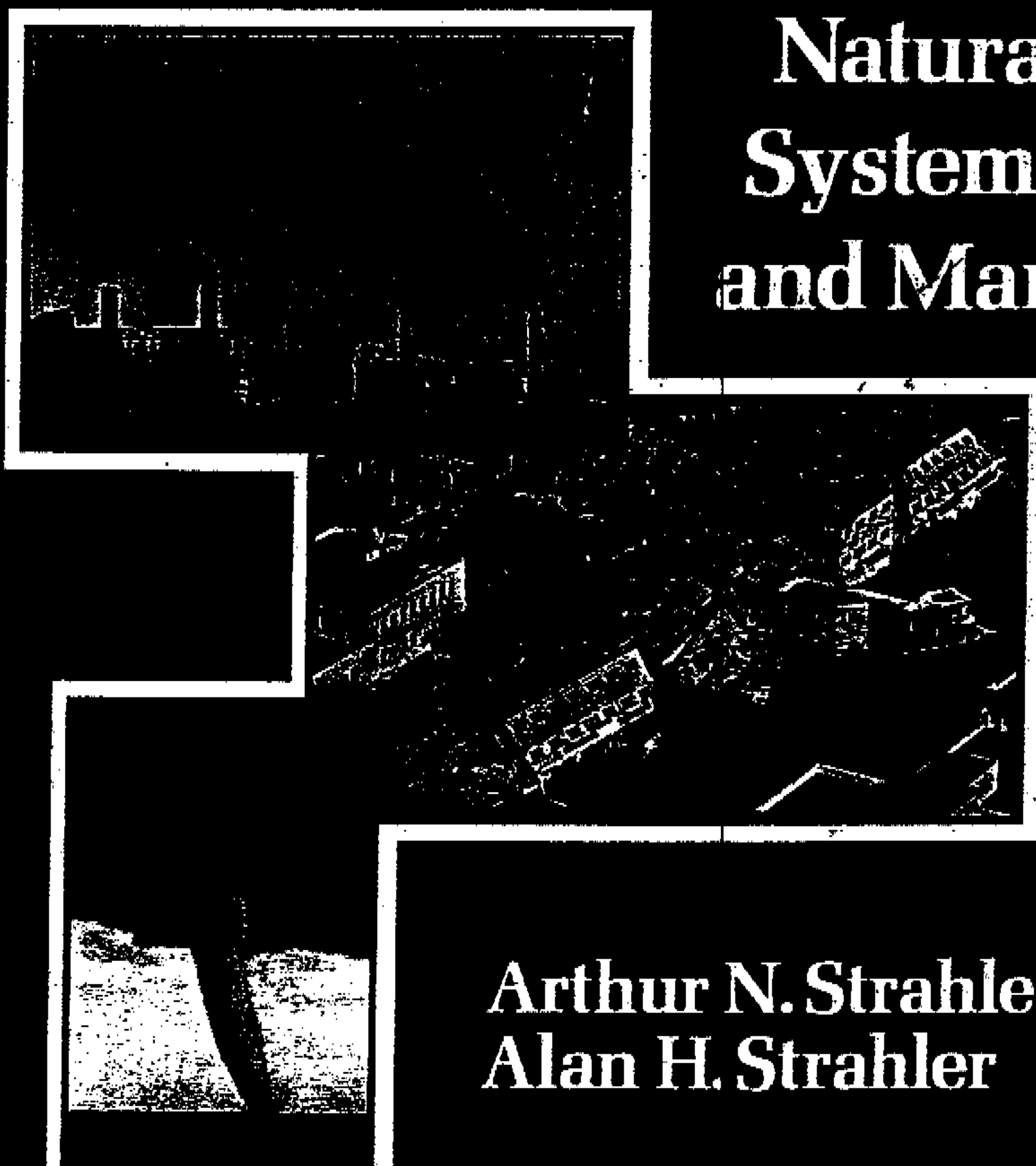
Environmental Geoscience:

Interaction between Natural Systems and Man



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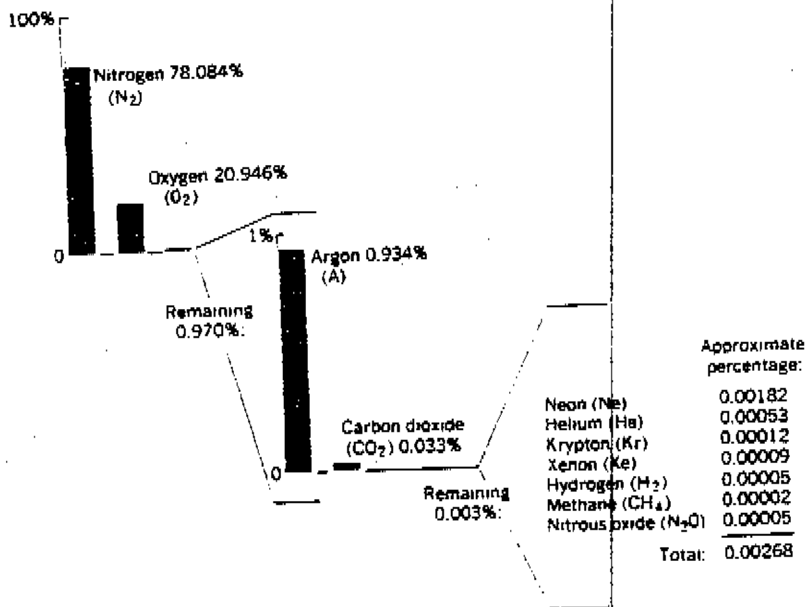

Figure 1.1 Component gases of the lower atmosphere (homosphere), as percent by volume. (Data from E. Gleuckauf. 1951. *Compendium of Meteorology*. Am. Meteorological Soc., Boston. p. 6. Table V. From A. N. Strahler, 1971. *The Earth Sciences*. 2nd ed., Harper & Row, New York.

and follow with the solid earth, building up a resource bank from which many categories of information can later be drawn upon to understand complex environmental problems affecting the biosphere.

Introducing the Atmosphere

The earth's atmosphere consists of a mixture of various gases surrounding the earth to a height of many miles. Held to the earth by gravitational attraction, this envelope of air is densest at sea level and thins rapidly upward. Although almost all of the atmosphere (99%) lies within 18 mi (29 km) of the earth's surface, the upper limit of the atmosphere can be drawn approximately at a height of 6000 mi (10,000 km), a distance approaching the diameter of the earth itself.

From the earth's surface upward to an altitude of about 50 mi (80 km) the chemical composition of the atmosphere is highly uniform throughout in terms of the proportions of its component gases. The name *homosphere* has been applied to this lower, uniform layer, in contrast to the overlying *heterosphere*, which is nonuniform in an arrangement of spherical shells.

Pure, dry air of the homosphere consists largely of *nitrogen* (78.084% by volume) and *oxygen* (20.946%) (Figure 1.1). Nitrogen does not easily enter into chemical union with other substances, but there are processes by which the gas is combined into nitrogen compounds vital to organic processes of the biosphere. In contrast to nitrogen, oxygen is highly active chemically and combines readily with other elements in the process of *oxidation*. Combustion of fuels represents a rapid form of oxidation, whereas certain forms of rock decay (weathering) represent very slow forms of oxidation.

The remaining 0.970% of the air is mostly *argon* (0.934%). *Carbon dioxide*, although constituting only about 0.033%, is a gas of great importance in atmospheric processes because of its ability to absorb heat and thus to allow the lower atmosphere to be warmed by heat radiation coming from the sun and from the earth's surface. Carbon dioxide is also an effective emitter of radiation and acts to cool the upper atmosphere.

Green plants, in the process of *photosynthesis*, utilize carbon dioxide from the atmosphere, converting it with water into carbohydrate. A pronounced rise in the carbon dioxide content of the atmosphere has been noted since 1900 and is a result of Man's combusion of vast quantities of hydrocarbon fuels. This example of Man's impact upon his environment is developed in Chapter 6. Cycles of replenishment and withdrawal of nitrogen, oxygen, and carbon (as carbon dioxide) from the atmosphere and oceans are explained in Chapter 19.

The remaining gases of the homosphere are *neon*, *helium*, *krypton*, *xenon*, *hydrogen*, *methane*, and *nitrous oxide*, listed in decreasing order of percentage by volume. Altogether, these constituents total slightly less than 0.003% by volume. All of the component gases of the homosphere are perfectly diffused among one another, so as to give the pure, dry air a definite set of physical properties, just as if it were a single gas.