water density calculated from T_m of ice VI is 1212 kg/m^3, which yielded a pressure of 775 MPa at T_m = 8.1°C; a pressure of 779 MPa was obtained when we assumed that the bulk water density was 1213 kg/m^3 (on the basis of the melting point of ice V). The two calculated pressures for the melting of the new phase at 8.1°C agree. Similar results were also obtained for other melting temperatures (Fig. 3) even under more extreme *P-T* conditions where uncertainties are involved in extrapolating both the melting curve of ice V (*18*) and the equation of state of water (*19*).
21. A quantitative determination of the birefringence cannot be made because samples were viewed between the two diamonds, the tips of which become birefringent under stress.
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23. The lowest frequency band sharpened somewhat with decreasing temperature, but no new peaks appeared. This observation, together with weak frequency shifts, indicates that the phase did not become significantly more ordered with cooling. The 192 cm^{-1} band and the structure of spectrum in the O–H stretching region are also similar to that measured for ice III; however, the latter also has a characteristic band at 95 cm^{-1}, which was not observed for the new phase.
24. Kamb (*13*) proposed that pressure-quenched ice VI is partially ordered with space group *Pmmn*. In its stability field, the phase is proton-disordered (space group $P4_2/nmc$) and a fully ordered form (space group *Pn*) was also predicted (*13*). Subsequent study by W. L. Kuhs, J. L. Finney, C. Vettier, and D. V. Bliss [*J. Chem. Phys.* **81**, 3612 (1984)] confirmed that the space group of ice VI is $P4_2/nmc$. Our results indicate that the new phase is more extensively disordered. Because of the lack of data, it is difficult to speculate the relation, if any, between the new phase and the one recently found at lower pressures by Lobban *et al.* (*14*).
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Evidence Against a Significant Younger Dryas Cooling Event in New Zealand

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Pollen records of deglacial sequences from northwest Nelson, New Zealand, demonstrate that there was no significant temperature decline associated with the Younger Dryas in New Zealand. Records of glacial advances at this time were either the product of increased snow accumulation under enhanced precipitation regimes or random variation rather than the result of a regional thermal decline. This finding supports those models of Younger Dryas initiation that require neither enhanced westerly circulation nor significant thermal decline in the Southern Hemisphere.

The Younger Dryas (YD) was a brief but intense climatic deterioration that occurred 11,000 to 10,000 radiocarbon years before the present (B.P.), during the termination of the last glaciation. The New Zealand record of YD is crucial to understanding the phenomenon on a global scale, as only New Zealand and Chile and Argentina possess mid-latitude glaciers in the Southern Hemisphere that are likely to be sensitive to atmospheric cooling, and the South American record has proved inconclusive and contradictory (*1–3*). In New Zealand, a significant advance of the Franz Josef Glacier in Westland has been dated to YD times (*4*). Although the dating (*5, 6*) and the interpretation that the advance relates to thermal decline (*7*) are controversial, the record has been widely cited (*8–10*) as evidence of the interhemispheric influence of the event.

Supporting evidence of cooling in the New Zealand region during the YD has been elusive. Some other glacial advances in the Southern Alps may be coeval, but adequate dating control is lacking; where dated sequences of deglacial ages do occur, there is no concentration of ages in the YD Chron (*11, 12*). The other primary source of climate data from New Zealand are pollen studies, but these have consistently shown a pattern of ongoing afforestation from 14,000 to 10,000 radiocarbon years B.P. This is interpreted as a stepwise warming with no trend reversals (*13*); however, only a few sites covered the YD Chron in detail, and there were no sites near the glaciers. We present a pollen record, from a climatically sensitive site, that covers the YD.

The Cobb Valley in northwest Nelson lies about 300 km north of the Franz Josef Glacier (Fig. 1), close to the west coast of the South Island. It has the same regional climate as Westland. The mountains of northwest Nelson were less extensively glaciated than the main ranges of the Southern Alps, because they are at lower elevations, but small piedmont caps and widespread valley glaciation occurred. Terminal and lateral moraines, roche moutonée fields, and other evidence of valley glaciation are present in the Cobb Valley and on a plateau north of the valley. Associated with the terminal moraine complexes are a series of kettle holes formed by the melting out of large blocks of stagnant ice. These kettles have subsequently infilled with lake sediments and peats. The oldest of these kettles started filling soon after the Last Glacial Maximum (LGM; ~18,000 radiocarbon years B.P.), and it is almost certain that a valley glacier still occupied the lower Cobb Valley during the deglaciation.

We obtained three pollen records (Fig. 2) from different kettle holes that extend back beyond the YD. All three records show consistent trends. At full glacial times, the residual vegetation in the Cobb consisted of grasses, daisies, other herbs, and low shrubs (Fig. 2A). Rapid revegetation occurred 13,000 radiocarbon years B.P. [(*12*) and Fig. 2C], and the herbaceous flora was replaced by a low shrubland dominated by *Phyllocladus* (a dwarf podocarp). Soon thereafter another montane podocarp, *Halocarpus*, and a *Nothofagus* (southern beech)—represented by fuscasporites-type pollen, probably mountain beech (*N. solandri* var *cliffortiodes*)—expanded. At all sites, the dominant vegetation associations until after 10,000 radiocarbon years B.P. comprised mixes of these taxa. *Halocarpus* and *N. solandri* gradu-

Table 1. Radiocarbon dates from Cobb Valley and adjoining areas.

Code	Age* (conventional)	Age† (calibrated)	Core (depth in meters)	Material	Notes
NZA7771	3,511 ± 72	3,870–3,643	CV1 (0.98)	Peat	Arrival of silver beech
NZA8032	9,991 ± 76	11,630–11,005	CV1 (1.93)	Peat	Termination of YD
NZA6325	11,195 ± 95	13,214–13,000	CV1 (2.06)	Peat	Onset of YD
NZA7198	13,200 ± 85	15,904–15,578	LS1 (2.95)	Rootlets	Onset of postglacial flora
NZA8033	17,120 ± 100	20,531–20,048	CV3 (3.91)	Fine organics	LGM

*Age in conventional radiocarbon years B.P. †Calibrated age range in years B.P. (*19*).

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ally displaced *Phyllocladus* from communities. These species, along with silver beech (*N. menziesii*), which was present at some sites early in the deglaciation but appears to have expanded at most sites in the mid- to late Holocene, remain dominant to the present day. There is no indication from any of these diagrams of a climatic deterioration during the deglaciation. In order to investigate this, we resampled and counted one core at 1-cm intervals through the key time phase (Fig. 2B). Radiocarbon ages precisely bracket the entire YD period (Table 1 and Fig. 2B), and counts extend on both sides of the period.

The only vegetation change observed is a temporary replacement of *Halocarpus* by beech at the end of the YD. This is not a temperature effect but a site hydrology effect. The high values of beech exactly coincide with a period of inorganic sedimentation at the site interpreteted to be the result of the site drying out. None of the temperature-sensitive taxa respond. Cold-loving taxa (the daisies, the grasses, and *Phyllocladus*) show no increases through the period, and the *Halocarpus* and beech ("warm" indicators) are stable when treated as a group. There is no signal of a thermal decline during, before, or after the YD.

Hellstrom and co-workers have obtained an oxygen isotope profile from speleothems on nearby Mount Arthur (*12*). This record shows an excursion coeval with the YD and a similar excursion early in the Holocene. The Holocene excursion is inconsistent with known glacial advances and thus may reflect local changes in westerly circulation or in ocean fronts in the Tasman Sea. Historical advances of the West Coast glaciers are associated with periods of enhanced westerly flow (*7, 14*). This is a response to a combination of enhanced orographic snowfall in the catchments and reduced summer ablation due to increased cloud cover. Thus, both the pollen and isotope data imply that precipitation increased during the deglacial period in New Zealand. Localized readvances of climatically sensitive West Coast glaciers have not required thermal forcing.

The lack of a widespread or significant YD event in the Southern Hemisphere has implications for understanding its origins. One model, the polar jet hypothesis (*15*), suggests that an increase in elevation of the Laurentide Ice Cap in the years preceding

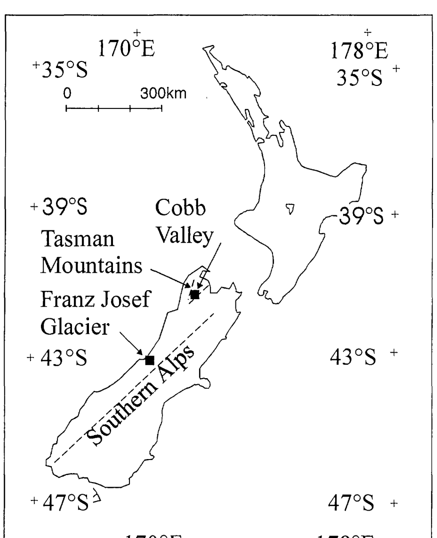

Fig. 1. The locations of Cobb Valley and other important features are shown in New Zealand.

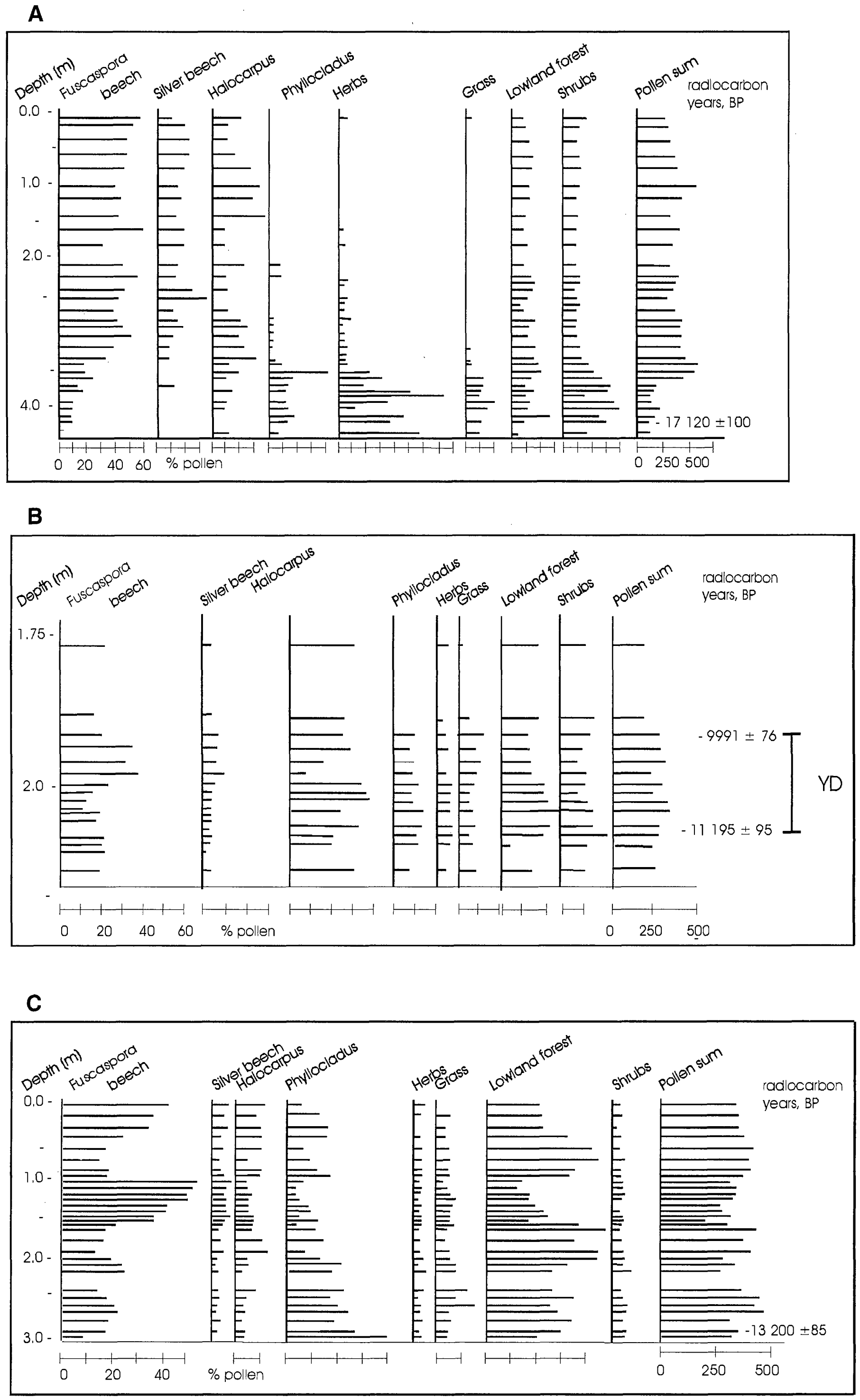

Fig. 2. Pollen diagrams for three pollen core sites in the Cobb Valley area. (**A**) Core CV3 record, which displays the complete deglacial sequence. (**B**) YD section of CV1, located about 75 m from CV3. (**C**) LS1 at Lake Sylvester. This high-altitude site (1300 m) demonstrates that modern vegetation had been established by 13,000 years B.P.

the YD triggered an equatorward reorganization of zonal circulation over North America (*16*). Other zonal belts might be displaced southward, including the Intertropical Convergence causing increased zonal circulation in the Southern Hemisphere. Such enhancement in the Southern Hemisphere, however, is inconsistent with the absence of a YD dust spike in Antarctic ice records (*17*), suggesting that the event, if present, was not marked by enhanced windiness.

Another possible cause of the YD, reduced production of North Atlantic deep water, has the most pronounced climatic response in the Southern Hemisphere, because transfer of heat to mixed layers in the Southern Ocean is reduced (*18*), and sea-ice should grow. The 3.3°C mean annual cooling in the Southern Hemisphere predicted by one simulation of this process (*18*) is incompatible with our record.

Processes that yield either a largely North Atlantic signal (for example, iceberg or freshwater caps over the North Atlantic without changes in deepwater formation) or global processes that yield small thermal changes (a reduction of the greenhouse gas CO_2 by 50 ppm would cause a 1°C decline) are consistent with the absence of a marked thermal signal from NZ.

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Callosal Window Between Prefrontal Cortices: Cognitive Interaction to Retrieve Long-Term Memory

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A perceptual image can be recalled from memory without sensory stimulation. However, the neural origin of memory retrieval remains unsettled. To examine whether memory retrieval can be regulated by top-down processes originating from the prefrontal cortex, a visual associative memory task was introduced into the partial split-brain paradigm in monkeys. Long-term memory acquired through stimulus-stimulus association did not transfer via the anterior corpus callosum, a key part interconnecting prefrontal cortices. Nonetheless, when a visual cue was presented to one hemisphere, the anterior callosum could instruct the other hemisphere to retrieve the correct stimulus specified by the cue. Thus, although visual long-term memory is stored in the temporal cortex, memory retrieval is under the executive control of the prefrontal cortex.

The primate inferior temporal cortex, located at the final processing stage of visual object perception (*1*), plays an important role in recall as well as storage of visual memory; inferotemporal neurons can be dynamically activated by retrieval of visual long-term memory in monkeys (*2*), and electric stimulation of this region results in imagery recall in humans (*3*). The neural network that enables such imagery recall in cognition has not been established. A likely component is the prefrontal cortex, which has been implicated in executive processes such as planning, working memory, and memory retrieval (*4, 5*). A conventional approach by means of lesion to the prefrontal cortex often produces devastating cognitive impairments (*4*). On the other hand, the capacity for interhemispheric transfer through the anterior corpus callosum (CC), the callosal window between prefrontal cortices (*6, 7*), would positively highlight executive processes undertaken by the prefrontal cortex. So far, there has been little evidence for what transfers via the anterior CC (*8, 9*), whereas it has been established that posterior callosal fibers between sensory cortical areas (*7*) provide channels for communication in each modality (*6, 8, 10, 11*). In a clinical report of an epileptic patient who had undergone selective posterior callosotomy (*12*), although sensory stimuli lateralized to the nondominant right hemisphere could not be transferred for naming, semantic features of these stimuli somehow could be described by the expressive language system of the left hemisphere. This observation leads to a hypothesis that top-down processes originating from the prefrontal cortex can regulate retrieval of long-term memory from the modality-specific posterior association cortex, even in the absence of direct sensory input. To test this hypothesis, we examined in partial split-brain monkeys whether the prefrontal cortex can instruct, through the anterior CC, the contralateral hemisphere to retrieve long-term memory when sensory interaction between posterior cortical areas is prevented (Fig. 1A).

Monkeys underwent two-stage scheduled commissurotomy (Fig. 1B) (*13*). In the first operation, we transected occipito-temporal

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