RELATIVELY little information is available on the breeding of ducks and practically no genetic investigations have been made on the improvement of the breeds. Because of the lack of records, no survey of duck breeding has been made, nor has the Department of Agriculture used ducks in its breeding investigations. The same is true of practically all the State experiment stations. On the other hand, although Federal research in poultry breeding has not dealt specifically with ducks, it has dealt with fundamentals in genetics, and principles of management have been worked out that are applicable to all poultry, including ducks. The size and extent of the duck industry in this country seem to warrant careful study of this important aspect of poultry breeding.

Duck raising is conducted as a side line in nearly all sections of the United States, where ducks are kept in small flocks on general farms. These farm flocks are kept primarily for meat production and while the birds have been selected for size and market type, very little attention has been given to careful pedigree breeding. Commercial duck raising has been extensively developed as a highly specialized industry on Long Island, N. Y. (fig. 1) and to some extent on a few commercial duck farms in several other sections of the country. Relatively little has been published on the methods used in the selection and breeding of ducks on these commercial duck farms.

Few ducks have been bred for high egg production in this country because of the lack of demand for duck eggs as food. Relatively few ducks of the breeds especially adapted for egg production have been kept here and few ducks with high egg records have been produced. That ducks can be bred for very high production has been demonstrated in many egg-laying contests in other countries, in which the duck records have equaled or exceeded the best records made by chickens either here or abroad.

PRODUCTION OF GREEN DUCKS

Although most flocks of ducks are small, about 12 million ducks are raised each year in the United States. They are raised in every State, the greatest total farm production occurring in the North Central States. Large commercial duck farms in New York place that State first in total number of ducks raised, Long Island alone producing nearly a million annually. These market ducks from the large commercial flocks are called green ducks. They are hatched in the winter and early in the spring, forced for rapid growth, and marketed
at 9 to 13 weeks of age when they attain a weight of 4½ to 6 pounds each. Ducks produced on general farms are not forced for rapid growth; they are hatched in the spring and marketed in the fall and winter when they are 5 to 7 months old. These ducks from farm flocks, although twice as old when they are marketed, are little if any larger than the green ducks.

The number of ducks raised in this country is about three times the number of geese but less than two-thirds the number of turkeys.

Duck production is similar to turkey production in that both ducks and turkeys are raised primarily for market as young birds, and relatively few breeders or mature birds are kept. While chicken and turkey production have shown a marked increase during the last 25 years, duck production is barely holding its own. Ducks are primarily in demand in the large cities, especially among persons of foreign extraction. The number of ducks kept in proportion to the total population is much lower in the United States than in most other countries, where there is a better demand for duck meat and for duck eggs.

**ORIGIN AND HISTORY OF DOMESTIC DUCKS**

All domesticated ducks, with the exception of the Muscovy, are descended from the wild mallard (fig. 2). While actual references to ducks go back to only a few years previous to the Christian era, it is reasonable to suppose that wild mallards were domesticated at a much earlier period than this. Common domestic ducks of Europe, among which there was a variety of colors, were brought to the United States by the early settlers.

There are three classes of ducks—the meat class, the egg class, and the ornamental class. Only a few representative breeds of each class...
DUCKS

will be discussed in this article. In the meat class, the Rouen, Aylesbury, Pekin, Cayuga, and Muscovy are among the well-known breeds.

The Rouen, which has the same color markings as the wild mallard, shows the effect of domestication by its greatly increased size and superior fleshing qualities. This breed originated near Rouen, France, whence it derives its name, but it was greatly improved in England, where it was bred for very large size, the males weighing 9 to 11 pounds alive and the females 8 to 10 pounds. It was brought into the United States about 1850 and became quite popular but is now kept in this country primarily by fanciers.

The Aylesbury is a white duck that originated in England early in the nineteenth century. It is a large duck with a massive body, that is carried nearly horizontal. The Aylesbury duck was first brought into this country about 1849 and was used on the first duck farms, but was eventually replaced by the Pekin. Duck breeders in this country consider it less hardy than the Pekin.

The Pekin duck (fig. 3) originated in China and little is known of its history in that country. It is a white duck of medium size, more upstanding in type than the Aylesbury, an excellent market bird and noted for its vigor and hardiness. The breed was brought into the United States from China in 1873. It rapidly became popular and soon replaced all other breeds for commercial duck raising. Crosses were made of the Pekin with Aylesbury and other breeds, but the pure Pekin was found to be much better adapted for commercial duck farming and has since maintained this position as the best and only commercial market duck. The first small importations of Pekins, from which most of the present commercial flocks are descended, were very good market ducks, not greatly different in appearance, size, or other economic characters from those of today.

The Cayuga duck (fig. 4, D) is of interest because it was produced in Cayuga County, N. Y., and also because it is solid black in color. It was developed about 1850 and was just becoming well known when the Pekin, which was better adapted for the market, came along and replaced it.
The Muscovy, or Brazilian, duck is a native of Brazil and is considered a different species from the wild mallard and from the other domestic ducks. The period of incubation for Muscovy eggs is 33 to 35 days, compared with 28 days for eggs of other domestic breeds of ducks. The breed was introduced into the United States between 1840 and 1850. The Muscovy drake is about one-third larger than the duck, while in all the other market breeds the male and the female are practically equal in size.

The egg-laying class, of which the Indian Runner (fig. 4, E) is the outstanding breed in this country, was brought into United States only about 40 years ago. It is an upright Penguin type of duck noted for great prolificacy. It was named Indian Runner because of its supposed introduction from East India, but the evidence appears to show that it was a selected duck of a type common in Belgium and the Netherlands. Because of its small size it is not so well adapted as the Pekin for meat production. The Khaki-Campbell duck is a popular breed of this class in foreign countries.

In the ornamental class there are ducks of all sizes, types, and colors, which indicates that great variation has been brought about through selection and breeding. The Call (Fig. 4, A and B) and the Black East India are bred for extremely small size, the White and Gray Calls being miniatures of the Pekin and Rouen, respectively, while the East India is a small-sized Cayuga. The Mandarin and the Wood ducks are the most ornamental of the small breeds of waterfowl. Their plumage contains many brilliant colors and is handsomely marked. In the ornamental class there are also larger ducks, such as the Crested White (Fig. 4, C), which is distinguished by a well-developed crest on the top of its head. Figure 4 shows a few of the variations that occur in the breeds of ducks.

**Improvement by Breeding**

Improvement of ducks of the meat class in this country has been largely confined to the selection of a few individuals notable for size, type, and rapid growth out of the large number raised for market each year. On commercial duck farms 40 or more young ducks are
Figure 4.—Great variation has been produced in ducks through selection and breeding: 
A, Gray Call male; B, Gray Call female; C, Crested White; D, Cayuga; E, Indian Runner.
marketed annually from each female breeder. Selection of a few of the outstanding birds from a large flock does not give an accurate measure of the breeding value of the flock, but this selection, starting from high-quality stock, has resulted in the production of very uniform flocks of Pekin ducks. These ducks are noted for their rapid growth and for uniformity in size and type. Pekin ducks have not been bred or selected for high yearly egg production but they lay very steadily during the months when eggs are desired for hatching.

**Principles of Breeding**

An article by Jull in the 1936 Yearbook of Agriculture contains a thorough discussion of the principles of breeding, the use of inbreeding and cross-breeding, breeding for disease resistance, and other aspects of poultry breeding that apply to ducks no less than to chickens. A careful study of the breeding investigations that have been made with chickens and with turkeys should be of much assistance to those interested in improving the breeding of ducks. No attempt will be made to discuss these breeding principles in detail here—for this information the reader is referred to Dr. Jull's article.

Jull stresses the importance of what he calls a three-P program, involving production records, pedigrees, and progeny testing. Production records, he points out, are of great value; yet many good individual producers fail to produce good offspring. Pedigree breeding, in which detailed records are kept of the breeding birds and their offspring, is an improvement over breeding from production records alone, but again there is no positive assurance that a bird with a good ancestry will always produce good offspring. Since ducks are rarely trap-nested, practically no thorough pedigree breeding has been carried on with them. Progeny testing, which is the best method of evaluating any poultry breeding stock, has not as yet been applied to the breeding of ducks in this country.

In fact, ducks offer a virgin field for poultry breeding research, especially in the inheritance of meat characters. The first practical steps in a breeding program would be the use of the production record, the pedigree, and the progeny test. They involve expense, however, in the keeping of records, securing individual egg records, and maintaining breeding ducks beyond the age now customary; and duck breeders apparently do not feel that this expense is justified under present conditions. A very different situation exists among breeders of chickens, who are primarily interested in breeding for eggs.

**Breeding for Size and for Quality of Flesh**

Ducks are kept and selected primarily for flesh production. Good body type and rapid growth to market size are desired for economical production. But very little research work has been done on the breeding of poultry for meat or flesh production or on the inheritance of body size. W. F. Waters of the Iowa Agricultural Experiment Station has shown that inheritance of body size in chickens is extremely complex, and experiments in crossing a large and a small breed at the National Agricultural Research Center, Beltsville, Md., indicate that a large number of genes are involved.

1 See list of selected references, p. 1377
As already indicated, breeding work with Pekin ducks has been confined principally to the selection of birds of the desired market type, size, and weight, that is, those weighing about 5½ pounds when dressed at 10 to 12 weeks of age. A larger Pekin can easily be produced, but it would not be so well adapted to the market demand; moreover, large heavy ducks are not usually as good breeders as those of medium size. Since only a small percentage of the ducks raised are kept for breeding, it is a relatively easy matter to select good-sized, rapid-growing, and early-maturing birds for the breeding flocks.

Inbreeding and Hatchability

The Pekin ducks have been bred for a longer period without introducing outside stock than have any of the popular breeds of chickens. No work on the use or effect of inbreeding in the egg-laying breeds of ducks has been reported. The results secured with inbreeding chickens for egg production should be applicable to the breeding of ducks. Almost all the Pekin ducks in this country are descended from two small importations. There have been periods when it would appear that many of the flocks on Long Island were being too closely inbred and that this resulted in widespread poor hatchability. From experiments with chickens it has been concluded that hatchability tends to decrease and chick mortality tends to increase with close inbreeding.

Hatchability is an inherited character that can be improved by careful selection and breeding. However, the fact that Pekin ducks are usually mass mated and are rarely trap-nested makes it very difficult to select for hatchability. In these mass matings there is usually one male for every six or seven females. It would be very desirable to select males for breeding on the basis of high hatchability of the eggs of their dam and their progeny.

Cross-Breeding

It is sometimes claimed that cross-breeding produces increased vigor in the offspring. There has been very little cross-breeding of ducks except in farm flocks where the birds are bred indiscriminately. The purebred Pekin is the only breed used on commercial duck farms in this country for meat production. Ducks of the Aylesbury breed were occasionally crossed with the Pekins in this country some years ago, but the reports of this introduction of Aylesbury blood have been unfavorable and these crosses have been entirely eliminated from the breeding flocks. It is reported that outcrosses of the Pekin on the Aylesbury are occasionally made in England to improve the breeding qualities of certain flocks that show poor fertility and lack of vigor. The mule duck, a cross of the Muscovy on the common domestic duck, is occasionally made, especially in the Southern States. The hybrids are not fertile when bred together, but they will breed to some extent with either parent race.

Selection for Disease Resistance

Ducks are considered less subject to disease than chickens, and mortality in commercial flocks, both in the young ducks and in the mature stock, is usually much less than with chickens. Commercial
duck breeders started with good Pekin stock and appear to have kept their ducks relatively free from disease by good management of the breeding flocks. No experimental work has been reported, however, on breeding ducks for disease resistance. There has doubtless been much less chance for the spread of disease than in the case of chickens, since most ducks are very healthy, and commercial duck farming is a highly specialized industry largely conducted on very light sandy soil by a small number of breeders who usually hatch and raise their own

stock, while the ducks on general farms are kept in very small flocks and hatched and reared by natural methods with very little trade in day-old ducklings or breeding stock.

Breeding for Meat Production

On commercial duck farms picking out breeders has been almost entirely a matter of selection from appearance and by handling the birds. Ducks have been bred from large flock matings; few if any special matings have been made; the birds are not trap-nested and there has been no selection of outstanding breeders on the basis of individual pedigree records. However, the uniformity of the original stock and the selection of small flocks of breeders from very large numbers of ducks have brought about a much greater uniformity in type and size than can be found in any other kind of poultry (fig. 5). The best flocks of ducks are so highly bred that there is practically only one market grade.

The best-appearing young birds are selected when they are 8 to 10 weeks old and reserved for further selection as breeders. At this age the birds intended for market are changed to fattening rations.
Breeding males are usually selected during June and females during the early part of July. When these selected ducks reach market age they are again carefully examined and only the best are kept. Breeding ducks are selected for good length, width, and depth of body, and for early maturity. While good size and quick growth are desired, stock showing any sign of coarseness is discarded. Heavy birds with very deep keels have a tendency to take on too much fat and are likely to show low egg production, poor fertility, and lack of vigor. Most breeding ducks are kept only through their first laying season, as young ducks are better producers and lay earlier than older ones. The use of only mass matings and this restriction to young breeding stock made it impossible to do any careful pedigree breeding or progeny testing. Retaining a few of the best breeders for a second season and keeping adequate records for these birds would be worth trying.

Young Pekin ducks are efficient producers of meat. The young ducks raised on commercial farms have been selected and bred for rapid growth and at 10 to 12 weeks of age they are nearly as large as they are at maturity. At 12 weeks of age Pekin ducks weigh about 6 pounds, or 50 times their initial weight. Chickens fed for rapid growth and marketed as broilers at 12 weeks of age weigh about 2 1/2 pounds, or less than one-half as much as ducks of the same age, while at maturity the ducks weigh about the same as chickens.

Up to about 1910 market growers exhibited their ducks at the poultry shows and competed to some extent in the sale of breeding stock meeting standard requirements. Since that time commercial duck farmers have shown much less interest in the requirements of the standard, largely disregarding any points that did not meet their own particular market demands.

Breeding for Egg Production

Ducks of the egg-laying class have been selected and bred for very high egg production. Records of individual ducks and of small flocks show egg yields as high in number as the best records made by hens, and higher in total weight. In this country there is very little interest in the egg-producing breeds of ducks, largely because of lack of demand for duck eggs for market. The Indian Runner duck, which is one of the best egg producers, experienced a moderate boom beginning about 1907, but the interest in the breed lasted only for about 7 or 8 years. Duck eggs are usually in good demand only early in the spring, especially around Easter time. There has been some indication of a slightly increased demand during the last year or two in some markets.

Duck egg-laying contests have been conducted in England and other foreign countries, where the egg breeds are kept much more extensively than they are in the United States. Trap nests used in Germany are

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1The first standard for Pekin ducks was published in 1874 and the following year this breed was admitted to the standard of the American Poultry Association. In 1888 the following standard weights were adopted: Old drake, 8 pounds; old duck, 7 pounds; young drake, 7 pounds; young duck, 6 pounds. In 1910 the weights were increased 1 pound in each class and more emphasis was placed on development of ducks with deep bodies and long keel bones.

2The Indian Runner duck standard was first adopted by the American Poultry Association in 1898. Relatively few changes have been made in the standard and these changes have been largely confined to minor points. Standard weights are 4 1/2 pounds and 4 pounds for adult drakes and ducks, respectively. The standard calls for a long slender bird with carriage approaching the perpendicular. The so-called utility type of Indian Runner duck, bred only for egg production, is less upright in carriage and not so slender as the standard type, which is bred primarily for exhibition.
illustrated in figure 6. The 161 ducks entered in one of the English contests averaged 225 eggs in 48 weeks. The average weight of all eggs was 2.57 ounces, which gives an egg production per duck of 36 pounds, 3 ounces, or about eight times the average weight of the ducks of the egg-laying class. This is a much greater average production per pound of body weight than is made by chickens in the egg-laying contests. Many individual duck records of over 300 eggs per year have been made, while the highest individual production runs over 360 eggs. The use of the single-pen system or of trap nests for keeping records of individual ducks goes back only about 16 years in England, but great progress has been made in improving egg production during these years. Considerable inbreeding has been used, and pedigree breeding and the keeping of production records have been practiced. Progeny testing offers an opportunity for still greater improvement in breeding for egg production.

**Figure 6.—Trap nests used in Germany in pedigree breeding of ducks for egg production.**

**Improving Size and Color of Eggs**

Size and color of duck eggs are inherited so that, where individual records are kept, careful pedigree breeding and selection will lead to material improvement. It is desirable to maintain good egg size in both the egg and the meat breeds. Considerable variation occurs in the color of duck eggs, which have a tendency to show various shades of green. This is natural, since the wild mallard produces eggs with
green shells. Shell colors range from white for the Pekins and well-
bred Indian Runners to green for Rouens and dark green or black for 
the Cayuga. When the Cayuga and Black East India ducks begin 
to lay, their eggs are almost black, but as production increases the eggs 
gradually lose their black color and become dark green. White-
shelled eggs are desired for market and the popular egg breeds show the 
great improvement that has been made in selecting and breeding for 
white eggs. Duck eggs produced by farm flocks on range, which are 
poorly fed, are not considered to be of as good a flavor as duck eggs 
produced from well-managed flocks.

Ducks offer a virgin field for poultry breeding research, especially for 
the inheritance of meat characters, since ducks are used almost ex-
clusively for meat.

GENETIC RESEARCH

Very little information has been reported on the genetic composition 
of the domestic breeds of ducks. The principal plumage-color-in-
heritance work in this country has been conducted by R. G. Jaap at 
the University of Wisconsin. A few other research reports on the 
breeding of ducks will be found in the list of references. Jaap studied 
the inheritance of three types of white spotting. Two of these types 
were found to be simple recessive and the third type exhibited incom-
plete dominance. The dominant type of white markings is found in 
the Fawn and White and the Penciled Indian Runner varieties and is 
due to the homozygous expression of a dominant type of white spotting, 
RR, designated “runner.” The two recessive types of spotting are 
found in ducks having white primary wing feathers. One class is due 
to the heterozygous expression of the genes for runner, Rr; the other 
to a recessive gene, w, for white primaries.

Jaap also reported on three allelomorphic genes which produce 
differences in the mallard-plumage pattern. These three alleles are 
restricted mallard color, Mr, mallard, M, and dusky mallard, md. 
Another article describes the effects of a recessive gene which produces 
a light color phase in mallards. In the juvenile feathering, in the adult 
plumage of the female, and in the summer plumage of the male the 
light-phase gene produces a lighter color tone in the ducks that are 
genetically restricted mallard color, mallard, or dusky mallard color. 
During the summer the adult Rouen male takes on a drab plumage 
similar to the plumage of the female. After the fall molt the male 
again assumes his normal bright-colored plumage. Young drakes also 
have this drab female coloring before they take on their adult plumage.

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