally an egg is laid with the air cell in the wrong place. Depending on the location of this air cell, chicks may still hatch. Air cells can be moved, but this procedure is very difficult and should never be attempted by the inexperienced. The determining factor for hatchability is the location of the chick's head just prior to pipping and the amount of drawdown that occurs in the egg.

Displaced air cells are not easily dealt with. It is preferable that these eggs lose more weight than would normally be acceptable which allows for more air space in the egg at hatch time. It is still important not to force the loss of too much weight, causing the chick to dehydrate and die. In larger cockatoos and macaws an 18-20% weight loss is an acceptable target weight if hatching assistance is provided. Fluid feeding may be beneficial shortly after hatching to help replenish the lost weight.

Air cell on the side of the egg

If an air cell is on the side of an egg and drawdown has begun, aggressive hatching assistance is warranted. Open the shell over the air cell leaving an opening of about 10 mm to observe the chick inside. If you are operating on a very small egg, open it far enough to peek inside.

As hatch time approaches, the chick will naturally begin the rotation process to escape the shell. The observer needs to ensure that the chick does not rotate its head back into the flesh portion of the egg and drown itself. Usually the time a chick begins to rotate corresponds with the time that most major blood vessels have receded. This helps tremendously if the shell needs to be chipped away as the chick rotates to free itself. The object of this procedure is to supply air to the chick until it is safe to remove it from the egg.

The outlook for successful hatching of eggs with this problem is not good. It is best to attempt to create an air pocket at the pip site by putting a pin hole through the shell over the original air cell and relieving the pressure. Elevate the pip site and, hopefully, the chick will shift into the original air cell.

Air cell at the small end of the egg

Rarely is a displaced air cell located at the small end of the egg, however, when this does occur, hatching assistance will be required. Most often there will be no drawdown when the time arrives for these

eggs to hatch, so they require close observation if they are to be hatched successfully.

Immediately upon noticing a pip mark on the shell of these eggs, a pinhole should be placed in the shell extending into the original air cell. Very small pieces of shell should be chipped away from the pip site, taking care not to damage the membrane. Do not rotate the egg during the procedure so the chick will remain in the same position. Three or four drops of sterile water can be injected into the original air cell to help loosen the membrane and make it more pliable so the chick can kick down into that area. This will cause air to be brought in through the pip site and hopefully provide enough oxygen to maintain the chick until hatch time. Once again, rotation of the chick could cause its death unless the new air cell at the pip site is large enough to accommodate sufficient air. Observe the chick closely and assist the hatch when blood supplies in the membrane have disappeared. Be sure to check the yolk sac to be sure it has been absorbed. If an external yolk sac is present, the chick is not ready to hatch and will probably die if forced to emerge. Place the egg back in the hatcher until the yolk sac is absorbed. It may be helpful to place the egg in a plastic bag to prevent the chick from drying fast to the eggshell.

HATCHING PROBLEMS IN THE NEST BOX

Often upon inspection of the nest box, a pipped egg will be found. The anticipation of a chick hatching may draw you back to the nest box 24 hours later to find that the egg still has not hatched. What should be done? If the hen is taking good care of the egg, do nothing for an additional 24 hours, at which time the pipped egg can be assisted.

First, and of most importance, you should candle the egg to determine if the chick is ready to hatch. If no blood vessels are visible during candling, you can assist the chick using the procedures in the "Hatching Assistance" section in this chapter.

After successfully hatching, the chick, may need to be hand-reared. If the hen is very calm, sometimes the chick may be returned to the nest, but this is very risky in most cases. If the chick must be raised by the parents, an infertile egg of approximately the same size, warmed to the proper temperature, should be placed in the box when you pull the pipped egg for hatching. In many cases this will pacify the hen until you return with her newly hatched chick. However, this method should not be practiced on aggressive breeding pairs as they will often destroy the chick upon returning to the box.

CLEANING NEWLY HATCHED CHICKS

Newly hatched chicks are very delicate. Sometimes bending the beak or feet during handling can be enough to cause a permanent disfigurement. Although most chicks emerge from the shell clean, occasionally a chick will hatch that is covered with feces or excessive albumen. If allowed to dry, the down on the chick will become hardened and adhere to the chick's skin. Pulling at the hardened down may cause bruises or even bleeding. Instead, a good washing is in order.

Chicks should be kept warm when washing them. Sterile gauze pads with warmed saline water should be used to wipe the sticky liquids off the skin. Be sure to clean the beak and nares so the chick can breathe properly. Do not rub hard in the area of the naval as this area is very tender and will rupture easily.

If membranes are still attached to the naval area, they should be removed only if no blood is present. Place the chick back in the hatcher until these membranes dry up on their own. Once dried, a pair of scissors can be used to snip the cord to about three-quarters of an inch from the chick's naval. If there is any indication that the chick is getting weak, stop what you are doing and place it back in the warm hatcher.

A final step to prevent the possible entry of bacteria into the chick's naval is to treat it with a 1% Betadine Solution. Using a paint brush or a Q-tip moistened in the solution, wipe all around the umbilicus and the belly area. Once again, be careful not to be too rough and cause bleeding. Repeating this procedure is generally not necessary except in cases where the umbilicus remains slightly open for a few hours (see "Open Umbilicus").

INSPECTION OF NEW CHICKS

A post-hatch inspection of new chicks is very important. As previously discussed, the navel area of all chicks should be inspected immediately for an open umbilicus or possible unretracted yolk sac. Treat these situations as mentioned earlier.

Deformities in the beak or head may be normal and no cause for alarm as they are often caused by the cramped quarters inside of the egg. These slight deviations will usually disappear in a day or two and will need no treatment. Crooked beaks that do not correct themselves may require some type of physical therapy in order to attain their correct position and shape. Consult an aviculturist or avian veterinarian that has seen these conditions previously. Do not waste time as beak deformities will only worsen as time passes and they may become a permanent disfigurement if left unresolved.

The chick's feet are another area that needs to be looked at as soon as possible. The toes will not necessarily assume the proper position for a few weeks, but they should be extended flat from the foot and not rolled into a ball for support. This is an indication of another ailment that will remain with the bird for the rest of its life if not treated at a very young age. Once again, an experienced aviculturist or veterinarian can be of assistance. I stress the word experienced because treatment of normally formed beaks or feet could cause a problem to evolve. Quite often these extremities will appear to be distorted but are, in fact, perfectly normal.

Some chicks emerge from the egg with weak necks that fall backwards of forwards in an uncontrollable manner. These problems usually cure themselves over time but can be assisted by use of some type of support. Legs and hips will often be weak and could also use a support system that can be designed by your avian veterinarian.

There is one more thing that I take notice of on a newly hatched chick, the color of the skin. At hatch time, the skin should appear pink or slightly yellowish. If it is pale white or extremely red, there is something wrong and medical help should be sought immediately. Pale chicks may be in need of oxygen or nutrients and red chicks could have an acute case of bacteria or a virus. Do not hesitate too long before asking for assistance; it is better to be safe than sorry.

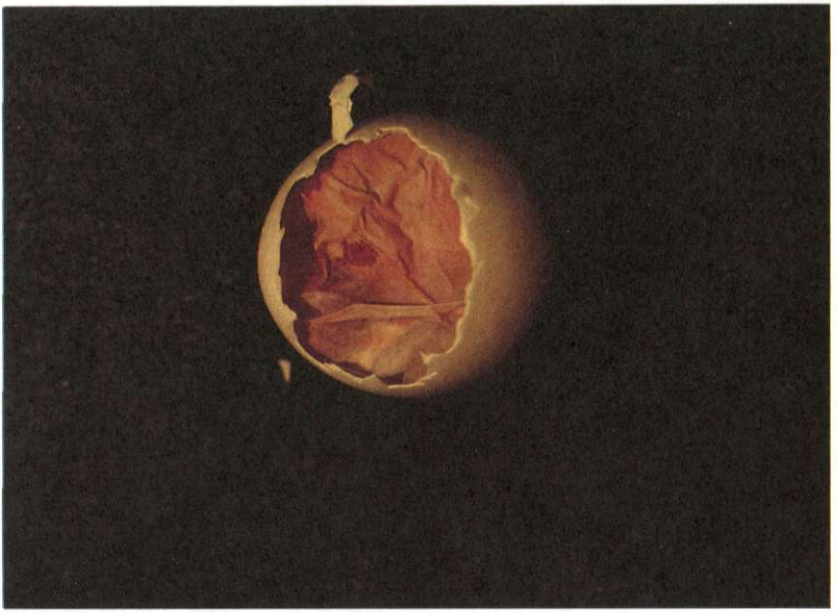
The final area to be inspected is the color of the yolk sac that is under the skin on the chick's abdomen. This yolk is usually visible due to the extremely thin skin on the chick's body. In normal chicks this yolk should appear yellow or, perhaps, slightly on the green side with tiny blood vessels surrounding it. If it looks black or bright red it may be infected with some type of bacteria or fungus. Cultures of the digestive tract, close monitoring of feces, and a visit to the veterinarian could eliminate worry and curb any potential problems. If an infected yolk sac is present and untreated, digestion will cease and the chick will eventually die.

It is a good idea to record the phone numbers of people that have experience in avian pediatrics. Sometimes your questions can be easily answered on the telephone and taking the chick out of the house will not be necessary.

QUICK REFERENCE "HATCHER" PROBLEM SOLVING

This chart is to be used only if a trend has developed in chicks once placed in the hatcher. Adjustments should not be made based on one or two individual hatch problems.

Symptom of Trend	**Problem**
1. Chick stuck to shell membrane	Wet bulb temperature too low Fan blowing across the eggs
2. Normal looking chicks dead in shell after pip.	Dry bulb temperature too low Possible bacterial problem Check vent position for possible ventilation problem.
3. Chicks hatch and abdomen red or dark.	Possible bacterial problem Substrate or cloth used in hatching dish could be abrasive to the chicks skin.
4. Chicks pip but take too long to hatch.	Eggs are being rolled around or turned Wet bulb temperature too low Dry bulb temperature too low Weak hatches due to improper incubation environment. Hatch assistance may be helpful
5. Chicks die after being moved to the hatcher.	Temperatures of the extremes Wet bulb too low Ventilation problem Weak due to improper incubation environment.
6. Chicks pip same spot and fail to rotate.	Hatch in need of assistance Wet bulb temperature too low Egg being turned or moved Weak hatch due to improper incubation environment.
7. Chicks die after pip with unabsorbed yolk sac or open umbilicus.	Temperatures too high.



After removal of the shell over the air cell, moisten the inner shell membrane to make the blood vessels appear.

When the membrane is moistened and no blood vessels appear, it is safe to remove the membrane and slowly assist the hatch.

Citron Crested Cockatoo chick.

chapter 8

Using Chickens as Natural Incubators

CHOOSING THE RIGHT CHICKENS

Selection of chickens to incubate parrot eggs should be based on their willingness to sit. Several breeds of chickens are available through many poultry distributors, but a final selection should be closely scrutinized as many strains bred for show and meat production do not sit well. The best place to acquire the desired chickens, with the inbred willingness to brood, would be from private aviculturists who have been using these birds for this purpose.

Silky Bantam hens have been used successfully and unsuccessfully in the United States and abroad for hatching parrots. The risks involved here are more than I am personally willing to take, so I chose the Cochin Bantam hen. It has been my experience that these inbred hens will sit for up to four or five months on eggs, or even rocks for that matter. On one occasion I used one of these hens to incubate parrot eggs from February 20th until late August of the same year. Not once did she resist returning to her nest for incubation duty. Not only do these hens stay *broody* for great lengths of time, but they are also calm enough that swapping eggs to and from nests is no problem. This allows for hassle-free incubation, whether it is your primary method or a back-up system in case of a power failure.

Young chickens can sometimes be obtained from people who are already using them to incubate eggs of other species. Ask these suppliers about the chicken's willingness to incubate in terms of how long they remain broody. Be sure to obtain chickens at least nine months prior to the time you plan to need them, as it may take several months for them to begin laying eggs of their own. Hens of any species do not

automatically sit when given an egg. They must first begin laying themselves which stimulates the incubation cycle.

WHAT IS BROODY?

The term broody is an old poultry term used to describe a hen that has entered into the final stage of reproduction. This stage is triggered by the release of the hormone prolactin from the pituitary gland after the last egg of her clutch has been laid. Sometimes this hormone is released prior to the laying of the last egg, but the egg is usually in the process of being formed and laid.

Once a hen has begun the brood cycle, her number one priority is to sit and incubate her eggs. In certain breeds of chickens, this urge is so strong that she will sit on any eggs that are placed in her nest. These are the favorable breeds to acquire if the hens are to be used for incubating the eggs of parrots or other exotic birds.

There are a few obstacles that you may have to overcome before utilizing chickens to incubate other eggs. When a hen has become broody, she may resist a move to another nest. If this move is not necessary she is sometimes better left where she chose to lay her eggs originally. Substituting parrot eggs in her original nest, and removing her eggs will often solve the problem of re-associating her to another location. Be aware that she will not always return to her nest but may climb onto any nest of eggs that is visible. This is a good reason to monitor her return to the nest or keep the other nests around her void of any eggs.

After her return to the nest, either by you or by her own choice, disturbance in front of or around her nest must be kept to a minimum. Most broody hens will not move if disturbed, but will vocalize in a threatening manner. There are occasions when a hen will jump up and fight to defend her nest. Allowing this to happen may cause eggs to be broken. The presence of other chickens around the nesting site is not recommended. If the rooster is allowed to remain in the nesting area, he will sometimes harrass the incubating hens.

If not properly monitored, two hens may crawl onto the same nest on top of one another. When this happens there are usually broken eggs when the hens are removed. The desire to sit on a nest is very strong and may cause arguing and bickering among the broody hens.

CHICKENS FOR INCUBATION (General Management)

Whether or not the chickens of today are the original fowl referred to in the first chapter of the Bible, they have certainly been successfully

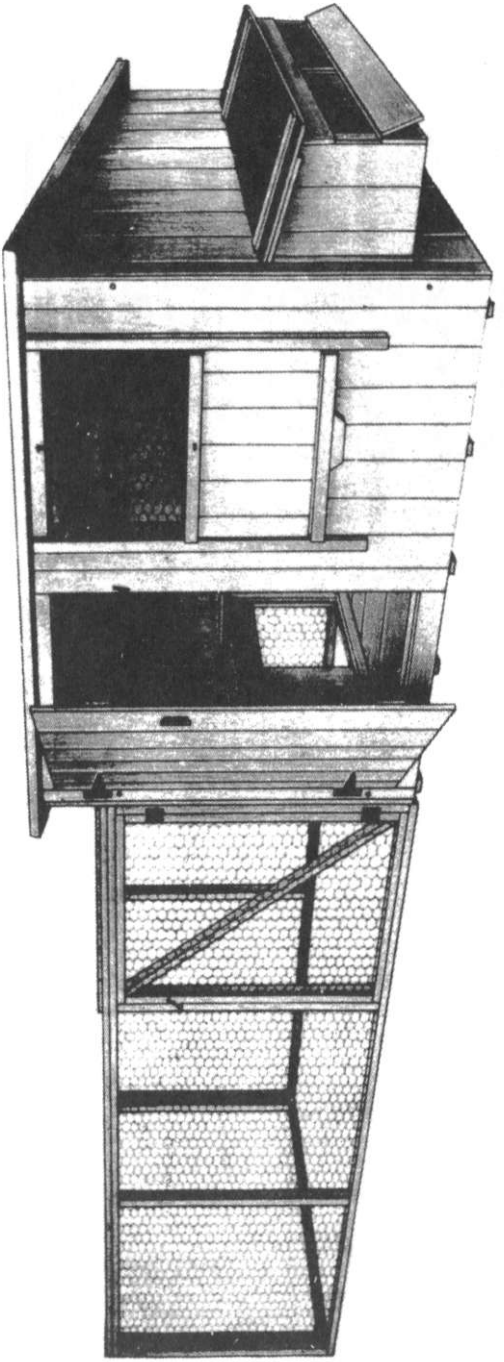
incubating eggs for a long time. For as long as man has kept domestic fowl, we still have not completely mastered the science of incubating eggs. Now the question that warrants an answer is whether we really need to master incubation if an obvious professional, the chicken, is so readily available. After all, when we want to add a garage to our home, we do not go back to college and study structural engineering, we simply hire a professional to get the job done. This attitude is not a cop out, but a reasonable solution.

After selecting the type of chickens best suited for the job, there are a few things that need to be accomplished. First, you must ensure that you have at least one rooster or the supply of future incubators will eventually run out. The number of hens needed will depend on the number of eggs you plan to have at the height of breeding season. Each hen can accommodate from one to eight macaw eggs with no problem. Placing all of your eggs in one "basket", however, is never recommended. Eggs can be placed under chickens for two or three weeks and newly laid eggs can be added to replace the older ones. This type of management reduces the number of chickens needed to do the job. It is possible to incubate 400 eggs over a five month period with four or five hens.

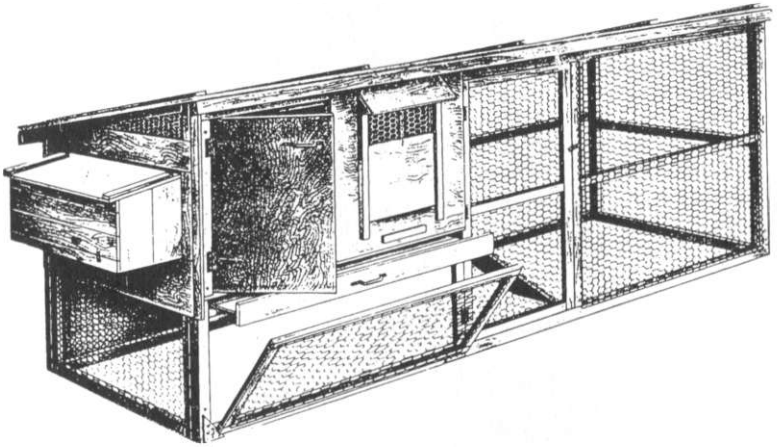
Next, the hens need adequate housing where they can get down to what they do best, raise a family. Metal snap together laying nests are available from Stromberg Pets Unlimited, Pine River Minnesota 56474, and are readily accepted by the hens. The construction of the chicken coop can be of your own design as long as there are two incubating areas available, one for parrots and one in which the remaining chickens may lay their own eggs. When designing a coop, be sure to keep cleanliness in mind. These enclosures can become fouled rapidly if not maintained properly.

All chickens acquired, for any reason, should visit a veterinarian to receive necessary vaccinations against today's common poultry diseases. An outbreak of any disease in the coop during breeding season could be detrimental to your incubation system. Hens should be vaccinated against Fowl Pox, Newcastle Disease, or any other disease that a vaccine is available against. This should be accomplished before placing parrot eggs under your hens. Transmission of disease through the eggshell is rare, but unnecessary chances should be avoided. Periodic worming of chickens is also recommended.

After accommodations are complete and the flock is in place, nature will make the first move. Depending on what part of the world you live in, your parrots may begin to lay before your chickens do. Artificial lighting can be installed in the chicken coop, and daylight hours can be slowly increased to between 14 and 16 hours daily to



Poultry Shed (5 ft. x 3 ft.) and Scratching Run (8 ft. x 3 ft.)
(Courtesy: Nimrod Press Ltd.)



The "Hen-Pen" for those with limited space

(Courtesy: Nimrod Press Ltd.)

stimulate laying. This, combined with a good balanced diet and healthy chickens, should complete the ground work for your new natural incubators.

NEST TRAINING YOUR CHICKENS

Training a chicken sounds almost insane. In actuality you need to acclimate the hens to their new role in your operation. This is easily accomplished if the routine remains the same each day.

After the chickens have laid a clutch of eggs and begun to incubate, they can be used for exotic parrot eggs without much of a hassle. It is preferable to allow the chicken to incubate and hatch her own chicks first, but this often leads to a four month delay before she will begin to lay and sit again. A hen that remains calm during incubation when tapped lightly on the beak with your finger, will do well with a three day training program. At no time should a hen that deserts the nest during this test be allowed to incubate parrots.

Once a broody hen is chosen, she is moved along with her own eggs to a private area of the coop and placed in a nesting box similar to the one in which she originally laid. Wire mesh or some comparable material needs to be attached to the nesting box entrance to keep her from leaving the nest at times other than her scheduled breaks. For several days the hen should be allowed to sit her own eggs until she becomes comfortable with your schedule.

BREAKS FOR THE HENS

When the chickens are performing incubation duties, they need to be relieved a few times a day. Open the nest and carefully lift the hen off the eggs, being careful not to allow her to drag an egg off with her. Sometimes an egg will be tucked tightly under the wing and will fall to the ground when you release the bird. Please take my word for this, I've seen it happen.

It is wise to lock the chickens out of their nests when they are on break. If the chickens decide to return to the nests by themselves, they could fight if one enters the wrong nest. Always supervise their return and be sure the same chicken returns to her own nest.

Break time is usually about ten or fifteen minutes. The cooling of the eggs over this short amount of time was of no consequence in my program as the weather was warm. If you are in a cold climate area, you may have to supervise the entire break and return the hens to the nests sooner after they are finished eating and defecating. If breaks are cut very short, relieve them a few additional times each day to prevent weight loss and failing health.

Break time becomes a favorite time for the chickens after a few days. They will be awaiting your arrival each day at the same time. Usually after they have eaten enough and satisfied their thirst, they will leap to the roost outside the nests and wait for you to let them back onto their eggs.

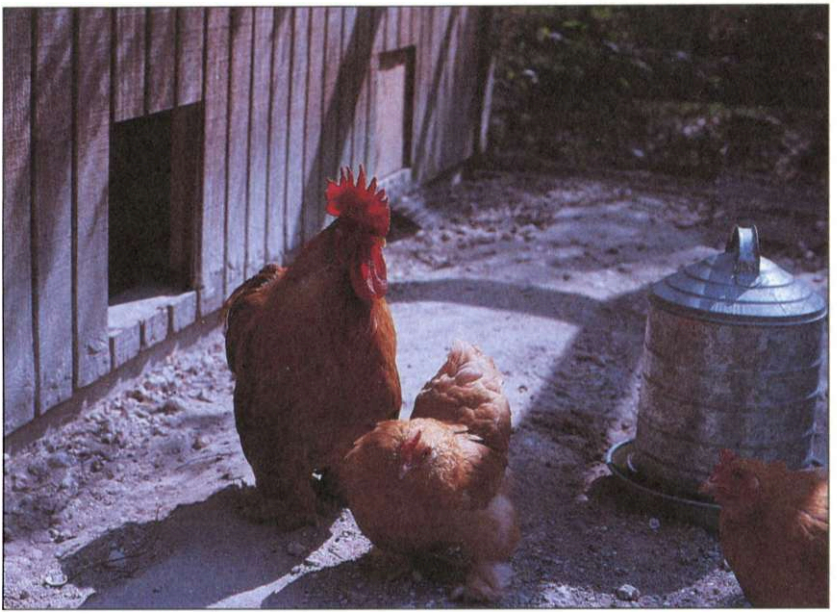
IDENTIFICATION OF YOUR SITTING HENS

The Bantam hens that I use for incubators are all similar in appearance and must be identified by different colors of non-toxic felt tipped markers. The marks must be darkened often as they will fade over the course of a week or so. Chickens can be marked in different places, such as the head, left or right wing, nape, etc., to aid visual identification.

Plastic leg bands with large numbers are also available from poultry supply houses. These come in handy and are recognizable from some distance.

POULTRY NUTRITION

Keeping your chickens on a well-balanced diet is important and easily accomplished due to all of the research that has been done on domestic fowl. Through centuries of research, feed manufacturers have come up with extruded food that makes it very easy to maintain a small flock of natural incubators.



Buff Cochin bantam chickens.

Always number eggs that are placed with chickens for incubation. Eggs that are due to hatch can be located and moved to the machines for hatching.

Red-vented Cockatoo chicks.

Citron-crested Cockatoo chick.

Consult your local feed supply store about the different poultry mash products available in your area. Various protein levels are manufactured for the different stages of life your chickens go through. It should not be difficult to figure out which one to feed as they are usually labeled with obvious use descriptions like "chick start and grow", "chicken laying pellets", etc. When your chickens have reached their full-grown size and it is time to produce eggs, laying mash of approximately 15% protein is fed along with minimal quantities of scratch grains and greens or vegetables. Be sure to provide laying hens with oyster shell, a source of calcium for good strong eggshells.

If provided with good nutrition, security and fresh water, your chickens could become the most valuable incubator you own.

HATCHING PARROTS UNDER A CHICKEN

Allowing parrot eggs to pip and hatch under a chicken is not recommended. Some breeders do this with no apparent problems, but it is with a well-supervised flock and requires precise timing on the part of the management. Chickens can be brutal to young chicks that do not look quite right.

Eggs should be moved to the main incubator approximately five days prior to expected hatch time. This will allow time for candling and observation during the *drawdown* stage, a very important time in the hatching process.

If eggs should accidentally pip under the chickens, do not panic. Simply move the pipped egg to the high humidity hatcher unit for hatching.

SORTING EGGS FOR CHICKEN INCUBATION

A good broody hen will incubate eggs of any size regardless of how they compare to the normal size of her own eggs. Mixing eggs of a very large species with eggs of small species is not recommended. The smaller eggs might not receive the proper turning if they do not touch the breast of the hen.

Placing only one egg under a hen will keep her interested in incubation. I have placed up to eight eggs of approximately the same size under each one. Eggs can be pulled away and replaced as they approach hatching time. If no replacement is available, and you remove the last egg, the hen will lose interest in sitting and begin the laying process in a few weeks. Dummy eggs or plastic eggs can be placed under the hen if new parrot eggs are expected shortly and it is necessary to keep the chicken sitting.

KEEPING TRACK OF THE EGGS

Knowing what species is due to hatch and when are very important reasons for keeping track of eggs. Since baby parrots look similar at hatch time, it is preferable to keep track of the eggs to know what species you are hand feeding, but the most important reason is to ensure that you know when you have a hatch time approaching, especially if you are inexperienced with a candler.

Establishing an egg numbering system is the easiest method of inventory. At the beginning of each year, begin with a new numbering system and maintain a log of important data on each numbered egg. It is easiest to begin your egg numbers with the year they were laid followed by the sequence number assigned for a particular individual. For example, 89-01 tells you what year the egg was laid and that it was the first egg of the year. Write the number in two separate locations on the eggshell with a #2 pencil because one of the numbers will invariably be rubbed off. Always be sure to log the egg numbers on some type of master log sheets so you know what species it is and the lineage from which it originated. It is also a good idea to tack a piece of paper up in the chicken coop indicating which eggs are under each hen so there is little confusion when hatch time approaches. It may be necessary to darken the numbers on the eggs periodically if the pencil marks become smudged or faded.

POTENTIAL PROBLEMS IN THE CHICKEN COOP

Since most parrot breeders are not well versed in poultry keeping, it may be helpful to address potential problems in the chicken coop.

After acquiring chickens to be used as incubators, it is a sensible idea to take them to a veterinarian for inoculations as previously mentioned. Fowl Pox is very common and a vaccine against this disease can be purchased from a local feed store if you prefer to inoculate the chickens yourself. This disease can be more annoying than harmful, but it should be prevented to alleviate any undo stress on your sitting hens.

Mites are also common in chickens and can be prevented by a monthly dusting with 5% Seven dust. Hold the chickens upside-down and lightly dust the bird, being sure to get dust under the feathers. Nests and grounds can also be dusted without harm to the flock.

A periodic check for intestinal parasites (worms) is also recommended. Fecal samples can be collected and sent to a lab for analysis. This check should be performed semi-annually to keep the chickens in the best of health. Chickens with a severe worm infestation can lose a lot of weight and will usually stop producing eggs.

Coccidiosis is a disease of the digestive tract caused by a protozoan parasite. Losses of chicks that appeared healthy just hours before, combined with bloody feces or weight loss, could indicate this problem. Treatment consists of sulfa-based anticoccidials that are available from feed stores and can be administered in the water supply. Consultation with a veterinarian or poultry producer is advised if Coccidiosis is suspected. (Hofstad)

Snakes, rats, opossums, or other predators should be prevented from entering the chicken coop. The sight of any of these pests can frighten a sitting hen and cause her to break or abandon eggs. When constructing an area for your chickens, plan appropriate barriers to exclude these predators.

Last but not least, any eggs that become damaged need to be repaired and placed in the incubator. If damage is very slight it is often possible to repair them and place them back under the hen. If eggs become rotten from the invasion of bacteria, the hen may desert the nest. Eggs that do contain bacteria will smell bad when held to the nose.

chapter 9

Learning from Your Mistakes

EGG NECROPSY/EXAMINING DEAD EMBRYOS

Although this may be an unpleasant subject, it is a very important one in solving problems associated with artificial incubation. Many times the cause of a chick's death is directly related to the incubation environment and certain patterns that emerge could indicate that adjustments need to be made. **Damaged eggs that fail to hatch are not a reason for incubator adjustments**.

When you are sure a chick is dead in the shell, it needs to be cracked out for examination. If an odor exists or a discoloration of the fluids (such as brownish green) inside is noticed, a bacterial culture should be performed. This will assist you in evaluating the cleanliness of your incubators or hatchers. Deaths caused by an incubator or hatcher contaminated with bacteria can be corrected. Keep in mind that a few bacterial problems can be passed on from the hen to the egg.

TEMPERATURE AND HUMIDITY RELATED DEATHS

Other problems that commonly exist are temperature and humidity related. Chicks that live to pip the shell and then are found dead are often overweight and drown from excessive fluid in the egg. Upon examination you may notice a light pink, very soft chick with excessive fluids or *edema* under the skin. If you look closer, often you will notice the beak and nares are congested with thick fluids and albumen. If chicks in this condition are common occurrences, a lower incubator humidity (or wet bulb temperature) is in order. Consult the section on "Egg Weight Management" for some tips on how to correct this problem.

On the opposite end of the spectrum is the chick that is very small,

dry looking, and adhered to the shell membranes. The remaining albumen in these eggs will be very thick and sticky. These results are usually the product of a hatcher or incubator that is too dry. Increase the humidity if a pattern evolves and a number of these deaths occur. Examination of the eggshell will sometimes reveal other clues that the environment was too dry. If the shell is dry and flaky and crumbles easily, evaluate the humidity setting you are using.

Bright red embryos (as red as a rose) are often the result of a temperature that was consistently too high or fluctuated too high. These chicks look as if all of the blood vessels under the skin burst. If a number of eggs that were in the same incubator show these symptoms, suspect elevated temperature as the cause.

Chicks that die from a temperature that is too low are very difficult to diagnose. The only time I am certain that a low temperature caused a death is if the chick is way behind in development for the number of days of incubation that it received.

CONGENITAL DEATHS

Congenital death is a term used to describe an inherited physiological reason for fatality. These deaths are not obvious unless a pair of birds consistently lay eggs that die or have similar hatch-related problems.

Occasionally a congenital problem can be detected during necropsy of the egg. These problems are usually the more obvious ones such as an exposed spinal column (spinabifida), or other exposed organs or displaced extremities. These types of abnormalities will usually not be incubation related unless the incubation environment was way out of line. If you have any question about the death of the embryo, it should be sent to an avian pathologist for evaluation.

OTHER DEATHS

Sometimes opening an egg that has failed to hatch will provide some insight as to the cause of death and better prepare you to deal with it next time. It is not always easy to tell if the shell of an egg is too thick for the chick to hatch but performing a necropsy on an egg of this type will yield some interesting clues. Thick shells that have prevented the hatching of a chick will be tough to peel away with a pair of tweezers. On the inside of the shell, close to the location of the chick's head, there will often be scratch marks where the chick tried to break through the shell. Often times, there will be fine white powder around the egg tooth on the chick's beak. Even a strong chick

will eventually suffocate if it cannot break through the shell for fresh air. It is helpful to watch the remaining eggs in that particular clutch to see if they will be in need of hatching assistance.

If an egg necropsy reveals thick yellow or green fluids throughout the interior of the shell, it could be the result of a broken yolk or allantois. Chicks will push frantically with their feet in the hatching process and sometimes they will accidentally break into the yolk or allantoic membrane. When this happens, it usually results in the death of the chick.

Death in the egg as a result of dehydration or the use of too low a humidity setting will be apparent when the egg is opened. The inner shell membranes around the chick will be dry, hard, and stuck to the beak and face of the chick. Deaths of this sort can be avoided through the use of an elevated humidity during the hatching process.

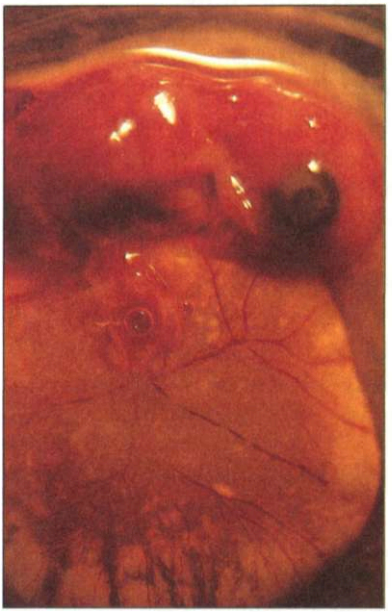
PROFESSIONAL EVALUATIONS

As previously mentioned, incubation-caused deaths are very difficult to analyze if you have limited experience in the subject. If patterns do develop, it may be advisable to locate an embryologist at a local university for evaluation. Keep in mind, however, that most of these people have their experience with chicken embryos and to quote the world renowned avian veterinarian Dr. Susan Clubb, "A horse is not a cow, and a parrot is not a chicken."

PRESERVING UNHATCHED EGGS FOR SCIENCE

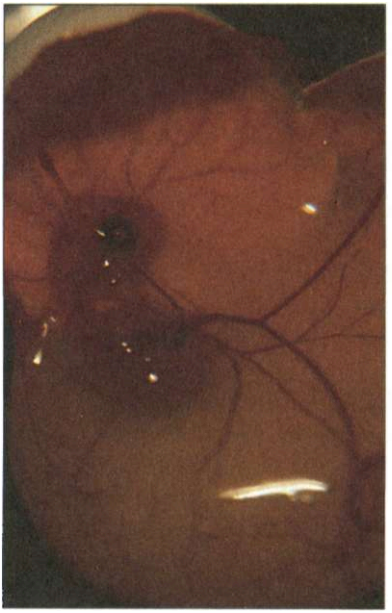
Museums and universities around the world are in need of data on eggs of exotic birds. We, as aviculturists, are in a position to provide some of this data by supplying these organizations with the eggs of rare or even common species of exotic birds. In many cases these institutions will also accept frozen carcasses of birds to be preserved for exhibit.

Eggs should be preserved only if the cause of death is known. If there is some uncertainty, the egg should be examined to see if it yields any clue about the cause of death. The most common procedure for egg preservation is to drain the egg by making a hole close to the small end of the egg. Do not make the hole directly on the point of the egg because these eggs are displayed on their sides with the hole out of sight. To make the hole, slowly rotate a 1/8″ or 1/4″ drill bit between the fingers until the hole is almost large enough for the bit to sink inside. Using a twenty gauge needle, break away the membrane from inside the hole. Hold the egg with the hole pointing down over a bucket



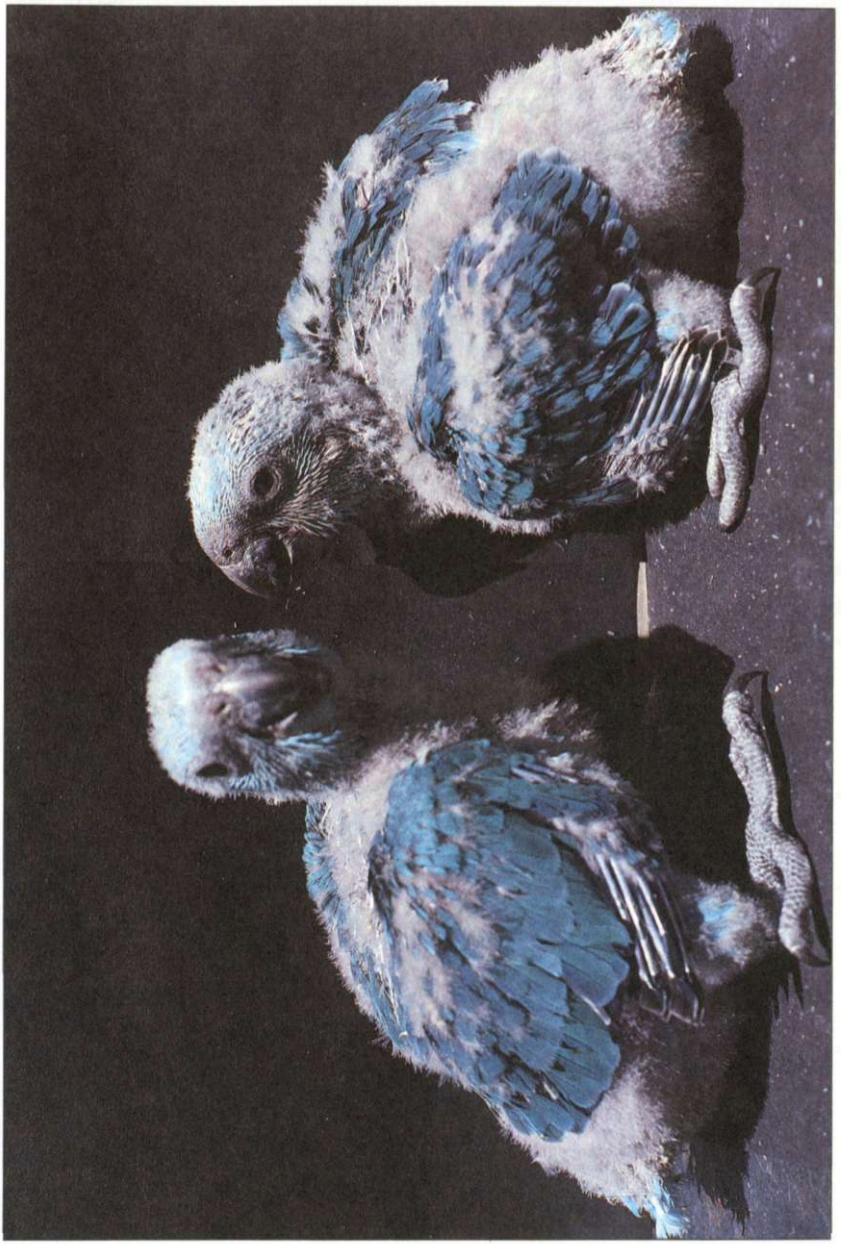
Examining dead chick with autolyzed yolk and possible bacterial infection.

Mold spores on a fertile egg yolk.



Examining dead embryos.

Dead chick with unretracted yolk sac.



The authors extensive experience and knowledge of incubation of exotic eggs is demonstrated by this photo of the first ever successful captive hatch of the extremely rare & valuable Blue mutation Yellow Naped Amazons. Prior to this hatch seven were known to exist in the world, one cock and six hens. The chicks shown are from a pair owned by Vorens Aviary, Florida, U.S.A.

or tub and using a syringe of warm water with a twenty gauge needle attached, force water up into the egg. The contents of the egg will slowly come out along the needle and fall into the bucket as the water displaces it. Follow up with a final rinse using a mild bleach solution to prevent future bacterial growth.

After the original contents of the egg are out, draw the water or bleach solution out of the egg as well and allow it to dry for several hours. On thin-shelled eggs this procedure must be performed carefully or the shell will shatter in your fingers.

Eggs can be preserved even if they died late in the incubation cycle, although in most cases flushing them out is not pleasant. On eggs with large embryos in them, it may be necessary to flush what you can and allow the remainder to sit for a few days, at which time the procedure is repeated. Continue flushing out the contents every other day until all that remains is the skeletal structure of the chick. On eggs of very common species it may not be worth the effort if chicks die late and are fully formed.

Many people refrain from preserving eggs because they expect the contents to have a foul odor. If eggs candle clear, are not filled with dark bacterial liquid, and the shell is intact, they will not have a bad smell. Bacteria in the egg is the cause of the "rotten egg" odor that can occur.

Appendix I

Species Specific Coefficient (Css)

Cockatoos:	
Citron Crested	.0005577
Galah	.0005515
Greater Sulphur Crested (galerita)	.0005470
Leadbeater's	.0005565
Lesser Sulphur Crested	.0005495
Medium Sulphur Crested	.0005400
Moluccan	.0005540
Palm*	.0005464
Palm (Goliath)	.0005345
Triton	.0005450
Umbrella	.0005456
Macaws:	
Blue and Gold Macaw	.0005465
Buffon's Macaw	.0005462
Caninde Macaw*	.0005544
Hyacinth Macaw*	.0005460
Military Macaw	.0005447
Red Fronted Macaw	.0005495
Scarlet Macaw*	.0005474
Eclectus Parrots	.0005350

* Sample group numbers fewer than 15.

Appendix II

Table of Desired Egg Weight Losses

Species	Egg Weight Loss Goal
Cockatoos	
Bare Eyed Cockatoo *(Cacatua sanquinea)*	14-16%
Citron Crested Cockatoo *(Cacatua sulphurea citroncristata)*	13-17%
Galah *(E. roseicapillus)*	15-18%
Greater Sulphur Crested Cockatoo *{Cacatua galerita galerita)*	16-18%
Leadbeater's Cockatoo *(Cacatua leadbeateri)*	12-15%
Lesser Sulphur Crested Cockatoo *(Cacatua sulphurea)*	13-15%
Medium Sulphur Crested Cockatoo *(Cacatua galerita elenora)*	15-18%
Moluccan Cockatoo *(Cacatua moluccensis)*	16-20%
Timor Sulphur Crested Cockatoo *(Cacatua sulphurea parvula)*	13-15%

Triton Sulphur Crested Cockatoo *(Cacatua galerita triton)*	15-20%
Umbrella Cockatoo *(Cacatua alba)*	16-18%
Macaws	
Blue and Gold Macaw *(Ara ararauna)*	15-19%
Buffon's Macaw *(Ara militaris ambigua)*	16-20%
Caninde Macaw *(Ara glaucogularis)*	17-20%
Green-winged Macaw *(Ara chloroptera)*	17-20%
Hyacinth Macaw *(Anodorhynchus hyacinthinus)*	17-20%
Military Macaw *(Ara militaris)*	16-20%
Red-fronted Macaw *(Ara rubrogenys)*	14-16%
Scarlet Macaw *(Ara macao)*	15-19%
Eclectus Parrots *(Eclectus roratus roratus)*	14-17%
Rose-ringed parakeets *(Psittacula krameri manillensis)*	9-12%

Appendix III

Parrot Incubation Periods

(Taxonomic arrangement from Parrots of the World)

SPECIES	TOTAL INC. PERIOD	PIP TO HATCH INTERVAL
Cockatoos *(Cacatua)*		
Bare-eyed Cockatoo (C. *sanguined)*	23-24 days	36-48 hours
Citron Crested Cockatoo (C. *sulphurea citrinocrisiata)*	25-26 days	36-48 hours
Galah *(Eolofhus roseicapillus)*	22-24 days	24-36 hours
Greater Sulphur Crested (C. *galerita galerita)*	27-28 days	36-48 hours
Leadbeater's Cockatoo (C. *leadbeateri)*	26 days	24-48 hours
Lesser Sulphur Crested (C. *sulphurea)*	24-25 days	24-48 hours
Medium Sulphur Crested (C. *galerita elenora)*	26-27 days	24-48 hours
Moluccan Cockatoo (C. *moluccensis)*	28-29 days	24-48 hours

SPECIES	TOTAL INC. PERIOD	PIP TO HATCH INTERVAL
Palm Cockatoo *(Probosciger aterrimus)*	28-30 days	48-96 hours
Variability in Palm Cockatoos is due to difference in species, Larger Goliath eggs will go 29-30 days and the smaller species will go 28-29 days.		
Philippine Red-Vented Cockatoo (C. *haematuropygia)*	24 days	24-48 hours
Red-Tailed Black Cockatoo *(Calyptorhynchus magnificus)*	30 days	24-48 hours
Slender-Billed Cockatoo *(C. tenuirostris)*	23-24 days	24-48 hours
Triton Cockatoo (C. *galerita triton)*	27-28 days	24-48 hours
Umbrella Cockatoo (C. *alba)*	28 days	24-48 hours
Macaws *(ARA)*		
Blue and Gold Macaw *(Ara ararauna)*	26 days	24-48 hours
Buffon's Macaw *(Ara militaris ambigua)*	26 days	24-48 hours
Caninde Macaw *(Ara glaucogularis)*	26 days	24-48 hours
Green-winged Macaw *(Ara chloroptera)*	26 days	24-48 hours
Hyacinth Macaw *(Anodorhynchus hyacinthinus)*	26-28 days	24-48 hours
Military Macaw *(Ara militaris)*	26 days	24-48 hours
Red-fronted Macaw *(Ara rubrogenys)*	26 days	24-48 hours
Scarlet Macaw *(Ara macao)*	26 days	24-48 hours

SPECIES	TOTAL INC. PERIOD	PIP TO HATCH INTERVAL
Amazons *(Amazona)*		
Yellow Naped Amazon Yellow Fronted Amazon Yellow Crowned Amazon Double Yellow Headed Amazon *(Amazona ochrocephala "group")*	28-29 days	24-48 hours
Blue-Fronted Amazon *(Amazona aestiva)*	26 days	24-48 hours
Lilac-Crowned Amazon *(Amazona finschi)*	26 days	24-48 hours
Red Lored Amazon *(Amazona autumnalis autumnalis)*	25-26 days	24-48 hours
Spectacled (White Fronted) *(Amazona albifrons albifrons)*	24 days	24-48 hours
Green-Cheeked Amazon *(Amazona viridigenalis)*	26 days	24-48 hours
Conures		
Pyrrhura conures	23 days	24-48 hours
Aratinga conures	24 days	24-48 hours
small *Aratinga conures*	23 days	24-48 hours
Asiatic Parakeets *(Psittacula)*		
Alexandrine Parakeets *(Psittacula eupatria)*	24-25 days	24-48 hours
Rose-Ringed Parakeets *(Psittacula krameri manillensis)*	23-24 day	24-36 hours
Derbyan Parrakeet *(Psittacula derbyana)*	26 days	24-48 hours
Moustache Parakeet *(Psittacula fasciata)*	25-26 days	24-48 hours

SPECIES	TOTAL INC. PERIOD	PIP TO HATCH INTERVAL
African Parrots		
Congo African Grey Parrot *(Psitticus erithacus)*	28 days	24-72 hours
Timneh African Grey Parrot *(Psitticus erithacus timneh)*	26 days	24-48 hours
Senegal Parrot *(Poicephalus senegalus)*	24-25 days	24-48 hours
Meyer's Parrot *(Poicephalus meyeri)*	24-25 days	24-48 hours
Jardine's Parrot *(Poicephalus gulielmi)*	25-26 days	24-48 hours
Other Parrots		
Amboina King Parrot *(Alisterus amboinensis)*	20 days	24-36 hours
Australian King Parrot *(Alisterus scapularis)*	21 days	24-48 hours
Eclectus Parrots *(Eclectus roratus)*	28 days	24-72 hours
Caiques *(Pionites melanocephala)* *(Pionites leucogaster)*	25 days	24-48 hours
Cockatiels *(Nymphicus hollandicus)*	21 days	24-48 hours
Green-Winged King Parrot *(Alisterus chloropterus)*	20 days	24-48 hours
Quaker (Monk) Parrakeet *(Myiopsitta monachus)*	23 days	24-48 hours
Budgerigar *(Melopsittacus undulatus)*	18 days	24-36 hours
South American Red Capped Parrot *(Pionositta pileata)*	23 days	24-48 hours

Phillipine Blue-Naped Parrot *(Tanygnathus lucionensis)*	26 days	24-48 hours

SPECIES	TOTAL INC. PERIOD	PIP TO HATCH INTERVAL
Lories		
Blue Streaked Lory *(Eos reticulata)*	27 days	24-48 hours
Black lory *(Chalcopsitta atra atra)*	27 days	24-48 hours
Red Lory *(Eos bornea bornea)*	27 days	24-48 hours
Yellow-Backed Lory *(Lorius garrulus flavopalliatus)*	27 days	24-48 hours
Pionus *(Pionus)*	25-26 days	24-48 hours
Parrotlets *(Forpus)*	19 days	24-36 hours
Brotogeris		
Canary Winged Parrakeet *(B. versicolorus versicolorus)*	22 days	24-36 hours
Orange-flanked (Grey Cheeked)Parrakeet *(B. pyrrhopterus)*	22 days	24-36 hours
Love Birds *(Agapornis)*	22 days	24-48 hours

Appendix IV

Breeding and Incubation Forms

INCUBATOR/HATCHER TEMPERATURE LOG SHEET

Date	Dry Bulb Temp.	Wet Bulb Temp.

BREEDING PAIR INFORMATION

Species-_____ **Latin-**_____

Pair#-_____ **Male's#-**_____ **Female's#-**_____

Cage Number-_____

Nestbox size and shape (Describe)-

Nesting Material Used-

Courtship Display Observed-

Mutual Preening?	**Yes**	**No**
All Year?	**Yes**	**No**
Does male feed young?	**Yes**	**No**
Does male help incubate?	**Yes**	**No**
Does hen sit well?	**Yes**	**No**
Artificial incubation used	**Yes**	**No**
Can pair be used as surrogates?	**Yes**	**No**
Will pair raise young?	**Yes**	**No**

Average number of eggs per clutch? _____
How many clutches per year? _____
How many fertile eggs? _____

Comments: (continued on back)

DAILY EGG WEIGHT LOSS

Species_____ **Length**_____**mm**
Cage_____ **Breadth**_____**mm**
Egg Number_____ **Lay Date**_____
Fresh Weight_____**gms**

Weight Loss Goal (This egg only)

Weight Loss= $\frac{(X)\,(W)}{(I)}$

Where (W)=Fresh Weight
(X)=Desired % Loss
(I)=Days to Pip

Day #	Goal Weight	Actual Weight	Diff (+or-)	Date

Fresh Weight
Pip Weight = % Loss

Inc.Period_____
Days to Pip_____

Comments and Observations: (Continued on back)

EGG PRODUCTION SUMMARY

Cage	Species	Date Laid	Date Hatched	Egg #

Appendix IV

Yearly Breeding Record

Species_____
Cage_____

Pair#_____ **Female#**_____ **Male#**_____

Date Laid	Fertile(Y/N)	Date Pip	Date Hatch	Comments

1st Clutch

2nd Clutch

3rd Clutch

4th Clutch

GENERAL USE EGG LOG

Egg # Date Laid Inc. Period Expected Hatch Date

Comments:

Egg # Date Laid Inc. Period Expected Hatch Date

Comments:

Egg # Date Laid Inc. Period Expected Hatch Date

Comments:

Egg # Date Laid Inc. Period Expected Hatch Date

Comments:

Egg # Date Laid Inc. Period Expected Hatch Date

Comments:

Appendix V

Relative Humidity Chart

DEGREES DIFFERENCE BETWEEN DRY AND WET BULB TEMPERATURE

Dry Bulb Reading	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
60	94	89	84	78	73	68	63	58	53	48	44	39	34	30	26	22	18	14
65	95	90	85	80	75	70	65	61	56	52	48	44	39	35	31	28	24	20
70	95	90	86	81	77	72	68	64	60	55	52	48	44	40	36	33	29	26
75	95	91	87	82	78	74	70	66	62	58	55	51	47	44	40	37	34	31
80	96	92	87	83	79	75	72	68	64	61	57	54	51	47	44	41	38	35
85	96	92	88	84	80	77	73	70	66	63	60	56	53	50	47	44	41	38
90	96	92	88	85	81	78	75	71	68	65	62	59	56	53	50	47	44	41
95	96	93	89	86	82	79	76	72	69	66	63	60	58	55	52	49	47	44
100	96	93	89	86	83	80	77	73	70	68	64	62	59	56	54	50	49	46

RELATIVE HUMIDITY

To compute the relative humidity in the incubator or hatcher, subtract the wet bulb temperature from the dry bulb temperature and locate this number on the top row of the chart. Come down the column until you are on the line that corresponds to the dry bulb temperature in the left column. This will give you the approximate relative humidity to within one or two percent.

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Glossary

ADDLED SHAKEN OR JARRED. MOVED AROUND QUICKLY.

AIR CELL AIR POCKET FOUND UNDER THE SHELL NORMALLY LOCATED IN THE LARGE END OF THE EGG.

ALBUMEN THE CLEAR AND WHITE LIQUID PORTIONS OF THE EGG.

ALLANTOIC MEMBRANE ONE OF THE TEMPORARY ORGANS OF THE EMBRYO INSIDE OF THE EGG. THE ALLANTOIC MEMBRANE PERFORMS THE FUNCTIONS OF RESPIRATION, NUTRIENT SUPPLY, AND WASTE ELIMINATION.

BLASTODERM FERTILIZED OVUM FOUND ON THE YOLK OF AN EGG.

BLASTODISC INFERTILE OVUM THAT APPEARS ON THE YOLK OF AN EGG AS A WHITE DOT.

BLOOD FEATHERS FEATHERS THAT ARE IN THE PROCESS OF GROWING AND ARE STILL IN A BLOOD FILLED SHEATH WHERE THEY EXIT THE SKIN.

BREAKOUT TERM USED TO DESCRIBE THE INSPECTION OF AN EGG THAT HAS BEEN CRACKED OPEN FOR ANALYSIS.

BROODY A PHYSICAL AND PSYCHOLOGICAL STAGE A HEN GOES THROUGH WHEN INCUBATION COMMENCES.

CALCAREOUS LAYER MIDDLE LAYER OF SHELL OF THE EGG CONSISTING OF CALCIUM CARBONATE USED BY THE CHICK FOR SKELETAL DEVELOPMENT.

CANDLING THE ACT OF SHINING A LIGHT THROUGH AN EGG TO OBSERVE THE DEVELOPMENT THAT IS TAKING PLACE.

CAPPING PLACING A CUP SHAPED PIECE OF SHELL OVER AN OPENED EGG TO PREVENT SEVERE MOISTURE LOSS.

CHALAZA THE THICK SPIRAL STRANDS OF ALBUMEN THAT ATTACH TO THE YOLK AND HELP TO SUSPEND IT IN THE CENTER OF THE EGG.

CHROMOSOME FEATHER SEXING A FAIRLY NEW PROCEDURE WHERE BLOOD FEATHERS ARE ANALYZED AND CHROMOSOMES ARE MATCHED IN PAIRS TO DETERMINE THE SEX OF THE BIRD.

CLOACA THE SINGLE VENT OPENING OF THE BIRD LOCATED ON THE UNDERSIDE JUST ABOVE THE BEGINNING OF THE TAIL. THE CLOACA IS THE COMBINED OPENING FOR THE DIGESTIVE AND REPRODUCTIVE SYSTEM OF THE BIRD.

CLUTCH A SET OF EGGS.

CLUTCH INTERVAL THE TIME PERIOD THAT PASSES BETWEEN THE LAYING OF TWO CLUTCHES OF EGGS.

CONGENITAL INHERITED FROM THE PARENTS.

CUTICLE OUTER MOST LAYER OF SHELL OF THE EGG. THIS LAYER CONSISTS OF LAYERS OF DRIED MUCOUS.

CUTTLEBONE THE CALCIUM RICH BACK BONE OF THE CUTTLEFISH.

DEAD-IN-SHELL ANY FERTILIZED EGG THAT FAILS TO HATCH.

DETERMINATE LAYERS BIRDS THAT LAY A PREDETERMINED NUMBER OF EGGS IN EACH CLUTCH. EGGS THAT ARE LOST OR BROKEN ARE NOT REPLACED.

DIMORPHIC HAVING VISUAL DIFFERENCES IN PLUMAGE BETWEEN MALES AND FEMALES OF THE SAME SPECIES.

DRAWDOWN A CHANGE IN SHAPE OF THE AIR CELL PRIOR TO PIP. USUALLY SIGNIFIES THAT THE CHICK IS MOVING ITS HEAD INTO THE AIR PORTION OF THE EGG.

DRY BULB TEMPERATURE MEASURED AMOUNT OF HEAT WITHOUT REGARD TO HUMIDITY.

EDEMA EXCESS FLUIDS THAT BUILD UP IN TISSUES.

EGGBOUND A HEN THAT HAS AN EGG WITH A HARD SHELL LODGED SOMEWHERE IN THE REPRODUCTIVE SYSTEM.

EGG YOLK PERITONITIS AN INTERNAL INFECTION CAUSED BY THE PRESENCE OF YOLK IN THE ABDOMEN OF THE BIRD.

GERMINAL DISC WHITE DOT APPEARING ON THE SURFACE OF THE YOLK OF AN EGG. THE GERMINAL DISC CONTAINS THE FEMALE OVUM, AND IF FERTILIZED, THE MALE SPERM CELL.

HATCHABILITY TERM USED WHEN DETERMINING THE CHANCES THAT AN EGG HAS TO BE HATCHED. OVERALL HATCH RATE.

HYGROMETER INSTRUMENT USED TO MEASURE HUMIDITY IN THE AIR.

INCUBATION PROCESS OF APPLYING HEAT TO EGGS TO CAUSE EMBRYONIC DEVELOPMENT TO TAKE PLACE.

INCUBATION RHYTHM THE PERIODS OF HEATING AND COOLING OF EGGS THAT OCCUR NATURALLY DUE TO THE PARENT BIRDS GETTING ON AND OFF OF THE EGGS.

INDETERMINATE LAYERS THE SPECIES OF BIRDS THAT WILL LAY AN UNDETERMINED NUMBER OF EGGS IN EACH CLUTCH. IF EGGS ARE LOST OR BROKEN, THEY WILL OFTEN LAY ANOTHER EGG TO TAKE ITS PLACE.

INFUNDIBULUM FUNNEL-SHAPED ENTRANCE TO THE FEMALE OVIDUCT.

ISTHMUS SECTION OF THE OVIDUCT WHERE THE INNER AND OUTER SHELL MEMBRANES ARE ADDED TO EGG DURING FORMATION.

LAYING INTERVAL THE AMOUNT OF TIME BETWEEN THE LAYING OF EGGS IN A CLUTCH.

MAGNUM THE LONGEST PORTION OF THE OVIDUCT WHERE THE ALBUMEN IS ADDED TO THE EGG DURING ITS FORMATION.

MALPOSITION TERM USED TO DESCRIBE AN EMBRYO THAT IS IN THE INCORRECT HATCHING POSITION WHEN HATCH TIME ARRIVES.

MAMMILLARY LAYER INNERMOST LAYER OF SHELL OF THE EGG THAT ATTACHES TO THE OUTER SHELL MEMBRANES.

NATURAL INCUBATION POSITION THE POSITION IN WHICH AN EGG IS INCUBATED BY THE PARENTS. THIS POSITION IS MOST OFTEN WITH THE EGG LAYING ON ITS SIDE.

OVA MANY FEMALE SEX CELLS.

OVIDUCT THE ENTIRE FEMALE REPRODUCTIVE TRACT THAT THE EGG PASSES THROUGH DURING FORMATION.

OVUM ONE SINGULAR OVA.

PAIR BONDING FIDELITY BETWEEN TWO BIRDS.

PALPATING TO MANIPULATE BY USING THE FINGERS.

PERIOD OF ATTENTIVENESS TIME PERIOD THAT A BIRD SPENDS ACTIVELY SITTING AND INCUBATING EGGS.

PERIOD OF INATTENTIVENESS TIME PERIOD WHEN PARENTS ARE NOT ACTIVELY INCUBATING EGGS.

PHOTO CYCLE THE INCREASE AND DECREASE OF DAY LENGTH THROUGH THE SEASONS. SAME AS PHOTO PERIOD.

RICKETS BONE DISEASE CAUSED BY CALCIUM AND VITAMIN D DEFICIENT DIETS OR INCORRECT CALCIUM PHOSPHOROUS RATIOS IN FOOD RATIONS.

SHELL GLAND TERM USED TO DESCRIBE THE UTERUS OF A FEMALE BIRD.

SUBCUTANEOUS DIRECTLY UNDER THE SKIN BUT NOT INTO THE TISSUES.

SURGICAL SEXING PROCEDURE WHERE AN ENDOSCOPE IS INSERTED INTO THE BIRD'S ABDOMEN TO VIEW THE SEX ORGANS TO DETERMINE SEXUAL DIFFERENTIATION.

TRANSPIRATION MOISTURE AND GAS LOSS THROUGH THE SHELL OF AN EGG.

UTERUS LARGE THICK-WALLED SECTION OF THE OVIDUCT WHERE THE SHELL IS PLACED OVER THE SHELL MEMBRANES DURING EGG FORMATION. ALSO CALLED THE SHELL GLAND.

WET BULB TEMPERATURE MEASURED AMOUNT OF HEAT USING A THERMOMETER WITH A MOIST WICK ON THE END OF IT. THE REDUCTION IN TEMPERATURE DUE TO THE WATER EVAPORATION IS DIRECTLY RELATED TO THE RELATIVE HUMIDITY IN THE SURROUNDING AIR.

YOLK THE YELLOW PORTION OF THE EGG THAT FUNCTIONS AS THE MAIN SOURCE OF NUTRITION FOR THE GROWING EMBRYO.

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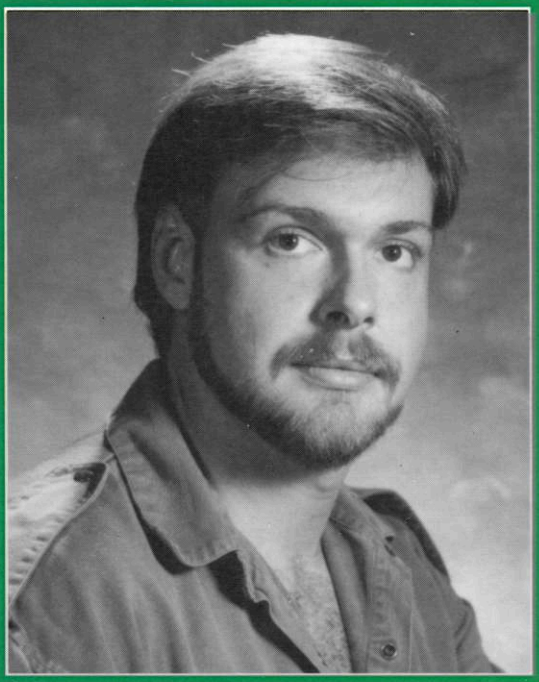

Rick Jordan's knowledge and experience in incubation and neonatal care is impressive. His accomplishments include the world's first ever captive hatch of the extremely rare and valuable Blue mutation Yellow Naped Amazons along with eight Black Palm Cockatoo chicks. Many rare parrots are hatched regularly including Caninde Macaws, Hyacinth Macaws, Slender-billed Cockatoos, Major Mitchell's Cockatoos, Lutino Alexandrine Parakeets, Illiger's Macaws as well as many others. On average Rick incubates some 300/450 exotic eggs per year.

Rick Jordan's concern for endangered species has prompted him to establish a breeding base of as many Asiatic Parakeets as possible. Many are either endangered or already extinct in the wild. His personal collection now numbers 35 individuals representing nine species including both Malabar Parakeets and Lutino Alexandrine Parakeets.