MORE EXTRAORDINARY ADAPTATIONS

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Introduction

The *perfection* of adaptation is a constant source of wonder to me. All this intricacy of adjustment can scarcely be necessary. Indeed, the evolutionist concedes this for he claims that less was good in its way and long served the species until better was attained. But when enough was good, why has the adaptation progressed to an ever finer finish until *superb* complexity and interadjustrnent became *the rule?*

Just as the good predicates the good artificer, so the best subsumes the best. Nature "showeth His handiwork."

Senses

The fire ant, *Solenopsis saevissima* (F. Smith), produces an odour trail that other fire ants will follow, by laying down the secretion of a special accessory gland released through the sting.[1]

Plants

Sensitive plants[2] have an organ called the pulvinus at the base of the leaflet and at the base of the petiole. At its centre is a strand of vascular tissue surrounded by a cylinder of thin-walled cells separated by larger intercellular spaces. In certain states the cells engorge and stiffen. Under other conditions fluid is secreted in the intercellular spaces and the pulvinus becomes flaccid, Groups of cells by themselves can become turgid or lax, producing bending of the organ. It can even lift a leaf against gravity quite readily—this being almost comparable to a muscular contraction.

The orchid family deserves attention, too. They are so variable that similar flowers can be found in different genera having unlike vegetative parts.[3] Dissimilar flowers are often seen in the same genus. In some of the polymorphic genera there is as much variation between individuals as between species. They are eccentric forms. Their seeds[4] are so minute they contain little or no stored food. They cannot survive alone, and after the first few days die unless a beneficial fungus forms a symbiotic relationship with them. This symbiosis is most marked in the saprophytic species, for their nongreen leaves cannot photosynthesize. These orchids are actually parasites on fungi. The flowers can take almost any form. There may or may not be spurs, and Darwin thought spurs implied nectar, but, really, few or none have nectar, In those which do it may appear *after* impregnation and so be of no use in attracting insects. The numerous and highly extravagant forms of processes on orchids seem to have no use but to assist in classification! The orchid lip is more variable than the rest of the plant only in some genera, Adam says, and illustrates this with pages of drawings. It is hard to find common ground, she admits, upon which to organize comment. The pollinia, even the pollen grains, differ remarkably. The heritable characters appear almost numberless. All this, too, in light of the fact that only 25 species of at least 10,000 have been studied thoroughly to date. In the orchid embryo only the first division is consistent in all taxa. In a few the second division is consistent—but in only a few. Natural and artificial intergeneric hybrids are known.

So here is the most variable plant family known, where every possible variation from root to symbiont to flower is recorded. It raises a host of questions about adaptation. Why are so many forms needed, all of them adequate? Why has no other family emulated the orchids? It is as if "Nature" was demonstrating its virtuosity here for no ascertainable reason. Why has no narrow standardization by "selection" been achieved here?

Symbiosis

The Portuguese man-of-war[5] is a whole colony of different organisms. One kind forms the float, one supplies the fishing tentacles and a third kind consists of the digesting gastrozoids. A fourth type of organism looks after reproduction. These types of creatures do not survive long after separation. The gas of the float is secreted by a sort of gas gland, as in the swim bladder of fishes. It can inflate a deflated float in minutes and apparently has a feedback mechanism controlling its activity. The resting gastrozoid is only 1 to 2 mm. in diameter but can expand to 20 mm. or more and can take up a small fish with the help of its neighboring gastrozoids. The tentacles carry batteries of stinging nematocysts. Normally these are inverted tubes, held closed by a trigger. If stimulated the tube everts and may extend 100 to 300 times the diameter of its capsule. The surface of the tube is studded with a variety of spikes and hooks, and at the same time the tube can sting with a toxic fluid, about 75 per cent as strong as cobra venom. But loggerhead turtles eat these jelly-fish nonchalantly and the small, gay fish, *Nomeus gronovii*, lives and feeds inside the tentacles. Its stomach may contain many nematocysts. It can be stung, but quickly recovers. Indeed, it is 10 times as resistant as other fish.

For Food

The woodpecker has a unique arrangement of its toes for grasping trees—two forward and two pointing back. The mid-feathers of its tail are very strong and by a curious adaptation these main supports do not molt until all the rest of the tail has been replaced and can hold the bird up on a trunk. It has an uncanny ability to locate insects under bark or through wood, probably by pecking, then listening *acutely.* It can hit hard wood as often as 100 times per minute but not get dizzy, for the woodpecker has a thick skull, a straight, hard, sharp beak, and powerful neck muscles. The bones between beak and skull are not rigidly joined as in most other birds but have a spongy connective tissue pad between, The tongue may be 4 times as long as the beak and can go around curves or bend to reach ants in their burrows. It is often pointed and has little barbs like fish-hooks on its tip. Often, too, it has a sticky substance on its end. This tongue can whip up over the bird's head and even snatch food from behind the head. The California acorn-storing woodpecker makes rows of holes in certain trees, then tamps acorns into them. These are stores to which it later returns year after year–and always to the right tree.

The archer fish[7] *(Toxotes jaculatrix)* is a living water pistol. It can aim a jet of water accurately at a range of 2 to 3 feet, and douse an insect it wants to capture. But this is only one minor way of securing its food. Hence the interesting question to evolutionists: if spouting is so unimportant to this fish, why has it been a factor in survival and selection and differentiation within the species? The propulsive force is produced by a sudden compression of the gill covers. The tongue lies along a groove in the roof of the mouth to make the bore of the water gun. But how does a fish below the surface discern and aim at small objects above the surface? Refraction is not a real problem, says Luking, because it fires nearly vertically and from close to the surface. For close prey it leaps to bite, and this it can do effectively because it has binocular vision and can direct its eyes forward to see close to the snout, The fish aims its jet just below its prey, detaching it by the rebound! Its eyes have an unusually large number of rods, giving it fine vision in dim light.

Solitary or predatory wasps[8] number hundreds of genera, Each species hunts just one prey, perhaps only one species or genus, and thus these wasps have a wide repertory of hunting techniques. The males live solely on plant exudates–only the females hunt, This host specificity, which can be very narrow, is odd since the larvae of the wasps can often develop normally on quite different prey than the mother brings to them, Wasps rarely make mistakes in the selection of their prey, Evans insists, yet in various parts of its range a wasp may select a different array of flies-or a wasp may change from one prey to another. The sequence of stereotyped actions of the attacking wasp varies in adaptation to the anatomy of its prey. It may be a single sting, if that is all that is needed for one large ganglion, as in many Homoptera, or it may be a series arranged to paralyze the jumping legs of a cricket before its other legs, or be inserted along the thorax and then underneath to catch the prolegs of certain caterpillars as well as the thoracic legs. The exact ganglion need not be penetrated precisely since the venom can diffuse into the appropriate muscles from a more random sting. The predator wasps are able to distinguish mimics that fool vertebrates regularly, such as tree hoppers or preying mantids.

Metabolism

In Hebron Fjord in Labrador supercooled fish live at 100 to 200 metres depth where the water is —1.7° C all the year round and below the freezing point of fish blood by 1°C. If brought to the surface and freezing is triggered by touching them with ice they freeze throughout and die. They survive where they are because there is no ice down there to trigger freezing.

Ross[9] tells of Mexican carpenter ants *(Camponotus abominalis)* who during the day keep caterpillars of a rare butterfly in closed burrows, a few ants staying inside to guard the precious larvae. The burrows are close to the latter's food plant. In the evening the guardian ants inspect this bush for marauders, then shepherd the caterpillars out to eat. The ants then jump on the larvae and drink their honeydew on the spot. When dawn approaches the ants herd the caterpillars down into their burrows again and seal these with mud pellets. They even guard the larva when it becomes a chrysalis. The caterpillars are never found where the carpenter ants are not seen and cannot live without them!

As the fish-like tadpole[10] changes into a frog its nitrogen excretion alters from 90 per cent ammonia to 90 per cent urea. The arginase needed to catelyze arginine into urea increases by 10 times during metamorphosis. Arginine derives from ammonia by a process demanding three enzymes. These increase likewise, by as much as 50 times, What a wonderful biochemical mobilization for life on land! The blood serum at the same time increases its albumin and so conserves circulating fluids. Tadpole haemoglobin readily loads oxygen and frog hemoglobin unloads it as readily. The former does not contain cysteine. The long vegetarian gut of the tadpole shortens in the insectivorous frog. Enzyme changes accompany this to handle the new high-protein diet in the pancreas and bowel. The bull frog tadpole, like a fish, has purple porphyropsin in its retinal rods, but this changes in the frog to red rhodopsin. No adaptational reasons for this can be thought of, says Friedin. He concludes that the biochemistry of metamorphosis may not parallel the biochemistry of evolution precisely!

In the kangaroo the epitheliums of the embryo's mouth grows so intimately to the nipple epitheliums that the mouth is lacerated if the baby is forcibly removed[11].

Elephants and women and whales have attendants at childbirth, the latter (in whales) nuzzling the newborn whale to the surface to let it breathe.

All types of placentae occur in primates, our haemochorial type being shared with insectivore "lower" than the tree-shrews and with Tarsius. Indeed, it is very hard to outline a phylogenetic tree for the placenta, Rhodes regards the foetal circulation and its transition to extra-uterine life, the intrauterine foetal movements, and so on, as "fantastic adaptations" which shake his faith, "convinced evolutionist" as he is!

Odoriferous glands in mammals have nothing in common but their smell[12], They may be occipital (Arabian camel), suborbital (antelope), on the throat (Californian mastiff bat), scapular (fruit bat), sternal (opossum), lateral (shrew), dorsal (golden hamster), axillary (man), supracaudal (guinea pig), interdigital (ruminants), scrotal (potto), soles of feet (mice), anal or perineal (stoat, civet), preputial (musk deer, muskrat, beaver). The crocodile has them in its cloaca. Many are altered by hormones. They have been classed as pheromones,

The quarter-inch long Stenodus beetle[13] when attacked by a water-strider, squirts out a bit of detergent from its abdominal glands. This breaks the surface tension of the water in front of the attacker, which sinks, and a small wave pushes the Stenodus out of danger. Indeed, they can move as fast as 2½ feet per second due to their detergent, However, the protective powers of the Stenodus work only astern. On a frontal attack the water-strider wins.

Mead-Briggs[14] found that rabbit fleas, *spilopsyllus euniculi*, can produce mature eggs only when feeding on a pregnant rabbit. The eggs develop pari-passu with the rabbit pregnancy, *whenever laid*, and hatch when the rabbit gives birth. If the eggs are moved to an unsuitable rabbit they become smaller again. Cortisone given to the host matures the eggs of the flea. Hence vertebrate hormones such as hydrocortisone may play a role in the reproduction of blood-sucking arthropods!

Two moths, the corn ear-worm (Heliothis) and Abbott's sphinx (Lapara)[15] can raise their own thoracic temperature as much as 17° F. Certain antennary spines act as aerials to receive wavelengths of 1.7, 2.35, 6.0 and 8.6 microns, The compound eyes of certain moths act as sensitive radio-meters searching out specific hot points in the far infra-red range—hence their success in finding "hot" mates.

Luminescence occurs in more than half the zoological phyla. Some species of prawns and fish have both extracellular and intracellular luminescence. In deep-sea squids, prawns and fishes there are often accessory structures increasing the efficiency of the light organs (like bull's eye-lanterns). A mass of light-producing photocytes lie inside, and the front of the organ may have one or several lenses. The reflector in fireflies is probably urate crystals, and in fish platelets of guanine. In squids a pair of light-organs fits into the ink-sac, and in them are compartments holding luminous bacteria, with a reflector and lens. The ink-sac forms an opaque screen behind. The light organs of fishes can be located on the ventral body wall, lower jaw, or the wall of various parts of the gut. Since organs containing luminous bacteria emit light continually there are also appropriate devices for varying the light intensity or for screening it.

Scale-worms have luminescent scales which flash intermittently–may flash, too, when cast off from the body. Stomiatoid fishes from the ocean depths have a rotating mechanism which can turn the light organs down to conceal them. Of two fishes with large bacterial cheek luminescent organs, one, Anomalops, can rotate its organ thus but the other, Photoblepharon, draws an opaque curtain over it! Very different chemical compounds can be used in light production, as Nicol[16] points out. The luciferin of bacteria and of a marine clam, Pholas, can be somewhat similar, but in fireflies it is much different, and there is another type again in the minute shelled crustacean, Cypridena, or in the jellyfish, Aequorea. It seems that luminescence is a convergence phenomenon and has taken many chemical approaches. No one has yet offered a good reason for luminescence in minute protozoa. Perhaps it has sexual uses in some forms, or defensive purposes, or assists in keeping a shoal of creatures together.

General Comment

None is needed, really. When the Lord makes creatures or plants fit they are really fit [17,18].

Conversely, one thinks of the argument on "maladaptation," e.g. the horses before equus or the saber-toothed tiger. Apparently the early horses grazed side by side with equus for millions of years. That is good survival. And Gay-lord Simpson says of the saber-tooth that if its teeth made eating difficult yet it took 40,000,000 years to starve it to death. It was not *badly* mal-adapted![19]

Adaptation is a long cadenza full of harmonics and arpeggios. It demonstrates the virtuosity of God.

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