POULTRY HEALTH & PRODUCTION

Introduction

The Poultry Industry

- Size of Poultry Enterprises
  - Small farm flocks
  - Large commercial operations
- Important Factors for Success in Poultry
  - Proper feeding
  - Good management
  - Sanitation
- Three General Types of Chicken Enterprises
  - Egg production
  - Broiler production
  - Raising replacement pullets

The Poultry Industry

**Egg production – laying hens are kept to produce table eggs.*

**Broiler production – raising of chickens for meat.*

- Vertical Integration – two or more steps of production, marketing and processing are linked together. Usually set up by feed manufacturers or poultry processors. They provide the financing needed and have most of the control of management decisions that are made in the production process.
- Advantages of Poultry Raising
  - High feed efficiency
  - Fast return on investment
  - Spreading income throughout the year
  - High return compared to feed costs

The Poultry Industry

- Advantages of Poultry Raising
  - Low land requirements
  - Adaptability to small part time enterprise and large commercial enterprise.
  - The operation can be highly mechanized with high output per hour of labour.
- Disadvantages of Poultry Raising
  - Serious problems with diseases and parasites.
  - Need for high level of management ability, especially for large commercial flocks.
  - Need for large amount of capital for large operations.
  - Limitations of zoning on the location of flocks.

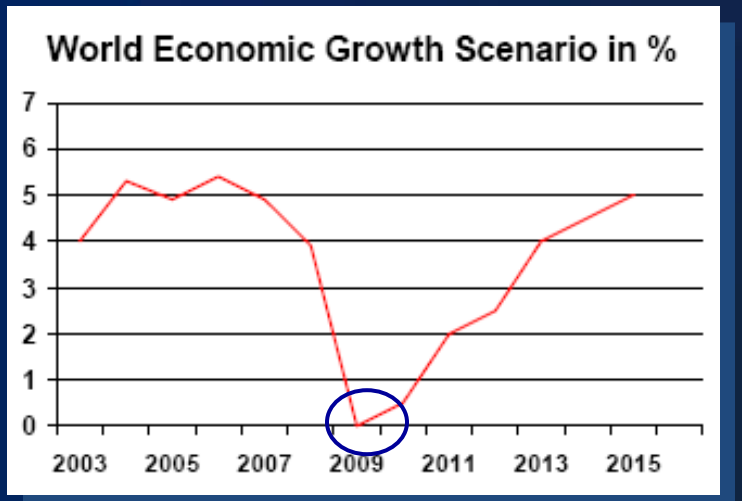
The Poultry Industry

- Disadvantages of Poultry Raising
  - Death losses maybe high due to predators and stampeding.
  - Quality of product must be carefully controlled.
  - Careful marketing is required.
  - High volume is needed for economical enterprise.
  - Problems of waste disposal and odour.

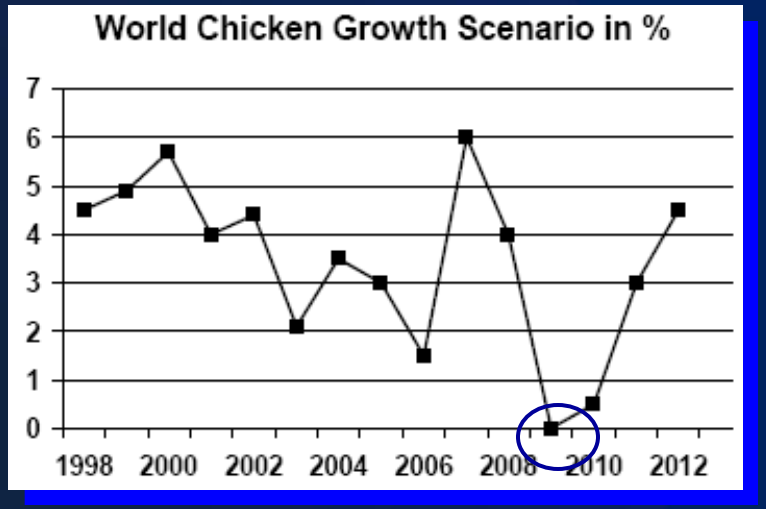
The Poultry Industry

- Importance of Poultry Raising
  - To provide for food (meat & eggs)
  - For sport – cockfighting, hunting
  - For pleasure – message carriers (pigeons), raising fancy chickens as hobby.
  - For health – work not heavy but gives good exercise.
  - Others- ornamental (plumes of ostriches), production of fertilizers (manure)

When Will the Downturn in World Economy End?



Source: IMF



Source: FAO

- Global economy is currently in a free fall from a growth rate of 4% in 2008 to 0% in 2009
- Most likely take-off point appears to be either 2010 or 2011

- Chicken growth will be falling as well from 4% in 2008 to 0% in 2009 as weak global economy curbs spending
- As the economy recovers in 2010, chicken growth will also rebound slowly before increasing more rapidly in the years after 2010

Source: Dr. Paul Aho, Ph.D., Arbor Acres, Broiler Economics, February 2009

Slower Growth for Broiler Production

BROILER SUMMARY – SELECTED COUNTRIES
(in '000 Metric Tons – Ready-to-Cook Equivalent)

PRODUCTION	2007	2008 (p)	2009 (f)	% to Total	Growth '08 vs. '07	Growth '09 vs. '08
United States	16,211	16,677	16,487	22%	3%	-1%
China	11,354	12,650	13,700	18%	11%	8%
Brazil	10,305	10,895	11,417	15%	6%	5%
European Union - 27	8,250	8,400	8,495	11%	2%	1%
Mexico	2,683	2,775	2,860	4%	3%	3%
India	2,240	2,490	2,770	4%	11%	11%
Russian Federation	1,350	1,550	1,780	2%	15%	15%
Argentina	1,280	1,425	1,550	2%	11%	9%
Iran	1,423	1,425	1,425	2%	0%	0%
Japan	1,250	1,260	1,260	2%	1%	0%
Thailand	1,050	1,140	1,200	2%	9%	5%
Others	10,780	11,046	11,293	15%	2%	2%
World Total	**68,176**	**71,733**	**74,237**	**100%**	**5%**	**3%**
Annual Growth Rate		***5%***	***3%***			

Source: USDA-FAS "Livestock & Poultry: World Markets and Trade", October 2008 *(p) preliminary, (f) forecast*

Chicken competitiveness in converting feed into meat will benefit from high feed cost. This cost advantage is a catalyst for continued growth in consumption.

BROILER SUMMARY – SELECTED COUNTRIES
(in '000 Metric Tons – Ready-to-Cook Equivalent)

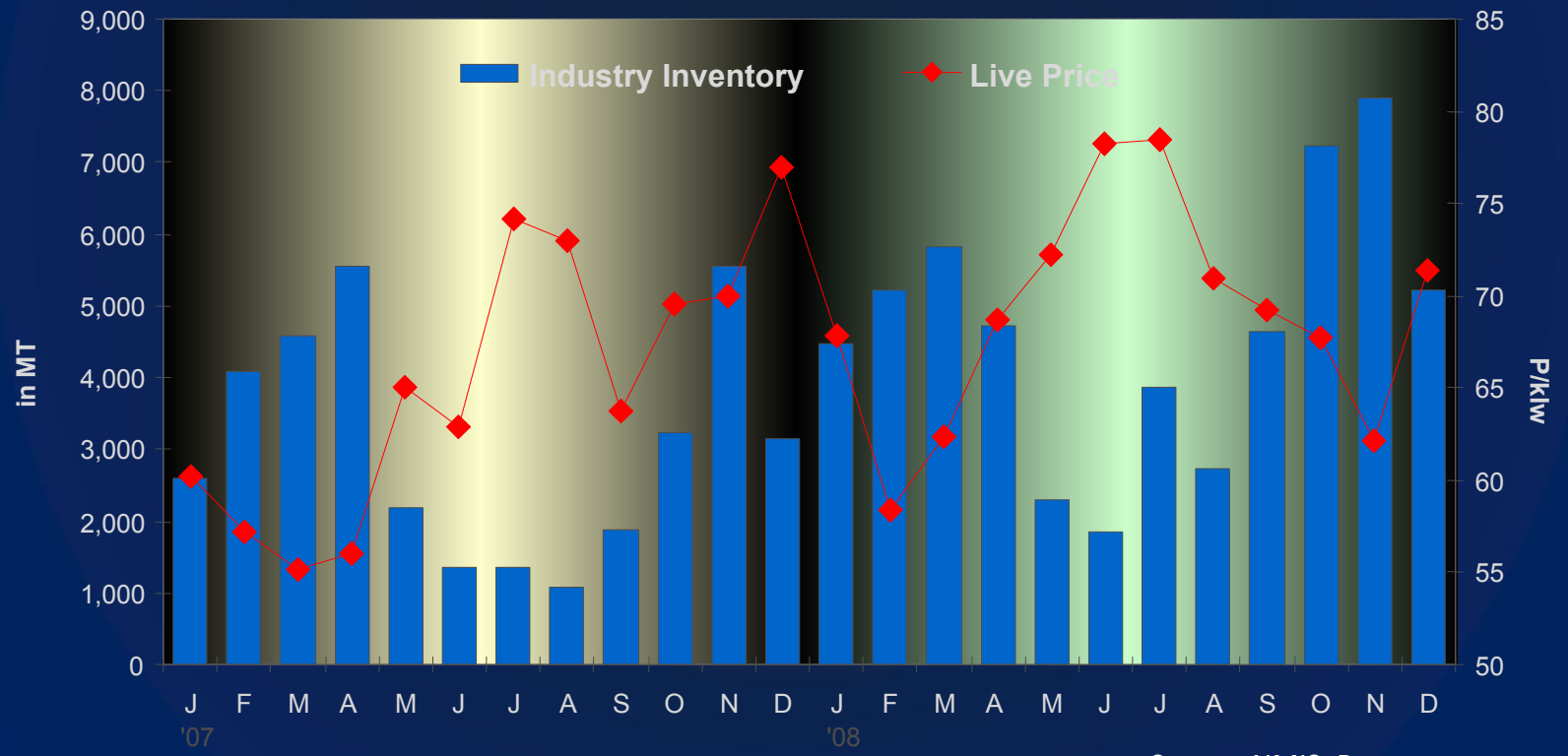
CONSUMPTION	2007	2008 (p)	2009 (f)	% to Total	Growth '08 vs. '07	Growth '09 vs. '08
United States	13,567	13,692	13,682	19%	1%	0%
China	11,478	12,825	13,867	19%	12%	8%
European Union - 27	8,265	8,450	8,565	12%	2%	1%
Brazil	7,384	7,565	7,757	11%	2%	3%
Mexico	3,067	3,188	3,295	4%	4%	3%
Russian Federation	2,581	2,780	2,968	4%	8%	7%
India	2,239	2,490	2,770	4%	11%	11%
Japan	1,945	1,932	1,935	3%	-1%	0%
Iran	1,464	1,454	1,454	2%	-1%	0%
Argentina	1,190	1,315	1,420	2%	11%	8%
South Africa	1,241	1,267	1,300	2%	2%	3%
Others	13,488	14,432	14,818	20%	7%	3%
World Total	**67,909**	**71,390**	**73,831**	**100%**	**5%**	**3%**
Annual Growth Rate		***5%***	***3%***			

Source: USDA-FAS "Livestock & Poultry: World Markets and Trade", October 2008 *(p) preliminary, (f) forecast*

PHILIPPINE POULTRY MARKET

Market Developments in 2008

- From a moderate glut in Q1, broiler industry experienced a downturn in supply from May – August due to typhoon damage and industry-wide deterioration in broiler growth



Source: NMIS, Datacon

- Supply eventually recovered starting July to the point of being above demand in Q4 as the increase in supply was met by weak markets

PHILIPPINE POULTRY INDUSTRY

Outlook for 2009

Raw Materials

- Corn supply and prices still uncertain, but imported feed wheat is a viable alternative
- Soybean meal outlook generally positive

Demand

- Major challenge to sustain growth
- Pork shortage will allow chicken consumption to increase

Supply

- Breeders in place for major expansion
- Significant increase in small, new entrants
- Possible cutbacks in case of oversupply

BIOSECURITY

An Essential Part of Poultry Production

DEFINITION

Protecting flocks from any type of infectious agent by applying logical & effective management principles & understanding methods by which disease agents are transmitted.

OBJECTIVES

✔ *To limit the introduction of infection into a poultry operation.*

✔*To reduce lateral spread between units following an initial outbreak.*

FACTORS INFLUENCING RISK OF INFECTION

- ✔ *Location of Farm*
- ✔ *Design of Facilities*
- ✔ *Range of Flock Age*
- ✔ *Proximity of Farm to central facilities as Feedmills,Processing Plants, and Hatcheries.*

THREE SPECIFIC PRINCIPLES OF DISEASE PREVENTION

1. ***Secure by Design***
2. ***Secure by Planning***
3. ***Secure by Restriction***

SECURE BY DESIGN

** Parent flock complexes should be separated from nearest poultry farm by at least 1 km.*

** Buildings are at least 25 meters away from perimeter fence.*

** Poultry houses are at least 25 meters apart.*

** Where possible, commercial units should be operated on an all-in all-out basis.*

** Farm should be located in areas with a low density of commercial poultry.*

** Farm should be situated in areas devoid of backyard or non-commercial flocks.*

SECURE BY DESIGN

** Farms should be located sufficiently close to public roads to facilitate access.*

**Location of farm, sequence of flock placements and operating procedures should take into account prevailing wind direction.*

** Farm should be securely fenced, with notices clearly displayed.*

** Poultry house should be inaccessible to wild birds and rodents.*

SECURE BY PLANNING

** Cleanout procedures should be thorough and effective.*

** Removal of litter, preferably in bulk and transported to a remote location.*

** Removal and decontamination of equipment at a central point on the site.*

** Compliance with the step by step disinfection procedure recommended by the Animal Health services Dept.*

** Water supplied to farms should be chlorinated to a level of 5 ppm to eliminate pathogens.*

SECURE BY PLANNING

* *Special provision should be made to remove sick and injured birds from flocks.*

* *Appropriate methods of disposal of dead birds should be developed.*

* *In the absence of disease outbreaks, it is recommended that down time (rest period) be maintained at least 14 days prior to next loading for broilers and 4 weeks in the case of breeding stock.*

* *Constant monitoring of flocks to determine freedom from infection.*

SECURE BY RESTRICTION

** Biosecurity requires control of human traffic and this involves not only those regular workers on a site but particularly visiting servicemen.*

** All poultry facilities should be provided with a decontamination module to enable personnel to change to farm clothing.*

** It is necessary to maintain an inventory of protective clothing of the correct sizes for workers, supervisors and visitors and to ensure that there is a program of regular cleaning and disinfection.*

** A record should be kept of all visitors to a site including name, date of visit and nature of business.*

SECURE BY RESTRICTION

** Vehicles should not be allowed access unless absolutely necessary, and any that do should be thoroughly sprayed with disinfectant before gaining access.*

** Feed delivery vehicles should be washed before returning to the mixing plant to prevent dissemination of infection.*

** Where possible, feed should be delivered in the sequence of younger to older flocks and special precaution should be taken if a disease is present or suspected on an individual farm.*

Characteristics if different active ingredients of hatchery disinfectants

Chemical Type	Antibacterial	Antifungal	Antiviral	Antispores	Toxicity	Corrosiveness	Detergency	Cost
Formaldehyde	Good	Good	Good	Good	High	Low	Poor	Low
Chlorine Based	Good	Poor	Poor	Good	Low	High	Poor	Low
Quaternary Amm Based	Good	Variable	Variable	Ineffective	Low	Low	Good	Low
Phenolic Based	Good	Good	Variable	Variable	High	Variable	Poor	High
Iodine Based	Good	Good	Good	Good	Low	Low	Low	High
Glutaraldehyde	Good	Good	Good	Good	Medium	Low	Low	High
Acetic Acid Based	Good	Good	Good	Good	Low	Variable	Low	High

BASIC POULTRY NUTRITION IN THE TROPICS

Our present-day birds are veritable factories of egg and meat. They manufacture these products from the feeds given to them as raw materials.

In order to expect a good and efficient feed conversion into eggs or meat, the feed must be of good quality and of sufficient amount.

e.g. layers 50% production – 200 grams of 2-day ration into an egg weighing more than 50 grams; 1 kg of broiler meat- less than 3kg of feeds.

Science , helped develop chickens into efficient converters of feeds into eggs and meat. Besides improving the genetic make up of the chickens improving them in almost all production parameters, they have formulated feeds and instituted feeding regimen so that now, it is not unusual to observe hens laying more than 200 eggs a year and a broiler to weigh 1.5 kgs or more in 38 days.

BASIC POULTRY NUTRITION IN THE TROPICS

Feeds of plant and animal origin consist of chemical compounds known as:

- Proteins
- Carbohydrates
- Fats
- Vitamins
- Minerals

These nutrients are utilized as:

1) Source of heat and energy
2) Building materials

The heat produced by oxidation of nutrients maintains body heat; the energy carries on the various physiological processes of digestion, blood circulation, respiration and voluntary movements of the animal.

As building materials, the nutrients take care of the repair of worn-out tissues and the production and development of flesh, bones, eggs and feathers.

BASIC POULTRY NUTRITION IN THE TROPICS

•*Proteins (meat, fish, shrimps, legumes , etc)* – first digested in the proventriculus by the enzyme pepsin in the presence of hydrochloric acid, both of which are constituents of gastric juice. In the small intestines these are further digested by the enzymes trypsin of the pancreatic juice and intestinal juice into the final product of digestion which is the *amino acid*.

• *Fats and Oils* – digested by the bile and pancreatic juice to be converted into the final product of digestion which are *fatty acids* and *glycerine.*

• *Carbohydrates* – These include starch, sugar and fiber.

- *It will be noted that the end products of digestion are:*
  - *Amino acids from Proteins*
  - *Glucose from Carbohydrates (Starch and Sugar)*
  - *Fatty Acids and Glycerol from Fats and Oils*

• *Vitamins* – chemical substances taken in small amount that enhances utilization of other elements. They have led to the control and practical elimination of various poultry and animal diseases.

BASIC POULTRY NUTRITION IN THE TROPICS

• *Minerals* – supplements needed by the body. Main bulk of which are found in the skeleton and egg shell. The minerals needed by birds which have to be provided in the ration are calcium, phosphorus, sodium chloride (ordinary table salt) and manganese. These are found in feeds but not enough to meet the requirement of birds for maximum growth and production.

Protein Sources:

Animal Origin- fishmeal, meat scraps, meat and bone meal, skim milk, whey, shrimp-meal

Plant Origin – soybean oil meal, peanut oil meal, brewer's yeast, copra or coconut oil meal, monggo, corn by-products, ipil-ipil leaf meal, distiller's yeast.

Carbohydrates Sources:

Corn, corn grit, corn bran, rough rice (palay), rice brewers, molasses,

BASIC POULTRY NUTRITION IN THE TROPICS

Mineral Sources:

Common table salt, Calcium (oyster grits , limestone), phosphorus (bone meal), manganese (manganese sulphate or manganese chloride), cobalt (cobalt chloride).

Vitamin Sources:

Vitamin A – cod-liver oil, yellow corn and ipil-ipil leaf meal.

Vitamin B-complex – rice bran,, corn, milk products, molasses, yeast and young grass.

Vitamin D – sunlight, cod-liver oil and yeast.

Vitamin E – green leaves, ipil-ipil leaf meal and sprouted grains.

BASIC POULTRY NUTRITION IN THE TROPICS

Forms/Kinds of Feed:

Birds raised for commercial purposes should be given mostly with concentrates and very little roughage. Concentrates are those that are low in fiber content, but high in digestible nutrients.

* MASHES are feed mixtures containing ingredients in finely ground form.
  - Booster mash
  -Starter mash
  - Grower mash
  - Finisher mash
  - Laying mash

*CRUMBLES are feed mixtures containing ingredients in coarsely ground form. It is midway between mash and pellets. It has most of the advantages and disadvantages of pellets but because of its smaller size it can be fed to younger chicks. Often they are used from 1 day of age. The texture of crumbles should be intermediate, neither too course or too fine.

BASIC POULTRY NUTRITION IN THE TROPICS

Forms/Kinds of Feed:

* PELLETS compressed mash by running it through specialized equipment. With pellets, the chicken cannot pick out certain parts of the feed, but must eat it all. It becomes more important in medicated feeds.

Advantages:

1) Wind loss is less than with mash
2) Most feed dustiness is eliminated
3) When handling feeds there is no separation of ingredients when feed is pelleted.
4) Pelleting destroys some bacteria in the feed (salmonella)
5) Pelleting increases feed density and birds can consume more low energy (high-fiber) feeds.
6) Certain feed ingredients are unacceptable to chickens (rye, buckwheat, barley) but when feed is pelleted, consumption is markedly increased.
7) The heat, moisture and pressure from pelleting may increase the efficiency of the ration.
8) There is less feed waste from the feeders.

BASIC POULTRY NUTRITION IN THE TROPICS

Disadvantages:

1) There is the added cost of pelleting the mash.

2) Some pellets crumble when they are moved by automatic feeding systems, and the finer particles are wasted.

3) Pellets increase water consumption.

4) The droppings are wetter when pellets are fed.

ZONE OF THERMONEUTRALITY

Chickens being warm blooded (homeothermic-capable of maintaining a constant body temperature despite variations in the temperature of the surroundings), have the ability to maintain a rather uniform temperature of their internal organs (homeostasis). However, the mechanism is efficient only when the ambient temperature is within certain limits; birds cannot adjust well to extremes. Therefore it is very important that chicks be housed and cared for so as to provide an environment that will enable them to maintain their thermal balance.

The thermoneutral zone, is the range of temperatures (ambient temperature) at which an animal does not have to actively regulate its body temperature. Regulation of body temperature occurs through raising the metabolism. Therefore, when the birds do not have to regulate their body temperature, they do not have to raise their metabolism, hence the constant metabolism in the thermoneutral zone.

ZONE OF THERMONEUTRALITY

The confines of the internal body temperature of birds show more variability than mammals, so much so that there is no absolute body temperature. In the adult chicken this variability is between 40.6 degrees centigrade and 41.7 degrees centigrade.

The chicken is continually producing heat through metabolic processes and muscular activity, and the heat lost from the body must equal the heat produced or the body temperature will rise.

Methods of Heat Liberation:

Radiation – when the temperature of the bird's surface is greater than the adjacent air, heat is lost from the body by radiation, and ceases when the temperature of the surrounding air is reduced to, or below, the temperature of the bird's surface area.

ZONE OF THERMONEUTRALITY

Methods of Heat Liberation:

Conduction – when the surface of the bird comes in contact with any surrounding object, either air, or some solid material, as when the bird sits on a cool floor.

Convection – when cool air comes in contact with the surface of the bird the air is warmed. The heated air expands, rises, and heat is carried away as the warmer air moves on. When the speed of air moving over the body is increased, as by fans, the amount of heat lost from the bird by convection increases. As the ambient temperature rises, heat lost by convection decreases, and when it reaches body temperature there is little loss by this method. In still air there is none.

Vaporization of water – as a replacement for moisture lost through sweat glands in most mammals, the chicken uses a process of evaporative cooling by the vaporization of moisture from the damp lining of the respiratory tract. Heat lost in this manner is a major method of heat elimination from the body of the bird when the ambient temperature is high.

ZONE OF THERMONEUTRALITY

Methods of Heat Liberation:

Fecal Excretion – a small amount of heat leaves the body with fecal excretions.

Production of eggs – heat lost with the laying of an egg is evident, but of minor importance.

Lethal Body Temperature

when the heat produced by the bird is greater than that dissipated through the various process of elimination, the deep body temperature rises. When it gets to a certain point the bird dies of heat prostration. This is said to be the upper lethal temperature which is about 47 degrees centigrade.

ZONE OF THERMONEUTRALITY

Mechanism to maintain Body Temperature:

At 21 deg centigrade, 75% of all heat generated by the bird is lost through radiation, conduction and convection. This is influenced by the ambient temperature. Cold weather make these systems do their job well. But when the environmental temperature are at or near the body temperature of the bird, they operate only a little or not at all.

The hen's ability to dissipate heat is influenced by the skin temperature rather than by the deep body temperature. As the temperature of the air surrounding the bird decreases, the blood vessels in the skin contract, thus reducing the blood flow, which in turn acts to reduce the amount of heat lost from the body. When the temperature of the surrounding air increases, the blood vessels dilate, increasing the flow of blood, thereby increasing the amount of heat lost.

ZONE OF THERMONEUTRALITY

Panting – when radiation, conduction and convection are unable to transfer all the heat produced, this is the mechanism that takes over. Panting is a means of bringing more outside air in contact with the membranes of the respiratory tract. Heat is removed from the body by the coming air itself. And because the outside air has a lower humidity, more moisture is absorbed from the bird, along with its content of heat. This is known as *insensible heat loss.*

Adequate housing, from an environmental standpoint ,is what is necessary to meet the optimum requirements for best growth, freedom from stress, good egg production, high fertility, and the most efficient utilization of feed. Briefly, adquate housing must provide the flock with optimum air quality and temperature conditions so that performance may be optimized.

ZONE OF THERMONEUTRALITY

Ammonia Concentration – ammonia in a poultry house can become troublesome when the concentration is high. It is nauseating to the caretaker, irritates the eyes and affects chickens. Ammonia is measured in parts per million (ppm). Normally 15 ppm will prove uncomfortable for human beings; 50 ppm for 8 hours is considered the maximum allowable concentration.

Tolerance level for chickens – continuous high concentration lessens the activity of the cilia of the respiratory tract of chickens. With laying birds, 30 ppm are probably slightly injurious, affecting egg production and general health of the birds, while 50 ppm produce serious trouble, particularly growth. Much higher concentration though can be tolerated (100ppm) for short periods. However, the amount produces a higher incidence of breast blisters, and water consumption is higher. Thus for practical purposes, ammonia concentration should not be over 25 ppm.

Reducing ammonia fumes – increasing ventilation, replacing litter, reducing *ph* of the litter to below 7.0 (ammonia release is rapid when *ph* is 8 or above)

ZONE OF THERMONEUTRALITY

Types of Poultry Houses based on Ventilation System:

1) *Open-sided Poultry House* – most of the poultry houses in the world are conventional or open-sided, that is they rely on free flow of air through the house for ventilation.

Cooling the Open-sided House:

-sprinkle the house roof
- sprinkle the ground area outside the house
- use foggers in the poultry house
- use fans outside of or in the poultry house

2) *Controlled-environment House (tunnel-ventilated house)* – a type of house wherein inside conditions are maintained as near as possible to the bird's optimum requirements. Completely insulated with no windows. Air is removed by exhaust fans and fresh air is brought in through intake openings. Artificial light, rather than natural daylight is used to illuminate the interior. The houses are not heated except for brooders. The heat from the birds is used to keep inside temp within the range for maximum efficiencies.

ZONE OF THERMONEUTRALITY

Types of Poultry Houses based on Design:

Several innovations in house design have evolved over the years. Their importance is based on many factors including reduction in floor space per bird, less labor, higher fertility with breeding birds, better disposition of droppings, and improved sanitation. Each of these houses can use either the open-sided or environmentally controlled systems.

1) *Cage house* – most variations are the result of climatic conditions. In cool to cold climates, the environmentally controlled house is almost a must. In mild climates, only a roof over the cages seems to be necessary.

2) *Slat and Litter house* – the slat and litter house is constructed so that a part of the floor area is covered with slats. Although built primarily for those birds producing hatching eggs, particularly meat-type breeders, the house may also be used for growing birds, but they must be trained to use the slats when they are young.

ZONE OF THERMONEUTRALITY

Types of Poultry Houses based on Design:

3) *All-slat house* – commercial laying birds may be kept on an all-slat floor. The advantage is that it requires less floor space per bird than when the birds are kept on a litter floor. On litter, commercial laying pullets will require about 2 sq feet of floor space per bird. When they are kept on an all-slat floor, 1 sq foot is enough.

4) *High-rise house* – to overcome many of the evils of conventional handling of wet manure, the high-rise house has become increasingly popular. It provides for in-house drying and sheltered accumulation of the droppings until the flock is sold or until disposal of the manure can be arranged.

A high-rise house is essentially a two-story house. The top floor is for the birds in cages or on a slat floor. The bottom floor, with no ceiling, is directly underneath and is used for the accumulated manure. Each is about 7 feet high.

ZONE OF THERMONEUTRALITY

Cooling the House:

Moving more air through the poultry house when the outside temperature gets above 29.4 degrees centigrade is not the solution to providing a comfortable environment for the birds. The four accepted methods of cooling the birds are :

1) Low-pressure fogging system – fogging nozzles that operate at regular water pressures are installed throughout the house or over the birds in cages.

2) Pad-and-Fan system – exhaust fans in the house draw incoming air through a wet pad where the evaporation of moisture from the pad reduces the temperature of the incoming air.

3) Fog-and-Fan system – this is similar to the pad-and-fan system except that incoming air is drawn through a hood in which high-pressure foggers have been installed. As air is drawn through the fog, its temperature is reduced.

4) High-pressure fogging system – special nozzles convert water from liquid to vapor form. This change has a great cooling effect on the air in which it comes in contact.

POULTRY HEALTH & PRODUCTION

Parts of Male & Female reproductive System

Male Reproductive System

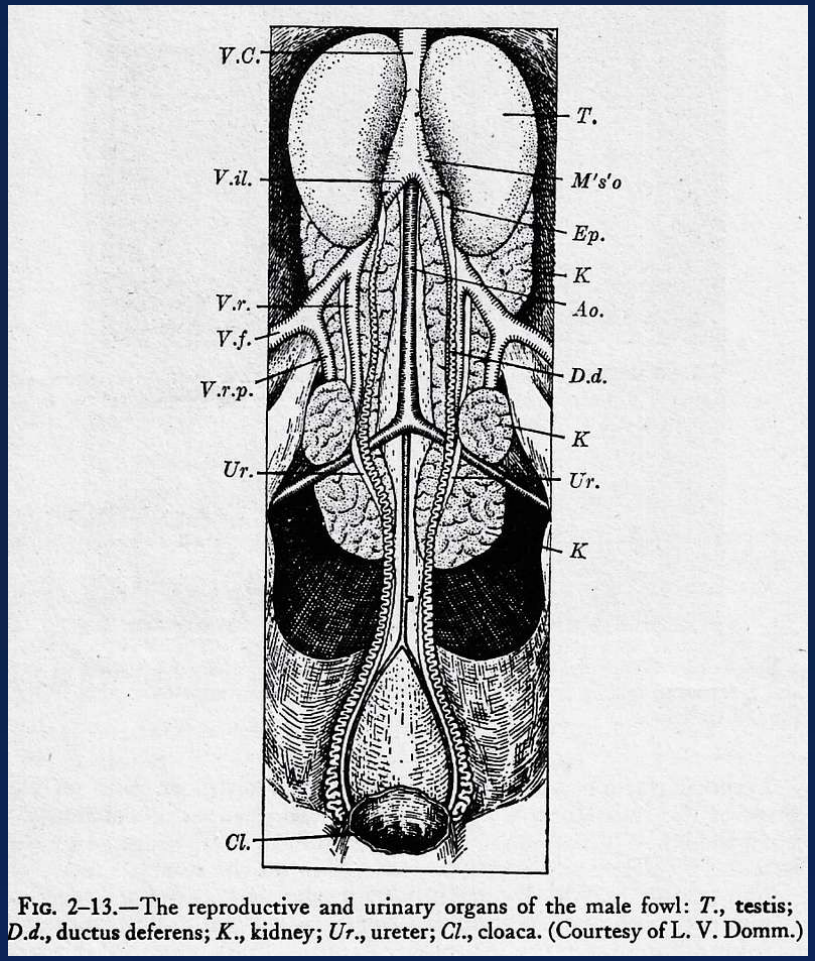


FIG. 2–13.—The reproductive and urinary organs of the male fowl: *T.*, testis; *D.d.*, ductus deferens; *K.*, kidney; *Ur.*, ureter; *Cl.*, cloaca. (Courtesy of L. V. Domm.)

Reproductive System

- Male
  - Consist of two testicles in the dorsal area of the body cavity just in front of the kidneys.
  - The many ducts of the testes lead to the vas deferens which carry the semen from the testicles to the papillae in the dorsal area of the cloaca, and then to the copulatory organ located in one of the folds of the cloaca.
  - Normally semen is stored in the vas deferens. Here it is diluted with lymph fluids, and both are ejaculated as a mixture during copulation.
  - The penis of a male chicken is quite small as compared with water fowls which have well-developed, long and twisted organ.

Reproductive System

- Male
  - Lymph enters the penis to form a mild erection, but does not enter the cloaca of the female.
  - Rather during mating the cloaca of the female only opens to expose the end of the oviduct where semen is deposited, then finds its way up the oviduct.
  - The spermatozoa show a long pointed headpiece, followed by a long tail. The pH of semen is between 7.0 and 7.4.

Female Reproductive System

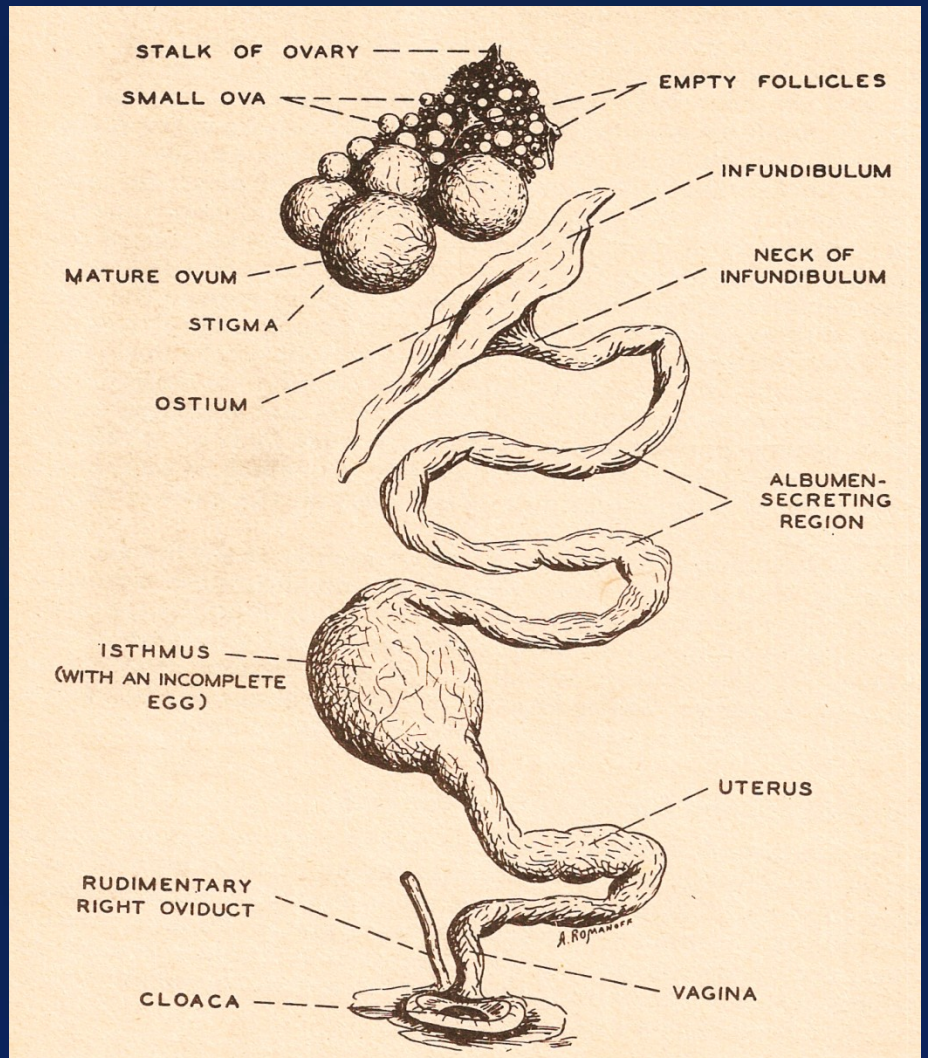


FIG. 2–11.—The ovary and oviduct of a chicken. (Courtesy of A. L. Romanoff and J. Wiley and Sons, Inc., New York.)

Reproductive System

- Female
  - Ovary – at the time of early embryonic development, two ovaries and two oviduct exist, but the right set atrophies, leaving only the left ovary and oviduct at hatching. Prior to egg production the ovary is a quiet mass of small follicles containing ova. Some are large some are microscopic. Several thousands are present in each female chicken.
  - Oviduct – long tube through which the yolk passes and where the remaining portions of the egg are secreted.
    - *Infundibulum* – funnel-shaped upper portion of the oviduct. Search out and engulf the yolk to cause it to enter the oviduct.
    - *Magnum* – albumen-secreting portion of the oviduct. Four layers are:
      - Chalazae – twisted cords from opposite poles of the yolk. Tends to keep the yolk centralized after egg is laid.
      - Liquid inner white
      - Dense inner white – makes up the largest portion of the egg albumen.
      - Outer thin white

Reproductive System

- Female
    - *Isthmus* – where inner and outer shell membranes are formed in such a manner as to represent the final shape of the egg.
- Uterus – primarily the shell gland.
- Vagina – the next section of the oviduct where cuticle is deposited on the shell to fill many of the shell pores. Egg stays here for only a few minutes before they are laid.

POULTRY HEALTH & PRODUCTION

The Egg

The Egg

Formation of the Egg

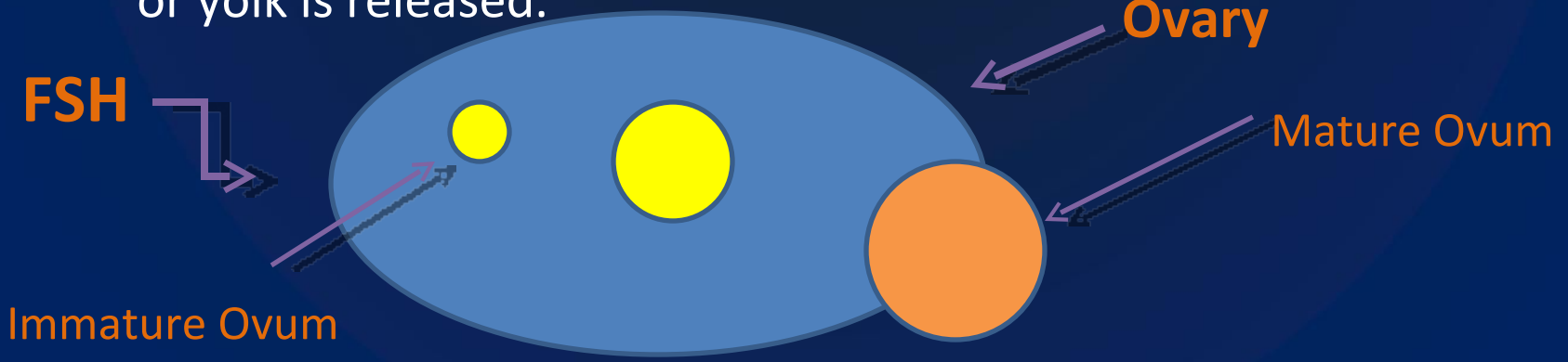
The avian egg consists of a minute reproductive cell quite comparable with that found in mammals. But in the case of the chicken, this cell is surrounded by yolk, albumen, shell membranes, shell and cuticle. The ovary is the one responsible for the formation of the yolk; the remaining portions of the egg originate in the oviduct.

The Egg

Formation of the Egg

The yolk is not the true reproductive cell, but a source of food material from which the minute cell (blastoderm) and its resultant embryo partially sustain their growth.

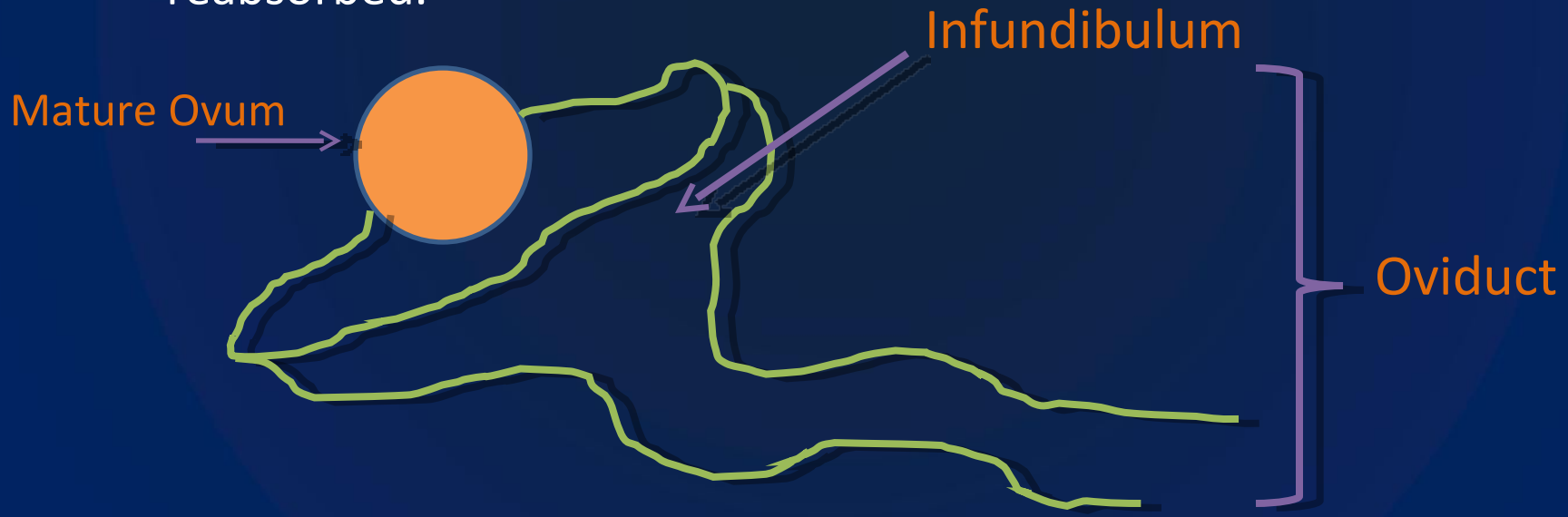
When the pullet is sexually matured, the ovary and the oviduct undergo many changes. The Follicle Stimulating Hormone produced by the Anterior Pituitary Gland causes the ovarian follicles to increase in size. At the time of ovulation, mature ovum or yolk is released.



The Egg

Formation of the Egg

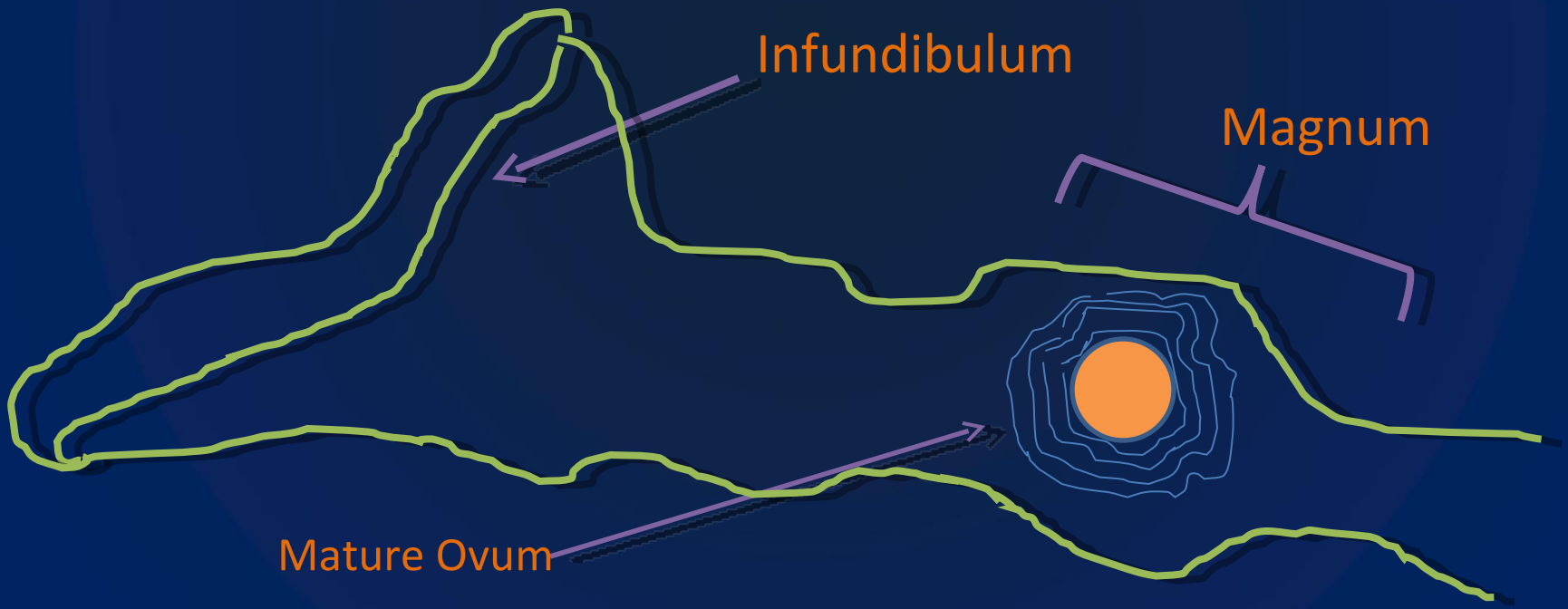
The ovulated egg is engulfed by a funnel-like structure of the oviduct called the *Infundibulum*. Occasionally the infundibulum does not pick up a yolk released from the ovary. When this happens the yolk is lost in the abdominal cavity and eventually reabsorbed.



The Egg

Formation of the Egg

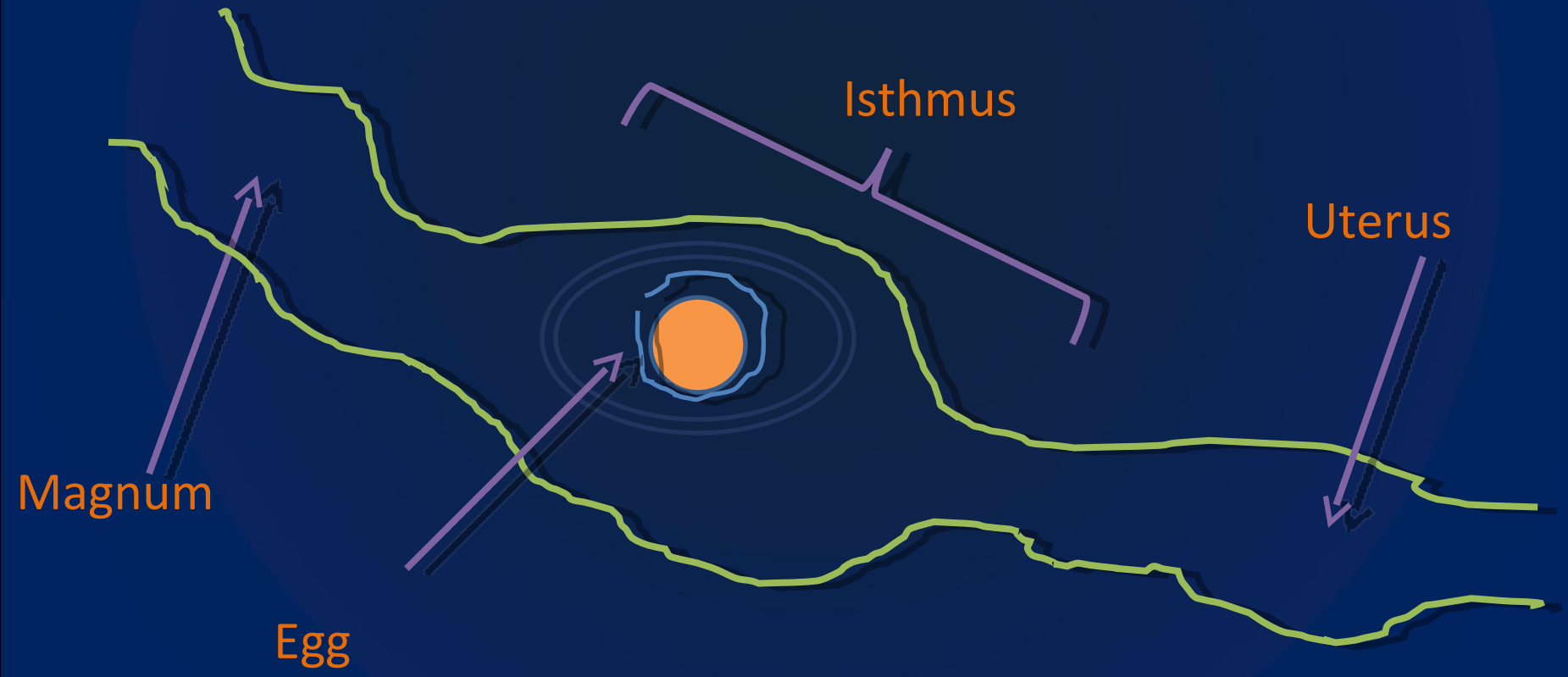
The magnum is the longest portion of the oviduct where the albumen or egg white is secreted around the yolk. Four distinct layers are recognized, they are the chalaziferous layer, inner thin albumen, the thick albumen and the outer thin albumen.



The Egg

Formation of the Egg

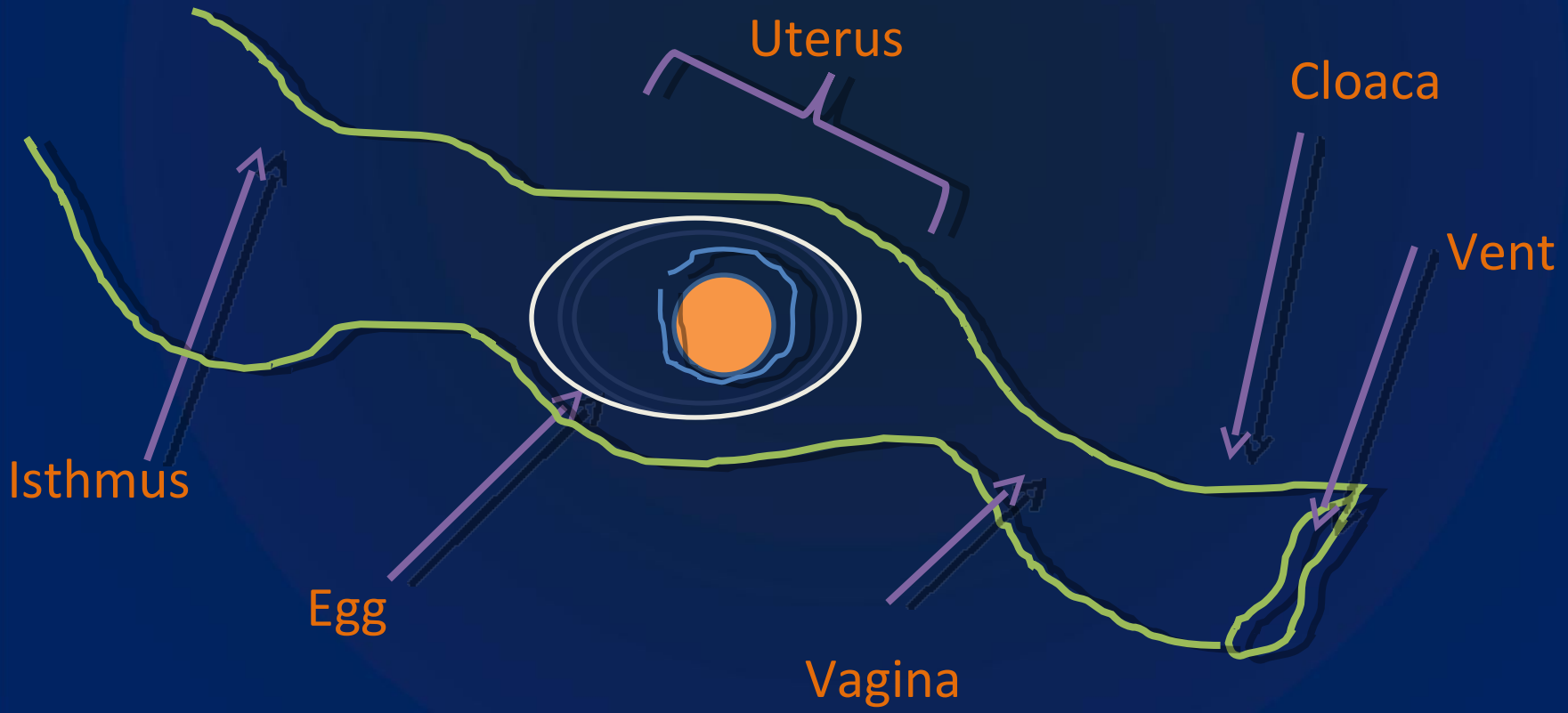
The shell membranes are added to the egg in the isthmus. The are two membranes formed, an inner and an outer shell membrane.



The Egg

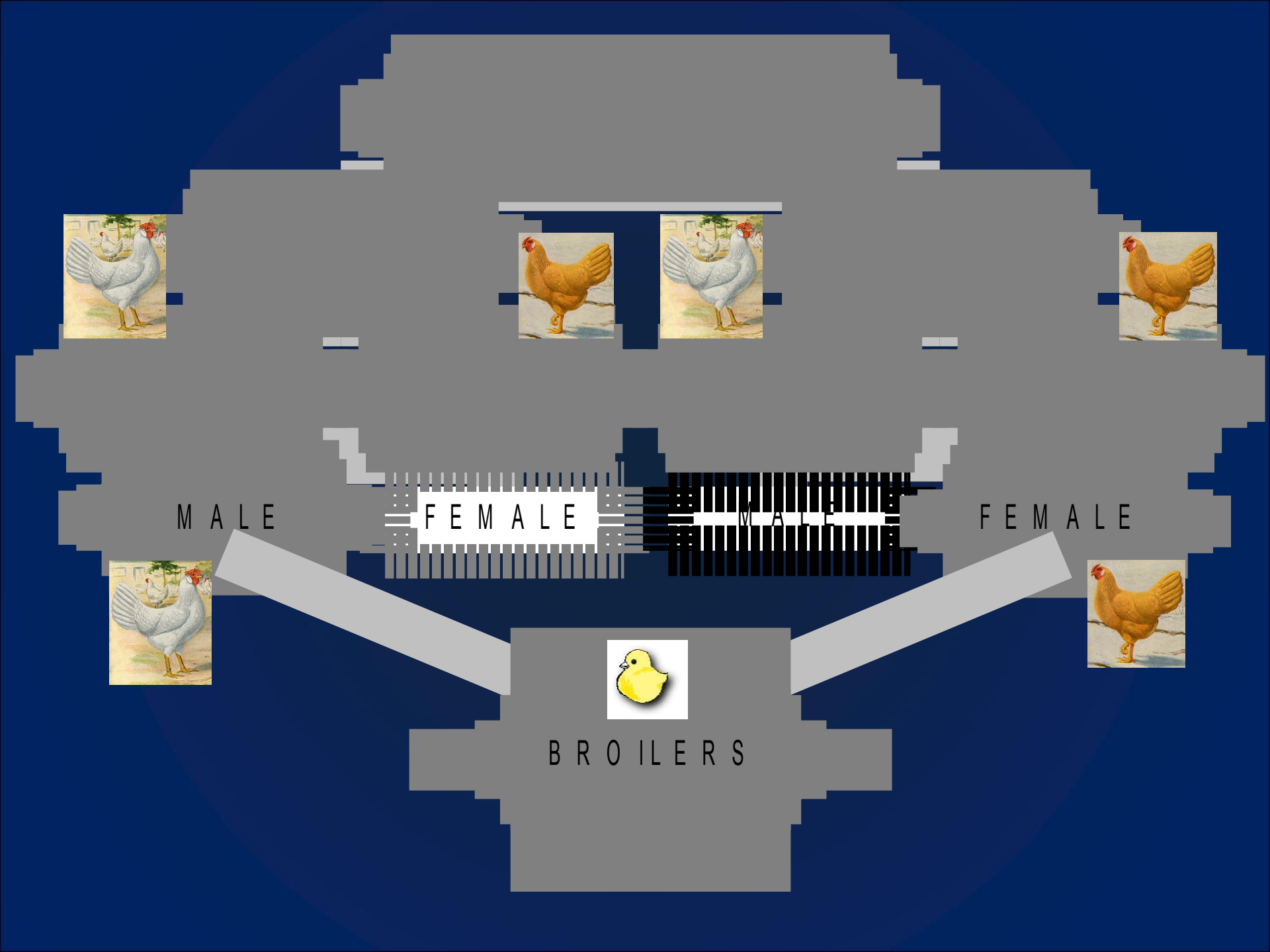
Formation of the Egg

The egg remains longest in the uterus, or shell gland, where the eggshell is formed, a process requiring 19 to 20 hours.



POULTRY HEALTH & PRODUCTION

Basic Poultry Breeding and Breeder Management


MALE
FEMALE
MALE
FEMALE
BROILERS

Breeder Management

Three Types of Breeder Birds:

- Breeders that produce pullets that lay white eggs for human consumption.
  - Standard Leghorns
  - Mini Leghorns

- Breeders that produce pullets that lay brown eggs for human consumption.
  - Sex-link (gold male and barred female parents)
  - Brown egg (gold male and silver female parents)

- Breeders that produce straight-run broiler chicks.
  - Non-sexed-linked (progeny cannot be sexed at day old)
  - Sexed-linked (progeny can be sexed at day old)
  - Mini-meat type

Breeder Management

Although breeding flocks will consist of only 10% as many males as females (1:10), the males are responsible for 50% of the gene makeup of the progeny and must be given more room, more feed and special handling.

Meat-type grandparents produce male-line cockerels that are smaller than that of female-line chicks because male-line produce smaller and fewer eggs, and smaller eggs produce smaller chicks. These chicks from the male-line must therefore be started separately from the female-line.

As chicks, breeding birds must have complete isolation; as adults they will be blood-tested to determine if they are free of common diseases. Isolation of the flocks must be complete to prevent entrance of the disease from the outside. Separate personnel must be used; they must shower and put on clean clothing before entering the premises.

Breeder Management

Brood-Grow System of Growing

This is the system in which breeding stock use the same poultry house for brooding and growing. This system makes it easier to carry out the many necessary vaccination programs. About one third of the building is used for brooding after which the birds are given access to the entire house until layer breeders are about 18 weeks of age and broiler breeders 20 weeks of age. They should then be moved to permanent laying houses.

Breeder Management

Brood-Grow-Lay System

With this program the same house is used for brooding, growing and laying. Once the chicks are placed in it, they never leave. This means that the house is really designed for laying birds and cockerels, then temporarily converted to a brooding and growing facility. The number of birds to be placed in it at the start of the laying period will determine the number of chicks placed in it at day old.

Breeder Management

Layer Breeder (Leghorn) Management during Brooding and Growing

1) *Sex intermingled* – starting the sexes separately in the same house by brooder guards. Interchanging brooders from males and females every now and then (for when the guards are removed the chicks have a tendency to return to the same brooders rather than mingle with all the pullets). When two weeks of age, the brooder guards should be removed to allow the cockerels and pullets to run together.

2) *Sexes raised separately* – separating cockerels and pullets by using a high wire fence. At 12 weeks of age, 5% of the cockerels are mixed with the pullets. At 18 weeks of age when culling of the inferior cockerels is completed, remaining cockerels are mixed with pullets preferably at night when its dark to reduce fighting in the males.

Breeder Management

Broiler Breeder (Meat-type) Management during Brooding and Growing

Ad libitum type of feeding is not recommended for this type of birds, because they have a tendency to grow bigger than they should. Ideal weight at 24 wks for male should only be about 3.36 kgs and for female at 2.5 kgs. Giving free feed access makes weight 50% more than the ideal wt. Therefore, feed restriction is the main ingredient of a management program.

1) *Sexes raised separately* – with meat-type birds it is recommended that males and females be raised separately until 21 weeks of age. Then mixing is done at the ration of 12 males per 100 females. At sexual maturity (22wks) number of males is reduced to 9 to 11 per 100 females.

Breeder Management

Broiler Breeder (Meat-type) Management during Brooding and Growing

2) *Sexes intermingled* – keeping the sexes separate for the first 2 weeks. During this period the beak will be completed and the smaller cockerel chicks will get off to a good start for they will not be crowded by the larger pullet chicks. When 2 weeks old, place an equal number of cockerel chicks under each brooder containing pullet chicks.

Breeder Management

Hatchery Procedures for Breeder Chicks

The hatchery has certain responsibilities that are different when hatching and delivering breeder chicks.

Number of Each Sex to Deliver

If the primary breeder develops both male and female parent lines the hatchery will be responsible for hatching and delivering the required number of male-line cockerels and female-line pullets. These numbers will be as follows:

- Layer Breeders (Leghorns) – 10-12 cockerel chicks for each 100 pullet chicks

- Broiler Breeders – 12-15 cockerel chicks for each 100 pullet chicks.

Breeder Management

Toe Trimming and Comb Trimming

To prevent injury to the backs of the females during mating, the toes of day old meat type cockerel chicks should be trimmed at the hatchery. Trim at the outer first joint of the back toe and inside toe of each foot with the use of an electric beak trimmer or toe clipper.

To prevent comb pecking and injury by adult males as a result of setting up social order, combs of male chicks are usually trimmed at the hatchery.

Breeder Management

Sexing Errors

Toe and comb trimming also offer a means of identifying the sex of male and female parent lines. Trimmed comb and toes would mean cockerels and untrimmed comb and toes would mean pullets.

As no sexing procedure is perfect, there are errors, and birds that were sexed erroneously must be removed from the growing flock as soon as identified. If left in the flock many factors of genetic excellence in production will be forfeited.

	cockerel chicks	pullet chicks
Combs trimmed	keep	sexing error
Toes trimmed	keep	sexing error
Combs untrimmed	sexing error	keep
Toes untrimmed	sexing error	keep

Breeder Management

Hatchery Vaccination and Medication

Common vaccines given at the hatchery level for breeders are Marek's, ncd, ib, coccidiosis.

Medications usually are incorporated in Marek’s vaccine (gentamycin or lincospectin)

Breeder Growing House

Practically all breeders are raised in one of the following two types of houses:

1) All-litter floor

2) Slat-and-litter floor

Breeder Management

Water Consumption by Growing Leghorns (Layer Breeders)

Varies according to the ambient temperature.

Water Consumption by Growing Broiler Breeders

Feed restriction plays a big role on water consumption of these type of birds. Water consumption is greater when chickens are on a restricted feeding program (skip a day feeding program) This type of program nowadays is rarely being practiced in breeder farms. Feed restriction is done mainly by reducing the ration allocated for the birds on a per day basis.

Breeder Management

Egg-type Breeders and Body Weight

Although leghorn breeders do not usually put on excess weight, more often their problem is with achieving standard weight. The best remedy is to increase the caloric content of the feed. However when they become heavy formula of ration can be adjusted. Same goes true with male birds.

Meat-type Breeders and Body Weight

Birds should not be made too heavy during sexual maturity so as for them to produce their maximum number of eggs during their life cycle. Restriction of feed consumption is the best way to control body weight.

Breeder Management

Response to correct mature body weight of broiler breeder females:

3) Body weight uniformity is improved
4) Onset of egg production is delayed
5) First eggs are larger
6) Egg production during laying cycle is increased
7) More hatching eggs are produced during the laying year mainly because of the larger egg size
8) Laying house mortality is reduced
9) Feed cost of growing pullet to sexual maturity is usually lowered
10) Feed cost of producing a dozen hatching eggs is reduced
11) The fertility of the hatching eggs is increased
12) The hatchability of the hatching eggs is improved

Breeder Management

Special Handling of Broiler Breeder Parents

Daily Controlled Feeding During Growing – special automatic feeders are designed so that the required amount of feed is given each day rather than by skipping days. The daily allotment of feed for the house is automatically weighed, then dumped into a hopper from which it is delivered in a tube simultaneously to the feeding pans or trough with a chain speed of 100 ft per minute. All pans and troughs are uniformly kept full until the day's allotment of feed is consumed.

Breeder Management

Special Handling of Broiler Breeder Parents

The Blackout Growing House for Meat-type Birds – Growing pullets and cockerels under a black out lighting program has many advantages. However, the sexes must be raised in separate houses inasmuch as the lighting schedules are much different during growing. The house must be environmentally controlled with forced-air ventilation and capable of being completely blacked out

Advantages:

1) There is greater control of the age at sexual maturity.
2) Consumption of growing and laying feeds are reduced with financial saving.
3) Flock uniformity is better
4) Age of sexual maturity can be delayed so the flock produces large first eggs
5) Egg production is increased to as much as 8%

A regular restricted feeding program may be used, but use daily restriction rather than a skip-a-day feeding program.

Breeder Management

The Breeder House

Floor Space – breeding females require more floor space than females kept only for he production of market eggs.

Floor Type – wire flooring has not been very satisfactory for meat type breeders, or even egg-type breeders. Fertility is bound to drop about 2-3% for layer breeders and 5-7% with broiler breeders.

Nests – a ratio of 1:4 should be observed in providing nests. That means one nest for every four pullets in the breeding house. Nests for broiler breeders should be slightly larger than those for layer breeders. A perch should be in front of all nests and it should be constructed so that it may be used to close the nest at night.

Light - an adequate program of lighting is requisite for maximum egg production as well as commercial egg production.

Breeder Management

Feeder Space for Breeders during Egg Production

Feeder space for breeders are usually greater than for laying pullets (layers of table eggs).

FEEDER SPACE REQUIREMENTS FOR BREEDER BIRDS (LITTER FLOOR OPERATION)

Breed	Trough Space	Number of Birds	
	Inches	Pan	Tube Feeder
Mini-Leghorn	3.25	15	19
Standard Leghorn	3.75	13	16
Medium-size Egg Type	4.25	11	13
Mini-Meat-Type	5.00	10	12
Standard Meat-Type	6.00	8	11

- Space for each male and female
- Space for one side of trough only
- Tube feeder approx 12 inches in diameter
- Pan feeder with a diameter of 16 inches.

Breeder Management

Water for the Breeder Flock

**Adequate water is important to the breeder flock and the demand increases greatly as the ambient temperature rises.

**Although the breeder flock involves about 10% males, each male drinks approximately the same amount of water per day as a female. Therefore the males in the flock should be included with the females when water consumption is calculated. Broiler breeders drink 65-75% more than layer breeders.

Breeder Management

Type of Floor and Flock Management

Managing on the Litter Floor - clean and dry litter floor will be necessary if the breeders are to be kept on the floor. Not only will this improve the general health of the birds but it will prevent the feet of the pullets from becoming dirty and carrying the dirt into the nests. Hatching egg cleanliness is essential in breeder operations.

* *Prevent floor eggs* – floor eggs are usually dirty, difficult to clean and sanitize and a probable cause of blowups or exploders in the incubator. There must be a low incidence of floor eggs if the breeding operation is to be practical and profitable.

* *Have an adequate number of nests* – no hen should be forced to lay on the floor because there is no nesting space available. Pullets seem to want to use the nests more if the nest sections are placed cross-wise of the house.

Breeder Management

Type of Floor and Flock Management

Managing on Slats and Litter - most new broiler breeder houses are constructed to use this system. Even though it has some drawbacks, the benefits far outweigh the disadvantages.

The following is a comparison made between a slat-and-litter house versus the all-litter house:

1. The litter area of the slat-and-litter house is difficult to ventilate.
2. Birds lay about five more eggs on the all-litter floor than the slat-and-litter floor.
3. Nearly three times as many floor eggs will be laid on all-litter as slat-and-litter.
4. Some birds continually lay eggs on slats in preference to nests.
5. Laying house mortality is slightly higher on the slat-and-litter floor than on the all litter floor.
6. The cost of maintaining a breeder hen is identical.
7. The cost of producing a dozen hatching eggs is the same.

Breeder Management

Type of Floor and Flock Management

Managing on the All-Slats Floor - most poultry men keeping broiler breeders have been discouraged with the all-slat house. Fertility is lower, and most of the floor eggs laid on the slats are broken. Layer breeders and medium-size breeders seem to be better suited to slats, and many such birds are housed in this type of accommodation.

Flightiness on slats – pullets particularly leghorns tend to be more flighty on an all-slat floor. They may fly back and forth through the house if it is not separated by partitions. Light, flexible netting may be suspended at intervals crosswise of the house. The bottom edge should be loose and about 2 ft above the slats to allow room for the birds to walk under it.

Location of nests – the bottom of the nests should be closer to the floor than is the case with litter floors.

Body weight on slats – there is some inclination for birds to get heavier on slats than on litter. They seem to move less. Thus, any feed control program to maintain body weight becomes more important when the birds are on slats.

POULTRY HEALTH & PRODUCTION

Hatchery Operation

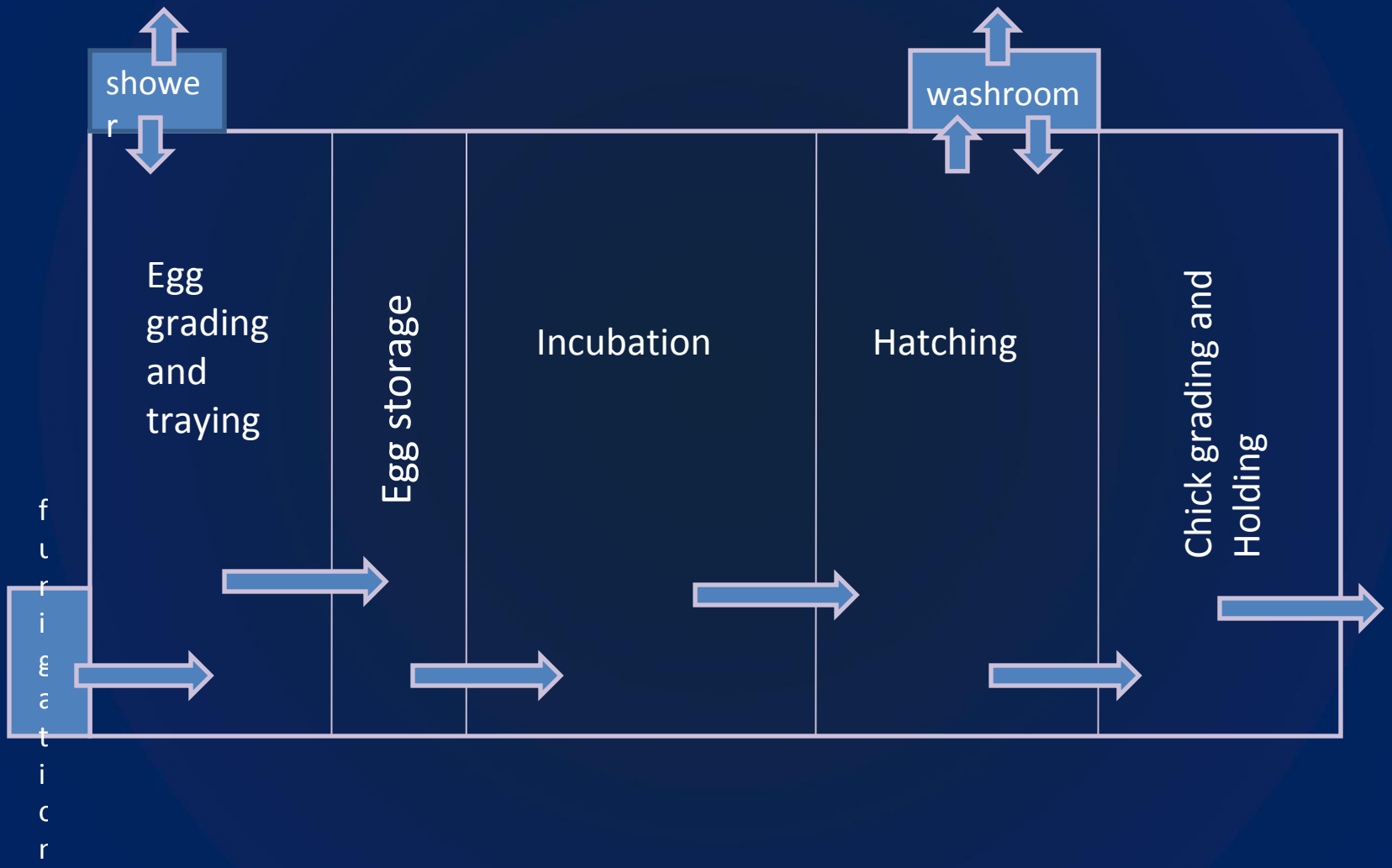
Hatchery Operation

- Because of the importance of hatchery isolation with modern MG and MS disease-control programs, proper location of the hatchery is important.
- The Hatchery should be situated at least 305 meters from houses containing chickens.
- The hatchery area should be a separate unit with its own entrance and exit, unassociated with those of poultry farms.
- The size of the hatchery is computed as follows:
  1) Egg capacity of the setters and hatchers
  2) Number of eggs that can be set each week.
  3) Number of chicks that can be hatched from each setting.
  4) Number of chicks that can be hatched each week.

Hatchery Operation

Egg Capacity of Incubators (setters &hatchers)	Number of eggs that ca be set		Number of chicks that can be hatched at 85% hatchability	
	Per setting	Per week	Each hatch	Each week
100,000	16,666	33,333	14,166	28,333
200,000	33,333	66,667	28,333	56,667
400,000	66,667	133,333	56,667	113,333
600,000	100,000	200,000	85,000	170,000
800,000	133,333	266,667	113,333	226,667
1,000,000	166,667	333,333	141,667	283,333

Egg-chick flow through Hatchery



Hatchery Operation

- Employees delivering hatching eggs to the hatchery must not enter the hatchery in the course of their duty.
- Egg should be delivered to the door of the fumigating cabinet.
- Similarly, employees responsible for loading chicks into the chick delivery vans must not enter the hatchery building.
- Hatchery employees should deliver chick boxes to the truck delivery door where they are taken by the truck driver and loaded into the truck.

Hatchery Operation

- Hatchery Ventilation is required to:
  - Supply oxygen
  - Remove carbon dioxide
  - Remove heat from the incubators
  - Provide incubators with air of proper texture.
  - Remove heat produced in the hatcher and chick rooms.
- Positive air pressure is created in a room when the volume of air coming in is greater than that going out. With the reverse, a negative room pressure is created.
- Regardless of the place where the air enters the hatchery, the air within the building should always move towards the washroom, the most contaminated room in the hatchery. Thus each room into which the air moves should have a lower static pressure (air pressure) than the room from which it came. If not, the air will flow in the opposite direction.

Hatchery Operation

- Air from the hatcher room and chick-holding room should be exhausted through a water bath to prevent chick down from these two rooms from being blown into the open air. This then is redrawn into the intake of the ventilating system and recirculated to all rooms in the hatchery.
- In the Egg Holding Room, use a 75% relative humidity to prevent eggs from drying too rapidly during the pre incubation period.

Hatchery Operation

- In the *Egg Holding Room*, use a 75% relative humidity to prevent eggs from drying too rapidly during the pre incubation period.
- *Setters and Hatchers* will operate more uniformly and economically if the relative humidity of this two rooms is maintained at 50%.
- In the *Washroom* chicks are removed from the hatching trays and boxed. Use an exhaust hood over this area to reduce cross-contamination.
- In the *Chick-Holding room* maintain a relative humidity of 65% to prevent excessive chick dehydration.
- After the trays are washed they are placed in their buggies and moved to the adjacent *Clean Room* to dry. The clean room should always have more static pressure than the washroom so air always flows from the former to the latter. Sometimes this can be used as fumigating room.

Hatchery Operations

Room	Temperature		RH %	Air Pressure	
	Degrees F	Degrees C		%	Pressure
Egg Holding	65	18.3	75	0	even
Setter	75	23.9	50	0	even
Hatcher	75	23.9	50	5	negative
Chick Holding	75	23.9	65	10	negative
Washroom	60-70	15.6-21.1	60-75	10	negative
Hallways	60	15.6	65-70	5-10	negative
Clean Room	70	21.1	50-60	5	positive

Hatchery Operation

- Sanitation plays an important part in the operation of a hatchery. It is a must.
- Debris should be collected and either removed or incinerated.
- Some key points in handling tremendous hatchery residues:
  - Keep he material in a damp condition when floors and incubators are being cleaned in order to keep as much of it out of the air as possible.
  - Do not sweep debris, vacuum it.
  - Do not track from the washroom being the most contaminated part of the hatchery.
  - Use chick-down collectors over the exhaust from the chick hatchers and chick-holding room.

Hatchery Operation

- There are two alternatives for waste removal, namely
  - Use a commercial eggshell vacuum
  - Place the waste in bags of plastic or similar material and remove it from the hatchery.
- Clean and sanitize the hatchery thoroughly. When in doubt, sanitize again.

<u>Other Hatchery Rooms</u>:

- Small office
- Lounge and lunch room
- Small laboratory
- Rest rooms
- Tool room.
- Emergency generator room
- Electrical control room
- Box storage room
- Electrical monitoring room

Hatchery Operation (Equipment)

- Good equipment plays an important part in increasing hatchery profits. Not only will the hatchability of the eggs and chick quality be improved, but labor cost will be lowered.
- Choice of hatchery equipment are based on many factors, namely:
  - Size of hatchery
  - Number of hatches per week
  - Type of disease control program
  - Whether breeder chicks or commercial pullet chicks are hatched.
  - Type of incubator
  - Hatchery services provided, such as beak, comb and toe trimming, vaccination and so on.

Hatchery Operation (Equipment)

- *Water softeners and filters* – an analysis of the water should be made. Excessive minerals will cause lime deposits on humidity controls, spray nozzles, and jets, making them inoperative. Proper filters and water softener may be needed.
- *Water Heaters* – the demand for hot water in the hatchery is great. Industrial-type heaters with a large capacity should be installed.
- *Egg-Handling Equipment*
  - Hatchery Carts – wheeled carts, semi lift carts, hand trucks, pallets.
  - Conveyors – moving cases of eggs, boxed chicks and materials short distances may be expedited by using conveyors rather than carrying them.

Hatchery Operation (Equipment)

- *Egg Grading and Washing Equipment*
  - Vacuum egg lifts
  - Graders for hatching eggs.
  - Hatching Egg Washers
- *Emergency Electric Stanby Plants*
  - What type of Plant?
  - Automatic or Manual?
  - Electric Load Required
  - Wiring the Standby Plant.
- *Incubating-Hatching Equipment*
  - Modern Chicken Egg Setter and Hatcher

Hatchery Operation (Equipment)

- *Other Hatchery Equipment*
  - Egg Candler
  - Test thermometers
  - Movable Chick Service turntables
  - Chick Box Racks
  - Chick counters
  - Sexing equipment
  - Vacuums
  - Pressure Pumps
  - Tray Washers
  - Comb Trimming Shears
  - Beak Trimming Equipment
  - Toe Trimming equipment

Hatchery Operation

Maintaining Hatching Egg Quality

- Maintaining the hatching potential of a newly produced egg is of vital importance.
- A lot can happen from the time the egg is laid to the time it enters the incubator.
- Much of the inherent ability of the egg to hatch and produce a quality chick may be lost as a result of faulty egg handling during this critical period.

In the chicken House

Nesting Material:

- Many eggs are broken in the nest as a result of inadequate cushioning of the nesting material.

Hatchery Operation

Maintaining Hatching Egg Quality

In the chicken House

Nesting Material:

- More important is the prevention of stained and dirty eggs as a result of unclean and wet nesting material.
- Nesting materials should be absorbent; durable; coarse, so they will not be blown easily from nests; dust-free; porous , so eggs will cool more quickly; of good cushioning quality; and inexpensive. Common nesting materials are:
  - Extruded volcanic ash - dried sugar cane
  - Shavings - chopped corn cobs
  - Peat moss - straw, hay
  - Rice hulls - excelsior nest pads

Hatchery Operation

Maintaining Hatching Egg Quality

In the chicken House

- Peanut hulls
- Carpet remnants
- Shredded paper

- oyster shell mixed with shavings

Training birds to use the nests

- Have the lowest nest perch (27 in.) above the floor of the house.
- Place the nest in the pen before the birds start to lay.
- Put the nesting material in the nests when the nests are placed in the pens. Keep the nesting material clean before egg production. As hens may refuse the nest if it is dirty, dusty or soiled.
- Supply adequate nesting material always. If bare surface of the nest is exposed, birds are not likely to lay in them.

Hatchery Operation

Maintaining Hatching Egg Quality

Training birds to use the nests

- Provide adequate ventilation to help keep the nest dry and the birds comfortable.
- Provide one nest for every four hens. If birds cannot get into the nest to lay they will be forced to find a “nest” on the floor.
- Pick up floor eggs 6 to 8 times a day when birds start to lay. Other birds tend to lay more floor eggs when they see eggs on the floor.

Collecting Hatching Eggs

- Normally eggs should be collected 4 times a day. However, during periods of extreme temp. 5 to 6 times collections will be necessary.
- The pre incubation hens do when eggs are in the nest covers the time difference of newly laid eggs from those laid 3-4 hours.
- Eggs laid late in the day should be collected the same day rather than left in the nests until the next morning.

Hatchery Operation

Maintaining Hatching Egg Quality

Collecting Hatching Eggs

- Eggs may be collected by a sloping nest floor that delivers eggs to a belt that moves them to the end of the house as fast as they are laid. This reduces pre incubation time to a minimum and improves egg shell disinfection, because eggs may be sprayed or fumigated faster after laying.
- Hens should not be allowed to sit in the nests overnight. Hence nests should be closed at night and opened early in the morning before laying begins.
- Eggs should be cooled immediately after collection. And this can be done more effectively if they are placed on flat containers rather than boxes or trays. Placing them on flats allow the maximum amount of air circulation around the eggs.

Hatchery Operation

Maintaining Hatching Egg Quality

Collecting Hatching Eggs

- Non hatching eggs should immediately be separated from hatching eggs. This prevents cross contamination. And this may be helpful if grading egg size is not done in the hatchery.
- Use plastic flats instead of those made of fiber for easier and more effective washing and disinfection.
- Egg baskets should not be used. Piling of eggs is not advisable. Also using egg baskets would mean transferring the eggs again. The less handling the better.

Hatchery Operation

Maintaining Hatching Egg Quality

Reducing Bacterial Contamination of Eggs

- There must be an efficient sanitation and disinfection program designed for each hatchery.
- It must be remembered that there is no egg free of contamination. Even those removed from the oviduct show bacterial contamination.
- Common bacteria involved are E. Coli, Salmonella and Pseudomonas.
- Optimum temperature and humidity brings about proliferation of these microorganisms in 15 minutes.
- Surroundings and materials where egg is exposed after being laid such as floor litter, dirty nesting material and intestinal filth add to its contamination.
- Unless the weather is extremely warm the egg contents begin to cool, shrink, and produce internal suction immediately after the egg is laid. Suction and shell penetration of bacteria are greatest immediately after oviposition.

Hatchery Operation

Maintaining Hatching Egg Quality

Reducing Bacterial Contamination of Eggs

- For bacteria to penetrate however, they have to pass several barriers as the egg cuticle, egg shell and shell membranes.
- Good quality egg shell is more important in maintaining egg quality than time. Since specific gravity is directly related to thickness of egg shell, said parameter is used in selecting good quality eggs. The higher the spec. gravity the thicker the shell thus lesser bacterial contaminants to penetrate.
- Popular disinfectants used in sanitizing eggs:
  - Quaternary ammonium compounds
  - Quaternary Ammonium and Formaldehyde mixture
  - Formaldehyde gas
- For best results eggs should be sprayed or fumigated while they are still warm. When eggs are cooling, the egg contents are shrinking and drawing in any disinfectant that is on the outside of the shell. Once the eggs are cooled. This process stops.

Hatchery Operation

Maintaining Hatching Egg Quality

Reducing Bacterial Contamination of Eggs

- With automatic belt pick ups, eggs are delivered continuously to the end of the house. This has sanitizing benefit, because eggs can be sprayed as fast as they are delivered negating the delay when eggs are sprayed in the house after each gathering.

Transporting Hatching Eggs

- The optimal temperature should be 18 degrees centigrade with a relative humidity of 70-80%.
- Although such transportation will not normally affect hatchability, the time involved from said transit as well as variations in the ambient temperature beyond normalcy will affect hatchability.

Hatchery Operation

Maintaining Hatching Egg Quality

Egg Selection and Hatchability

- The term quality refers to:
  - Condition outside the shell
  - Condition of the shell itself
  - Condition of the embryo
- Egg size
  - Always, a normal size egg produce a satisfactory hatch than small and big ones.
- Egg size and Chick size
  - Chick size is related to egg size as well as the relative humidity of the air surrounding the eggs prior to and during incubation.
  - Chicks also lose weight rapidly after hatching because of dehydration, so day-old chick weight varies greatly.

Egg weight as it affects Day-old chick weight

Egg Weight (grams)	Chick Weight (grams)
52.0	33.8
54.3	35.3
56.7	36.9
59.1	38.4
61.4	39.9
63.8	41.5
66.2	43.0

Eggshell Imperfections

- Eggs closest to ovoid shape hatch best. Excessively long, thin, Or completely round eggs do not hatch well.

Description of Abnormality	% Hatchability
Normal	73.9
Misshape (due to ridges)	65.0
Slightly round	63.2
Small	62.4
White (no pigment)	49.3
Obviously round	47.8
Pimpled (rough shell)	18.8
Wrinkled (obvious)	12.7
Dark top (rough area)	7.6

Hatchery Operation

Maintaining Hatching Egg Quality

Shell Color and Thickness

- Those with darker shells will hatch better than those with lighter shells. However, since hatchability is a genetic factor, strains of chickens may be developed that produce high or low hatchability irrespective of eggshell color.
- Egg shell thickness is important to hatchability. For best results eggshell should be between 0.33 and 0.35 mm in thickness.
- Many people candle eggs prior to setting in order to remove the checks and cracks. Cooling eggs overnight before examining them help make invisible cracks more visible.

Hatchery Operation

Maintaining Hatching Egg Quality

Interior Quality

- Hatching eggs should be handled carefully.
- Haugh units – the higher the reading of Haugh units for albumen quality, the better the better the hatchability of eggs. Best hatches are secured when the Haugh units of fresh eggs are 80 or over.
- The longer the eggs are held the lesser is the Haugh unit which also indicates that the albumen has lower viscosity thus reducing hatchability.
- Loss of viscosity means lower ovomucin a protein essential for embryonic growth. Therefore eggs with high Haugh unit readings hatch better than those with low readings.

Hatchery Operation

Maintaining Hatching Egg Quality

Handling eggs prior to incubation

Once eggs are laid they must be held for a day or more to fit the setting schedule of the incubator. The conditions under which the eggs are held have a great bearing on helping to maintain as much of their original quality as possible.

Embryonic Threshold

Although the optimum temperature for embryonic development in the incubator is 37.5 degrees centigrade, this does not mean that there is no embryonic growth when the temperature is below this figure. There is a threshold temperature of 24 degrees centigrade. Above which embryonic growth commences below which it ceases.

It must be remembered though that each time temperature goes above or below the threshold the embryo grows weaker and its chance for hatching decreases.

Hatchery Operation

Maintaining Hatching Egg Quality

Egg Holding Room Temperature

Temperature in the egg holding room should be 18.3 degrees centigrade to curtail embryonic development completely.

When eggs are held for more than 5 days , holding at 10.5 degrees centigrade will produce better hatches.

Egg Holding Room Humidity

Regardless of the type of container or tray used to hold the eggs, the relative humidity in the egg holding room should be 75%. This level materially reduces egg evaporation and does not cause deterioration of egg cases.

Hatchery Operation

Maintaining Hatching Egg Quality

Effects of Holding Hatching Eggs

When hatching eggs are held at a temperature of 18.3 degrees centigrade, embryonic development is fully arrested. However, hatchability decreases for each day the eggs are held. Eggs held for less than 5 days shows little perceptible reduction in their hatchability or in the quality of chicks hatched from them. When the period of holding is more than 4 days, hatchability will drop with each additional day.

- Hatching time is delayed 30 minutes and hatchability is reduced 4% for each day eggs are held or stored after 4 days.

Eggs with good shell quality from older breeders hatch almost as well as those from younger breeders.

Effects of Egg Storage on Hatchability and Incubation Period

Days of Storage	Hatchability of Fertile Eggs %	Hatching Times as a Delay from the Normal Hour
1	88	0
4	87	0.7
7	79	1.8
10	68	3.2
13	56	4.6
16	44	6.3
19	30	8.0
22	26	9.7
25	0	

Hatchery Operation

Maintaining Hatching Egg Quality

Position of Eggs during Holding Period

During a holding period of less than 10 days eggs should be placed small end down in the trays or on the flat. When held longer than 10 days, hatchability will be improved if eggs are held small end up.

Moisture Condensation on Eggshell

When eggs are removed from a cold room to a room with higher temperature, as moving eggs from the cool egg-holding room to the egg traying room, moisture will often condense on the shells; this picks up additional bacterial organisms floating in the air and increasing shell contamination.

Remedy for Moisture Condensation

- Decrease humidity from egg-traying room
- Increase temperature in the egg traying room. When temp is increased, the relative humidity decreases, thus lowering the condensation of moisture.

Hatchery Operation

Maintaining Hatching Egg Quality

Grading and Traying Hatching Eggs

- If it is necessary to sort hatching eggs by size, the process should be completed after the eggs have cooled in the egg holding room.
- Egg handling increases the number of cracked eggs. Do not grade eggs unless absolutely necessary.
- The size of a newly hatched chick is directly related to the size of the egg from which it hatches. Variations of the minimum will be between 52.0 and 56.7 grams/egg.

Warming Eggs

- Hatching eggs should not be removed from the cool holding room and placed directly in the setters. They should be warmed to room temp first, but not to any temp above 24 degrees centigrade or embryonic development will be initiated.

Hatchery Operation

Maintaining Hatching Egg Quality

Warming Eggs

- The warming process may take 4-6 hours depending on the temp of the egg holding room.
- In some instances hatching eggs are pre incubated to increase the percentage of hatchability. The increase is between 1-2%. They are subjected to a temp of 38.2 degrees centigrade for 6-8 hrs, then cooled to room temperature before being placed to incubators.