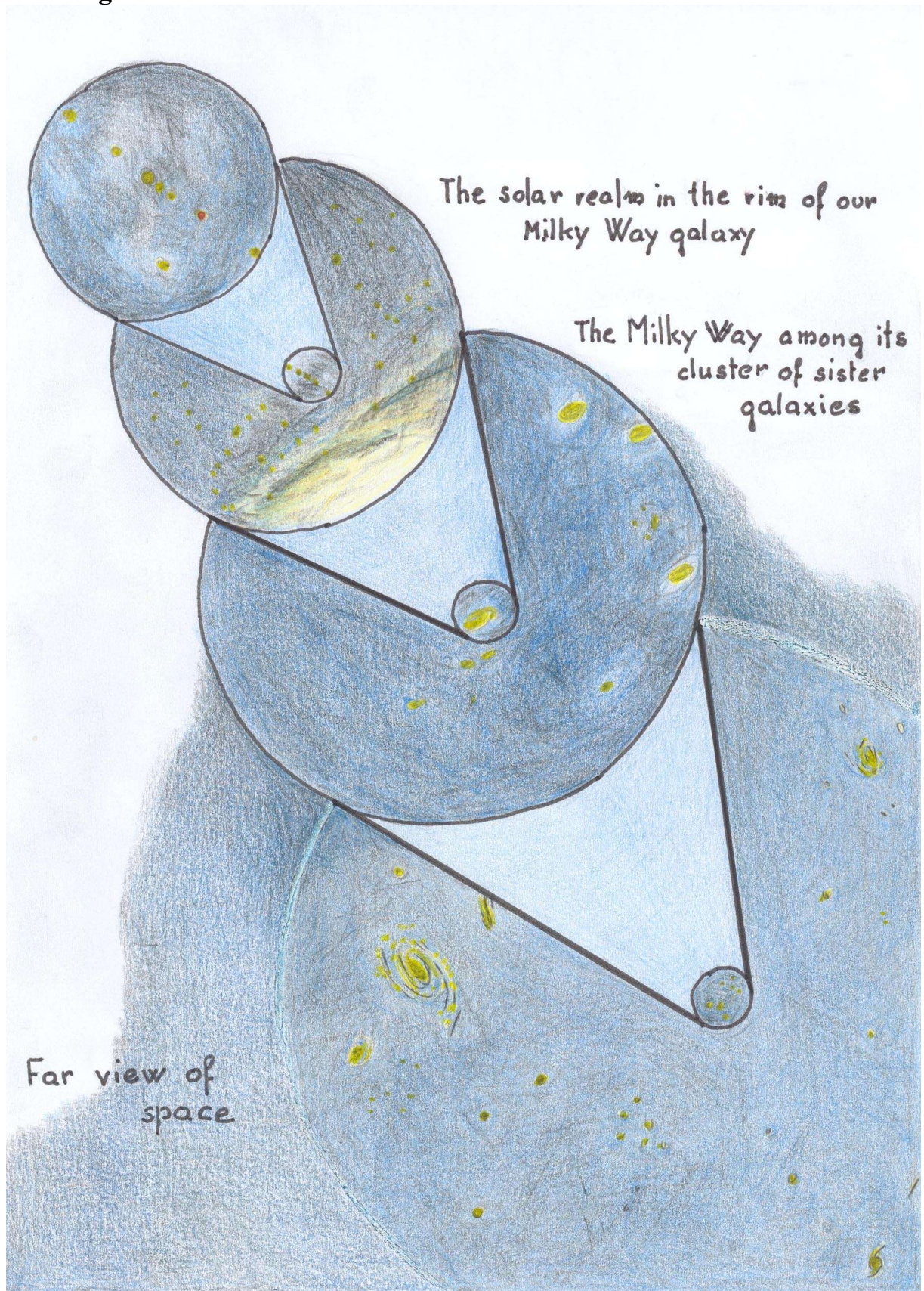


A T L A S

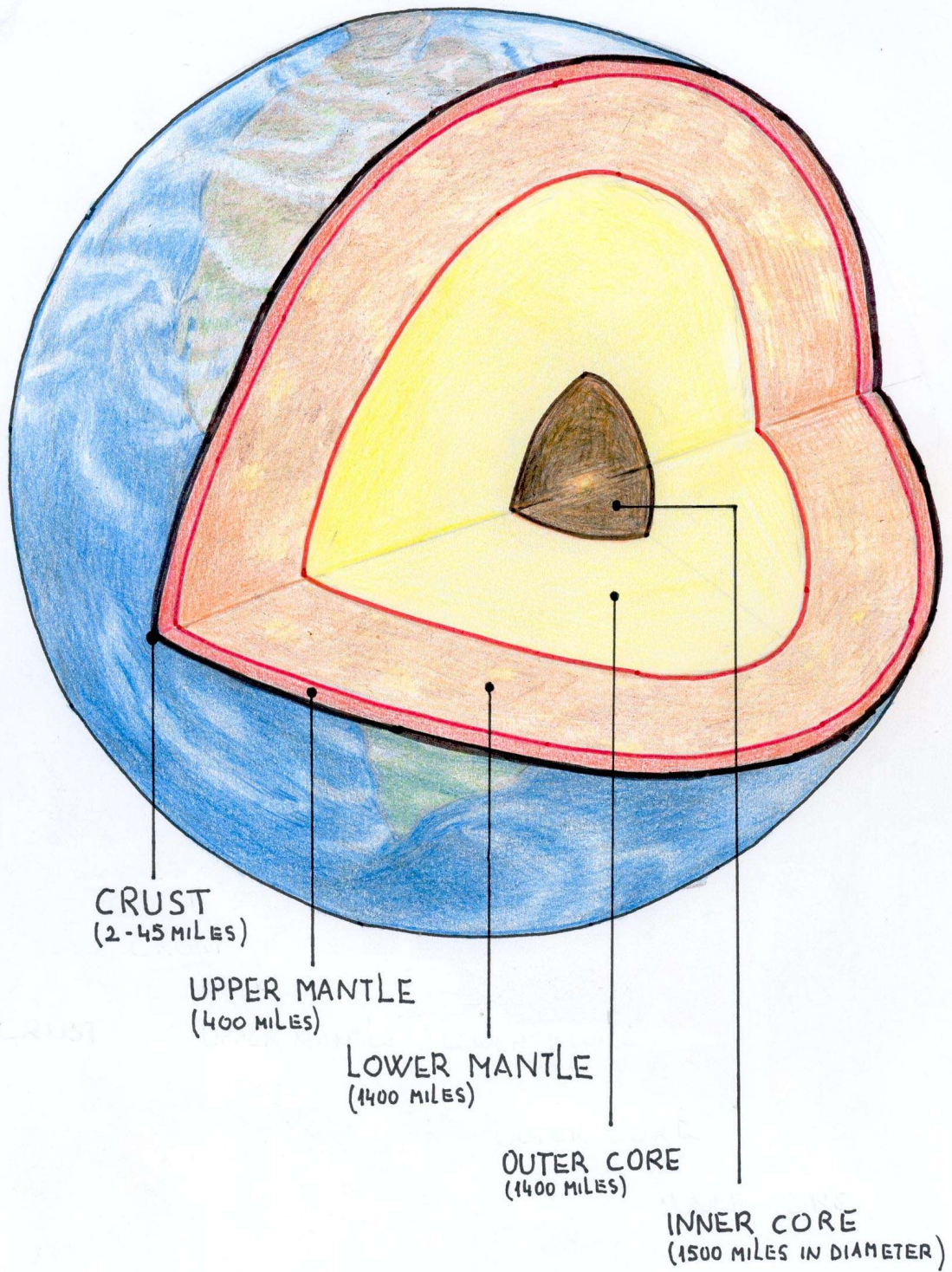
CONTENT:

- Drawing No 1. – Far View of Space
- Drawing No 2. – Planet Earth
- Drawing No 3. – Geology of the Earth
- Drawing No 4. – Oxygen Appearance on the Earth
- Drawing No 5. – Earth and Radiation
- Drawing No 6. – Radian Energy
- Drawing No 7. – The Transfer and Transformation of Radian Energy
- Drawing No 8. – The Atmosphere – Temperatures
- Drawing No 9. – Creation of Ozone in the Atmosphere
- Drawing No 10. – Catalytic Ozone Destruction Cycle in Stratosphere Involving Nitrous Oxide
- Drawing No 11. – Catalytic Ozone Destruction Cycle in Stratosphere Involving Water Vapour
- Drawing No 12. – Catalytic Ozone Destruction Cycle Involving Chlorofluorocarbons
- Drawing No 13. – Creation of the Ozone in the Troposphere
- Drawing No 14. – Atmospheric Ozone Destruction
- Drawing No 15. – The Decline of the Atmospheric Ozone over South Pole
- Drawing No 16. – Atmospheric Carbon Dioxide and Earth Temperature
- Drawing No 17. – Variations of Carbon Dioxide in the Earth Atmosphere
– Variations of the Earth Temperature During last Millennium
- Drawing No 18. – Human Population Over Past Centuries
– The World use of Coal, Petroleum and Natural Gas
- Drawing No 19. – The Atmospheric Concentration of Methane – Last Millennium
- Drawing No 20. – The Water Cycle
- Drawing No 21. – The Large Scale Salt Transport System in Today's Oceans
- Drawing No 22. – Processes in the Carbon Cycle
- Drawing No 23. – Processes in the Sulphur Cycle

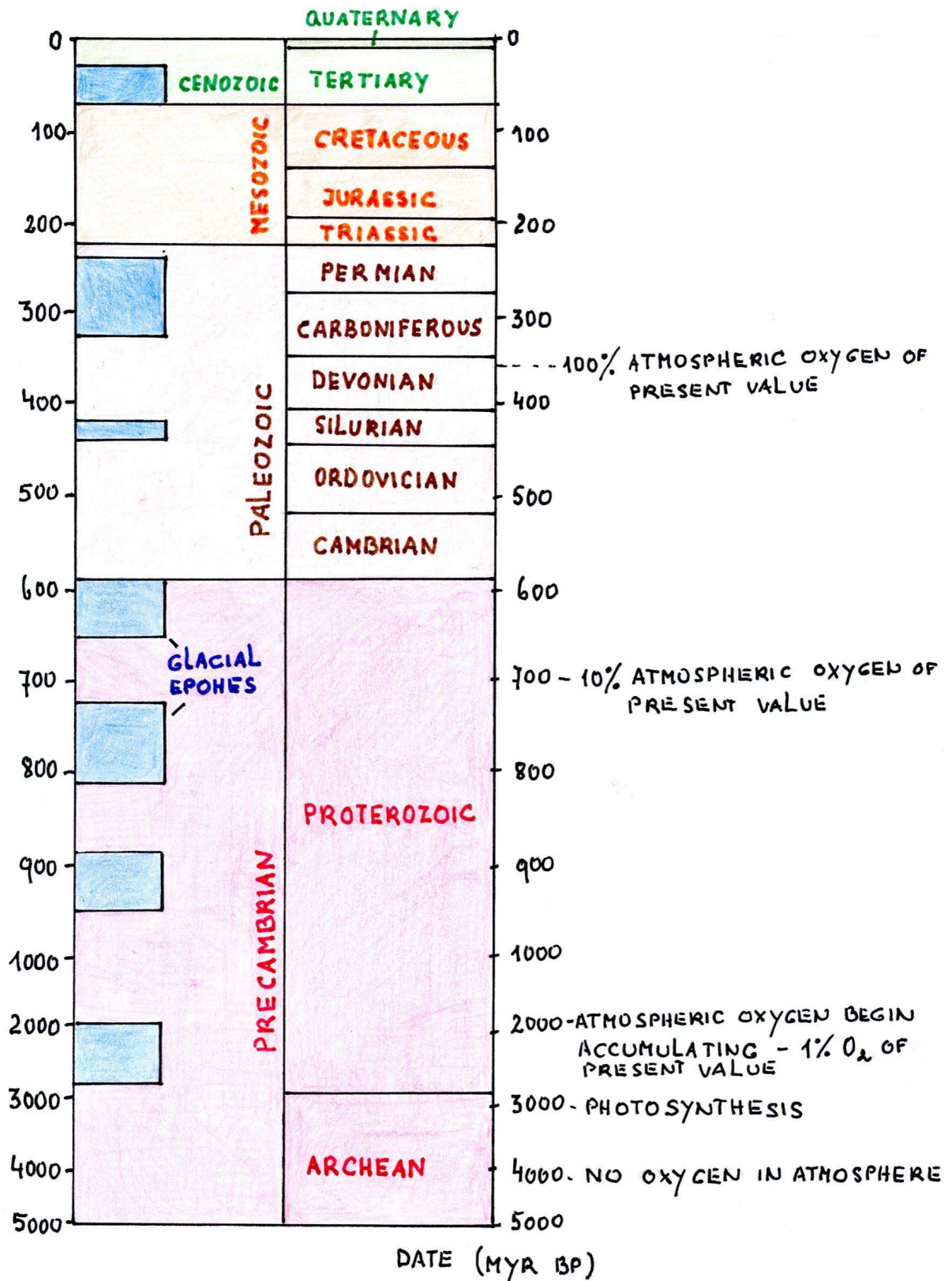
Drawing No. 1



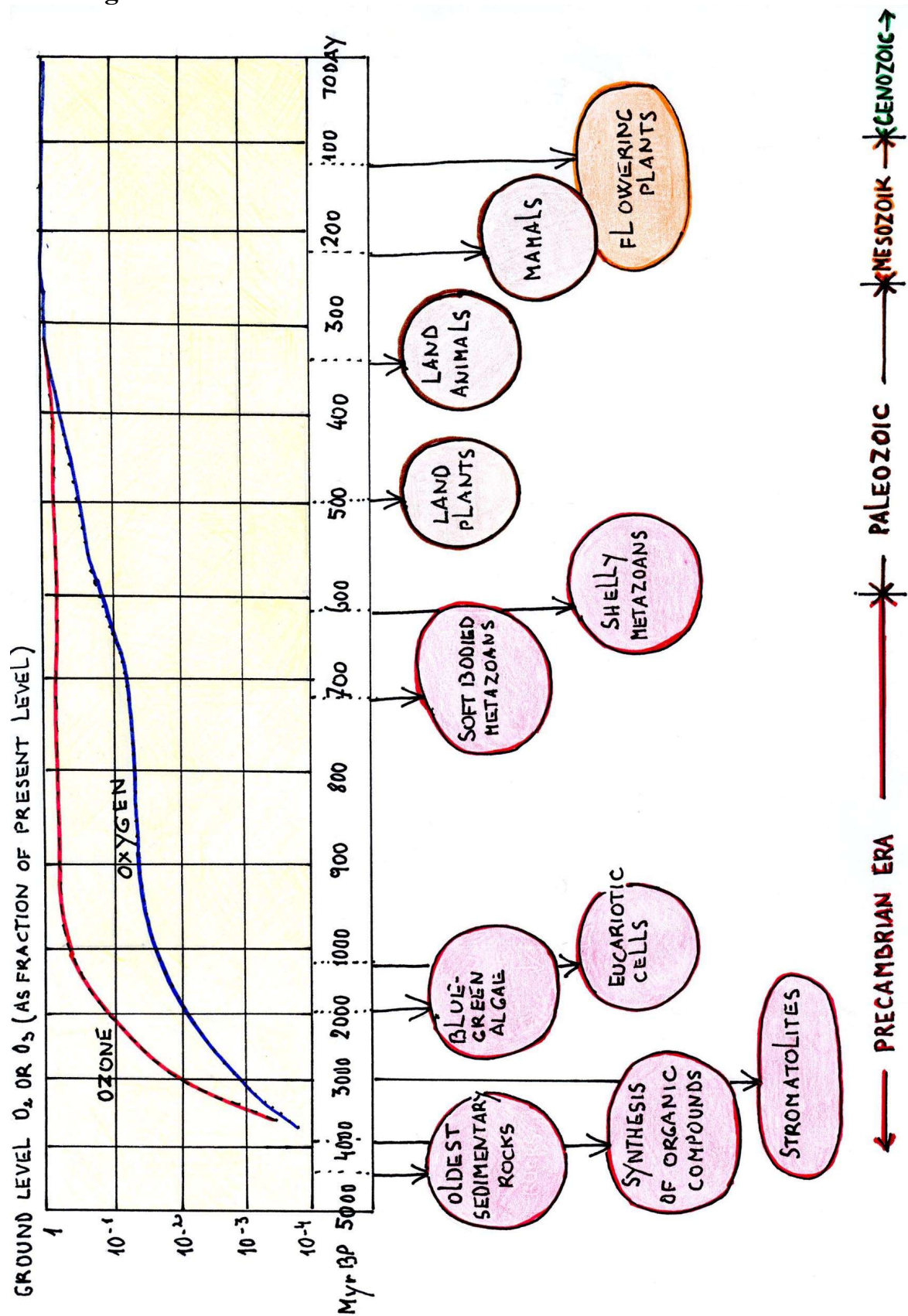
Drawing No. 2



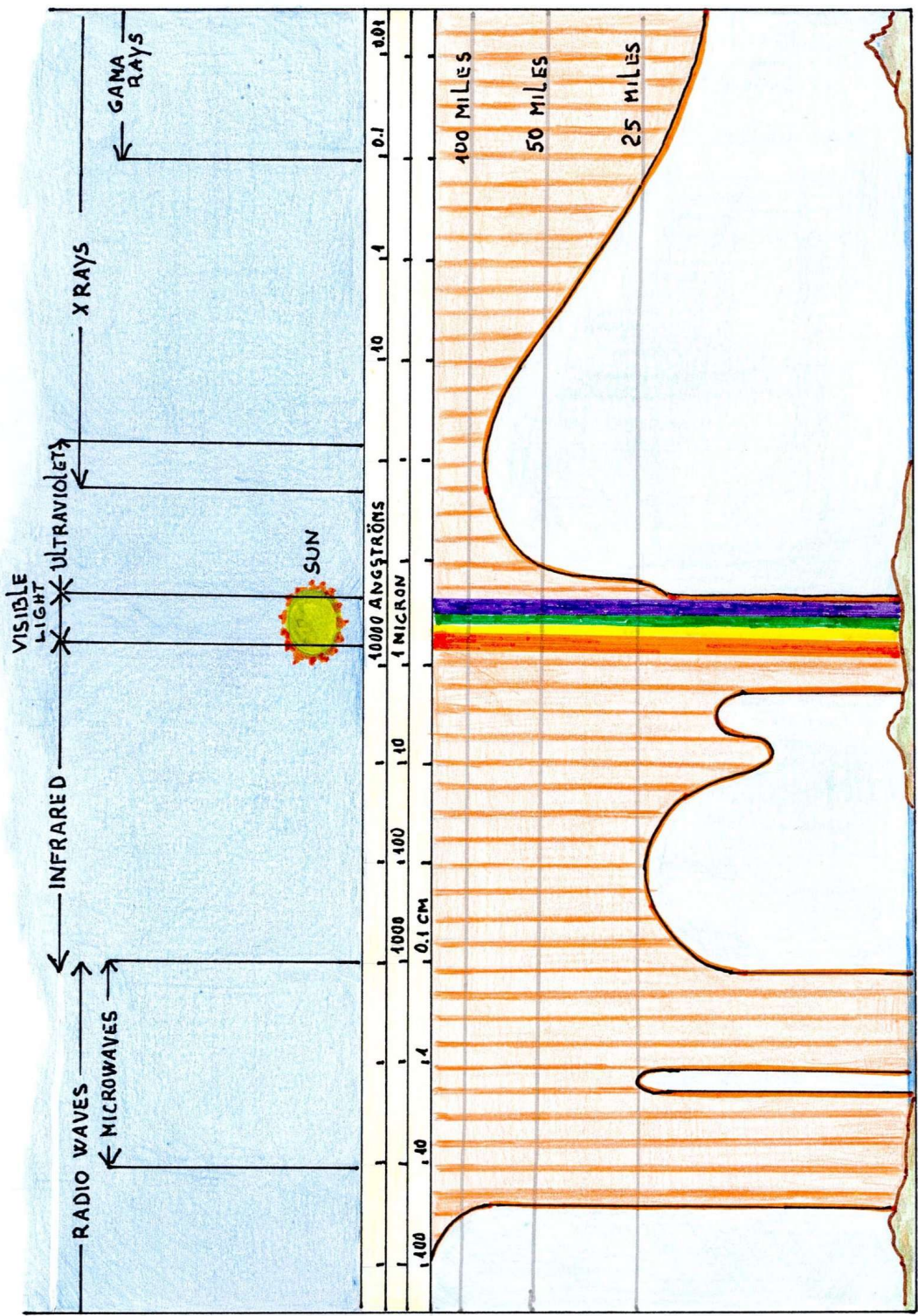
Drawing No. 3



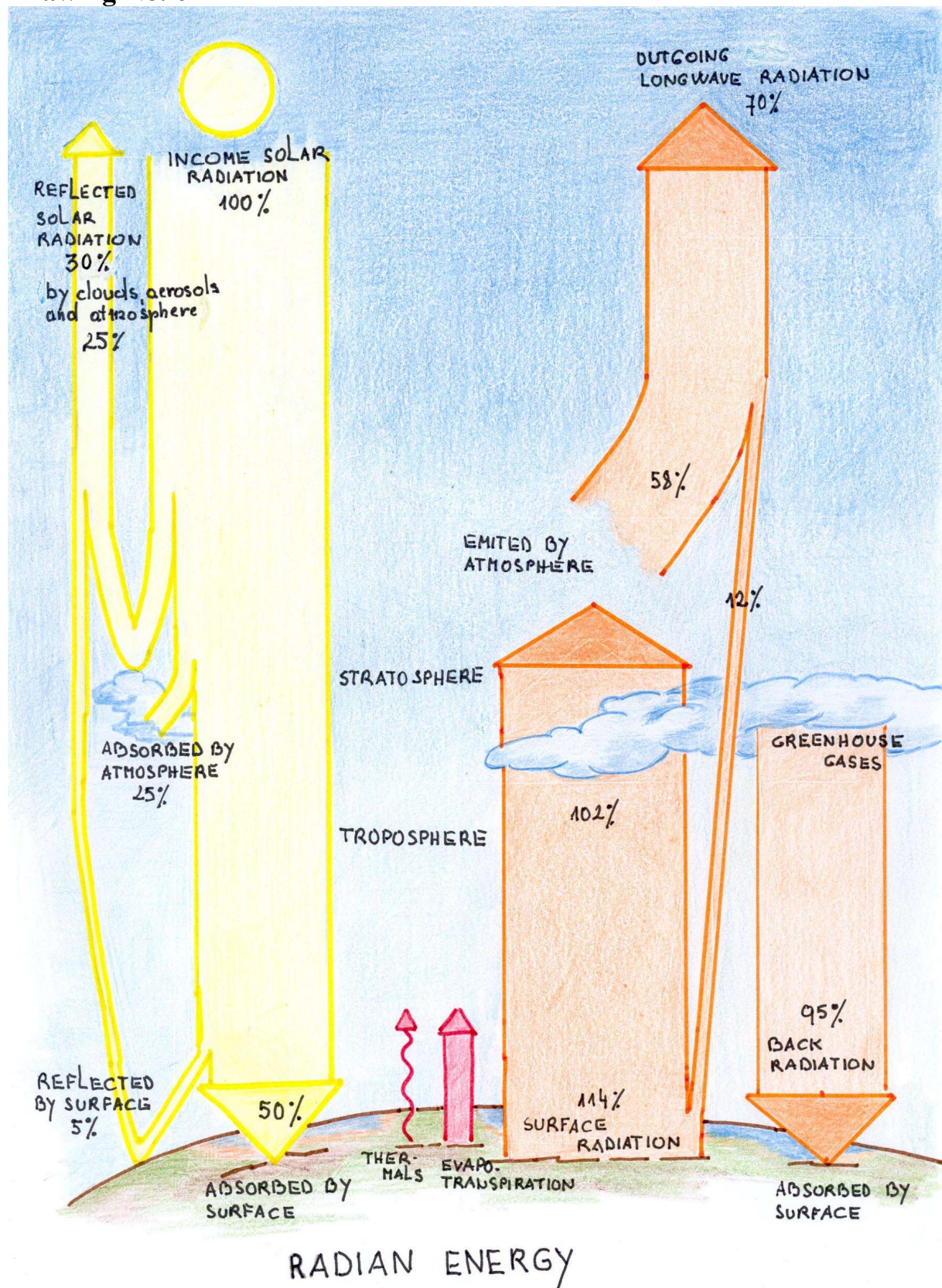
Drawing No. 4



Drawing No. 5

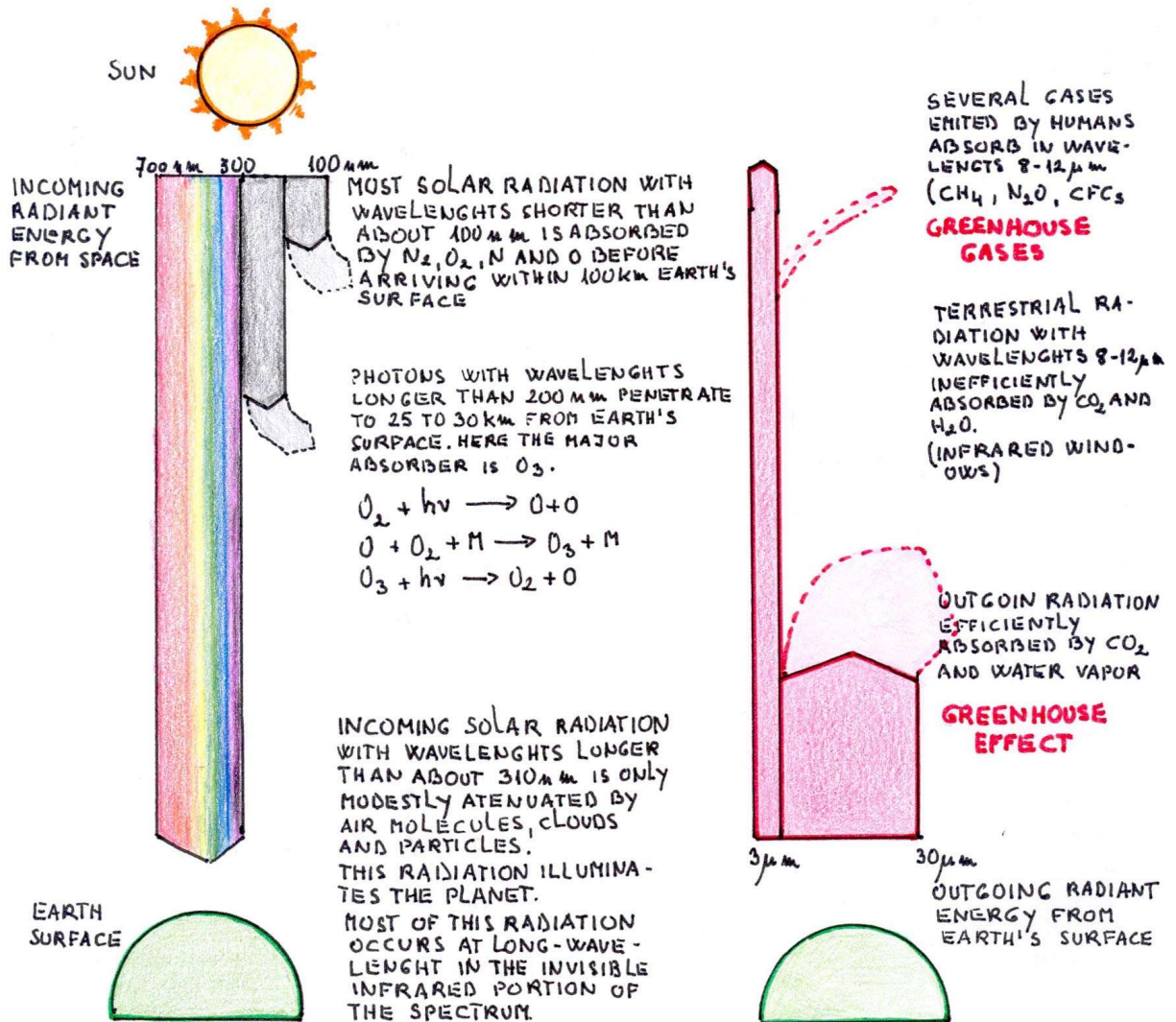


Drawing No. 6



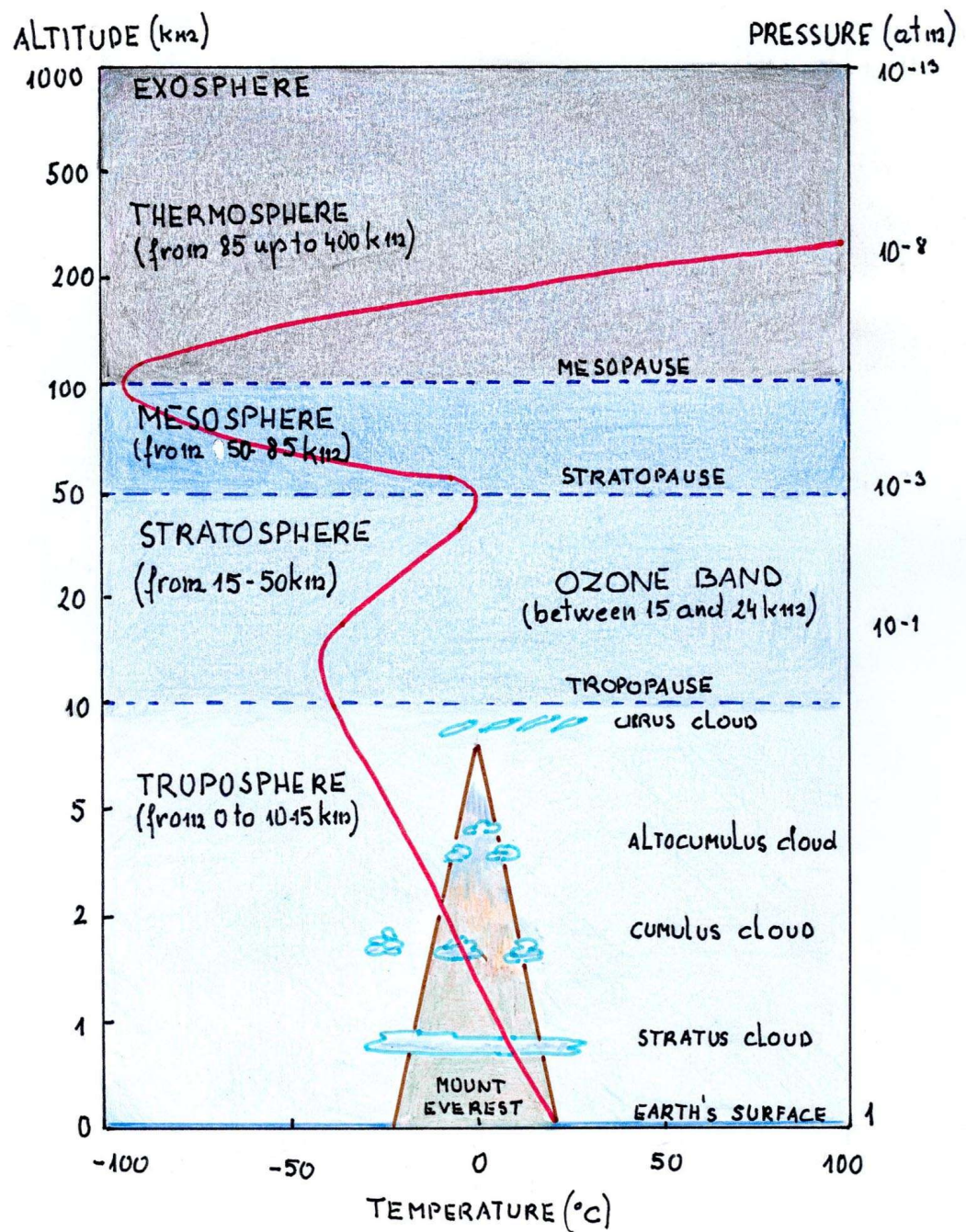
Drawing No. 7

THE TRANSFER AND TRANSFORMATION OF RADIATIVE ENERGY



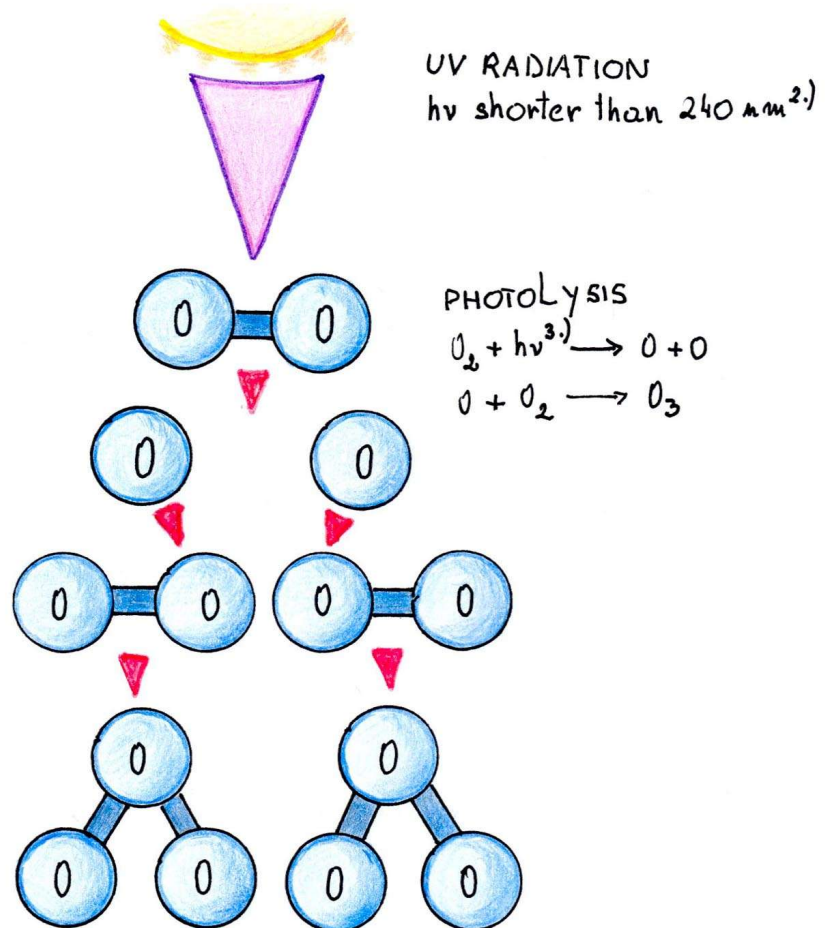
- $1 \mu m = 10^{-6} m$; $1 mm = 10^{-9} m$
- $h\nu$ IS STANDARD SYMBOL FOR A SINGLE PHOTON OF APPROPRIATE FREQUENCY TO BE ABSORBED BY, AND FURNISH ENERGY TO, THE MOLECULE DESTINED FOR DISSOCIATION
- M IS ANY AIR MOLECULE (USUALLY N_2) OR OXYGEN THAT ACQUIRES THE EXCESS ENERGY LIBERATED BY REACTION: $O + O_2 + M \rightarrow O_3 + M$

Drawing No. 8



Drawing No. 9

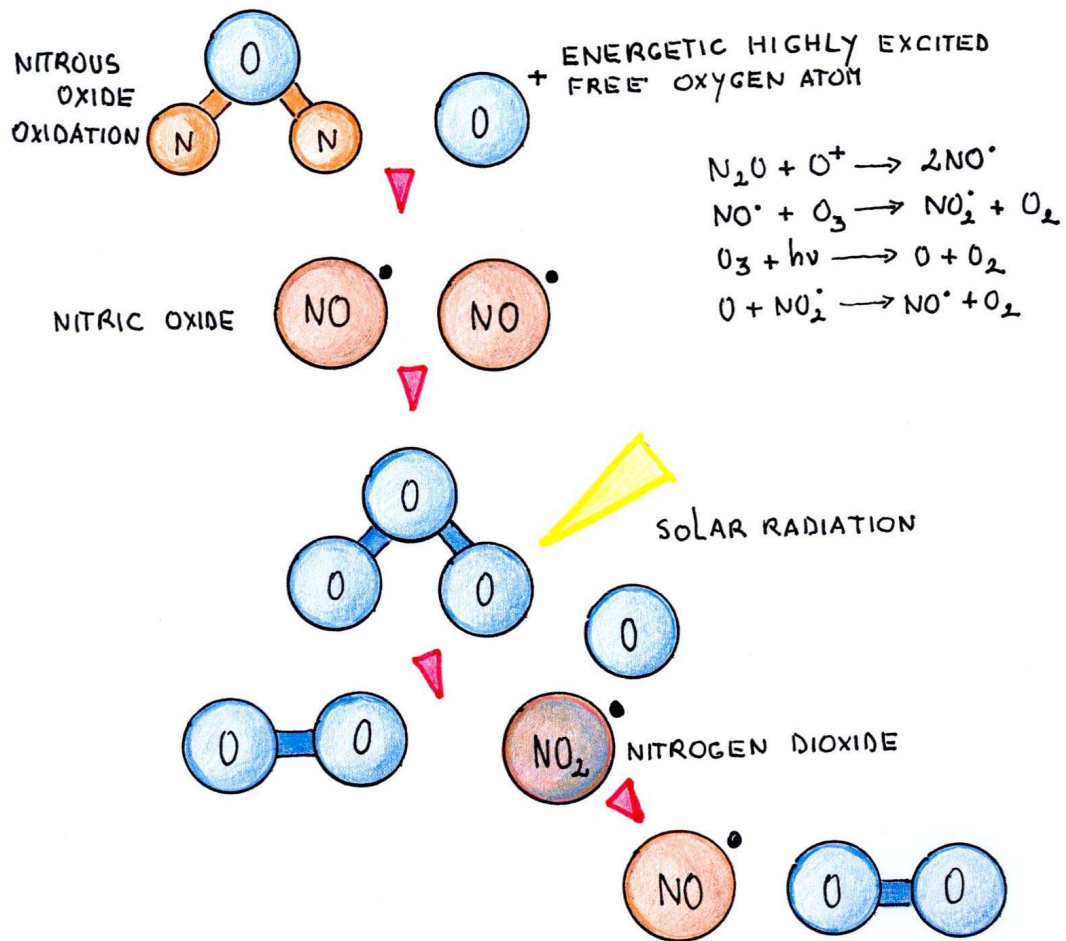
CREATION OF OZONE IN THE ATMOSPHERE ^{1.)}



- 1.) 90% of ozone occurs in the stratosphere, where it is produced by the action of solar radiation on oxygen
- 2.) $1 \text{ nm} = 10^{-9} \text{ m}$
- 3.) symbol for a single photon of appropriate wavelength

Drawing No. 10

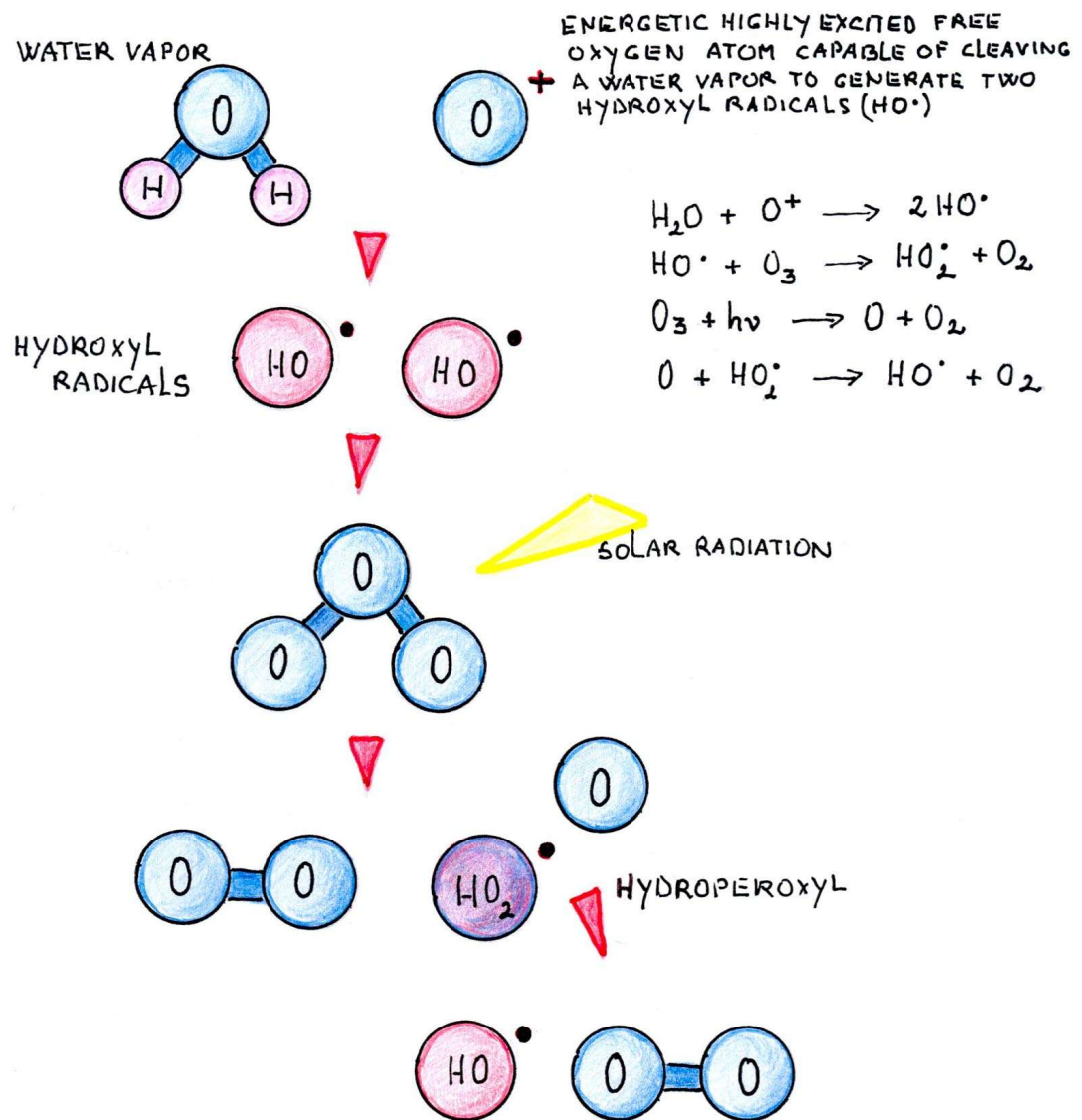
CATALYTIC OZONE DESTRUCTION CYCLE IN STRATOSPHERE INVOLVING NITROUS OXIDE (N_2O)



- MOST OF NO_x IN STRATOSPHERE IS A CONSEQUENCE OF GROUND-LEVEL EMISSIONS OF N_2O , LARGELY FROM MICROBIOLOGICAL PROCESSES IN SOIL AND OCEANS.
- NITRIC OXIDE CAN ALSO BE INJECTED DIRECTLY INTO STRATOSPHERE, FOR EXAMPLE BY HIGH-FLYING AIRCRAFT. NO_x EMITTED BY AUTOMOBILES AND POWER PLANTS ARE EFFICIENTLY CONVERTED TO THE NITRIC ACID (HNO_3) AND REMOVED FROM THE AIR BY RAINFALL.

Drawing No. 11

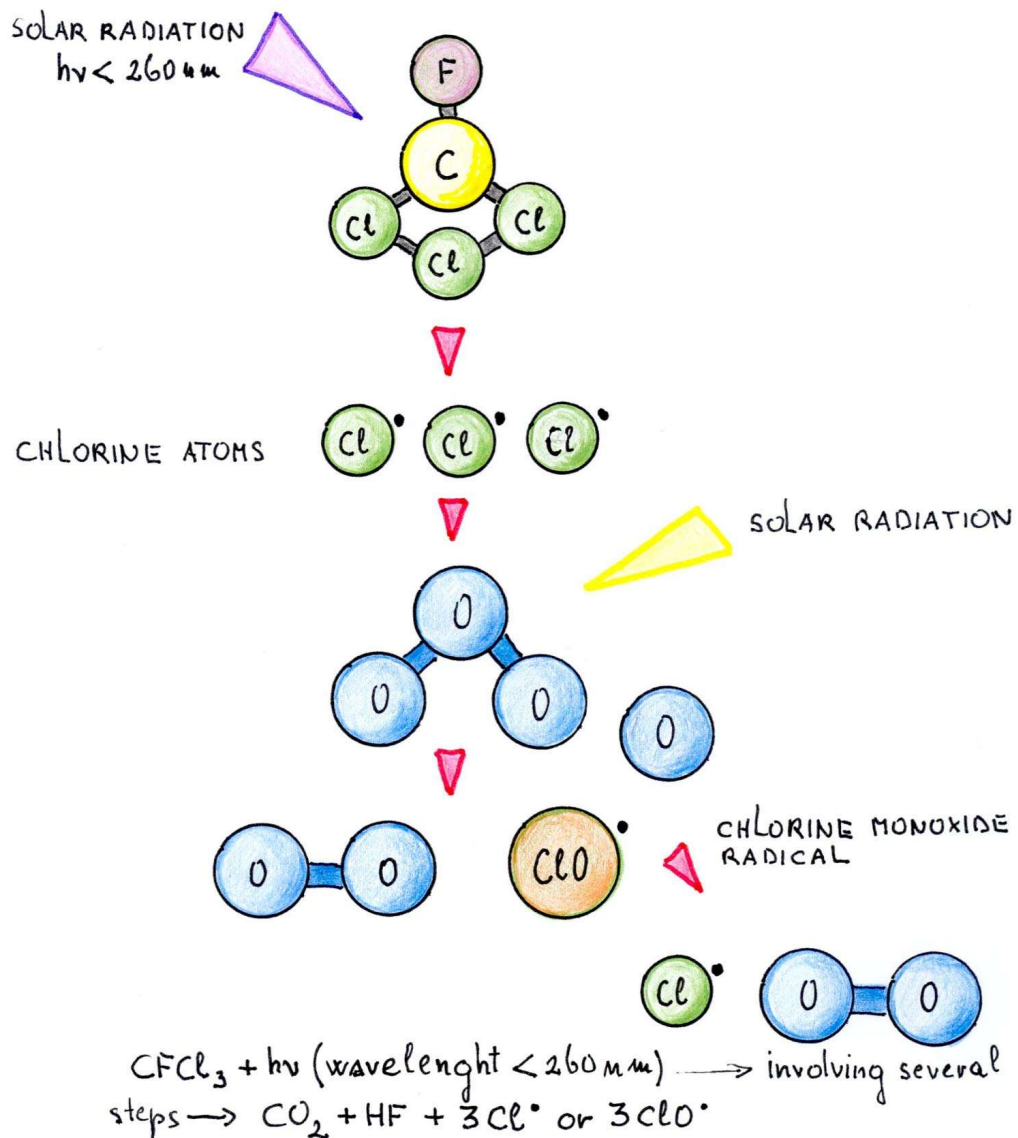
CATALYTIC OZONE DESTRUCTION CYCLE IN STRATOSPHERE INVOLVING WATER VAPOR (H₂O)



- + ABSORBING SOLAR RADIATION OZONE READILY DISSOCIATES. A SMALL FRACTION OF THAT RADIATION HAS ENOUGH ENERGY TO PRODUCE NOT JUST FREE OXYGEN ATOM, BUT A HIGHLY EXCITED ONE.
- FREE RADICALS WITH ODD NUMBER OF ELECTRONS AND THUS HIGHLY REACTIVE

Drawing No. 12

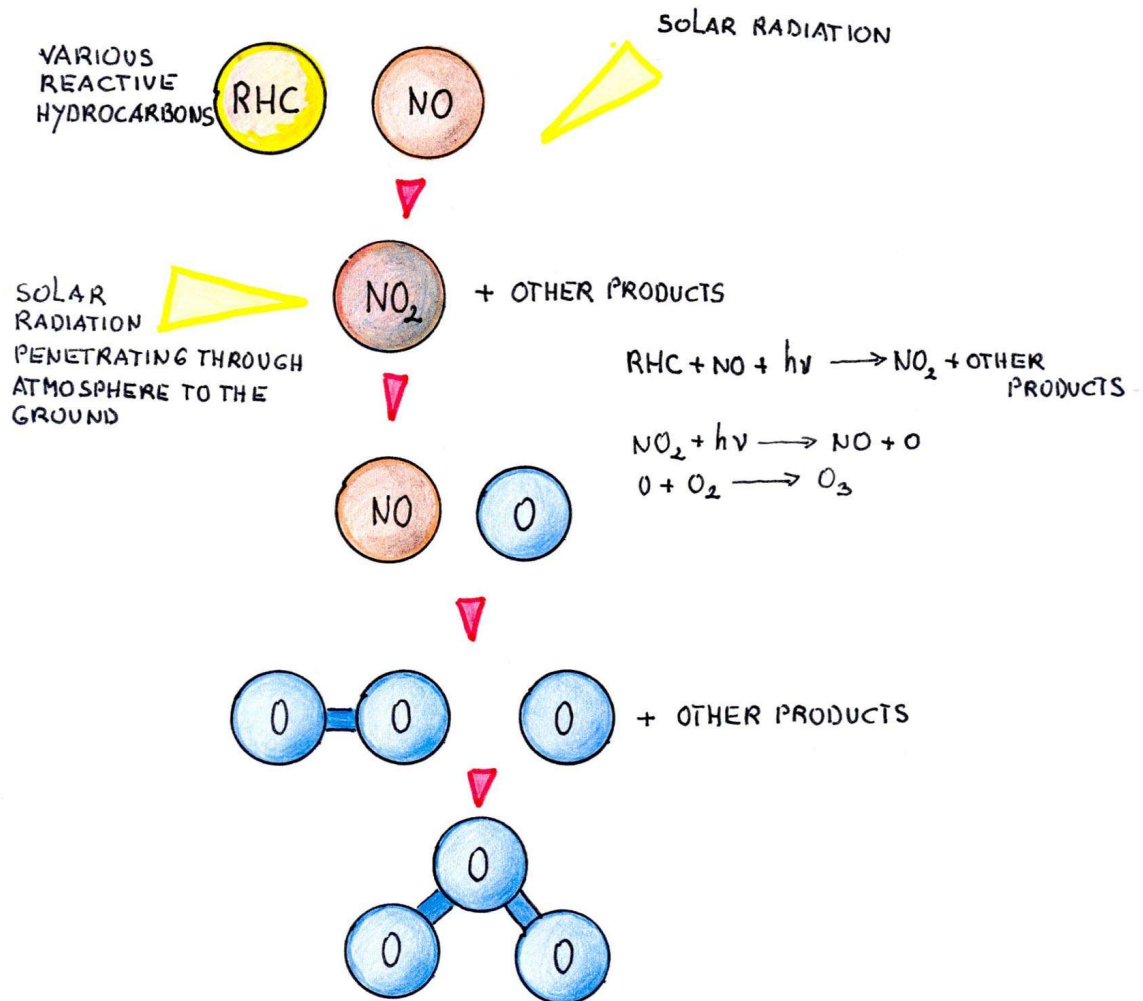
CATALYTIC OZONE DESTRUCTION CYCLE IN STRATOSPHERE INVOLVING CHLOROFLUORO- CARBONS (CFCs)



- MINOR AMOUNTS OF CHLORINE ARE ALSO SUPPLIED TO THE STRATOSPHERE BY OCCASIONAL VULCANIC ERUPTIONS AND BY THE UPWARD TRANSPORT OF METHYL CHLORIDE (CH_3Cl), A PRODUCT OF SEAWEED AND BIOMASS BURNING
- THE NATURAL CHLORINE CONTENT OF THE STRATOSPHERE IS ABOUT 0.6 ppbv, THE QUANTITY SUPPLIED BY CFCs IS CURRENTLY ABOUT 3 ppbv.

Drawing No. 13

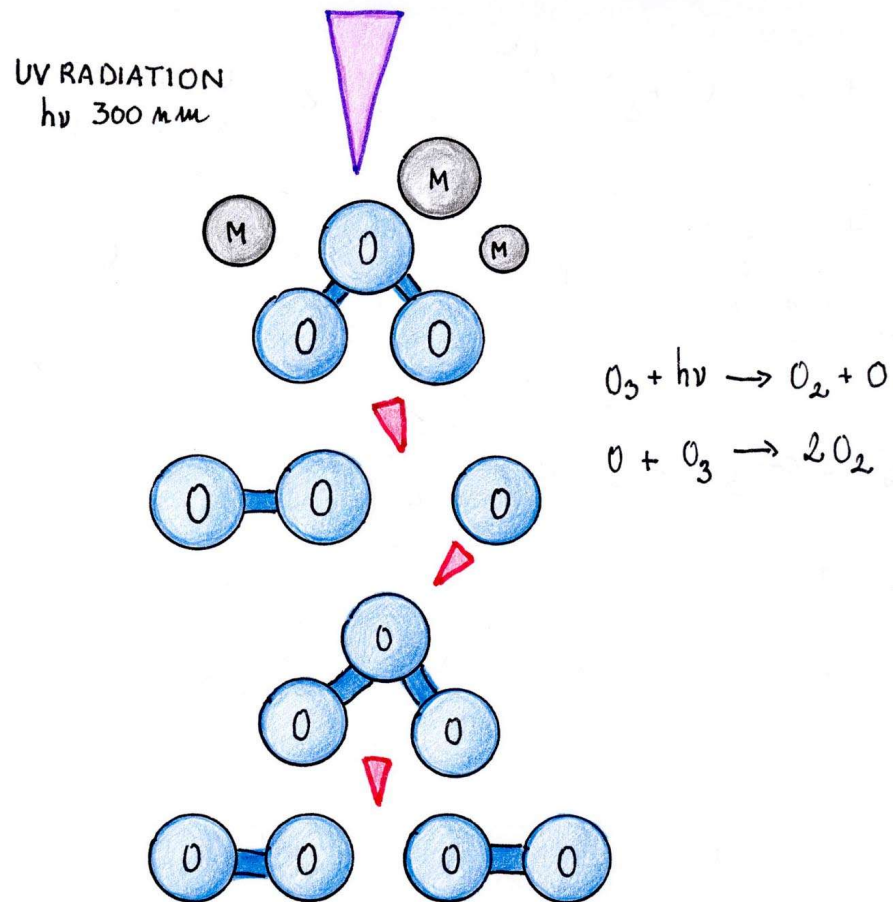
CREATION OF OZONE IN THE TROPOSPHERE



- BEFORE HUMAN TECHNOLOGY PROGRESS, NO_x WERE PRESENT ONLY ON OCCASION, DURING FOREST FIRES OR LIGHTENING FLASHES.
- RHC IN NATURE ARE ALSO EMITED BY VEGETATION (FOR EXAMPLE TERPENES ARE RHC MOLECULES. URBAN OZONE GENERATION IS MOST EFFICIENT WHEN THE RELATIVE PROPORTION OF RHC TO NO_x IS ABOUT 7:1.

Drawing No. 14

ATMOSPHERIC OZONE DESTRUCTION

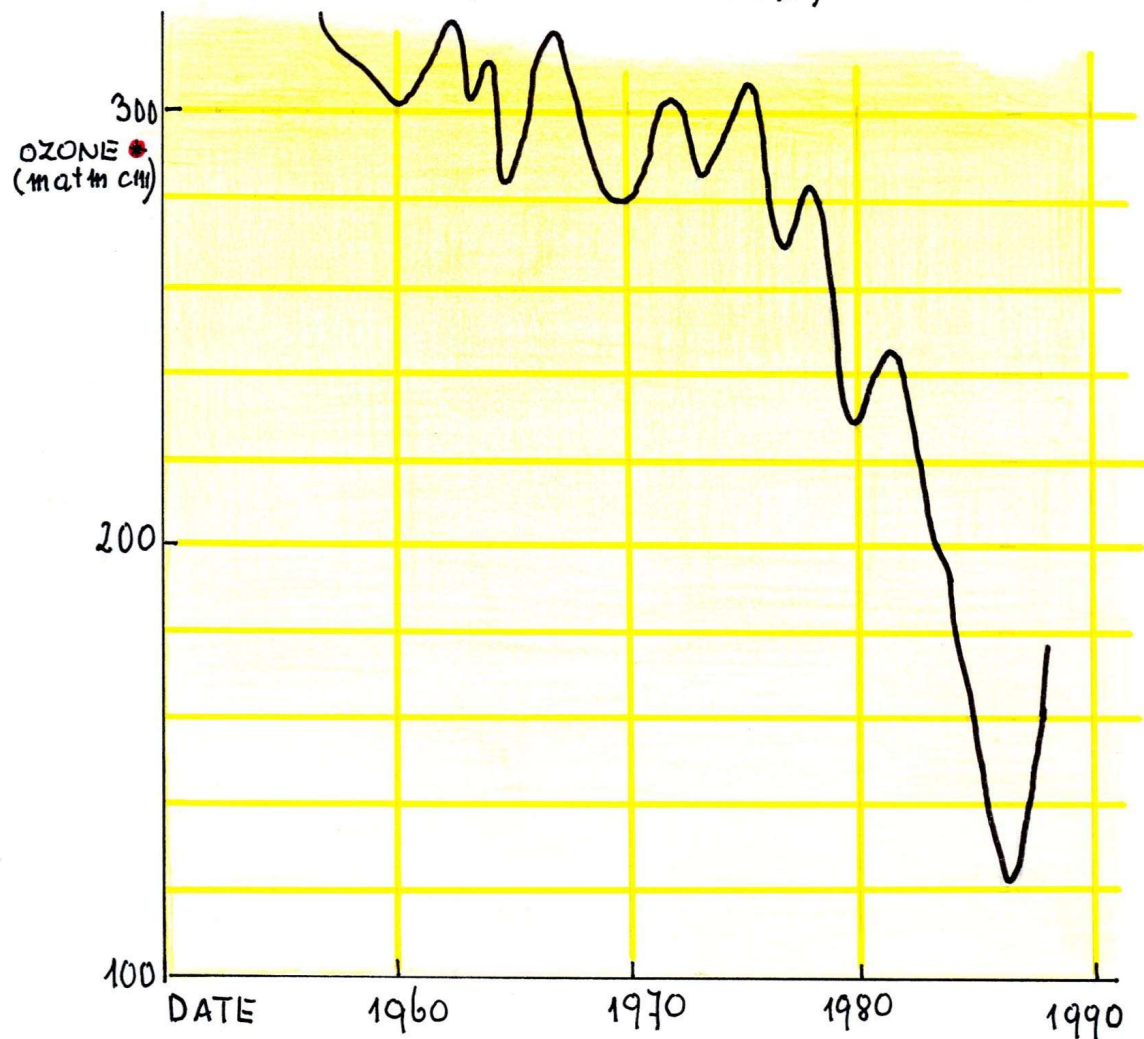


X TROPOSPHERIC OZONE ORIGINATES FROM THE STRATOSPHERE, FROM WHICH IT OCCASIONALLY DESCENDES THROUGH ATMOSPHERIC MOTIONS, SINCE PHOTODISSOCIATION OF MOLECULAR OXYGEN TO PRODUCE OZONE CAN OCCUR ONLY AT WAVELENGTHS SHORTER THAN 240 nm.

(M) ANY AIR MOLECULE THAT ACQUIRES THE EXCESS ENERGY LIBERATED IN REACTION $O + O_2 \rightarrow O_3$ (FOR EXAMPLE H_2O , N_2 , CFCs, $CHCl_3$..)

Drawing No. 15

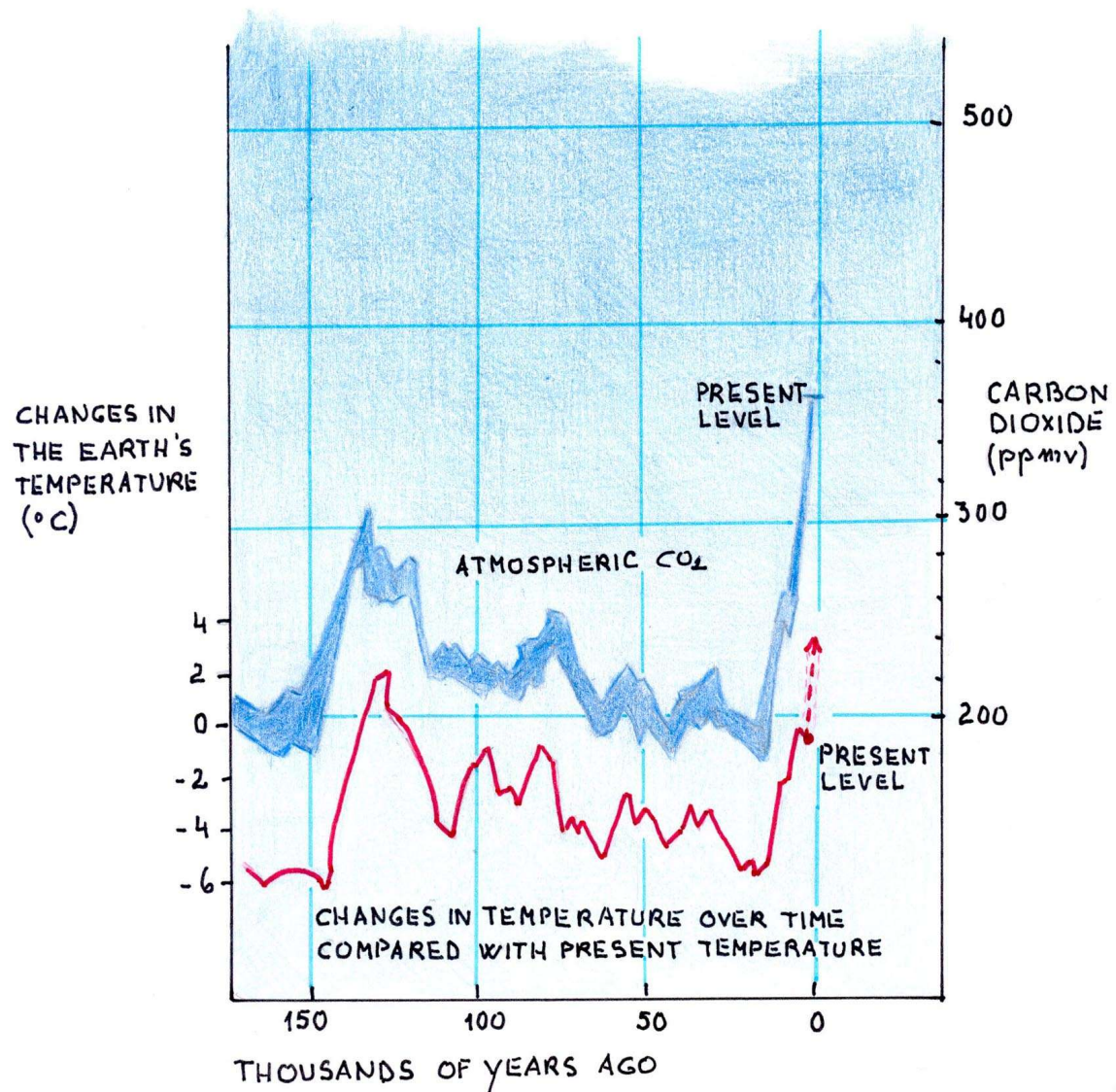
THE DECLINE OF ATMOSPHERIC OZONE OVER SOUTH POLE (FROM 1979 TO 1990 OZONE CONCENTRATION FELL BY MORE THAN 50%)



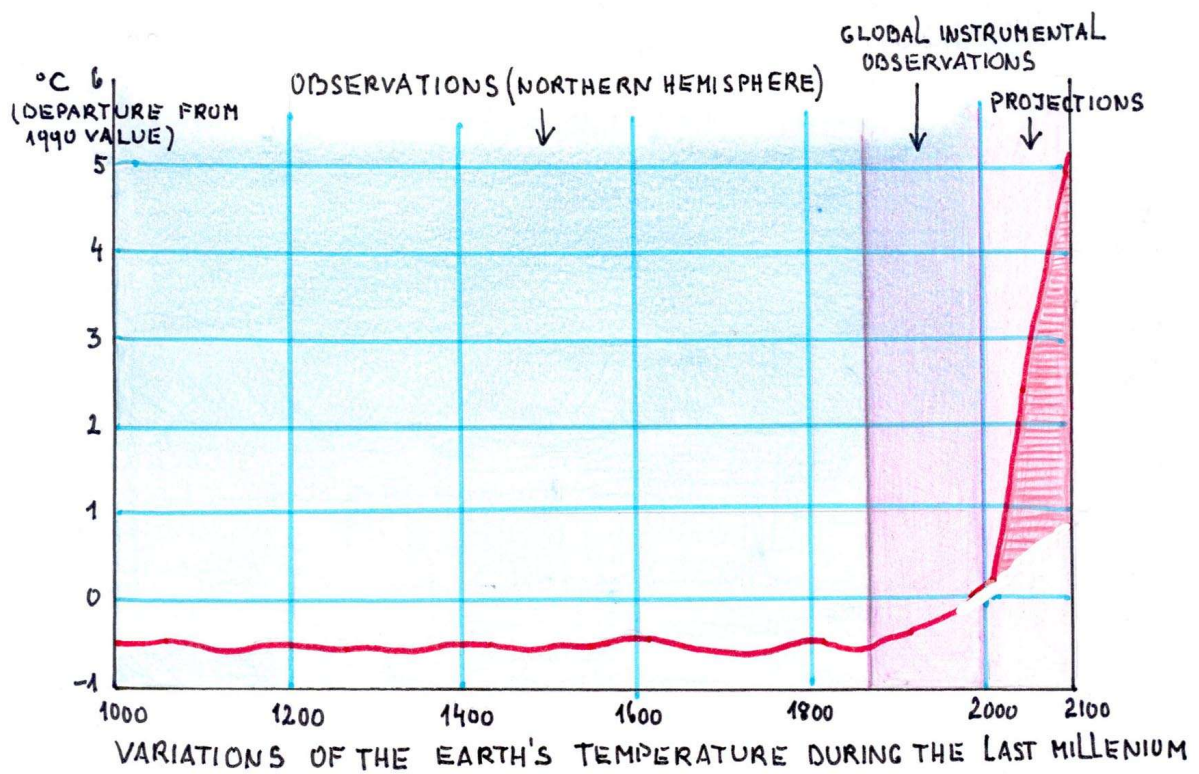
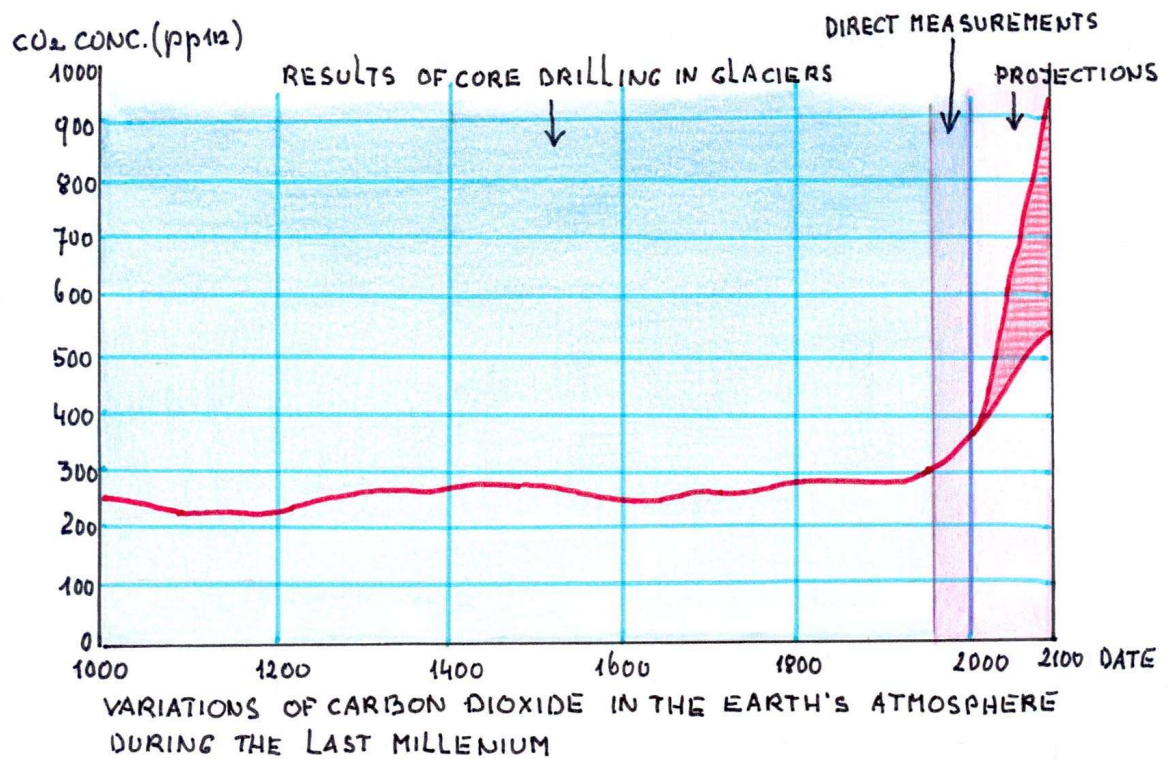
- A LAYER OF GASEOUS OZONE 1mm THIC A 1 ATMOSPHERE PRESSURE AND 0°C CORRESPONDS TO 100 matm cm

Drawing No. 16

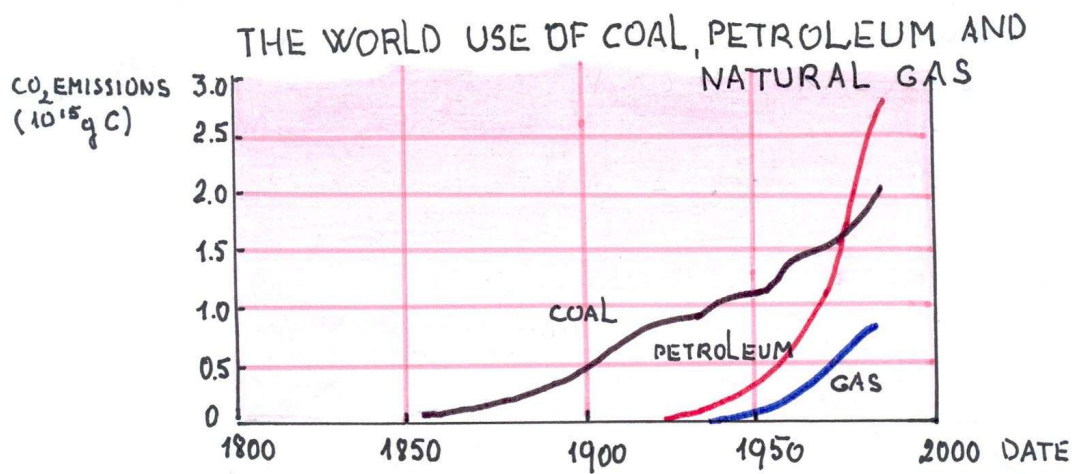
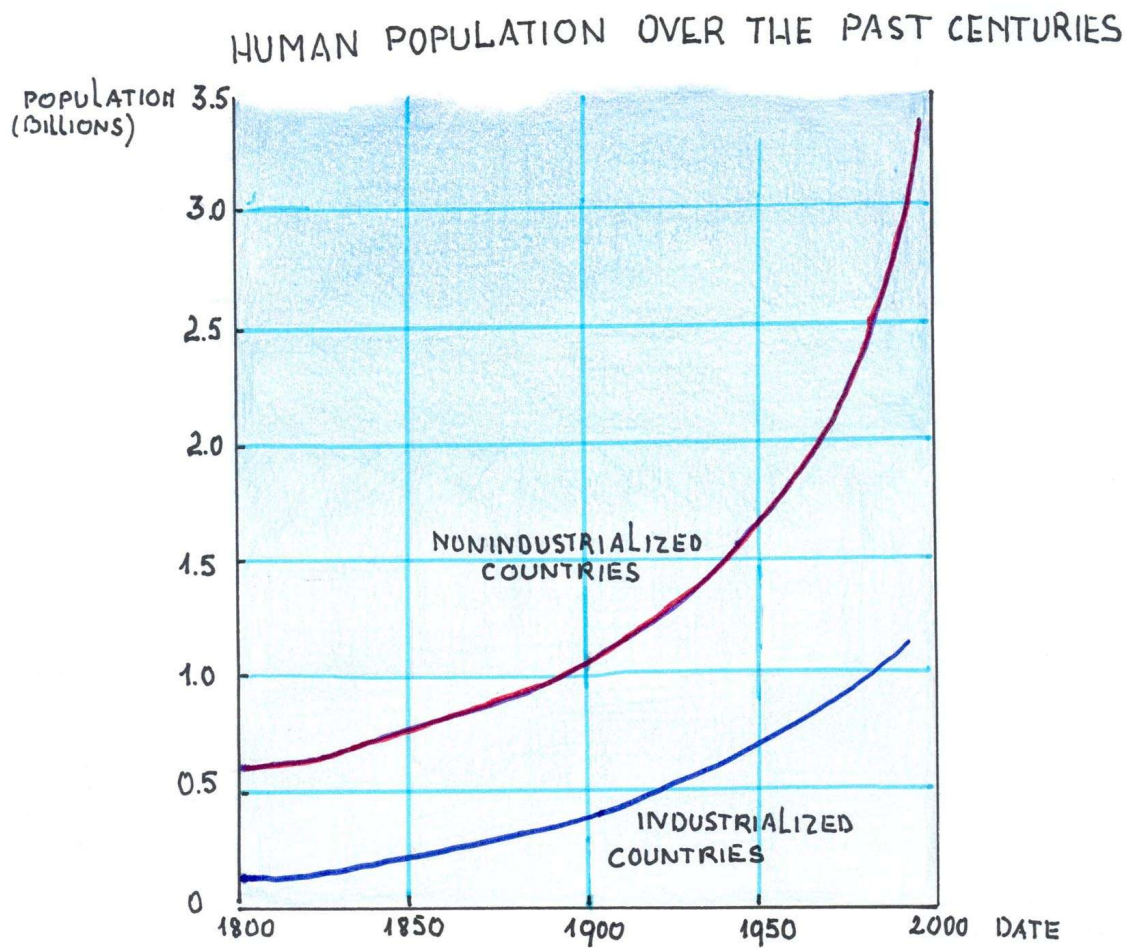
ATMOSPHERIC CONCENTRATION OF CARBON DIOXIDE AND CHANGES IN THE EARTH'S TEMPERATURE



Drawing No. 17

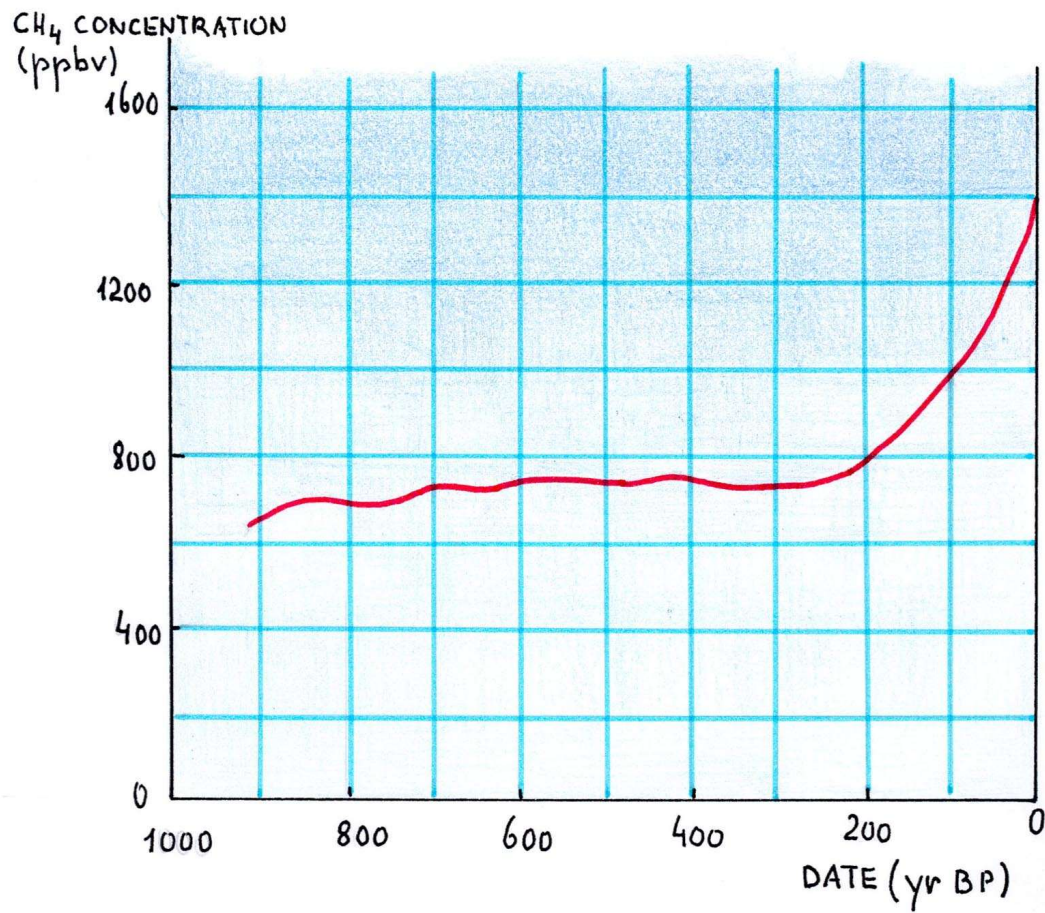


Drawing No. 18



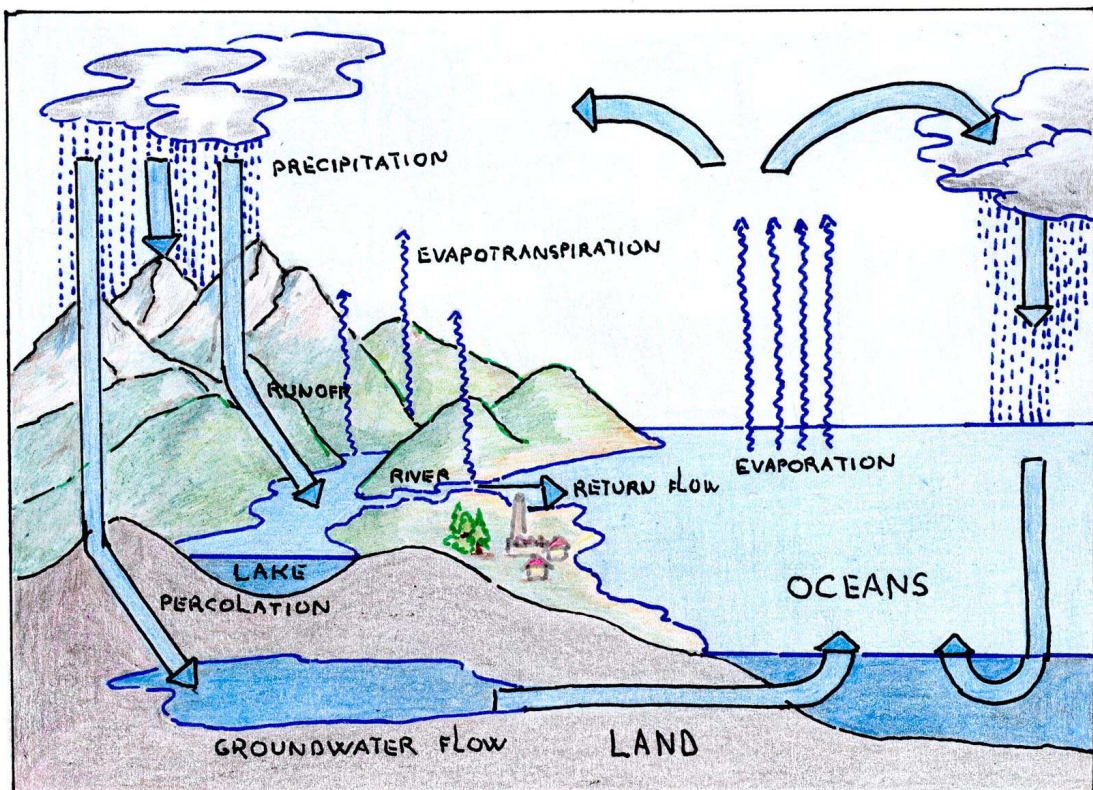
Drawing No. 19

THE ATMOSPHERIC CONCENTRATIONS OF METHANE (CH_4) OVER THE LAST MILLENNIUM

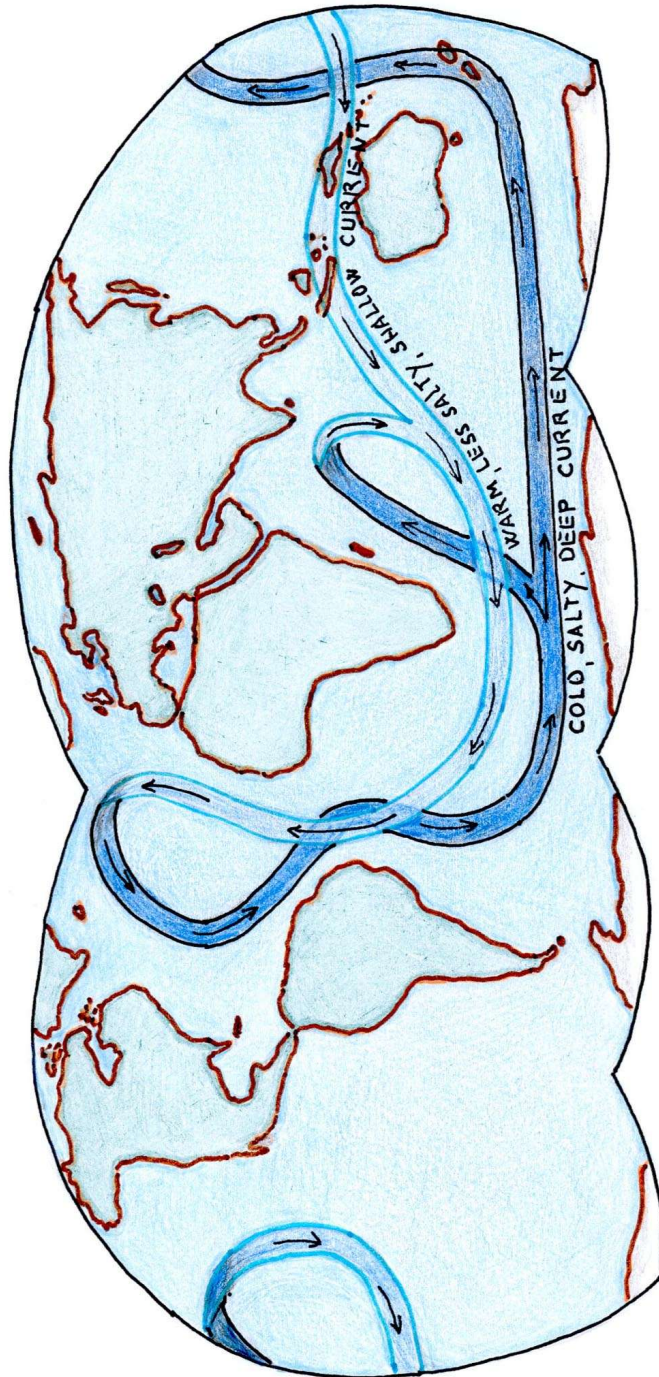


THE WATER CYCLE

RESERVOIRS OF AVAILABLE WATER ON EARTH		
Reservoirs	Volume(10^6 km^3)	% of total
Oceans	1350	97.3
Glaciers	29	2.1
Aquifers	8	0.6
Lakes and rivers	0.1	-
Soil moisture	0.1	-
Atmosphere	0.013	-
Living biosphere	0.001	-

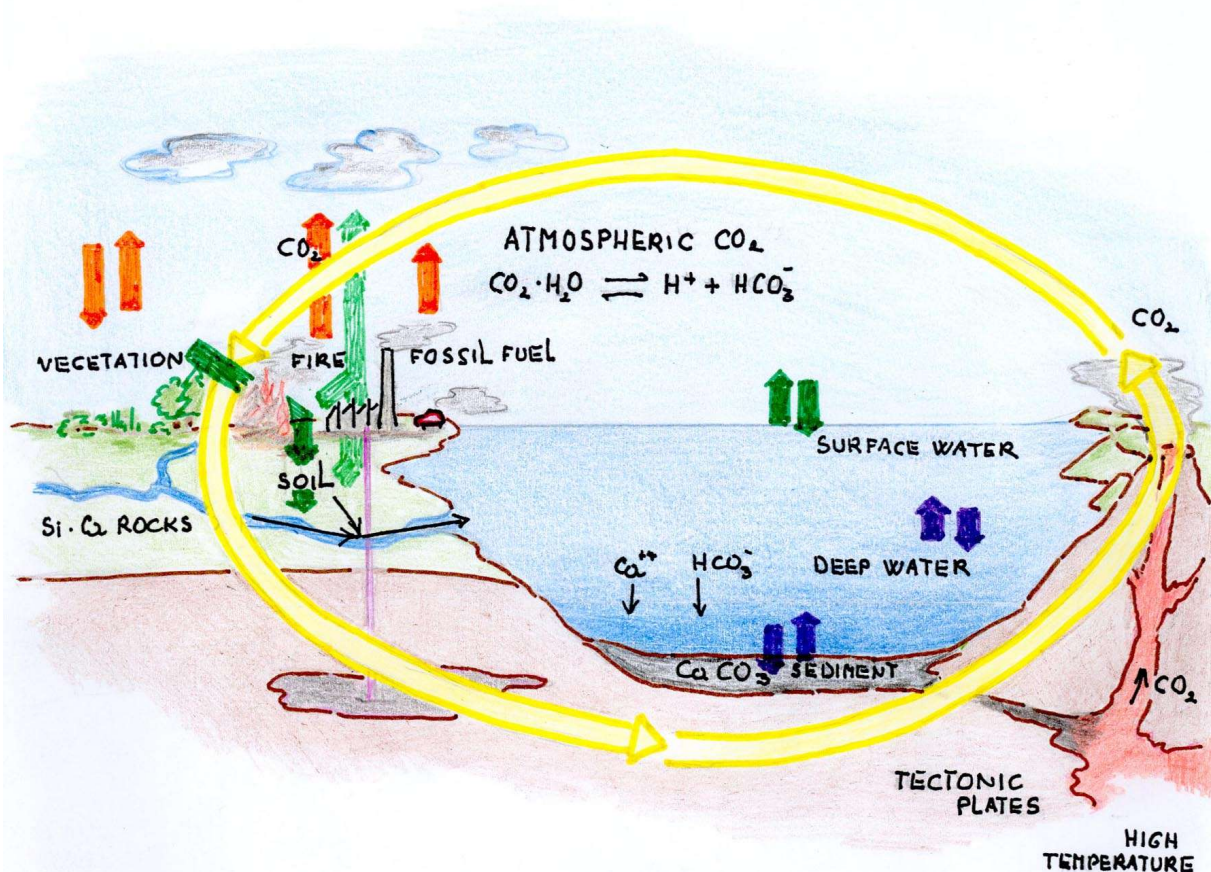


THE LARGE-SCALE SALT TRANSPORT SYSTEM IN TODAY'S OCEANS



- DEEPER FLOW- THERMOHALINE CIRCULATION - ARISES FROM DENSITY VARIATIONS. WATER IS DENSER WHEN COLD AND/OR MORE SALINE.
- MIGRATION OF COLD, SALTY WATER A FEW THOUSAND METERS BENEATH THE OCEAN SURFACE IS BALANCED BY COMPENSATING CURRENTS CLOSER TO THE SURFACE MOVING TOWARD THE SITES WHERE THE WATER IS SINKING.

PROCESSES IN THE CARBON CYCLE



SPEED OF EXCHANGE IN THE CARBON CYCLE

- Very fast (less than 1 year)
- Fast (1 to 10 years)
- Slow (10 to 100 years)
- Very slow (more than 100 years)

Drawing No. 23

