

RIJKSUNIVERSITEIT GRONINGEN

Interactions between *Emiliana huxleyi* and
the dissolved inorganic carbon system

Proefschrift

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In memory of my best friend and mother,
Wil Buitenhuis van Veen
(1937-2000)

Colophon

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Statements

1. If you think that the whole is greater than the sum of the parts then you have overlooked some parts (page 7).
2. By a rough estimate, *Emiliana huxleyi* precipitates 1.4 ‰ of the oceanic CaCO₃ production, and is therefore probably not the most productive CaCO₃ precipitating organism on earth (pro: chapter 1, contra: Westbroek et al. 1985).
3. There is no missing sink (chapter 1).
4. Doubling of the atmospheric CO₂ (at constant alkalinity) decreases the atmospheric CO₂ sink of a bloom of *E. huxleyi* by 1% (chapter 1).
5. *E. huxleyi* blooms reduce the atmospheric CO₂ concentration more than blooms of algae that are solely made of organic material (pro: chapter 5; contra: Robertson 1994).
6. It is possible to reduce our standard of living without reducing our quality of life, and it is necessary to do so in order not to compromise the quality of life of future generations.
7. If we tend to associate what we enjoy with what is bad for us then there is something wrong with our educational system.

A thesis is not written by just one person

When I was about 12 years old, we brought a cassette player during the summer holidays, and as far as I can remember only one cassette: 'The concert in Central Park' by Simon & Garfunkel, which contains the following acknowledgement: 'I would like to thank the police department, and the fire department, and the park's commissioner, and Ed Koch. And particularly, you know, people who never get recognised for doing ... for doing good deeds for the city are donating half of the proceeds that they are making tonight. The guys who sell and lose joints are giving the city half of their income tonight.' Subsequently, I have been very uncomfortable with acknowledgements. There is also a practical reason for me not to prepare a list of everybody who has helped me to do my PhD: if I tried to make the list exhaustive it would be so long that nobody would read it, and still I could not hope to make it complete; conversely, I can think of no criteria to select the people who have been most important.

Well, that is the theory and it sounds all right to me, but it doesn't work ... I enjoyed sharing rooms with Marcel Veldhuis, Judith van Bleijswijk, Paul van der Wal, Rob Kempers, Willem Stolte, Anna Noordeloos and Corina Brussaard. Hein de Baar is my promoting professor. That should explain his central importance to the work that lies before you, and if it doesn't, nothing I can say will make it any clearer. Nelleke Schogt and Klaas Timmermans freely provided me with laboratory space, which was much appreciated. Rob Kempers, Erika Koning, Martin Laan, Herman Boekel, Edwin Keijzer, Edwin de Jong, Ruud Groenewegen, Jeroen de Jong, Patrick Laan and Josje Snoek gave excellent technical assistance. And then there's at least another page worth of people who helped with intellectual, moral and/or technical support.

A story

Emiliana huxleyi is a unicellular marine alga that likes carbon so much that it fixes it in two forms, organic and inorganic. At first sight the inorganic part looks rather beautiful both when seen under an electron microscope (Figure 1.4) and when seen from space (Figures 2.1b and 1.6). But when looked at from a chemical perspective, it turns out that it is just one component (CaCO_3), precipitated in a single crystal form (calcite). The converse is true for the organic part. At first sight it is just the preparation of more alga by that same alga. This is called growth. But this organic part is prepared by a complicated recipe, the basic manipulations of which are shared by all life on earth. The general outline of these manipulations are known and involve such almost mundane processes like DNA replication, RNA transcription, protein translation, electron transfer and ion transport. The total result of all this is rather startling. Although it does not follow that the whole is greater than the sum of the parts, the observation of what all this moving around and recombination of physical particles can accomplish in terms of living organisms makes one rather more cautious in any subsequent inference of logical conclusions from observable facts (statement 1).