point one way, the melodic prose neither condemns this nor advises that; nevertheless, a theme emerges by the close of the last page — recreational use of forests, pointedly native forests, may very well become the principal use. Recreational appreciation of forests is the highest appreciation.

In their advocacy of dominant recreational use this volume corrects several misconceptions held by many people in the vanguard of the environmental movement: exotic trees and forests are sometimes lovely and even aesthetically equal to native trees and stands; hunting is a major form of valid recreation; preservation does not always maximise recreation; introduced animals, not just native fauna, can make a thrilling recreational experience for other than the hunter; people enjoying forests in all their varied ways, hosts of people, are the ultimate goal. Forest managers everywhere will welcome this aspect of The Forest World of New Zealand. They will respect and appreciate the dazzling display of our forests as a well-spring of emotional sustenance — one valuable facet of their resource. Maybe they will feel heightened sensitivity to the intangible values they work with and so frequently modify. But to the forest manager walking the thankless tightrope of optimum land use, before the eyes of varied pressure groups and rival land-holders hoping he will fall, the book provides no helpful answers nor solves any problems.

C. D. Gleason


In 1970 an epidemic disease swept swiftly over the corn crop of the United States, causing losses approaching one billion dollars.

Important among factors contributing to the epidemic were (i) the sudden appearance of a new strain of the corn leaf blight pathogen, and (ii) the susceptibility to it of most of the genetically uniform corn being grown in the United States. Additionally, the weather in 1970 was favourable to development and dispersal of the fungus. The key lesson of 1970 is that "genetic uniformity is the basis of vulnerability to epidemics". Investigation showed that most other major crops, likewise, are impressively uniform genetically, and thus also disturbingly vulnerable.

The implications for other crops of this most destructive epidemic were such that the United States National Research Council set up a special Committee on Genetic Vulnerability whose deliberations and conclusions are presented in the 307-page report under review.
“Part A examines the corn blight epidemic in detail: Technology is assessed; some historic epidemics and the phenomena of epidemics — the influence of the weather, the parasite and the host — are examined; insect outbreaks are considered; and the economic implications of epidemics are assessed.

“Part B deals with the major crops of the United States; that is, how important are they, how are they bred to improve yield and reduce costs, and to what extent may each be genetically vulnerable to epidemics?

“Part C explores the challenges to science and to the nation that are posed by genetic vulnerability”.

The challenges to scientists in Part C include constant lookout for exotic pests and for parasite mutants, and the provision of a backup capability comprising diverse genes to be thrown into the breach as needed. The nation must fund a watchdog system that will include quarantines, overseas monitoring, maintenance of gene pools, surplus storage and crop insurance.

When dealing in detail with the major crops of the United States, the report, surprisingly, fails to discuss any forest crop in detail. In passing, the chapter which discusses major historic epidemics does refer to chestnut blight, Dutch elm disease and white pine blister rust, saying that “epidemic diseases of forest trees present still more serious difficulties” (italics added). One of the committee members, Dr P. R. Day, when repeating the warnings on genetic vulnerability of crops in Annual Review of Phytopathology, 11, 1973, cited a contemporary forest epidemic of massive proportions — jarrah dieback disease, caused by Phytophthora cinnamomi — which has devastated over 150 000 hectares of forest in Western Australia and is still spreading on a wide front, there and in Victoria.

What of Pinus radiata in New Zealand or in other countries where one or a few exotic species dominate the forestry scene? Does one detect an air of complacency stemming from the relatively trouble-free history of P. radiata? One hopes not. This species has not even a near rival in growth rate and versatility. In New Zealand we will be dependent upon it for the foreseeable future. Lessons can be learnt from the corn blight epidemic. Moreover, the principles emphasised in the report from the National Academy of Science of the United States also apply to forest disease problems.

Dothistroma needle blight, behaving far more aggressively than in its native habitat, has almost eliminated radiata pine in East Africa and provided a rude jolt in New Zealand. However, we have been fortunate (with P. radiata but not with other species) in that not only do properly timed copper
sprays applied from the air give remarkably effective economic control over most of the affected area, but also that trees develop resistance after 15 to 20 years of age. What do we know, though, of the ability of the causal fungus to develop new, more aggressive races? Virtually nothing. Ivory, in East Africa, and Podger, working in New Zealand, have shown that *Pinus radiata* as a host varies greatly in susceptibility to *Dothistroma pini*. One day we may need to exploit that variability and call on the genetic resources of the species, in the event that the fine line between reasonable manageability (as at present) and lack of adequate control may be over-stepped by mutation within *D. pini*. The disturbingly fine threshold nature of this situation is highlighted by the fact that it would undoubtedly take only a small amount of genetic alteration in the pathogen to change it from relatively innocuous on *P. radiata* to seriously limiting.

In our single-minded emphasis on radiata pine and our thankfulness for its relative tolerance to needle blight, we tend to forget that *D. pini* has, in fact, already had an enormous influence on pine forest management in New Zealand. It has eliminated ponderosa and corsican pines from further consideration as timber species, in many parts of the country, and has restricted us effectively to just one, *P. radiata*. And what of the present impact of *D. pini* on that species, even without a mutation in the pathogen? It is not as slight as optimists might imagine. The necessity to spray at least twice up to 15 to 20 years of age is not without economic significance. Even with spraying, the impact of disease that does occur must depress total timber production.

In comparison with corn and other highly selected and inbred crops, the variability present in *P. radiata* is high. However, we must make sure that we can continue to have access to this variability. The Forest Service tree breeding programme is designed to keep the genetic base of *P. radiata* in New Zealand as broad as possible, consistent with obtaining improvement in form and growth rate. This, however, is not enough: it is of major importance to have much wider reserves of genetic material available outside the programme that can be searched for resistant genes when required.

Just as *Dothistroma* came in unexpectedly, so, too, undoubtedly, will other pathogens that are not yet established in this country. The cost in terms of lost yield, price of control measures and impact on management could be enormous, and quarantine restrictions aimed at preventing such introductions must always be rigorous and well-supervised. How easy would it be, for example, for western gall rust to come in on vegetative material, and then spread without the need
for an intermediate host? Parmeter and Newhook have shown, using New Zealand seed in California, that New Zealand radiata pine are not resistant. A warning for those who draw up and administer quarantine regulations: newly arriving pathogens with a serious potential may be relatively unimportant in their country of origin. Even after *Dothistroma* needle blight became epidemic here, it took five years of conscious searching even to find the pathogen on *P. radiata* in its native California! Thus, for quarantine purposes, recording of pathogens as “major” and “minor” has little relevance and could, in fact, be grossly misleading.

With genetic vulnerability always a factor to be reckoned with, despite the observable variability we already have in New Zealand, the small remnants of *Pinus radiata* forest in California suddenly assume an importance far outweighing their aesthetic value and their almost non-existent commercial value. As stated by Vavilov and accepted by plant breeders, the most productive source of resistance genes in any crop is typically its centre of evolutionary origin where the species has been exposed longest to the selective influences of the widest range of native pathogens. We must urge conservation of as many native Californian stands of *P. radiata* as possible to ensure that not only we, but the many other countries dependent on this species, may have access to the widest possible range of resistant genes.

Professor W. J. Libby of the University of California, Berkeley, has a programme under way to preserve the genetic variability present in the native habitats of *Pinus radiata*, which includes careful seed collection and storage procedures. He does, however, face difficulties, so it would be most appropriate for the N.Z. Institute of Foresters, on behalf of many nations, to press, through the Society of American Foresters, for the urgent preservation as a potential gene pool of major portions of all the remaining native stands of *Pinus radiata* in California.

It deserves stressing once more that although the report on genetic vulnerability was called for in respect of agricultural crops, the principles involved, the challenge to scientists and the warning to industry, are all very much applicable to forestry.

F. J. Newhook
C. Gardner Shaw