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Comparison of the Evolution of Orchids with that of Bats

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Abstract. The evolution of orchids and bats is an example of DNA's own evolution which has resulted in structures and functions which are not necessarily related to any obvious advantage to the organism. The flowers of orchids resemble: humans, apes, lizards, frogs and even shoes. The faces of bats resemble plant leaves but also horseshoes. These similarities are not accidental because they emerge repeatedly in different genera and different families. This evolutionary situation bewildered botanists and zoologists for many years, but is now elucidated by the molecular unification of plants and animals derived from the following evidence: (1) Contrary to expectation, plant and animal cells (including those of humans) could be fused and the human chromosomes were seen dividing in the plant cytoplasm. (2) Orchids, bats and humans have about the same number of genes: orchids, 21,841; bats, 21,237 and humans circa 20,000. (3) These three groups contain the same homeotic genes which decide: flower formation (orchids), body segmentation (bats) and body segmentation (humans). The leaf pattern, is formed in plants by the LEAFY master gene, but this pattern even appears in minerals, which have no genes, an indication that pure atomic processes are responsible for its emergence at the organism level.

Keywords: orchids, bats, evolution, DNA's own evolution.

EVOLUTION IS A WELL ESTABLISHED PHENOMENON BUT ITS MECHANISM REMAINS TO BE ELUCIDATED

Evolution is one of the best established phenomena in biology. Its firm basis rests mainly on the following data: (1) The comparison of structures and functions in invertebrates and vertebrates. (2) The documentation from the fossil record. (3) Analysis of cells and chromosomes in most well known organisms. (4) Sequencing of DNA, in a long array of species, that has allowed to establish phylogenetic relationships at the molecular level. (5) Other molecular studies that included the structures and functions of RNA and proteins and their key interactions.

However, this does not mean that the *mechanism* that is responsible for evolution is known.

(1) A mechanism can only be physico-chemical, and we are only approaching this stage of investigation with the building of Synchrotron Radiation

Accelerators and Spallation Sources as those built at Lund University, Sweden, and in other countries.

(2) One is also far from understanding the source of the ramification into many branches of organisms which has led to the establishment of the different alleys that are called: phyla, orders, families, and other natural divisions. Examples of this situation are: (a) The origin of vertebrates from invertebrates which remains far from being understood (Daeschler and Shubin 2011). (b) The emergence of birds from reptiles which is a source of permanent debate (Zhou 2004). (c) The classification of flowering plants, with their recurring symmetries, which bewilders botanists (Denffer *et al.* 1971). (d) The comparative work, based on the sequencing of DNAs. This has led to the creation of Databases but many species have not yet been included (Fang *et al.* 2015).

(3) The own evolution of DNA, as well as that of proteins and RNA, continue to be virgin land. As pointed out by Branden and Tooze (1991), as long as we do not know the rules of the interactions between these molecules at the atomic level, evolution of the chemistry of life will remain in a primitive stage.

However, every important phenomenon in science, demands an explanation. The recourse, called the ”prevailing theory”, has been the use of random mutation and selection. Geneticists know well that random mutation and selection occur in nature, but these are antiquated ”solutions” that have been superseded . Selection is solely a system of choice and as such cannot substitute a physico-chemical mechanism. Random mutations occur, but have been shown to be of little importance in evolution. Directed mutations have now been well established as positive events in species transformations (Zhang and Saier 2009).

SIMILARITY BETWEEN PLANTS AND ANIMALS. — THE IMPOSSIBLE BECAME POSSIBLE

1) In the early days of Genetics it became established that plant and animal chromosomes needed to have a centromere and telomeres if they were to survive during cell division. But plants were so different from animals that these basic similarities were not considered significant.

2) Genes started to be located in great numbers in the chromosomes of *Drosophila*, humans and maize. However, plants had no brain, and no blood circulation, as a consequence they had to have quite different genes.

3) When the first genes were isolated in the test tube, the ribosomal RNA genes could be recognized in bacteria, plants and animals, not having changed appreciably for millions of years. Haemoglobin, the carrier of oxygen in animal blood, was also present in plants. Again this similarity of molecular organization was a curiosity.

4) The genes for 18S and 28S ribosomal RNA were found in over 500 species to be located not at random, but tended to appear in plants, animals and humans, near telomeres. Their position could be defined by an equation (Lima-de-Faria 1973). Genes were considered to occur at random, as one still tends to think today, and the response was that this was a particular case.

5) Suddenly, what was considered impossible, became possible. The fusion between plant cells and human cells was considered impossible. But it was achieved rapidly when the enzymes to remove the cell wall of plant cells became available. The experiments were controlled by the use of the radioisotope tritium and the human chromosomes were seen to divide in the plant cytoplasm. Later the fusion of human sperm with plant cells could be observed occurring under the microscope (Dudits *et al.* 1976, Lima-de-Faria *et al.* 1983). Actually this work opened the way to present day biotechnology.

6) Molecular analysis brought the crucial information. The genes that decided the segmentation of the body of insects, were the same that led to the formation of vertebra in the human column and those which decided the formation of floral parts (sepals, petals, stigma and anthers) in a plant. These are the homeotic or Hox genes (Lu *et al.* 1996).

7) This does not mean, however, that we are in possession of the molecular cascades that occur between the gene and the final formation of traits that shape the pattern of animals and plants. This is why the comparison of the evolution of the Orchids with that of Bats becomes relevant.

THE STRUCTURES AND FUNCTIONS OF ORCHIDS EXHIBIT A REMARKABLE EVOLUTIONARY VARIATION

The Orchids (Family Orchidaceae) have confused botanists for three centuries due to the following features:

THE RICHNESS OF ORCHID SPECIES

The orchids display an extraordinary variation. They constitute approximately 10% of flowering plant species (Zhang *et al.* 2017) having about 28,000 currently accepted species, distributed in about 763 genera (Christenhusz and Byng 2016).

The number of orchid species is nearly equal to the number of bony fishes, more than three times the number of bird species, and about four times the number of mammal species.

THE ORIGIN OF ORCHIDS AND THE FOSSIL RECORD

About 135 million years ago the plant kingdom began to develop vascular plants with enclosed seeds, the angiosperms, which spread rapidly (Barth 1985).

Orchid fossils trapped in amber, in the Baltic Sea, are 15 to 20 million years old (Poinar and Rasmussen 2017). But genetic sequencing indicates that orchids may have arisen 76 to 84 million years ago or may go back to 100 million years ago (Chase 2001).

The fossil record from rocks is poor because orchids ”are herbaceous plants and therefore are not good subjects for fossilization”. As a result they are poorly documented in sedimentary deposits. Besides, fossils are not considered reliable because of their resemblance to present-day orchids. This means that ”Most extant groups are probably very young” (Arditti 1992). The result is that: ”There is no general agreement regarding the time of the origin of the orchids” (Arditti 1992).

Dressler (1993) asks: ”To what other group of plants are the orchids most closely related?” His answer is ”Unfortunately, there is little agreement on the proper classification of these plants”.

ORCHID FLOWERS ASSUME THE MOST UNEXPECTED SHAPES RESEMBLING: HUMANS, APES, BEES, WASPS AND EVEN SHOES

It is not only the great variation in flower shape that has confused researchers but, above all, is the display of patterns that have no immediate relationship to the environment or any obvious advantage to the organism (Table 1, Fig. 1).

Blamey *et al.* (2013) in their ”Wild Flowers of Britain and Ireland” give the common names of near 20 species of orchids. Most of them have a resemblance to animals and to humans. These last are called ”manikins” (meaning a little man). They are: (1) Manikin Orchid, Burnt-tip Orchid (*Neotinia ustulata*). (2) Manikin Orchid, Lady Orchid (*Orchis purpurea*). (3) Manikin Orchid, Military Orchid (*Orchis militaris*). (4) Manikin Orchid, Monkey Orchid (*Orchis simia*). (5) Manikin Orchid, Man Orchid (*Orchis anthropophora*). (6) Lizard Orchid (*Himantoglossum hircinum*). (7) Frog Orchid (*Coeloglossum viride*). (8) Greater Butterfly Orchid (*Platanthera chlorantha*). (9) Bee Orchid (*Ophrys apifera*). (10) Wasp Orchid (*Ophrys trollii*). (11) Fly Orchid (*Ophrys insectifera*). (12) Late Spider Orchid (*Ophrys fuciflora*). (13) Ghost Orchid (*Epipogium aphyllum*). (14) Lady's Slipper (*Cypripedium calceolus*). (15) Tongue Orchid (*Serapias lingua*) (Fig. 4).

Several features are remarkable: (1) The patterns are not accidental because the same shape reappears in species which do not belong to the same genus (*i.e.* are not closely related). This is the case of the human figure in *Neotinia* and *Orchis*. (2) The resemblance displayed by the flowers is so perfect that it is included in the scientific name: monkey-face Orchid, *Dracula simia* (simia = monkey), *Orchis anthropophora* (anthro = human), *Ophrys apifera* (*apis* = bee), *Ophrys insectifera* (fly), *Serapias lingua* (lingua = tongue). (3) The pattern that exhibits these unexpected similarities, is not displayed by all the parts of the flower, but is usually restricted to the lip. This is the lower petal of the flower called also ”labellum”, another constraint in pattern development. (4) The common names, given to these species, were coined by leading botanists who, generation after generation, recognized the same similarities (Table 1).

THE STRUCTURES AND FUNCTIONS OF BATS DISPLAY ALSO A REMARKABLE EVOLUTIONARY VARIATION

Like systematists dealing with the classification of Orchids, zoologists were confronted with great difficulties when analyzing the evolutionary features of bats.

THE LARGE VARIATION OF BAT SPECIES

The bats build the Order Chiroptera which is divided into 21 Families. These comprise not less than 1,400 species, an impressive number since it represents about 20% of the described mammalian species (Fang *et al.* 2015). Besides, they are present on every continent except Antarctica (Wilson and Mittermeier 2019). According to Hill and Smith (1984) they constitute one of the largest and most widely distributed groups of mammals.

THE ORIGIN OF BATS AND THE FOSSIL RECORD

“The origin and evolution of bats is poorly understood” (Hill and Smith 1984) and they add that ”Any

Table 1. Orchid species in which the flowers are similar to animal structures and other unexpected shapes. Common and scientific names according to Blamey *et al.* 2013, "Wild flowers of Britain and Ireland". The words used and the statements made by the authors are in quotation marks.

Common name	Species name	Resemblance described by botanists
Common Spotted Orchid	*Dactylorhiza fuchsii*	Common orchid General pattern
Pyramidal Orchid	*Anacamptis pyramidalis*	Foxy—smelling
Green-winged Orchid	*Anacamptis morio*	Fragrant, Purple Dark green veins
Manikin Orchid Burnt-tip Orchid	*Neotinia ustulata*	”Manikin” is the name given to a little man. Manikin lip
Manikin Orchid Lady Orchid	*Orchis purpurea*	Manikin lip ”Lip” is the lower petal of an orchid flower, also called ”labellum”
Manikin Orchid Military Orchid	*Orchis militaris*	Sepals (the ”soldier’s” helmet)
Manikin Orchid Monkey Orchid	*Orchis simia*	Manikin lip having narrow “limbs” as a human
Manikin Orchid Man Orchid	*Orchis anthropophora*	Lip with very narrow ”limbs”
Lizard Orchid	*Himantoglossum hircinum*	”Fancifully lizard-like by taking the manikin theme to an extreme”
Frog Orchid	*Coeloglossum viride*	”Flowers supposedly like a jumping frog”
Greater Butterfly Orchid	*Platanthera chlorantha*	Two petals diverging at right angles
Bee Orchid	*Ophrys apifera*	”Look remarkably like the rear of a small bumblebee”
Wasp Orchid	*Ophrys trollii*	Wasp looking flowers
Fly Orchid	*Ophrys insectifera*	Manikin lip. ”Petals antenna-like (hence the ”fly”)”
Late Spider Orchid	*Ophrys fuciflora*	”Hieroglyphic on its lip”
Ghost Orchid	*Epipogium aphyllum*	Excellent camouflage lip bent back
Lady’s Slipper	*Cypripedium calceolus*	Billowing unspurred lip
Heart-flowered Tongue Orchid	*Serapias cordigera*	”Middle lobe shaped like an ace-of spades (not hearts)”
Tongue Orchid	*Serapias lingua*	Middle lobe intermediate between the other two species
Monkey-face Orchid	*Dracula simia*	Central part of flower ”bears a striking resemblance to a monkey’s face” (Thorogood 2018)

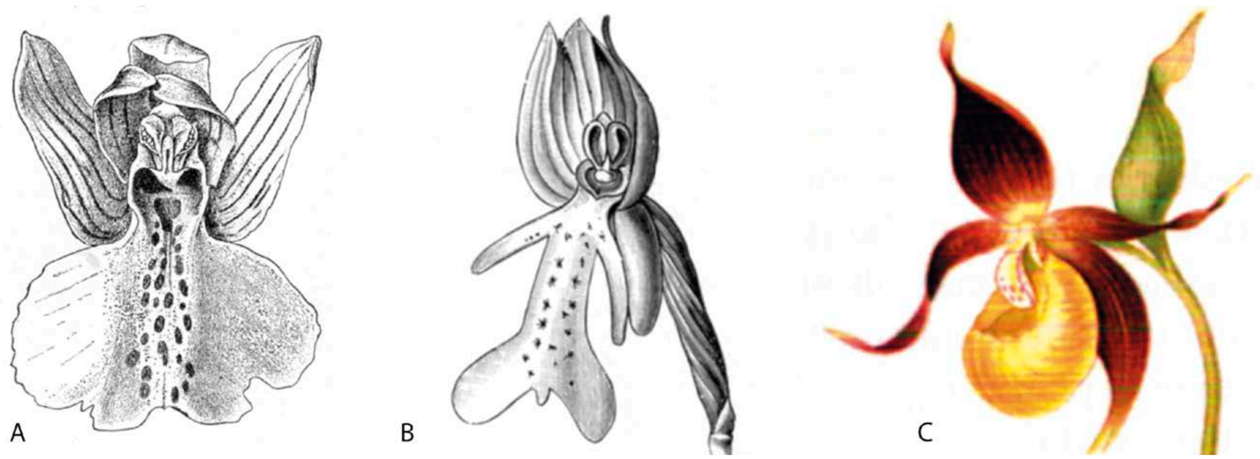

Figure 1. Three different types of orchid flowers, which represent their great variation in pattern. The shape of the flower is not related to any obvious advantage to the organism. (A) *Orchis Morio*, Green-winged orchid. An example of a flower with the general shape. (B) *Orchis militaris*, Manikin orchid or Military orchid. In this species the flower’s ”lip” resembles the human body with: head, open arms and open legs. (C) *Cypripedilum acaule*, Lady’s slipper. Another species in which the ”lip” resembles a shoe or a slipper.

scenario concerning the origin and early evolution of bats is clearly speculation". The reasons are: 1) The fossil record is poorly represented. 2) The 30 fossil genera that have been identified are most similar to present living bats. 3) Some of these fossils are recent, dating from the Ice Age. 4) The fossils are so well preserved that the stomach contents remain visible. 5) The fossil record extends to approximately 60 million years ago, but it is suspected that the bats may have had originated earlier 70-100 million years ago. The orchids are considered to have arisen at the same time.

Of special importance is that, as noted by Hill and Smith (1984) "Although primitive in some features, these bats possessed some characteristics that are as advanced as some of modern living species of Microchiroptera" and "All existing evidence suggests that bats changed relatively little compared to other mammals as a group". Teeling *et al.* (2018) add that "The evolutionary history of bats has stimulated some of the most passionate debates in science".

THE FACIAL TRAITS OF BATS ARE HIGHLY VARIED AND RESEMBLE THE MOST UNEXPECTED SHAPES INCLUDING THOSE OF PLANTS

Wilson and Mittermeier (2019) give the common names of the over 20 families of bats. Several names refer to the shape of the tail, others to their feeding habits but most deal with the facial pattern of bats. These are: (1) Hog-nosed bats (nose like that of pigs). (2) Trident bats (nose with the shape of a plant leaf with 3 projecting parts). (3) Old world leaf-nosed bats (frontal part of face as a large leaf). (4) Horseshoe bats (face having a horseshoe-shaped plate). (5) Bulldog bats (looking like

Table 2. Bat families and their resemblance to plant and animal structures and functions. Common and scientific names according to Wilson and Mittermeier (2019), "Handbook of the mammals of the world" Vol. 9. The words used and the statements made by the authors are in quotation marks.

Common name	Family name	Resemblance described by zoologists
Old world fruit bats	Pteropodidae	Standard bat face. Lack of laryngeal echolocation
Mouse-tailed bats	Rhinopomatidae	Free long tail like in wild mice
Hog-nosed bats	Craseonycteridae	Nose as in pigs
False- vampires	Megadermatidae	Canine teeth and large molars like other carnivore mammals. Feed on mammals or reptiles.
Trident bats	Rhinonycteridae	Noseleaf with 3 prongs. A "prong" is a pointed projected part
Old world leaf-nosed bats	Hipposideridae	Frontal part of face as a large leaf. Like leaves found in many plant families
Horseshoe bats	Rhinolophidae	"Ornate facial growths including horseshoe-shaped plate"
Sheath- tailed bats	Emballonuridae	Refers to the juxtaposition of the tail with the membrane stretching between the legs. "Use territorial songs that include six different "syllables""
Slit-faced bats	Nycteridae	Long narrow cut on face as a distinctive cleft running longitudinally along muzzle
Madagascar sucker- footed bats	Myzopodidae	"Distinctive sucker-like structure on wrists and ankles" that stick to surface. Like those found in tadpoles of frogs and some insect species."Ears with mushroom-like structure"
New Zealand short-tailed bats	Mystacinidae	"Known as singing bats. Echolocation calls are multiharmonical. Can have up to four harmonics". "Walk on the forest floor. The most terrestrial bats in the world"
Bulldog bats	Noctilionidae	Face like that of a race of dogs. "Distinct from that of any other species of bat"
Smoky and Thumbless bat	Furipteridae	Muzzle with oval or triangular nostrils
Disk-winged bats	Thyropteridae	Have adhesive disks on their hindfeet
Ghost- faced bats	Mormoopidae	Frightening appearance. Modified lips that form a funnel
Naked-backed bats	Mormoopidae	Like naked mole rats. *Heterocephalus*
Mustached bats	Mormoopidae	Like "Mustached monkey". *Cerco pithecus*
New world leaf-nosed bats	Phyllostomidae	Fleshy noseleaf above nostrils. Plant leaf face like the situation found in the body of some insect species
Funnel-eared bats	Natalidae	Large ears like those of hares
Free-tailed bats	Molossidae	Tail separated from wings as in birds
Long-fingered bats	Miniopteridae	Finger mutations. Like those found in humans
Wing-gland bats	Cistugidae	Unlike glands found in other mammals, but probably like sebaceous glands
Vesper bats	Vespertilionidae	"Vesper", means active in the evening. Like other species of vertebrates such as vesper mouse and vesper finch

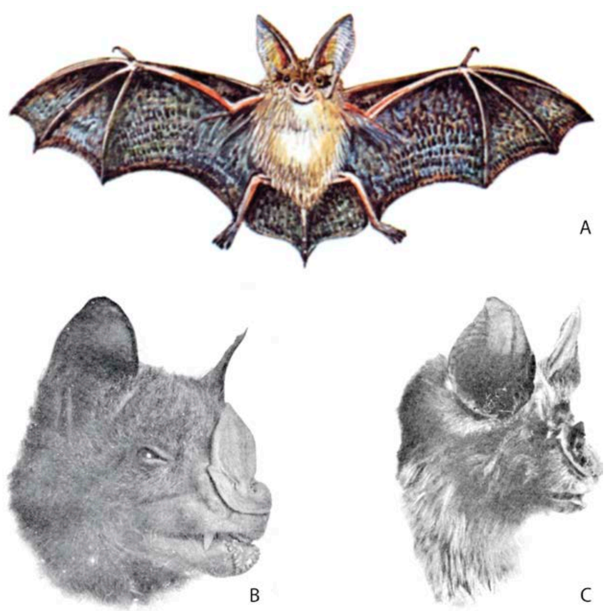

Figure 2. Three different types of facial structures of bats that represent their great variation in pattern. The shape of the nose is not related to any obvious advantage to the organism. (A) Bat species (name not indicated). Common facial pattern with protruding nose. (B) *Phyllostomus hastatus*. Face with shape of leaf. Belongs to Family Phyllostomidae, New World Leaf-nosed bats. This species is called Spear-nosed bat because the leaf has a sharp point on the upper part like the leaf of many deciduous trees (e.g. Oaks, Elms, Mangolias and others). (C) *Rhinolophus ferrumequinum*. Called Mediterranean Horseshoe bat. The facial pattern which resembles a horseshoe, is so striking that is included in the scientific name (ferrum = iron, equinum = horse).

a race of dogs). (6) Ghost-faced bats (with frightening appearance). (7) New world leaf-nosed bats (with fleshy noseleaf above nostrils, the leaf pattern being similar to that present on the body of some insect species).

The leaf pattern has arisen in not less than three independent families: Rhinonycteridae, Hipposideridae and Phyllostomidae. Thus, it is not an accidental event.

The nose takes not only the shape of different animals but even of a horseshoe (horseshoe bats). This is a most unexpected pattern, like that of an orchid which resembles a ladie's slipper (Table 2, Fig. 2).

Significant is that the common names given to all species were not coined by the general public but by leading zoologists. Besides, successive generations of scientists continued to use the same designation, a confirmation that the patterns displayed are so striking that their names were not modified.

SELECTION HAS BEEN INVOKED AND DENIED TO EXPLAIN ORCHID AND BAT EVOLUTION

Dressler (1993) uses several new types of selection, which are called *r*-selection and *k*-selection, to explain the evolution of the orchids. But he feels obliged to conclude that ”At first glance, the production of many tiny seeds would seem to fit the characteristics of *r-selection*, but in other respects, most orchids fit this pattern poorly” and he adds: ”The classification of the orchids has been difficult because of the great amount of parallelism”. By parallelism he means the repetition of the same pattern that is seen in: pollen structures, flower form, seed formation and pollination patterns (Table 7).

The great difficulty for evolutionists who follow the general interpretation is that for selection to have a positive effect it has to have an advantage for the individual. But such is far from being the case when a flower looks like a shoe or a bat has a face that resembles a horseshoe.

“Mimicry is bizarre” (Dressler 1993). ”There are many cases of generalized food flower mimicry, that do not involve a clear and recognizable model”. ”In generalized food flower mimics, the pollinators soon learn that the flowers offer no reward”. ”Orchids do not just deceive

Table 3. Number of protein-coding genes in animals and plants.

Organism	Species	Gene number	Reference
Animal	Pteropus Alecto (bat)	21,237	Fang, J. *et al.* 2015
	Homo sapiens	20,000	Pennisi 2003 Merchant *et al.* 2007
	Ascaris suum (worm)	18,500	Jex *et al.* 2011
	Daphnia pulex (water flea)	30,907	Colbourne *et al.* 2011
Plant	Apostasia shenzhenica (orchid)	21,841	Zhang *et al.* 2017
	Chlamydomonas reinhardtii (unicellular alga)	15,143	Merchant *et al.* 2007
	Arabidopsis (flowering plant)	26,341	Merchant *et al.* 2007
	Medicago truncatula (legume plant)	62,388	Young *et al.* 2011
	Cajanus cajan (pigeon pea)	48,680	Varshney *et al.* 2012

Table 4. Evolutionary similarities between orchids and bats.

Property	Orchids	Bats
Origin	Eastern Asia 40 to 80 million years ago. No general agreement regarding time and origin	Australasia 30 to 60 million years ago. No general agreement regarding time and origin
Fossil record	Fossils poorly documented in sedimentary rocks	Fossils found from various periods but limited
Fossil preservation	Leaves and seeds preserved but ”no positive or useful record”	Stomach contents well preserved as in extant species
Fossil appearance	Fossils are already very similar to living orchids. ”Evolved fully formed”	Fossils are already very similar to modern living bats
Systematic location	Under debate, included in the order Asparagales	No intermediate forms to other mammalian orders. Location most uncertain
Number of species	22,000 to 30,000	1,400
Extreme variation	Tremendous radiation. Flowers with most unexpected forms	Face with most different forms
Resemblance to particular structures	Assuming the shape of: Ghost Humans Apes Frogs Lizards Butterflies Bees Wasps Flies Spiders	Assuming the shape of: Ghost Mouse Hog Horse shoes Bulldog Leaves
Plant exhibiting animal pattern and animal exhibiting plant pattern	Resemblance of flowers to bees and wasps is so striking that insect males copulate with flowers	Face with leaf form which is characteristic of several tree families
Repeated occurence of plant-animal pattern	Similarity to insects occurs in: 3 species of *Ophrys*; and similarity to humans occurs in: *Neotinia* and 4 species of *Orchis*	Similarity to leaves occurs in 3 distinct families: 1) Old world leaf-nosed bats 2) New world leaf-nosed bats 3) Trident bats

Table 5. Occurrence of structures with leaf shape from minerals to bats.

Minerals	Flowering plants	Insects	Bats
Native copper Native gold Native bismuth	The typical shape of leaves is most common in deciduous trees	Wings with leaf shape *Kallima* (butterfly) *Phyllium pulchrifolium* (grasshopper)	Frontal part of head with leaf shape. Old world leaf-nosed bats 90 species. New world leaf-nosed bats 217 species.
No genes present. Atomic self-assembly	*Homeotic genes* deciding formation and position of flower parts. Master gene *LEAFY* deciding leaf formation	*Homeotic genes* deciding body segmentation which affects body pattern	*Homeotic genes* deciding body segmentation, but effect on facial pattern not yet investigated

pollinators through sexual deception of animals, but also through mimicry of other plants” (Stevens 2016) and adds: ”how this type of deception evolved is also unclear”.

Zoologists were led to a similar approach when analysing the value of selection in the evolution of bats. Some invoked ”positive natural selection” and ”Darwin-

Table 6. Structures and functions with no obvious positive effect for the organism and those with a positive effect.

Orchids		Bats	
No obvious positive effect	Positive effect	No obvious positive effect	Positive effect
Flower resembling: Lady's slippers Monkeys Humans Frogs Lizards	Movement of flower lips. Enhancing of pollination by insect trapping. Enhancing of pollination by resembling bees and wasps.	Face resembling: Leaf Horseshoe Hog Bulldog	Movement of larynx producing sounds. Echolocation used in insect trapping

Table 7. Present interpretations of orchid and bat evolution, evoking selection as well as denying it. The statements made by the various authors are in quotation marks.

Orchids		Bats	
Interpretation	Reference	Interpretation	Reference
Selection deciding evolution. New kinds of selection: *r*-selection and *k*-selection related to habitat and environment	Stearns 1977	Bat genes submitted to "positive natural selection"	Hawkins *et al.* 2019
		Genomes submitted to "Darwinian selection"	Dong *et al.* 2016
"Selection pressure" as the motor of evolution	Arditti 1992	Bat genes have undergone "Relaxed natural selection"	Dong *et al.* 2016
Selection considered inappropriate to explain evolution of orchids. "Great deal of parallel evolution"	Dressler 1993	Selection considered inappropriate to explain evolution of bats. "Evolution of bats is clearly speculation"	Hill and Smith 1984
Fossils are similar to modern orchids	Arditti 1992	"Fossils are already very similar to modern Microbats"	Wikipedia
Fossil record is limited and reveals little about evolution	Arditti 1992	"The evolutionary history of bats has stimulated some of the most passionate debates in science"	Teeling *et al.* 2018

ian selection" (Hawkins *et al.* 2019, Dong *et al.* 2016), but others considered selection inappropriate to explain the evolution of bats (Hill and Smith 1984), Teeling *et al.* 2018) (Table 7).

SIMILARITY OF GENE NUMBER, AND OF GENES, BETWEEN ORCHIDS AND BATS ELUCIDATE THE EMERGENCE OF IDENTICAL PATTERNS AND THE APPEARANCE OF TRAITS NOT ADVANTAGEOUS TO THE ORGANISM

From the beginning it was assumed that humans had to have at least 200,000 genes. As late as 2000 Gilbert (2000) gave the figure 150,000 genes, based on the number of proteins present in the human body.

This value sprang from the one gene — one protein relationship accepted in the 1970s. Soon, it became evident, that a single gene could give rise to several different proteins and later genes turned out to be large complex structures consisting of coding and non-coding regions (exons and introns).

The sequencing of the bases in DNA led to a surprising answer. Humans had about 32,000 genes coding for proteins (Bork and Copley 2001), but this figure has subsequently been reduced to circa 20,000 (Table 3).

As DNAs continued to be sequenced, in many different organisms, it turned out that the number of genes is not a good indicator of evolutionary relationships and moreover it is not related to organism complexity (Lima-de-Faria 2014). The flowering plant *Arabidopsis* has 26,341 genes. Some plants have even more genes than humans. *Medicago* is a legume plant with 62,388 and *Cajanus* (a pea) 48,680 genes. Their large numbers are due to genome duplications. Even more relevant is that *Daphnia* (a minute water flea) has 30,907 genes.

It is thus not surprising that bats, orchids and humans have about the same gene numbers: 21, 237, 21,841 and circa 20,000 respectively (Table 3).

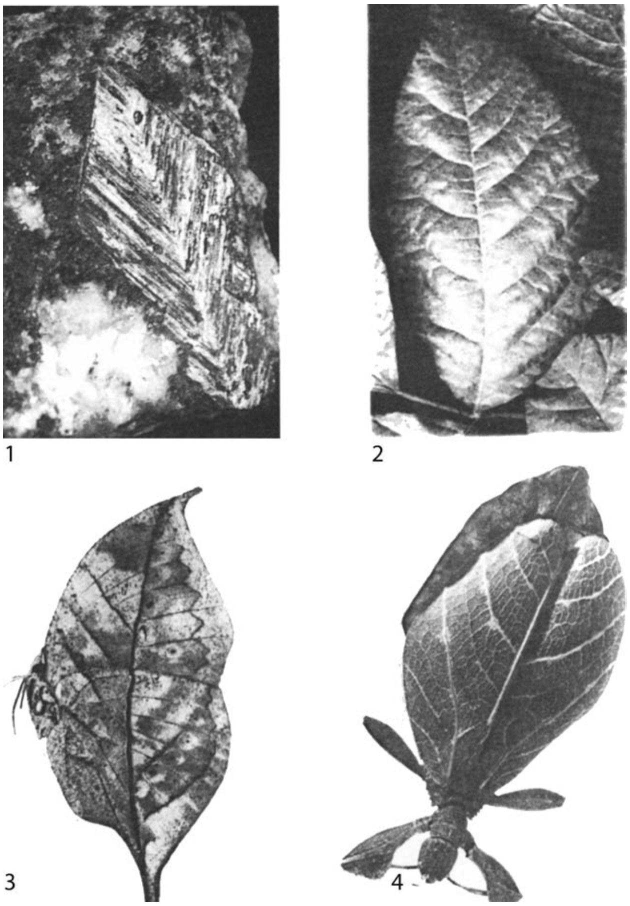

Figure 3. The leaf pattern which occurs in minerals, plants and insects. (1) Mineral, pure bismuth in native state. (2) Plant, leaf of poison ivy *Rhus toxicodendron*. (3) The leaf-like butterfly *Kallima*. (4) The leaf-insect *Chitoniscus feedjeanus* showing leaf-like modifications of the fore-wings, including a midrib and lateral veins.

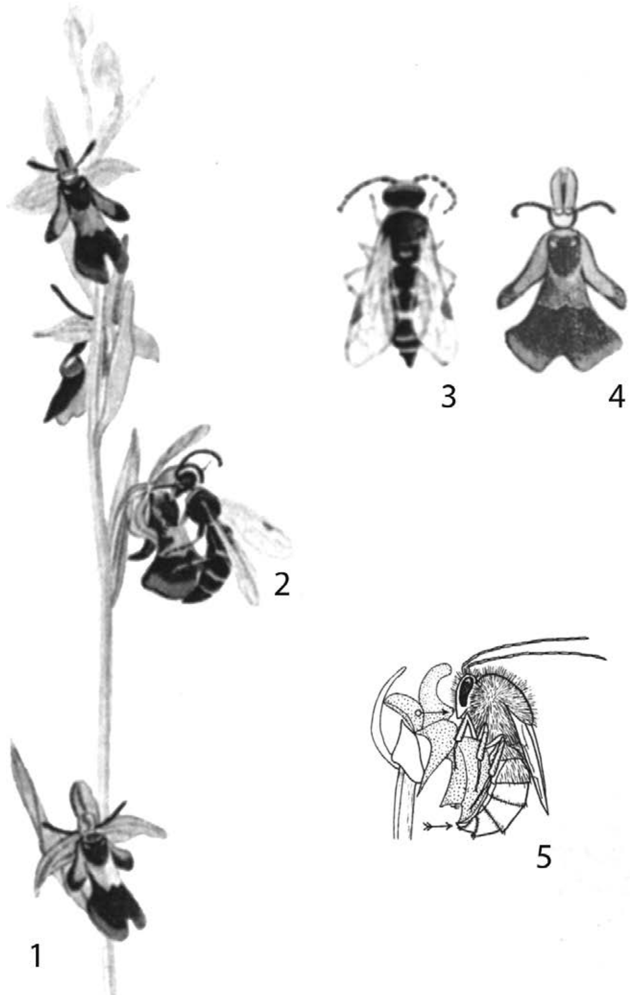

Figure 4. An insect copulates with a flower. Orchid *Ophrys insectifera*. (1) Flowering plant. (2) Male of the insect species *Gorytes mystaceous* making copulatory movements over the flower. (3) Female of the same species. (4) Flower lip drawn separately to show similarity to insect. (5) The flower of the orchid *Ophrys bombyliflora* covered by the copulating male of the insect Eucera sp.

In addition many basic genes are common to mammals and plants. But one could hardly conceive that the *Homeotic* genes, which decide the segmentation of the vertebral column in humans, are the same that determine the sequence of the flower parts in plants (Lu *et al.* 1996). The *lip* of orchids is one component in the process of flower formation (Table 5). Moreover, the leaf pattern found in orchids, like in other plants, is decided by a series of leaf genes that have been sequenced, the master gene being called *LEAFY* (Glover 2007).

Hence, the similarity between the patterns of orchids and bats is not fortuitous, but has a genetic basis (Tables 4 and 5).

Remarkable is that minerals, which have no genes, and whose pattern emerged before DNA and the cell appeared in evolution, also build leaf patterns (Fig. 3). One should not forget that DNA consists of the same atoms that are found in minerals and that different atom combinations result in the same mineral pattern (Lima-de-Faria 2017) (Table 5). In this connection it is relevant to recall that the basic function of proteins and other macromolecules resides, not on their amino acid sequences, but on their metal atoms. This is the case in: haemoglobin (iron), chlorophyll (magnesium), vitamin B_{12} (cobalt) and zinc proteins (zinc). It is the atoms that are exposed to other molecules that create the final pattern of the organism.

DNA'S OWN EVOLUTION DOES NOT NECESSARILY LEAD TO THE BUILDING OF ORGANS WITH ADVANTAGE TO THE ORGANISM

It is usually not realized that DNA has its own evolution which results in the formation of traits that may be of advantage but may also be of no advantage to the organism.

By manipulation of eye genes, in which DNA sequences were moved within the genome, Gehring (1998) was able to produce fruit flies with eyes located on: the head, legs and even wings. Flies, which normally have only two wings were also produced with four wings. This work was further extended to birds leading to the creation of birds with four wings instead of two (Cohn *et al.* 1997). In all cases the new organs were normal and functional, being constituted by the same body parts such as muscles, veins and articulations. Hence, DNA can produce, by alteration of its own sequences novel structures that the organism gets as a ”surprise”.

The evolution of the orchids and of the bats is a valuable example of the production of structures without any special advantage to the organism. But this does not exclude that there are also structures and functions which led to a subsequent positive effect to the organism's survival or reproduction (Table 6).

At present, botanists and zoologists, continue in vain to evoke, or deny, the role of selection in the evolution of orchids and bats. But the use of the large accelerators of electrons and neutrons is transforming molecular biology into atomic biology. Consequently it will furnish a better picture of the basic evolutionary similarities that unite these organisms.

SOURCE OF FIGURES

Fig. 1 (A) Gola, G. et al. 1943. Tratado de Botanica. Editorial Labor, Barcelona, Spain (Fig. 718, page 924). (B) Strasburger, E. 1943. Tratado de Botanica. Manuel Marin Editor, Barcelona, Spain (Fig. 831, page 671). (C) Lindman, C.A.M. 1926. Bilder ur Nordens Flora (Plate on page 419).

Fig. 2 (A) From Lima-de-Faria, A., 1995, ”Biological Periodicity”, Fig. 3.5, page 18, Source: Perrins, C. 1976. Bird Life. An Introduction to the World of Birds. Elsevier, Phaidon, London, UK (Fig. page 28). (B) Cabrera, D.A. et al. 1935. Historia Natural, Volume 1, Zoologia. Instituto Gallach, Barcelona, Spain (Fig. page 37). (C) Cabrera, D.A. et al. 1935. Historia Natural, Volume 1, Zoologia. Instituto Gallach, Barcelona, Spain (Fig. page 37).

Fig. 3 From Lima-de-Faria, A., 1988, ”Evolution without Selection”, Fig. 3.8, page 27, Sources: (1) Medenbach, O. and Sussieck-Fornefeld, C. 1983. Minerais (Translation of: Mineralien. Mosaik Verlag, Munich 1982). Ed. Publica, Lisbon, Portugal. (2) Feininger, A. 1956. The Anatomy of Nature. Crown Publishers, New York, USA. (3) Cott, H.B. 1951. Animal form in relation to appearance. In: Aspects of Form. Whyte, L.L. (Editor). Lund Humphries, London, UK: 121-156. (4) Cott, H.B. 1951. Animal form in relation to appearance. In: Aspects of Form. Whyte, L.L. (Editor). Lund Humphries, London, UK: 121-156.

Fig. 4 From Lima-de-Faria, A., 1988, ”Evolution without Selection”, Fig. 9.26, page 116, Sources: (1) to (4) Mossberg, B. and Nilsson, S. 1977. Nordens Orkidéer. J.W. Cappelens Förlag, Oslo, Norway, pages 1-128 (Page 15). (5) Kullenberg, B. 1961. Studies in Ophrys Pollination. Zoologiska Bidrag från Uppsala 34: 1-340.

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