Sense Organs Evolution

Eyes Of Invertebrates And Vertebrates

December 19th, 2009

Cephalopoda possess the best eyes among invertebrates. Their vision is in no way inferior to that of higher vertebrates. Another branch of invertebrates, the arthropods, attained a high level of evolution, but, for some reason, this did not apply to their eyes. They compensated for this shortcoming by combining a great number of ocelli (pyramids with the base turned outwards and covered by a chitinous crystalline lens) into a few big eyes of an involved pattern, each eye consisting of hundreds and even thousands of such pyramids. By the joint efforts of their individual, usually rather short-sighted ocelli, insects and Crustacea can perceive the size and shape of objects.

The history of the eyes of vertebrates began in a diller-ent way. The otl-shore area of many seas and oceans is inhabited by curious small animals called lancelets. They look like small fishes and resemble the blade of a surgeon's lancet, from whence their name came. The organ of vision of the lancelet is its brain. Light-sensitive cells are scattered all along the nerve trunk of the lancelet which has a transparent body. It can thus differentiate between light and darkness, which is all it needs for its way of life.

Apparently, the ancestors of the vertebrates, like lancelets, also saw with their brain. But when their bodies had lost their transparency, bundles of light-sensitive nerve cells had to move otV the brain outside. This has become the pattern of the evolution of the eyes in all vertebrates. At a certain phase in an embryo's development two pieces separate from the brain and gradually develop into eyes. So, our eyes are, in fact, pieces of the brain that have moved outside to the sunlight.

The further development of the eyes in vertebrates followed the same pattern: they acquired refractive and accommodation systems and muscles which move the eye. The design became more and more involved until it resulted in our present eyes, capable of deciphering the jungles of the worst scrawl in the world and of distinguishing the slightest tints in colour. At the same time the animal brain also became more complex. The eye as such is merely a light-receiving device, like a camera. What we actually 'see' with is the brain. The brain pieces together the information it receives from the millions of the light-sensitive cells in the eye into a single picture. The snapshots made with the eye are developed in the laboratory of the brain.

Vision And Optical Analysers

December 16th, 2009

The optical analyser developed under the influence of sunlight, so it did not need to be so complicated. The eyes of various animals can perceive no more than a three-octave light flux. The range of light perception is thus only one-fifth that of the sound range. Few animals on our planet are indifferent to light. Even the eyeless protozoa can distinguish light from darkness. Sensitivity to light is based on the property of some chemical reactions to be accelerated in the presence of light. Hence, the protoplasm of practically any cell in a multicellular organism can perceive light, and it needs no eyes for this purpose.

The forerunners of the organ of vision were special light-sensitive cells which could react to feebler light than the other cells in the organism. There are some creatures in which these special light-sensitive cells still exist. One that we know well is the earthworm. It has no eyes, but is quite happy with the numerous light-sensitive cells in its skin. With these cells it feels negligible changes in illumination, which man ca'nnot perceive. It was from such light-sensitive cells scattered all over the body that the eye gradually developed in the course of evolution. At first it was just an accumulation of light-sensitive cells in one spot. Such eyes readily distinguish light from darkness, but they cannot tell from where the light is coming.

The eye then evolved in the following way. The light-sensitive cells gradually acquired a transparent cover and screens of pigment cells that did not allow light into the eye from all directions. Then the light-sensitive spots turned into pits, or even sacs, the first eyes worthy of that name. These eyes could catch light coming only from a certain direction and easily established thereby the direction of the incident light rays. From this primitive optical device there remained but one step to the eye of higher animals: the eye only had to acquire refractive and accommodation systems modifying the refractive index and, last but not least, the oculomotor apparatus that made an active search for visual information possible.

Development of Sound Signalling

December 14th, 2009

When life began on our planet, profound silence prevailed. The only sounds to be heard were those of thunderbolts and the roar of breakers against the sombre desolate dills by the primordial seas, but those sounds were of no interest to most animals. It was only after the animals themselves had achieved a higher stage of evolution and learned to wander about and devour one another that faint sounds began to be distinguished on the Earth. They were sounds of a biological origin produced by animals themselves. This prompted the development of the acoustic analyser and the sound signalling.

Extremely multifarious receptor devices, from wide-range to those only detecting a very narrow band of sounds, had to be evolved to cope with the gamut of sound sources.

Certain bats can best hear very high-pitched sounds of up to 300 kilocycles, but they can also hear very low sounds. Their auditory organ has a range of fifteen octaves. The nocturnal moths on which these bats feed have no use for such an enormous sound range. The tympanic organ of their wings is only able to pick up the ultrasonic signals of the bats. The organ for this limited function is similarly very simple in design. It consists of a membrane, air-sacs and two sensory nerve cells. Their sole function is to perceive the sound produced by the bat and to give the command so that the moth quickly changes direction of flight.

Man’s Principal Sense Organs

December 14th, 2009

Of the six principal sense organs three are the most important to us. We can lose the sense of taste and, certainly, smell, and not even bother about it. One could even somehow put up with the loss of the sense of touch, but the loss of vision, hearing, or sense of equilibrium seriously incapacitates a person. These are the principal senses we use to perceive the world we live in.

Man’s main sense organs do not always coincide in importance with the main analysers in animals. Many representatives of the animal kingdom have very feeble vision and some are completely blind. Others are deaf, or only hear very badly, and yet they still manage quite well. As to the organ of equilibrium, this is an extremely important analyser and almost all multicellular animals have it.

Even in unicellular animals zoologists have discovered certain structures remotely resembling the organ of equilibrium of higher animals. The parasitic infusoria possess a device of this sort. They have a special vacuole, a small peripheral sac with some crystalline inclusions, similar in structure to the statocyst (the sac of the labyrinth maintaining static equilibrium) in multicellular animals. If it is some day discovered that the vacuole does indeed fulfill the same function, it will not be surprising. There are many remote corners on our planet plunged in pitch-darkness, many spots where no sound ever penetrates, but the Earth gravity is ubiquitous and inescapable.

There are grounds for believing that light has played an active part in the origination of life. At any rate, light sensitivity, which seems to have been possessed even by primary living matter, soon gave rise to a special organ, the organ of vision. Even contemporary unicellular flagel-lata perceive light. The unicellular animals, particularly the Peridinia, many of which can themselves emit light, have rather large eyes. Their eyes are a bowl-shaped accumulation of reddish, fat-like, light-sensitive pigment located in the anterior part of the Peridinia, at the base of the flagellum. In the pigment there is a transparent grain of starch which serves to refract and focus light.

Of the three main sense organs which are most essential to man, the two oldest are the organs of vision and equilibrium. These organs which are, on the whole, very dissimilar, have one interesting feature in common. Although the organs of vision and equilibrium have greatly modified in the process of their evolution and perfection, they differ less in design and specific function than the acoustic analysers and the sound receptors in various animals. This is obviously because the organs of vision and equilibrium were both shaped under the impact of some single, constant global factor; the sense of equilibrium was formed under the influence of the Earth gravity, and vision under the impact of sunlight. But on the Earth there has never been any unique and standard source of sound.

Discussing the nature and functions of principal sense organs and the way they evolve.