CONCERNING POULTRY

TWIN CHICKS

Text: Elio Corti and Elly Vogelaar

In the photo: 4-legged duckling.
Photo Nicky Janaway

Every now and again we see something in the Animal World to be special enough to hit the newspapers, for instance a four-legged chick. We view these pictures with a mixture of pity and disgust, but also with curiosity. This is not a 'malformation' like cross beaks, crooked toes or splayed legs - things we know how to explain, often being caused by incorrect temperature during incubation, a result of improper feeding of parental flocks or 'genetic faults' due to too much inbreeding. The four-legged chicks however are something completely different.

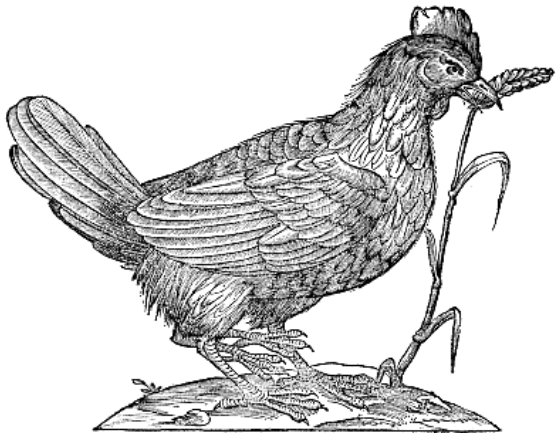
In the ancient times famous naturalists tried to unravel the reason for these monstrosities being born, but since even the 'normal' development of the chick in the egg was still a mystery, it took long before a corner of the veil was lifted. In the book of Ulisse Aldrovandi **(**[1] (physician and naturalist, Bologna 1522-1605) we read: Hippocrates (Greek physician, Kos 460 - Larisa c. 370 BC) says that the chick is nourished by the albumen and is formed in the yolk. But, Aristotle (Greek philosopher and naturalist, Stagira 384 - Chalcis 322 BC) claims that, on the contrary, the chick takes nourishment from the yolk and is generated from the albumen.
According to Aldrovandi we must not at all listen to Gerolamo Cardano - an Italian physician, philosopher, mathematician (Pavia 1501 - Roma 1576) - who affirms that wings and legs arise from the yolk.

Cardano is quoted by Conrad Gessner (Swiss physician and naturalist, Zürich 1516-1565) at page 420 of Historia animalium III (1555):
"In fact the wings and the legs are formed from the yolk. It is a proof of this the fact that from an egg with two yolks without a separating membrane chicks are born with four wings and as many legs, and they are regarded as a portent, like that which once happened in Milan, Gerolamo Cardano."
At the same page Conrad also wrote: "I hear that trilecitha eggs are found, that is, with three yolks: but more often with two yolks, and that usually they show a cavity in the middle of the shell."

Of course in those days there were no microscopes, X-rays or (digital) cameras, and the only way to understand the chick's growing was by each day dissecting an egg which a hen was incubating, and describing and picturing by hand the results. Volcher Coiter (Groningen 1534 - Brienne, Champagne 1576), assistant of Aldrovandi, was the first one to do this and his findings were published in Nürnberg 1573. So now the development of ONE chick was clear, but there still was no clue on how the monstrosities (mostly conjoined twins) developed….

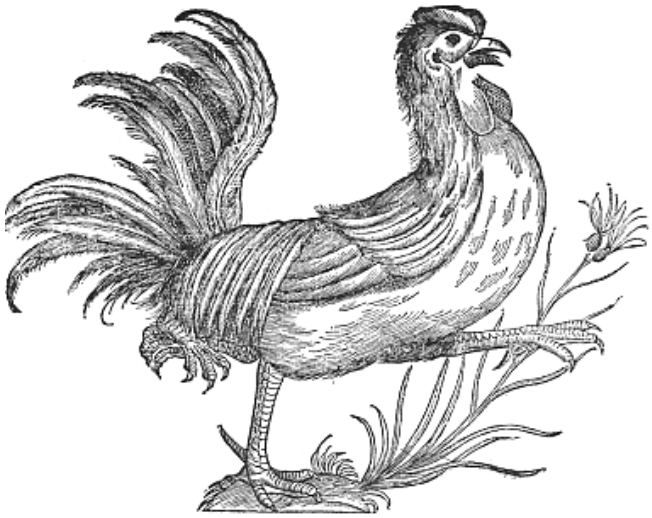
These are some monstrosities documented by Aldrovandi and by the humanist and encyclopaedist Lycosthenes, alias Conrad Wolffhart (Rouffach, Alsace 1518 – 1561)

Left: These twin chicks had only one head and parts their bodies were joined. - Colmar (France) 1538 AD - Drawn by Aldrovandi from *Prodigiorum ac ostentorum chronicon* (1557) of Lycosthenes.



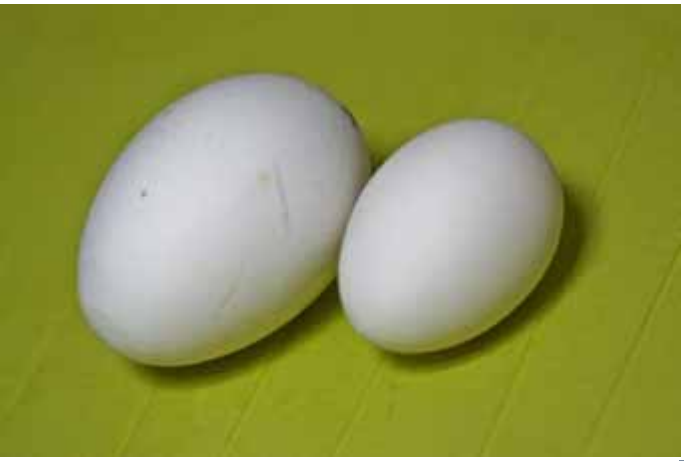
Right: four-legged hen.

Left: This skeleton is of a monstrous chick. Note that the foot which grows out from the rump has six - not five - toes.



Right: Four-legged monstrous rooster.

Since then many things have been examined and embryonic development of the domestic birds are relatively well understood and described. The reason of such birth defects causing 'monsters' can vary though. To keep with the 4-legged chicks: the medical term for this is Polymelia and it is also known in humans. The extra limbs are most commonly shrunken and/or deformed. Possible cause: sometimes an embryo started as conjoined twins (Siamese twins), but one twin degenerated completely except for one or more limbs, which end up attached to the other twin. Such a chick could come from a twin-yolked egg, or from eggs which are greater than normal compared to the others laid by that hen. A breeder would be able in noting this. Even Aristotle **([2]** described this (Historia animalium VI,3): "In some twin-yolked eggs a thin partition of albumen intervenes to prevent the yolks mixing with each other, but some twin eggs are not provided with such partition, and the yolks run into one another. There are some hens that lay nothing but twin eggs, and in their case observations have been done about what happens in the yolk. In fact one of them, which had laid eighteen eggs, hatched twins out from them, except from those which turned out to be unfertilized. The rest however were fertile, apart from the fact that one of the twins is bigger and the other smaller, while the last twin was monstrous". (Translation by Elio Corti.)



Above and right: Twin Yolked Egg. Photo courtesy of Mishary
www.SOMEcontrast.com

Twin Yolked Eggs

Now what exactly is a twin egg or double-yolked egg? According to Frank Rattray Lillie, 1919, The development of the chick; an introduction to embryology **([3]**. "This abnormal egg is due to simultaneous or almost simultaneous liberation of two yolks and their incorporation in a single set of egg-membranes. The two yolks are usually separate in such cases and are derived, presumably, from separate follicles. But two yolks within a single vitelline membrane have been observed; such are, in all probability, products of a single follicle."

Twins

It is generally said that twin-yolked eggs cannot hatch. It should be unable in rightly developing because of the egg shell, not providing enough 'room' for two chicks in the one egg. However, apart from the ancient case mentioned by Aristotle, there are more reports of twin chicks from double-yolked eggs. In 1849 Bernard reported that a hen had laid 10 double-yolked eggs which were incubated and hatched and produced nine pairs of twins; 18 well-formed chicks, with only a single egg failing to hatch. In 1953 a study of Jeffrey et al. (4) (concerning 208 double-yolked eggs) resulted in the successful hatching of two viable chicks from a double-yolked egg. According to Jeffrey et al. **([4]** many

embryos died before day 7 and mortality of the embryos in the late stages was again very high, due to difficulties associated with hatching. It was generally observed that when one member was infertile or died early, the other member developed to be larger that normal.
A very recent case (2008) was reported by Rebecca Bowers from West Tennessee, who put 3 double-yolked eggs in her incubator and actually had two eggs develop 2 chicks each. They were unable to hatch by themselves and she decided to help. 3 chicks survived. The whole experiment can be watched at http://www.youtube.com/watch?v=S1ZeEY-kt7A&feature=channel (part 1) and http://www.youtube.com/watch?v=nuJPNAfuG3s (part 2)

Monstrosities
However, in these studies we find no mentioning of 4-legged chicks or other monstrosities. The occurrence of bird twins belongs to rarities and are not often noticed, because the twin chicks hardly ever hatch by themselves. It is inferred that crowding is a major factor in preventing hatching. Often one twin is unable to break the shell because of abnormal position or not reaching the air sac.
While analysing eggs that failed to hatch, sometimes cases of twin embryos are found. Often these embryos are deformed and conjoined, with shared internal organs, others are joined at the head and neck regions. And another striking thing is found: In many cases the embryos share the same yolk sac!

Photo: Both sides of Conjoined twin chicks (cephalopagus) of the Common Fowl *(Gallus domesticus)* preserved in alcohol, from the collection of the Natural History Museum Rotterdam. Origin and background of the specimen is unknown.
The photo was published in Straatgras – the magazine of the Museum http://www.nmr.nl/nmr/binary/retrieveFile?instanceid=15&itemid=366&style=default (Sorry, in Dutch only, but with interesting photos!) Photo courtesy of Kees Moeliker.

Monovular twins?
Would you believe that in an egg with only one yolk could happen what is described below, that in the chick embryo could happen what happens in humans - the development of monovular twins?
In the Dutch magazine 'Tijdschrift voor Diergeneeskunde' **([5]** was reported: "On the 10th of April 1959, a Dutch breeder obtained 12 chicks, including a set of twins, from 11 eggs in one tray of his incubator. The twin chicks were much smaller and lighter than their fellows but showed no obvious defects. As double-yolked or otherwise abnormal eggs are not normally incubated, it seems probable that the twins were hatched from an egg with a single yolk and therefore monozygotic. One twin died 3 days after hatching; the other survived for 7 days".

Complete monovular twins are very rare in the eggs of domestic fowl. In fact, all bird twins coming from single- or double-yolk eggs are still considered a nature phenomenon. In 1921 Prof. Charles R. Stockard **([6]** attributed polyembryony in birds to interruption of development before the completion of gastrulation.

Photo: These conjoined twins of emu shared the same yolk sac. They died at about 35 days of incubation and had one (very deformed) head, joined thoraxes and shared internal organs, except for lungs and kidneys. **([7]**
Photo courtesy of EJPAU - Nature University in Wroclaw.

Four-legged chicks
Lately the occurrence of 'alive'4 legged birds has been noticed more frequently, but very little information about the 'how and why' of avian twins is published.

The main question that haunted the scientists throughout the years is whether these 'monstrosities' are caused by an incomplete cleavage of the embryo during the early stage of development (which should have become twins) or by a secondary joining of two embryos, which had developed in an early stage as true

twins. Small extra legs between the normal legs can also be caused by the body axis forking in the dipygus condition (with two buttocks).

Deformed chicks are often stillborn, and when born alive they are often not able to survive. Also most of the 4-legged chicks don't live long. It is commonly thought that it is very rare for such a chicken to survive and grow up healthy.

Apart from the extra pair of legs, often other things are wrong, as in the story of this little one, named 'Forzie' and hatched in New Zealand, Sept 4, 2006. It died Nov 17-2006, probably because it had two anuses.

Marlene Dickey, the owner of the chick said: "Forzie developed two bottoms, and I think he got glugged up. The chick weighed about as much as a 'good pound of butter' and grew feathers very slowly."

Mike Brooks, executive director of the New Zealand Poultry Industry Association, said: "Four-legged chickens are as rare as hens' teeth and were something he had heard of but never seen". The reason why Forzie had extra legs was, according to Hamilton vet Keith Houston, the fact that the stem cells located in the egg split into four, instead of the normal two.

Forzie was stored in a freezer awaiting a taxidermist to stuff it. Once stuffed, the chick will be donated to the Auckland Museum to be put on display.

Left: Forzie, the four-legged chick from New Zealand. Sources: Wikinews / Waikato Times. More photos on www.hemmy.net

But sometimes they do live long. In 2005, a four-legged chick was hatched at Brendle Farms in Somerset, Pennsylvania. The story was carried on the major TV network news programs. The bird was found living normally among the rest of the chickens after 18 months. The second (hind) legs are fully formed but non-functional.

See also http://animal.discovery.com/videos/amazing-animal-videos-chicken-with-two-extra-legs.html

Another example is the 4-legged cock of Mr. Cao, of Changchun, China. He thought the 4-legged chick wouldn't survive, but he kept it out of pity and it magically grew up healthy. Even more bizarre is that the chick was in an egg that he cracked for supper…. According to Mr. Cao, it could have been the summer temperature that enabled it to hatch. The chicken was bullied by the other chickens at first. It was very tame and seldom fought back, but it grew faster than its rivals and has now turned the tables. It grew up to be a full-size cock. "The neighbours are calling it the four-legged king," Cao added. See http://www.4to40.com/newsat4/index.asp?id=2260&city=Changchun

Four-legged pigeons also hit the news sometimes, like this one in the Netherlands. The young in the photo is 7 days old. Apart from its normal set of legs, it has an extra pair at the lower part of its back. The owner noticed the malformation when he picked the little one up to put on a leg band. The young looks healthy so far and the owner decided to keep it and see what becomes of it.

Left, above and below: Young pigeon with 4 legs. Photo courtesy Vincent Krijtenburg, website vincentkrijtenburg.nl

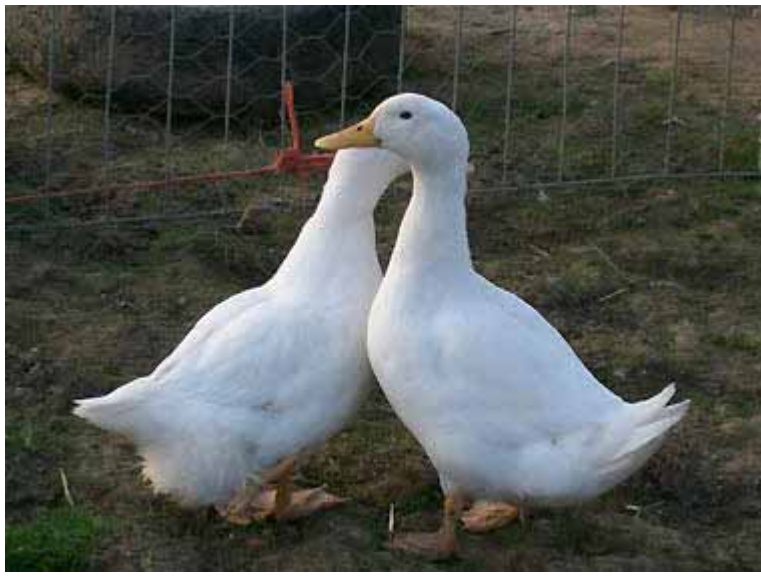
A research by Hollander and Levi **([8]** shows interesting facts. Two sets of twins from pigeon eggs of normal size and attached to single yolk-sacs are described. For one of these the pedigree was known and the twins were both females. It was at first supposed that they might be 'identical twins', but it was observed that they differed markedly in the length of the down filaments. The embryos were well past the age at which the down becomes fully developed, so that differential age at death is not responsible. Thus the most probable explanation is a genetic one: the twins, being female, received sex-linked factors only from the father; the father was heterozygous for the sex-linked 'dilution' factor, which is responsible for shortness of down. On this basis, the twins are the product of not one but two spermatozoa, and presumably also two blastodiscs on a single yolk.

Right: Twins from pigeon egg. The AUK Volume 57-July 1940. Photo Copyright by The University of New Mexico.

A duckling with 4 legs was hatched in the UK in February 2007. This one – called Stumpy - sure hit the news, and again when in April 2007 it lost one of its extra limbs after getting caught in its pen. A year later, in May 2008, his remaining spare leg fell off in a natural way, so now Stumpy has just two legs and is living happily ever after. He is mated to Alice. His owner, Nickey Janaway wrote: "Stumpy hasn't become a dad yet; I shall have to put some more eggs in the incubator to see whether he is successful with mating - he does like to practice though! His problem is that where he has his spare pelvis on the right while his "bits" are on the left so if he sits on the female square then Part A doesn't make contact with Part B!"

See Stumpy's life story on http://www.warraweeduckfarm.co.uk/1.html

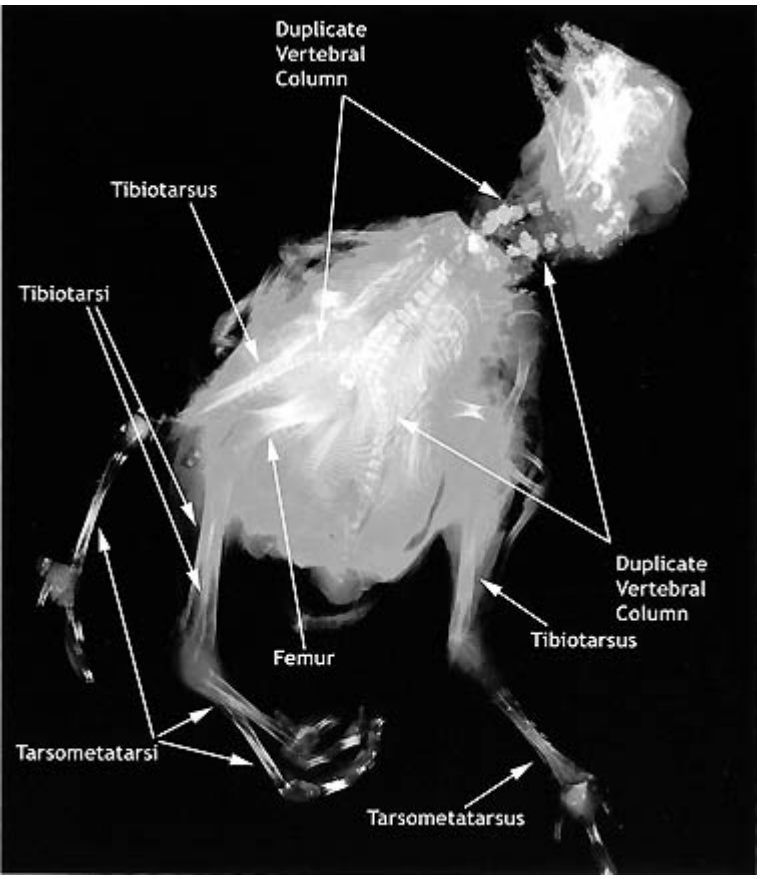
Left: Stumpy, 2 days old.
Below: From duckling to grown up.



Right: Stumpy (l) with his partner Alice.

All these wonderful photos of Stumpy are courtesy of Nicky Janaway of the Warrawee Duck Farm.

Researchers on developmental abnormalities in wild populations of birds - as per example the Lesser Snow Geese - suspects that 4-legged goslings or other abnormalities are due to developmental toxicants in the bird's habitats. Insecticides and herbicides would be a likely class of candidates to acting as type 1 teratogens. **([9] See** http://research.amnh.org/~rfr/rfr2003a.pdf



Left: X-Ray of a 4-legged chick. Note the duplicate vertebral column.

In an email of 21-7-2000 Mikhail Romanov (Genetics Scientist, CRES - Conservation and Research for Endangered Species at the Zoological Society of San Diego) wrote to Elio Corti: "The frequency of the mutations and monstrosities was not greater in the times of Aldrovandi compared to today. Indeed, it is somewhat greater nowadays because of the enormous harmful impact on nature caused by the human beings. According to publications from the World's Poultry Congress in New Delhi, 1996, the incidence of genetic anomalies in chicks is 0.25%. A virtually similar frequency has been found in turkeys (0.23%), but in the web-footed animals it was more than double quantity (0,54-0,56%)."

Even though scientists and poultry researchers have not been able to exactly quantify the effects of the environment and of toxic substances on the embryo development in birds, maybe one should think more on the impact we humans have on animals and nature in general.

Sources:

1. Aldrovandi, Ornithology, 2nd volume (1600)
2. Aristotle, Historia animalium VI,3
3. Lillie, Frank Rattray, 1919. The development of the chick; an introduction to embryology.
4. Jeffrey et al.1953. Observations on double-yolked eggs from the domestic fowl.
5. Maas, H. J. L. " De Schothorst", Amersfoort. Tijdschrift voor Diergeneeskunde.
6. Charles R. Stockard, 1921.
7. Monika Wiercińska, Danuta Szczerbińska, 2005. The ostrich and emu egg hatchability with reference to dead embryo analysis.
8. W. F. Hollander and W.M. Levi, 1938. Twins and late embryonic monstrosities in pigeons.
9. R.F. Rockwell, B.M. Pezzante, P. Matulonis, 2003. Developmental Abnormalities in Wild Populations of Birds: Examples from Lesser Snow Geese.
10. Wikipedia.