BOOK REVIEW

C. R. Harington (ed.), *The Year Without a Summer? World Climate in 1816*, Canadian Museum of Nature, Ottawa, 1992, 576 pp.

In the summer of 1816, Lord Byron and his friends Mary and Percy Bysshe Shelley spent their vacation on the shores of Lake Geneva in Switzerland. Rather than the normally delightful weather they expected, "it proved a wet, ungenial summer, and incessant rain often confined us for days to the house." (Shelley, 1818, p. xxii) In fact it was so gloomy that they held a writing contest to see who could come up with the best ghost story, the most appropriate expression of their common dismal feelings. Mary won, and the famous novel *Frankenstein* was born. The book both begins and ends with the monster trudging across a bleak ice-covered wasteland, *e.g.*:

So strange an accident has happened to us that I cannot forbear recording it, although it is very probable that you will see me before these papers can come into your possession.

Last Monday (July 31st) we were nearly surrounded by ice, which closed in the ship on all sides, scarcely leaving her the sea-room in which she floated. Our situation was somewhat dangerous, especially as we were compassed round by a very thick fog. We accordingly lay to, hoping that some change would take place in the atmosphere and weather.

About two o'clock the mist cleared away, and we beheld, stretched out in every direction, vast and irregular plains of ice, which seemed to have no end. Some of my comrades groaned, and my mind began to grow watchful with anxious thoughts, when a strange sight suddenly attracted our attention and diverted our solicitude from our own situation. We perceived a low carriage, fixed on a sledge and drawn by dogs, pass on towards the north, at the distance of half a mile; a being which had the shape of a man, but apparently of gigantic stature, sat on the sledge and guided the dogs. ... (p. 4)

Byron was also inspired that summer and wrote *Darkness*, the beginning of which is reproduced without comment in the frontispiece of this book, both as the original handwritten manuscript and in an early printed version. This poem first came to my attention 10 years ago in the context of the nuclear winter theory, and is a passionate expression of that scenario as well as a moving product of the summer of 1816:

I had a dream, which was not all a dream.
The bright sun was extinguish'd, and the stars
Did wander darkling in the eternal space,
Rayless, and pathless, and the icy earth
Swung blind and blackening in the moonless air;
Morn came and went – and came, and brought no day,
And men forgot their passions in the dread
Of this their desolation; and all hearts
Where chill'd into a selfish prayer for light:
And they did live by watchfires – and the thrones,
The palaces of crowned kings – the huts,
The habitations of all things which dwell,
Were burnt for beacons; cities were consumed,
And men were gather'd round their blazing homes
To look once more into each other's face; ...

The purpose of the book reviewed here is to address the question of whether Shelley and Byron were making too much of the weather that summer. The summer in New England that year also had extreme weather. Was 1816 truly a 'Year Without a Summer' globally or just a local European and New England phenomenon? What were the causes of these extreme climate anomalies? Were they the result of the Tambora volcanic eruption in April 1815, in Indonesia, or caused by solar variations, El Niño/Southern Oscillation (ENSO) events, or random weather variations?

The product of a workshop held in Ottawa, Canada, in 1988, *The Year Without a Summer? World Climate in 1816* provides a collection of new and up-to-date research that goes a long way to answering these questions. It consists both of papers from the workshop and an excellent summary of the global evidence of the climate of 1816 by Cynthia Wilson, one of the workshop organizers. Although the workshop was held 5 years ago, many of the papers include references published in 1989 and the summary by Wilson includes references from 1990. It has been completely retyped and well edited and does not suffer from the usual failings of such volumes. Although the papers were written 3 years ago, in general they have not been superseded by new work.

Although the cool summer of 1816 was not universally felt around the globe, large regions, including North America, Europe, Argentina, India, and China experienced record anomalies. Even portions of South Africa experienced cool and wet conditions in the growing season, but Southern Hemisphere climate would not be expected to change much in response to Tambora, due to the overwhelming oceanic influence.

The hypothesis that Tambora was responsible for these climatic anomalies receives substantial support. Evidence is given not only of the effects of Tambora on the 1816 climate, but of other major volcanoes of the period. The many time series of temperature, tree rings, and other evidence span several decades around 1816. The most anomalously cold years are 1784, after the 1783 Laki and Asama eruptions; 1809, after an unknown 1808 eruption; 1816; and 1836, after the 1835 Coseguina eruption. Dai *et al.* (1991) recently showed that the 1808 or 1809 eruption is clearly evident in acidity records of ice cores from both Greenland and Antarctica. Only Villaba and Boninsegna (pp. 493–509) explicitly consider this volcano in their analysis, although its acidity record is present in Figure 6 of the paper by Thompson and Mosley-Thompson (p. 490). I bring this up because it is mentioned several places in this book that the cooling in 1816 began before the Tambora eruption. A volcano one half or one third the size of Tambora in 1808 would explain this cooling, and explain why the effects of Tambora were not larger than they were. Several authors suggest that if Tambora had erupted in a warmer climate, the effects would have been less harsh. While this is true in an absolute sense, in a relative sense they would have been larger and more easily attributable to the volcano. While solar variations and ENSO are briefly mentioned, this book does not contain any evidence that they were important for the 1816 climate.

This is not the first publication on the 'Year Without a Summer'. Even U.S. Vice-President Al Gore devotes a large section of his recent book (Gore, 1992) to this phenomenon. I reviewed the book by Stommel and Stommel (1983) a decade ago (Robock, 1984), but it mainly presented evidence of the climate change and did not evaluate the causes of the change in much detail. The present volume updates that work and the summary by Stothers (1984), and incorporates much new work in climate reconstruction, especially with ice cores and tree rings, and makes a compelling case for the effects of large volcanic eruptions on climate.

One of the most interesting aspects of this book to me was the social science content, the detailed descriptions of the sensitivities of societies to climate change, and the new quantitative techniques being used to extract information on climate change from diaries and records of the period. The extensive records of the Hudson's Bay Company prove extremely useful in this regard for determining Canada's climatic record of this period. It was fascinating to discover in the chapter by William R. Baron that the effects of the 1816 summer on agricultural productivity of New England did not have to do with the average temperature, which was low but not abnormally so, but with a series of killing frosts that reduced the growing season. This, along with a severe drought, reduced agricultural output to record low levels. In Europe, by contrast, there were record low temperatures accompanied by above average rainfall and cloudiness, the combination of which slowed the growth of crops and produced fungus and molds. Thus food production was negatively affected in both regions, but by different mechanisms, pointing out the complex relationship between climate and human impacts. Post (1977) previously described the effects of this disruption of food supplies on Western society. This volume updates that work and goes farther, by describing the situation in societies in the rest of the world.

The book is intended for those interested in "historical climate (particularly that of the Little Ice Age) and its human impact; relationships between volcanism and climate; and the ways paleoclimatic proxy data are gathered, treated and interpreted." (p. 7) It satisfies these goals admirably and I highly recommend it for anyone studying the effects of volcanoes on climate or the impacts of climate change on humans.

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