Following the presentation of his own paper, and those by Trotman, McKinnon and Black, Chavasse chaired the discussion. He opened this by calling for comments on Trotman's plea for more direction from Government.

Bunn stated that a basic decision was whether the forest should produce material suitable for sawn timber, or for reconstituted wood. In the former case appearance and strength were all-important, but these factors could be ignored if the wood was to be chipped or reduced chemically. Tustin supported this essential statement of requirements, but also emphasized the criterion of scale: that forests should be planned to supply a viable industrial unit. Prior mentioned the value of regional planning in achieving economical use of resources, and A. D. McKinnon cautioned that all plans and forecasts should make provision for a periodic review of objectives and methods.

The question “Should we site nurseries with regard to optimum growth of planting stock, or for maximum convenience in supplying forests?” was responded to by Black, who pointed out that, although production costs for 1½/0 and 2/0 stock were double those for 1/0 trees, it was important to consider subsequent growth and strike. Molloy felt that any transport problems resulting from selecting a climatically suitable site could be overcome. He cited Stockley's plan for an ideal nursery to include an airstrip.

Chavasse introduced the subject of grazing stock in planted areas, a topic which had been considered by J. D. McKinnon in his paper. Swale mentioned his company had run cattle in stands not less than five years old — i.e., in established regenerated or planted areas. He said later that grazing was rent-free for the first year and subsequently 20 cents/acre per annum. He noted the cost would increase if the practice became popular and competitive. At present there was considerable uncertainty and little experience with this type of management. Stock owners had reported forest grazing resulted in resistance to disease and hardening of their stock.

Church suggested grazing in widely spaced stands did not really fit in with the National Development Conference proposals for a 52,000 acre planting programme.

Hocking said the idea was not a new one and had been considered, in conjunction with the Department of Lands and Survey, at Te Wera. It was essential to have a large-scale farm operation adjacent to provide the necessary flexibility in stock management.

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Godfrey said that cattle were of great value in controlling toetoe, but that where grass competition was particularly heavy even heavy grazing could not eliminate the root competition provided by a dense sward. He suggested the problem could perhaps be overcome by the use of larger tree stocks and better screefing. J. D. McKinnon was of the opinion that the main benefits would come at the time of first tending and cited the very high pruning costs in gorse areas. Kirkland supported Godfrey's comment and said the problem of grass releasing is even more intense when considering second crop establishment. M. Williams stated that such proposals could perhaps be introduced in suitable localities, particularly as a method of securing winter run-off for stock. Integration with an appropriate type of stock management would be essential — e.g., beef cattle and cows in calf. Tutu could be a problem: it was safe enough during the winter but in the spring stock would have to be excluded. Otherwise a great deal of money could be lost — "Ten thousand dollars don't buy many cattle".

In reply to a question by Molloy on the practice of continuing wrenching after cessation of shoot growth, Black said winter soil temperatures tended to remain high enough for continued wrenching. He admitted subsequent hardening-off was limited. Rook stated that physiological evidence indicated optimum hardening-off is dependent on wrenching during the growing season, when maximum fibrous root development occurs. Benson pointed out that in Australia planting sites were more favourable, often as a result of better site preparation, and this may be the reason for lesser knowledge and use of wrenching. Bunn stated that wrenching was carried out to check height growth before planting out; in their warmer climates, the Australians and South Africans do this by stopping the water supply. He said wrenching diverts much of the photosynthate to root development. In experiments, in which properly wrenched stock had been planted during every month throughout the year, survival rates had exceeded 90% in every month. However, the March-April plantings took off at least a month earlier than plantings during the winter months, and consequently gained almost half a year of extra growth. Kirkland stated that, at Kaingaroa, survivals decreased from 90% for stock planted early in the planting season to 60% for stock planted late in the season.

J. M. Mitchell chaired the discussion following presentation of papers by Wilkinson, Cornwall, Armitage, Page, Bowers, Hall and Church.

Swale questioned the need for roading to logging standards at the time of crop establishment, many years before logging would be carried out. Wilkinson replied that, despite the fact that road maintenance was an expensive item, a good, but not intensive, network was required for land clearing, salvage logging and burning.

In reply to a question by Molloy concerning the wetting of tree tops to raise the humidity in plastic bags, Wilkinson said this treatment was little more than an afterthought in his trial.
Trotman asked Page if he had considered using fire to prepare logged areas for second crop establishment and also how he assessed the adequacy of regeneration. Page pointed out that there were administrative difficulties in using fire at Kaingaroa and went on to outline the regeneration assessment used. Kaingaroa require 1,000 evenly spaced trees/acre and so have based their sampling on a milacre; 40 sampling points each with 10 subplots were used. Within subplots the number of seedlings was estimated and a proportion of subplots were counted to provide a check. This system enables calculation of total stocking in stems per acre and effective stocking — i.e., the proportion of plots stocked. Aerial seeding resulted in stockings of 3,500 to 10,000 s.p.a. To obtain 1,000 s.p.a., an initial stocking of 5,000 s.p.a. was required.

Following up Page’s comment on difficulties in establishing a second crop through logging slash, Prior suggested a point must be reached when slash salvage for pulping would be economic. Page replied that pulpwood was removed from all areas as a part of the logging operation, the destination of logs being decided on the skids. Kirkland said all logs over 10 cu. ft must be removed at the time of logging. Assessments showed the total slash volume of material greater than 4 in. in diameter and 4 ft long was usually about 300 to 400 cu. ft/acre. Sutton pointed out that the cost of extracting this material would be at least three to four times the cost of normal logging, at about 10 cents per cu. ft. He said that, if tidying-up costs were added to the old crop stumpage, from an economic point of view, stumpages would be reduced. McKee said most of the logging slash was material broken during felling. Page again noted the safety factor when considering slash burning, after McKee had reintroduced the subject. Benson, speaking from Australian experience, stated that burning should be carried out under optimum conditions — e.g., 30 to 40% relative humidity and 80° F. Planning should work at least three to four years ahead, and areas of up to 1,000 acres should be burned-off at one time, so that the fire created its own updraught. He said all adjacent stands were previously pruned to 8 ft and that all material less than 2 in. diameter is consumed. Spiers, considering the use of fire, noted the size of the investment at Kaingaroa and said that the risk period continued for a long time after most of the burning was completed. He said the extent of the logging operation was a problem and concluded that mechanical methods, which had been ignored, may be just as cheap. Conway suggested that at Kaingaroa larger contiguous units, rather than the staggered settings now used, could help to solve the problem. McKee compared the unpredictable New Zealand weather with that in Australia but emphasized the eventual need to use fire as a tool. He suggested that poor regeneration, which necessitated using high-quality planting stock might, in the long term, be an advantage rather than a problem. Page replied that shortages of labour, seed and planting stock would force us to accept regeneration for many years yet. Aerial seeding would not be superseded for at least ten years.
Armitage said that the slash problem at Riverhead was not as severe because of the extremely high standards of utilization (down to 3 in. top), resulting from the closeness of a major market. He also said that breakage is not a problem because of the smaller trees involved.

To allay any impression that fire had not been used at Kaingaroa, Kirkland said cutover burning had been practised successfully for the last three years — the scale of the problem was the difficulty.

Bunn suggested to Armitage that the nutrient deficiency at Riverhead could be used to maintain good form and thus reduce the initial number of trees planted. Armitage had no data to support this hypothesis but he did note that initial growth without fertilizer was very slow. Mitchell suggested sowing of pasture and grazing at Milton might be used to replace green cropping. Wilkinson said this had been done at Milton where oats were used as a green crop. Stockley said maize could not be used because of frost. He pointed out that clover was a very difficult weed at Milton. Furthermore, the 80-year-old pastures-land incorporated in the new nursery extension in 1964 was now no better than the old nursery.

In reply to a question from Day, Cornwell said from mid- to late November was the optimum time for spraying gorse in releasing; later, new tree growth might be damaged. Wilson outlined the technique developed at Ashley to deal with gorse: Twenty months before planting all tractor areas (slopes up to 27 or 28°) were disced. At the same time, inaccessible areas and pockets were aerially sprayed. The sprayed areas were then burned-off so that the seedling regrowth could be sprayed again in the January/February before planting. The dead gorse was short enough to plant through. Removal of the gorse released browntop which suppressed further gorse growth, although some sucker growth continued. The main objective was to retain dominance by the pines following planting.

Swale noted that suppression rather than eradication of gorse was being aimed at. Difficulties would still be met at the time of tending and again in the second rotation. Wilson said reinvasion had not occurred in thinning so far.

Molloy took the chair, following the group of papers delivered by Herrick, Day and Valentine.

McKelvey asked what stumpages were paid for beech logs, both for peelers and for sawtimber. Valentine replied 6 to 7 cents per cubic foot, and 80 to 100 cents per 100 bd. ft, on outturn, respectively. Following up his reference to conversion of poor stands in the Rowallan Miscellaneous Working Circle by planting ash-type eucalypts, Manning asked whether the resultant two-storey stands would not pose problems in logging. Valentine said that it had been solved in Europe, where it had been operated for at least four centuries: heavy early thinnings were used to reduce stem density, and the eucalypts would be removed much earlier than the final crop of beech. Molloy remarked that the studies of selective logging
in Westland had shown that damage could be kept to a negligible level.

In response to Bower's question why residual areas of native bush were being left behind in Westland's exotic re-afforestation areas, since they provided such a troublesome harbourage for opossums, Day explained that they were usually impossible sites — either very steep hillsides or on high terraces, with compacted soils and non-existent drainage. Molloy explained that opossum populations had to be held in check until the native regrowth had come away and masked the planting stock: as Peter Herrick had pointed out, on burnt-over and newly-planted areas the planted stock would be the only green things apparent to animals. *Pinus contorta* were particularly susceptible. However G. A. Greig quoted a case from the "King Country", where 88% of a *P. contorta* plantation had been stripped of bark over at least two whorls. Yet they had recovered completely: "Two years later you couldn't see a sign of the damage."

Chavasse wished to know what area of land was available for exotic afforestation in the region. Day: "120 thousand acres, of which we are only planting one thousand acres a year." Molloy: "That is within 30 miles of Greymouth, but further afield there are 200 thousand acres or more." W. W. MacGregor asked why Sitka spruce was being used in Westland, and Day replied that it was reasonably tolerant of wet sites, it had a good rate of growth, and it was not palatable to opossums. Molloy commented further that on the hill soils Sitka spruce made about 12 in. to 15 in. of height growth during the first three years, and then took off — with an increment of 4 ft or more per annum.

Godfrey asked about the relative costs and effectiveness of conversion methods for current logging areas and old cut-over. Day: "Our own operations on cut-over would require 17 to 20 man-hours per acre, costing $40 to $45, including all overheads. With skyline logging we can get it down to $20 to $25 per acre." Bunn queried the relative difficulty of burning-off different forest types. Valentine replied that there was little trouble with beech forest, but podocarp forest would not be so easy; while Day emphasized the difficulties with old cut-over, compared with recently logged areas, owing to the heavy regrowth of ferns, etc. Regrowth following a successful fire was also denser and more rapid on old cut-over. Molloy considered that, to secure a good burn following logging, there was little advantage to be gained by leaving the slash to "cure" for a lengthy period. Once the foliage and smaller material were dry they should be burned, since the larger material dried out very little subsequently. T. Johnson asked for comments on a case at Te Hoi, where the contractors felling secondary and residual vegetation had "got ahead" of the logging operation itself, and a much cleaner burn-off had resulted subsequently. Day said that they had tried it too — and had never secured a better burn-off. A closer and more broken fuel resulted where logging followed the felling of residual vegetation. The problem was to get contractors to do
it: nor was it favoured by the logging crews. Godfrey: “Our contractors favour clearing before logging, to avoid having to cut by hand through fallen tops, etc.” Mitchell asked how soon clearfelled areas became invaded with bracken, that could be burned. His experience indicated a necessary interval of 12 years. Day: “Within 3 years we sometimes get sufficient bracken, but up to 6 years may be required, depending on the area concerned.”

Conway chaired the discussion following papers by Tustin and Priest. Tustin’s paper was discussed first.

Cornwell suggested that efficient poison thinning techniques were available and he considered poison thinning costs were lower than power-saw thinning costs. Tustin noted considerable variability in the success of poison thinning and felt this factor overrode initial cost. He was also of the opinion that chainsaw thinning was not necessarily more expensive. Kirkland said poison thinning was a precise and highly skilled operation. It had been carried out over at least 2,000 acres of Kaingaroa during the last couple of years with a precision of 3 to 4% of the trees that had to be killed or retained. Powersaw thinning was slightly more expensive at Kaingaroa. Johnson pointed out that the scale of the operation was important.

Chavasse noted that a recent paper in the Journal of Forestry proposed a thinning regime that would reduce the total yield by 7½%. Over a planted area of 2 million acres, this would be equivalent to the production from 150 thousand acres. Both Tustin and Sutton noted that demand was not yet sufficient to require maximum volume production per acre. The additional costs of extraction for small dimensions could not be warranted.

Trotman suggested it might be possible to quit small-wood thinning at nominal cost to avoid thinning-to-waste. Purey-Cust pointed out the universal problem of waiting for markets which never arrived. He suggested the primary criterion was to decide on the objects of growing the crop and then achieve these the best way. Bowers said that forestry was an investment: a maximum return was to be sought.

In the opening discussion on Priest’s paper, McKelvey noted that the Waikato Valley Authority aimed at regulating water yield, preserving water purity, preventing channel aggradation and conserving farmlands, amongst other objectives. He said these objectives would have different importance in different localities, and wanted to know what were the conservation objectives in various units of watershed management. Priest said that they were still at an early stage in defining these objectives.

Armitage asked whether the use of Waikato watershed water for Auckland city supply would have any effect on the land-use pattern. Priest replied that this water would be drawn from small and relatively isolated catchment heads — e.g., the Hunua Ranges.

McGregor noted the importance of identifying the constraints in conservation and land-use projects — i.e., the physi-
cal, climatic and socio-economic factors. However, the institutional ones were also important — e.g., legal aspect. He asked how far the administrative constraints were being taken into account. Priest said liaison between interested bodies was maintained.

Conway commented that, in Land Use Classifications, the vital stage was at the point where a judgement was made over the actual class of an area of land. The same area would have different classifications on different maps, according to whether the compilation was oriented towards agriculture, forestry, etc. Bunn concluded that this made an economic evaluation of alternative uses absolutely essential. Kirkland then delivered his summing-up address.