Attention is now being turned to stress factors other than heat.

Scientists at NCSU are convinced a better understanding of reproductive physiology is essential to solving some of the world's most basic problems.

"Look at the world today," Ulberg commented.

"On the one hand, man must learn to control his own population. On the other hand, man must learn to feed the people who already exist."

The greatest food need of the world today is more protein. By delving into the beginnings of life, Ulberg and his NCSU coworkers hope to find ways to increase the supply of animal protein through making each breeding animal more productive.

How this research might relate to human population control is a subject that must be pursued by other scientists. There is no doubt, however, that greater animal reproductivity and reduced human reproductivity are but two sides of the same coin.

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**Chicken in Every Pot—the Broiler Bonanza**

H. R. BIRD

Suppose you went to your favorite market to get a ready-to-cook broiler and found that it was marked 62 cents per pound instead of the customary 33 or 35. What would your reaction be? Astonishment? Unbelief? Rage? Yet 62 cents is about the "normal" price one would expect if broilers had followed the general trend of consumer prices in the last 25 years.

Why didn't they follow the general trend? Research has changed the broiler's genes, diet, family life, physical environment, life expectancy, and even his personality.

The young chicken may well be the most researched animal in this much-researched world.

Research workers and growers have done great things to the broiler, but they have not always been very successful in predicting what the broiler would do next. In 1938, I first visited the Delmarva Peninsula and became acquainted with broilers and broilermen. Every conversation eventually got around to "overproduction" and "low prices." Where would they find the people to eat all the broilers that they were producing?

Well, the total number produced in the United States in 1938 was 82 million. In 1966 it was 2.5 billion. The average price of live broilers was 17 cents per pound in 1938. It was 15 cents per pound in 1966.

In 1953, I served with a committee appointed by the American Feed Manufacturers' Association to estimate livestock numbers and feed use for the next year. The statistics indicated that broiler numbers in 1954 should be about 987 million. One member of the committee suggested we could get some publicity by being the first to predict a one-billion-broiler

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Brooder cover is lifted from chicks, left, in a Bethlehem, N.C., family farm operation involving several 10,000-bird broiler houses. Above, closeup of chicks.

year. We squelched our colleague. We were interested only in an accurate prediction, not in publicity. But he had the last laugh. There were 1,048 million broilers in 1954.

In 1938, there was one major broiler area, the Delmarva Peninsula of Delaware, Maryland, and Virginia. In 1964, the 10 leading States in order of importance were Georgia, Arkansas, Alabama, North Carolina, Mississippi, Texas, Maryland, Delaware, Maine, and California.

In Delaware I was told that a major factor in the beginning of the industry in the 1930's was the success of Mrs. Wilmer Steele in growing broilers for the New York market. Wilmer Steele retired from the Coast Guard to join his wife in the broiler business and went on to become a leader in feed manufacturing, poultry processing, and banking in his area.

The low cost of modern broilers is not the sole reason for the great increase in consumption. There have also been major improvements in quality. About 1940, one writer stated: "A broiler is a scrawny, blue-looking object that tastes good in spite of its unfortunate appearance."

Why were they blue looking? Partly because they had no fat and therefore no yellow pigment in the skin. It was considered impossible to put fat on a young chicken. The other reason for the blue look was dark pigment in the skin of the dark-feathered broilers.

All the early broilers were Barred Plymouth Rocks, with black-and-white barred feathers. Then the general-purpose red-feathered New Hampshire breed was developed by Andrew Christie and other New England poultrymen. These birds excelled in growth rate and efficiency, but the industry still clung to barred feathers. They crossed Barred Rock males with...
New Hampshire females to produce fast-growing barred-cross birds. But the New Hampshires were big boned and angular, and even well-fleshed birds sometimes looked scrawny when they were dressed.

The big increase in consumption of broilers during World War II convinced industry leaders that there were still greater opportunities for expansion if better quality birds could be produced. Under the leadership of Howard Pierce of the Great Atlantic & Pacific Tea Co., Inc., a series of Chicken-of-Tomorrow Contests was held, with the financial support of the A. & P. Co. Breeders submitted samples of eggs which were hatched at a central point. The chicks were reared to broiler weight, slaughtered, dressed, and scored for growth rate, efficiency, viability, fertility, hatchability, and dressed grade, including a grade for conformation (shape or build).

The New Hampshire could provide everything except conformation. The Chicken of Tomorrow had to have a broad breast and thick drumsticks. One needed only to look in the Standard of Perfection to find the model with the right conformation. It was the Cornish. But for years the Cornish were reputed, more or less accurately, to grow slowly and inefficiently, to feather slowly, to lay poorly, and to have low fertility and hatchability. A combination of the good qualities of New Hampshire and Cornish seemed like a good approach to the Chicken of Tomorrow.

However, some breeders concentrated on improving the White Plymouth Rock from the standpoint of growth rate and conformation.

National contests were held in 1948 at the University of Delaware and in 1951 at the University of Arkansas. For the award ceremony in 1951, the principal address was given by Vice President Alben W. Barkley. Dr. Lewis Webster Jones, president of the University of Arkansas, presided, and Governor Sid McMath welcomed the visitors—including a congressional delegation. But the man of the hour was Charles Vantress of Live Oak, Calif. His Cornish-New Hampshire crosses had won the first national contest in Delaware, and they repeated their victory in the second. In 1940, the Vantress Poultry Breeding Farm was almost unknown beyond the boundaries of its own community. With the impetus of the two victories, it quickly grew into one of the largest international poultry breeding operations.

Today's broilers are produced with maximum efficiency by crossing two strains having different characteristics. The strain furnishing the female parents must lay well and hatch well to produce broiler chicks efficiently. Of course, its growth rate and conformation are important, too. In the strain furnishing the male parents, the breeder puts primary emphasis on growth and conformation, letting egg production and hatchability be secondary.

Male broiler lines derive mostly from Cornish and New Hampshires.

Cut-up broiler fryers in Takoma Park, Md., supermarket.
The female lines are derived mostly from White Rocks.

But even a modern broiler, with his genes all properly arranged, doesn’t grow very well on an old-fashioned diet. We tried this at the University of Wisconsin in 1957, feeding male broiler chicks a diet that was recommended in 1907, one that was recommended in 1932, and one that was recommended in 1957. At 9 weeks of age, the average weights of the three lots of chickens were 0.6, 2.0, and 3.2 pounds, respectively. The pounds of feed required per pound of gain for the three groups were 5.2, 3.0, and 2.0. In the 1930’s, broilers reached 3 pounds in 14 weeks on 4½ pounds of feed for each pound of gain. Now 3-pound broilers are grown in 8 weeks with 2.25 pounds of feed per pound of gain.

Research on vitamin D by Hart, Halpin, and Steenbock at the University of Wisconsin in the 1920’s made production of poultry independent of sunshine and permitted it to move indoors. The Wisconsin investigators developed feeds containing corn, wheat byproducts, meat meal, milk byproducts, alfalfa meal, minerals, and cod liver oil. Early broiler feeds were of this type, and most of the time they were satisfactory. But knowledge of the chick’s requirements was sketchy, and nobody knew much about the normal variation in vitamin content of feedstuffs. Vitamin deficiencies were rather commonplace.

Information on nutritive requirements accumulated rapidly, and in 1947 Scott, Singsen, and Matterson developed the Connecticut Broiler Formula, based largely on research on the requirements published by the Universities of California, Cornell, Texas A. & M., and Wisconsin and the U.S. Department of Agriculture. By using synthetic vitamins, the Connecticut investigators were able to reduce the levels of wheat byproducts and increase the corn, thus raising the energy content of the feed. Higher energy levels made it possible to put some fat and yellow color into the skin.

Broilers need protein, too, but we never had enough protein to feed our livestock properly until 1957. We achieved sufficiency by an enormous increase in production of soybeans and soybean meal. Formerly, soybean meal was considered unsuitable for chickens, but research revealed how to supplement it with vitamins and minerals, and it is currently our major source of protein.

The last big step in supplementing soybean meal was taken in the USDA laboratories at Beltsville in 1946 when we showed that soybean meal plus an unidentified vitamin from cow manure was as effective as animal proteins. The unknown vitamin was shown to be formed in manure by fermentation. In 1948, vitamin B₁₂, isolated in the laboratories of Merck and Co., proved to be identical with the “cow manure vitamin D.”

Left, lazy susan rotary table with 24 bins for ingredients helps assure accurate mixing of vitamins and other microcomponents in commercial feed company “microroom” facility. Right, control panel at another feed mixing installation.
Soon it was being produced in large quantities by more esthetic fermentations.

In 1950, Stokstad and Jukes of American Cyanamid Co. were experimenting with a fermentation residue from the production of the antibiotic, chlortetracycline, to determine its effectiveness as a B<sub>12</sub> supplement. They found B<sub>12</sub>, but they also found another growth-promoting substance which turned out to be the residual antibiotic which had not been completely removed in processing. Low levels of antibiotics in feeds improve growth and conversion of feed to broiler. Use of antibiotics since 1950 has saved an estimated 3 million tons of broiler feed. Even with use of the most sensitive methods available, no antibiotic can be found in the meat of broilers fed low levels of antibiotics.

Before World War II, broilermen tried to keep the death loss below 10 percent. Today a grower can’t stay in business unless he can keep death loss below 5 percent. Lloyd and D’Armi of the University of Delaware showed that average mortality in commercial flocks in Delmarva in 1952 was 7.2 percent. In 1962, it was 3.67 percent. Formerly, the biggest killer was the group of diseases called coccidiosis, caused by several species of microscopic parasites that attack the chicken’s intestinal tract. These diseases are still a problem, but they are quite effectively controlled by drugs called coccidiostats. Other important developments in disease control were vaccines against fowl pox, Newcastle disease, and laryngo-tracheitis.

Since 1950, antibiotics have been used to control Mycoplasma infections. Progress is being made in eliminating these diseases by testing breeding stock and slaughtering reactors.

Through a similar testing program, carried on by the National Poultry Improvement Plan, pullorum disease was largely eliminated from chickens even before the broiler industry began its rapid growth.

In 1938, in order to minimize infections, most broilers were grown in houses that were 20 by 20 feet. Such a house accommodated about 500 broilers. As methods of disease control improved, producers began to experiment with larger houses. Now most broiler houses are 40 or 50 feet wide. Ventilation is more difficult if they are wider. Length seems to be limited only by the amount of money the builder has or can borrow. Some new houses are windowless with “controlled environment,” including heating and cooling systems.

So today’s broilers have different genes, different diets, different family life, different life expectancy, and different environment than their predecessors. I mentioned earlier that the broiler’s personality also has changed. Growers used to explain the 20 by 20 house partly as a disease-control measure and partly as a means of preventing piling up and minimizing cannibalism. An unaccustomed noise might cause a whole population of broilers to pile up in a corner with many deaths resulting, or an epidemic of cannibalism might occur; and the greater the number of birds per unit, the greater would be the losses.

Today’s large broiler houses may have a few partitions or they may not. I have seen at least 40,000 broilers in one pen. Neither the 40,000 broilers nor their owners seemed concerned about piling up or cannibalism. Perhaps the geneticists, besides getting rid of the scrawny blue look, have also eliminated some of the broiler’s antisocial tendencies.

Or perhaps the better diet and better physical environment have reduced tension and frustration.

Broilermen worry about prices, about the number of chicks the competitors are starting, about viruses, about feed supplies, and about the merits of different coccidiostats, and ventilation systems.

The broilers just keep rolling along, increasing in numbers, and producing tastier drumsticks and white meat faster and more efficiently.