# A comparison of *Ad Hoc Committee Report* (Wegman, Scott, Said) section 2.1, p.14-5 and *Paleoclimatology: Reconstructing Climates of the Quaternary* (Bradley) sections 5.1, 5.2, 6.8

Regular font indicates substantially close wording between the two sources, *italic* represent paraphrased sections, **bold** represents significant departures of Wegman et al from Bradley, and ***bold italic*** represent points of outright contradiction between the two. Paragraphs have been reformatted for easy comparison.

| Wegman | Bradley |
|---|---|
| **Wegman – 2.1 Ice cores - para 1** | **Bradley – 5.1 – p. 125** |
| The accumulated past snowfall in the polar caps and ice sheets provide a very useful record for paleoclimate reconstruction. *We shall refer to ice cores in this section even though strictly speaking there is a combination of snow and ice.* | The accumulation of past snowfall in the polar ice caps and ice sheets of the world provides an extroaordinarily valuable record of paleoclimaticl and paleo-environmemal conditions. *These conditions are studied by detailed physical and chemical analyses of ice and firn (snow that has survived the summer ablation season) in cores recovered from very high elevations on the ice surface.* |
| | Footnote 10 : |
| *Somewhat compressed old snow is called a firn. The transition from snow to firn to ice occurs as the weight of overlying material causes the snow crystals to compress, deform and recrystalize in more compact form.* As firn is buried beneath subsequent snowfalls, density is increased as air spaces are compressed due to mechanical packing as well as plastic deformation. Interconnected air passages may then be sealed and appear as individual air bubbles. At this point the firn becomes ice. | *The metamorphism of snow crystals into fim. and eventually ice occurs as the weight of overlying material causes crystals to settle deform, and recrystallize, leading to an overall increase in unit density*. When firn is buried beneath subsequent snow accumulations, density increases as air spaces between the crystals are reduced by mechanical packing and plastic deformation until … interconnected air passages between grains are sealed off into individual air bubbles (Herron and Langway, 1980). At this point, the resulting material is considered to be ice. …*thus "ice cores" sensu stricto are actually fim cores near the surface (see Table 2.2 in Paterson. 1994). This distinction is not very important except in the reconstruction of past atmospheric composition (see Section 5.4.3) … and the term ice core will henceforth be used to refer to both ice and firn core sections.* |
| | **Bradley – 5.1 – p. 126** |
| Paleoclimatic information derived from ice cores is obtained from four principal mechanisms: 1) analysis of stable isotopes of water and atmospheric oxygen; 2) analysis of other gases in the air bubbles in the ice; 3) analysis of dissolved and particulate matter in the firn and ice; and 4) analysis of other physical properties such as thickness of the firn and ice. | Paleoclimatic information has been obtained from ice cores by four main approaches. These involve the analysis of (a) stable isotopes of water and of atmospheric O2; (b) other gases from air bubbles in the ice; (c) dissolved and particulate matter in the firn and ice; and (d) the physical properties such as thickness of the firn and ice. |

**Wegman – 2.1 Ice cores - para 2**

*The mechanism by which stable isotopes of oxygen and hydrogen carry a temperature signal is as follows. An oxygen atom can exist in three stable forms with atomic weights of 16, 17 or 18. Oxygen with an atomic weight of 16 makes up 99.76% of all oxygen atoms. Similarly, hydrogen can exist in two stable forms with atomic weights of one or two, the latter being called deuterium. Hydrogen with atomic weight of one comprises 99.984% of all hydrogen. Thus water molecules can exist in several heavy forms when compared with normal water, which is made up of two atomic-weight-1 hydrogen atoms and one atomic-weight-16 oxygen atom.*

*The vapor pressure of normal water is higher than the heavier forms of water with evaporation resulting in a vapor that is relatively speaking poor in the heavier forms of water*. Conversely, the remaining water will be enriched in water containing the heavier isotopes.

When condensation occurs, the lower vapor pressure of *water containing the heavier isotopes will cause that water to condense more rapidly than normal water.*

The greater the fall in temperature, the more condensation will occur; hence, the water vapor will exhibit less heavy isotope concentration when compared to the original (sea) water. *Thus the relative isotope concentrations in the condensate will be a direct indicator* of the temperature at which condensation occurred.

**Bradley – 5.2 p. 129-30**

*In common with most other naturally occurring elements, the constituents of water, oxygen, and hydrogen, may exist in the form of different isotopes... Thus, oxygen atoms (which always have 8 protons) may have 8, 9, or to neutrons, resulting in three isotopes with atomic mass numbers of 16, 17, and 18, respectively ($^{16}0$, $^{17}0$ and $^{18}0$). In nature these three stable isotopes occur in relative proportions of 99.76% ( $^{16}0$ ),0.04% ($^{17}0$ ), and 0.2% ($^{18}0$). Hydrogen has two stable isotopes $^{1}H$ and $^{2}H$(deuterium) with relative proportions of 99.984% and 0.016%, respectively. Consequently, water molecules may exist as anyone o nine possible isotopic combinations with mass numbers ranging from 18 ($^{1}H_2\,^{16}0$) to 22 ($^{2}H_2\,^{18}$) …*

*The basis for paleoclimatic interpretations of variations in the stable isotope content of water molecules is that the vapor pressure of $H_2\,^{16}O$ is higher than that of $HD^{16}0$ and $H_2\,^{18}O$ (10% higher than HDO, 1% higher than $H_2\,^{18}O$). Evaporation from a water body thus results in a vapor that is poorer in deuterium and than the initial water;* conversely, the remaining water is (relatively speaking) enriched in deuterium and $^{18}O$. …

When condensation occurs, the lower vapor pressure of *HDO and $H_2\,^{18}O$ results in these two compounds passing from the vapor ro the liquid state more readily than water made up of lighter isotopes. …*

The greater the fall in temperature, the more condensation will occur and the lower will be the heavy isotope concentration, relative to the original water source (Fig. 5.4). *Isotopic concentration in the condensate can thus be considered as a primary function* of the temperature at which condensation occurs …

**Wegman, 2.1 - Corals**

The term “coral” refers to the biological order *Scleractinia*, which have hard calcium-based skeletons supporting softer tissues.

An important subgroup for paleoclimate studies is the reef-building corals in which the coral polyp lives symbiotically with single-celled algae. These algae produce carbohydrates by means of photosynthesis and are affected by water depth, water turbidity, and cloudiness. Much of the carbohydrates diffuse away from the algae providing food to the coral polyp, which in turn provide a protective environment for the algae.

Reef-building corals are strongly affected by temperature and, as temperature drops, the rate of calcification drops with lower temperature potentially presaging the death of the colony.

Coral growth rates vary over a year and can be sectioned and x-rayed to reveal high- and low-density bands. High density layers are produced during times of higher sea surface temperatures.

[?? Thus not unlike tree rings, data on corals also can be calibrated to estimate (sea) surface temperatures.??]

**Bradley - 6.8 – Coral**

The term "coral" is generally applied to members of the order Scleractinia, which have hard calcareous skeletons supporting softer tissues (Wood, 1983; Veron, 1993).

For paleoclimatic swdies, the important subgroup is the reef-building, massive corals in which the coral polyp lives symbiotically with unicellular algae … The algae produce carbohydrates by photosynthesis and thus are affected by water depth (most growing between 0-20 m) as well as water turbidity and cloudiness. Much of the organic carbon fixed by the algae diffuses from the algal cells, providing food for the coral polyps, which in turn provide a protective environment for the algae.

Reef-building corals are limited mainly by temperature … When temperatures fall to to 8 ·C, the rate of calcification (skeletal growth ) is significantly reduced and lower temperatures may lead to death of the colony.

Coral growth rates vary over the course of a year; when sectioned and x-rayed, an alteration of high - and low·density bands can be seen (Fig. 6.39). High density layers are produced during times of highest SSTs (Fairbanks and Dodge, 1979; Lough and Barnes. 1990) providing a chronological framework for subsequent analyses.