Photos by Jaynee Salan, © 1989

A beautiful cluster of seven pied ringneck nestlings five weeks old.

American Pied Indian Ringnecked Parakeet…

a developmental journey

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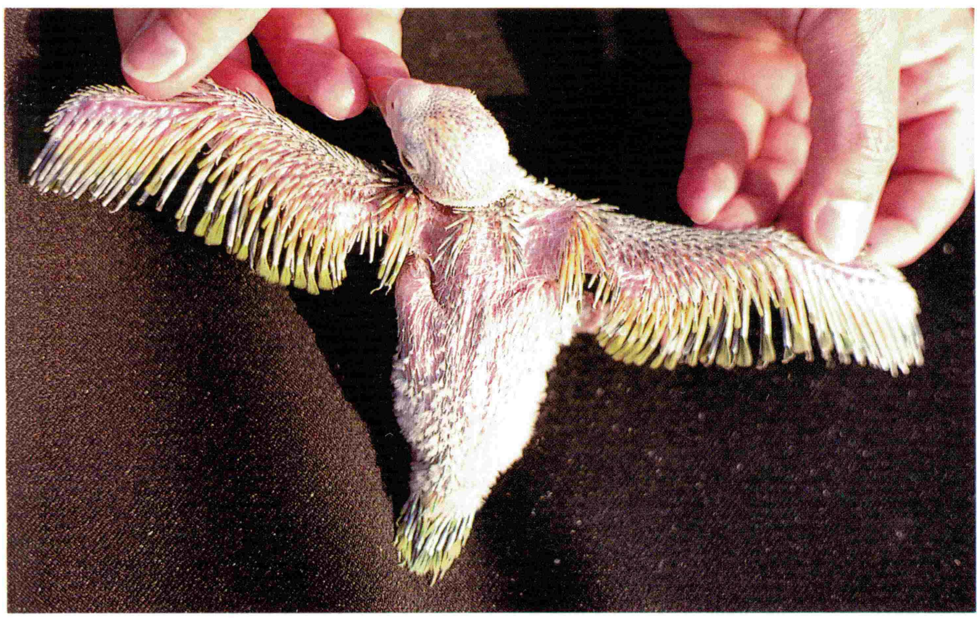
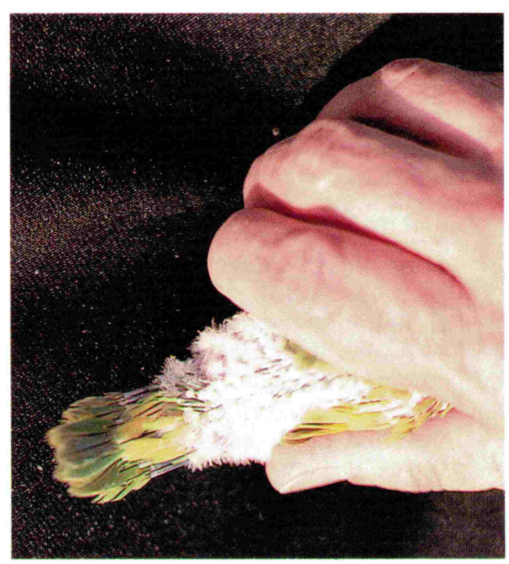
Genetics have come a long way from the days of Gregor Mendel, when a gene was considered an information-containing element of unknown chemical nature that gave rise to an observable trait such as Mendel's experiments with round or wrinkled peas. Working with pea plants, Mendel discovered the fundamental principles of heredity in the 1860s. Clearly, regulation of gene expression is a major key to development. Discovering the genetic underpinnings for this dramatic transformation is a major challenge of biology today.

We are now in an era of biological discovery of unprecedented excitement and achievement. Genetic information is expressed by its translation into proteins of specific structure and



A two-week-old nestling showing the initial mosaic feather tracking. The developing yellow primary flights can be seen while still encased in the keratin sheaths.



The yellow mosaic pattern is already developing in the tail feathers of this two- to three-week-old nestling.

Six-week-old pied ringneck chicks.

function which, in turn, brings about an organism's phenotype (the expressed traits).

Mutagenesis, the creation of mutations, can occur in a number of ways as the cells respirate, repair, and recombine. This can lead to base-pairs of substitutions, insertions or deletions. Since determining how genes are translated into proteins in the 1960s, scientists can give a description of inheritable changes that arise.

The DNA (deoxyribonucleic acid) inherited by an organism, controls the activity of each cell by specifying the synthesis of enzymes and other proteins. A gene does not build a protein directly but, instead, dispatches instructions in the form of RNA (ribonucleic acid) which, in turn, programs protein synthesis. Cells are governed by a chain of command: DNA - RNA - protein. The scheme is known as the "Central Dogma of Molecular Biology," a term coined by Francis Crick.

The Developmental Process

Very early in embryonic development a process called *gastrulation* gives rise to the first large scale cell movement in which cells begin to specialize and are committed to a position within the developing embryo. Measuring position through chemical signals creates grated signals. For example, a salamander can regenerate some body parts with the chemical stimulant vitamin A.

John Gurdin, a British scientist, conducted a series of experiments with frogs in the 1960s. He took fully specialized (committed) intestinal cells from a white tadpole, broke open the nucleus of the cell and inserted that package of instructional genes into a green frog's fertilized egg whose own nucleus had been killed. The green frog's egg now had the nucleus, the instructional genes, of a white tadpole's intestinal cell. It should be able to instruct the embryo to become a white tadpole rather than a green tadpole.

The experiment was done hundreds of times and, in a few cases, it worked. Gurdin proved that one cell in the body could carry the genetic blueprint for the entire animal.

The avian genome (organism) consists of some thousands upon thousands of individual genes, each of which serves a function. The genes are arrayed along pairs of chromosomes. Ninety-five percent of the genes encode for routine functions and are called housekeeping genes that perform general duties within all cells. They eat, metabolize, breathe and do everyday things.

Master control genes comprise the other five percent. These central regulatory switches organize cells into patterns that make up tissue, and their far-reaching effects tell the cells where to go and what to become within the developing organism.

We look at master control genes as programming chips, setting up genetic programs and turning on banks of lower genes and coordinating their activity. This, in turn, creates a "cascade of gene expression" and, multiplied over many cells, determines what kind of tissue will form. If that gene is mutated, then a different cascade takes place. A tiny change in this master control gene completely alters the body pattern of the bird and transforms the body tissue. In this case, the pied ringneck has a reduction and partial blockage of melanin deposition. Yellow birds are manifested from a complete blockage of melanin deposit; blue birds result from a blockage of the capability of conversion of carotenoids or lipochromes. A true pied mutation is the result of a partial blockage of melanin deposit, occurring in the nest as a neonate. A mosaic pattern appears as the feather tracking develops for the first time, as is the case with this bird.

Homeotic Genes

Master genes not only control spacial patterning but also control timing. That is, genes which control particular aspects of the timing of development and body patterns are called homeotic genes. Homeotic genes, genes that control the overall body plan of an animal, are currently receiving a lot of attention in the field of research regarding the regulation of development. Homeotic gene sequences have also been identified in insects such as fruit flies (drosophila) and other insects, crustaceans, annelids (microscopic worms), amphibians, birds and mammals. These are animals with a body plan containing repeated segments of genes, significant in the formation of the segmented pattern and in the developmental determination of each of the body segments.

The Legacy

I have never felt more proud to be an American aviculturist than on that particular day in May 1983, when the pied ringneck chick appeared for the first time in the nest. I had finally received my breakthrough after 12 years of research. As I took the nestbox off the wall and laid it in the sun for a better look inside, tears welled up in my eyes and a shiver went up my spine. Every breeder who has ever raised birds dreams of this happening one day, and those of you who have had this happen know the feeling is impossible to describe.

Equally memorable was the occasion in San Francisco in 1985 at the AFA convention where I was recognized for my work with an Avy award for achievement with the development of this bird.

Physical Traits

After spending six more years working to establish and out-cross this bird, we know now that this mutation will hopefully become what aviculturists come to think of as a cornerstone of the new plateau for varigated colors in future ringneck mutations.

The bird is astonishingly striking visually. This is a simple recessive, blue-eyed individual. They are as hardy as the green phase and are as large, retaining quite a remarkable size. The mosaic pattern develops in the nest and retains its beautiful varigated pattern all of its life. The eye color is *always* blue. In fact, I can find all members of this pure strain throughout the aviary when I look at their eye color. They all have striking sky-blue eyes, whether they are green split pied or the visual mutation. I am also finding that the outcrossed birds are retaining some visual nuances, such as the eye color, that have become traits of this mutation. Hopefully in time I will be able to detect other split traits visually besides the feather ticking at the nape of the neck which is also classic to pied birds.

Probably the most astounding feature I have discovered about this mutation is that *all* of the male birds no longer acquire a moustachial ring. It is absent forever!

The oldest visual male is six years old and has no ring. Ever since I discovered this, I have always thought of it as though the artist were signing her work. However, this strain does produce as many males within the gene pool as females. The ratio runs about fifty-fifty with an occasional extra bird. The extra bird will usually be a male.

The color pattern on each bird affects all the loci on the chromosome and the bird displays a varigated color in all parts of its body. No two birds look alike which, again, is classic to pied birds.

The History

When the Psittacine Registry was completed in 1947 in England, there were only 42 lutino ringnecks known to exist and these were the result of breeding experiments done by the Duke of Bedford and Alfred Ezra since 1918.

In 1949, Harold and Letha Rudkin acquired the first two lutino birds and two green split lutinos eventually arrived in southern California.

By 1950, "Rud" was beginning to produce progeny and simultaneously the Duke of Bedford obtained two blue ringnecks from India. There were never any accounts as to their origin but the blues were immature when they arrived in England. The blue color is also referred to as "cyanistic," meaning blue. The only other blue bird known to exist at that time was an account of a blue ringneck during the 1920s owned by M.G. Malleck of Calcutta but no attempt was ever made to reproduce from it. It was reputed to have lived in a cage made of gold.

By 1952, the Duke of Bedford sent two young blues to David West in California and two additional blues in 1953.

In 1954, Rud acquired an adult pair of blue ringnecks and two youngsters from Dave's aviary and work then commenced to build a strain of blue ringnecks. Experienced budgie breeders at that time knew that once the lutino and blue mutations were combined it would be possible to produce an albino form of the ringneck. The difficulty would lie in the fact that up to that time no lutino male ringnecks had been raised in California.

By 1959, Rud had a fine, adult male lutino mated to a blue female. From this pairing in 1959 and 1960, six young were produced, five lutino females split for blue and a dominant green male split for lutino and blue.

The first albino produced was bred from a brother and sister mating; green split male lutino and blue and a female lutino split blue. The nest revealed three youngsters consisting of a lutino, a blue and an albino. When the albino was partially feathered, the parents attacked and killed it. In the spring of 1968, Rud's patience was rewarded when a pair of blues produced one albino and one blue chick. The original albino which died was a male. It was given to the Los Angeles County Natural History Museum.

Because of the extraordinary vision and unwavering commitment of David West, Rae Anderson, Harold Rudkin, Paul Schneider and other premier breeders of their time, we have this astounding bird today. All of these men and many more since will always be my heroes. ●