

with either one gene type or the other. The scattered losses produced the evolutionary mosaic at the level of species or even strain.

Croft *et al.*³ also provide evidence that a bacterium, *Halomonas*, upregulates the biosynthesis of vitamin B₁₂ when in the presence of algal exudates. Many algae are members of a loose taxonomic grouping known as the protists. These are often unicellular and include such organisms as *Amoeba* and *Paramecium*. The phenomenon of endosymbiosis, in which one organism (such as a bacterium) takes up residence inside another, to mutual benefit, has been thoroughly studied in protists, especially with regard to the origins of the chloroplast and mitochondrion. But possible ectosymbioses — literally, more superficial relationships — involving bacteria and algae have received less attention.

An earlier investigation did indeed show that *Thalassiosira* and other marine diatoms, all of which require vitamin B₁₂, could be grown without the vitamin when bacterial cultures were added to the diatom cultures¹⁰. Such studies hinted at the existence of a symbiotic relationship. But unlike Croft *et al.*, the authors of this study did not identify the bacteria involved or the specific genes (or enzymes) concerned, and they did not demonstrate upregulation of a bacterial gene in response to a chemical signal from the algae.

Croft and colleagues' approach³ could profitably be adopted more broadly, because protists have a much wider variety of basic biochemical pathways than do either animals or plants. We can hope that the enzymatic pathways leading to other amino acids, sugars, lipids and so forth — which have long been known to be diverse in protists and to show similar evolutionary mosaic patterns¹¹ — will likewise be examined using the genome data now available. It is likely

that additional symbiotic vitamin-B₁₂-producing bacteria will be identified, and that other vitamins are produced by symbiotic bacteria.

But non-symbiotic bacterial sources of vitamins may be equally or more important. For example, concentrations of vitamin B₁₂ in the oceans vary with season, and there is strong circumstantial evidence that this vitamin is produced on the ocean floor at depths where darkness makes it unlikely that an algal-bacterial symbiosis can exist¹².

Clearly, the paper by Croft *et al.* doesn't answer all questions. But it greatly advances our understanding of why the vitamin-B₁₂ requirements are so sporadic among the algae, and also points to an enticing variety of research opportunities. ■

Robert A. Andersen is at the Provasoli-Guillard National Center for Culture of Marine Phytoplankton, Bigelow Laboratory for Ocean Sciences, West Boothbay Harbor, Maine 04575, USA.
e-mail: randers@bigelow.org

1. Provasoli, L. & Carlucci, A. F. in *Algal Physiology and Biochemistry* (ed. Stewart, W. D. P.) 741–787 (Blackwell, Oxford, 1974).
2. Lewin, J. C. & Lewin, R. A. *Can. J. Microbiol.* **6**, 127–134 (1960).
3. Croft, M. T., Lawrence, A. D., Raux-Deery, E., Warren, M. J. & Smith, A. G. *Nature* **438**, 90–93 (2005).
4. Farnintzin, A. *Bull. Acad. Sc. St. Petersburg* **17**, 31–70 (1871).
5. Pringsheim, E. G. *Beitr. Biol. Pfl.* **11**, 305–334 (1912).
6. Provasoli, L., Hutner, S. H. & Schatz, A. *Proc. Soc. Exp. Biol. Med.* **69**, 279–282 (1948).
7. Hutner, S. H. *et al. Soc. Exp. Biol. Med. Proc.* **70**, 118–120 (1949).
8. Swift, D. in *The Physiological Ecology of Phytoplankton* (ed. Morris, L.) 329–368 (Univ. California Press, Berkeley, 1980).
9. Guillard, R. R. L. & Ryther, J. H. *Can. J. Microbiol.* **8**, 229–239 (1962).
10. Haines, K. C. & Guillard, R. R. L. *J. Phycol.* **10**, 245–252 (1974).
11. Ragan, M. A. & Chapman, D. J. *Biochemical Phylogeny of the Protists* (Academic, New York, 1978).
12. Menzel, D. & Spaeth, J. P. *Limnol. Oceanogr.* **7**, 151–154 (1962).



50 YEARS AGO

"Use and abuse of English in science" — Another problem which is causing increasing concern — to printers as well as to editors — is the frequent and indiscriminate use of abbreviations in the form of a single capital letter, or a group of capitals, to represent the name of a substance, or perhaps even an adjective or adverb. The printer is concerned because a page of text sprinkled with capital letters is not pleasing in appearance; and like other craftsmen, he feels that his efforts are being frustrated... The use of abbreviations, especially initial letters, is now becoming so fashionable among scientists that one suspects authors sometimes go out of their way to use them. ... this fashion may, if not checked, defeat its own ends and produce a veritable 'Tower of Babel'. Indeed the time does not seem far away when high-school pupils will have to learn a new table of symbols apart from those atomic.
From *Nature* 5 November 1955.

100 YEARS AGO

A return has been published, we learn from the *Pioneer Mail*, regarding the measures adopted for the extermination of wild animals and venomous snakes during the year 1904. The total mortality among human beings reported to have been caused by wild animals was 2157, against 2749 in 1903. The most notable decrease occurred in Madras and the United Provinces, namely, from 438 and 404 in 1903 to 237 and 193 in 1904 respectively... The mortality from snake-bite rose from 21,827 to 21,880. It is reported that in the Seoul district of the Central Provinces anti-venin was used with success in two cases, and the question of introducing more generally the treatment of snake-bite by potassium permanganate is under the consideration of the local Government. The total number of snakes killed was 65,378.
From *Nature* 2 November 1905.

GLOBAL CHANGE

Sea level and volcanoes

Anny Cazenave

Large volcanic eruptions cool the world ocean. In doing so, they temporarily reduce the increase in ocean heat content and the rise in sea level attributed to warming caused by greenhouse-gas emissions.

Global warming is producing a rise in sea level. Observations from tide gauges and satellite altimetry indicate that sea level has been rising by 1.8 millimetres per year since 1950 (ref. 1) and about 3 millimetres per year during the 1990s (ref. 2). The two causes are a thermal expansion of sea water in response to ocean warming, and the input of extra water from the melting of glaciers and ice sheets on land³. But against the background of this overall increase, global mean sea level displays interannual to decadal oscillations of the order

of several millimetres. These oscillations have received scant attention to date. Some of them result from changes in ocean heat content associated with internal perturbations of the ocean-atmosphere system, such as the El Niño–Southern Oscillation and Pacific Decadal Oscillation⁴. But other processes, probably related to the 'forcing' effects of natural climate variation, also play a role.

On page 74 of this issue, Church *et al.*⁵ use climate simulations to reveal the effects of volcanic eruptions on sea level between 1890 and