George Philander – Is the Temperature Rising? The Uncertain Science of Global Warming, Princeton University Press, Princeton New Jersey, 1998

A 3.5 The Greenhouse Effect, page 221 to 225

In this Appendix Philander explains the Green House Effect.

Light from the sun radiates to the earth. The earth has an atmosphere. Philander first assumes a thin sheet of glass of uniform temperature. This is an idealised model of the atmosphere. Rays from the sun go though the glass and hit the surface of the earth, which then warms up. As a body warms up so it radiates more heat, and the earth in this case radiates infra-red heat upwards. This glass absorbs this heat and warms up. So the glass radiates heat both out into space and back towards the earth. Scientists call the radiation of heat back towards the earth the *greenhouse effect*.

Without an atmosphere there would be no greenhouse effect. The earth would be too cold to sustain life as we know it. The Law for the Conservation of Radiative Heat says that a surface absorbs as much heat as it radiates. This applies to the surface of the earth as much as it applies to the surface of the earth's atmosphere.

The idealised model serves the purpose of initial conceptual explanation but is limited. A better approximation to the earth's atmosphere is to divide it into three layers. Each layer exchanges heat only with its immediate neighbours. So layer one absorbs the heat radiated from the earth's surface. Layer one radiates an equal amount back to the earth as it does to its neighbouring layer. The same applies to the other two layers. Each layer has an 'optical thickness'. This reflects the efficiency with which each layer absorbs heat. The temperature of the surface increases with optical thickness. Optical thickness is the depth of the layer. The deeper the layer the further the heat/light has to travel and the more it gets absorbed. The result of the greenhouse effect is an average earth surface temperature of 15 degrees centigrade. Without an atmosphere it would be -18 degrees centigrade.

(summarised by Paul Hendler)