**BLOOD AND BONE CHANGES IN A BREEDING HEN**

**By Dr.T.G.Taylor.**

When I was asked to write about budgerigar biochemistry or anatomy I thought I would combine both subjects in a single article by discussing the chemical changes which occur in the blood of hen budgerigars in the ten days or so which elapse between putting in the nest boxes and the laying of the first egg, and the anatomical changes in the skeleton which accompany the blood changes. Both blood and bone changes are closely related to the egg laying process.

A good sized hen weighs about 50 grams (nearly 2 ounces) and during the week before laying her first egg she gains approximately 10 grams; that is', her weight is increased by 20%. This additional weight is due to several factors; an increase in size of the ovary and oviduct, an increase in blood volume, increased deposition of fat and to new bone formation. Associated with an increase in size of the ovary, itself stimulated by the gonadotrophic hormones of the anterior pituitary gland, is the secretion into the blood of female sex hormone, (oestrogen), and the other changes listed above are largely due to oestrogen.

Egg yolk consists of approximately half water and half solids, and of the latter, half is protein and half fatty substances. Yolk fats and proteins are manufactured in the liver and they are transported to the ovary in the blood. The ova remove the yolk solids from the blood, thereby growing larger and larger, and when fully grown they are shed into the body cavity and engulfed by the funnel of the oviduct. The ova ripen in succession and are shed at intervals of 48 hours.

It is not to be wondered at that the amounts the fat and protein in the blood increase at this time; and the levels remain at a high level throughout the period of laying. After the last egg is laid the amounts of fat and protein fall gradually until the non-breeding levels are reached. Fat and protein are not the only blood components that increase during the pre-laying and laying periods; the calcium, phosphorus, vitamin A and riboflavin concentrations in the blood also increase, and it may well be that other vitamin levels are also augmented. It is in this way that adequate amounts of vitamins and minerals in the egg are ensured, though the increases in the blood vitamin levels mentioned above are dependent on there being adequate tissue reserves in the body of the bird and adequate supplies in the food.

It is interesting to note in passing that in spite of the fact that the blood calcium level more than doubles during the laying period and that the egg yolk is relatively rich in calcium, there is still not enough calcium inside the egg to provide sufficient calcium for the calcification of the skeleton of the chick, and approximately 80% of the calcium found in the bones of the chick at hatching is drawn from the shell during the incubation period.

The changes which occur in the skeleton during the pre-laying period are related to the provision of calcium for the calcification of the egg shell (the shell is composed almost entirely of calcium carbonate). During this period a whole new system of secondary bone is laid down in the marrow cavities of most of the bones of the skeleton and by the time the first egg is due to be calcified, this new bone almost fills the marrow cavity in some cases. When a femur from a non-laying bird is shown side by side with that of a laying bird the extent of this medullary bone, as it is called, is clearly shown.

The medullary bone takes the form of fine interlacing spicules which grow out from the inner surface of the marrow cavity. The spaces between the spicules are occupied by the blood vessels and red marrow tissue. Characteristic changes occur in medullary bone during the process of egg shell calcification. Shortly after an egg enters the shell gland, rapid bone destruction sets in and it persists throughout the period of shell formation (approximately 24 hours). After the egg is laid, the bone forming phase gives rise to one of bone formation and the calcium required for calcification of this bone is derived from food calcium absorbed from the intestines, provided the birds are supplied with ample cuttlefish bone or other sources of calcium. During the bone destroying phase, calcium and phosphorus are released into the blood; the calcium is deposited on the shell and the phosphorus is largely excreted in the urine and voided in the droppings.

These cyclic changes of bone destruction followed by bone formation continues until the marrow cavity returns to the resting condition. The formation of medullary bone is under the influence of oestrogen, but the male sex hormones are probably involved as well. The stimulus responsible for the initiation of the bone destroying phase is not known for certain, but it may well be the parathyroid gland.

The breeder has little or no control over these hormonal effects. All he/she can do is to make sure that the birds are really fit before mating, to feed the birds a complete diet and leave the rest to nature.