Candidate's Exam No ______ Question ______

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EVOLUTION

Evolution is a biologic process, but it is also significant to geology. The evidence for this process comes from fossil - the province of the geologist and from living organisms - the province of biologist. Evolution is conveniently refer to as the biologic equivalent of the continuing changes that have occured and continue to occur on the earth.

The concept of evolution states that all living organisms have arisen from pre-existing living things by a gradual process of change over a very long period of time, thus evolution implies that present day species have not always existed as such, but have arisen from previously existing organisms, their ancestors. Over many millions of years organism of today merely represent the product of change over a long period of time.

Evolution is broadly the sum total of adaptive changes that have taken place over a very long period of time. It leads to the development of new

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Candidate's Exam No ______ Question ______

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species from earlier ones - new species that live their lives in different ways from the species from which they evolved. Many species also become extinct in this never ending process.

HISTORICAL DEVELOPMENT OF EVOLUTION

1. Linnaeus Work

In 1737, Linnaeus in his book Systema Naturae attempted to classify all living organisms in a logical system. He used two names; genus and species for each kind of organisms and this system is still in use. The value of this system is that it showed that there are degrees of similarities and differences among organisms rather than ~~random~~ variations

2. Lamarcks Work

In 1809, Chevalier de Lamarck published important theory of evolution, although his theory was disproved. He proposed some useful ideas. He proposed the concept of Adaptation by living organisms to a particular environment. He recognised that in order to live animals have to be efficiently adapted to its environment, and it is critical to the understanding of evolutionary theory.

While appreciating the significance of Adaptation Lamarck felt that new organs must arise from new needs and that these acquired characters were inherited, as he postulate that neck of the giraffe had become longer in response to a need to reach leaves up on the tree.

3. Curiers Work

One of the strong critics of Lamarcks was ~~Georges~~ Georges Frederic Depobert Cuvier, who studied the vertebrate fossil bones found in the sedimentary beds of the paris basin. He was an antievolutionist and attack Lamarck on two grounds

I. Lamarck believed that organisms became more complex through evolution, but Cuvier noted that the fish that he found in ancient rocks were already very complex.

II. He could not see any evidence of gradual change in the fossils

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Candidate's Exam No ______ Question ______

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that he studied, The bones in each Successive bed were different from those in the underlying bed and there was no trace of any intermediate steps neccessary in evolution.

For these reasons, he believed in seperate creation for each bed and that the change in rock type from bed to bed was by the revolution that killed the organism and so set the stage for the next generation.

Cuvier did some excellent work in his studies of fossil vertebrate. He founded mordern comparative anatomy, which is one of the lines of evidence of evolution. If the skeletons of vertebrates are compared similar bones are found in each, although they may serve a somewhat different function in each. In some cases, the correspondence is very close (Fig. 1 below). It is highly unlikely that most vertebrates would have the same bones, unless all evolved from a single common ancestor.

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Candidate's Exam No ______ Question ______

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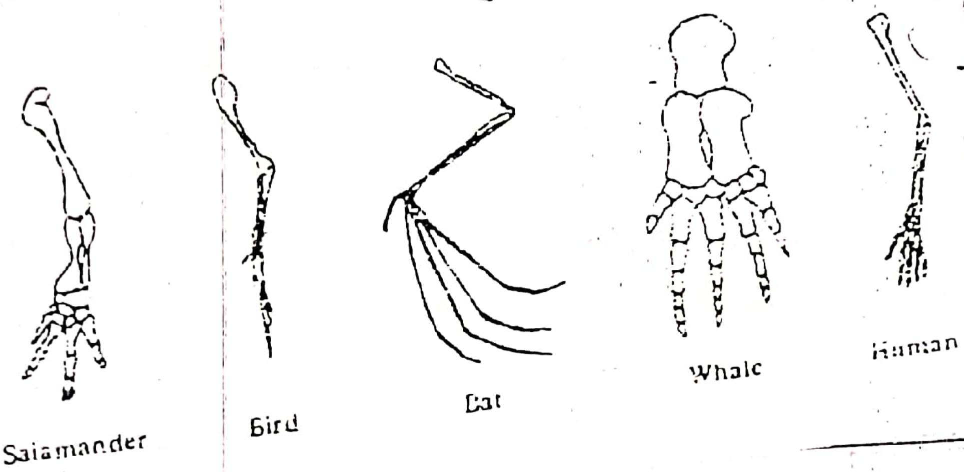

Fig-1: The similarity of bones in forelimbs of vertebrates. Similar bones serve different purposes in each of the examples. It seems very unlikely that such different limbs should have similar bones without evolution.

Surely the most efficient design of a whale fin, a bird wing and a human hand would not all use the same bones for such different functions.

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Candidate's Exam No ______ Question ______

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4. Darwins Work.

Charles Darwin read Charles Lyell's book on principles of Geology while on Survey vessel: H.M.S. Beagle on evidences of uniformitarianism (Enquiry on how far past changes of the earth's surface are referable to causes now in operation - present is the key to the past) and that the earth is older than currently thought. This ideas influences Darwins thinking on slow biologic change over a long period of time.

During the voyage (1931-1936), Darwin made several observations both biologic and geologic, but one of the well known observations he made, was the study of finches in the Galapagos island, about 1000km off the coast of South America, too far for these birds to fly, Darwin found 13 species of finches, the 13 species vary mainly in the size and shape of their beaks and this reflects in their food (fig 7 below).

With his observations and studies, as well as clues from other peoples work, Darwin

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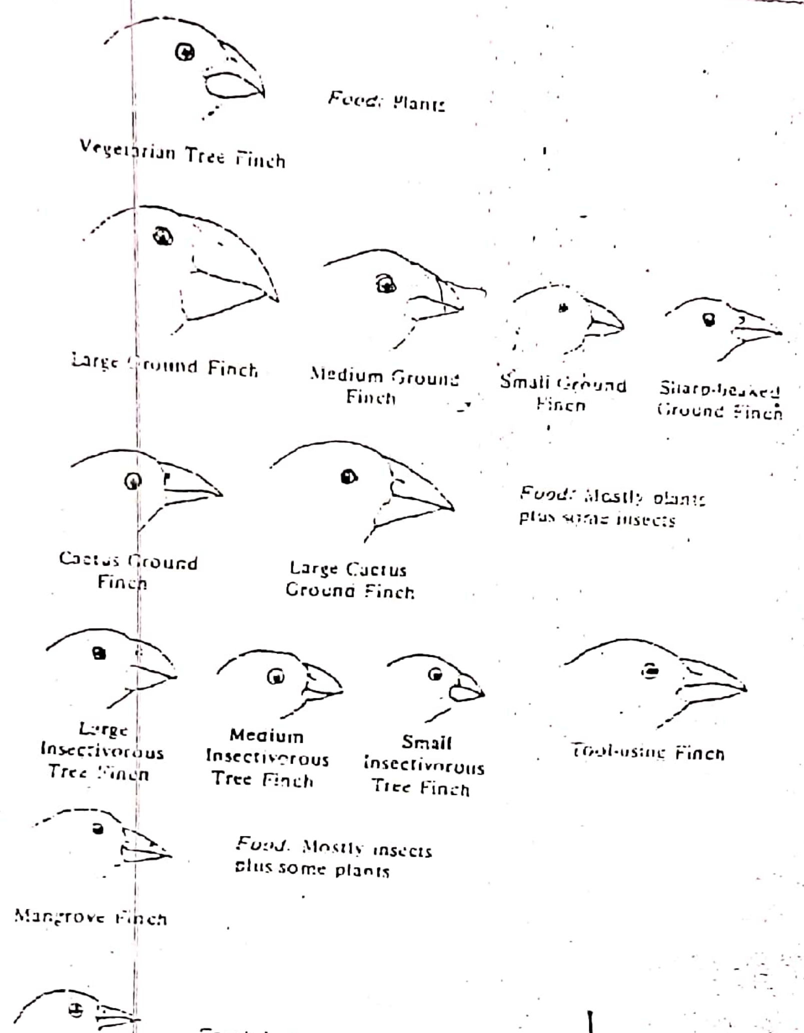

Fig 2: Darwin's finches of the Galapagos Islands. These finches apparently evolved from a common ancestor. Notice the differences in the shapes of their beaks and in the size of the birds.

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formulated an hypothesis on evolution which he showed to his friends but did not publish it. Darwin did not relent in gathering facts to support his ideas.

In 1958, Darwin received a letter from Alfred Wallace, a fellow naturalist on a trip in area known as Indonesia. The letter contained similar ideas he has in his unpublished work, namely: The origin of species by natural selection. Darwin's friend arranged for both essays to be presented under joint authorship on the same day using the title: On the tedency of species to form varieties, and on the perpetuation of varieties and species by means of natural selection.

1959, Charles Darwin published a book that revolutionised the science of biology. This famous book, on origin of species by means of Natural Selection; outlined how present day organisms evolved from earlier, different species. This theory replaced Lamarcks and based on four observations.

1. Most organisms produce a large

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Candidate's Exam No ______ Question ______

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number of offspring more than can be expected to survive and reproduce.

II. The size of a given population remains fairly constant, although there may be fluctuations.

III. Individuals within a specie always show variation.

IV. Some variations are more favourable to existence in a given environment than others.

From these observations, he made the following deductions:

I. All living organisms are constantly involved in a struggle for existence.

II. In a population, those that tend to survive and reproduce are the individuals whose variation give them competitive advantage over the rest. These are the fittest in that they are best adapted to their environment. The favourable variations they posses are passed on to their offspring.

Darwin, thus identified environmental

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Candidate's Exam No ______ Question ______

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pressures as the main cause of Natural selection, they cause favourable variations to accumulate and unfavourable ones to be weeded out over thousands of generations, favourable variations naturally selected by the environment accumulate sufficiently to give rise to new species from ancestral species. Therefore, according to Darwin, natural selection acting through environmental pressures is the driving force behind evolutionary change.

Darwin did not know how inheritance work, so he could not explain the source of variation and how individual variation arise. This was one of the main criticisms against his theory at that time. The work of the Austrian monk Gregor Mendel in 1967 and later Morgan, 1910 that provide genetic experiment and theory that supplied the understanding of heredity essentials that significantly explains Darwins theory.

Morden View of Evolution (Neo-Darwinism)

The current theory of the process of evolution makes use of present day

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Candidate's Exam No. ______ Question ______

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Knowledge of genes and chromosomes to explain the source of genetic variation upon which natural selection works.

It also postulated that although natural selection is the only driving force that regularly produce adaptive evolutionary change, other forces too play a part in evolution. Scientist now identified Mutation, gene flow and genetic drift as the other natural forces that are also responsible for evolutionary change.

GENES: Genes are the primary unit of hereditary, carrying the genetic code which is responsible for directing the development and functions of the whole organisms. They are found on chromosomes in the nuclei of all cells. When a cell divides, the genes duplicates themselves, so that each daughter cell has an identical set of genes as the original parent cell. Genes are actually a seg nt of DNA on which each gene information is encoded.

The inherited genetic material in an organisms known as genotype is reacted upon by the environment through sensor genes to create a developed individual. This individual, the product of both heredity and environment is the phenotype.

MUTATION: These are random changes in DNA that alters genetic information, and so introduce new characteristics. They may occur in body cells or during gamete formation.

GENE FLOW: When members of a population interbreed; genes are recombined in various ways and spread across the population. This is called gene flow. Different population of the same species can also interbreed. When this happens, there is gene flow between the populations. However, population of different species cannot interbreed, so there is no gene flow between them. The total gene content of a species is known as gene pool. Big changes in the gene content of a gene pool give rise to new species.

GENE DRIFT: This is the random fluctuations of gene frequencies in a population, such that the gene amongst offspring are not a perfect representation sampling of the parental genes. Although drift occurs in all population, it effect are most felt in very small isolated population in which it give rise to random fixation of alternative alleles.