

## Lecture Synopsis

R.P. Wayne  
(6 lectures)

Atmospheric Chemistry

1. Introduction to atmospheric chemistry

The variety of atmospheres in the solar system  
Chemistry, photochemistry and cyclic processes in atmospheres;  
Origins of the atmospheres in the Solar system  
Composition of Earth's atmosphere and comparison with Venus and Mars  
Pressures and temperatures in the Earth's atmosphere; "greenhouse" heating

2. The stratosphere

The ozone layer and its significance  
Oxygen-only chemistry  
Evolution of the atmosphere and life  
Importance of minor constituents in atmospheric chemistry  
Catalytic cycles for ozone destruction, reservoirs, *etc.*  
Sources and sinks of minor species  
Dynamics, motions and chemical processes  
Modelling atmospheric chemistry  
Atmospheric measurements of minor species, atoms and radicals

3. Perturbations to stratospheric ozone

Man's contribution to catalytic species  
Stratospheric aircraft; fertilizers and agriculture  
The CFC problem; halons - bromine chemistry; CFC alternatives  
Polar ozone chemistry - the Antarctic "hole" and Arctic perturbations  
Trends in ozone concentrations - their detection and their consequences

4. The troposphere

Sources and sinks of tropospheric gases; biological sources  
Oxidation in the troposphere: initiation, oxidation, ozone production  
The importance of the oxides of nitrogen; PAN; the nitrate (NO<sub>3</sub>) radical  
The importance of the hydroxyl radical  
Feedbacks in atmospheric chemistry; "Gaia"

continued overleaf

5. Heterogeneous chemistry, air pollution and related topics

Aerosols and droplets, and chemistry occurring on and in them  
Homogeneous and heterogeneous oxidation of sulphur compounds  
London smog and acid rain  
Photochemical air pollution and Los Angeles smog

6. Airglow; the mesosphere

Optical emission from atmospheres and information that it yields  
Excitation mechanisms  
Hydroxyl emission - the Meinel bands  
The emissions from atomic and molecular oxygen  
Atomic sodium emission

*Reading Material*

Some sources are:

- R.P. Wayne, *Chemistry of Atmospheres*, 3rd edition, OUP, 2000.  
Hobbs, P.V., *Introduction to Atmospheric Chemistry*, CUP, 1999.  
Seinfeld, J.H. and Pandis, S.N. *Atmospheric Chemistry and Physics*, Wiley, 1998.  
B.J. Finlayson-Pitts and J.N. Pitts, Jr., *Chemistry of the upper and lower atmosphere*, Academic Press, 2000  
T.E. Graedel and P.J. Crutzen, *Atmospheric Change*, Freeman, 1993.  
T.E. Graedel and P.J. Crutzen, *Atmosphere, Climate and Change*, Scientific American Library, 1997.  
P. Brimblecombe, *Air: Composition and Chemistry*, 2nd edn., CUP, 1996  
J.L. Seinfeld, *Atmospheric Chemistry and the Physics of Air Pollution*, Wiley, 1986  
G. Brasseur and S. Solomon, *Aeronomy of the Middle Atmosphere: Chemistry and Physics in the Stratosphere and Mesosphere (second edition)*, D. Reidel, 1986.  
P. Warneck, *Chemistry of the Natural Atmosphere*, Academic Press, 1988  
J.S. Levine, ed., *The Photochemistry of Atmospheres*, Academic Press, 1984  
J. Gribbin, *The Hole in the Sky*, Corgi Books, 1988  
C.C. Park, *Acid rain*, Methuen, 1987

The first of these books was written specifically with the needs of chemistry undergraduates in mind, and a (biased) opinion suggests that it is still probably the most accessible up-to-date account available. A much condensed version of some of the material is to be found in an article available in most college libraries

R.P. Wayne, *Atmospheric Chemistry*, Science Progress, **74**, 379 (1990)

The books by Graedel and Crutzen and by Brimblecombe are interesting, easy to read, and cover additional material. That by Finlayson-Pitts and Pitts deals with the chemical aspects in detail, while those by Brasseur and Solomon and by Seinfeld lean more towards physics and atmospheric dynamics, transport and motions. Warneck is particularly strong on heterogeneous reactions. The last two books are popular accounts of two important topics, perhaps becoming a little dated now.

**WEB SITE FOR NOTES:**

<http://physchem.ox.ac.uk/~wayne/atmos.html>