sively that the *Pto* resistance gene had been cloned. Far from being the expected receptor (with, for instance, a membrane-spanning domain) the protein encoded by the gene appears to be a serine-threonine protein kinase.

Preliminary results on the structure of the *Pto* locus suggest that intralocus recombination events may have occurred which may be a mechanism for the generation of diversity. This could explain why, in many plants, race-specific (and indeed other) resistance genes frequently map to the same position[10].

So now both partners of a gene-for-gene interaction are known in some detail. How they interact is another question. On the pathogen side, the *avrPto* gene, in common with other avirulence genes from bacterial pathogens, has no homology to other proteins in the databases (so no clues there as to how it might work)[11]. One possibility is that *avrPto*, like the *avrD* gene (also from *P. syringae* pv. tomato), leads to the production of a low-molecular-weight elicitor of resistance[12]. This could then interact with the *Pto* gene product, or at a point higher up the signal-transduction pathway, to produce a hypersensitive response. Like *avrD*, the *avrPto* gene expressed in the soybean pathogen *P. syringae* pv. *glycinea* elicits the hypersensitive response on soybean in a race-specific manner[9]. This leads to the prediction that the relevant soybean cultivar should contain a resistance gene similar to *Pto*. Likewise, an *Arabidopsis* resistance locus has been identified using avirulence genes from a soybean pathogen[13]. Avirulence genes from bacteria specific for different plants can be nearly identical (implying similarity of the corresponding resistance genes), so it is possible that resistance genes cloned from one plant may function in another[14].

Practical (as opposed to molecular) plant pathologists have limited use for gene-for-gene resistance as it is not always durable; moreover, most plant disease resistances do not seem to be of the gene-for-gene type. Where these molecular studies may prove more useful is in the elucidation of the signal-transduction pathway resulting in the hypersensitive response, and in the clues that this may give as to how to turn it on in response to any pathogen rather than those rarities carrying specific avirulence genes. □

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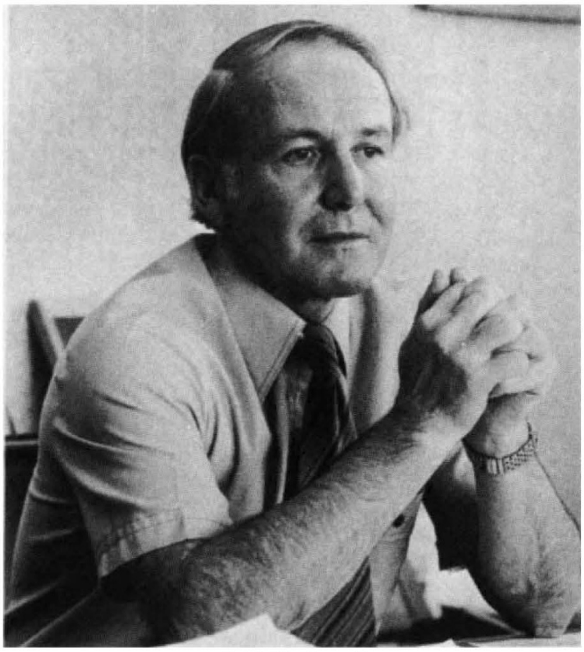
OBITUARY

A. E. (Ted) Ringwood (1930–93)

"Our understanding of the Earth in all her aspects has developed dramatically in the last 25 years. This has been an exhilarating period to have been an Earth scientist. I feel very fortunate and fulfilled to have been able to participate in some of these developments."

These were Ted Ringwood's words in 1991 before the Italian National Academy as he accepted the Feltrinelli Prize, one of the most valued international prizes for scientific or cultural achievement. His premature death from cancer, on 12 November, has robbed Earth sciences of one of its most creative and stimulating contributors. Since the 1960s, Ted Ringwood's name has been synonymous with frontier research on processes in the Earth's upper mantle and the nature of the mantle transition zone. His pioneering studies at that time used germanates as analogues for high-pressure silicate phases, and he continued to lead this field, by a combination of prediction and experimental confirmation, for over 30 years.

Ted Ringwood was born and educated in Melbourne. His initial training in geology took a new direction when, for his Ph.D. studies at the University of Melbourne, he applied the geochemical concepts of V. M. Goldschmidt to the prediction of new mineral structures that should be stabilized by the very high pressures and temperatures of the Earth's mantle. After a brief post-doctoral position at Harvard, he was recruited by John Jaeger in 1958 to the newly established department of geology and geophysics at the Australian National University. Throughout his career, he worked to ensure that this institution became recognized internationally for research excellence. He began his experimental work in 1959 with diamond-anvil synthesis of high-pressure polymorphs. I was recruited by Jaeger in 1962 to work with him and our close association continued until 1976. Our early work was on the origin of basalts and their conversion to high-pressure eclogite (garnet and pyroxene). We explored the concept of the gabbro-to-eclogite transformation acting as a tectonic engine within both a model of continental growth and a 'sea-floor spreading' model of ridges and trenches. Later, Ringwood was to develop the idea of how phase transformations in the subducted slab controlled mantle convection. His strength lay in seeking points at which models could be tested — either by real-Earth data or by an experimental approach. Always forceful and often controversial in debate, he challenged interpretations from geophysical observations when they conflicted with geochemical data or models.



A. E. Ringwood

Although primarily directed at understanding the deep Earth, his very-high-pressure studies also took him into the design and demonstration of ultra-hard materials based on diamond aggregates and synthetic cubic boron nitride. He also turned his knowledge of mineral chemistry to an issue of global concern — the safe disposal of high-level nuclear waste. He devised and demonstrated the 'SYNROC' concept of containing radioactive elements in stable mineral assemblages. He saw clearly that excellence in basic research was necessary to solve practical problems, but also worked to ensure that potential applications of his basic research were followed through.

Ted Ringwood was a vigorous contributor to debates on the evolution of the Solar System. With the return of the lunar samples, he used the experimental approach to investigate the origin and significance of lunar basalts. As ever, his fertile mind led him to present speculative hypotheses, rapidly followed up with experimental tests. He could look back over a career studded with ideas, some now discarded, others forming the firm foundation of current knowledge. Ted Ringwood's death at a time of continuing productive research is a great loss — he was one of the most internationally honoured of Earth scientists and a great Australian. David Green

David Green will be Director of the Research School of Earth Sciences at the Australian National University, Canberra, Australian Capital Territory 0200, Australia from January 1994.