Heritability of egg size is approximately 60%—a very high value compared to the heritability of most other economic characters—and indicates that individual selection for egg size is to be preferred to family selection.

A further simplification of the problem of changing the egg size of a flock by breeding selection is possible as a result of a study of genetic correlations between the weights of eggs laid at different times of the year. It was found that the weighing of several consecutively laid eggs in the first November of a spring-hatched pullet’s life provides a sufficiently accurate measure of a bird’s genotype for spring maximum egg weight. Thus it becomes possible to modify egg size by selection very rapidly since individual pullet—rather than hen family—selection is effective for this purpose.

Shell Thickness

An extensive study on the inheritance of shell thickness indicates that the heritability of this trait is between 15% and 30%. In addition, another 10% of the variation in this character appears to be due to non-chromosomal maternal effects. Among other findings in this study several points emerge: 1, shell thickness and shell smoothness are independent, except that very rough shells tend to be thin; 2, while the shell thickness of eggs laid by a given bird declines in the summer and fall of the second year of life, there is a high correlation between shell thickness of eggs produced at different times of the year by the same bird; 3, White Leghorn hens laying creamy eggs tend to produce thicker shells than their sisters laying white eggs; and 4, specific gravity of fresh eggs was found to be a highly accurate measure of shell thickness.

Respiratory Diseases

An outbreak of an obscure respiratory disease, tentatively diagnosed as atypical coryza, in the Leghorn flock of pullets permitted an investigation of genetic differences in resistance to this disease between different lines of birds.

In spite of a lack of previous exposure for at least 17 years to any respiratory infection, it was found that such genetic differences did exist. The line selected for a high incidence of blood-spotting happened, presumably by chance, to be the most resistant one, while crosses between inbred lines were found to be more resistant—though not necessarily so, statistically—than the inbred lines themselves.

The effect of atypical coryza upon reproduction was studied. Following recovery from the disease, a very high proportion of waste and low quality eggs were obtained from some pullets which later returned to normal rates of production, while many others never returned to a normal rate of egg production. Despite a very low mortality attributable to the disease, the hen-housed production index for the production strain for the year was only 117.7 eggs as against 224.7 eggs the previous year.

The effect on hatchability was also disastrous. The percentage of total eggs set that hatched from a typical pen was 29.0 for the hatching season. When infertile and broken eggs were taken into account, the hatchability of fertile intact eggs was 37.5%. Eggs from pullets that failed to pause during the disease outbreak hatched 59.9% of all eggs set, while those that hatched 20.0%. These data provide further support to the evidence for variation in resistance to the disease.

Gains from Selection

Studies on the response to selection pressure for several characters were continued. In one experiment, selection was continued to its ultimate point until the line selected—for incidence of crooked toes—has, in the past year, produced a 100% incidence of the defect.

In other instances gains in response to selection are still being obtained, as in the case of selection for the blood-spotting tendency. Here in the selected line about 23% of all eggs contained blood spots detectable under a commercial candler, compared to 1% in the production-bred flock and 7.5% in a limited number of crosses between the two lines.

In still other instances gains from selection have either slowed down or have at least temporarily ceased altogether. The selection experiment for shank length falls into this category. After continuing responses for seven generations, further generations of selection failed to increase shank length in the selected lines.

The reasons for failure of selection were investigated, and it was found that the major reason—though not necessarily the only one—lies in the poorer reproductive rate of the extremely long-shanked birds. Eggs laid by them did not hatch as well as those laid by their shorter-shanked contemporaries. Similarly, the viability of chicks from the dams falling into the extreme class with respect to shank length was lower than that from shorter-shanked birds. This finding may have far-reaching significance in selection studies, since it suggests that artificial selection for a particular trait, if carried on long enough, may interfere with a flock’s optimum reproductive performance.

Egg Production in Turkeys

Unlighted turkey hens lay about 60% of their eggs in the afternoon, while unlighted chicken hens lay about 60% in the morning. Time of day when the eggs were laid did not influence the fertility or hatchability of the turkey eggs obtained.

The fact that there was no relation between time of day that the eggs were laid and their hatchability is of interest since all-night lights—which may be expected to cause some changes in the time when eggs are laid—cause an increase in waste eggs as compared with morning light only. These waste eggs included all eggs unfit for hatching such as broken or cracked and obviously thin shellled as well as double yolked and dwarfed eggs.

It is likely that the apparent effect of all-night light on shell quality may account for some of the unfavorable effects of all-night lights on hatchability which have been reported. Because of the unfavorable effect of all-night light on egg quality without a compensating increase in total egg production, all-night lights should not be used on breeding turkeys.

Antibiotics

An intensive research program on the mode of action of antibiotics as growth stimulators has been undertaken in collaboration with the Division of Bacteriology at Davis. Certain types of yeasts seem to be encouraged to develop in the intestinal tract when antibiotics are fed. Continued on following page.
tutes of these yeasts are being studied to
top antibiotics.

Protein Concentrates
Expeller-produced cottonseed meal has
been found to be a good protein concen-
trate for chicks. The suspected lysine and
methionine deficiencies were not found
when the meal was fed to chicks at levels
providing most of the protein of the diet.
Cottonseed meal should not be used in
diets for laying hens because of its detri-
mental effects upon egg quality.

Studies on raw unprocessed soybeans
have shown the presence of a diuretic ef-
fect which can be destroyed if the beans
are heated. The feces of birds fed raw
soybeans contain a methionine-rich com-
plex, indicating a poor digestion of the
protein in the beans.

Alfalfa Meal Studies
Research has been continued on the
use of chick rations containing high levels
of alfalfa meal. The diets employed con-
tained 20% alfalfa meal, which is about
to five times the amount ordinarily
used in chick rations. This high level pro-
duces a marked depression in growth. If
a mixture of sterols and a vegetable oil
is added to the diet the growth-depressing
effect can be overcome. Effective sterols
which have been used are cholesterol and
purified soybean sterols.

Inexpensive crude sources of sterols
have been investigated and some of these
give promise of usefulness. Studies are
being continued on the feasibility of using
high levels of alfalfa meal when sterols
and vegetable oils are added to the ration.

Tryptophane Requirements
The tryptophane requirement of turkey
poults for optimum early growth is ap-
proximately 0.25% of the ration. No
symptoms other than poor growth were
noted in tryptophane deficient poult's.

Miscellaneous Feedstuffs
Coconut meal and molasses have been
studied as feedstuffs for chicks with the
view of determining in what way high
levels of these feedstuffs might be used
when they are inexpensive. Levels of co-
conut meal as high as 20% and molasses
levels as high as 15% have been used ex-
perimentally with good growth results.
Raisins were fed to turkeys in the late
growing period at 10% and 30% of the
grain mixture with no marked adverse
effect on body weight gains, efficiency of
gain and market quality. Turkeys were
reluctant to eat raisins when first given
them, but after becoming accustomed to
the raisins the turkeys consumed them to
the extent of 16% of the entire ration.
Ground carob pod and bean caused some
depression in growth when fed at
5% of the ration and caused marked
growth depression and high mortality in
chicks when fed at 40% of the ration.
Decorticated—dehulled—safflower oil
meal was found to be deficient in lysine and
methionine when used in a practical
chick starter. It could be used satisfac-
torily in combination with soybean oil
meal and fishmeal but not soybean oil
meal alone.

Slipped Tendon
Manganese-deficient and normally fed
chicks were weighted down by strapping
small pieces of lead to their backs. These
treated chicks were found to have a higher
incidence of slipped tendon—perosis—
than unweighted chicks. This observation
suggests that weight itself, rather than
more rapid growth rate, is the explana-
tion for the greater incidence of perosis
among the largest birds of a flock.

Fly Control
In response to inquiries from poultry-
men, feed containing zinc oxide was stud-
ed as a possible fly control agent for
poultry manure. Even feed levels of zinc
oxide high enough to result in growth
depression did not cause a significant de-
crease in the fly population when the
manure was used as a fly breeding me-
dium. This work was done in collabora-
tion with the Division of Entomology in
Berkeley.

Sour Egg Infections
Egg spoilage due to infection with a
fluorescent Pseudomonas species is de-
tected with difficulty by ordinary candling
but may be detected readily by candling
with ultraviolet light. Factors affecting
the frequency and rate of development
of this type of spoilage include the fol-
lowing among others:
1. Concentration of organisms in the
infecting medium: increasing cell num-
bers from 10 to 10⁴ per milliliter in water
susensions progressively increased the
numbers of spoiled eggs obtained when
eggs were immersed for short periods in
theses suspensions.
2. Temperature differential between
eggs and suspension: infection occurs
most readily if the suspension is colder
than the eggs and increases with increas-
ing difference up to a differential of 37.8°
F at least.
3. Subsequent storage temperature:
spoilage develops most rapidly at 59° F.
Slower development of spoilage may be
observed down to 32° F and at higher
temperatures, but spoilage due to this or-ganism is almost completely inhibited at
86° F due to the peculiar chemistry of
egg albumen.

Fumigation Studies
Preliminary results indicate that ethyl-
ene oxide gas may be effective in pre-
venting Pseudomonas spoilage in eggs if
applied as a fumigant within four days
from the time the eggs are infected. Prac-
tical utilization of this fumigant presents
some problems now being studied.

Chicken Flavor
In a study of the flavor constituents
in chicken meat, methods have been de-
veloped to obtain volatile components
released by steam distillation of the meat.
These volatiles have proved to be com-
posed of separable parts, one having a
meat flavor and the other a typical chicken
flavor. It is the latter which gives chicken
meat its characteristic odor.

Cooling and Shade
Investigations were made on the skin
temperature of birds for the purpose of
gaining an objective measurement of com-
fort in the hen. Radiometer readings and
touch thermocouples were used to make
the measurements. The results show a
high correlation between skin tempera-
ture and rectal temperature. Further work
is needed to determine the significance of
this finding.

The shade requirement of growing tur-
keys was investigated. Four groups of
turkeys were used in a test. The amounts
of shade given per bird were 1, 1½, 2,
2½ square feet. No differences were
observed in the growth of the birds to the
end of 26 weeks. The amount of water
consumed and rectal temperature was in-
versely related to the amount of shade.
A short term test to show the effect of
water consumption on the incidence of
pendulous crop was inconclusive.

Shipping Boxes
Studies on chick shipping box tempera-
tures and ventilation were continued. The
lethal temperature of chicks inside a filled
chick box was found to be about 106° F.
When the chick box was sealed and the
room temperature raised to 100° F the
temperature inside the box rose to a lethal
temperature. A room temperature of 90°
F was found to be about the critical tem-
perature as far as removing plugs in the
box for ventilation to remove excess heat
was concerned. Such factors as diurnal
variation in temperature, regional tem-
peratures to which the chick would be
exposed, sunshine, radiators and cold
winds complicate the problem of provid-
ing comfort to chicks in shipping boxes.