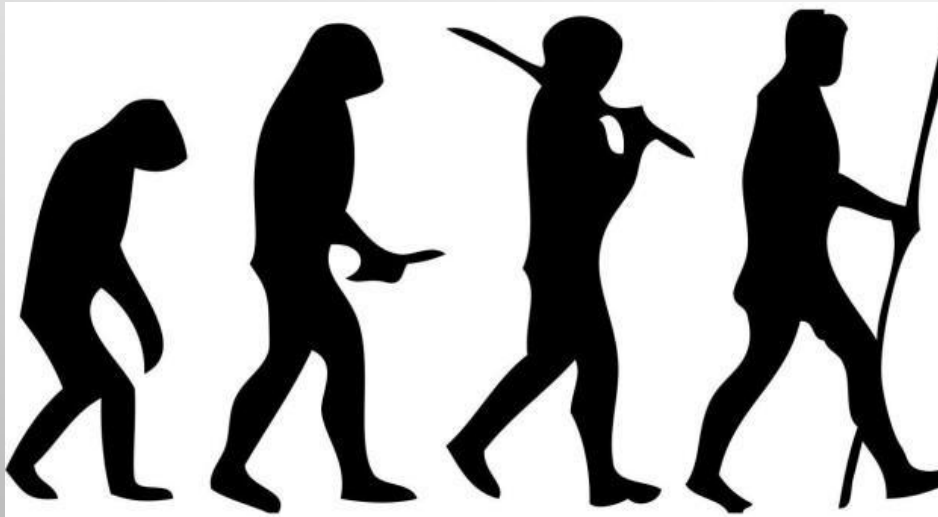


THE PROBLEM OF EVOLUTIONISM



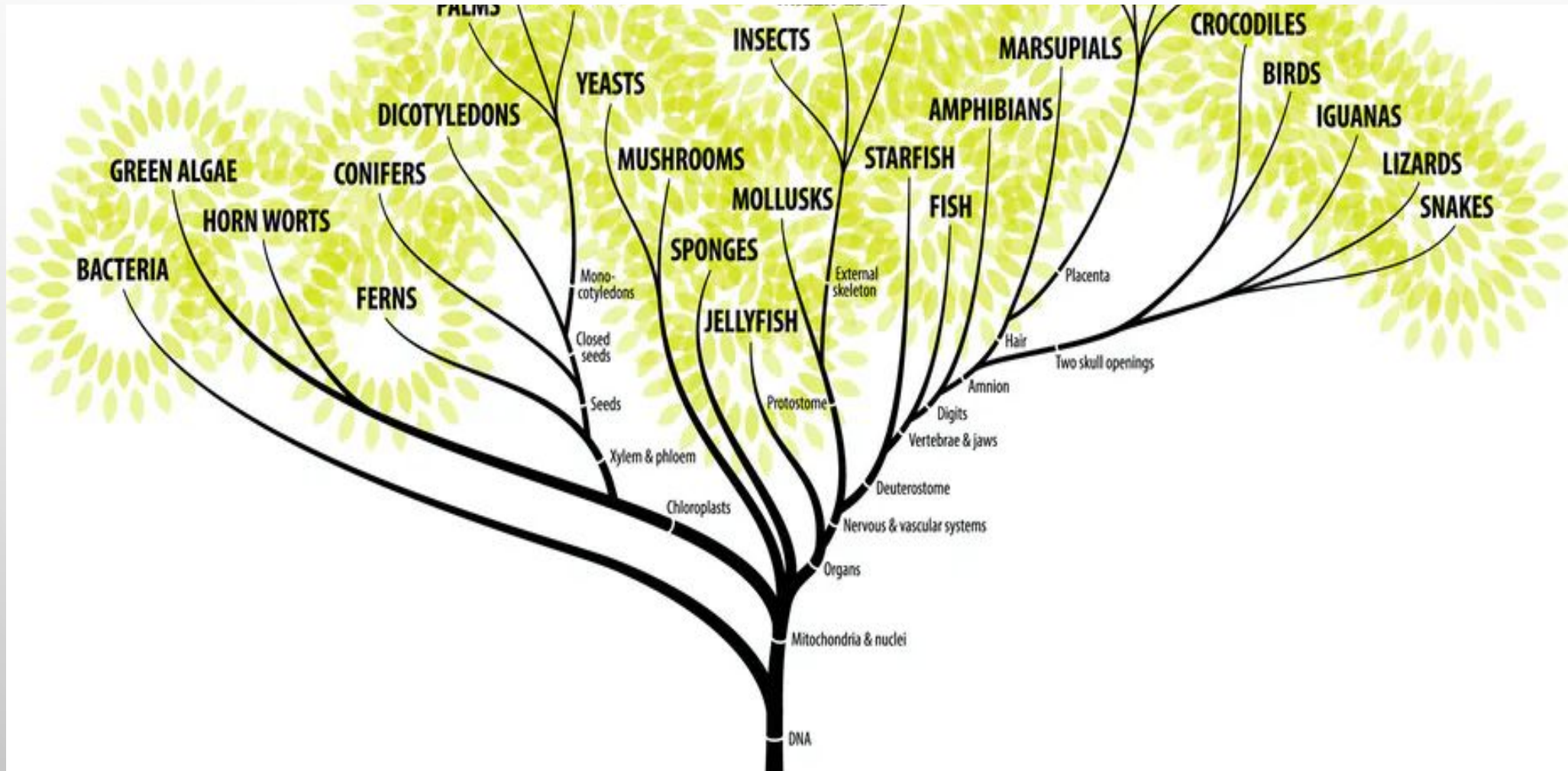
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EVOLUTION

- **EVOLUTION** IS CHANGE IN THE HERITABLE CHARACTERISTICS OF BIOLOGICAL POPULATIONS OVER SUCCESSIVE GENERATIONS. THESE CHARACTERISTICS ARE THE EXPRESSIONS OF GENES THAT ARE PASSED ON FROM PARENT TO OFFSPRING DURING REPRODUCTION. DIFFERENT CHARACTERISTICS TEND TO EXIST WITHIN ANY GIVEN POPULATION AS A RESULT OF MUTATION, GENETIC RECOMBINATION AND OTHER SOURCES OF GENETIC VARIATION. EVOLUTION OCCURS WHEN EVOLUTIONARY PROCESSES SUCH AS NATURAL SELECTION (INCLUDING SEXUAL SELECTION) AND GENETIC DRIFT ACT ON THIS VARIATION, RESULTING IN CERTAIN CHARACTERISTICS BECOMING MORE COMMON OR RARE WITHIN A POPULATION. IT IS THIS PROCESS OF EVOLUTION THAT HAS GIVEN RISE TO BIODIVERSITY AT EVERY LEVEL OF BIOLOGICAL ORGANISATION, INCLUDING THE LEVELS OF SPECIES, INDIVIDUAL ORGANISMS AND MOLECULES.

- THE SCIENTIFIC THEORY OF EVOLUTION BY NATURAL SELECTION WAS CONCEIVED INDEPENDENTLY BY CHARLES DARWIN AND ALFRED RUSSEL WALLACE IN THE MID-19TH CENTURY AND WAS SET OUT IN DETAIL IN DARWIN'S BOOK *ON THE ORIGIN OF SPECIES*. EVOLUTION BY NATURAL SELECTION WAS FIRST DEMONSTRATED BY THE OBSERVATION THAT MORE OFFSPRING ARE OFTEN PRODUCED THAN CAN POSSIBLY SURVIVE. THIS IS FOLLOWED BY THREE OBSERVABLE FACTS ABOUT LIVING ORGANISMS:
- (1) TRAITS VARY AMONG INDIVIDUALS WITH RESPECT TO THEIR MORPHOLOGY, PHYSIOLOGY AND BEHAVIOUR (PHENOTYPIC VARIATION),
- (2) DIFFERENT TRAITS CONFER DIFFERENT RATES OF SURVIVAL AND REPRODUCTION (DIFFERENTIAL FITNESS) AND
- (3) TRAITS CAN BE PASSED FROM GENERATION TO GENERATION (HERITABILITY OF FITNESS).



THE STRUGGLE FOR EXISTENCE

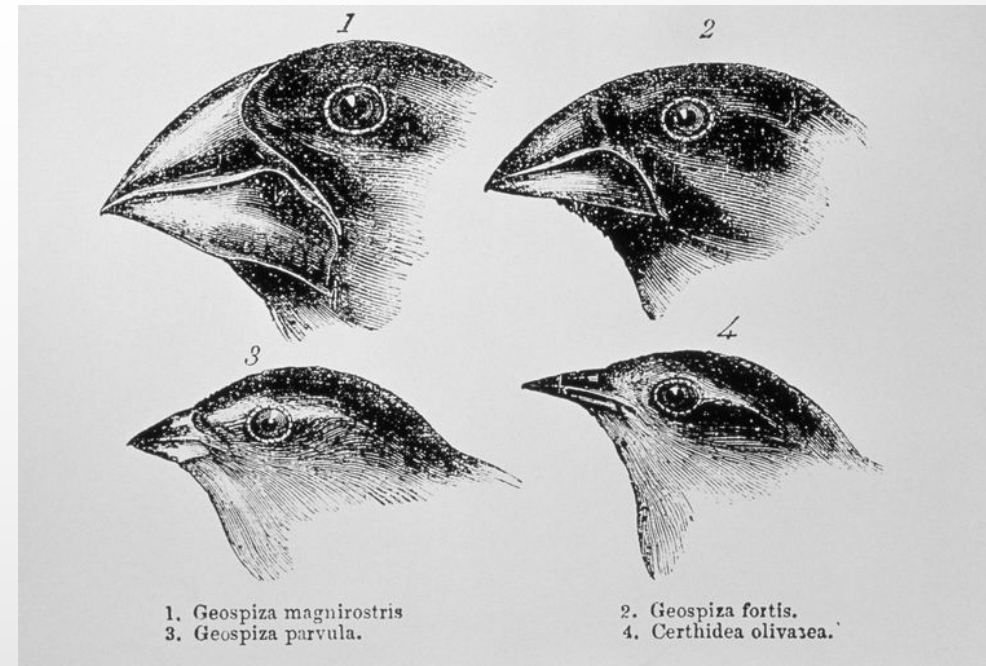
- THE CONCEPT OF THE STRUGGLE FOR EXISTENCE CONCERNS THE COMPETITION OR BATTLE FOR RESOURCES NEEDED TO LIVE. IT CAN REFER TO HUMAN SOCIETY, OR TO ORGANISMS IN NATURE. THE CONCEPT IS ANCIENT, AND THE TERM STRUGGLE FOR EXISTENCE WAS IN USE BY THE END OF THE 18TH CENTURY. FROM THE 17TH CENTURY ONWARDS THE CONCEPT WAS ASSOCIATED WITH A POPULATION EXCEEDING RESOURCES, AN ISSUE SHOWN STARKLY IN THOMAS ROBERT MALTHUS' AN ESSAY ON THE PRINCIPLE OF POPULATION WHICH DREW ON BENJAMIN FRANKLIN'S OBSERVATIONS CONCERNING THE INCREASE OF MANKIND, PEOPLING OF COUNTRIES, ETC

- CHARLES DARWIN USED THE PHRASE "STRUGGLE FOR EXISTENCE" IN A BROADER SENSE, AND CHOSE THE TERM AS THE TITLE TO THE THIRD CHAPTER OF ON THE ORIGIN OF SPECIES PUBLISHED IN 1859. USING MALTHUS'S IDEA OF THE STRUGGLE FOR EXISTENCE, DARWIN WAS ABLE TO DEVELOP HIS VIEW OF ADAPTATION, WHICH WAS HIGHLY INFLUENTIAL IN THE FORMULATION OF THE THEORY OF NATURAL SELECTION. IN ADDITION, ALFRED WALLACE INDEPENDENTLY USED THE CONCEPT OF THE STRUGGLE FOR EXISTENCE TO HELP COME TO THE SAME THEORY OF EVOLUTION. LATER, T.H. HUXLEY FURTHER DEVELOPED THE IDEA OF THE STRUGGLE FOR EXISTENCE

EVOLUTIONISM

EVOLUTIONISM IS A TERM USED (OFTEN DEROGATORILY) TO DENOTE THE THEORY OF EVOLUTION. ITS EXACT MEANING HAS CHANGED OVER TIME AS THE STUDY OF EVOLUTION HAS PROGRESSED. IN THE 19TH CENTURY, IT WAS USED TO DESCRIBE THE BELIEF THAT ORGANISMS DELIBERATELY IMPROVED THEMSELVES THROUGH PROGRESSIVE INHERITED CHANGE (ORTHOGENESIS).

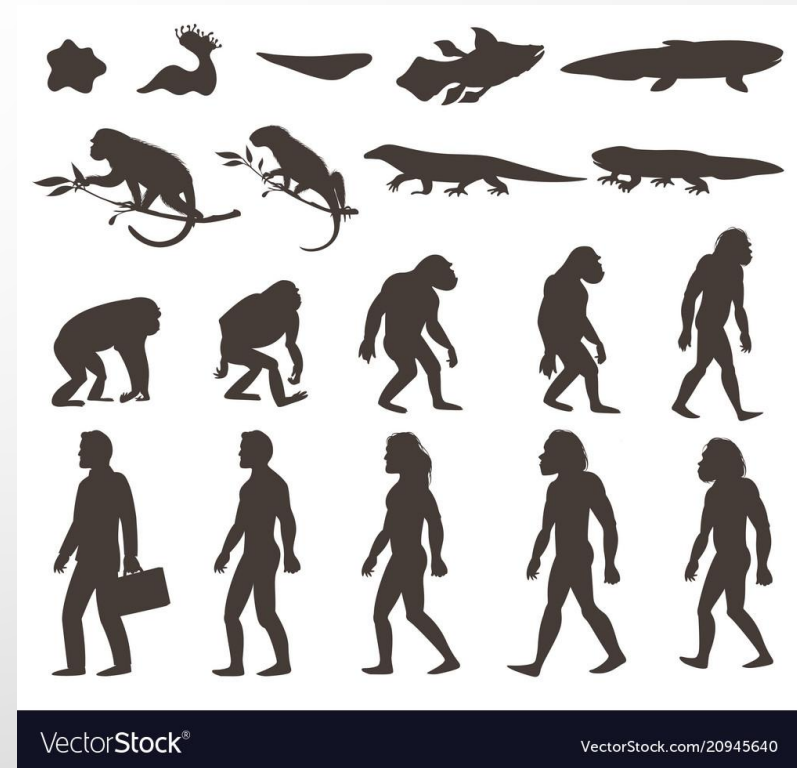
THE TELEOLOGICAL BELIEF WENT ON TO INCLUDE CULTURAL EVOLUTION AND SOCIAL EVOLUTION. IN THE 1970S THE TERM NEO-EVOLUTIONISM WAS USED TO DESCRIBE THE IDEA "THAT HUMAN BEINGS SOUGHT TO PRESERVE A FAMILIAR STYLE OF LIFE UNLESS CHANGE WAS FORCED ON THEM BY FACTORS THAT WERE BEYOND THEIR CONTROL".



- THE TERM IS MOST OFTEN USED BY CREATIONISTS TO DESCRIBE ADHERENCE TO THE SCIENTIFIC CONSENSUS ON EVOLUTION AS EQUIVALENT TO A SECULAR RELIGION. THE TERM IS VERY SELDOM USED WITHIN THE SCIENTIFIC COMMUNITY, SINCE THE SCIENTIFIC POSITION ON EVOLUTION IS ACCEPTED BY THE OVERWHELMING MAJORITY OF SCIENTISTS. BECAUSE EVOLUTIONARY BIOLOGY IS THE DEFAULT SCIENTIFIC POSITION, IT IS ASSUMED THAT "SCIENTISTS" OR "BIOLOGISTS" ARE "EVOLUTIONISTS" UNLESS SPECIFICALLY NOTED OTHERWISE. IN THE CREATION–EVOLUTION CONTROVERSY, CREATIONISTS OFTEN CALL THOSE WHO ACCEPT THE VALIDITY OF THE MODERN EVOLUTIONARY SYNTHESIS "EVOLUTIONISTS" AND THE THEORY ITSELF "EVOLUTIONISM".

THEORY OF EVOLUTON

THE THEORY OF EVOLUTION BY NATURAL SELECTION, FIRST FORMULATED IN DARWIN'S BOOK "ON THE ORIGIN OF SPECIES" IN 1859, IS THE PROCESS BY WHICH ORGANISMS CHANGE OVER TIME AS A RESULT OF CHANGES IN HERITABLE PHYSICAL OR BEHAVIORAL TRAITS. CHANGES THAT ALLOW AN ORGANISM TO BETTER ADAPT TO ITS ENVIRONMENT WILL HELP IT SURVIVE AND HAVE MORE OFFSPRING.

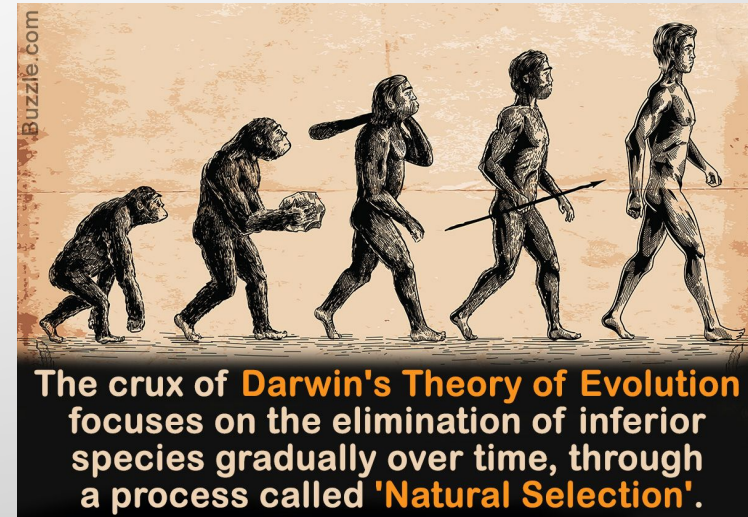
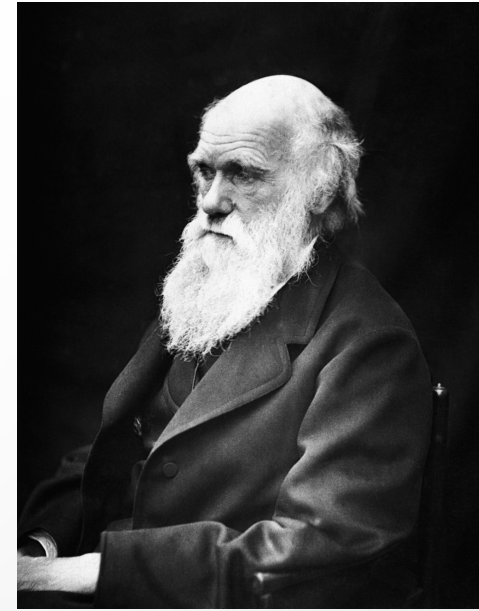


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DARWIN THEORY OF EVOLUTION

A THEORY OF BIOLOGICAL EVOLUTION DEVELOPED BY THE ENGLISH NATURALIST CHARLES DARWIN (1809–1882) AND OTHERS, STATING THAT ALL SPECIES OF ORGANISMS ARISE AND DEVELOP THROUGH THE NATURAL SELECTION OF SMALL, INHERITED VARIATIONS THAT INCREASE THE INDIVIDUAL'S ABILITY TO COMPETE, SURVIVE, AND REPRODUCE. ALSO CALLED **DARWINIAN THEORY**, IT ORIGINALLY INCLUDED THE BROAD CONCEPTS OF TRANSMUTATION OF SPECIES OR OF EVOLUTION WHICH GAINED GENERAL SCIENTIFIC ACCEPTANCE AFTER DARWIN PUBLISHED *ON THE ORIGIN OF SPECIES* IN 1859, INCLUDING CONCEPTS WHICH PREDATED DARWIN'S THEORIES.





Natural



Selection



NATURAL SELECTION

- NATURAL SELECTION IS THE DIFFERENTIAL SURVIVAL AND REPRODUCTION OF INDIVIDUALS DUE TO DIFFERENCES IN PHENOTYPE. IT IS A KEY MECHANISM OF EVOLUTION, THE CHANGE IN THE HERITABLE TRAITS CHARACTERISTIC OF A POPULATION OVER GENERATIONS.
- EXISTS WITHIN ALL POPULATIONS OF ORGANISMS. THIS OCCURS PARTLY BECAUSE RANDOM MUTATIONS ARISE IN THE GENOME OF AN INDIVIDUAL ORGANISM, AND THEIR OFFSPRING CAN INHERIT SUCH MUTATIONS. THROUGHOUT THE LIVES OF THE INDIVIDUALS, THEIR GENOMES INTERACT WITH THEIR ENVIRONMENTS TO CAUSE VARIATIONS IN TRAITS. THE ENVIRONMENT OF A GENOME INCLUDES THE MOLECULAR BIOLOGY IN THE CELL, OTHER CELLS, OTHER INDIVIDUALS, POPULATIONS, SPECIES, AS WELL AS THE ABIOTIC ENVIRONMENT. BECAUSE INDIVIDUALS WITH CERTAIN VARIANTS OF THE TRAIT TEND TO SURVIVE AND REPRODUCE MORE THAN INDIVIDUALS WITH OTHER LESS SUCCESSFUL VARIANTS, THE POPULATION EVOLVES. OTHER FACTORS AFFECTING REPRODUCTIVE SUCCESS INCLUDE SEXUAL SELECTION (NOW OFTEN INCLUDED IN NATURAL SELECTION) AND FECUNDITY SELECTION.

- TAKE THE EXAMPLE OF WHALES — USING EVOLUTION AS THEIR GUIDE AND KNOWING HOW NATURAL SELECTION WORKS, BIOLOGISTS KNEW THAT THE TRANSITION OF EARLY WHALES FROM LAND TO WATER OCCURRED IN A SERIES OF PREDICTABLE STEPS. THE EVOLUTION OF THE BLOWHOLE, FOR EXAMPLE, MIGHT HAVE HAPPENED IN THE FOLLOWING WAY



THE MODERN SYNTHESIS

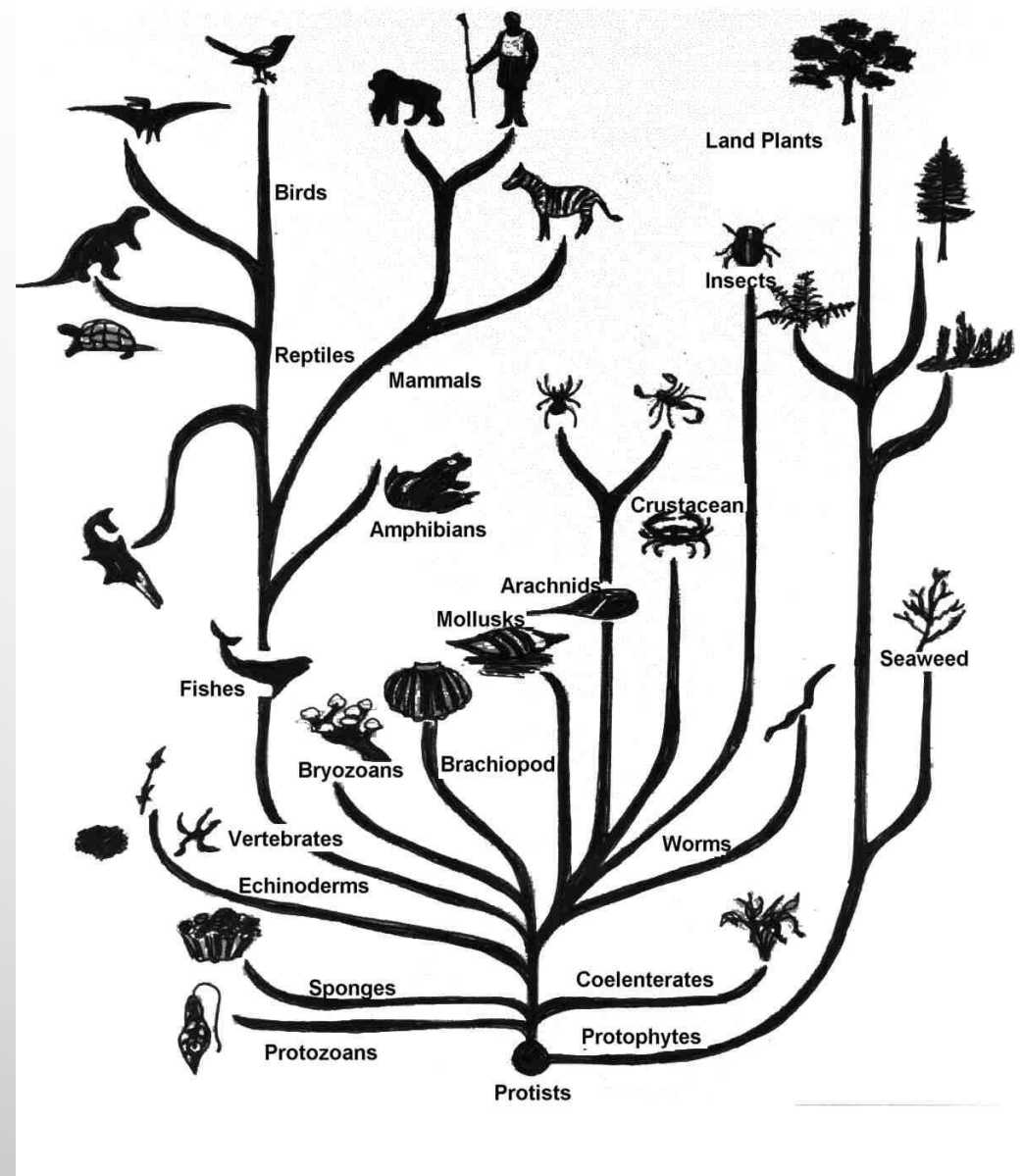
- NATURAL SELECTION RELIES CRUCIALLY ON THE IDEA OF HEREDITY, BUT DEVELOPED BEFORE THE BASIC CONCEPTS OF GENETICS. ALTHOUGH THE MORAVIAN MONK GREGOR MENDEL, THE FATHER OF MODERN GENETICS, WAS A CONTEMPORARY OF DARWIN'S, HIS WORK LAY IN OBSCURITY, ONLY BEING REDISCOVERED IN 1900¹. WITH THE EARLY 20TH CENTURY INTEGRATION OF EVOLUTION WITH MENDEL'S LAWS OF INHERITANCE, THE SO-CALLED MODERN SYNTHESIS, SCIENTISTS GENERALLY CAME TO ACCEPT NATURAL SELECTION. THE SYNTHESIS GREW FROM ADVANCES IN DIFFERENT FIELDS. RONALD FISHER DEVELOPED THE REQUIRED MATHEMATICAL LANGUAGE AND WROTE *THE GENETICAL THEORY OF NATURAL SELECTION* (1930). J. B. S. HALDANE INTRODUCED THE CONCEPT OF THE "COST" OF NATURAL SELECTION. SEWALL WRIGHT ELUCIDATED THE NATURE OF SELECTION AND ADAPTATION. IN HIS BOOK *GENETICS AND THE ORIGIN OF SPECIES* (1937), THEODOSIUS DOBZHANSKY ESTABLISHED THE IDEA THAT MUTATION, ONCE SEEN AS A RIVAL TO SELECTION, ACTUALLY SUPPLIED THE RAW MATERIAL FOR NATURAL SELECTION BY CREATING GENETIC DIVERSITY.

IMPACT OF EVOLUTION

- DARWIN'S IDEA HAD A PROFOUND INFLUENCE ON 19TH CENTURY THOUGHT, INCLUDING HIS RADICAL CLAIM THAT "ELABORATELY CONSTRUCTED FORMS, SO DIFFERENT FROM EACH OTHER, AND DEPENDENT ON EACH OTHER IN SO COMPLEX A MANNER" EVOLVED FROM THE SIMPLEST FORMS OF LIFE BY A FEW SIMPLE PRINCIPLES. THIS INSPIRED SOME OF DARWIN'S MOST ARDENT SUPPORTERS—AND PROVOKED THE STRONGEST OPPOSITION. NATURAL SELECTION HAD THE POWER, ACCORDING TO STEPHEN JAY GOULD, TO "DETHRONE SOME OF THE DEEPEST AND MOST TRADITIONAL COMFORTS OF WESTERN THOUGHT", SUCH AS THE BELIEF THAT HUMANS HAVE A SPECIAL PLACE IN THE WORLD.

- IN THE WORDS OF THE PHILOSOPHER DANIEL DENNETT, "DARWIN'S DANGEROUS IDEA" OF EVOLUTION BY NATURAL SELECTION IS A "UNIVERSAL ACID," WHICH CANNOT BE KEPT RESTRICTED TO ANY VESSEL OR CONTAINER, AS IT SOON LEAKS OUT, WORKING ITS WAY INTO EVER-WIDER SURROUNDINGS. THUS, IN THE LAST DECADES, THE CONCEPT OF NATURAL SELECTION HAS SPREAD FROM EVOLUTIONARY BIOLOGY TO OTHER DISCIPLINES, INCLUDING EVOLUTIONARY COMPUTATION, QUANTUM DARWINISM, EVOLUTIONARY ECONOMICS, EVOLUTIONARY EPISTEMOLOGY, EVOLUTIONARY PSYCHOLOGY, AND COSMOLOGICAL NATURAL SELECTION. THIS UNLIMITED APPLICABILITY HAS BEEN CALLED UNIVERSAL DARWINISM.

- A PREREQUISITE FOR NATURAL SELECTION TO RESULT IN ADAPTIVE EVOLUTION, NOVEL TRAITS AND SPECIATION IS THE PRESENCE OF HERITABLE GENETIC VARIATION THAT RESULTS IN FITNESS DIFFERENCES. GENETIC VARIATION IS THE RESULT OF MUTATIONS, GENETIC RECOMBINATIONS AND ALTERATIONS IN THE KARYOTYPE (THE NUMBER, SHAPE, SIZE AND INTERNAL ARRANGEMENT OF THE CHROMOSOMES). ANY OF THESE CHANGES MIGHT HAVE AN EFFECT THAT IS HIGHLY ADVANTAGEOUS OR HIGHLY DISADVANTAGEOUS, BUT LARGE EFFECTS ARE RARE. IN THE PAST, MOST CHANGES IN THE GENETIC MATERIAL WERE CONSIDERED NEUTRAL OR CLOSE TO NEUTRAL BECAUSE THEY OCCURRED IN NONCODING DNA OR RESULTED IN A SYNONYMOUS SUBSTITUTIO. HOWEVER, MANY MUTATIONS IN NON-CODING DNA HAVE DELETERIOUS EFFECTS. ALTHOUGH BOTH MUTATION RATES AND AVERAGE FITNESS EFFECTS OF MUTATIONS ARE DEPENDENT ON THE ORGANISM, A MAJORITY OF MUTATIONS IN HUMANS ARE SLIGHTLY DELETERIOUS.



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Thank
you!