

CONCERNING POULTRY

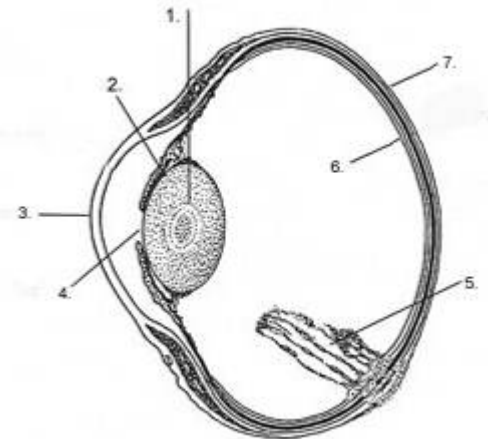
THE EYES

Photo above: Elio Corti.

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The eye

The main structures of the eye of the chicken are similar to those of other vertebrates. The outer layer of the eye consists of the transparent *cornea* at the front, and two layers of *sclera* – a tough, white collagen fiber layer which surrounds the rest of the eye and supports and protects the eye as a whole. The eye is divided internally by the *lens* into two main segments: the *anterior segment* and the *posterior segment*. The anterior chamber is filled with a watery fluid called the *aqueous humour*, and the posterior chamber contains the *vitreous humour*, a clear jelly-like substance.

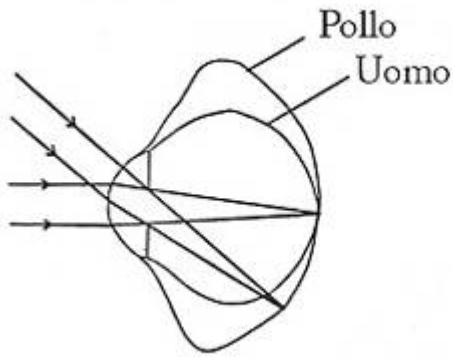


Right: Chicken eye.

1. Lens. 2. Iris. 3. Cornea. 4. Pupil. 5. Pecten. 6. Retina. 7. Sclera.

The *retina* is a relatively smooth, curved multi-layered structure containing the photosensitive *rod* and *cone cells* with the associated neurons and blood vessels. Rods are more sensitive to light, but give no colour information, whereas the less sensitive cones enable colour vision. Night-vision relies on the rods, while daytime vision mainly relies on the cones. The chicken's eye has more cones than the human eye and less rods. That's why chickens have poor eyesight in the dark.

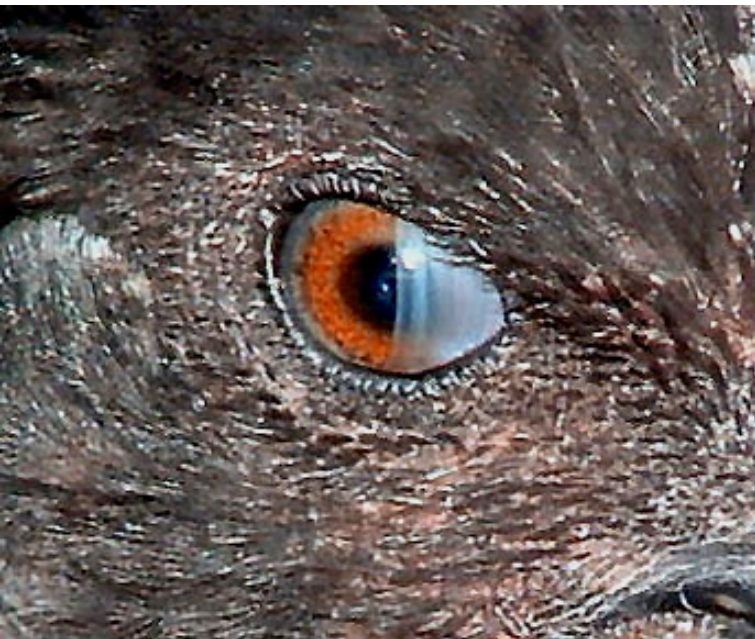
There is one structure, the *pecten oculi*, which is unique to birds. It is a poorly understood body consisting of folded tissue which projects the retina. It is well



supplied with blood vessels and appears to keep the retina supplied with nutrients and may also shade the retina from dazzling light or may act as aid in detecting moving objects.

Left: Different visual abilities. Schematic sketch of human (*Uomo*) and chicken (*Pollo*) eye that have been overlapped through an adjustment of their respective size, so that the polar diameters are identical.

The chicken's eyeball is flatter than the human eyeball. Unlike mammals, the chicken retina is nearly equidistant from the lens at all points, so visual acuity is uniform throughout most of the field of vision.



Left: The 'third eyelid' of a chicken. Photo: Pauline van Schaik.

Eyelids

The eyelids of a bird are not used for blinking. Instead, the eye is lubricated by the nictitating membrane, a third concealed eyelid that sweeps horizontally across the eye like a windscreen wiper. The nictitating membrane is somewhat transparent and it also covers the eye and acts as a contact lens in many aquatic birds when they are under water. When sleeping, the lower eyelid rises to cover the eye.

The chicken's eye is well supplied with tears that drain from the eye into a collecting sac and then into the nasal

cavity via a special duct. A very fine, sensitive, transparent membrane called the conjunctiva covers the surface of the eye ball and the inside of the eye socket.

Eye sight

Vision is the most important sense for birds. With their eyes on the sides of their heads, chickens have a wide visual field and can almost see completely around. (300 degrees) However, this is also a disadvantage, as each eye sees a separate image (only 26° binocular), so the chicken can hardly perceive depth when its head is still. The chicken brings this about by moving its head, which creates a divergence between objects in the foreground and objects further away. The second aspect is that the chicken can actually see better if they keep their head still. (Chickens cannot roll their eyes from left to right and back, like we can). That is why, when you see a chicken walking, the head is quickly moved forward with each step. And when a chicken is looking at you, it first turns the head and then looks at you with only one eye.

The chicken's vision is rather similar to ours, except that birds have a higher threshold of light intensity; chickens perceive light up to and over 100 Hz as flickering, while we see this as a constant light stream.

A new study has found five types of light receptors in the chicken's eye. While humans can only see red, blue and green, chickens can also detect violet, including some ultraviolet. In addition, the cones in most avian eyes have a specialized structure that could be described as 'cellular sunglasses': a lens-like drop of oil within the cone that is pigmented to filter out all but a particular range of light.

Nevertheless the great attention devoted to the visual function by the researchers, there are things that still need clarification, for instance the degrees of individual variability. We already know some breed differences exist: Malay go to sleep later than other chickens and they are still able to see in the dusk.

Windows to the soul

Beyond being described as windows to the soul, eyes are often regarded as windows to the general health and well being of the body. Chickens can be troubled by diseases or infections, which sometimes are noticeable in the eyes.



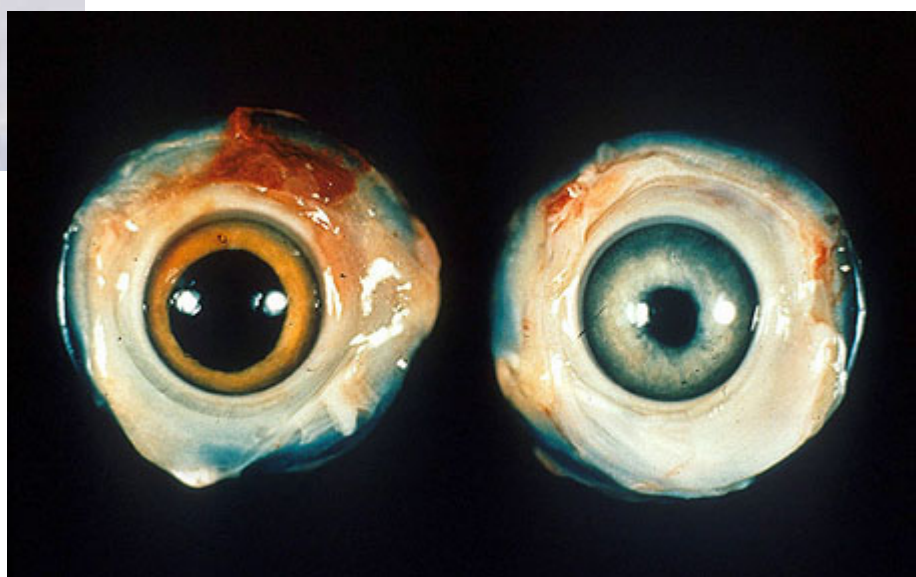
For example, *avian pox* (caused by a virus) typified by nodular lesions in the (unfeathered) skin – head, comb, wattles - can also develop around the eyes.

Left: Avian pox.
Photo: Monique de Vrijer.

Below: Normal chicken eye on left. Eye lesions and irregular pupil caused by Marek's disease on right.
Photo: United States Department of Agriculture. <http://www.ars.usda.gov/>

Marek's disease is another viral disease of chickens, developing tumors in nerves and causing lameness and paralysis.

Tumors can also occur in the iris and cause irregularly shaped pupils and blindness. Chicks can be vaccinated on the day of hatching, but recent studies have shown that conventional *Marek's disease* vaccines may not prevent the formation of tumors in the eye.



Chickens suffering with respiratory diseases (*mycoplasmosis*, *Infectious Coryza*) show discharge from the nose and eyes or even foam in the eyes. The face is often swollen around the eyes and wattles, depending on the severity of the infection. These infections do not damage the eye itself, but cause discomfort to the bird, leading to rubbing and scratching of the eyelids and, frequently, even vision may be affected because of the swelling.

The salmonella bacteria can cause several different eye infections, such as purulent *conjunctivitis* or *ophthalmitis*, both marked by the discharge of pus and /or inflammation of the eyelids and the conjunctiva (the membrane that lines the eye).

Also *Aspergillosis* – a fungal infection, caused by a fungus that is often present in poorly dried litter - may cause eye problems. It commonly causes the infection of the chicken's respiratory tract, but it may affect the eyes as well. The eye becomes inflamed and severe damage can occur.

Right: Cockerel suffering with respiratory disease; the face is swollen around the eyes and wattles.

Photo: Pauline van Schaik.

Chickens rely heavily on their sense of sight to carry on their daily activities, thus a bird with eye problems is at disadvantage in competing for food, water and even its social position in the pen. Separation of infected birds from the unaffected is crucial as a control measure and to give them the extra care and support they need.



In case of bacterial eye infections you can clean the eyes with a non-medicated eyewash for pets or humans. For pox, the lesions can be treated with an iodine solution such as Lugols or Betadine. Respiratory diseases can only be treated with antibiotics bought with a prescription from a veterinarian. Take an ill chicken to a veterinarian if possible. Because birds rely so heavily on their eyesight, any problems should be treated immediately.

A chicken will be fine if it's blind in one eye, but if it's blind in both eyes, you need to cage it if you decide to keep it.

The Third Eye

Chickens have light sensitive cells within the brain (in the pineal gland) that can perceive day and night and even the seasons. These influences are probably caused by the actions of the pineal gland, producing melatonin. In birds and reptiles the pineal is the so-called 'third eye', directly influenced by light. (In mammals the pineal gland is influenced through the eyes.) The melatonin influences the biological clock (day-night rhythms, seasonal rhythms) and this again influences the *hypothalamus* and through this the *pituitary*. The hormones produced here in turn influence metabolism and the sexual organs. In birds and reptiles the pineal is close to the skin and needs no interaction with the eye to register day/night cycles (this is where the notion of the 'third eye' comes from). Thus, their pineal gland is the master clock. Many of the oldest fossil vertebrates, had a socket in the skull that appears to really have held a functional third eye.

Eye colour

In chickens, we normally see only the coloured iris; it's really hard to see the white of a bird's eye because pupil and iris essentially fill the exposed portion of the avian eyeball. Although sometimes we see also the white of the eye – for instance in some breeds like the Brahma, where the eyelids often uncover a wider area of the inner eye. This is probably because of their characteristic 'face': they have (or should have) sunken eyes, with eye-brows, due to the traits they inherited from the game birds used to create them.

Right: A Brahma cock, showing also the 'eye white'. Photo: Bobo Athes.

At 'birth', all chicks show dark eyes, except for the albinos that lack both carotenoids and eumelanin, and show a bright red iris, actually being the reflection of blood in the eye tissue.

Only after the first 8 weeks of life a classification of the colour of the iris can be hazarded; however, the definitive colour is mostly reached only with the sexual maturity, when carotenoids and melanins show the maximum of their expression. In the female, after the beginning of the laying period, the colour of the eye can change once again, due to reduction or absence of carotenoids, which pass to the yolk.



Left: Chick with dark eyes. Photo: Pauline van Schaik.

The various anatomical structures of the eye have a pigmentation varying in intensity according to the genotype. Two populations of pigimentary cells are involved, having a different embryological origin, both able to synthesize eumelanin. Moreover, chromatophores are present, able to store the carotenoids. An important deposit of carotenoids is represented by the fat, whose colour, in the absence of these chemical compounds, would be grey blue.

In addition to these two colours, we should not forget the red, given by the capillaries in which the blood is flowing. On this point we have to be precise about the fact that the eyes of the rooster are often more intensely red, since he has a patrimony of red blood cells greater than the hen; a physiological situation to be found in humans as well. It happens that in a hen, during the laying period, anemia is more prone to appear and also easier to detect, mainly through a reduction in the intensity of the amount of red within the iris, also connected to the reduction of the yellow from carotenoids.

For the judges we have to add a piece of information that will avoid excessive penalization in the case of 'elderly subjects'. Even if in young subjects a radial disposition of the pigment converging toward the pupil can sometimes be observed, this situation is very frequent in rather old roosters, once normal. This particularity springs from the expansion of the capillaries of the iris, that can eventually intensify colour due to the pigments.

The two basic pigments carotenoid (orange) and melanin (brown) together with the varying amounts of blood, present on the surface of the iris, can produce eyes that are yellow, orange, fiery red, orange brown, dark brown or any of the many variations in-between.



The 'normal' eye colour of chicken is 'bay', meaning a reddish eye, an eye that is neither red nor yellow. The term comes from the Latin adjective *badius*, that has an equivalent in French *bai*, and in Italian *bazzotto*.

Left: Eye of a Sultan hen.

Below: Eye of the Spanish Fowl, hen.



Above: Bay coloured eye.

Right: Eye of a Rosecomb bantam.

Below right: Eye of a Hamburg bantam hen. Photos in this page: Elio Corti.

Scientific research has not yet fully revealed the genetics of the chicken's eye colour, and scientists don't always agree with each other's findings.

The genes involved in the colour of plumage and skin also influence the colour of the eye. *E* (Extended black) and *ER* (Birchen) plumage colour leads to a brown eye. The effect of the allele *E*, joined with that of the alleles *id+* (dun) and *idM*, leads to a dark brown eye and the fibromelanotic phenotype leads to a dark (almost black) eye, characterized by an impressive deposit of melanin in the whole eye. Other genes, such as the gene *B* (Barred) and the gene *eWh* (wheaten), have an inhibiting effect on the eumelanin in the eyes.





The recessive white *c* has scarce effects in this sense, also shown by the fact that the dark eye joins to the fibromelanotic phenotype of the white Silky (photo left).

To realize how many colours are requested by the standard and what variants are allowed, we can quote the characteristics of the Ancient English Fighter: It can have red eyes, red face and white legs, as well as black eyes, black-purple face with black legs and beak.

The Pearl grey eye

The intensification of the pigmentary colour doesn't occur when the capillaries are so thin that they don't give a red colouring to the iris. But the iris doesn't even become yellow and brown coloured if both carotenoids and superficial eumelanin are absent. If on the surface of the iris a layer of opaque granules is present, inhibiting the perception of the pigment set on the back side, the so-called pearl eye occurs; that is a characteristic at least desirable and also required by the standard of certain breeds with hard feathering, among which the Cornish excels.



**Above: Pearl eye in a Kulang Aseel hen.
Photo: Willem van Ballekom.**

The pearl eye, characteristic of Cornish and Aseel, desirable also in Malays and Shamo, demands the presence of two genes, at least: one gene reduces the diameter of the blood capillaries, the other gene has to be able to inhibit the deposition of carotenoids, and probably also a third gene, causing the deposition of the opaque layer of granules. The characteristic, on a polygenic basis of pearl eye, is inherited in a recessive way, but it doesn't seem to behave entirely in this particular way. The standard of the Cornish often allows the eye to vary from pearl grey to pale red. In this case, without doubt, some more dilated capillaries are present, in the absence of carotenoids. Clive Carefoot observed this in the Cornish bright yellow eyes, probably when the blood vessels are not visible and the carotenoids are present in high quantity. There is no doubt, nevertheless, that a breeder devoted to this breed has to aim for pearl grey eyes.