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The Hunt Institute for Botanical Documentation, a research division of Carnegie Mellon University, specializes in the history of botany and all aspects of plant science and serves the international scientific community through research and documentation. To this end, the Institute acquires and maintains authoritative collections of books, plant images, manuscripts, portraits and data files, and provides publications and other modes of information service. The Institute meets the reference needs of botanists, biologists, historians, conservationists, librarians, bibliographers and the public at large, especially those concerned with any aspect of the North American flora.

Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

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POULTRY HUSBANDRY 4
Jan. 5,1919.

POULTRY HUSBANDRY

I. Opportunities and Possibilities in Poultry Husbandry.
   A. Many great changes in Poultry Husbandry have occurred because of the growth of cities,where poultry cannot be produced,due to labor-saving machinery on the farm which enables relatively fewer producers to satisfy market demands.
      1. In 1787 there were only 13 cities with 5000 inhabitants while 96% of the entire population of the United States was rural.
      2. Within the last 50 years the greatest change in this respect has taken place.
      3. In 1910 the census reports 1232 cities,composed of 42% of the people of the nation.
      4. In 1920 over 50% of the people of the United States will live in cities
      5. In addition,there are many people living near cities that are consumers not producers of poultry - for example,around Boston the conditions are suburban while in the entire state of Massachusetts 90% of the people live in cities.
   B. The greatest social problem is the increased cost of living which nevertheless acts as "a safety-valve on economic conditions" because it induces the back-to-the-land movement.

II. Advantages in Poultry Keeping.
   A. Life in the open air.
   B. Cheap living.
   C. More independence than city dweller as is shown by the fact that only 35% of the people in the city own their homes while over 60% of the country people own theirs (In New York City,even,only 12% are owners).
   D. Women can run poultry plants because it involves no heavy,physical labor.
   E. Rapid extension of good roads,telephone,and other improvements make living comfortable.
   F. Development of the automobile makes transportation and travel easy.
   G. Rural free delivery keeps the farmer in daily touch with market conditions, etc.,of the city.
   H. Extension of interurban trolley lines enable people to live in the country and still have many city advantages.

III. Marketing Facilities for Poultry and Poultry Products.
   A. Of all sections in the United States,the eastern one has the advantage of marketing because the proportion of consumers to producers is very great and the former has no trouble of disposing of all his products.
   B. New England has the very best market conditions for poultry.
   C. Because of the assurance of a good market and a large proportion of consumers to producers,the poultry outlook is bright.
   D. The producer in the East can almost sell his products from his door thereby avoiding middlemen and pocketing a large amount of the retail price.
   E. Poultry is highly perishable,though less than milk,small fruits,etc.,that the highest qualities must be produced near the consumers.(This is being changed by cold storage plants,refrigeration,and shipping facilities.)
   F. Although grain is very cheap in the Central West,the producer there does not gain as much as the Eastern one because of the distance from markets.
   G. Although the climate is very favorable for poultry in the South,the producer there does not gain as much as the Eastern one because of the increase of deseage and insect pests.

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IV. Production,Consumption,and Exportation of Poultry.
A. There has never been a period of over-production in poultry and eggs.
B. United States in one year produced 60 - 70 million dollars worth of poultry and eggs,
i. The average citizen uses 400 eggs and 8 fowl per year although in some sections farmers have been eating their poultry and sending beef,pork, etc.,to market instead.
C. There is no country with an appreciable surplus of poultry and eggs although Holland and Denmark has a little that is shipped to England.
D. China used to export eggs to America but there is an embargo upon them now.
V. Climate in Relation to Poultry Husbandry.
A. Heaviest production of eggs in March,April,and May.
B. Lowest production in October,November,and December.
C. In months of lowest production,highest price for eggs prevails (law of supply and demand).
D. Largest number of fall eggs must be produced by pullets.
i. Chicks must be hatched at such a time that they be mature in the fall as they will not lay until reasonably mature.
2. A late fall as in Massachusetts gives the pullets time to mature and therefore is the cause of higher winter egg production.
3. The fall climate of New Jersey is of the greatest advantage because of its mildness.

Jan. I2.
I. Domestic Fowl originated from two distinct branches of the Gallinae:
A. Jungle Fowl,GALLUS BANKIVA,is still a denizen of the well-watered jungle country of the lower ranges of the Himalayas from Kashmir to Assam,and parts of Central India to Burma,especially in the vicinity of scattered cultivation.
i. Characteristics of Jungle Fowl:
a. Had light bones and body; consequently could fly considerable distances.
b. Had willow-colored shanks.
c. Had single comb.
d. Had plumage like modern Brown Leghorn or Black-brested Red Game.
e. Layed on the average I2 to I5 eggs only in Spring; just sufficient to keep the species from becoming extinct.
f. Weighed about one and a half pounds.
B. Malay or Aseel Fowl is now practically or even actually extinct; it lived in Malay Peninsula and eastward to Cochin-China,Sumatra,and Java.
2. Characteristics of Malay or Aseel Fowl:
a. Had heavy bones and body; consequently it could not fly well and stayed on the ground which fact probably caused its extinction.
b. Had yellow shanks.
c. Had pea comb.
d. Had plumage similar to that of Jungle Fowl.
e. Layed on the average I2 to I5 eggs only in Spring; just too few to keep the specie from becoming extinct.
d. Weighed over one and a half pounds.

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C. The present egg producing chickens are descended from the light, nervous Jungle Fowl. (analogous to dairy type of cattle)
D. The present meat producing chickens are descended from the heavy Malay or Aseel Fowl. (analogous to beef type of cattle)
E. The present "dual purpose" chickens is a crossing of the two original species.

II. The Beginning of the Domestication of Fowl.
A. Prehistoric man began to snare fowl.
B. Prehistoric man later domesticated fowl in a crude way.
C. Man domesticated the Malay Fowl before all others - the earliest written records of domestication are 3000 years old.
D. At present man has bred and domesticated fowl so carefully that 60 breeds and 146 varieties exist. More varieties descended from one original species than the sum of varieties of horses, cattle, sheep, and pigs.

III. Nomenclature.
A. Nomenclature for terms defining relationship.
1. "Class" constitutes a group of fowl that have a common locality of origin or that have some distinctive characteristics.
2. "Breed" constitutes a group of fowl that have a particular characteristic in shape.
3. "Variety" constitutes a group of fowl that have the same shape as others of the breed but that differ in color of plumage or type of comb.

B. Nomenclature for terms defining plumage.
1. Barring is effected by feathers that have bars of different color but of even width perpendicular to the shaft.
2. Penciling:
a. Transvers penciling is like barring except that the bars are of uneven length that follow the outline of the feathers.
b. Crescentic penciling is effected by bars that follow the outline of the feathers.
3. Lacing is effected by bars of a different color from the ground color that run around the outer edge of the feathers.
4. Striping is similar to lacing except that a bar follows the outer margin of the feather.
5. Mottling is effected by a small white band or section on a black background.
6. Spangling is similar to mottling except that it is more regular having a dark oval tip on a white background.
7. Shafting is effected by the feathers being of a different color from the shaft.
8. Stippling is effected by the feathers having irregular dots of a color differing from the background.
9. A beard is a tuft of feathers growing from the lower mandible.
10. A crest is a tuft of feathers growing on the top of the head.
11. A muff is a tuft of feathers growing from either side of the face.

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C. Nomenclature for defining shape of comb.
1. Single comb is long,narrow;and toothed or serrated blades are at the edge.
2. Rose comb is long,solid and terminating in many small spikes.
3. Pea comb is composed of three small single spiked combs placed side by side,the middle one being the largest while the middle section in each is longer than the ends.
4. V-shaped comb resembles a pair of antlers (found in crested fowl).
5. Strawberry comb is small and fleshy without blades.

IV. General Classification of Poultry is done according to two methods:
A. By the Standard Classification.
1. The standard is revised by the Poultry Association periodically every five years.
2. The Standard Classification defines the breeds and gives the scales of points for breeding and judging only show birds in the United States and Canada.
3. The Standard Classification recognizes twelve classes of domestic fowl,two of water fowl,and one of Turkey.
4. The Standard Classification recognizes sixty breeds; forty-two of domestic fowl,eighteen of water fowl and Turkey.
5. The Standard Classification recognizes one hundred and forty-six varieties; II8 of domestic fowl,twenty-two of water fowl,and six of Turkey.
6. The American Poultry Association has regulations according to which new breeds and varieties are admitted to the Standard Classification (The Buttercup has not yet been admitted).
7. Many breeds of Bantams are merely miniature counterparts built upon the same model as some larger breeds.
8. Several "keys" for identifying fowl according to the Standard Classification are:
a. Solid or parti-colored plumage.
b. Number of toes.
c. Color of ear-lobe; the variations are white,red,and purple.
d. Color of shank; the variations are pink,white,yellow,slate.

B. By the Utility Classification which has nothing to do with the Standard Classification and is therefore a flexible one as it often depends upon the individual strain of breeding.
1. General or Dual Purpose Type.
a. The general shape of the body is that of an inverted derby. The bones are coarse.
b. Examples are Plymouth Rocks,Wyandottes,Rhode Island Reds, Orpingtons,and Langshans.
2. Egg Type.
a. The general shape of the body is that of an egg. The bones are fine and the fowl is lean and nervous.
b. Examples are Leghorns,Anconas,Minorcas,Andalusians,Campines.

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3. Meat Type.
   a. The general shape of the body is large,rectangular,and block-like. The bones are heavy. (Most of the European class are of this type).
   b. Examples are Cochins,Brahmas,Dorkings,Cornish,and Sussex.
4. Game Type.
   a. The general shape of the body is tall[illegible].
   b. Examples are Black-brested Red,Duckwing,etc.
5. Ornamental Type.
   a. The shapes of the bodies are diverse.
   b. Examples are Silkies,Frizzles,Bantams,etc.
   c. This type is economically unimportant.

CHAP. III. INCUBATION

Jan. 18

I. History of incubation as an art and science of hatching eggs.
   A. Egyptians and Chinese used artificial methods of incubation 2000 years before Christ.
      1. Egyptian art of incubation.
         a. Incubator was a large,mud-plastered building with a central isle and separate compartments for eggs that were placed on straw.
         b. Heat was furnished by means of manure and regulated by adding or taking away manure from chamber.
         c. Capacity in some cases 100000 chicks per year.
         d. Bought eggs at approximately $3.50 per thousand; sold chicks at one dollar per hundred.
         e. Art was passed down from father to son for many generations, while the trade secrets were closely guarded.
      2. Chinese art of incubation.
         a. Incubators were large,wicker baskets with false bottoms.
         b. Heat was furnished by means of charcoal in lower chamber or false bottom.
         c. Eggs were turned daily by placing eggs from one basket into another - thus those that were on top one day were at the bottom another.
      3. The science of incubation in Europe and especially in America is modern.
         a. In 1845 a self-regulating valve for temperature was invented.
         b. Since about 1885 an American,Charles A.Cyphers made excellent machines with the hot water heating system.
         c. Not until recently has progress been very rapid.
         d. Since about 1905,Americans have been depending largely upon central hatching stations.
            1! Some central hatching stations ship millions of chicks yearly.
            2! A central hatching station in Texas has a capacity of 800000 eggs at one time.

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II. Factors in successful incubation.
A. The use of good eggs.
i. Not only the parents but several previous generations should have had health, vitality (due to exercise, green feeds, housing, etc.), and proper management.
2. Eggs should be fresh when put into incubator.
a. Egg is never in perfect condition except directly after being laid.
b. Eggs not older than ten to forteen days should be placed in the incubator although preferable as soon as posible after being laid.
c. Vitality of germ is lost after 3 weeks.
3. Eggs should have been stored properly if not used directly after being laid.
a. Eggs should be stored in north-east corner of cellar.
b. Eggs if kept in large numbers should be put on swinging shelves as they are apt to absorb moisture and become mouldy.
c. Germ in egg is in dormant stage when below 68 degrees F.
d. Germ in egg freezes at 28 F.
e, Germ in egg is therefore stored best at a temperature between 45 and 50 degrees F.
f. Freshly laid egg is full but as the temperature is lowered from 106 degrees F., the body temperature of the hen, to that of the surrounding air, the liquid contracts thereby forming an air-cell the diameter of a dime at the thicker end of the egg.
g. Egg should be kept in damp locality so that it may not lose water by evaporation thereby producing stunted chicks.
h. Egg should be kept from drafts.
i. Egg must be turned if kept for any length of time because,
1. Under shell is an outer and an inner membrane.
2. Around yolk is the vitelline membrane.
3. Yolk is 64% fat and therefore rises to top of contents of egg, pressing the vitelline membrane against the inner membrane. If the egg is not turned, the vitelline membrane sticks to the inner one because of evaporation and if the egg is then turned the vitelline membrane is ruptured causing the embryo to die.
B. Skillful operation - requires attention according to directions of mamufacturer three times a day.
C. Environment of incubator.
i. Incubator should be placed in cool cellar free from drafts but with good ventilation as the growing embryo requires a constant supply of oxygen.
a. A comparatively dry cellar should be ventilated by a sufficient number of windows hinged at the bottom and swinging inward.

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b. An exceedingly damp cellar should be ventilated the same as the dry one except that an air shaft should be provided leading from the bottom of the room to the outside through the roof.

2. If the incubator is of the non-moisture type,a railing of bricks a few inches high is laid around the foot of the incubator into which heavily moistened sand is placed.

III. Principles of incubation are fundamental ones of physics and chemistry — immitate nature.

A. Incubation period:
1. Fowl,average is 2I days - egg type 20 days; meat type 22 days.
2. Turkey: shortest 24; average 26; longest 30.
3. Duck: shortest 28; average 30; longest 32.
4. Goose: shortest 27; average 30; longest 33.
5. Pigeon: shortest I6; average I8; longest 20.
6. Pea hen: shortest 25; average 28; longest 30.
7. Guinea hen: shortest 20; average 23; longest 25.
8. Swan: shortest 40; average 42; longest 45.

B. Temperature:
1. As thermometer is raised one inch from bottom of tray, the temperature rises one degree.
2. Temperature in incubator should be,
a. I02 degrees F. first week.
b. I02½ degrees F. second week.
c. I03 degrees F. third week.
d. If temperature becomes too high or too low,the chicks will lack vitality.
e. Run machine a few days before putting in eggs.
f. The first five days of incubation are especially important.
g. After the eighteenth day the temperature will rise of itself rapidly due to the warmth produced by the chicks in the shell - if the temperature does not rise over I05 degrees F.it does not matter

C. Moisture:
1. Eggs should not lose more than one-sixth of their weight before hatching.
2. Sometimes a tray of moist sand is put into incubator.
3. At hatching time:
a. The air in the machine should be so moist that droplets will form on the inner side of glass.
b. The air may be too moist rather than too dry.
c. If the air at hatching time is too dry,the membranes in the egg become dry and leathery so that chick may have difficulty in coming out of the shell

D. Fresh air is just as much required for developing eggs as for hatched chicks.

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E. Turning.
1. Eggs must be turned twice daily to prevent "stuck yolks".
2. Begin turning on night of third day.
3. Stop turning on night of eighteenth day.
4. Do not only turn the eggs but reverse the trays as well.
5. Eggs are turned in small machines by taking four double handfuls out of the middle of tray,rolling those from the outside into the centre,and filling in the vacant places with the eggs that had been removed.
6. Eggs are turned in large machines by placing an empty tray on top and inverting both.
7. Eggs sometimes are turned in large machines by means of a patent device.
8. Eggs under hen are turned by shuffling the body and with the aid of the bill.

F. Cooling.
1. Hen must leave nest once a day for food,excercise,etc.,which give the eggs a chance to cool.
2. Cooling is unnecessary in the incubator.

G. Testing is accomplished by placing the egg before an electric light.
ii For the first test white eggs are examined usually from the third to the seventh day,but brown ones are examined from the sixth to the seventh because the shell is more opaque.
a. If clear after being in incubator,they are infertile and may and may be sold for human consumption at two-thirds the price of fresh eggs.
b. If the inner part resembles a spider due to the embryo and the ramifying blood-vessels,the egg is fertile.
2. For the second test,the eggs are examined from the twelvth to the fourteenth day.
a. If a circle appears in the egg,this shows that there is a blood ring due to a dead embryo - these eggs may be sold to tanners.

IV. Hatching device subdivides incubation into natural and artificial.
A. Hen is best device.
1. Efficiency varies according to breed and according to individual.
a. General Purpose fowl are best because,
1! They possess a good broody instinct.
2! They are of proper size.
3! They will remain on eggs.
b. Meat Breeds are poor.because,
1! They have good broody instinct but are clumsy.
2! They are too heavy and may crush eggs or chicks.
c. Egg breeds are very poor.

B. Limitations to natural incubation.
1. Hen is not dependible because of irratic broody instinct.
2. Hen is unable to hatch large enough number of chicks.
3. Breed may lack broody instinct.
4. During incubation parasites increase rapidly.
5. Is expensive because hen is idle a week before setting,3 while incubating,and 2 before she will resume laying.

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V. Miscallaneous facts:
A. Incubating,brooding,and rearing,which constitutes the replacement division,is very important as 60 to 85% of the chickens must be replaced yearly.
B. Four types of incubators according to the method of heating have existed up to the present time.
1. Contact heater (discarded).
2. Radiation by means of closed circuit of air or water (discarded).
3. Diffusion by means of open circuit.
4. Deflection,a combination of contact heater and radiation.

CHAP IV. BROODING AND REARING.

Jan.25.

I. Brooding and rearing is fundamental in Poultry Husbandry since a large percentage of chickens must be replaced yearly.There are many small details in brooding and rearing that can be perfected only by practice.
A. Artificial brooding.
i. Outdoor type.
a. Earliest type of brooder used but now discarded.
b. Was box six feet long having,
1! a partition in box as hover for confining heat.
2! the remaining space covered with litter for an exercising area.
3! a separate compartment outside of box for kerosene heating device.
4! a heat regulating device.
2. Indoor type.
a. The attached kind.
1! Has hot water open pipe heater along one side as in the College Brooder House.
a! Is permanent construction used for brooding large number of chicks.
b! Has many separate compartments.
2! Has two hot water open pipe heaters with 6 to 8 pipes along middle of building with a pit between.
a! Is special permanent structure used for brooding very great numbers of chicks in limited space.
b! Has full monitor roof with windows along East and West.
c! Has extercising area towards outer walls.
b. The detachable kind,the highest development with the kerosene lamp.
1! The hover can be adapted to any room or building.
2! Lamp is in galvanized iron container outside of house at rear.
3! Hover is in house.
4! Hover is drum for radiating heat.
5! Inside hover is compartment with water that is heated.
6! Hover has slit curtains.
7! Hover has disk thermostat.

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3. Unattached type.
   a. Are like adaptable hovers except that the heater is built in the hover.
   b. Portable hovers belong to this type.
4. The modern method is the adaptation of the coal stove around which the hover is built. This is a great advance in brooding because,
   a. Fire risk is minimized.
   b. Coal is economized.
   c. Stove is easily operated.

II. Fundamental qualities a brooder should possess.
A. Constant supply of sufficient heat.
   1. Kerosene lamps could not accomplish this because they must of necessity be small while the operator must turn the flame to such a height that danger of fire existed.
   2. It was impossible to heat a brooder for a large number of chicks with an oil lamp.
   3. Coal stove,on the other hand,radiates enough heat at any outside temperature.
B. Constant supply of fresh air under hover.
   1. Poultry need especially much fresh air because their body temperature is very high and they oxydize three times as fast as mammals.
   2. A blue flame gasoline brooder perfected at Cornell several years ago,had ideal ventilation but that fuel has deteriorated and advanced in price.
C. Should have varying areas of temperature.
   1. When chicks are hatching in incubator,the temperature should be about 103 degrees F.
   2. When chicks are to be taken out of incubator,the temperature should have been cooled gradually to 100 F.
   3. When chicks are placed in hover,the temperature near the rim should be 100 F.
   4. The temperature 6 inches from hover should be 92 F.
   5. The temperature one foot from hover should be 85 F.
   6. The temperature 18 inches from hover should be 65 F.
   7. This variation of temperature gives chicks oportunity to suit themselves.
D. Capacity of brooder house.
   1. Brooder house should be large enough for labor efficiency.
   2. Brooder units should be as large as convenient and still be suitable for the promotion of growth and vitality in chick.
   3. The maximum number of chicks to put into brooder should be between 250 and 350.
   4. Too large units tend to check growth.
   5. Large units of 800 to 1200 chicks have very high mortality.
   6. There should be 4 chicks to the square foot approximately.
   7. Incubator manufacturers exaggerate in giving capacity of brooders so put in less than the minimum recommended by them.

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E. Some means of regulating heat.
F. Should have sunlight the greater part of the day.
   1. Absolutely necessary to avoid having sun beams or sun spots fall in brooder house especially far from hover as chicks wishing to take sun bath go there,become lost and chilled,and possibly die.
   2. To avoid sun spots,have flood of light stream into building from east and west windows.
G. Hover space for chicks.
   1. Hover space is determining factor for number of baby chicks to put into brooder.
   2. Brooder space is determining factor for number of older chicks to put into brooder as these do not require so much heat.
   3. At night the chicks should be lying around outer margin of hover.
   4. Toward morning,the temperature tends to drop and the chicks are able to gomunder brooder without crowding.
H. Floor of brooder should be level.
I. Economy of cost of equipment - this should be minor item.
J. Economy in cost of operation,the factors being labor and fuel.
   1. Cost of fuel is minor item.
   2. Cost of labor is most important item.
K. Durability - should be usually of galvanized iron.
L. Should be easily cleaned and disinfected.
M. Should have slanting roof and be so constructed that chicks cannot roost on machine.
N. Brooder house should be high enough so that operator may get inside of it. This is the main objection to outside brooders.
O. Minimum danger from fire.
   1. Danger of fire is the main objection to oil heaters.
   2. Danger of fire is negligible in case of coal stove,the only danger being that of carelessly leaving red-hot coals on litter.
P. Brooder house should be so constructed that operator can take care of it without having the chicks escape - This is main objection to outdoor brooders.
Q. Brooding device should be so simple that minimum of skill is required.
R. Portability.
   1. Brooder house should be small enough so that it can be moved to different localities as chicks must not be reared on same ground two seasons after another.
   2. Smallest convenient brooder house is 6 X 6 ft.
   3. Brooder houses most often used are 6 X 8 and 8 X 8 ft.
   4. Convenient brooder houses are 8 X 10 and 10 X 10 ft.
   5. Largest convenient brooder house is 12 X 14 ft.

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III. Priciples of Brooding.

A. Removing chicks from incubator.

i. Leave chicks in incubator for 36 to 48 hours after hatching befor putting them in brooder.

2. Reduce temperature to I00 degrees F. in incubator only when c chicks are dry.

3. Transfer chicks from incubator to brooder by placing them into a cloth covered and lined basket.Put in brooder 2 hours before dark.

4. Operator should touch chicks only when he wears woolen gloves.

5. Chicks after hatching are provided by nature with some yolk in their abdomen which lasts for 60 to 72 hours so do not feed them too soon after hatching.

B. Which chicks to discard.

i. Do not help chicks out of eggs - if they are too weak to get out of egg,they lack vitality and are worthless.

2. Raise strong chicks only as weak ones are apt to become infected disease which they may communicate to the stronger ones.

IV. Feeding Chicks (make all changes gradually).

A. Do not feed until 48 hours old.

B. Second day give no water but either sweet or sour milk should be kept continually before them as this prevents white diorrhea,and a little of the following scratch ration:

SCRATCH RATION

I5 % cracked wheat
70 % chick corn
I5 % pin-head oats or steal cut oats

C. Third morning give a little of the mash following,and the scratch ration sparingly at 6 A.M.,9 A.M.,I2 M.,and at 3 P.M. At 6 P.M. give as much of the scratch ration as the chicks will clean up;

MASH

I00 lbs wheat bran
I00 lbs wheat middlings
I00 lbs meat scrap
I00 lbs ground oats
I00 lbs gluten feed
I00 lbs corn meal or if imposible to get,hominy or corn feed meal
200 lbs bran

D. First week after that give scratch and mash rations 5 times daily and keep ground bone and grit before them always

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E. Thereafter give water and green foods as chopped sprouted oats,chopped cabbage or mangels. Have mash before them at all times in a crumbly moist condition but feed scratch ration only 4 times daily.
F. At fifth week reduce scratch grain feeding to 3 times daily and give mash ration without the bran.Never give them as much grain as they can eat except at night.

V. Shipping day-old chicks.
A. They may be shipped by parcel post.
B. If to be shipped for long distance,they are rapidly hardened off.
C. They are put into corrugated cardboard box having 4 compartments,into each of which 26 chicks are placed allowing for 4 % mortality.
D. They are given no food nor drink until at destination.

VI. Preparation of brooder.
A. Should be sprayed with coal-tar disinfectant before using.
B. Should be in good repair.
C. Should have clean hover curtains or,if these are too soiled,take 2 or 3 thicknesses of burlap and slit the cloth at irregular intervals.
D. Floor should be covered with one inch clean,dry sand with ¾ inches clover or alfalfa chaff on top.
E. For several days put standing strip of tar paper I2 to I4 inches high around hover leaving an area of 6 inches so that chicks must stay near heat.
F. Gradually increase inside area made by tar paper strip until chicks are able to fly over it when it may be removed for good.

Feb. I. CHAPTER V. FEEDING; THE BALANCED RATION.

I. Feed is any substance which when taken into the body and properly digested and assimilated will nourish it. In the case of the hen this applies to grit, charcoal,and even water and oxygen,besides those materials commonly classed as food.
A. To be profitable,a hen must change raw vegetable and mineral matters into edible human food in the form of poultry or eggs.

II. Feed,upon which there is much data first collected by the Germans a hundred years ago,is a very important factor in Poultry Husbandry because it represents about 65% of the total cost of keeping chickens.
A. The first requirement for food in an animal body is that used for maintainance.
1. This is to produce energy and keep the life processes going.
2. 75 to 80% of food assimilated is used for this.
3. If only sufficient food for maintainance is given an immature animal,it will die as an organism must either progress or decline.
B. When the first requirement has been met,the extra feed,especially in immature animals,is used for growth.
C. Only after the first two requirements have been met generously can production occur either in the form of meat or eggs in poultry.
1. Only 20% of the feed assimilated is used for reproduction,therefore this last 20% is the important factor for gain.

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III. Hen always insists on laying eggs that are I00% perfect.
A. Egg is composed of,
i. Yolk which is 64% fat and is made in ovary which is the main part of reproductive system.
2. White or albumen which is made in oviduct and is part of reproductive system.
B. If there is no surplus of fat in her system,she cannot lay.
i. She must have a large reserve of fat,especially around walls of abdoman,or she will not lay as she does not prepare to lay only a few eggs at a time but a large number.
2. She also must be in good physical condition before she will lay.
3. There is only danger of her getting too fat if she must not work for her living when given a good ration. (See Chap. ; ,)

IV. Hen and Jersey cow compared as to efficiency in assimilating certain feeds.
A. Hen lays 200 eggs yearly of which 3.8 is dry matter or solids.
B. Cow gives I000 pounds milk yearly of which I4% or 2.9 is dry matter.
C. Hen eats grain that could be used for human food,and very little roughage.
D. Cow eats roughage that could not be utilized for human food,and very little grain.
E. Cow of all farm animals is the most efficient as she utilizes roughage.
F. The hen is the most efficient animal after the cow - all other farm animals follow these in efficiency.

V. Fundamental factors for a poultry ration.
A. Palatability or flavor is important factor because if feed suits taste of hen,she will eat much of it and consequently produce more meat or eggs
i. It is not known to what extent the hens' power of taste is developed,nevertheless she shows a decided taste for some things.
a. Although rye and wheat are almost identical according to chemical tests,hen refuses to eat rye but will eat all the wheat she can get.
b. Does not like feed that is finely ground.
c. Especially does not like finely ground flour.
d. Does not like many feeds that are good for her,as forinstance middlings,therefore she must be forced to eat them.
B. Availability or digestibility.
i. Digestion of animals is not perfect,so foods vary widely in digestibility.
2. Coefficients of availability or digestive coefficients:
a. 78.8% of corn meal is digested while rest is wasted.
b. 58.0% of oats is digested while rest is wasted.
c. 32.6% of oat hulls is digested while rest is wasted.
d. I3.8% of rice hulls is digested while rest is wasted.
e. 80.0% of meat scrap is digested while rest is wasted.

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C. Quantity: food for maintainance is 80% of entire quantity that can be assimilated,therefore the extra 20% is the important one because it is required for production.

D. Balanced or nutritive ratio.

i. Defined as relationship between one pound of digestible protein and an unknown number of pounds of digestible carbo-hydrates in a feed or in a ration.

2. Two important groups of nutrients are:

a. Proteids.

i! Complex chemical compounds.

2! Always composed of nitrogen,carbon,hydrogen and oxygen; while iron,phosphorus,sulphur and calcium are sometimes in it.

3! Are used by animal body in the production of blood,lean meat as muscle,nerve tissues,hoof and horn,hair and feathers.

4! Are hard to break up in stomach and therefore difficult to digest.

b. Carbo-hydrates.

i! In comparison to proteids are simple chemical compounds.

2! Always composed of carbon,and hydrogen and oxygen as found in water.

3! Are used for production of energy.

4! Are easy to break up in stomach and therefore readily digested and absorbed into body.

3. Balance between proteids and carbo-hydrates is most important.

a. Proteids are composed of the same elements as the carbo-hydrates and consequently if a surplus of proteids exists but a deficiency of carbo-hydrates,the proteids can be substituted to a limited extent to produce the required energy.

b. If a surplus of carbo-hydrates exist but a deficiency of proteids,no substitution can take place,consequently the amount of protein is the limiting factor that determines the result from the ration.

c. Fat is a carbo-hydrate but as it produces two and a fourth times as much energy as the other forms of carbo-hydrates,to find the nutritive ratio of a substance multiply percentage of fat content by $2\frac{1}{4}$,add the amount to the percentage of Nitrogen Free Extract,and devide by the percentage of protein.

4. Nutritive ratio is the amount of carbo-hydrates to every pound of protein.

a. For growing chicks should be I : 4.

b. For adult chickens should be I : 4.53.

c. A wide ration would be I : 6.

i! Among immature animals especially the mortality will be high because the animal cannot grow.

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d. A narrow ration would be I : 2.
   1! This produces bad digestion and overtaxes the kidneys.
   2! This wastes the protein which is most expensive part of ration.
   3! This produces an inferior excrement which is much poorer balanced plant food because it contains too much nitrogen.
e. A balanced ration if overfed,either
   1! forces an increased production of eggs or meat.
   2! forces the animal to eliminate the surplus food nutrients undigested.

5. Nutritive ratio must be such that the combination of feeds will produce just as many yolks as whites.
   a. Yolk of egg being mostly fat requires carbo-hydrates.
   b. White of egg requires protein.
   c. I00 lbs of corn will produce 255 yolks and I34 whites;therefore if only fed corn,the hen will lay I34 eggs as every egg must be perfect.
   d. I00 lbs of meat scrap will produce I06 yolks and II07 whites; therefore if only fed meat scrap,the hen will lay only I06 eggs.
   e. Nutrient requirement for 500 lbs live weight of hens per day is
      27.5 lbs Dry Matter.
      I.5 lbs Ash (incombustible residue of feeds).
      5. lbs Protein.

E. Mechanical Condition as hardness,size,shape,color,adhesiveness,etc.
   1. Experience only can determine what mechanical condition is best.
   2. If ration is too compact,use more bran,alfalfa,ground oats,etc.,with the feed to make it lighter.
   3. Wheat possesses ideal mechanical condition.
   4. Whole dent corn is too large.
   5. Low grade flours are too adhesive.

F. Bulk: hen requires certain volume of food to distend intestine - this can be done by using bran,alfalfa meal,ground oats,etc.

G. Fibre.
   1. Is cellulose which acts as framework of plants.
   2. Dairy cow is most efficient changer of fibre into available human food.
   3. Hen cannot digest much fibre as they are more like swine in that respect - thus the low maximum of 5 to 7% of fibre is all that can be utilized economically by hens and hogs.

H. Hens are naturally grain or seed eaters (mostly granivorous but also insectivorous.

I. Ground feed.
   1. Grain feed is called scratch grain.
   2. Ground feeds are called dry mash - this is fed in addition to scratch grains because there is limit to the amount of grain a hen can grind in her crop.

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J. Variety.
   1. A one grain ration is bad because it offers no variety.
   2. Ration should consist of 2 to 4 kinds of grain in scratch grain and at least 2 to 3 kinds,in addition to meat scrap,in dry mash.

K. Green Food.
   1. Give green food daily.
   2. Green food is given because it acts as a tonic,not for the sake of nourishment as it has little food value.
   3. Green food can be most easily supplied in form of mangel beets as a large crop can be grown on one acre.
   4. Sprouted oats is the best green food but it takes much labor to prepare
   5. Cabbage is excellent.
   6. Kale is used on Pacific coast.
   7. In summer give rape,rye,oats,short clipped alfalfa or clover,lawn clippings,etc,

L. Meat food is very essential as some form of animal protein is necessary.
   1. Best form of animal protein is milk whether butter or skimmed.
   2. Meat scrap,which is biproduct of slaughter houses,is not as good as milk but it is easier to feed.
   3. The following experiment shows that animal protein is necessary:
      a. Flock (A) of pullets that received no protein averaged 35 eggs.
      b. Flock (B) of pullets that received animal protein averaged I35 eggs a year.
      c. Next year flock (A) received animal protein and averaged II5 eggs.
      d. Next year flock (B) received no protein and averaged 28 eggs.

M. Mineral food.
   1. Particularly important in case of growing chicks as they require ash and $Ca_3(PO_4)_2$ for the formation of bone - ground bone is fed to them.
   2. Hens need calcium carbonate for the formation of egg-shells - crushed oyster shells are fed to them.

N. Grit.
   1. "Mica Spar" is best kind of grit because of its sharpness and excellent wearing qualities in gizzard.
   2. Two classes of grit exist:
      a. Non-limestone grit.
      b. Limestone grit which is said to furnish enough calcium carbonate so that no oyster shell need be provided. This is wrong, oystershell must be provided after all as the calcium carbonate is not in available form.

O. Water is necessary as flush for digestive tract and is also carrier of nutriment,beside being in chemical composition with other elements to compose body.
   1. 55% of chicken is water.
   2. 65% of egg is water,

P. Medicinal quality.
   1. Wheat bran and linseed oil meal is naturally laxative.
   2. Cotton-seed meal is naturally constipating.
   3. Avoid stock tonics - they are unnecessary.

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Q. Effect of food on color of product and on skin and flesh of fowl.
  1. Effect of feed on color of yolk.
    a. Lack of green food in winter produces a light yellow yolk.
    b. Abundance of green food in summer produces dark yellow yolk.
  2. Effect of feed on color of skin and flesh. (skin is not as easily affected as flesh)
    a. Yellow colored skin and flesh,preferred by the American because it seems to denote richness,is produced by
      1. yellow corn.
      2. wheat bran.
    b. White or pinkish colored skin and flesh,preferred by the European, is produced by white cornmeal,buckwheat middlings,rice meal,and hominy in fatting ration.

R. Effect of feeds on composition and quality..
  1. Chemical composition of egg cannot vary.
  2. Quality of egg varies as to consistancy and flavor.
    a. Dealers in Middle West prefer April and May eggs for cold storage as they have more consistancy.
    b. Dealers in Middle West do not want June and July eggs,which they call Grass Eggs,because they seem watery and will not keep in cold storage.

S. Effect of food on flavor of egg and fowl.
  1. Onions,cabbage,leeks,or any materials that are partially decomposed impart disagreable flavor to egg.
  2. Celery diet as finish for Guinea fowl 2 weeks before killed gives it a wild flavor so that it may be sold in hotels as grouse,partrige,etc.

T. Wholesomeness.
  1. All feeds should be clean and wholesome.
  2. Do not feed partially decayed matter,particularly not corn-meal,meat scrap,ground bone,etc.,when mouldy or decomposed.

U. Symmetry in ration applies to the constituent parts of ration when well-balanced,as follows:

1.	Scratch grain	37.5% or 50%
2.	Dry mash	37.5% or 25%
3.	Animal protein	IO%
4.	Green feed	IO%
5.	Mineral food	5%

V. Total protein content.
  1. Hen's body is composed 21% protein live weight,while the dry matter of her body is 48.9% protein.
  2. Entire egg is composed of II.4% protein,while the dry matter of egg is 49.8% protein.
  3. Farm grains are from 8 to I2% protein.
  4. Biproducts,as gluten feed,average 20 to 30% protein.
  5. Meat foods are 40 to 80% protein.

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W. Adaptability of feed to purpose for which it is fed.
1. Growing ration is I : 4
2. Laying ration is I.: 4.6
3. Fattening ration is I : 6. or above.

X. Cost and availability of feed.
1. Cost is most important factor.

Y. Manurial value depends on undigested residue in regard to plant food contents. This is of minor consideration.
1. Composition of fresh hen manure of birds fed equal parts corn and oats:

Water	46.84%	
Nitrogen	I.38%	
Phosphoric acid	.50%	
Potash	.4I%	value $5.2I per ton

2. Composition of fresh hen manure of birds fed nothing but corn:

Water	26.74%	
Nitrogen	I.I0%	
Phosphoric acid	.24%	
Potash	.27%	value $3.88 per ton.

VI. Adaptability of various foods and grains for poultry feeding.
A. Fowl cannot digest much fibre.
B. No one farm grain is essential,but one can substitute another grain instead.
C. Grains feeds
1. Wheat is ideal grain for poultry and therefore fed extensively before the war.
a 1. Nonmillable wheat and other biproducts were fed during war times.
b 2. Wheat screenings,which were fed during war times,is largely composed of weed seeds and therefore unwise to feed to chickens as the seeds might germinate after passing through alimentary canal and become pests on the farm.
c 3. Burnt or scorched wheat,which is readily available,is "salvaged" wheat that has been burned accidently in grain elevator or barge fire and thus unfit for human use,or it may be wheat that has been allowed to get ~~moul~~ mouldy and then purposely scorched - this latter form is almost swindle.
d 4. Shrunken wheat,which is readily available,is wheat that did not have time to mature because of unfavorable climatic conditions.
a. This,in proportio to other grades of wheat is the best for poultry food because of the large gluten or protein content.
b. The gluten found in the aleurone layer is formed first,and then the starch - thus this immature wheat has a larger proportion of protein than ripe wheat.
c. The value can only be determined by sampling it.
2 D. Corn is second best poultry grain.
a 1. Is always comparatively cheap.
b 2. Is by far the most digestible of grains.
c 3. Is excellent food but not balanced,therefore should not be used in large proportion for chicks as it lacks mineral matter.
d 4. Is most economical form of carbo-hydrates
e 5. Is best cracked.

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E. Oats are the third best poultry grain.
1. Hulled oats are the best single feed especially for chicks as the feed is almost balanced,the nutritive ratio being I : 7. The only draw back to feeding hulled oats is their cost.
2. Unhulled oats have a too large proportion of hulls to kernels.
a. If you wish to purchase unhulled oats,buy heavy-weight oats as the proportion of fibre to kernel is small.

F. Barley is excellent and will be fed in great quantities to poultry in the future as it will no longer be made into beer. Good wheat substitute although proportion of hulls is high.

G. Buckwheat not often fed.
1. It is expensive.
2. Too many hulls while percentage of fibre is II.3
3. Is better winter ration than summer ration because it is heating.

H. Rye least desirable because of nonpalatability.

I. Peas.
1. Seldom used.
2. High in protein,the percentage being 20.
3. Peas,oats,and barley form a good ration.

J. Kafir Corn.
1. Substitute for corn in arid sections.
2. Somewhat high in fibre.

K. Millet.
1. Too expensive.
2. Too small to be fed to mature poultry.
3. Good for adding variety to ration.

L. Culled rice.
1. Exclusively fed in Orient.
2. Extensively fed in South.
3. Rice polish isbbest form of rice to feed.
4. Boiled rice is excellent tonic for chicks with diorrhea,but feed it dry.

M. Sunflower seed.
1. At moulting time add sunflower seed or linseed oil meal to mash because these are high in mineral matter that is required for feathers.
2. May throw entire head of sunflower into chicken yard so that chickens may eat it at will.

D. Mash Feeds are essentially a forcing feed because of high protein content
1. Cornmeal is fundamental ingredient in dry mash because mash feeds are essentially feeds for forcing growth and consequently a ration high in protein is required.
2. Gluten feed is readily available.
3. Hominy chop,a biproduct of cereal manufacturers,is good as fattening ration.

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4. Wheat middlings and wheat bran.
   a. Universally used to add bulk to feed.
   b. Good for growing stock as 6.3 is mineral matter.
5. Red Dog Flour is low-grade flour or high-grade middling.
   a. Excellent as fattening ration.
   b. Fine for ducks in mash mixture.
6. Alfalfa meal.
   a. Used to lighten mash and give it bulk.
   b. Erroneously supposed to be substitute for green feeds - give green food nevertheless.
7. Linseed oil meal.
   a. Excellent, particularly at moulting time.
   b. Give limited quantity.
   c. Buy "old process" linseed oil meal, not "new process".
8. Barley byproducts.
   a. Seldom used.
   b. Brewers' dry grains excellent for dairy cattle but not for hens.
9. Buckwheat byproducts.
   a. Middlings, being 75% digestible, are good for fattening ration.
10. AVOID COTTON SEED MEAL absolutely because it is slightly poisonous (?due to gossipol?).

E. Green feeds.
   1. Sprouted oats.
      a. Best form of green feed.
      b. Sprouting entails much labor.
   2. Mangel beets are cheapest green feed, especially in winter.
   3. Lawn clippings.
      a. Excellent for small flocks.
      b. Clippings can be allowed to wilt and then are put into sacks for keeping.
      c. Feed clippings by putting them into a one-inch poultry wire basket.

F. Mineral Feeds.
   1. Ground bone is most efficient means of providing calcium phosphate which is necessary for growing chicks.
   2. Calcium carbonate, in form of oyster-shell, etc., is necessary for hens.
   3. Sharp grit to grind up grain in gizzard.
   4. Charcoal.
      a. Necessary for chicks and therefore fed powdered in mash.
      b. Not necessary for mature birds.

G. Animal protein in some form is necessary.
   1. Milk whether fresh or sour.
      a. Best form of animal protein.
      b. Necessafy for growing chicks.
      c. Drawback to using milk is that 500 lbs. skimmed milk is equivalent to only 35 lbs. meat scrap.

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2. Meat scrap.
   a. Is most readily available form of animal protein.
   b. Buy high grade.
   c. Manufactured from byproduct of butcher shops.
      1! Put into vats with superheated steam to render out fat which is used for soap,etc.
      2! Residue is dried,ground,and sold as meat scrap.
   d. Minimum of fat should be in meat scrap so that it cannot become rancid - if low in fat comtent,it will keep indefinitely as it is sterile.
   e. The higher in protein the better.
   f. Should contain no hair nor hoof.
   g. Due to method of manufacture,burlap may be in it.
3. Tankage.
   a. Is made of entrails of slaughtered animals.
   b. Is almost powdered.
   c. Is used especially for feeding swine.
   d. Buy high grade.
4. Fish meal.
   a. Is byproduct of glue factories.
   b. Is 20% lower in protein than meat scrap.
5. Blood meal is not commonly used because it is too concentrated.
6. Green cut bone.
   a. Is most stimulating.
   b. Deteriorates rapidly when in thick layers.
   c. Do not feed more than ½ ounce per hen 2 or 3 times a week.

Feb. I4. CHAPTER VI. HOUSING.

I. Types of poultry houses.
   A. In nature,fowl roosted in trees.
      i. Avoided most diseases,parasites,etc.
      2. Laid only in Spring.
   B. Glass front type.
      i. Object was to conserve heat radiated by fowls body and thus produce spring-like conditions in winter.
         a. Therefore house was insulated.
         b. Therefore front was double glazed.
      2. Drawback.
         a. Since fowl have no sweat glands,one pint of water is given off daily from lungs instead,thereby saturating the air with water.
         b. Fowl suffer from cold,because of damp,stuffy atmosphere and become sick.
         c. Litter becomes wet and serves as breeding place for microbes.
      3. Result is that this type of building is not suitable as conditions of fresh air and heat cannot be combined economically.

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C. Scratching shed type was devided in front and in back,and partitioned; the front being ventilated but not the roosting quarters.
D. Type of house with roosting quarters in rear could not maintain pure air without ventilation.
E. Fresh air poultry house developed from accidental discovery of Prof. Gowell that ventilation is important for egg production.
i. Has front open except for muslin curtain.

II. Construction of fresh air poultry house.
A. Location.
i. Exposure: should face southeast; if impossible,then south; or east; or west.
2. Air drainage: avoid pockets of dead air as in hollows,etc.
3. Water drainage:
a. House should be on sloping ground.
b. Soil should be light and loose; avoid clay or silt soils as they are too compact.
4. In reference to other buildings.
a. Should be on higher ground than barnyard so as to avoid drainage from there.
b. Should be near grain bins,etc.
5. If running water is unavailable,locate building near water supply.
6. Shelter poultry house by other buildings,orchard,or neighboring hill or wood particularly on north and west sides.
7. Shade necessary in summer - orchard is ideal.
B. Size depends on relationship of production of hen per yeat,and labor efficiency.
i. Hen will give greatest production when kept in small flock.
2. The larger the pen in proportion to birds,the more eggs; but one must have large flocks for labor efficiency.
3. Most efficient size of unit are flocks of 350 - 400 hens.
C. Shape.
i. As near square as possible.
2. Must not be deeper than 24 - 25 feet because sun could not light up back portion.
3. Most convenient shape is 25 feet deep and as long as necessary.
D. Height should be great enough to allow attendant head room though rear walls need not be higher than 4½ feet.
E. Types of roof.
i. Single span or shed roof simplest to build.
2. Uneven span or combination roof disadvantageous because some rain-water falls from roof in front of house.
3. Even span or gable tends to give low front wall,thereby making house dark.
4. Half monitor impracticable.
5. Full " " .

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F. Types of floor.
1. Dirt is cheapest in initial cost but mostvexpensive in the end as floor must be renewed yearly.
2. Board is easily cleaned,warm in winter,but not permanent.
3. Concrete is permanent,most costly,ratproof,dry if properly constructed, cheapest over period of 20 years.
a. As it is necessary to cover all floors with 6 - I0 inches litter, coldness of stone floor is minor matter.
b. Construction of concrete floor so as to make it absolutely dry.
1! Build before house.
2! Concrete is damp due to capillary attraction which draws up water to concrete if no insulation exists.
3! Must insulate against moisture if soil is not easily drainable.
4! 4 to 8 inches of filler in form of cinders,very coarse gravel,or broken stones,must be used.
5! Tramp filler down well.
6! Put 2 inch layer of I (cement) - 3 (sand) - 6 (gravel) mixture on top of filler,then run tarpaper lengthwise,lapping 4 inches and where spliced overlapping 2 feet. Tack strips down with galvanized roofing nails letting heads protrude so that cement will set around them.
7! Put 2 inch layer of cement on top and do not finish with trowel as this forms slippery floor.

G. Factors in determining number of feet floor space that will accommodate hen
1. Kind of breed.
2. Size of unit flock.
a. As size of pen is increased one may decrease number of floor feet per hen.
b. Pen with 400 square feet floor space accommodates I00 birds.
c. Pen with 25 square feet floor space accommodates 4 birds.
d. 4 square feet per hen is minimum conservative working average for large pen.
e. 6 square feet per hen is minimum conservative average for small pen.
f. 6 to 8 square feet per hen is minimum conservative average for Asiatic breeds.

H. Ventilators and windows.
1. Artificeal heating not practicable - liberal quantity of cracked corn furnishes enough bodily heat.
2. Temperature in good house should not vary more than 5 - 8 degrees.
3. Number of feet of open ventilation and of glazed area depends upon number of square feet floor space.
a. One square foot ventilating area for every I2 sq. ft.floor space.
b. " " " glazed " " " I5 " " " "

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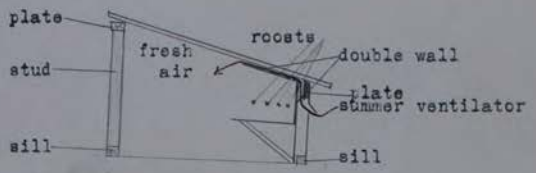
4. Arrangement of ventilators and windows.
   a. Ventilating area,which is screened with wire,should run horizontally along top of house because stuffy,hot air rises.
   b. At inside of ventilating area have muslin-covered board frame to drop over ventilating area in case of extreme cold or in storms as combs of fowl must not freeze.
   c. Windows should run vertically from floor to eaves so that sunlight can reach to back of house.

I. Walls.
   i. Does not pay to double board poultry house except at back and at sides of roosting closet,ventilating area for summer use being situated as in following diagram:



J. Interior fixtures should be,
   1. Off the floor.
   2. Portable.
   3. Few in number: perches,waterplatform,dry mash hopper,broody pen,and possibly dropping boards necessary.
   4. Inexpensive and home-made. Cost of new would be $2 - 3 per hen.
   5. Simple and therefore sanitary.

K. Interior fixtures.
   i. Droppings boards.
      a. If they will be cleaned regularly twice a week,have them.
      b. If they could not be cleaned often provide,
         i! I4 inch plank on edge under roosting compartment with litter on one side and sand or other absorbant material under roosts which is to be cleaned out 2 or 3 times yearly.
   2. Nests.
      a. Open nests - provide one for every 6 hens.
      b. Trap nests - provide one for every 4 hens.
         i! I2 X I2 inches for Mediterranean and American breeds.
         2! I4 X I4 inches for Meat breeds..
   3. Water receptacle.
      a. Pail better than pan;should hold I2 - I4 quarts.
      b. Place on 2 feet square platform made of slats which is I8 inches from ground,at wall.
   4. Dry mash hopper - either home-made or commercial of galvanized iron.
   5. Broody coop should be handy to nests. It is made of slats or wire bottom to make it uncomfortable as possible.Hen absorbes yolks when broody.

      If put in coop right away,it will lay in three weeks again.Can hang coop under tree in summer.

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CHAPTER VII. POULTRY DISEASES.

I. General remarks on poultry diseases.
A. Text books: "Diseases of Poultry",Surface & Curtis; "Poultry Diseases", Kaupp.
B. Of all farm animals,it does not pay to have poultry treated by veterinarian when sick unless it is exceptionally valuble show-bird.Wounds heal quickly.
i. Formula for disease is; Disease equals virulence devided by resistance
2. Measures to prevent disease.
a. Strong vitality in breeding stock.
b. Avoid filth which harbors bacteria.
c. Avoid dampness.
d. House flock properly,especially in regard to ventilation.
e. Feed flock properly.
f. Keep flock free from parasites which reduce vitality.
g. Give flock sufficient amount of exercise.
h. Give pure drinking water and see that common drinking pail is not carrier of disease.
C. Non-epidemic diseases.
i. Bumble foot
a. Cause: improper perches that are either too narrow,possess sharp edges,are too high from floor so that heavy bird when jumping up or down them bruises feet;concrete floor insufficiemtly covered with litter; some sharp foreign substance that penetrated foot and possibly caused infection.
b. Symptoms: corn on lower surface of foot.
c. Treatment:
1! Make X-shaped inscisson in swollen part with knife.
2! Peal back edges of skin and squeeze out pus,etc.
3! Disinfect with corrossive sublimate in warm water at I/IOOO strength,or with 5% solution formalin.
4! Bandage wound and place bird in separate pen where it cannot exercise.
2. Crop-bound.
a. Cause:
1! Mechanical blocking of lower outlet of crop which prevents food from going into stomach by feathers,straw,etc.,OR,
2! Paralysss of crop muscles due to disease - no cure.
b. Symptoms: bird keeps on eating but food does not leave crop,thereby distending it.
c. Treatment:
1! Hold bird by shanks and try to shake out food OR,
2! Give I - 2 tablespoonfuls castor or olive oil; wait about an hour and then try to massage mass to break it up.
3! If hen continues to eat and remains crop-bound,make a slit in upper portion of crop and with button hook or spoon force out food.

a.

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a! Wash crop with warm water,
b! Sew up crop with silk thread soaked in alcohol,tying knot at each stitch; similarly sew up skin.
4! Feed milk,etc.,for several days.

3. Frozen comb.
a. Cause: cold,damp air.
b. Symptoms:
1! Hens; low production.
2! Cocks; poor fertility.
c. Treatment.
1! Restore circulation by applying vaseline and massaging OR,
2! Thaw out comb in cold water and apply vaseline.

4. Bleeding comb.
a. Cause: fighting or accident.
b. Symptoms: slight bleeding or profuse bleeding causing death.
c. Treatment:
1! Apply solution IO - I5% tanic acid.
2! Then dust with powdered antiseptic as iodoform adding carbolated vaseline..

5. Egg-eating.
a. Cause:
1! Idleness of hens which contract all kinds of vices.
2! Might be caused by not feeding enough oyster shell.
3! Egg might be soft shelled,birds accidently break them,taste them and aquire habit of eating them.
b. Treatment:
1! Furnish exercise.
2! Have nest dark.
3! Eat worst offenders.

6. Feather-pulling.
a. Cause:
1! Improper ration that is too wide.
2! Depluming mite which burrows at root of feathers causing them to loosen.

7. Egg-bound.
a. Cause:
1! Mechanical blocking of oviduct often in case of heavily forced pullets.
2! Blocking of oviduct by too large an egg.
3! Blocking of oviduct by egg that is lodged sideways.
b. Treatment:
1! Injection of oil might help in very few cases.
2! Usually none.

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8. Protrusion of oviduct.
   a. Cause: May follow egg-bound.
   b. Treatment:
      1! Isolate bird if oviduct is outside of body.
      2! Wash and replace oviduct.
      3! Put in dark pen,bandage,and feed on mash.
9. Leg weakness.
   a. Cause:
      1! Too much bottom heat when chicks are in brooder.
      2! Lack of calcium phosphate in chick ration.
      3! Chick grows faster than its legs.
      4! In mature stock cause by degeneration of spinal chord (paraphlegia).
   b. Symptoms: inability to run about or weakness of legs.
   c. Treatment:
      1! In chicks: regulate bottom heat; correct ration;put outside on ground as soon as possible; and if due to supergrowth of body to legs,feed less.
      2! In adults - none.

D. Contagious diseases - 75% of these start as colds and develop into roup, and chickenpox - isolate all infected birds.
   1. Fall colds.
      a. Cause: overcrowding or unsanitary conditions,particularly ventilation,in brooder house giving especially pullets colds.
   2. Roup (organism unknown).
      a. Cause: advanced stage of cold.
      b. Symptoms:
         1! Whitish cheesy pus from nostrils or eyes of bird.
         2! Nasal passage obstructed and head swollen.
   3. Canker (very contagious).
      a. Symptoms: cankerous patches at roof of mouth and throat.
   4. Chicken -pox (epidemic in winter in certain sections).
      a. Symptoms:
         1! Scabs about comb andcwattles,face and head.
         2! Scabs are small granular masses of pus.
      b. Treatment.
         1! Vaccinate.
         2! In advanced stages - kill.
         3! In insipiant cases.
            a! Dip nasal passage,but not eyes,in 5% solution of coal tar disinfectant as lysol,or concentrated potassium permanganate.
            b! Remove scabs and cankers in mouth with sharpened stick.
            c! Disinfect with formalin and then dust with iodoform.

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5. Vent gleet (very infectuous).
   a. Cause: unknown.
   b. Symptoms:
      1! Foul-smelling discharges from vent.
      2! "Roup in reverse portion of bird's anatomy."
      3! Male bird mating with but one infected hen will infect others with which he may mate.
   c. Treatment: none; kill all infected birds.
6. Cholera (rare in North but having high mortality, sometimes 30 - 75%.
   a. Symptoms:
      1! Greenish or reddish green intestinal discharge which is very infectuous.
      2! Lesion in intestines which bleed.
   b. Treatment:
      1! Kill and burn all infected birds.
      2! Clear out pens thoroughly.
      3! Disinfect pens with 5% carbolic acid and place no litter in them.
7. Tuberculosis.
   a. Cause: germ that gives tuberculosis to birds only.
   b. Symptoms: gradual wasting away; particularly the breast.
   c. Treatment: none - kill all infected birds.
8. Blackhead (most serious in turkeys).
   a. Cause: coccidium which is a protozoan.
   b. Authority on disease is Dr. P.Hadley of Rhode Island.

E. External parasites - bibliography: Farmers' Bull. 801; Storrs Bull. 86; Cornell Bull. 359; Cornell Circular 29.
1. Mites, which are most bothersome in warm weather, live in cracks and perches of poultry house visiting poultry at night to suck their blood, thereby reducing their vitality.
2. Lice, of which there are 8 species, 5 of them common, have biting mouth parts with which they eat dandruff and scales of fowl. They always live on bird, certain species confining themselves to definite parts of the body.
3. Mite control - disinfect with carbolic acid and then whitewash.
4. Lice control.
   a. Allow birds to dust themselves.
   b. Dust bird twice a year with Lowry Licepowder OR,
   c. Dust bird twice a year with the following:
      1! One part creosol and three parts gasoline mixed together to which a sufficient amount of dry Portland Cement is added.
      2! Keep in closed container.
      3! Dust bird by holding by shanks and with hands rubbing powder into skin, under wings, vent, neck, thighs, and head.

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d. Distribute one of following ointments twice yearly over skin by putting small portion under each wing,vent,neck,thigh,and base of tail.
1! Mercuric or 25% strength of "U.S.P.Blue" - deadly poison - which is to be diluted with equal parts vaseline.
2! Sodium fluoride according to directions in Farmers Bulletin 80I which can be procured from the Congressman of your home district or from Chief,Division of Publication, Washington,D. C.

March I5. CHAPTER VIII. POULTRY NOT INCLUDING FOWL.

I. Poultry besides including chickens comprises ducks,geese,guineas,peafowl,pigeons, turkeys,pheasants,swans,and ostriches.
A. 295876000 poultry were in United States according to census report of April I9I0.
B. 280,340,000 or 95% were domestic fowl,an increase of 20% since I900.
C. 4,43I,000 or I.5% were geese,a decrease of 2I.9% since I900.
D. 3,688,000 or I.2% were turkeys,a decrease of 44.I% since I900.
E. 2,904,000 or I.-% were ducks,a decrease of 39.8% since I900.
F. 4,5I0,000 or I.5% included all other poultry not mentioned.

II. Ducks,like fowl,may be divided into two classes:
A. Meat breed to which the following belong: Pekin which possesses white plumage and is most often bred as it is relatively easy to keep breed pure,Muscovy,Rouen which developed from wild mallard in France,Call Duck,Cayuga which originated in New York State.
B. Egg breed to which Indian Runner duck belongs - this is not yet well established though brought to America from England in I882.
C. Raising of Pekin ducks is a well established industry in Eastern United States,particularly in the duck farms of Eastern Long Island.
i. Ducks are hardier than chickens and are easy to raise.
a. Are especially herbivorous.
b. Need only three-sided shed as shelter.
c. Are not attacked by as many diseases as chickens.
d. Increase faster in weight than any other fowl except possibly geese - common market weight for "Green Ducks" of I0 weeks of age is 5 pounds.
2. Duck raising.- normally lay 82 - I00 eggs from Dec.I5 to Feb 1 or 15, then moult in July.
a. Usually hatched in incubators at commercial plants.
b. Not fed first 36 - 48 hours.
c. Put in brooder with open pipe system.
d. Ration for first week is bran,cornmeal,middlings,in equal parts in addition to 5% sand by weight,fed 5 times daily moistened preferrably with milk.
1! After third day 5% meat scrap is added.
2! After fourth day green feed is given as chopped lettuce, onions,alfalfa,or clover.
3! Until feathers are grown,keep out of rain.

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e. Ration for second week to eighth week 2 parts wheat bran,1 patt wheat middlings,1 part cornmeal,½ part meat scrap,and 5% sharp sand by weight.
   1! Second week feed 4 times daily.
   2! From third to eighth week,which is growing period,feed all they will eat.

f. At eighth week put on grass-covered range if possible,giving fattening ration to those that are to be sold.
   1! Marketable ducks.
      a! Put in fattening shed and give whole bran,middlings, cornmeal,10% meat scrap,and 5% sand by weight.
      b! Feed 3 times daily what they will clean up in 15 minutes
      c! At 10 weeks of age,should weigh 5 pounds on average and be ready for market.
   2! Means of distinguishing sex.
      a! Male is larger,and coarser around head.
      b! Male rarely quacks but hisses.
      c! Male has 2 small curled up feathers at tail.
   3! Breeders,which should be the largest and most vigorous birds, should be selected at this time and given chance to swim - marketable birds need no water except for drinking.
      a! Do not use ducks for breeding until 2 years old.
      b! May use drakes first year.
      c! For early breeding,have one drake for 4 - 5 ducks.
      d! For normal breeding,have one drake for 8 ducks.

III. Geese.

A. All domesticated geese are descended from the Gray Lag Goose of Europe.
   i. Domestication began in France - the most important breed being the Toulouse; young goose weighing 16 lbs,adult goose 20,young gander 20, adult gander 26.
   2. Embden Goose domesticated in Northern Germany; young goose weighing 16 lbs,adult goose 18,young gander 18,adult gander 20.

B. Geese are easily and cheaply raised.
   1. Eat even more green feed than ducks.
   2. No grain need be fed in spring and summer.
   3. Thrive in swampy,waste land.
   4. Acre of low pasture land would accommodate about 30 geese.
   5. Must have some high,dry ground.
   6. Need no shelter except three-sided shed with straw bedding in winter.
   7. Since geese have only a partially developed crop,they must not be fed whole grains.

C. Goose raising.
   1. Nesting.
      a. Geese lay not more than 20 - 30 eggs in spring even though not allowed to set.
      b. Geese,being very particular in choosing nesting sites,require individual nests.
      c. Nests should be made of boxes filled with straw and secluded in a dark,sheltered place as in brush thicket.

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2. Hatching.
   a. Goose eggs do not hatch satisfactorily in incubators.
   b. Set the first eggs that goose lays under chickens,five under each hen,but let the goose hatch out the last batch she lays.
3. Raising.
   a. Gozzlings for first 10 days get cornmeal with 10% meat scrap or 6 parts cornmeal,6 parts middlings or shorts,1 part meat scrap, moistened with milk or water. After fourth day,they are given green feed in addition to the ration.
   b. After 10 days old,gozzlings get no ration at all,but are allowed to pasture.
   c. It is customary to give geese a little grain feed 2 or 3 times a week so as to keep them from wandering and becoming wild.

D. Production of Noodled Geese.- specialized industry of Watertown,Wisconsin.
1. Manufacture of noodles.
   a. Made of stiff batter of low-grade flour,cornmeal,sifted barley meal,and oatmeal mixed with buttermilk.
   b. Run through sausage press and then cut in 2 - 3 inch lengths.
   c. Noodles rolled in good grade flour and edges rounded off.
   d. Placed in wire tray and cooked in double-boiler until all rise to top.
   e. When cooked,noodles are plunged in cold water to prevent them from sticking together.
2. Method of feeding geese.
   a. Toulouse geese,eady to be fattened,are brought in from pasture and placed im 10 X 12 foot stalls,one for every 12 or 14 birds.
   b. Outside of feeding times,nothing is given but warm water sprinkled with cornmeal.
   c. In one corner of pen is enclosure 3 feet square with 1½ foot opening in which feeder sits on milking-stool.
   d. When ready to be fed,goose is led into enclosure,feeder holds her body between legs and stuffs with noodles soaked in warm water; fed in beginning about 4 - 5 times daily,
   e. Times of feeding increased to every 3 hours or less both night and day.
   f. No bird is fed unless crop is empty of food from previous feeding.
   g. Feeding period,generally from Nov.15 to Dec.20,lasts 2 to 3 weeks or until goose is about to get sick from strain.
3. Gain from Noodled Geese.
   a. Gain in weight is 30 - 40%.
   b. PATE DE FOI GRAS made of livers which increase tremendously in size.
   c. Cost of gain in weight is 10 - 20 cents per pound.
   d. Price per pound depends directly upon weight.
      1) Geese weighing 20 - 22 pounds bring 20 - 22 cents per pound.
      2) Best geese which weigh 34 - 36 pounds bring 34 - 36 cents per pound.
   e. Noodled Geese sold especially to Jews in cities.

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IV. Turkeys.
A. The turkey is an American bird which in some cases was taken to Europe where several breeds were developed.
B. Turkey industry declined because of Blackhead disease to which the wild species is immune.
C. Important varieties according to value are: Mammoth Bronze,White Holland, Narragansett,Bourbon Red.
D. Turkey raising.
1. Do not thrive in confinement - wooded area in which they may roam is best.
2. Cannot be raised with other fowl because of their susceptibility to poultry diseases.
3. Must not overfeed - milk is essential.

CHAPTER IX. METHOD OF KILLING AND DRESSING POULTRY.

I. Methods of killing.
A. Sticking.
1. Cut to bleed method is that of putting knife in bird's throat and severing neck veins at roof of mouth. Then blade is passed through rear lobe of brain,thereby causing feathers to loosen.
2. Stick to kill method is more difficult - cerebellum tissue is cut,making bird insensible.
B. Dislocating neck.
1. Method largely employed in England and Canada.
2. Used in killing only pigeons in United States.
3. Bird is held by shanks and head twisted outward and backward,and at same time slightly pulled,thereby dislocating neck.
C. Beheading.
1. Only permissible for home consumed poultry because,
a. Is objectionable in market as head tells sex,health,vitality,and breed of fowl.
b. Looks bad.
c. Where head is severed,carcas quickly becomes tainted.

II. Picking.
A. Dry picking.
1. Best method to employ.
2. Dry feathers can be sold.
3. Skin is not bruised,and remains white.
4. Carcas is of better quality.
B. Scald picking.
1. Birds thus picked are refused at many Boston markets.
2. Best way to scald pick is to put bird in water of 150 degrees temperature for 1 minute.
3. Takes longer to pick.
4. Skin becomes tender and tears easily when picked.
5. Carcas is of inferior quality.

OTTO DEGENER
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The poultry plant consists of 8 acres of land that has a well-drained, sandy loam soil.

The Poultry Administration Building (22' - 32') has twenty small incubators for individual student work, a candling room, and an egg storage room in the cellar. On the first floor is the office of the foreman, a student's room, and a class room; while the second floor serves as a living room. The incubator room has an automatic sprinkler equipment to insure against fires, although the kerosene for the incubators is piped in from the Oil Building. This structure contains a big kerosene supply tank, spray pumps, disinfectants, and tools.

The Brooder House (I4' - 92') is divided into four compartments. The brooder room (I4' - 72') has twelve pens, each of which will accommodate I00 chicks. The unique feature of the room is the open-pipe system of heating with hot water. The killing room (I4' - 34') is large enough to accommodate twenty students picking by the string method. Here also is an enclosed ice-box for chilling and shaping dressed poultry and even a cooling rack for I50 birds. The next room (I4' - 20') is used for a battery system of crate fattening in five compartments for each crate. The capacity is I50 birds in commercial plants. The end room (I4' - 26') is used for judging poultry.

The Poultry Mechanics Building (28' - 64') has two basements: the one contains the experimental incubator cellar, a root storage room, besides another room; the other, a Candee incubator with a turning device for 3000 eggs and a Blue Hen mammoth incubator for 2000 eggs. On the first floor is a carpenter shop; a room with feed bins and electric machinery for mixing, cutting, and grinding feed; and a grain storage room. The second floor is used as a stall loft.

The Long Laying House (I4' - I80') is divided into twenty open-front pens nine by forteen feet. Each pen holds twenty-five chickens and has two yards for them in front and back of the house sown to rye where the fowl are allowed to go at alternate times. The following chart gives the description of the pens and the birds in each:

VARIETY OF FOWL	KIND OF NEST	LAYING PER CENTAGE (in Dec. & Jan.)
White Plymouth Rock	trap	82
Barred Rock	trap	80
Rhode Island Red	trap	40
White Leghorn	trap	65
Brahma	trap	64
Rhode Island Red	trap	52
Barred Rock	trap	56
White Plymouth Rock	ordinary	45
White Plymouth Rock	"	40
Mixed Reds and Rocks	"	50
Mixed Reds and Rocks	"	52
#	"	56 65
**	"	30
~~Barred Rock~~ Rhode Island Red	"	45
Barred Rock	"	I8
Yearling Rhode Island Red	"	25
Leghorn		47

experimentally lighted

* kept under same conditions as those experimentally lighted except that they are kept under natural lighting conditions.

POULTRY PLANT REPORT.

There is also a Manure Shed (14 - 18') used for storing poultry refuse;a small breeding house (10' = 10') with a capacity of 15 hens; a duck house (14 - 18') for twenty birds; a two-hundred hen house (20' - 40') equipped with trap-nests; a one-hundred hen house (18' - 30') equipped with trap-nests and a detention pen (6' - 18'); seven summer roosting sheds of different dimentions and roofs each suitable for 100 hens; and twenty-two colony houses of different types including the Cornell and Tolman Houses,with a capacity of 3580 chickens in all.

There are two Experimental Breeding Houses.The one (18' - 72') is devided into three equal pens (18' - 18')each of which is equipped with trap-nests to accommodate a hundred hens. The other (18 - 60') is divided into two pens (18' - 18') to accommodate 90 hens for trap-nesting. In addition there are twelve breeding pens (3' - 7') for stud matings.

Before 1912 there were only six station houses of the poultry plant twelve by eighteen feet with a capacity for thirty hens. All the other buildings have been constructed since that time making poultry husbandry one of the leading subjectsoffered at the college.

In addition to the buildings for chickens,there are also yards for ducks and geese over the brook at the lower end of the range.

Two special ideal poultry houses have been built as models suited for back-yard poultry keeping. One is inexpensive as it may be made from any odd lumber to house twelve to fifteen hens in a structure eight by ten feet. The other is more attractive and consequently expensive. This would be 2 - 8 X 8 feet with a capacity for ten hens.

All the houses mentioned have self-feeders installed,plenty of ventilation by means of windows with burlap screens or even entirely open,and slanting roofs.

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IDENTIFICATIONS.

1. Rose Comb White Wyandotte.
2. White Plymouth Rock,
3. Speckled Sussex,
4. Silver Campine,
5. Barred Plymouth Rock,
6. Light Brahma,
7. White Leghorn.
8. Mottled Houdan.
9. Golden Seabright Bantam.
10. Rhode Island Red.
11. Black Cochin.
12. Silver Wyandotte.
13. Dark Cornish,
14. Blue Andalusian.
15. White Minorca.
16. Silver Gray Dorking.
17.
18.
19.

Rose Comb Brown Leghorn.
Silver Spangled Wyandotte.
Black-tailed Japanese Bantam.
Black Minorca.
Silver Penciled Wyandotte.

Partridge Plymouth Rock.

	PLYMOUTH ROCK	RHODE ISLAND RED	WYANDOTTE	BRAHMA	LEGHORN
SIZE	9½# 7½*	8½# 6½*	8½# 6½*	II# 8½*	5½# 4½*
DOMESTICITY	good	good	good	excellent	excœitable
LAYING ABILITY	good	good	excellent	fair	most excellent
% VALUE AS BROILER	excellent	excellent	good	excellent	excellent
$ " " FRYER	good	excellent	good	excellent	good
") " " ROASTER	good	excellent	good	excellent	fair
SIZE OF EGG	large	variable	small	large	large
COLOR OF EGG	brown	brown	brown	buff	white
HATCHABILITY	excellent	good	good	good	good
BROODINESS	fair	fair	fair	very br.	seldom
ADAPTABILITY	Gen. Pur.	Gen.Pur.	Gen.Pur.	Meat Type(hardy)	Egg Type

	CORNISH	MINORCA	ANCONA	ANDALUSIAN	ORPINGTON
SIZE	IO# 7½*	8# 6½*	5½# 4½*	6# 5*	IO# 8*
DOMESTICITY	fair	good	excitable	good	good
LAYING ABILITY	poor	excellent	fair	good	excellent
% VALUE AS BROILER	excellent	fair	good	fair	good
$ " " FRYER	good	fair	fair	fair	good
") " " ROASTER	good	bad	fair	bad	good
SIZE OF EGG	medium large	large	small	medium	large
COLOR OF EGG	buff	white	white	white	brown
HATCHABILITY	good	good	good	good	excellent
BROODINESS	very	seldom	seldom	seldom	fair
ADAPTABILITY	Meat Type	Egg Type(sl.delic	Egg Type	Egg Type(hardy)	Gen.Pur.(hard y)

\# male
* female
% broilers weigh from ¾ to 2½ lbs.
$) fryers weigh from 2½ to 3½ lbs.
") roasters weigh from 3½ lbs. upward.

SOURCES OF INFORMATION:

Brown "Races of Domestic Poultry"
Lewis "Productive Poultry Husbandry"
Lippencott "Poultry Production"
Robbins "Principles and Practices of Poultry Culture"
Weir "Poultry Book"

CHART

OTTO DEGENER
POULTRY HUSBANDRY IV.
Jan.18,1919.

OTTO DEGENER
POULTRY HUSBANDRY V.
Jan.25,1919.

REPORT

COMPARISON BETWEEN THE CYPHERS AND PRAIRIE STATE INCUBATORS.

I	NAME OF INCUBATOR
2	WHERE MADE
3	EGG CAPACITY
4	HOW HEATED
5	HOW IS HEAT APPLIED
6	IS IT OF THE MOISTURE OR NON-MOISTURE TYPE
7	IF OF MOISTURE TYPE HOW IS IT APPLIED
8	IS THE BODY BUILT OF WOOD,METAL,CORK,OR PAPER
9	IS IT SQUARE OBLONG OR CIRCULAR
IO	WHAT ARE THE OUTSIDE DIMENSIONS
II	WHAT IS THE INNER CUBICAL AIR SPACE PER EGG
I2	HAS IT LEGS OR NOT
I3	WHAT IS THE LENGTH OF THE LEGS FROM THE FLOOR TO THE BODY
I4	HOW FAR DO THE LEGS OF THE INCUBATOR REACH UP ITS SIDES
I5	IS THE INCUBATOR STABLE OR NOT
I6	HAS IT SINGLE OR DOUBLE WALLS
I7	IF THE WALLS ARE DOUBLE ARE THEY OF THE SAME MATERIAL
I8	IS THE INCUBATOR INSULATED OR NOT
I9	IF INSULATED,WITH WHAT
20	DO DOUBLE WALLS AND INSULATION COVER ALL FOUR SIDES
2I	IS THE GLASS-DOOR DOUBLE OR SINGLE GLAZED
22	IS THE EGG-TRAY SINGLE OR DOUBLE
23	IS THE EGG-TRAY EQUIPED WITH A NURSERY
24	HAS THE INCUBATOR A STATIONARY OR DROP BOTTOM
25	IS THE INCUBATOR WELL-PAINTED AND VARNISHED
26	IS THE BODY WELL CONSTRUCTED THROUGHOUT
27	BY WHAT METHOD IS IT HEATED
28	WHERE IS THE HEATING SYSTEM LOCATED
29	IS THE FUEL RESERVOIR SMOOTH OR RIMMED
30	HAS THE FUEL RESERVOIR A HANDLE OR NOT
3I	WHAT IS THE CAPACITY OF THE FUEL RESERVOIR
32	WHAT IS THE SIZE OF THE WHICK
33	IS THE CHIMNEY ROUND OR CONICAL
34	METHOD OF APPLYING HEAT
35	HOW IS THE INCUBATOR ESPECIALLY VENTILATED
36	IS THE VENTILATION DIRECT OR INDIRECT
37	CAN THE HEATING BE REGULATED
38	IS A VENT PROVIDED FOR THE LAMP FUMES OR DO THEY PASS DIRECTLY INTO MACHINE
39	IS THE THERMOSTAT BIMETAL OR BAR
40	IS THE THERMOSTAT A DISK
41	IF IT IS A DISK IS IT SINGLE OR DOUBLE
42	IF BIMETAL,HOW MANY BARS ARE THERE AND WHAT IS THEIR LENGTH
43	CRITICISMS ABOUT THE INCUBATOR

OTTO DEGENER
POULTRY HUSBANDRY V.
Jan. 25, 1919.

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REPORT

COMPARISON BETWEEN TWO WELL-KNOWN INCUBATORS, THE

and

	CYPHERS INCUBATOR	PRAIRIE STATE INCUBATOR
1		
2	Buffalo, N.Y.	Homer City, Pa.
3	twelve dozen	nine dozen
4	oil	oil
5	hot air	hot air
6	non moisture	moisture
7	-	pan of moist sand
8	wood	wood
9	oblong	oblong
10	28 - 33 - 20	24 - 30 - 16
11	405 cubic inches per egg of air	35 cubic inches per egg of air
12	4 legs	4 legs
13	33½ inches	31 inches
14	11 inches	9 inches
15	stable	stable
16	double	double
17	of same material	of same material
18	insulated	insulated
19	felt	felt
20	insulation and double walls on 4 sides	
21	doubly glazed door	doubly glazed door
22	single	single
23	with nursery	with nursery
24	stationary bottom	stationary bottom
25	fairly well painted	very well painted and varnished
26	wood seems of poorer quality	body excellently constructed throughout
27	diffusion	diffusion
28	outer right side of incubator	outer right side of incubator
29	smooth fuel reservoir	smooth fuel reservoir
30	no handle on reservoir	no handle on reservoir
31	125½ cu.inches about	74½ cu.inches about
32	one inch whick	one inch whick
33	round chimney	round chimney
34	diffusion	diffusion
35	has a hole in centre of floor	has hole at side
36	direct ventilation	indirect ventilation (probably)
37	heating can be regulated	heating can be regulated
38	vent for lamp provided	vent for lamp provided
39	bimetal thermostat	bimetal thermostat
40	not a disk	not a disk
41	-	-
42	tripple bars about 21 inches	two double bars about 21 inches long
43		

I think it is a pity that in a larger machine as this, the door should have been made the length of the incubator instead of along the narrower side. Whenever such a large door is opened, a much greater proportion of heat and moisture is wasted than if the door were smaller.

I think this incubator should have a hole for ventilation in its floor which might be opened and closed at will. When the chicks are about to hatch, this could be closed to save moisture thereby softening the egg membranes. The fuel receptacle in both incubators should have handles to facilitate work.

OTTO DEGENER
POULTRY HUSBANDRY IV
Feb. I, 1919.

Report on

ARTIFICIAL AND NATURAL BROODING COMPARED.*

Although the brooding of chicks is being done more and more by artificial methods, yet it is advisable in a few cases to do this by the natural method - that of the hen.

In commercial plants and among raisers of much poultry, brooding by means of the hen has been entirely supplanted by artificial means. Several reasons for this fact occur. For raising any large number of chicks, it is impracticable to use hens because they cannot be procured readily in early spring when it is most economical to raise chickens for the laying of eggs during the following winter. Then again, while the hen is hovering her adopted brood, she will not lay the desired "quota" of eggs that she would otherwise produce. Even after having hovered the chicks for a sufficiently long time, she will not resume laying for about weeks.

The exceptions to raising chicks artificially are first of all in the case of t the suburbanite who wishes to raise only a very limited number of chicks. A hover or brooder then would be only an extra expense. Even though it is advisable for farmers to have artificial brooders, the hen is by far the more efficient for this task. She takes better care of her brood because she is possessed with a strong maternal instinct during the incubating and brooding periods. In addition, her instinct which has been almost perfected for this duty by Natural Selection prompts her to do those t things that are beneficial to her offspring. For this reason it is advisable to raise valuable and prize chicks by this method. Whenever a special mating has taken place, the brood should be given to a reliable hen so that the best possible care in hovering may be given them.

We can notice that the hen hovers her chicks most of the time the first day. The second, she does not hover them so closely but urges them to eat and exercise a little. On the third day they are in the open most of the time, only occasionally going under the hen for warmth. A few days before you are ready to give a hen some chicks that have been but lately hatched in the incubator, choose a good mother that is healthy, and has clean scale-free legs. It is also necessary that she be freed of vermin several days before she is to foster the chicks. After everything has been prepared, put the hen in the coop first and then carefully place the chicks under her. If you put the hen in the coop last, she is likely to become mad and trample some of the chicks to death.

This is to certify
that it has taken me one hour and fifty-five minutes to look up the subject, make a first draft, and finally the finished copy. We have note besides which take me over an entire afternoon to put into form and copy as I am probably a slower worker than the others.

Otto Degener

OTTO DEGENER
POULTRY HUSBANDRY V.
February 7, 1919.

Report on

A BALANCED RATION FOR CHICKENS AND ITS NUTRITIVE VALUE

The following two rations are to be combined in equal amounts although each ration is to possess its ingredients in the proper proportion. Calculate the amount to be used for 100 lbs and determine the nutritive ratio of the new ration.

SCRATCH GRAIN		DRY MASH	
(a)	500 lbs cracked corn	(e)	100 lbs wheat bran
(b)	100 lbs feed wheat	(f)	100 lbs wheat middlings
(c)	200 lbs heavy oats	(g)	100 lbs corn meal
(d)	200 lbs barley	(h)	100 lbs gluten feed
		(i)	100 lbs ground oats
		(j)	100 lbs meat scrap
	1000 lbs total		600 lbs total

Reading the amount in percentage, we get:

50%	cracked corn	16.66%	wheat bran
10%	feed wheat	16.66%	wheat middlings
20%	heavy oats	16.66%	corn meal
20%	barley	16.66%	gluten feed
		16.66%	ground oats
		16.66%	meat scrap
100%	total	99.96%	total

Now divide the percentage by 2 as the rations are to be mixed in equal proportion and read the per cent as pounds. Then we get the following balanced ration:

(a)	25.00	lbs cracked corn
(b)	5.00	lbs feed wheat
(c)	10.00	lbs heavy oats
(d)	10.00	lbs barley
(e)	8.33	lbs wheat bran
(f)	8.33	lbs wheat middlings
(g)	8.33	lbs corn meal
(h)	8.33	lbs gluten feed
(i)	8.33	lbs ground oats
(j)	8.33	lbs meat scrap
	99.98	lbs total for balanced ration

To calculate the nutritive value of this balanced ration, multiply half the percentage of the several ingredients by their respective nutritive ration found in the accompaning chart. Then add the amount and devide by the number of ingredients getting the NUTRITIVE RATIO of the BALANCED RATION which is a little over 5.8 57 because the percentage has not been calculated to a sufficient number of significant figures. The nutritive ratio would probably amount to 6 .

Excellent neat work but
Report is not complete

NAME	% DRY MATTER	% ASH	% FIBER	% PROTEIN	% N.F.E.	% FAT	% TOTAL#	NUTRITIVE RATIO	*N.V
SCRATCH GRAIN									
WHOLE CORN	89.5	I.5	2.0	8.7	64.5	4.3	82.9	8.5	I2I
FEED WHEAT	89.8	3.9	7.4	9.6	44.6	3.6	62.3	5.5	I6I
HEAVY OATS	90.8	3.5	IO.9	9.2	40.5	3.7	58.0	5.5	I72
BARLEY	90.7	2.7	4.6	9.0	60.0	I.4	72.2	7.0	I39
DRY MASH									
FLOUR MIDDLINGS	89.3	3.7	4.7	I5.7	5I.I	4.3	76.5	3.9	I3I
WHEAT BRAN	89.9	6.3	9.5	I2.5	38.7	3.0	58.0	3.6	
WHEAT MIDDLINGS	89.5	4.4	6.0	I3.4	44.3	4.3	67.4	4.0	
CORN MEAL	88.7	I.3	2.3	7.0	64.I	3.4	78.8	IO.3	
GLUTEN FEED	9I.3	2.I	7.I	2I.6	46.6	3.2	75.4	2.5	
GROUND OATS	89.2	3.3	9.9	9.0	40.3	3.9	58.I	5.5	
MEAT SCRAP	93.0	24.5	2.5	50.I	-	IO.0	72.6	0.5	
FISH SCRAP	87.2	32.6	-	40.9	-	2.2	45.9	0 .I2	2I8
BUTTERMILK	9.4	.7	-	3.4	4.9	.I	8.5	I.5	II076

NUTRITIVE RATIO equals $\frac{(2\frac{1}{2} \times \%\text{Fat}) \text{ plus } \%\text{N. F.E.}}{\text{Protein}}$ or as in the case of corn

$\frac{(2\frac{1}{2} \times 4.3) \text{ plus } 64.5}{8.7}$ equals 8.5

** pounds necessary to deliver I00 pounds nutriment.

CHART

OTTO DEGENER
POULTRY HUSBANDRY V
February 7,1919.

OTTO DEGENER
POULTRY HUSBANDRY V.
February 14, 1919.

PROBLEMS IN POULTRY HUSBANDRY (CONTINUED)

II. Find cost of one pound of actual nutriment in the following feeds:

1.21	pounds	of	CRACKED CORN	necessary	to	produce	1 pound	nutriment $.03872
1.61	"	"	FEDD WHEAT	"	"	"	"	" $.05554
1.72	"	"	HEAVY OATS	"	"	"	"	" .04988
1.39	"	"	BARLEY	"	"	"	"	" .03753
1.31	"	"	FLOUR MIDDLINGS	"	"	"	"	" .04323
	"	"	WHEAT BRAN	"	"	"	"	" .
	"	"	WHEAT MIDDLINGS	"	"	"	"	" .
	"	"	CORN MEAL	"	"	"	"	" .
	"	"	GLUTEN FEED	"	"	"	"	" .
	"	"	GROUND OATS	"	"	"	"	" .
	"	"	MEAT SCRAP	"	"	"	"	" .
2.18	"	"	FISH SCRAP	"	"	"	"	" .
110.76	"	"	BUTTERMILK	"	"	"	"	" .71994

III. Find nutritive ratio of the following:

		Ratio
100 lbs	CRACKED CORN	8.5
100 lbs	FEED WHEAT	5.5
100 lbs	CORN MEAL	10.3
100 lbs	FLOUR MIDDLINGS	3.9
100 lbs	WHEAT BRAN	3.6
160 lbs	GROUND OATS	5.5
50 lbs	MEAT SCRAP	0.5
50 lbs	FISH SCRAP	0.12
Nutritive ratio of total		4.7

IV. Find cost of protein in the following:

buttermilk, one pound contains protein worth $ .0008655
fish scrap, one pound contains protein worth .0163600
meat scrap, one pound contains protein worth .0262023

OTTO DEGENER
POULTRY HUSBANDRY V.
February I4,I9I9.

PROBLEMS IN POULTRY HUSBANDRY

I. Find cost of I00 pounds of scratch ration, I00 pounds of mash ration, and I00 pounds of combination of the two rations when the cost of the ingredients is the following:

I00 lbs.	cracked corn	$ 3.20
I00	feed wheat	3.45
I00	heavy oats	2.90
I00	barley	2.70
I00	wheat bran	3.05
I00	wheat middlings	3.25
I00	corn meal	3.20
I00	gluten feed	3.30
I00	ground oats	3.05
I00	meat scrap	5.23

SCRATCH GRAIN

50 lbs cracked corn	costs	$ I.60
I0 lbs feed wheat	"	.345
20 lbs heavy oats	"	.6I
20 lbs barley	"	.54
I00 lbs total	"	$ 3.095

DRY MASH

I6.66 lbs wheat bran	costs	$ .508I3
I6.66 lbs wheat middlings	"	.54I45
I6.66 lbs corn meal	"	.533I2
I6.66 lbs gluten feed	"	.54978
I6.66 lbs ground oats	"	.508I3
I6.66 lbs meat scrap	"	.87I3I8
99.96 lbs total	"	$ 3.5II928

Cost of DRY MASH and SCRATCH GRAIN RATION for I00 lbs is $ 3.30
Cost of war ration composed of the following:

25	lbs cracked corn	costs	$ .80
5	lbs feed wheat	"	.I74
I0	lbs heavy oats	"	.29
I0	lbs barley	"	.27
8.33	lbs wheat bran	"	.254
8.33	lbs wheat middlings	"	.27I
66.66	lbs total	"	$ 2.06

OTTO DEGENER
POULTRY HUSBANDRY V
March I5,I9I9.

REPORT ON BACILLARY WHITE DIARRHEA.

Bacillary White Diarrhea is a very contagious disease for young chicks caused by the BACTERIUM PULLORUM. The loss sustained from this disease is particularly great among incubator chicks probably due to lack of carbon dioxide which is a predisposing factor. The original source of infection is the ovary of the mother hen. Thus,the organism might be contained in the yolks,and chicks from such infected eggs would have the malady when hatched. Therefore a certain percentage of chicks that have been hatched from eggs procured at an infected farm will develop the disease and give it to the healthy ones. This is most commonly done through the medium of infected food and water. Hence,normal chicks may acquire it by picking up infected droppings or food contaminated thereby.

The time when the infection spreads is when the chicks are less than three or four days old. The infection probably does not pass from adult to adult. The mortality,which is very high,depends upon the virulence and numbers of organism,the mode and time of infection,and the vitality of the chick. While a large percentage of infected chicks die under four weeks of age,some may survive the infection. These are likely to be weak and stunted,and seem particularly susceptible to other disorders. Nevertheless,since these harbor the infection and become the carriers of the bacillus they should consequently be killed.

Although any interference with the normal metabolism of chickens usually results in the excretion by the kidneys of more or less chalky matter which gives to the droppings an abnormal character,this sign does not necessarily mean that the bird suffers of white diarrhea. The more common symptoms in an infected flock additional to white droppings are the following:

1. The earliest deaths may occur within a very short time after hatching,without any prominent symptoms,excepting perhaps weakness and lack of vitality.
2. Soon the characteristic whitish discharge from the vent makes its appearance. This,however,may be slight or profuse,in color white or creamy,and sometimes mixed with brown.
3. The voided matter has a more or less sticky or glairy character,streaking thedown below the vent or clinging to the down in sufficient quantity to seal it up entirely.
4. Chicks become listless and sleepy,inclined to huddle together and remain under the hover.
5. Chicks lose appetite and eat little; while sometimes in attempting to take food,their action is more or less mechanical.
6. The wings begin to droop or project slightly from the body,with feathers ruffled.
7. In acute cases,the eyes are closed and chicks become indifferent to everything that goes on about them.
8. Chicks peep constantly; the sound being shrill or weak according to the strength of the individual.
9. Frequently when endeavoring to void excreta,the chicks utter a shrill twitter,apparently of pain.
10. Breathing may be labored while the abdomen heaves with each breath and occasionally a certain gasping or gaping occurs.

REPORT ON BACILLARY WHITE DIARRHEA.

II. During the progress of the disease,the chicks may die suddenly while still fairly strong.
I2. When the disease is prolonged,the chicks gradually waste away,becoming weaker and weaker untill scarcely able to support their own weight; in this state they occasionally rest against foreign objects
I3. The back seems to shorten and the abdomen to protrude out of proportion, causing the chick to look "stilty".
I4. With few exceptions,deaths occur while the chicks are under one month of age.
I5. Chicks that have had white diarrhea are greatly weakened in constitution and usually remain stunted.

Post mortem examinations would show all the organs in a comparatively normal condition except the following:

1. Crop empty or partially filled with a slimy fluid or with food.
2. Liver is pale,having streaks and red patches.
3. The intestines,which are pale and for the greater part empty,may contain a small amount of dark grayish or brownish matter.
4. Ceca is usually filled with grayish,soft material.
5. Unabsorbed yolk is either soft or hard like custard,in color yellow,brownish green,or even black.
6. Muscles of wings,breast,and legs may be wasted away.

Since there is no practical cure for bacillary diarrhea,strict preventive measures should be taken. From the time the chicks begin to hatch until they are removed to the brooder,the incubator should be kept dark,thereby preventing the chicks from picking at possibly infected droppings. Have the litter of such a kind that it will effectively seal the droppings. As soon as the chicks are ready for food,give them sour milk. Since the birds that have survived the disease become the carriers of it, kill and burn all of them.

The partial bibliography on Bacillary White Diarrhea is the following:

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College course

Massachusetts Agricultural College
Amherst
Department of Poultry Husbandry

Visit to Poultry Plant

Purpose: To familiarize the student with the equipment and general arrangement of a poultry plant.

The following outline will serve as a guide when inspecting the different buildings and poultry yards.

1. Poultry Administration Building 22' x 32'.

The basement of this building contains twenty small incubators which are used for student incubation work. An egg storage room and a candling room are separated from the main laboratory by a wooden partition.

The first floor accommodates the office of the foreman, student room, class room and a general work room. The second floor serves as living quarters for the foreman and his assistants.

Back yard houses 1 and 2 are designed as model types of houses suited for back lot poultry keepers. The former of very moderate cost, the latter more attractive and expensive. No. 1 - 8' x 10' capacity 12-15 hens. No. 2 - 8' x 8' capacity 10 hens.

2. The Oil Building and Tool Shed 10' x 12'.

The kerosene for the incubator is kept in this building. An underground pipe connects a large supply tank with the student incubator cellar. Disinfectants, spray pumps and garden tools are also kept there. Shed at rear.

3. Brooder House 14' x 152'.

This building is divided into four compartments; (a) brooder room (b) killing and dressing laboratory (c) fattening room (d) judging room.

a. The brooder room is 14 x 72 ft. in dimensions, and is divided into 12 brooder pens 5 x 10 ft. Each pen will accommodate 100 baby chicks. The pens are heated with an open pipe hot water system.

b. The killing room (14' x 34') will accommodate 20 students picking by the string method. The enclosed ice box is used for chilling and shaping dressed poultry. The equipment also includes a steel cooling rack, capacity 150 birds.

c. The third room (14 x 20) illustrates a battery system of crate fattening. There are five compartments in each crate and each compartment will accommodate from 2 to 4 grown fowls. The maximum capacity for mature fowls is 120. The commercial steel battery has 16 compartments each accommodating 6-10 birds. Total capacity 150 birds.

College courses

d. The last room (14' x 26') is used for judging poultry by the score card and comparison methods.

4. Poultry Mechanics Building. 28' x 64'.

This building consists of two basements, and first and second floors. The basement under the left wing contains the Experimental incubator cellar, a root storage room and a dark room for photographic supplies.

The mammoth incubation cellar is under the right wing. Entrance at the rear. The large Candee incubator has a capacity for 3000 eggs. The Blue Hen mammoth incubator has a capacity of 2000 eggs and is equipped with a turning device (loaned to College). The rooms on the first floor from left to right are: 1, shop or carpenter room; 2, feed bins and mixing room; 3, grain storage room.

The second floor is a large storage room.

5. Long Laying House.

This house is 14' x 180' and divided into 20 pens 9' x 14' in dimensions. The first 7 pens are equipped with trapnests. Each pen will accommodate 25 birds. Total capacity 500. Yards extend both to the front and rear of this building. Students who take Pen Management get their experience here.

6. Manure Shed Size 14' x 18' used for storing manure and as a hospital.

7. Small Breeding House.

Size 10' x 10'. Used at present as an overflow pen, capacity 15 hens.

8. Experimental Breeding House . Size 18' x 72'

Divided into 3 equal pens, 18' x 24', each of which accommodates 100 hens. All pens are equipped with trap nests.

9. Experimental Breeding House.

Size 18' x 60', divided into two pens 18' x 18' each accommodating 90 hens. All hens are trapnested. In addition there are 12 small breeding pens for stud matings. 3' x 7'. There are also 8 - 4' x 5' houses used for stud matings.

10. Duck House.

Size, 14' x 18'. Capacity 20.

11. Two Hundred Hen House.

Size 20' x 40'. Capacity 200. Equipped with trapnests.

College course

12. One Hundred Hen House.

Size 18' x 30'. Capacity 120. Equipped with trap nests and detention pen, 6' x 18'.

Summer Roosting Sheds

Four 10' x 10' shed roof capacity 100 chickens.
Two 24' x 18' gable " " 100 hens
One 20' x 14' " " " 100 hens

Colony Houses

Six 8' x 12', capacity 200 chicks each.
Four 8' x 8' Cornell houses, capacity 100 chicks each.
Three 8' x 10', capacity 200 chicks each.
Two 6' x 8', capacity 100 chicks each.
One 8' x 12' Tolman house, capacity 200 chicks each.
One 5' x 6' capacity 50 chicks.
One 10' x 20' capacity 300 chicks.
One 7' x 8', capacity 100 chicks.
One 4' x 6', capacity 30 chicks.
Two 10' x 10' capacity 250 chicks each.

Station Houses

The six red station houses East of the poultry plant proper comprises the original poultry plant until 1911 when the present plant was started. Size of each house 12' x 18', capacity 30 hens.

Ducks and Geese

The ducks and geese occupy 3 yards about 50' x 100' each, on the brook at the lower end of the range. They are sheltered in three small houses.

Land and Growing Range.

The poultry plant occupies 8 acres of land, about 5 of which is used as ranges for growing chicks.

The experimental chicks are brooded and grown on rented land. Seventeen 6' x 6' houses which have not been included above are used for that purpose. These houses each have a capacity for 100 chicks. 7 Open air roosting sheds 10' x 10' are also provided: Capacity each 150. There is a portable feed room 18' x 24', also a portable house for the caretaker.

Collegecourse

Summary

No. of buildings	Function	Capacity: Laying Hens	Capacity: Brooding
2	Administration and mechanics buildings		
1	Oil building and tool shed		
1	Long brooder house		1200
14	Laying and breeding houses	1500	
1	Duck house	30	
1	Manure shed		
8	Small stud mating houses		
39	Colony brooding houses		5300
3	Duck and geese houses		
7	Outdoor roosting sheds		
2	Portable feed room and caretaker's quarters		
7	Roosting sheds		
86		1530	6500

College
course

MASSACHUSETTS AGRICULTURAL COLLEGE
Department of Poultry Husbandry.
Amherst, Mass.

Key for Identifying The Breeds and Varieties of Domestic Fowl.

I. Ear Lobes Red.

A. Shanks Feathered.

1. Skin yellow

a. Comb Pea

1) Size large

Plumage

a) Body white, hackle and tail black, laced with white. — Light Brahma.

b) Male, breast black, back silvery white; female gray with dark crescentic penciling. — Dark Brahma

2) Size small

Plumage

a) Body white, hackle and tail black, laced with white — Light Brahma Bantam.

b) Male, breast black, back silvery white; female gray with dark crescentic penciling. — Dark Brahma Bantam.

b. Comb Single.

1) Size large

Plumage

a) Black — Black Cochin

b) Buff — Buff Cochin

c) Male, breast black, back red; female brown with black crescentic penciling. — Partridge Cochin

d) White — White Cochin

2) Size small

Plumage

a) Black — Black Cochin Bantam

b) Buff — Buff Cochin Bantam

c) Male, breast black, back red; female, brown with black crescentic penciling. — Partridge Cochin Bant

d) White — White Cochin Bantam.

e) Male, breast feathers golden bay tipped with black bars and white spangles; female, golden buff, each feather tipped with a black bar and a white spangle. — Mille Fleur Booted Bantam

2. Skin white

a. Toes 4.

1) Comb Single.

a) Size large

Plumage

(1) Black — Black Langshan

(2) White — White Langshan

b) Size small

Plumage

(1) White — Booted White Bantam

b. Toes 5

1) Comb Single

a) Beard and muff

Plumage

(1) Male, breast black, back reddish brown; female salmon brown. — Salmon Faverolle

(2) White — White Faverolle.

College Course

2) Comb
a) Crested and Bearded
Plumage
(1) White — Sultan

B. Shanks Non-Feathered.
I. Skin yellow.
a. Feathering loose.
1) Comb Pea
Plumage
a) Red
2) Comb Rose — Buckeye
Plumage
a) Barred
b) Black — Dominique
c) Buff — Black Wyandotte, Buff Wyandotte
d) Body white, hackle and tail black laced with white
e) Golden, laced with black — Columbian Wyandotte, Golden Wyandotte
f) Male, breast black, back red; female brown with black crescentic penciling.
g) Silver, laced with black — Partridge Wyandotte, Silver Wyandotte
h) Male, breast black, back silvery white; female gray with dark crescentic penciling.
i) White — Silver Pencilled Wyandotte, White Wyandotte
j) Red — Rhode Island Red
3) Comb Single
a) Size large
Plumage
(1) Red — Rhode Island Red
(2) Black — Black Java
(3) Black with white tipped feathers — Mottled Java
(4) Barred — Barred Plymouth Rock
(5) Buff — Buff Plymouth Rock
(6) Body white, hackle and tail black laced with white — Columbian Plymouth Rock
(7) Male, breast black, back red; female brown with black crescentic penciling. — Partridge Plymouth Rock
(8) Male breast black, back silvery white; female gray with dark crescentic penciling. — Silver Penciled Plymouth Rock.
(9) White — White Plymouth Rock.
b) Size small
Plumage
(1) Body white, tail black, — Black Tailed Japanese Bantam
(2) Black — Black Japanese Bantam
(3) White — White Japanese Bantam
(4) Male, breast black, laced with silvery gray, back silvery white; female, breast black laced with white, back black. Gray Japanese Bantam.

College course

b. Feathering close.
  I) Comb Pea
    Plumage
      a) Bla ck — Black Sumatra
      b) Male breast black, back red; female red with black crescentic penciling. — Dark Cornish
      c) Red with white lacing — White Laced Red Cornish
      d) White — White Cornish
  2) Comb Single
    a) Size large
      Plumage
        (1) Breast black, laced with white — Birchen Game
        (2) Black — Black Game
        (3) Male breast black, back red, hackle golden; female back grayish brown, stippled with golden brown. — Black Breasted Red Game.
        (4) Breast black, laced with lemon — Brown Red Game.
        (5) Male breast black, back and wing bows golden; female breast rich salmon, back gray stippled with darker gray. — Golden Duckwing Game.
        (6) Male breast white, back red; female breast salmon, back white. — Red Pyle Game
        (7) Male breast black, back and wing bows silver; female breast light salmon, back light gray stippled with darker gray. — Silver Duckwing Game
        (8) White — White Game
    b) Size Small
      Plumage
        (1) Breast black, laced with white, — Birchen Game Bantam
        (2) Bla ck — Black Game Bantam
        (3) Male breast black, back red, hackle golden; female back grayish brown, stippled with golden brown — Black Breasted Red Game Bantam
        (4) Breast black, laced with lemon, — Brown Red Game Bant
        (5) Male breast black, back and wing bows golden; female breast rich salmon, back gray stippled with darker gray. — Golden Duckwing Game Bantam.
        (6) Male breast white, back red; female breast salmon, back white — Red Pyle Game Bantam
        (7) Male breast black, back and wing bows silver; female breast light salmon, back light gray stippled with darker gray — Silver Duckwing Game Bant.
        (8) White — White Game Bantam
  3) Comb Strawberry
    a) Size large
      Plumage
        (1) Male breast black, back red; female cinnamon brown — Black Breasted Red Malay
    b) Size small
      Plumage
        (1) Male breast black, back red; female cinnamon brown. — Black Breasted Red Malay Bantam.

College Campus

2. Skin white
   a. Toes 4
      I) Comb Rose
         a) Size large
            Plumage
               (1) Male breast black, back red, female brown with black spangles. Redcap
            Plumage
               (1) Golden laced with black. Golden Seabright Bantam
               (2) Silver laced with black. Silver Seabright Bantam
      2) Comb Single
         Plumage
            a) Black — Black Orpington
            b) Blue — Blue Orpington
            c) Buff — Buff Orpington
            d) White — White Orpington
            e) Red — Red Sussex
            f) Reddish brown each feather tipped with a bar of black and a white spangle — Speckled Sussex
      3) Comb V
         Plumage
            a) Black — Crevecoeur
   b. Toes 5
      I) Comb Rose
         Plumage
            a) White — White Dorking
      2) Comb Single
         Plumage
            a) Male, breast black, hackle and saddle straw color; female, breast dark salmon edged with black, back black with light bay shafting. Colored Dorking
            b) Male, breast black, back and hackle silvery white; female, back gray stippled with darker gray — Silver Gray Dorking

II. Ear Lobes White.
   A. Shanks Non-Feathered
      I. Skin yellow
         a. Comb Rose
            Plumage
               I) Male breast black, back red; female back light brown stippled with darker brown. Brown Leghorn
               2) Buff — Buff Leghorn
               3) White — White Leghorn
               4) Black with white tipped feathers. Mottled Ancona
         b. Comb Single
            Plumage
               I) Black — Black Leghorn
               2) Male, breast black, back red; female back light brown, stippled with darker brown. Brown Leghorn
               3) Buff — Buff Leghorn
               4) Male breast black, back and hackle silvery white; female gray stippled with darker gray. Silver Leghorn.
               5) Male, breast white, back red, hackle light orange; female breast salmon, back white Red Lyle "

College course

6) White — White Leghorn
7) Black with white tipped feathers. — Mottled Ancona

2. Skin white
a. Toes 4.
I) Comb Rose
a) Size large
Plumage
(1) Golden with black spangles — Golden Spangled Hamburg
(2) Silver with black spangles. — Silver Spangled Hamburg
(3) Male reddish bay, secondaries with black parellel penciling; female bay with black parallel penciling — Golden Penciled Hamburg
(4) Male body white, secondaries with dark parallel penciling; female white with balck parallel penciling. — Silver Penciled Hamburg
(5) White — White Hamburg
Shape
(a) Back short and curved, comb small. White "
(b) Back long and straight, comb large. — White Minorca

(6) Black
Shape
(a) Back short and curved, comb small. — Black Hamburg
(b) Back long and straight, comb large — Black Minorca

b) Size small
Plumage
(1) Black — Black Rose Comb Bantam
(2) White — White Rose Comb Bantam

2) Comb Single
Plumage
a) Blue — Blue Andalusian
b) Black with golden-bay barring — Golden Campine
c) Black with silver barring — Silver Campine
d) White — White Minorca
e) Black
(1) Face red — Black Minorca
(2) Face white — White Faced Black Spanish
f) Buff — Buff Minorca

3) Comb
a) Non-Crested or Bearded
Plumage
(1) Black — LaFleche
b) Crested but not bearded
(1) Size large
Plumage
(a) Golden, laced with black, non-bearded — Non-Bearded Golden Polish
(b) Silver, laced with black. — Non-Bearded Silver Polish
(c) Body black, crest white, — White Crested Black Polish
(d) White — Non-Bearded White Polish

College course

(2) Size small
Plumage
(a) Non-Bearded Polish Bantam

c) Crested and Bearded
(1) Size large
Plumage
(a) Buff laced with lighter buff Buff Laced Polish
(b) Golden laced with black Bearded Golden Polish
(c) Silver laced with black Bearded Silver Polish
(d) White Bearded White Polish
(2) Size small
Plumage
(a) Buff laced with lighter buff
Buff Laced Polish Bantam
(b) White Bearded White Polish Bantam

b. Toes 5
1) Comb V
a) Crested and Bearded
Plumage
(1) Black with white tipped feathers Mottled Houdan
(2) White White Houdan

Miscellaneous:
Shanks, skin and earlobes purple, feathers white and silky White Silky
Feathers curled, comb single, plumage black, white, red or bay Frizzle

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MASSACHUSETTS AGRICULTURAL COLLEGE
Department of Poultry Husbandry.
Amherst, Mass.

American Standard Breed & Variety Classification with Standard Weights.

Most Common Classes only.
Classes in Standard Order.
Breeds arranged in each Class in order of Economical Importance.

Class 1 — American

Breeds 6, Varieties 20,

Plymouth Rocks: Varieties 6--Barred, White, Buff, Silver-Penciled, Partridge and Columbian.
Standard weights: cock, 9½; cockerel, 8; hen, 7½; pullet, 6

Rhode Island Reds: Varieties 2--Single and Rose comb.
Weights: Cock, 8½; cockerel, 7½; hen, 6½; pullet, 5.

Wyandottes: Varieties 8--Silver, Golden, White, Buff, Black, partridge, Silver-Penciled, Columbian.
Weights: cock, 8½; cockerel, 7½; hen, 5½; pullet, 5½.

Javas: Varieties 2--Black and mottled.
Weights: cock, 9½; cockerel 8; Hen 7½; pullet 6½.

Dominiques: I Variety--Rose Comb.
Weights: Cock, 7; Cockerel, 6; Hen, 5; Pullet, 4.

Buckeye: 1 Variety --Pea comb.
Weights: Cock, 9; Cockerel, 8; Hen 6½; Pullet 5½.

Class 2 — Asiatic

Breeds 3, Varieties 8.

Brahmas: Varieties 2--Light and dark.
Light Brahma weights: Cock, 12; Cockerel, 10; Hen, 9½; pullet, 8.
Dark Brahma weights: Cock, 11; Cockerel, 9; Hen, 8½; Pullet, 7.

Cochins: Varieties 4--Buff, Partridge, White, Black.
Weights: Cock, 11; cockerel, 9; Hen, 8½; Pullet, 7.

Langshans: Varieties 2--Black and white.
Weights: Cock, 9½; cockerel, 8; Hen, 7½; Pullet, 6½.

Class 3 — Mediterranean

Breeds 5, Varieties 18.

Leghorns: Varieties 9--Rose and Single comb; Brown, White and Buff; Single comb Black, Silver and Red Pyle.
Weights: Cock, 5½; Cockerel, 4½; Hen, 4½; pullet 3½.

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Minorcas: Varieties 5--Single and Rose Comb, Black and White. Single comb Buff.
Weights: S.C.Black cock, 9; cockerel, 7½; hen, [illegible]; pullet 6½.
All others: cock, 8; cockerel, 6½; hen, 6½; pullet, 5½.

Anconas: Varieties 2--Single and rose comb.
Weights: cock, 5½; cockerel, 4½; hen, 4½; pullet, 3½.

Andalusians: 1 variety--Blue.
Weights: cock, 6; cockerel, 5; hen, 5; pullet, 4.

Spanish: 1 Variety--White-faced Black.
Weights: cock, 8; cockerel, 6½; hen, 6½; pullet, 5½.

Class 4 English

Breeds 5, Varieties 13.
Orpingtons: Varieties 4--Buff, Black, White, Blue.
Weights: cock, 10; cockerel, 8½; hen, 8; pullet, 7.
Cornish: Varieties 3--Dark, White and White-laced Red.
Weights: Dark & White: cock, 10; cockerel, 8; hen, 7½; pullet 6.
White-laced Red cock, 8; cockerel, 7; hen, 6; pullet 5.
Dorkings: Varieties 3--White, Silver-gray, colored.
Weights: White: cock, 7½; cockerel, 6½; hen, 6; pul. 5.
Silver gray: cock, 8; cockerel 7; hen 6½; pullet 5½.
Colored: cock, 8; cockerel, 8; hen 7; pullet 6.
Redcaps: 1 Variety--Rose comb.
Weights: cock, 7½; cockerel 6; hen 6; pullet 5.
Sussex: Varieties 2-- Speckled and Red.
Weights: cock, 9; cockerel 7½; hen 7; pullet, 6.

* This classification follows the order of the American Standard of Perfection issued periodically by the American Poultry Association. A total of 15 classes, 60 breeds, and 146 varieties of domestic fowl, ducks, geese and turkeys are listed.

UTILITY CLASSIFICATION

1. General-Purpose Type--Plymouth Rocks, Wyandottes, Rhode Island Reds, Orpingtons and Langshans.
2. Egg Type--Leghorns, Anconas, Minorcas, Andalusians, and Campines.
3. Meat Type--Cochins, Brahmas, Dorkings, Cornish and Sussex.
4. Game Type--Black-breasted Red, Brown Red, Duckwing, etc.
5. Ornamental Type--Silkies, Frizzles, Bantams, etc.

the plumage relatively as sleek and glossy, but the plumage becomes worn and threadbare.

Changes in Secondary Sexual Characters.

The COMB, WATTLES AND EAR-LOBES enlarge or contract, depending on the ovary. If the comb, wattles and earlobes are large, full and smooth, or hard and waxy, the bird is laying heavily. If the comb is limp, the bird is only laying slightly, but is not laying at all when the comb is dried down, especially at molting time. If the comb is warm, it is an indication that the bird is coming back into production.

Molting.

When a hen stops laying in the summer, she usually starts molting. The later a hen lays in summer or the longer the period over which she lays, the greater will be her production, so that the high producer is the late layer and hence the late molter. The length of time that a hen has been molting or has stopped laying can be determined by the molting of the primary feathers. It takes about six weeks to completely renew the primary feathers next to the axial feathers and an additional two weeks for each subsequent primary to be renewed.

Temperament and Activity.

A good layer is more active and nervous and yet more easily handled than a poor layer. A high layer shows more friendliness and yet elusiveness than a poor bird. A low producer is shy and stays on the edge of the flock and will squawk when caught.

While the characters discussed have dealt specifically with the current year's production, it should be borne in mind that a high producer one year is, generally speaking, a high producer in all other years.

A METHOD OF JUDGING FOWLS FOR EGG PRODUCTION

As Formulated at the Judging School Held at Cornell University, Ithaca, N. Y., July 1-6, 1918, and Approved by the American Association of Instructors and Investigators in Poultry Husbandry.

In order to lay well, a bird must have a sound body. As a first consideration, a bird must be VIGOROUS AND HEALTHY if it is to be able to lay well. Vigor and health are shown by a bright, clear eye, a well set body, a comparatively active disposition and a good circulation.

Further, the bird must be free from PHYSICAL DEFECTS, such as crooked beak, excessively long toe nails, eyelids that overhang so that the bird cannot see well, scaly leg, or anything else that would keep the bird from seeing or getting an abundance of food.

Loss of Fat Due to Laying.

Color or pigmentation changes. (These should be observed by daylight.)

A laying fowl uses up the surplus fat in the body, especially it removes the fat from the skin. In yellow-skinned breeds this loss of fat can readily be seen by the loss of yellow color. The different parts of the body tend to become white, according to the amount of fat stored in the body and the amount of circulation of blood through that part. The changes occur in the following order:

The VENT changes very quickly with egg production so that a white or pink vent on a yellow-skinned bird generally means that the

bird is laying, while a yellow vent means a bird is not laying. It should be recognized that all yellow color changes are dependent on the feed, coarseness of skin and size of bird. A heavy bird fed on an abundance of green feed or other material that will color the fat deep yellow will not bleach out nearly as quickly as a smaller or paler colored bird.

The EYERING, that is, the inner edges of the eyelids, bleach out a trifle slower than the vent. The earlobes on Leghorns and Anconas bleach out a little slower than the eyering, so that a bleached earlobe means a little longer or greater production than a bleached vent or eyelid.

The color goes out of the BEAK beginning at the base and gradually disappears until it finally leaves the front part of the upper beak. The lower beak bleaches faster than the upper, but may be used where the upper is obscured by horn or black. On the average colored, yellow-skinned bird, a bleached beak means heavy production for at least the past four to six weeks.

The SHANKS are the slowest to bleach out and hence indicate a much longer period of production than the other parts. The yellow goes out from the scales on the front of the shanks first and finally from the scales on the rear. The scales on the heel of the shank are the last to bleach out and may generally be used as an index as to the natural depth of yellow color of the bird. A bleached-out shank usually indicates fairly heavy production for at least fifteen to twenty weeks.

The yellow color comes back into the vent, eyering, earlobes, beak and shanks in the same order that it went out, only the color returns much more quickly than it goes out. A vacation or rest period can sometimes be determined by the outer end of the beak being bleached and the base being yellow.

Body Changes Due to Laying.

A laying hen has a large, moist VENT showing a dilated condition and looseness as compared with the hard, puckered vent of a non-laying hen.

The whole ABDOMEN is dilated, as well as the vent, so that the pelvic arches are widespread and the keel is forced down away from the pelvic arches so as to give large CAPACITY. The more eggs a bird is going to lay the following week, the greater will be the size of the abdomen. The actual size of the abdomen is, of course, influenced by the size of eggs laid and by the size of the bird.

Heavy production is shown by the quality of the SKIN and the thickness and stiffness of the PELVIC ARCHES. Fat goes out from the skin and body with production so that the heavy producers have a soft velvety skin that is not underlaid by layers of hard fat. The abdomen, in particular, is soft and pliable. The STERNAL PROCESSES are very prominent and are generally bent outward. The thicker and blunter the pelvic arches and the greater the amount of hard fat in the abdomen, the less the production, or the longer the time since production.

One of the finer indications, but yet one of the most valuable, in picking the high layer is the fineness of the HEAD and the closeness and dryness of the FEATHERING. The head of a high layer is fine. The wattles and earlobes fit close to the beak and are not loose and flabby. The face is clean-cut. The eye is full, round and prominent, especially when seen from the front. The high layer is trimmer, that is, the feathers lie closer to the body, and after heavy production, the oil does not keep

College Course

HATCH CHICKENS EARLY.

"The early bird gets the worm"

Special emphasis is due the importance of early hatching. The time of hatching has a most direct influence on profits because it determines, more than anything else, the extent of egg production, as well as, prices received for eggs and market cockerels. Early hatched pullets have more days of maturity and, since there is a very definite correlation between the length of laying period and egg production, they are the greatest producers. Furthermore, the early pullet lays in the fall and winter when eggs are high and her eggs are not only greater in number, but also higher in value.

The Advantages of Early Hatching are:

1. A longer laying period giving a larger and more profitable egg production.
2. Greater returns from the sale of surplus cockerels.
3. More uniform distribution of egg production.
4. Greater proportion of eggs when prices are high.
5. More thrifty chickens, making a quicker, better and cheaper growth.
6. Excellent breeders that lay in early spring when hatching eggs are most wanted.
7. Pullets that maintain the flock production when hens are molting or being culled for market.
8. More uniform distribution of poultry labor and a lessening of its interference with other farm work.
9. More efficient use of equipment and greater efficiency in plant operation if proper proportion of very early hatching is done.
10. Greater Profits.

Recommendations.

General That all chickens be hatched before May 1.

The most profitable pullets mature to lay by November. Birds of the American breeds require about 200 days to come to maturity. Ordinarily, the poultryman had best observe the time required by his stock in former years to come into laying and then count back that length of time to fix his latest hatching date. Earlier hatches will, of course, have further advantages.

College course

Commercial plants That one third the hatch come off before March 10.

In order to maintain egg production during the late summer and fall when hens molt and are being culled for market, and before later hatched pullets get started, one flock of chickens should be hatched especially early and matured to lay in August. It is to be expected that some of these birds may molt during the early winter, but before doing so their production is profitable, often paying the entire cost of production, and the molt is usually partial, sometimes restricted to the hackle, and is quite rapid. Coming back into laying much earlier than do hens, and having had a rest from egg production, these early pullets make excellent breeders, laying when hatching eggs are most desired and hardest to obtain. Furthermore, the cockerels from this hatch bring the highest market returns, greatly reducing the cost of maturing the pullets.

Comparison Egg Values of Early and Late Pullets.

Date Hatched	Egg Production Before March 1	Egg Production After	Value Eggs Produced Before March 1	Advantage Early Hatches
Before Apr.15	63	95	3.43	1.15
After " "	40	95	2.28	----

College Course

OTTO DEGENER
EXERCISE 8

DAIRY 50

OBJECT: To determine the kind and extent of adulteration in samples of milk furnished.

DIRECTIONS: Test 8 samples of milk for adulteration.

1. Use Quevenne Lactometer, recording readings.
2. Test for per cent of fat, recording percentages. The Massachusetts standard for milk is: Fat 3.35%, solids not fat 8.80%, total solids 12.15%. Find if the above samples are up to the standard. If not, find out what is the matter with them, and calculate the percentages of adulteration.

SAMPLE NO.	TEMP.	LACT. RDG.	CORRECT RDG.	SP. GR. MILK	% FAT	%S. N. F.	% T. S.	SP. GR. SOLIDS	ADULTERATION
1	75	29.5	31.0	1.0295	4.0	8.55	12.55	1.29	water
2	60	31.0	31.0	1.0310	3.5	8.45	12.05	1.33	none
3	61	33.0	33.1	1.0330	3.0	8.87	11.87	1.36	water & skimmed
4	64	31.0	31.4	1.0310	3.0	8.45	11.45	1.35	skimmed
5	59	28.5	28.4	1.0285	2.8	7.76	10.46	1.36	skimmed
6	65	28.5	29.0	1.0290	4.2	8.09	12.45	1.29	water
7	72	29.0	30.2	1.0302	3.1	8.17	11.27	1.21	none
8	64	20.5	20.9	1.0209	2.2	5.66	7.86	1.35	water & skimmed

S. N. F. equals 1/4 LACT. RDG. plus .2 times % FAT

T. S. " 1/4 LACT. RDG. " 1.2 " % FAT

SP. GR. MILK SOLIDS equals $\frac{\text{MILK SOLIDS}}{\text{MILK SOLIDS} - (100 \cdot \text{SP. GR.}) - 100}$

SP. GR.

College course

OTTO DEGENER
ZOOLOGY 53

TIME SCHEDULE FOR STAINING ONION MERISTEMS IN IRON ALUM HEMATOXYLIN
(ABBREVIATED)

Xylol until paraffin has been removed.
Absolute alcohol for a minute at least.
95% alcohol.
Water for a minute at least.
Iron alum for 30 minutes to 1 hour.
Water for 5 minutes.
.5% hematoxylin for 24 to 36 hours. preferably but i hour would suffic
Water for 5 minutes.
Iron alum to extract excess stain. (10 - 30 minutes until dull grayish).
Water in several changes at least for 20 minutes and preferably 2 to 3 hours.
Remove excess water.
95 % alcohol for a minute at least.
Absolute alcohol for a minute at least.
Xylol until alcohol has been removed.
Add Canada Balsam and mount.

TIME SCHEDULE FOR STAINING HYDRA IN BULK AND IMBEDDING.

Remove picric acid by gradually getting up to 70% alcohol with pipett
Reduce to 50% alcohol by pipette method in 10 minutes.
Reduce to 35% alcohol by pipette method in 10 minutes.
Put in stain for 15 to 30 minutes in same bottle.
Put in distilled water
Put in 35% alcohol and raise to 70% gradually.
Put in acid alcohol till color fades if haematoxylin has been used.
Wash with fresh 70% alcohol.
Put in alkali alcohol till color returns.
Wash with fresh 70% alcohol.
Raise to 95% alcohol gradually by pipette method.
Leave in 95% alcohol at least 30 minutes.
Add absolute alcohol gradually.
Leave at least 1 hour in absolute alcohol.
Add chloroform drop by drop.
Add soft paraffin drop by drop for 1 hour.
Gradually change to hard paraffin and leave for 20 minutes.
Let harden in glycerin-smeared watch glass.

College course

OTTO DEGENER
ZOOLOGY 53

DOUBLE STAINING IN ALUM-COCHINEAL AND LYON'S BLUE.

Filter the alum-cochineal.

Pass slides through xylol and different grades of alcohol to water.

Put in alum-cochineal for 6 or more hours, until sections are well colored, showing nuclear up distinctly.

Rinse sections in water, passing them without delay into the different grades of alcohol till 95% is reached.

Alum cochineal does not overstain heavily. In case they are overstained leave them in 70% alcohol till of required shade.

Counterstain for 10 to 20 seconds in Lyon's Blue.

Lyon's Blue stains easily and quickly so take necessary precautions.

Rinse in 95% alcohol.

Pass into absolute alcohol for three to five minutes.

Place in xylol till alcohol has been removed.

Mount in Canada Balsam.

College
course

FORMULAE

Mayer's Albumin Fixative:

Chop the white of an egg with scissors and filter it through moist filter paper. Add equal volume of glycerin, and a bit of salycilate of soda (1 gram to 50 cc.) or thymol to prevent putrifaction.

Zenker's Fixing Fluid.

Corrosive sublimate	5 grams
Potassium bichromate	2 grams
Sodium sulphate	1 gram
Water	100 cc.

Glacial acetic acid, 5 cc., to be added just before using. To bulk of tissue to be fixed add 20 times the amount of fluid.

Mueller's Fluid (for fixing nervous tissues especially).

Potassium bichromate	20 - 25 grams
Sodium sulphate	10 grams
Water	1000 cc.

Acid alcohol:

Alcohol (70 %)	99 cc.
Hydrochloric acid (pure)	1 cc.

Normal saline:
This is a 0.7 % solution of sodium chloride in distilled water. It is a termed a normal salt solution because it is of about the same density as natural lymph and therefore less harmful to living tissues than distilled water.

Grades of alcohol:
To obtain a given per cent. of alcohol through dilution of a higher per cent. with distilled water, subtract the per cent. required from the per cent of the alcohol to be diluted; the difference is the proportion of water that must be added.

Absolute alcohol:
This can be prepared in the following manner: Heat crystals of copper sulphate until the water of crystailzation is driven off. Then add this anhydrous sulphate to a bottle of commercial high per cent. alcohol. The water in the alcohol immediately unites with it, turning it blue. Now add anhydrous sulphate until it no longer turns blue and filter to get the absolute alcohol.

OTTO DEGENER
ZOOLOGY 53

College
card

Formalin:

Commercial formalin is a 40% solution of formaldehyde in water. Thus a 4% solution of formalin would be made by taking four volumes of commercial formaldehyde and 96 volumes of water.

Lyon's Blue:

Absolute alcohol	100.0 cc.
Bleu dexLyon	0.3 gram

Eosin:

Eosin	0.5 gram
Alcohol (95%)	100.0 cc.

Alum Cochineal:

Potassium alum	6. grams
Powdered cochineal	6. grams
Distilled water	90. cc.

Boil for half an hour; after the fluid has settled, decant the supernatant liquid, add more water to it, and boil it down until only 90 cc. of the decoction remains. Filter when cool, and add a bit of thymol or salicylic acid to prevent growth of molds.

Delafield's Hematoxylin:

Prepare 100 cc. of a saturated aqueous solution of ammonia alum. Dissolve 1 gram of hematoxylin crystals in 10 cc. absolute alcohol, and and add it, drop by drop, to the first solution. Then expose to air and light several weeks for oxidation. Thereafter filter and add 25 cc. glycerin, and 25 cc. methyl alcohol.

Orange G:

Make an aqueous solution of Gruebler's Orange G.

Gilson's Mercuro-Nitric Fixative.

Bichloride of mercury	5 grams
Nitric acid (Approx. 80%)	4 cc.
Glacial acetic acid	1 cc.
Alcohol (70%)	25 cc.
Distilled water	220 cc.

After the tissue has become opaque and fixed, which depends on the size and nature of the tissue, wash thoroughly in running water followed by 35 and 50% alcohol and then preserve in 70% alcohol. During washing, the mercuric salt is often not removed. It may be extracted by adding sufficient tincture of iodine to give a port-wine color. This must be repeated as long as the color fades. When the iodine color persists, the object must be put in 70 - 80% alcohol until all color disappears.

Erlicki's Fixative.

Bichromate of potash	5 grams
Sulphate of copper	2 grams
Distilled water	220 cc.

After the tissue has been fixed, remove to 35% alcohol and keep in dark to avoid precipitation. Finally run up to 70% alcohol in which it can be preserved almost indefinitely.

Colley
course

READINGS IN ZOOLOGY 53, TO GO WITH VERBAL INSTRUCTIONS AND DEMONSTRATIONS IN LABORATORY TECHNIQUE

GUYER -- Chapt[illegible], Preparation of Reagents.
Graded alc[illegible]ls; absolute (how made by the student); acid alcohol; norm[illegible] saline solution; formalin of different strengths; Zenker's [illegible]; Bouin's Fluid; alum-cochineal stain; Delafield's Haematox[illegible]; orange-G; Congo Red; Eosin; Lyons Blue; Mayer's Albumin Fixative.

MCCLENDON -- Biological Bulletin. Vol. XV, No. 1, June 1912, for simple paraffin bath.

GUYER -- Chapter 11, General Statement of Methods; including tables.

GUYER -- Chapter 111, Killing and Fixing; methods of fixing, including washing, with alcohol, Zenker, Bouin, and formalin. (see also memoranda under this chapter).

Guyer -- Chapter IV, The paraffin method, infiltration and sectioning, (see memoranda under this chapter).

GUYER -- Chapter VI. Staining and mounting, through double staining in haematoxylin and eosin.

LEE, "VADE-MECUM" --
Chapter I.
Chapter III, Functions, actions and characters of fixing agents; articles 26, 27, 28, 29, 30, 31, 32.
Chapter VI, De-alcoholization and clearing agents.
Chapter XI, Staining, see articles 201, 203, 204, 205, 207, 209, 210.

LEWIS AND STOHR -- Page 487 et seq.

OTTO DEGENER
ZOOLOGY 53

College course

I. Preparation of tissue for slide.
   A. Method of procedure.
      1. General consists of fixing, staining, dehydration, etc., and of mounting a series of sections for examination.
      2. Special consists of special staining, teasing, etc., to supplement the general procedure.
   B. Preparation.
      1. Preliminary essentially always the same.
         a, Object is to get the tissues into fit condition for any subsequent treatment by special processes as,
            1. Killing, not merely the individual but its tissues.
            2. Fixing by means of substances as Zenker's Fluid, Picric Acid, Mercuric Oxide for the purpose of getting the substance in a static condition similar to that found in life and for the purpose of facilitating staining.
            3. Washing, which is the process of removing any excess fixing fluid from tissues.
            4. Dehydration, which is the removal of water for the purpose of hindering decay and to facil itate imbedding.
            5. Dealcoholization or clearing, which is generally done with chloroform, xylol, toluol, benzole, cedar or other essential oils, etc.
            6. Imbedding, which is the process by which the specimen is brought from the clearing agent to the condition that allows sectioning.

College course

OTTO DEGENER
ZOOLOGY 53

TIME SCHEDULE USED FOR THE PREPARATION OF GUINEA-PIG TISSUES FOR EMBEDDING, SECTIONING, AND MOUNTING,

Oct. 4 5 P.M. Fix in Zenker's Fluid.
Oct. 6 8 A.M. Wash in running water.
Oct. 7 9 A.M. Put in 50% alcohol.
Oct. 7 5 P.M. Put in 70% alcohol.
Oct. 8 8 A.M. Put in 80% alcohol.
Oct. 8 5 P.M. Put in 90% alcohol.
Oct. 9 9 A.M. Put in 95% alcohol.
Oct. 10 9 A.M. Put in absolute alcohol.
Oct. 11 6:30AM. Put in absolute alcohol with equal amount chloroform.
Oct. 11 9:30AM. Put in pure chloroform.
Oct. 11 12 M. Put in chloroform saturated with soft paraffin.
Oct. 11 2 P.M. Put in soft paraffin.
Oct. 11 3:45PM. Put in hard paraffin.
Oct. 11 4:30PM. Embed.

(It is necessary to leave tissues 6 - 12 hours in the different strengths of weak alcohol, 24 hours in alcohol of 95% and higher, 2 - 6 hours in pure chloroform, and 2 - 4 hours in soft paraffin.)

TO FIX WITH MAYER'S ALBUMIN FIXATIVE
Rub minute amount of fixative on slide and then float sections upon it

TO STAIN WITH HAEMATOXYLIN (AND EOSIN)

10 - 15 min. in paraffin xylol.
5 min. in absolute alcohol.
½ min. in 95% alcohol.
½ min. in 80% alcohol.
½ min. in 70% alcohol.
1 min. in 50% alcohol.
1 min. in 35% alcohol.
till saturated in distilled water.
until pronounced blue (10 - 30 min.) in Haematoxylin.
wash in tap water as it is slightly basic. for 5 minutes.
½ min. in 35% alcohol.
½ min. in 50% alcohol.
5 (½) min. in 70% alcohol with iodine to give portwine color.
rinse in 70% alcohol.
till reddish in 70% acid alcohol.
rinse in 70% alcohol.
till blue is restored in 70% alkali alcohol.
rinse in 70% alcohol.
½ min. in 80% alcohol.
1 min. in 95% alcohol.
10 - 30 seconds in 95 % alcohol with eosin
rinse in 95% alcohol.
3 min. in absolute alcohol.
5 min. in xylol.
before all of xylol has dried, add drop of Canada Balsam and place cover-glass upon it. Set away in horizontal position until hard.