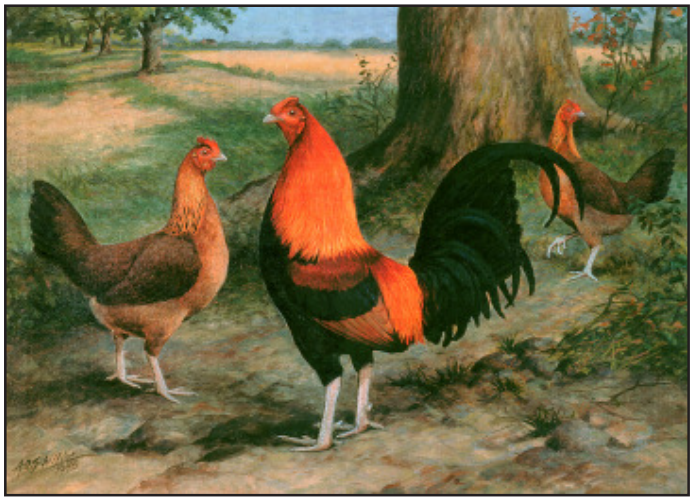
GENES

From the "Bantam Newspaper."

In all living things of nature, despite the many different types of cells in humans, poultry or any living creature, each one has the same 'Blueprint'. They all approximately contain the identical number and type of genes. (The Heredity Carrier). How then do some cells form one part of the body, such as eye, when other cells from the same blueprint form the heart, liver, skin, plumage and so on, in humans, fowls or other animals?



Old English Game Fowls

Scientists are only beginning to learn about the marvels of cell structure and growth. It was only a few years ago that they found out what it is that enables different cells to build different parts of the body even though every cell has the same blueprint, in physical make-up. This was the discovery of what scientists call 'Repressor Substances'. The best way to describe these is to liken them to 'Switches' that turn genes on and off.

To understand what cells are, also what genes are made of, and what these switches are and how they work, these must be clarified. First-ail living things are made up of tiny units called 'Cells'. Each cell is made up of living material called 'Protoplasm'. Even though scientists have analysed the chemical substances that make up this protoplasm they have not even begun to put them together so as to make living protoplasm.

If we looked at a single cell through a powerful microscope we would see that the cell is surrounded by a membrane that encloses a grainy appearing material called 'Cytoplasm'. This material flows about within the cell, distributing nourishment and ridding the cell of waste products. Now within that cytoplasm is a large dot or sphere, and it is called the 'Nucleus'. All cells, except red blood cells, which are manufactured by the bone marrow, contains a nucleus. The nucleus is like the brain of the cell, directing the cell's activities. If the nucleus is removed or is damaged, then the cell dies.

What is inside the nucleus? Inside are the chromosomes, the genes and many other chemicals, including the basic materials for the switches. Think of all these inside each cell and most cells are so small that it takes a powerful microscope to see one. The beginning of life in the one cell is a single fertilized egg cell, much-much smaller than a pin-point. So it is true that life is made from a cell that small. But how do all the different body parts come from one single cell that small? It is complicated because not only are the various body parts different but there are also hundreds of different kinds of cells, bone cells, blood cells, muscle cells, nerve cells and many others. The different cells have many different shapes. Some are round, others are long and hair-like, some look like blocks, others are shaped like ribbons, cylinders or are even spiral, like a spring. Even the human body is made up of millions and millions of such cells. The question of how the single or original cell is able to grow and produce so many different things has not only puzzled scientists but has also been a large source of mystification.

A few years ago several French Geneticists suggested that somehow there must exist a thing called 'Repressor Substance'. In other words there must exist a 'switch' that turned off certain genes in one cell while other genes in that cell were turned on, so that they could grow into a certainty organ. But in another cell a switch would turn on the very genes that were turned off in that first cell, so it could build a different organ or body structure. Did their theory prove to be correct? Let's imagine we are looking inside the nucleus of a microscopic cell that is starting to form a body and see if these French Scientists were right. Let us say that about an hour ago the sperm from the sire with it's 23 Chromosomes reached the egg of opposite sex, also containing 23 Chromosomes. These combined to form 23 pairs or 46 Chromosomes, altogether, inside the nucleus of this cell. Right there, within a matter of minutes the complete set of blueprints for an entirely new structural body was decided upon. The entire system is unified so that the digestive system for example operates in harmony with the nervous system, the blood system and all other parts to make a complete structure.

All this begins inside the nucleus of a cell, so small that a pin-point looks huge by comparison. Take the case of the Human Body and compare the huge computer that man has made. The Human Body is far far

more complex, better made and equipped to do far more kinds of work under all kinds of conditions than any machine man has ever made. While electronic brains can solve mathematical problems, can they build other machines like themselves with problems to work on, and when or how many. The versatile human brain is easily capable of such decisions. The computer takes up a lot of space, the human brain's very compact. As we realize the fowl and animal brains, to a certain degree operate the same for them. Think of the millions of cells in all living creatures and each cell is more complex than any computer.

Another thing too, if the calculating machine breaks down, it can do nothing for itself. A break or a cut in a human or fowl body usually is repaired by the body itself. So there is a big difference between the living bodies and machines that man makes.

All living creature's bodies are certainly made in marvellous ways and learning something about them helps us to appreciate better how they function, the part that the hereditary code of genes play in their reproduction.

We don't know how many genes are involved in poultry. There must be at least a dozen pairs involved in body size alone. Other genes involve egg size, egg shape, colour, comb, lobes, etc., so there are many.

What is a chromosome? If we could see one it would appear to be a fine hair like line. But it is so small that the details of it cannot be seen even with powerful microscopes. However the general function and composition of chromosomes are generally understood by use of a variety of other methods of analysis. These studies show that chromosomes are the bearers of the genes.

Gold and Silver Campines

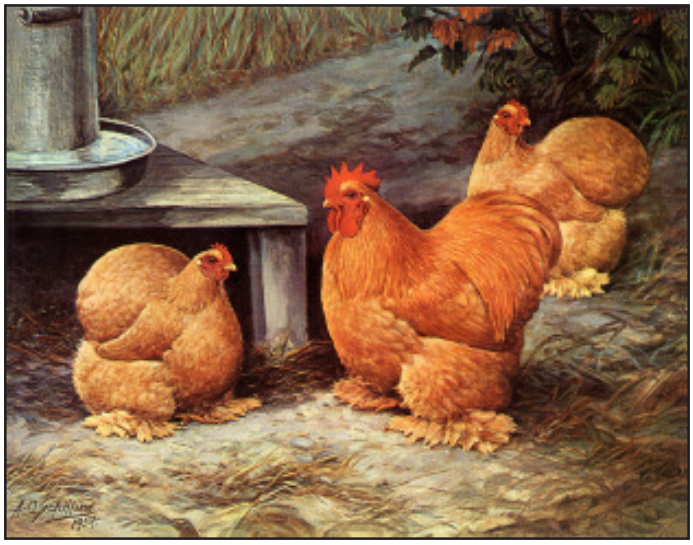
A gene is a complex molecule made up of many smaller molecules linked together to form a chain. It weighs only about two-ten-trillionths of an ounce, and is made up of a chemical substance known as deoxyibonucleic acid. A more simple expression is D.N.A. (the code name). This stands for the chemicals that make up the complex molecule we call a gene. That molecule carries the inheritance code. The sire's sperm provides half of the D.N.A. and the female's egg the other half.

The D.N.A. contains the blueprint for the chick, offspring or progeny. Awe inspiring is the fact that it would take a large public library to contain as much information as the D.N.A. contains.

Even more inspiring is it, that all this information is passed onto each new cell that is formed, so that every cell of the bird's or animal's body has the same information as the original fertilized egg cell. That applies to cells of the heart, the eyes, the combs, the wattles, in fact all the other body parts and plumage. Where the 'switches' come in - if all the cells contain the same blueprint, how does each cell use only that part of the code it needs to build it's own part of an organ? Every chick has it's eyes where they belong, ears, combs etc. and they always grow in the same place. What makes the right organs grow in the right places? This is where those 'Repressor Substances' or 'Switches' come in. In 1 967 scientists discovered that certain Protein Molecules, those infinitely versatile building blocks of life, were they long looked for repressor substances, the switches that turn genes on and off. This discovery proved correct the theory of those French Scientists. So it is a protein molecule that makes possible the selection of one particular part of the blueprint while filing the rest away. The Cell Nucleus contains the Chromosomes that carry the genes which are complex molecules made of chemical called D.N.A.. The D.N.A. which contain the baby chicks blue print is the same in animal. This D.N.A. directs the manufacture of various types of protein molecules which in turn pick and choose different parts of the blueprint to manufacture to complete the new chick or animal. Yes, that's a pretty good summary of it, all the various steps are tremendously complicated. Maybe someday one can tell more about how the cell makes these 'Protein Switches' and how these switches go about selecting the different parts of the blueprint to manufacture.

It can be told what has been learned so far. You have to remember that the ideas of science changes rapidly, so that before long there may be further changes and enlargements on what is known at present. The switches perform a huge job, to set the stage. Let's see how large this inheritance code is and how much of a job these switches have in turning it on and off to produce certain parts that are needed. As we have noted before the gene is a complex molecule whose chemical composition is called D.N.A. and is made up of many smaller molecules each of which is called a Nucleotide. A Nucleotide is made up of one

molecule of sugar and one molecule of phosphate and an organic base. There are four different kinds of Nucleotides and various numbers of these are linked together in so many different arrangements that they can't be counted. These different arrangements make what we call a Code or Blueprint. This Code or Blueprint contains the genetic information for each bird and animal including the human. The nucleotides are like different letters of the alphabet, the different combinations of letters produce a different meaning, so we can convey untold amounts of information. Even though there are only four types of Nucleotides they can combine in many different ways. As an example take the four letter word "same", if we rearrange the letters we get seam with a different meaning. Still another arrangement is mesa and another different meaning.



Buff Pekin Bantams

How many of these Nudeotides are combined in one gene? There may be 1,000 or more of them in one gene and remember, too, there may be tens of thousands of genes strung together to make one chromosome. Even a human cell contains 23 pairs of Chromosomes or 46 in all. Fowls may contain 12 pairs or more. So there is a tremendous amount of information that these switches have to turn on and off. With so many combinations available, the possibility of varieties in this code is practically unlimited. That is why hardly any two persons, chicks or animals look exactly alike.

How the switches are made. How can these D.N.A. Molecules be the same in every cell and yet different cells use only that part of the blueprint they need. By taking a look at an imaginary formation of a chain of D.N.A. under a microscope it is shaped like a spiral ladder. The double twisted parallel chains of D.N.A. separate themselves one from another. When that happens these strands of D.N.A. are building strands of what is called R.N.A. What is R.N.A.? It is the code name for Ribonnucleic Acid. It too is a long chain of molecules similar to D.N.A. but it's chemical composition is a bit different. Also its function is different. We might say that the D.N.A. is the architect that has the Master-Plans. The R.N.A is the messenger or the Engineer that the Architect sends to carry material and information to the right location in the cell to build our protein switch. So the D.N.A. gives the orders from it's master plan and the R.N.A. takes them and the building of our Protein Switches. These in turn build others just like themselves, eventually forming the body part' Blueprinted in the original D.N.A..

What exactly are Proteins? Proteins are highly complex substances found in all living organisms, They make up about 80% of the dry weight of muscles, about 70% of the dry weight skin and about 90% of the dry weight of blood. These proteins direct the chemical process of life, or what we call Metabolism. Are there different kinds of proteins? There appear to be many types. Infact, there maybe at least one protein for every chemical process that occurs in a cell. All proteins are built from the same material called Amino Acids. There are about 20 Amino Acids in each Protein Molecule. These Proteins also form chains that contain different sequences of their Amino Acids. The function of each protein depends upon the pattern of it's Amino Acids.

Be checking first of all the D.N.A. gives orders to the R.N.A.. In other words it arranges the R.N.A. in a certain sequence. Then the R.N.A. takes this message and begins collecting the different chemicals that it wants and forms various proteins or switches. It collects only the pattern that the D.N.A. has indicated. These proteins build others like themselves until a certain body part is complete. That is the general outline. But what happens if the Protein switch changes it's pattern and builds something different? This protein switch is not free to change its long chain of Amino Acids. It must stay fixed in the pattern in which it was placed. That is an unchangeable law put into this mechanism. Countless switches are built by the R.N.A. messenger under order from the D.N.A. Some of these switches begin building bones, others build the eyes, still others the heart and so on. Combinations of these protein switches act upon the genetic material in the cell, repressing that part of the code not needed. So then these protein switches build only one particular part of the body by turning on that part of the inheritance code in the gene while at the same time turning off another part of the code. It is really amazing when we realize that all this individual building is coordinated with the building in every other part of the body.