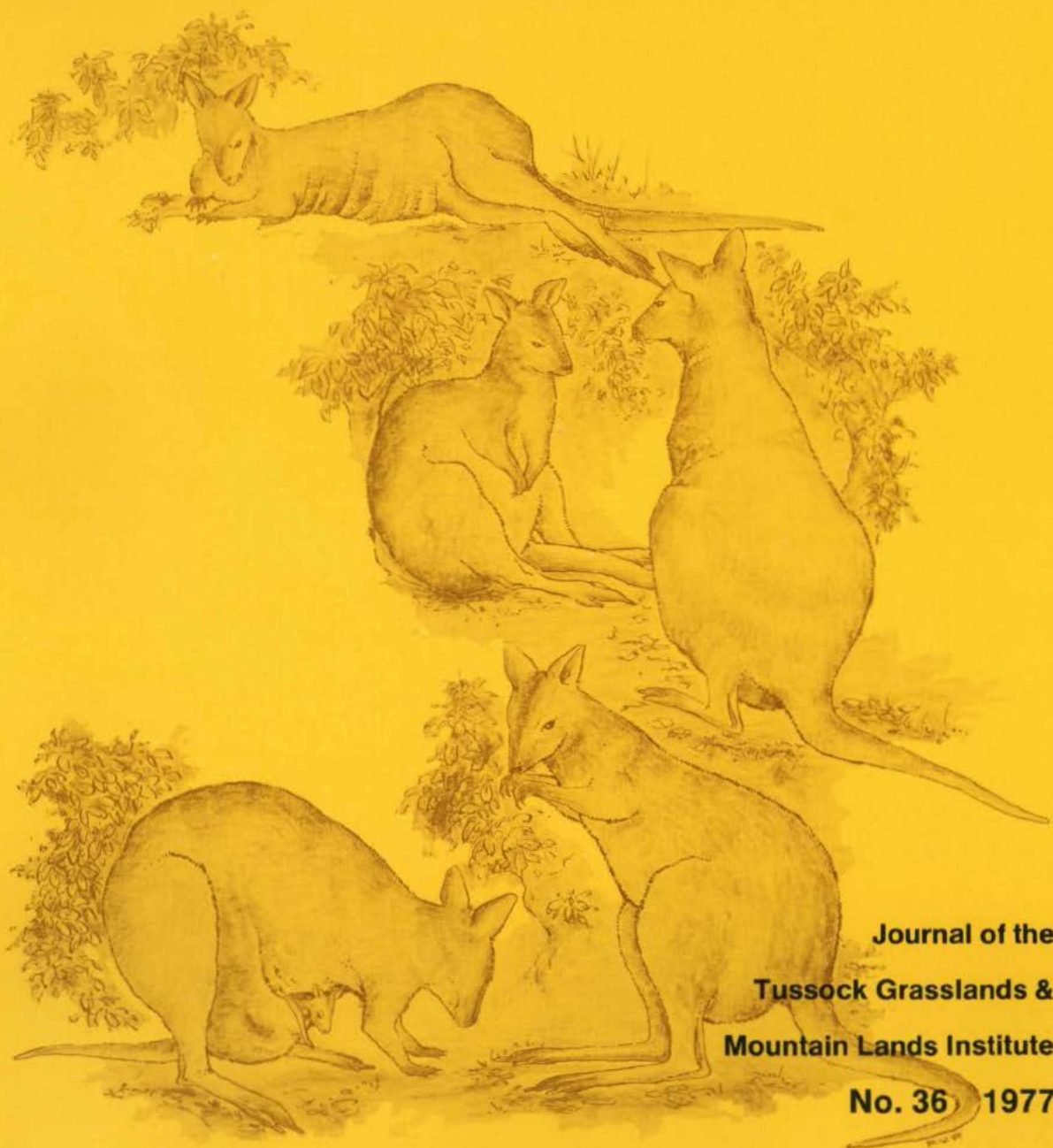


REVIEW



Journal of the
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No. 36 1977

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EDITOR'S NOTE: Since the article by A. S. D. Evans on 'Trespass' (Page 18) was written, the passage of the Wild Animal Control Act 1977 has made it unlawful to hunt or kill wild animals on farms without the express authority of the farmer. See Ruth Richardson on Page 19 of 'Straight Furrow', Volume 38, No. 4, 25 January 1978. — Editor

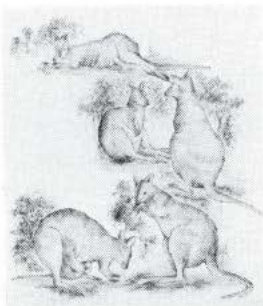
Review

JOURNAL OF THE TUSSOCK GRASSLANDS

AND MOUNTAIN LANDS INSTITUTE

NUMBER 36

SEPTEMBER 1977



cover:

MACROPUS
RUFOGRISEUS
FRUTICUS, better known
perhaps as the red-necked
wallaby. Problems involved
with the control of this
interesting, but noxious
animal are discussed by
Philippa Graham on page
5.

Editor
W. G. KREGER

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Illustrations &
Lay-out
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Winter survival of perennial grasses and clovers

G. G. Cossens

Perennial grasses occupy vast land areas, provide an important source of forage for livestock and wildlife, and are used extensively for conservation and recreation purposes. Although it is generally agreed that perennial grasses differ in their adaption requirements, information on the attributes of grass cultivars, with the possible exception of disease resistance, is scarce. Quantitative information, for example, on the cold tolerance or winter survival of perennial cool-season grasses is very limited (Levitt 1972, Smith 1964, 1968.)

In a country-wide survey of winterkilling, British investigators Baker and David (1963) found that ryegrasses (*Lolium* spp.) were severely injured whereas meadow fescue (*Festuca pratensis* Hud.) and tall fescue (*F. arundinacea* Schreb.), cocksfoot (*Dactylis glomerata* L.), and timothy (*Phleum pratense* L.) showed little or no injury. Although differences in winter injury among cultivars were small, those of continental origin tended to be more cold tolerant than those of maritime origin, and late-flowering cultivars tended to be more cold tolerant than early-flowering cultivars. Their survey also indicated that at rates of up to 224 kg N/ha, injury was greater when topgrowth was permitted to accumulate in autumn than when it was removed by rotational grazing in autumn. At rates in excess of 336 kg N/ha, injury was similar for ungrazed and rotationally grazed grass.

Response

Lucerne cultivars have been classified for relative cold hardiness (Jung and Larson,

1972) but not for drought hardiness. Levitt (1972) has related drought hardiness to cold hardiness and has concluded that species, as well as cultivars, hardened to drought or cold may respond similarly. Thus, differential response of lucerne cultivars to cold or drought should be similar. Plant height of lucerne cultivars during autumn growth periods is correlated with winter survival in that tall, erect-growing cultivars are less hardy than short, decumbent-growing cultivars (Smith, 1962). The apparent drought tolerance of Nui ryegrass may therefore include a winter hardiness that Ruanui does not possess. For this reason it may be a more suitable grass for the lower South Island.

Jung and Kochers (1974) found that a combination of several late winter freezes during the winter of 1971-72 in the absence of snow cover resulted in differential injury to cool-season grasses at Rock Springs, Pa. U.S.A. The purpose of their investigation was to relate the differential injury to genetic variations in cold tolerance, quantity of nitrogen fertiliser applied, and previous spring and summer clipping treatments. The information provided is applicable to most conditions where freezing temperatures cause winter injury. Because winter injury in their case occurred during a period of dehardening, it seems pertinent to mention that rate of dehardening is inversely related to the level of cold tolerance acquired (Levitt 1972, Smith 1968).

Trial details

In detail the work of Jung and Kochers was as follows: The grasses received 0, 60, 120, or 240 kg N/ha in spring and summer of 1971 and spring 1972. Half the plots at each

rate of N were clipped at vegetative growth stages in spring, and in early June, late July, and early October. The other half were clipped after head emergence in spring, and in late August and early October. Average winter injury ranged from less than 1 percent for reed canarygrass (*Phalaris arundinacea* L.) to 83 percent for two perennial ryegrass (*Lolium perenne* L.) cultivars. Kentucky bluegrass (*Poa pratensis* L.) and smooth brome grass (*Bromus inermis* Leyss.) were injured slightly (2 to 8 percent) more than reed canarygrass, and timothy (*Phleum pratense* L.) and redtop (*Agrostis alba* L.) sustained even more winter injury (12 to 18 percent). Average winter injury ranged from 14 to 57 percent for cocksfoot (*Dactylis glomerata* L.), 20 to 48 percent for tall fescue (*Festuca arundinacea* Schreb.) and 33 to 83 percent for perennial ryegrass.

Nitrogen fertilisation decreased winter survival of cocksfoot, tall fescue, and perennial ryegrass to a greater extent than it did other species. Kentucky bluegrass, smooth brome grass, and reed canarygrass were not severely injured by either clipping regime. One or more cultivars of cocksfoot, timothy, tall fescue, perennial ryegrass, and redtop sustained winter injury when clipped at immature growth stages but were not injured when clipped at mature growth stages. Differential injury associated with the clipping regimes increased as the rate of nitrogen applied increased.

Testing required

The large differences in winter injury among cultivars of orchardgrass, tall fescue, and perennial ryegrass suggest that tolerances to environmental stresses ought to be more thoroughly tested if we are to use new cultivars most effectively.

Although many grasses and legumes have been screened by the New Zealand Forest Service for high-altitude revegetation of eroded mountain soils and screes, their work has not included cutting regimes. Nordmeyer and Davis (1974) report that of the legumes, Huia white clover, Maku Lotus

(*L. pedunculatus*) and *Lotus corniculatus* were the most persistent species up to 1200m altitude. Ritchie (1974), comparing selections of grasses and legumes three years after establishment on screes at 1250m and 1430m altitude in the South Island, ranked chewings fescue, Yorkshire fog and brown-top as the best grasses. Cocksfoot was good at 1250m but poor at 1430m. Timothy was slightly inferior to cocksfoot; in fact all the species tested were poorer at 1430m than 1250 which might indicate 1250m as being the reasonable upper altitude limit of the grasses tried.

The legumes tried — white clover and *Lotus* — did not establish particularly well, only *Lotus* being satisfactory at 1250m. Further work by Nordmeyer, Lang and Roberts (1974) indicates that *Lotus* is more responsive to 20kg/ha nitrogen applied to assisted establishment than white clover. No winter damage effects due to nitrogen were noted. In mixed swards addition of nitrogen reduced clover yield by competition from sown grasses but, on the other hand, reduced frost lift. Dry matter production of clovers at 1000m altitude was usually in excess of 2000kg/ha per year although the cutting regime was not mentioned.

Stage of growth

Cossens (1973) reported large responses (greater than 50 percent) to applied nitrogen in a pure ryegrass (Ruanui) sward as compared with production from a ryegrass/white clover sward. During the severe winter of 1972 there was almost total kill of ryegrass on these trials at 730m and 1100m but not at 980m. The only difference in treatment of the plots was the stage of growth at the time the plants went into the winter.

The plots at 730m and 1100m were short (about 4cm) and with actively growing shoots having been mown on 2 and 8 of March 1972. The trial at 980m was cut on 3 May 1972 and regrowth had not started by the time the first heavy snows came on 11 May. These latter plots survived the winter,



all plots being particularly vigorous in the spring. There was no serious white clover damage on any trial. Later a sowing of a mixed sward of ryegrass, Huia clover and Apanui cocksfoot at 1100m indicated that during the 1974 winter there was a serious winter kill of ryegrass. Ryegrass was 3 percent of the sward in January 1975, cocksfoot 20 percent, the balance being red and white clover. A year before, the sward was 50 percent ryegrass, 20 percent cocksfoot and the balance clover.

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The war against the wallaby

Philippa Graham

The present Wallaby Board will find little comfort in the fact that the three Tasmanian sub-species of the red-necked wallaby liberated by Michael Studholme in 1874 were seasonal breeders, unlike the Australian mainland red-necked wallabies which are all-month breeders. Today this wallaby has spread from Waimate over an area of more than 800,000 hectares easily adapting and acclimatising to the entirely different conditions and vegetation compared to those of Tasmania.

To highlight the unscientific and haphazard liberations of wallaby species introduced to New Zealand it is worthwhile looking into the confusion arising over scientific names for the red-necked wallaby. It has been called "*Protemnodon rufogrisea*," "*Wallabia*" and "*Thylogale*." Tustin (1971) uses the term "*Macropus rufogrisea*" considering the animal indigenous to Australia only. Kean (1948) used "*Wallabia rufogrisea*" though he concedes that the animals

were probably of Tasmanian origin. Finally, in the most recent thorough research into the correct Catt (1975) settles for the longest name possible — "*Macropus rufogriseus fruticus*" or "Bennetts' Wallaby." In layman's terms the red-necked wallaby is also called the scrub, brush or black-tailed wallaby.

Mr Studholme obtained his wallabies from the Christchurch Acclimatisation Society who undoubtedly assisted in the spread of this pest. In 1904 the South Canterbury Acclimatisation Society's Annual Report stated that "two wallabies... have been successfully turned out at Mount Nimrod." In 1922 the same society was pleading for wallabies' protection against shooters. Yet in 1916 E. Studholme wrote to G. M. Thomson stating that the wallaby "are now found as far north as Bluecliffs... it is quite safe to say there are thousands of them... they are very hard on certain trees... if not kept in check they would no doubt become a great nuisance to farmers." Prophetic words indeed!

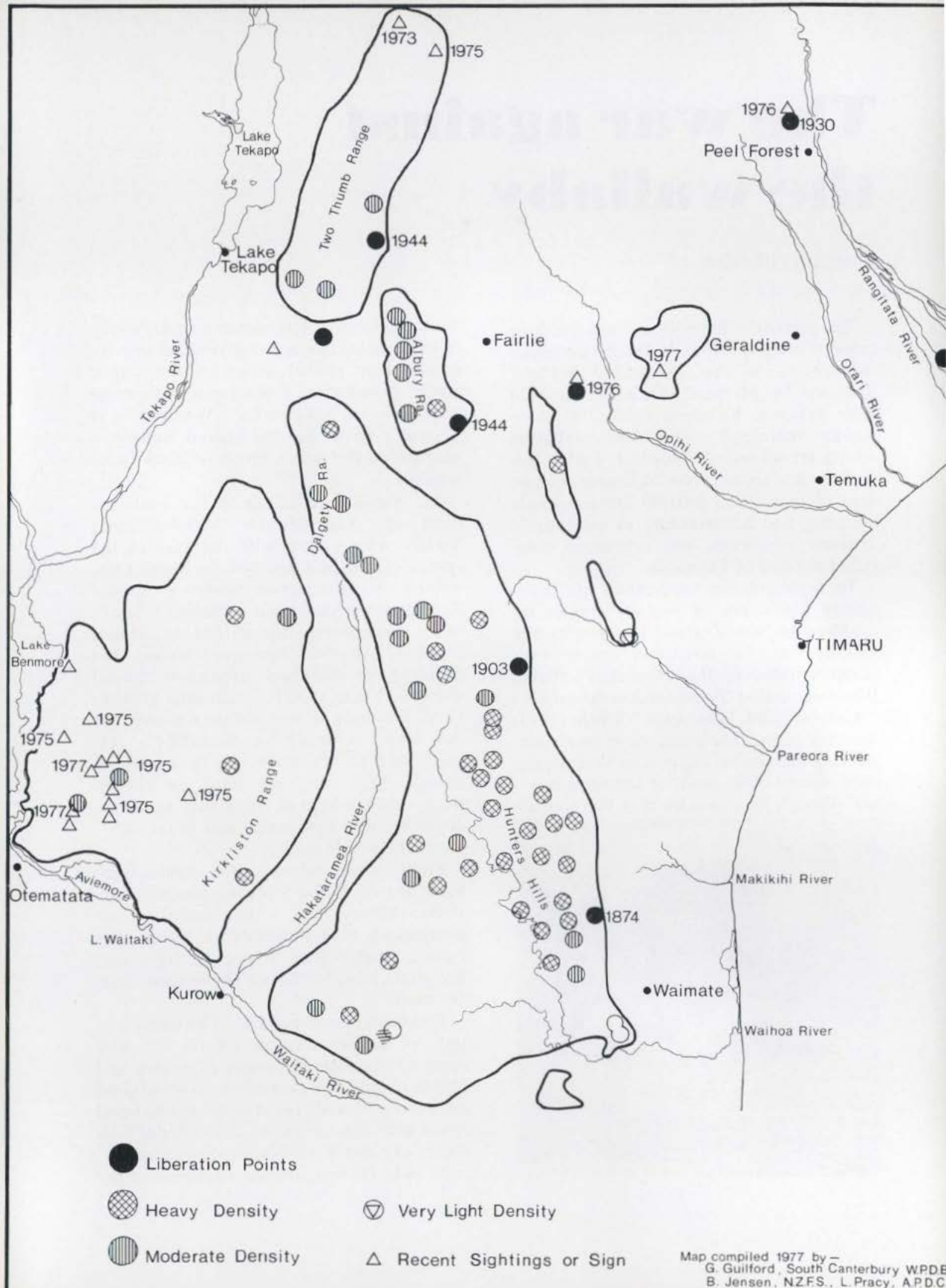
Briefly, other releases of wallabies were made at Fire-Wood Stream (approximately 1944); Albury Park — two wallabies approximately 1944; Pioneer Park; Mount Peel Forest; Burkes Pass — one hit by a car; Rangitata Island — haven't been seen since. See map.

Thomson points out that "The whole history of acclimatisation efforts in New Zealand abounds in (similar) bungles and blunders and while a certain measure of good has been achieved" (as in stocking lakes and rivers with fish for eating and fishing) "the record of harm done is enormously greater."

In 1946 Dr Woodhouse, chairman of the



Photo K. G. TUSTIN F.R.I.



South Canterbury Catchment Board, initiated the distribution of a questionnaire to affected farmers who claimed that the wallabies drove sheep from warm gullies, fouled sheep feed, competed with sheep for feed, damaged fences, destroyed snow tussock and prevented bush regeneration. The Wildlife Service of the Department of Internal Affairs came to the aid of the catchment board by employing mostly forestry shooters. They shot about 70,000 wallabies between the winters of 1947 and 1956, (see graph), at the cost of 10/- per animal. Meanwhile in the same period, private hunters shot about 30,000 wallabies. However, despite such large kills the wallaby rate of natural increase was higher. In 1956 wallabies were listed as "noxious" in the Noxious Animals Act but efficient and organised control methods were needed.

Again mounting concern over the situation moved runholders organised by Mr J. M. Sutherland, along with Mr Rowell of the South Canterbury Catchment Board to agitate for an amendment to the Rabbits Act 1959. This led to the formation of a Wallaby Destruction Committee of delegates drawn from the nine local (rabbit) pest destruction boards. A supervisor and two men were employed working under the authority of the eight pest boards and Mr H. J. Elgie, livestock officer, Waimate.

Damage by wallabies to Hunters Hills bush was such that farmers were required to fence areas hitherto used as boundaries. As the SCCB pointed out, fencing was needed for stock control so that systematic poisoning could be carried out with 1080 pellets. The results in 1960 were spectacular and stink-making as amazingly high kills were achieved and a 95 per cent kill was claimed. (Elgie 1961).

Ironically though, once the euphoria had dispersed, the W.D.C. by 1971 was facing the fact that despite persistent poisoning and shooting the wallaby had reached numbers giving a "sustained yield." (Tustin).

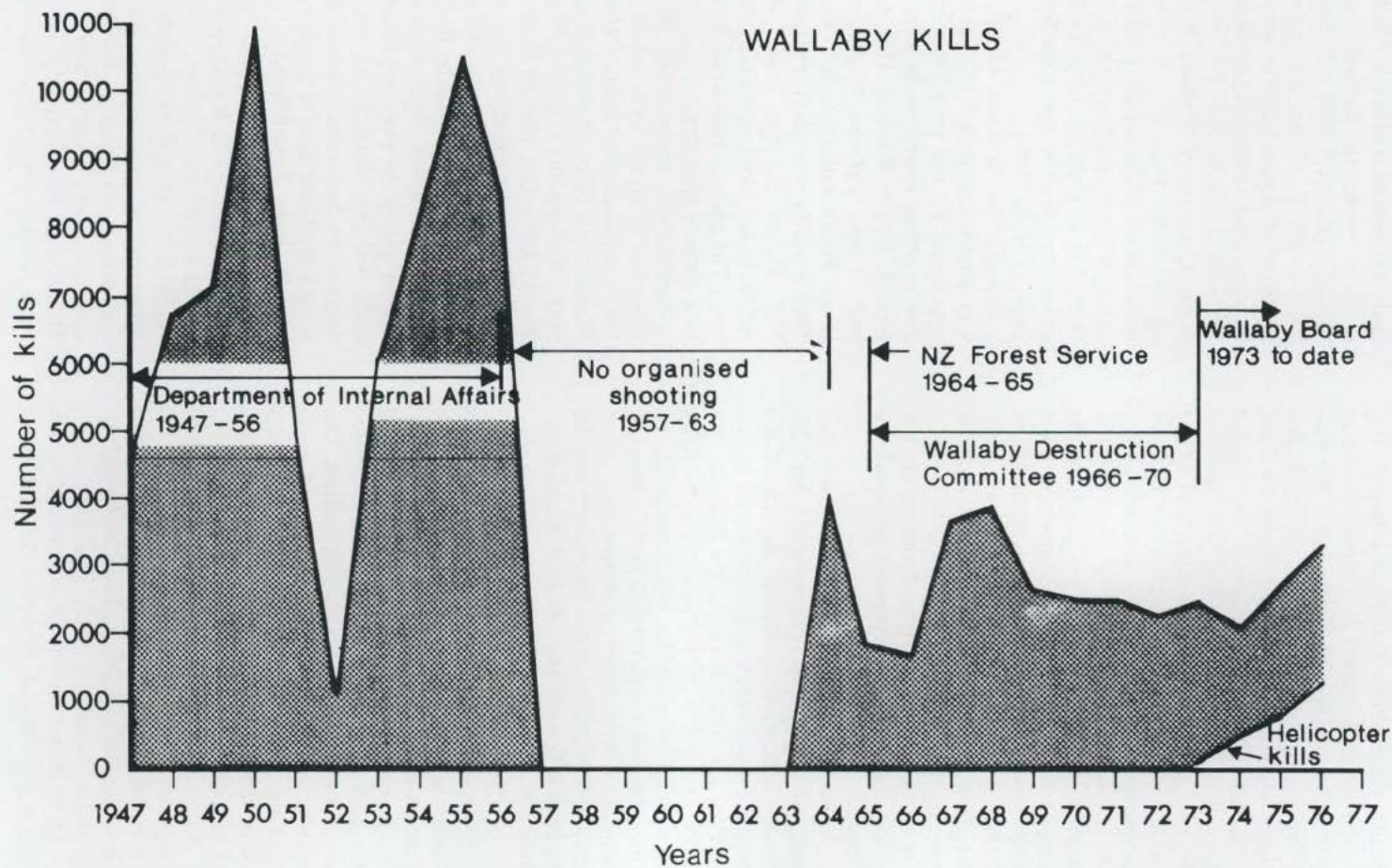
In response to this problem landowners and A.P.D. Board members decided that a

body independent of the A.P.D.B. be formed to deal with an animal that required specialised control measures. So a delegation led by Mr K. Patterson approached the Minister of Agriculture. Appropriate legislative amendments (1971) to the Agricultural Pests Destruction Act 1967 permitted the South Canterbury Wallaby Board to be set up and function in its own right with authority similar to that of the rabbit boards. For example, the supervisor was given power of entry for inspection. Also the board could order removal of cover. (See Sub-section 56 page 35 of the Act.)

Initially the Wallaby Destruction Board was partly composed of farmer members appointed by the Pest Destruction Board. The member board areas were Mackenzie, Buscot, Upper Waihao, Hakataramea, Albury, Upper Pareora, Waimate and Otaio. (Four Peaks withdrew from the W.D.C. in 1969 as wallaby control reverted back to the N.Z. Forest Service, under the Noxious Animals Act 1956, as wallaby numbers were low.) The above areas were defined as Wallaby Boards Districts.

Problems in maintaining member representation numbers have arisen as the gazetted board districts of Albury, Upper Pareora, Waimate and Otaio have amalgamated. (See map). Technically then, the Wallaby Board should have five elected district members only. It would therefore, be expedient to retain the old boundaries and so divide the South Canterbury Wallaby Board into eight wards, from which eight members could be drawn giving an even representation from each wallaby district. To accomplish this Section 99, Sub-section (a) of the 1967 Act would need insertion of the word "member" after Wallaby Board Ward.

Recently Upper Waihao amalgamated with the Kurow P.D.B. giving rise to another problem. From Kurow, incidentally a wallaby free area, farmers without first-hand experience of the animals could be elected to the board. At present the board legally consists of the Kurow, South Canterbury, Mackenzie, Hakataramea and Buscot districts. Conversely, to broaden the districts'



base from which interested and knowledgeable people could be drawn, Mr J. Irving, Ministry of Agriculture and Fisheries, Timaru, has suggested that Section 99, Sub-section (2) of the Agricultural Pest Destruction Act be altered to allow the appointment of ratepayers, not only the election of members from the Pest Destruction Boards within the Wallaby Board districts. This would be achieved by inserting after the word "members" the words "or ratepayer." Such proposals snagged on the Labour Party's reform proposals contained in the Local Government Act 1974. The National Government has modified legislation so that at least local P.C.B.'s retain their autonomy. At present the proposed amendments are being drafted at the Crown Law Office before undergoing the usual legislative process to become law.

Present composition of the Wallaby Destruction Board

Along with eight farmer representatives there are two Agricultural Pest Destruction Council members who are actual council members, appointed by the full council. They are Mr R. W. P. Cameron, Kurow member of the South Island Pest Destruction Board Association and Mr Fokerd, Wellington, who is appointed by the Director-General of Forests. Mr Fokerd has delegated his authority to his department in Christchurch, the present delegate being Mr R. Forsyth, senior field officer for the Canterbury Conservancy of the New Zealand Forest Service. Strictly speaking no legal provision exists for such A.P.D.C. delegating. Mr Forsyth would be best described as the liaison officer between the South Canterbury Wallaby Board and his department. Mr J. Irving, senior livestock instructor, is appointed to the board by the Minister of Agriculture. He has served on the Wallaby Board since its inception.

The role of the Forest Service

It is evident that from 1946 local Hunters Hills farmers comprised the group which took the initiative in countering the wallaby population increase. Any farmer worth his lick salt was reluctant to allow a Government department full control of a problem that concerned farming profitability. That department would have been the Forest Service. Some friction exists between the amateur Wallaby Board and the highly professional Forest Service men. For example, some Wallaby Board members lament that few experienced forestry shooters are available now that helicopters are used for venison recovery, so that experienced ground shooters have dwindled in numbers. Yet from Geraldine the Forest Service periodically sends trainees to the wallaby supervisor as unofficial help, so gaining from his skill and knowledge of wallaby control methods. Such "*noblesse oblige*" is understandable as the Forest Service certainly have men best called practical scientists, whose work has been and is indispensable to the A.P.D.B.'s and Wallaby Board.

As early as 1948 R. I. Kean, of the Forest Service, carried out field reports and gathered research material about wallabies. The year 1948 saw E. M. Kershaw reporting on wallaby eradication campaigns. (Department of Internal Affairs unpublished report.) In 1956 there was an upsurge in reports for the Forest Research Institute, Protection Forestry Division as the Noxious Animals Act passed responsibility for wallaby control to the Forest Service. K. Purdon, 1956, carried out a valuable wallaby population survey and with A. Cunningham reported on the effects of wallabies in the Hunters Hills, 1958. In 1960 and 1964 L. Boyd also reported on wallaby control campaigns.

The most comprehensive and systematic report by K. G. Tustin "Wallaby Control in the Hunters Hills," Report No. 106, 1971, could be best described as the "Wallaby Board's bible." This report provided badly needed facts, figures and recommendations

which the Wallaby Board, once formed, could follow. Besides discussing present wallaby control methods, Tustin recommended a simplified recording system for tallies and sightings in proportion to man hours involved, along with the marking of numbered run boundaries on a map; subdivided into 200 ha blocks if necessary. In this way a standard method of recording operations, especially shooting operations, and wallaby population trends was devised.

The most recent survey (1977) by Mr L. Pracy, an ex-Forest Service field officer, now working for the A.P.D.C., complements one made by him in 1975. In these reports Pracy provides practical guidelines and recommendations for the Wallaby Board and A.P.D.C. in the field of control problems. An up-to-date map of wallaby numbers has also been drawn up. Unless implementation of Pracy's recommendations are speeded up the A.P.D.B.s and S.C.W.B. could have difficulty in obtaining him for future necessary surveys. This aspect will be discussed further on.

At present the Forest Service is responsible for wallaby control in the Hook and Gunn's state forests and also bushed Lands and Survey Department reserves (Hunters Hills). Four Peaks, the Kakahu State Forest area and the Peel Forest area are also Forest Service areas where the use of 1080 pellets is the chief control measure. In the Peel Forest area few wallabies exist to build up in numbers and spread since liberations of 1930, not because of ultra-efficient control but rather because of the high rainfall. Catt cites the case of captive wallabies in Dorset, Britain, with a similar wet climate where he observed that the animal population remained static. Mr Jensen of the Forest Service, Geraldine, is inclined to agree. So while the Wallaby Board walks the tight-rope of trying to cope with the pest where numbers are high, the Forest Service acts as the safety net, sending experts to help cope and advise.

The role of the scientist

Many zoologists and biologists are fascinated by among other things, the wallaby's

unique reproductive feature — the "embryonic diapause." Most female wallabies conceive directly after a birth. The suckling joey in the wallaby's pouch leads to an arresting of the development of the embryo or "blastocyst" which does not implant, hence the term. Once the joey has become independent of the mother, the blastocyst resumes development and the breeding cycle so continues. The reproductive system is unique in structure. Such scientists as J. E. C. Flux, P. J. Moors, and K. A. Wodzicki are loath to see the A.P.D. boards under the 1956 Noxious Animals Act destroying the six species in this country. Admittedly the parma wallaby was rediscovered on Kawau Island although it is not as near extinct in Australia as was first thought. Do the botanists on the other hand have any idea as to whether the wallabies have caused the extinction of unique unrecorded flora on Kawau, Rangitoto and Motutapu islands? Has the selective feeding dama wallaby that is spreading around Rotorua insidiously modified plant associations which are probably incompletely recorded? The Hunters Hills area also needs a thorough plant and tree survey. As M. Davidson, page 146, writes, "order exists in a balanced ecological system with each species in its own appropriate niche but animals introduced into New Zealand are but fragments of the fauna of the life zones from which they came and as yet they are ecologically out of balance here." Compare this to Wodzicki's plea for a more "tolerant approach to the introduced animals which have become part of the New Zealand environment." Have they?

At present known biological control methods are not practical. A wallaby is best killed rather than allowing a time lapse needed before these measures became effective. Wallabies are not blowflies or grass grubs. They are relatively thinly scattered over about 800,000 ha of South Canterbury, much of it mountainous, with the eastern Hunters Hills providing the best cover and conditions. Commercial exploitation of skins or meat (too lean for pet food) is not economic, as the A.P.D. boards found when an attempt

was made to defray costs.

Tustin (1971) and Pracy (1977) both argue for a detailed study of wallaby feed preferences and requirements in differing vegetation zones to be carried out by scientists in future. Research to see to what extent the wallabies compete with sheep and cattle for food, in what numbers and where, would involve costly programmes in control areas. Furthermore, Catt points out that wallabies' paunch contents are difficult to identify as the food is so thoroughly chewed. As early as 1946 wallaby stomach contents were sent by the S.C.C.B. to the Botany Division of the DSIR, Wellington, for identification. However, the reply received stated that "the material was much disintegrated and for the most part unidentifiable."

Others including the Wallaby Board supervisor would like to see research carried out into wallaby social and mating behaviour and dispersal patterns, the latter especially in areas such as the Upper Pareora Gorge watershed. The use of radio transmitters and collars with coloured tags similar to those

used on chamois, would give a clear pattern for more efficient control measures. A scientist could be gainfully occupied in such work, tucked away in huts within such a research region. Scientists past and future slow up Wallaby Board work. However there is a pressing need for research in the fields suggested and also whether particular siren noises from a helicopter could flush the animals from cover or whether particular scented baits would be a useful lure.

The role of the shooter

"The wallaby furnishes great sport in shooting and is harder to hit than a rabbit, as when driven the animal does not hop, but goes on all fours and dodges from side to side running at a great rate." (Colonel Boscamen writing to Thomson, page 27.) Obviously the animals were liberated for sporting purposes.

Shooting alone has not controlled even the natural increase of the wallaby. As far back as September 1948 R. I. Kean in his field



Approximately 7000 Wallaby Scalps
Centrewood 1950.

investigation report, No. 11, page 2, stated that "dispersion must be considered to be primarily due to hunting pressure." Although Pracy disagreed with this conclusion in his 1975 A.P.D.C. wallaby report, he found in March 1977 that where only foot hunting had been carried out, wallaby numbers had increased.

The Wallaby Board employs a supervisor and about three shooters, more being employed during the winter months. Gun and dog shooting is effective in gullies with bush or scrub or open country with scrub cover. About two to six men with rifles equipped with telescopic sights of .222 or .243 calibre, use three to four dogs to flush out the wallabies. Great shooting skill is needed. Each area is covered twice yearly if possible and this technique is the best control method where cover is not too heavy and dense.

Occasionally, when free to do so, individual board shooters cover locally affected areas such as market gardens, where wallabies are causing problems. Spot lighting is another supplementary form of control used in areas bordering market gardens, winter feed or bush areas. Wallabies, however, have little "eye shine" so that they are difficult to pick up with a spot light.

Wallaby drives are highly inefficient in terms of wallabies killed. In 1961, 150 deerstalkers, along with Army personnel, joined with Kawau Island people in a chain to shoot the estimated population of 3,000 or so wallaby. They managed a kill of 175. At present the W.D.B. allows drives of up to 30 private and Deerstalkers' Association shooters. A June drive, held by the local Young Farmers, of 14 shooters shot about six wallabies but many more were sighted. Badly organised drives are dangerous, especially as present-day shooters prefer to do their own thing, rather than work as a team. Moreover, most shooters are urban dwellers. The Deerstalkers' Association, Timaru, complains that shooters are only allowed into areas six weeks after W.D.B. operations. This policy was openly recommended by Tustin (page 23, Report No. 106). From our own experience 25 shooters were

delighted with the 14 or so wallabies they shot during a drive.

So, few farmers are willing to allow wallabies to build up to such pest proportions. Farmers, suffering from the tremendous build-up of shooters' demands for sport, have welcomed the permit system also devised by Tustin. This scheme has been in force since May 1976, yet only recently did the S.C.W.B. send a circular to affected or interested people showing a sample permit and the addresses of those holding permit books. The Deerstalkers' Association would prefer to have their own permit system. With farmer co-operation the permit system is working with most permits being channelled through the board supervisor, so that suitable blocks not set aside for poisoning can be used for recreational shooting. Logically permits are not issued for the western boundary areas, to prevent wider wallaby dispersion. Nor does the supervisor give information about high density pockets set aside for poisoning, otherwise inconsiderate shooters move into such areas. Another point, health regulations require that shooters stay away from poisoned areas for a radius of 8 km. Permits are not issued from October to April, when pouched joeys are being dropped, to prevent shooters taking the animals, so causing further spread to other parts of the country. Regretfully for the shooter and hopefully for the farmer, the easy shooting of the old days is past; hunters must be fit and skilled shots.

For example, the W.B. chairman has allowed weekend shooters to stay at an empty house at Mount Nimrod, Hunters Hills, for a whole season's shooting. The results are interesting. In 1976, 40 wallabies were shot by the W.D.B. In 1977, to October, 105 were shot up in the high tussock area. Private shooters are not prepared to walk far for their shooting. They are of little value in keeping wallaby numbers down.

In an effort to save ammunition costs, the Army was tried with hopeless results. Eight unfit men per week for six weeks were sent from Burnham. Their obsolete rifles lacked telescopic sights and the boasting at the Cave

Hotel of the excellent meals gave rise to local apprehension to the safety of the native wood pigeons. To balance the record, a crack helicopter Army group shot 67 wallabies in two days. The private shooter has seen 2,441 wallabies and shot 774 in the period 31.8.75 to 8.6.77, that is 1141 man days. The private shooter has a far higher accident rate than the professional shooter too.

In 1973 helicopter shooting began and since has resulted in increasing tallies:

YEAR	HOURS	WALLABIES
1973 (Trial year)	140	77
1974	26	500
1975	20	800
1976	30	1248
1977 (To Oct.)	2.5	46

Snowfalls of at least 15cm provide excellent shooting conditions once the mist has cleared for maximum visibility. Helicopter shooting has proved to be a 95 per cent effective method of wallaby control. For maximum efficiency the S.C.W.B. needs to be able to finance such helicopter shooting for at least 100 hours flying time (cost about \$2.60 per animal based on one kill per minute). At present 40 hours flying is permitted although this would be extended if snow conditions were suitable.

Poisoning

Whether the environmentalists and conservationists like it or not, 1080 is at present the most suitable poison for wallaby control. As early as 1956 Pracy was directing poisoning trials in the Hunters Hills. Once the Rabbit Board Wallaby Destruction Committee was formed, grants enabled I. G. McIntosh of the Wallaceville Animal Re-

search Station, to invent a recipe for 1080 baits, chiefly for aerial broadcasting: 36 kg pollard, 5.4 kg molasses, 18 kg crushed linseed, flour, sugar, 340 ml raspberry oil, 284 ml aniseed and 680 ml 1080.

H. J. Elgie, Ministry of Agriculture, and Fisheries, Waimate, found that during the early 1960s huge numbers of wallabies were killed by aerial poisoning. Waimate land owners were certain that wallabies would become virtually extinct and stock carrying capacity increased dramatically. The numbers were permanently reduced (see graph) and farmers were able to graze cattle in higher numbers.

The early baits were too strong. W. H. D. Milne of Dalzell recalls without rancour that he lost about 280-300 wethers, when the West Coast strength baits failed to disintegrate in his 560mm average annual rainfall. He recalls that everything was killed including a small cherished herd of 30 red deer, the hares lay dying and became as thin as crows, although few rabbits were seen. Yet because of the high wallaby numbers displacing sheep this drastic move was necessary. The same situation arose at Nimrod Downs. Today the baits are less toxic, though paradoxically it is claimed that stronger baits leach more rapidly. The baits are coloured green as a bird repellent and an additive causes quicker disintegration so that farmers can move stock back onto poisoned blocks sooner.

Stock poisoning is an embarrassment and the W.D.C. found it expensive to provide alternative stock food during a drought in 1969 when baits remained toxic for many weeks. Farmers' reluctance to clear infested blocks of stock for aerial poisoning can frustrate the board, especially when a farmer withdraws permission at the last minute. The purchased bait materials are perishable. To counter this problem greater farmer co-operation is sought and a more binding farm survey sheet has been drawn up for signing by the farmer.

Understandably, farmers are often loath to see poison on their runs. Also greater stock numbers mean less flexible use of land.

Paradoxically, stock rates have been increased or even doubled where formerly high wallaby numbers existed. This has arisen too, from the advent of aerial topdressing of the 1950s as the actual cropping and sown grass area has not increased greatly. Topdressing has benefitted the wallaby as well. Last year to show the importance of farmer co-operation, the Wallaby Board carried out meetings of interested farmers in the Hakataramea Valley, Albury and Waimate. Farmers have been enthusiastic about the information given by K. Patterson and would like to see such gatherings organised about every five years.

Pracy recommends greater use of helicopters for precision patch poisoning to economise on the expensive poison baits. This year about 7300 ha will have been poisoned, including the Buscot area, hitherto not poisoned. Despite the use of other control measures this has led to a greater increase in wallabies so that this catchment area is overgrazed and in danger of eroding.

Natural bait poisoning is ideal for the bush pockets of the eastern Hunters Hills. The 1080 poison is spread on to mostly broadleaf, (*Griselinia littoralis*), in the form of a paste dissolved with an adhesive additive. Branches are broken and laid in suitable apparent wallaby feeding areas and about 10 leaves are poisoned underneath. This method can be tailored to the farmers' stock movements and is highly effective in high density areas.

Other problems facing the South Canterbury Wallaby Board

The prickly problem of scrub, particularly gorse, is that it is a potential breeding site for wallabies. Much gorse covers marginal or inaccessible land so that farmers have little incentive to control it. Efficient control is difficult and expensive to maintain in such areas.

At present the Wallaby Board has a high turnover of single shooters who are paid award wages, although the work requires fitness and a higher level of skills than are

required by, say, rabbit board employees. Recently new single men's quarters were brought in to replace the caravans which made the area look like a run-down camping site.

A utility vehicle and a motorcycle have been bought but other problems arise from lack of finance. A \$43,500 grant has been allocated from the Agricultural Pest Destruction Committee for the 1977-78 financial period. Of this 16 percent is used for material (poison, bait, ammunition); 45 percent is used for salaries, wages and allowances; 14 percent is used for telephone; 4 percent is used for motor and travelling; 5 percent is used for cartage, repairs, rates, general expenses; and 16 percent is used for capital.

A grant of \$47,450 will be recommended to the grants committee of the A.P.D.C. along with a contribution to the board of \$8,740 from member boards. This will mean a total income of \$56,190.

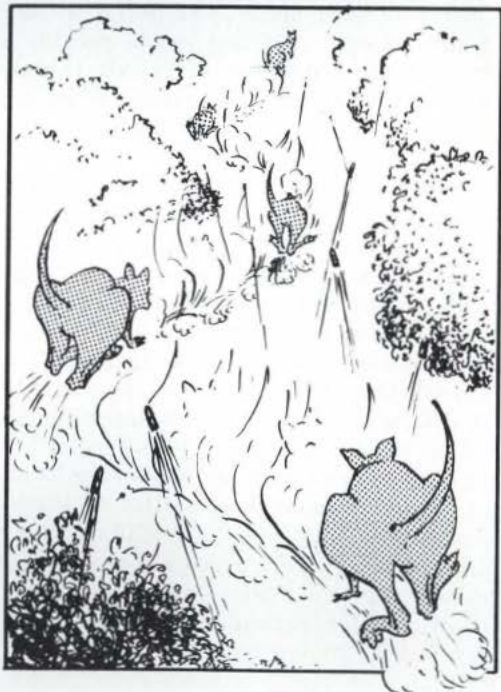
The board intends to increase the number of permanent shooters to six, along with a head man, a foreman and the supervisor, to allow the supervisor time for training of hunters, planning and carrying out ground and aerial surveys, also helicopter and ground hunting. The supervisor has been given scope for conducting comprehensive field inspections along with aerial surveys so that definite estimates can be deduced from such planning. He also helps in formulating control policies.

Finally, wallabies are not spreading at present. The chief problem is the upsurge in wallaby densities where only foot hunting has been carried out. Only where shooters with dogs chase animals across dam sites and bridges could dispersion occur. This is also true in the area west across the Mackenzie Plain from the Burkes Pass highway. The chief worry is that people will smuggle joeys and liberate them or keep them, as they are very adaptable to captivity. A Mr Basset-Smith and two men from Waimate have permits in the South Island to export the animals. The former, however, has reportedly had a shipment sent back to France. Any other wallabies in captivity must be

neutered. Tuberculosis is unlikely to cause problems with the present health regulations in force regarding cattle. Wallabies in high numbers pose a real threat to livestock numbers and catchment areas. The chairman of the Wallaby Board worries that younger farmers will forget how much of a pest the wallaby has been. Hence he gives talks to the Y.F.C. in affected areas.

Conclusion

The Wallaby Destruction Board has evolved as a human response to control a local pest that, in high numbers with farming, is unlikely to be exterminated. As farming and horticulture intensify, forestry demands grow and people become aware of the fragile state of the native bush remnants and the value of water and the catchment areas so wallaby control becomes vitally important. As Davidson summarises "land use will determine long term control of the wallaby."



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What's new in regional planning? (1)

K. A. Ackley

What was new about regional planning in the Local Government Act 1974? This legislation gave us an opportunity to activate an idea that has been around for a long time but has been unable to find adequate expression.

My thesis is that regional planning, far from being a threat to local autonomy, is the only sensible way to achieve economic and social and environmental viability for communities both large and small. Admittedly that is a rather grandiose claim but it can be justified in both positive and negative terms, some of which are set forth here.

1. It is first of all a means to accord recognition to the interdependence of town and country. Too many of us have lost sight of the critical dependence of an urbanised society on the natural resources which support it. All our needs — food, water, materials for shelter and all our technology, and much of our recreation — come from non-urban areas, and we would do well always to examine our actions in this context.

2. These urban-rural linkages are becoming increasingly complex and in some cases threatened. There must be a means to integrate these linkages. This can only be accomplished by a strong regional planning body with a clearly defined mission to systematically analyse them so that we have some understanding of their structure and how they function.

3. We must comprehend that we cannot continue to ignore the importance of an orderly regional infrastructure as the basic framework for solving many local problems and to bring some order to what is in fact a system of *interdependent* local authorities. The only alternatives are increased centralisation — which everyone is intuitively

against — or the chaos of total decentralisation with each locality left to fend for itself. The latter would almost certainly lead to megalopolises in Auckland, Wellington and Christchurch and failure everywhere else.

4. We must recognise that however unevenly the population is distributed, all citizens must be served. It must be acknowledged that a swollen central bureaucracy is hardly an efficient device for responding sensitively to the various and diverse needs of the entire country, nor is it sufficiently democratic. Nor is appeal to our parliamentarians adequate; their aggregate demands always exceed central government capability, and such an approach further erodes any possibility of stimulating local interest in self-help. With respect to the last point, regional planning would provide a means for co-ordinating local needs at a scale which would make them feasible, while still permitting the direct participation of people, not just remote agencies.

5. In further pursuit of a viable system of decentralisation, we must clearly identify the differences between matters of local concern and regional concern. This can be done without any infringement on the powers, duties and responsibilities of local government, but we must be clear on this point. The key word here is not separation of powers but co-operation; we must define those activities which can no longer be left to unco-ordinated treatment and place them in the hands of an organisation designed for such purposes as resolving inter-local conflicts, filling gaps in areas where needs are unmet, and monitoring the activities — and their effects — of all agencies operating in a region.

6. It is becoming urgent that the concept, no man is an island, be given some rational,

quantitative and qualitative interpretation with regard to how our actions affect our neighbours. Regional planning is the best scale for attempts to maintain a high degree of equilibrium in the environment. It offers the best hope for overcoming the conflicts and lack of co-operation between the "upstream" crowd and the "downstream" crowd. Environmental objectives are too often ignored or reluctantly acknowledged as constraints. But whether we interpret environmental objectives in terms of survival (i.e., ecological imperatives) or in terms of a change in societal preferences (e.g., in favour of a better definition of quality of life), they must be accorded recognition as worthwhile in and of themselves.

7. Regional planning could also provide a more rational basis for guiding economic development and stimulating it where it is presently deficient. A planning process dedicated to overseeing a regional infrastructure and evaluating it according to rapidly developing principles of regional science would constitute a service to industrial or any other kind of development far more attractive and productive than the current situation of extreme imbalance in resources and effectiveness between large and small communities.

8. Finally, central government may be said to be primarily interested in the equitable distribution of its resources; local government is primarily interested in functional activities aimed at maintaining and servicing its infrastructure. Thus perceived, there is a tremendous gap between these roles; if nothing else, regional planning could be the integrative co-ordinator between them.

These arguments are of course predicated on the belief that our current, fragmented decision structure generates problems which are not amenable to solution without too great a sacrifice in terms of social, economic and environmental costs. They are also predicated on the belief that, while reorganisation as a panacea often proves illusory, the emphasis here is not on regional planning as a reorganisation device *per se*, but rather regional planning as a system using old

methodologies — research, planning, decision-making, participation — in a new and more logical context.

In fact, accepting that there is no great ground swell of public opinion in favour of the system of regional government currently proposed — and little money or skill to implement it in any event — a worthwhile investment is nevertheless suggested. Government might set up two or three pilot programmes as an experiment. In each of several very diverse regions a few hundred thousand dollars to fund a small, carefully-chosen staff for a period of three to five years could be money well spent.

This mission of the staff of planners, economists, geographers, sociologists, and public administrators or political scientists would be to study the region as if they were dedicated to spending the rest of their lives there; to learn the territory, discover how the region functions, ascertain the needs and aspirations of the inhabitants and gradually translate all they can learn into a set of proposed policies for the future. Meanwhile, a director should be appointed to keep the staff functioning as a well-integrated unit and to conduct the necessary public education programme so that the people would be well informed.

If the staff does a competent job, as I predict it would, it could then become the nucleus for a full-fledged regional government with a clear duty to examine and refine the policies, and to develop concrete goals and objectives for the region. Government would surely get a good deal. The staff would be inspired by an unusual opportunity to operate in an entrepreneurial role, knowing that their efforts would pay off in the long term.

There are hopeful signs that much of what I have said is consciously recognised by the National Water and Soil Conservation Organisation and the Ministry of Works and Development Town and Country Planning Division. I would go further and create a fairly autonomous planning group whose allegiance is clearly and primarily identified with the people in the region it serves.

Trespass . . .

Penalties or education and prevention?

A. S. D. Evans

The policy of the Federated Mountain Clubs of New Zealand has a prime objective which states: "The conservation of all sound management of every kind of recreation and sport connected with mountains in the interests of those actively involved in such recreation and sport and the public generally, and to take such action joint or otherwise as may be necessary to carry out these objects and to maintain in perpetuity the quality of the environment necessarily implied by the objects."

This objective is carried out by member clubs in their enthusiastic involvement in the N.Z. Mountain Safety Council nationally and in district levels in educating its members and the public to act in a responsible manner when recreating in the outdoors.

Runholder co-operation, respect for other peoples' property and a code of country behaviour are integral parts of outdoor education sponsored and carried out by the federation and its member clubs.

Changes

For 20 years the New Zealand Deerstalkers Association has been pressing for two fundamental changes in attitudes to wildlife administration and firearm ownership.

(a) The setting up of a Conservation Authority to integrate and research the whole relationship of land, water, plant and wildlife interplay, which would also determine the wildlife values of the total resource.

(b) A licensing system which would license the firearm owner as distinct from the firearm itself.

An extract from the Association's *Wildlife* journal printed in 1967 discusses the implications of the system:

"Before we describe the system in detail, let us try to define what it should generate.

"It must produce a sportsman well enough acquainted with the provisions of the law of trespass, fish, game and conservation legislation, the ownership, maintenance and safe usage of firearms, and the rules and code of ethics of his particular sport. His required level of knowledge and proficiency should be at least sufficient to render a plea of ignorance of these basic requirements as being no defence.



"It must by virtue of this acquired knowledge and accepted responsibility confer status upon the individual sportsman and allow him to claim the right to hunt and fish all open public land and to negotiate the right to do likewise for private and/or restricted public land. This would naturally imply the right to own and use firearms for which he has qualified and to purchase fish and/or game licences.

"The system must also leave him in no doubt that failure to play to the rules will mean the loss of the conferred status, a denial of his right to take part in his sport and the loss of the use of his firearm while under suspension."

Both these national organisations have been and are continually instilling in their members the conservation of our environment and respect for other peoples' property and rights and as a result there is generally a good rapport between sportsmen, land-owners and administrators.

In all walks of life a few spoil it all for the others by irresponsible behaviour.

Trespassers

Today we have the trespasser and these can be placed in four categories.

1. The trampler, climber or hunter who inadvertently strays because the boundaries of land tenure are often not definable on the ground.

2. The trampler, climber or hunter who crosses land without authority for reasons of personal safety, under distress, to avoid delay because of weather or to seek help.

3. The trampler, climber or hunter who cannot be bothered reading maps, seeking information and approval and who generally goes it alone.

4. The shooter who deliberately trespasses and discharges firearms for personal gain, with or without dogs.

Organised clubs regularly conduct courses, open to the public, as part of the Mountain Safety and Safety with Firearms campaigns to educate the person who goes into the hills to be a responsible and welcome visitor.

This voluntary education has reduced to a minimum inadvertent trespass by club members, and the diminishing numbers of people who can be described as being in category 3.

The person in the fourth category, the shooter who deliberately trespasses and discharges firearms for financial gain is the one who has to be stopped whether he operates on foot or from the air.

There are calls throughout the country today for increased penalties to stop this type of trespass.

However increasing penalties won't stop trespass for financial gain, it will only scare off the timid operator.

The argument in favour of increasing penalties can best be summed up in the article on Access and Trespass in *Review* 35 in the conclusions on page 48: "All the law in the world won't help you physically catch a trespasser and there lies the heart of the problem."

If we read the Acts already on the Statute books we find two significant sections.



The Dogs Registration Act 1955 Section 26 states: "The owner or the agent of the owner of any stock or poultry, or any servant or person employed by any such owner or agent, may forthwith destroy any dog running at large among that stock or poultry."



The Arms Act 1958 Section 16 (1) states: "No person shall carry or be in possession of any firearm, ammunition, explosive or dangerous weapon except for some lawful, proper and sufficient purpose, and the burden of proving the existence of any such purpose shall lie upon the defendant."

Now a dog does not need to have worried stock or caused damage before the animal can be shot on the spot.

Prosecution

A person carrying a firearm on any property without the permission of the landowner or occupier can be prosecuted forthwith and risks a penalty of \$200 or three months jail or both.

There is no need to find the owner of the

dog and lay a complaint.

There is no need to give a warning to a trespasser carrying a firearm to leave the property.

They can both be dealt with successfully as soon as they trespass.

Now the problem, of course, is to catch the person.

Increased penalties will not stop the person working illegally for financial gain.

They may deter the small operator but when animals can be sold for \$2 a kilogram dead and \$400 live a one to two thousand dollar fine can be recouped in a few hours' operation.

The authorities and farming community have the whole-hearted backing of the Federated Mountain Clubs of N.Z. and the N.Z. Deerstalkers Association to stamp out trespass, but we are concerned at the mistaken belief that increasing penalties is the answer.

Further, they can seriously penalise a person who, caught by bad weather or for safety reasons, takes a short-cut or changes his planned route.

We would submit that if Government would license all meat shooters operating on foot or airborne the problem of trespass for financial gain would rapidly diminish.

The licence would require a meat seller and buyer to declare where each animal delivered to a depot was shot and with whose permission.

The declaration would be open to inspection by Police, Forest Service and if necessary to public scrutiny.

The N.Z. Forest Service and land occupier would determine how many animals could or should be taken from an area and a licence issued to allow an operator to remove a specified number of animals from a specified block of land.

Anyone found operating without permission or who falsified the licence conditions would lose his licence, his firearm and he could lose his means of transport.

It works with the car driver who transgresses and it could work with the irresponsible shooter who trespasses.

Incentive

This would take away the incentive to poach and steal wild animals as there would be no outlet for the shooter without a licence and cancellation of the licence of the meat buyer who falsifies a declaration.

It would not be possible for a land occupier to enter into an agreement with a licensed meat operator to declare that all the animals he shot legally or illegally came off his land because we now know approximately the yield of animals which can be taken from a given block of land annually.

Perhaps we should give more regard to the policies of the two national tramping and hunting organisations and the work they are doing to train and educate members, which results in co-operation with Government departments and land occupiers, and consider whether those who wish to use occupied land for their recreation should "join a club" to qualify.

Finally, if the farming community would assist in the campaign to license all game meat operators we may soon see an end to the

blatant trespasser who has caused so much of a problem to both the land occupier and the responsible recreationist.



Changes in membership of Committee of Management

Mr W. V. (Bill) Hadfield retired from the Ministry of Agriculture and Fisheries, and as a member of the Committee of Management of the Institute early last year. He had served on the committee since 1964.

His successor on the Committee as the nominee of the Director-General of Agriculture is Mr Nelson Cullen who is very well known throughout the South Island for his past work at, and out of Invermay Research Station. He is currently director of the Soil and Field Research Organisation of the M.A.F., at the Ruakura Agricultural Re-

search Centre in Hamilton. Mr Cullen graduated from Lincoln College in 1950 and his work at Invermay was largely concerned with pastures, including problems of establishment, management and seed production. A major project was concerned with land development investigation, particularly the establishment of legumes, near Te Anau. He was president of the N.Z. Grassland Association in 1971. He succeeded Mr George Holmes as director of the Invermay Research Centre in 1964, and was appointed to his present position at Ruakura in 1975.

Helicopters in fire control

J. R. von Tunzelman

In the autumn of 1971, a large tract of valuable protection forest and alpine grassland was severely damaged by fire in the lower Greenstone Valley near the northern end of Lake Wakatipu.

During the two weeks spent trying to contain the spread and extinguish the fire helicopters were used in several different roles.

Owing to the very steep and heavily forested nature of the terrain, men and equipment were positioned using the helicopters and monsoon buckets were used for one of the first times in an actual fire situation. Pumps, hose and hand tools were also dropped to the fire fighters using long drops which enabled the equipment to be placed anywhere it was needed by lowering it down through the high canopy of standing timber on the steep slopes. As there was no road access anywhere near the site, all equipment, stores, etc., had to be flown into the fire base in the valley.

Since then there has been a steady development of techniques and equipment used in conjunction with helicopters on fires and emergencies in the high country and forested areas.

Improvements

Many defects were found in the early model monsoon buckets, these were rectified, and a very efficient and reliable fire fighting tool is now available in the latest models. The early bucket operations required a passenger to manually trip the water valve on the bucket over the drop site. This reduced the useful water load carried in the bucket. One of the first developments

was to install an electrical valve control mechanism so that the pilot could trip the valve at will. This increased the volume of water available and increased the safety factor as without a passenger all the load associated with the monsoon bucket could be jettisoned at the touch of a button should the need arise.

Other improvements were to brace the bucket internally against collapse of the shell through the effect of the pull on the suspension mounting points and to clean up all the projections in the valve gear. Also, the suspension cables were enclosed in plastic hose to eliminate snagging on the valve gear during filling operations.

Detail improvements were also made in the valve seals on the water exit portal to avoid the seals becoming detached in use and an adjustable skirt was fitted to the bottom of the bucket to control the drop pattern of the water. With the skirt up, the water mushrooms from the bucket and spreads over a large area. With the skirt down, it is confined to a dense column. Recently fire retardant additives have become available. By adding these compounds to the water dropped by bucket an even more effective degree of use can be made of the water.

To use retardants it is necessary to fill the buckets using pumping equipment rather than trolling the bucket in a deep water source. By using a large capacity pump or two small ones a team of experienced men can compete favourably with an experienced pilot troll filling.

By eliminating the need to troll fill the bucket, the occasional dropping of the bucket in the water is also avoided as is the



Dumping water over a simulated fire
(maximum spread of water)

danger of the aircraft making a tail rotor strike in the water while trolling.

Standardised

By fitting standard electrical connections to the machines used by various companies, it is now possible to use most helicopters at very short notice and without time-consuming modifications.

The ability of a helicopter to deliver up to 545 litres of water in one concentrated dollop to any point on the fire front has great advantages over the dispersed spray of water as delivered by a fixed wing aircraft. The volume of water carried using monsoon

buckets can be quickly altered to suit the carrying capacity of individual helicopters. This is carried out by inserting level plugs in the body of the bucket as required. With all plugs in, the load is 545 litres, and by removing successive level plugs, can be reduced to 464 litres, 382 litres, 309 litres and, with all plugs out, to 245 litres.

Turn-around of machines flown by experienced pilots can be very quick, especially if they are aided by an experienced pump crew and large capacity pumping equipment.

A helicopter and monsoon bucket cannot be regarded as the complete answer to many fire situations. But, when used in conjunc-

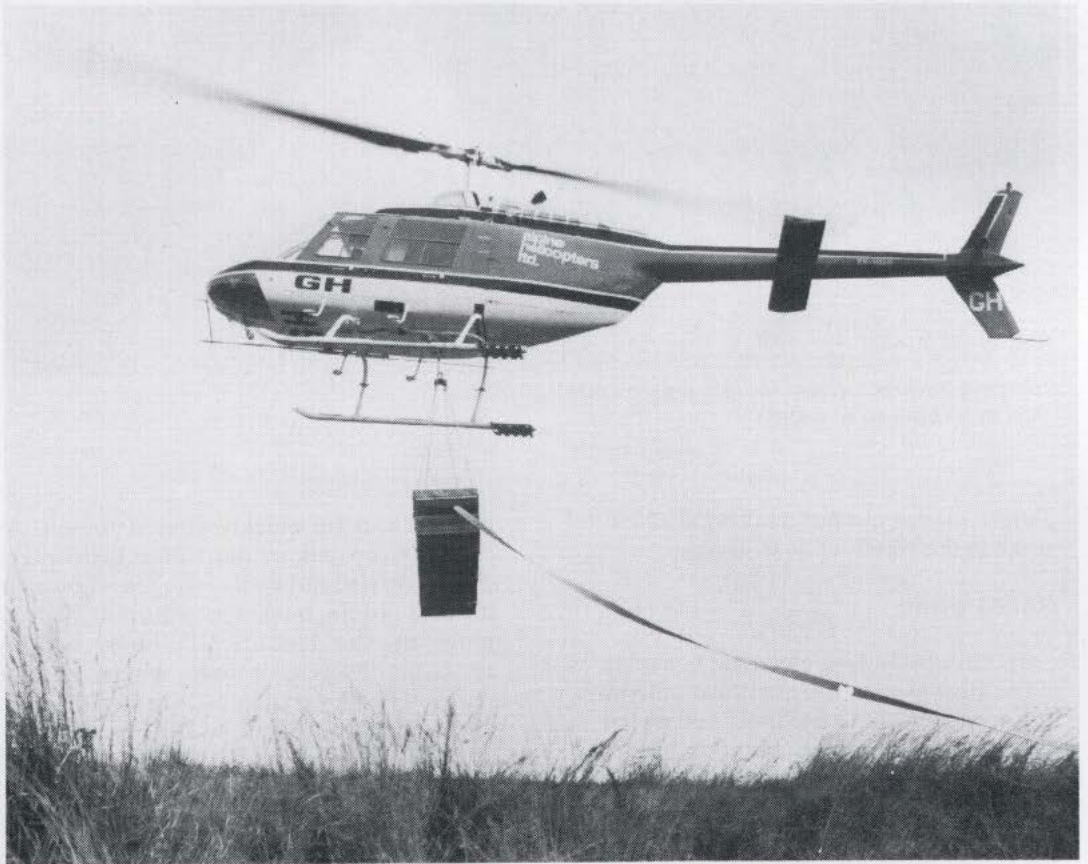
tion with men and hand tools, the follow-up work on the fire front can be done very effectively once the helicopter unit has reduced the fire and heat to a minimum. Having a helicopter available in a high-country fire situation can be a tremendous help to the crews if used efficiently to position men and gear to key fire-fighting points.

Along with hand tools, pumps, bulldozers, etc., the helicopter is now regarded by many as just another aid to fire suppression and although the initial costs can be high, very worthwhile savings can result in the long run. By selecting the right tools at the right time, many fires can be controlled with the minimum amount of damage and

spread.

Training of personnel for high-country fire control increases their ability to react quickly and safely to the needs as they arise. It is vital that crews using helicopters are aware of both their capabilities and limitations as well as the safe methods of approaching and departing from the machines in use.

To this end, the New Zealand Forest Service holds exercises in the use of helicopters in fire control where personnel who are likely to be used are given the opportunity to work with the aircraft and allied equipment.



Laying hose with utility box. Hook coupling is fitted with a swivel to allow box to turn while helicopter maintains it's heading into wind.

Other equipment

Another very useful fire tool is the utility box, a large container approximately 240 x 600 x 460cm deep which can be carried suspended from the cargo hook on the helicopter. It is designed for hose laying and can carry up to 910 metres of 40mm fire hose which can be laid out very quickly over rough and steep terrain. The box is designed for multiple use and most types of fire gear including pumps and hand tools can be positioned almost anywhere with it. Even an injured person could be uplifted in it in an emergency.

Other useful aids in current use include an automatic v.h.f. remote radio repeater which can be set up on a high point by the helicopter to ensure maximum radio coverage over the fire ground. Lengths of 25mm hose which is light in weight and easy to manipulate while under pressure, is effective in delivering quantities of water to control fires in many different fuels and where water supplies are limited.

A rescue net has been found useful to uplift injured and stranded personnel from places where helicopters cannot land. These nets can be suspended from the machine by various length strops to reach the patient yet the machine can maintain adequate rotor clearance from obstructions, i.e. bluffs, trees, etc. Water rescues are also possible and an experienced operator can actually scoop a body from open water. The best of these nets can be folded and stowed inside the cabin of the machine while in flight to the rescue scene. This eliminates the drag of carrying it externally.

Along with the need to suppress fires is the occasional need to light them and current developments allow for the safe and quick lighting from the air. Various techniques are used including the dropping of "DAIDS" which are delayed action incendiary devices. There is also a device called the "STING" which is essentially an aerial

ignition system fully controllable and suspended from the helicopter and used to drop burning liquid fuel to the ground. There are many benefits to be gained by engaging the use of the versatile helicopter on high country and forest fire control, amongst these being the ability to position fire fighters and their tools in strategic positions quickly and in a fresh condition.

Scrub fires

By using helicopters and monsoon buckets many fires in light tussock and scrub have been contained and in many cases completely extinguished. Without the aid of this modern machine, the fires could have spread unchecked over much greater areas. The basic point is that helicopters can attack the "hot" edge of a fire in rough country which could not otherwise be approached by men or ground machinery.

Trials with even relatively small machines fitted with spray tanks, less the booms, have shown that jettisoning tank loads of water ahead of a fire is a very effective means of controlling spread. Generally these machines can be quickly adapted to fire control use just by removal of the booms. Using their own support gear, such as water pumps and fuel tankers, they can often be on the job long before the specialised equipment arrives.

As the current number of civil helicopters operating in New Zealand is now in excess of 120, and many of these are based close to inaccessible regions, there is seldom much delay in engaging a machine. Initial costs can be rather high but their speed in getting the job done can result in cost savings. By attacking a fire or attending an emergency in the early stages, many situations can be dealt with quickly by a small team of experienced men who get to the scene quickly with their equipment and are able to take action before the situation gets out of hand.

Management plans

for unalienated Crown land

G. L. Holgate

Planned rational management of unalienated Crown land is long overdue. Management plans to ensure the wise use of these lands are now being prepared by Department of Lands and Survey field officers.

High-country unalienated Crown land, commonly referred to as U.C.L., has been conveniently forgotten in the past. However, growing public and Government awareness of its recreation potential and importance in water management, prompted the Land Settlement Board to formulate the management plan concept. The opening paragraph of the relevant resolution of 4 April 1973 states;

“That all Crown land retired from grazing either voluntarily, or by the Board itself, or under a soil and water conservation run plan, shall be administered according to a management plan to be prepared for each area of land having regard to its potential for improvement by known techniques, its importance in watershed protection and its potential for other uses.”

Management plans are designed to take care of the land by facilitating the complete management of it. They are multi-objective in scope, although a basic aim is to protect or improve vegetative cover. Ideally a plan is prepared for a distinct geographical unit, such as a mountain range or catchment, to ensure management decisions are made in regional context. Where unalienated Crown land comprises only a small part of such a unit, a detailed plan may be prepared for the smaller immediately available sub-unit, considered in relation to the greater adjoining area.

Each Lands and Survey office has drawn

up a schedule of all the unalienated Crown land in its district, and 10 initial areas have been selected as priorities for management plans in each land district. The relative priority of these areas has been agreed on by the catchment authority concerned.

The initial step in management plan preparation is a reconnaissance of the area, and the collation of available data. Further information is then obtained where necessary, with the assistance of other agencies and groups or individuals. These consultations are usually a valuable source of ideas and information. This leads to a detailed multi-objective assessment of the problems associated with various potential uses, and priorities for action.

The assessment is based on evaluation of resource factors such as climate, geology, soils, vegetation, fauna and water yield. Other factors taken into account include the area's history, scientific interest, erosion, fire risk and access. The potential uses of an area may be numerous and could include such major uses as water harvesting, grazing, recreation, reservation, scientific study and afforestation. The resolution of any conflicts between possible uses, within the limits of maintaining or improving the vegetation cover, completes the assessment. A detailed management plan, including all relevant data and proposed action, is then drawn up. The plan is submitted to the Land Settlement Board for approval, and is implemented when this is granted.

Much unalienated Crown land has little potential or capability for active utilisation. Even erosion control measures may be either unnecessary or impractical and the major use of such country will be for water harvesting. In all management areas, management will at least involve surveillance, with periodic

monitoring of vegetation cover, and animal and noxious weed control.

Although initially there were many frustrating delays in the preparation of management plans, three have already been approved, and a number are nearing completion. The Porter River Management Area encompasses 3883 hectares on the southern end of the Craigieburn Range. Activity to date has included oversowing and topdressing, as well as some planting of *Alnus viridis*, on 45 hectares of depleted country in an attempt to assist slope stabilisation and revegetation. Permanent plots to monitor any changes in vegetation cover have been established. A ski field operates in the management area, and the conditions of the lease are being supervised.

On the northern end of the Takitimu mountains, 594 hectares of country forms the basis for Waituna Creek Management Area. To date 97 hectares have been oversown and topdressed to arrest frost lift and sheet erosion on the higher portion, and to improve the vegetation cover generally. Some cattle grazing of well covered sections may be permitted in the future.

A management plan has been approved for the retired lands of Cloudy Peaks, on the eastern edge of the Two Thumb Range. This small area of 205 hectares will be included in the proposed Tekapo Management Area, which could eventually encompass some 71,250 hectares. The main activity on Cloudy Peaks has been revegetation work, carried out in association with the South Canterbury Catchment Board.

An area of 13,950 hectares to the west of

Lake Ohau constitutes the proposed Ohau Management Plan. The management plan is nearly complete, and it proposes to: review the tenure of the ski field and some holiday cottages; assist a stabilisation and revegetation programme on ski field roading scars; issue a grazing permit and a temporary tenancy over a total of 878 hectares; undertake a brier control programme; establish a short walking track; and negotiate improved legal access with adjoining lessees.

The proposed West Wanaka Management Area includes approximately 8500 hectares north-east of the Matukituki River. Proposals include oversowing and topdressing to enable the formation of a "green belt" to hold stock at the lower altitudes, the issue of grazing rights, the control of brier, and the formation of a fire break/access track.

In the Seaward Kaikoura Range, approximately 9100 hectares form the proposed Kowhai Management Area. The main proposals in the nearly completed plan are to permit existing recreational uses such as tramping, and to continue animal control to assist natural regeneration.

Management plans are a means of ensuring the rational management of high-country unalienated Crown land. All possible uses must be evaluated, and permitted uses must be compatible with the broad objective of wise land use. A strength of management plans, yet paradoxically a weakness, is that they require co-operation between Government departments, local bodies, recreational groups and private individuals.



Compensation under the Public Works Act

E. D. Fogarty

Throughout the world in countries where private ownership of land is recognised, it is also realised that any public developments cannot be carried out without affecting private rights and interests in land. Therefore states have enacted legislation giving them power to take or use land required for public works. It is a principle of our inherited British system of justice that although the rights of the individual must give way to the needs of the public, the individual should not suffer loss. Therefore the subject whose property is taken or damaged is given a right to claim compensation. The power to take land for public works in New Zealand and to grant compensation to those affected is embodied in the Public Works Act 1928.

The first comprehensive Act dealing with both the acquisition of land for public works and the assessment of compensation was the Public Works Act 1876. This Act was a consolidation of prior legislation from 1863 onwards, most of which was enacted to facilitate Sir Julius Vogel's public works scheme.

Interpretation of the provisions in the Public Works Act is aided by a large number of decisions by the courts, both in the United Kingdom and New Zealand. The decisions of the British Courts are applicable in New Zealand except where the New Zealand statute law differs from the United Kingdom's statutes.

Hydro-electric developments

The type of public work which most readily springs to mind when considering the South Island high country is the typical hy-

dro-electric scheme. High-country farmers and hydro-electric schemes have of necessity been neighbours these many years. The present work in the Upper Waitaki, and the work about to start on the Clutha continue to remind us that water remains our single largest source of electrical energy. Each year the Planning Committee on Electric Power Development in New Zealand reports to the Minister of Electricity, and a copy of this report is presented to Parliament. It is interesting to note from the 1976 report that the committee, in reporting on the investigation and development of sources of energy for electricity generation, makes the point that the remaining potential for hydro development in New Zealand needs to be investigated with vigorous and continuing effort. The committee draws attention to the fact that some sites which might once have been considered uneconomic are now likely to have a place in the planning options of the future. The committee goes on to comment that it is important that the investigation of hydro potential is pursued quickly but with due regard to other water and land management policies.

To the high-country farmer, to the farming industry in general, and to anyone who sees his home or business about to be inundated by the build-up of water behind a finished hydro dam the question uppermost in his mind must surely be: What compensation do I get for being placed in this situation, a situation not of my choosing? To answer that question one must look to the Public Works Act as enacted in 1928 and as amended over the last 39 years. One must look in particular to the amendments made in 1970, 1973 and

1975 which introduced and then further extended the concept of additional compensation, and at the 1976 amendment, which introduced the concept of alternative compensation. Before going on to examine these most recent provisions it is essential to grasp the fundamentals of compensation, a topic which has been with us since the founding of modern-day New Zealand and which was brought to this country as part of the British system of justice.

What is compensation?

“Compensation” is, of course, a metaphorical expression, the idea being derived from a pair of balances. The sense is that an owner from whom land is taken, or whose property is damaged, shall be given in money the equivalent of what is taken from him. On one side of the balance is his property before it was interfered with; on the other side is the property he has after the exercise of the compulsory power. The balances are equalised by a compensating amount of property (in cash) being placed on the balances so that the final result is that the owner has property to the same value either partly in land and partly in cash, or if the whole of his land is taken, then wholly in cash. In one sense, therefore, the process of taking his land and the payment of compensation can be regarded as a compulsory change in the form of property, the important point being that a person should be left with the same amount of property as he had before the exercise of the compulsory powers.

Needless to say it is the duty of those concerned with the assessment of compensation to hold the balances fairly, so that on the one hand the individual is not deprived of something to which he is justly entitled, and on the other hand he is not paid such a sum as would allow him to make a profit out of public funds. It is this concern with fairness and justice which has led to the amendments of recent times which have as their aim the updating and strengthening of the compen-

sation provisions to ensure that they meet not only adequately, but generously, the needs of our society. I will go on to speak of these recent revisions shortly but I would first like to comment briefly on the principles and practice of compensation as laid down in the Act and as interpreted over the years by the courts.

Entitlement to compensation

At the risk of seeming pedantic I would like to quote the section — I might mention the *short* section — which is the cornerstone of compensation under the Public Works Act. It reads: “Every person having any estate or interest in any land taken under this Act for any public works, or injuriously affected thereby, or suffering any damage from the exercise of any of the powers hereby given, shall be entitled to full compensation for the same from the Minister or local authority, as the case may be, by whose authority such works may be executed or power exercised.”

This section of the Act and in particular the words “full compensation” are generally regarded as the dominant provision in regard to compensation, but for what is meant by “full compensation” one must have recourse to the statutes and decisions of the courts.

At this point it is worth noting that only persons having interests in the land are entitled to claim compensation. It should be noted that the owners of interests less than freehold (e.g. Crown lessees) are perfectly entitled to claim compensation. But persons having merely licences to use the land or premises have no valid claim, nor do interests in chattels or personal rights confer any right to compensation.

Land injuriously affected or damaged

It should be noted that compensation is not limited to the value of the land taken. It is intended that the owner be adequately compensated for his losses including:

- The value of the land taken;
- The depreciation in the value of the balance retained (land injuriously affected);

- Damage suffered by land or buildings from the exercise of powers contained in the Public Works Act *and*;
- Any loss which flows from a compulsory acquisition provided first it is not too remote and secondly that it is the natural and reasonable consequence of the dispossession of the owner.

Rules of compensation

The rules governing the assessment of compensation are to be found in Section 29 of the Finance Act (No. 3) 1944. The rules are as follows:

- (a) Compulsory acquisition — subject to Part IIIA of the Principal Act, no allowance shall be made on account of the taking of any land being compulsory. The statute provides that the value of land taken shall be based on the assumption that the claimant stands in the position of a willing seller. The specific statement that no additional allowance should be made on the grounds that the land was taken compulsorily emphasises the requirement to value the land on a market basis.
- (b) The value of land shall, subject as hereafter provided, be taken to be the amount which the land if sold in the open market by a willing seller on a specified date might be expected to realise. This rule makes “market value” the test of value, as distinct from value to the owner or value to the taking authority. The intention basically is that a person deprived of his land should be placed in the position of receiving from the acquiring authority a sum neither more nor less than he would have been able to obtain on a sale to a private person.
- (c) The special suitability or adaptability of the land for any purpose shall not be taken into account if it is a purpose to which it could be applied only in pursuance to statutory powers, or for which there is no market apart from the special needs of a particular purchaser or the requirements of any Government department or any

local or public authority. This rule makes it clear that the measure of compensation is neither the gain nor the loss of the authority who takes the land but the loss of the person from whom the land is taken.

- (d) Where the value of the land taken for any public work has on or before the specified date been increased or reduced by the work or the prospect of the work, the amount of that increase or reduction shall not be taken into account. The intention of the rule is clear. Like rule (c) it is based on the principle that the owner is not to be allowed to make a profit out of the public work for which his land is required nor does the taking authority have to pay the value added to the land by such public work. On the other hand, where the value of the land has been diminished by the work or the prospect of the work the owner is protected from the injustice which would be done if such reduced value were adopted.
- (e) The court shall take into account by way of deduction from the total amount of compensation that would otherwise be awarded on any claim in respect of a public work (whether for land taken or injuriously affected or otherwise) any increase in the value of the land of the claimant that is injuriously affected, or in the value of any other land in which the claimant has an interest, caused before the specified date or likely to be caused thereafter by the work or prospect of the work. In other words the net loss to the owner is to be ascertained after allowing for any gain he receives from the work. Against the total sum of the value of the land taken and compensation for injurious affection must be set the betterment added by the work for his remaining land.

Disturbance

Generally speaking it is correct to say that an owner is entitled to be reimbursed for actual monetary loss of a temporary non-

recurring nature which arises as a direct result of the property being taken by the Crown, and which the owner could not have avoided by taking reasonable precautions. The losses must be such that they would not have occurred in the course of an ordinary sale of the property or the conduct of an owner's business and must be directly attributable to the owner being forced to give possession of the property to the Crown. Disturbance can only be claimed where it will occur, or actually has occurred. It is not a general amount to cover possible unspecified contingencies such as inconvenience.

The decided cases point out that there is an obligation on the owner to take all reasonable steps to ensure that losses are kept to a minimum. On the other hand, the taking authority is often in a position to minimise a claim for disturbance by delaying possession and extending every opportunity to the claimant to take any action necessary to keep his losses to a minimum. A typical case is the taking of a farm necessitating the disposal of stock, etc. If possession is required urgently and the claimant is prevented from remaining in possession for a reasonable time it becomes necessary for him to have a forced sale of his stock. He can take advantage only of the prices obtainable within a limited period of the year which may be in the off-season for the sale of stock. His losses therefore are likely to be very much greater than they would have been had he had an extended period within which to give possession to the Crown, thus enabling him to choose the best market upon which to sell the stock with a consequent reduction in loss arising from this cause.

The most common items which have been accepted either in practice or by the courts as a sound basis for a claim for disturbance are as follows:

Valuation fees and legal costs

With regard to an allowance for valuation fees and legal costs in relation to the negotiation of compensation for the taking of land

from the owner it is only reasonable that an owner who has not contemplated selling and has no practical knowledge of the property market should seek the opportunity of instructing a registered valuer and obtaining the representation of a solicitor. A question which sometimes arises is what is "reasonable." One could envisage a situation where an owner instructed a number of valuers and consulted a prominent barrister to conduct negotiations for the sale of a property such as a typical suburban dwelling. In these circumstances it obviously would not be reasonable that the owner should invoke services far in excess of those necessary to enable him to receive legal advice and guidance.

In addition to valuation fees and legal costs relating to negotiations in respect of the property acquired, it has been held in the case of a residential property which is in the occupation of the owner that the claimant is entitled to an allowance for the valuation fees and legal costs incurred in the purchase of an alternative dwelling.

Removal costs

Where premises are taken there is no obligation for the taking authority to take over movable chattels and to pay the owner of the property for such items. The chattels as such are not part of the property taken, but where certain items, of considerable value and use in the premises taken, are rendered virtually useless, the courts have taken the view that the loss of these items constitutes an allowable, compensatable loss.

The owner of a property taken by the taking authority would be entitled to receive the costs of removal of the household furniture to the alternative premises provided always that the alternative property is within the same general locality and that in view of all the circumstances such removal would be a reasonably justifiable move on the part of the claimant.

Loss of profits

Where, on the removal of a business, the operations are forced to close down during

the period of changeover from the premises taken from the claimant to the alternative premises, and as a result the business has ceased to earn during the period, the net loss suffered is a recognised claim under the heading of disturbance. The main point to note is that it is the net profit loss that is the subject of compensation.

Compensation for disturbance on the basis of loss of profits must be related to proved loss of actual profits. Loss of anticipated profits does not form the basis for a valid claim.

In New Zealand anticipated profits from the sale of surplus spoil from the land taken has been held by the courts to be an unsound basis for a claim for disturbance. It was held that this aspect could only be taken into account as a potential attributable to the value of the land and not as a basis for assessing compensation for disturbance (see *Green and McCahill Limited v. Minister of Works* (1965) N.Z.L.R. 580.

Additional compensation

Arising out of a Cabinet decision in 1969 amendments were introduced in 1970 to the Public Works Act to provide (in a new Part IIIA) for the payment of additional compensation, that is to say compensation over and above the "full compensation" to which an owner is entitled under Section 42 of the Act.

By amendments in 1973 and 1975 the provisions for additional compensation were further extended both as to quantum and/or eligibility. These amendments to Part IIIA of the Act are now included in the recently issued reprint of the Public Works Act.

Briefly the present situation is as follows:

Home owners

Where the Crown takes the initiative to purchase a designated property and requires vacant possession for an imminent public work the home owner is entitled to be paid a

solatium (or home-loss payment) of \$2000, provided the ownership has not changed since designated. If the owner takes the initiative to sell a designated property to the Crown he may be paid a solatium of up to \$1000. The amount of the solatium is not related to the value of the property. The original solatium of \$500 was increased more than once and extended to its present two levels. No doubt we could see it increased in the future.

Occasions will arise where nothing quite comparable in standard and value to the owner's property is available for sale on the market and the owner may be forced to buy a somewhat more expensive property in order to rehouse himself without lowering his standard of accommodation. In these circumstances an owner who is aged or infirm and lacking in means may be granted (interest free) an amount which would enable him to purchase a home of a comparable standard. The first \$1000 would not be repayable and the balance would be repayable either on the sale of the property, on the owner vacating the property, or on his death, whichever occurred first. Generally in the case of a married couple, for so long as one of the partners continues to live in the property the loan is not repayable.

If an owner lacks means alone — and there is no question of age or infirmity — then where the property taken has an agreed value of \$20,000 or greater up to 15 percent of the value of the property may be granted as a loan on such terms and conditions as are reasonable to enable that owner to re-establish.

Special assistance to owners of low-value homes

Special assistance is available to the owners of low-value homes who, because other low-value properties are not available for sale on the market, have to buy a considerably more expensive property in order to rehouse themselves, and they lack the means to do this.

The legislation provides that where the

value of the property being acquired is less than \$20,000 an amount up to the difference between \$20,000 and the market value of the property, or up to \$3,000 whichever is the greater, may be granted by way of loan on such terms and conditions as are reasonable. This means, for example, that an owner of a property with an agreed value of \$13,000 can be granted by way of loan up to \$7,000 if it can be shown that he needs to go up to this figure in order to re-establish himself without lowering his standard of accommodation. An owner of a property with an agreed value of \$18,000 can be granted by way of loan up to \$3,000 if it can be shown that he needs to go up to this figure.

Farmer or businessman

The legislation provides that where, in order to re-establish, a farmer or businessman is forced to acquire a somewhat more expensive farm or business premises so that he can carry on, and where he lacks the means to re-establish in such a property or premises, he may be granted by way of loan up to 15 percent of the value of his estate or interest in the land acquired, on such terms and conditions as are reasonable.

Part IIIA of the Act also includes provision for the refund of expenses to the owner where the Crown initiates negotiations for a designated property and then abandons the proposed acquisition because the property is no longer required.

There is also provision in this part of the Act for payments to tenants who occupied a property before the Crown made its intentions to acquire known and who were required to vacate that property. Removal expenses of up to \$300 may be paid to the tenant of a residential property. Up to \$1,500 may be paid to a tenant operating a business.

It should be noted that under Part IIIA payment of additional compensation by way of grant or loan, payment of a solatium of up to \$1,000, and payments to tenants, are at the discretion of the taking authority. Payment of the \$2,000 solatium is mandatory if the owner fulfils the criteria.

Alternative compensation

By an amendment to the Public Works Act in 1976 provision was made for the payment of alternative compensation, or as more popularly known for the provision of a "home for a home, business for a business, or farm for a farm."

As mentioned earlier in this article the basic principle of compensation is that an owner is entitled to be paid in cash for the loss which he has sustained. There have been occasions however when because land taken for a public work but not needed for that purpose has been available for disposal, compensation has sometimes been effected by granting an owner alternative land as compensation. A typical example would be the situation where in a road deviation land was required from a property, and the old road was available for vesting in the owner.

The 1976 legislation has been designed to cater for the situations where land comparable to that taken or required is not readily available on the market for sale or other disposition to the owner at a reasonable price for the re-establishment in the same area of his place of residence or his farming, commercial, or industrial undertaking. In these circumstances the amendment to the Act provides that the taking authority, with the consent of the owner, shall take all reasonable steps to grant to the owner in payment in whole or in part, alternative property.

Sources of alternative property

The question may reasonably be asked: From where does the Crown, or a local body, get a supply of alternative properties? A fundamental principle enshrined in the law of compulsory acquisition is that property cannot be acquired compulsorily from one person in order to vest it as compensation in another person. You cannot take from Peter in order to pay Paul. The logic of this is I feel obvious and requires no comment from me. However there always has been power for the taking authority to enter into voluntary

negotiations to acquire land for public works. In the 1976 legislation this power was extended to enable the Crown and local authorities to acquire any estate or interest in land and develop and construct buildings on such land or on any other land owned by the Crown or the authority, for the purpose of granting the land (or any part of it) in payment or satisfaction (or in part payment) of the compensation payable to the person entitled for any land taken, purchased or acquired for or in connection with a public work.

Inevitably a lead time ranging from several months to several years is needed if it is necessary for the taking authority to construct buildings, or develop land into farms or orchards, so that owners can be granted alternative properties.

The sources from which alternative properties could be available are as follows:

- (a) Unalienated Crown land or other land of the taking authority freely available for sale or other disposition.
- (b) Land reserved, taken, purchased, or required for any public work which is no longer required for any public work or which is no longer required for the use, convenience, or enjoyment of any public work.
- (c) Land acquired, and developed or developed and built on, specifically for the purpose of granting it as compensation.

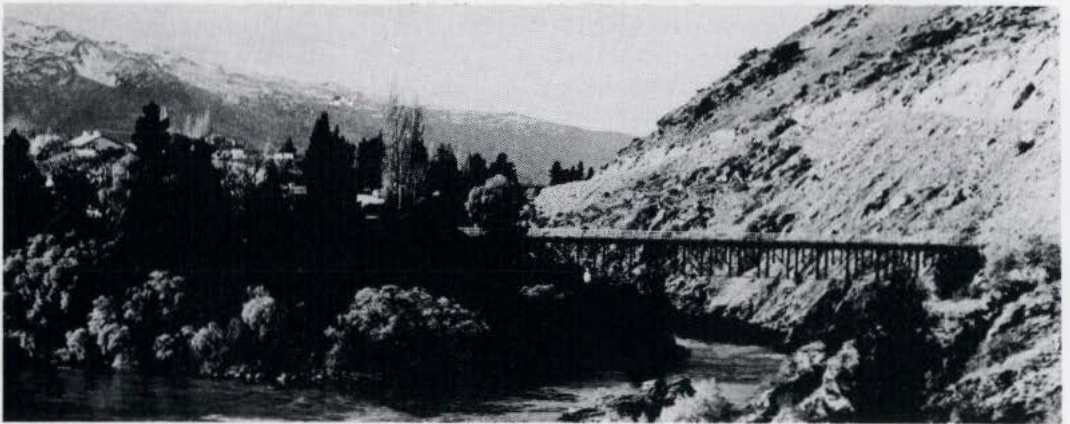
Determination of value, etc.

The 1976 amendment further provides that if no agreement can be reached as to the amount due by way of equality of exchange the taking authority or the person to whom the land is proposed to be granted may apply to the Administrative Division of the Supreme Court to fix the value of the property proposed to be so granted or the value of the land taken, or if necessary the value of both properties.

The amendment further provides that the taking authority may enter into an agreement with the owner for the repayment to the taking authority of any money due by way of equality of exchange on such terms and conditions (including interest) as may be agreed upon between the parties.

Review of Public Works Act

In the latter part of 1976 the Minister of Works and Development appointed a committee to undertake a review of the Public Works Act. The committee has called for submissions from interested parties and I am given to understand that a considerable number have been received and are under consideration. The findings of the committee are awaited with interest and it seems likely that this will lead to a complete rewriting of the Public Works Act. That, however, lies in the hopefully not too distant future.



In appreciation . . .

J. T. Holloway

Dr John Thorpe Holloway, "ecologist and explorer, denizen and defender of the high country of New Zealand," died in June in Christchurch after a brief illness.

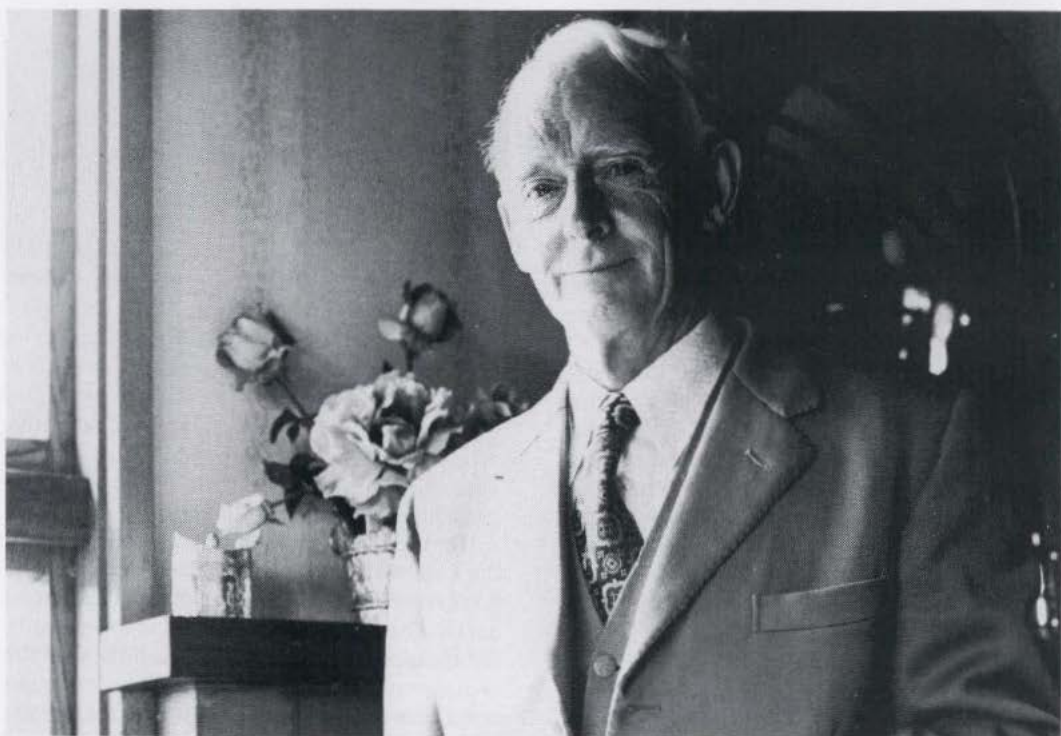
As a boy at school in Dunedin, he spent summer holidays in the Dart Valley at the head of Lake Wakatipu where he developed an abiding interest in plants and mountains. As a student at Otago University he became a member of the New Zealand Alpine Club. Working towards a science degree in the depression years (he graduated first class honours in botany and chemistry in 1937) and with paid work not available in the vacations, he persuaded the Department of Lands and Survey to supply him with food in return for maps of the unknown country he planned to explore. Thus for the summers of 1935, 1936 and 1937, with various companions, he tramped the valleys, passes, glaciers and peaks of the Barrier and Olivine ranges — country which had scarcely been seen since A. J. Barrington made his momentous journeys in 1864. Making first ascents of some 60 peaks, crossing more than a dozen new passes and exploring the headwaters of as many rivers, Dr Holloway amassed a vast knowledge of the botany and geology of the area, much of which appeared in four major articles in the *N.Z. Alpine Journal*. He produced excellent detailed maps and imaginatively named such features as Solution Col, Desperation Pass, Dilemma Glacier, Mounts Tempest, Blockade, Destiny and Climax. Recognition of one of the finest pieces of New Zealand exploration is found in the name of Mount Holloway for one of the main peaks of the Barrier Range.

On a study visit to Britain when war broke out he joined the N.Z. Forestry Unit serving with it for the duration. When he returned to New Zealand he joined the National Forest

Survey and until its completion in 1955 (when he wrote the final report) he was responsible for the collection of all ecological information and for the administration of field work in the South Island. As a result of his experience over these years he produced many botanical papers, models of scientific writing, the best known being the lengthy dissertation, "Forests and Climate in the South Island of New Zealand."

In 1956, Dr Holloway was charged with the establishment of the Forest and Range Experiment Station at Rangiora. The Forest Service had that year assumed responsibility for the control of noxious animals and the unit was required to survey and report on the condition of the watershed protection forests and the associated alpine grasslands and scrublands with particular reference to the effects of introduced animals. Dr Holloway's greatest achievement was the formation and training of a strong inter-disciplinary team capable of working anywhere in the mountain country, under all weather conditions and making a concerted well-designed attack on the key problems as they were isolated. The investigations carried out and recorded in 150 research papers have proved of vital significance in the planning and practice of soil and water conservation in the mountain lands of New Zealand.

As a member of the Committee of Management of the Tussock Grasslands and Mountain Lands Institute from its inception until his retirement in 1974, Dr Holloway played a major part in developing unity of purpose and action amongst all workers in the high-country field. His constant theme was: "There is no room in this work for professional parochialism, the great need is for joint effort and mutual understanding directed towards a common end, the well-



Dr John Thorpe Holloway

being of the watersheds." He was always an advocate too of extreme caution in the management of high-altitude land. As he said: "We cannot afford to add to the land requiring treatment. The prevention of mountain land erosion will always be far less costly than any possible cure."

Since his retirement, Dr Holloway concentrated on the writing up of research results in a form more suitable for general use and the production of books for students and the public on the problems of management of the indigenous forests.

The Royal Society of New Zealand elected Dr Holloway a fellow in 1959 and awarded him the Hector Medal for scientific achievement in 1966. In 1974 the University of Otago admitted him to the degree of Hon. D. Sc. and the following year the New Zealand Institute of Forestry made him an honorary member in recognition of his

membership for 30 years, his prolific contributions to their journal, and his leadership of several institute campaigns where conservation of mountain lands was one of the principal objectives.

Jack Holloway was of deceptive build, lithe, wiry and hardy; he did not seem to tire on the toughest journeys under the heaviest loads. He seemed to possess a natural immunity to accident even under appalling conditions of weather and terrain. But once he did slip over a 15 metre cliff, turned a double somersault, landed in a tree, and broke a cake of chocolate. He was an extremely modest man and apparently mild until he saw a basic principle infringed. Then he could attack in the same high-quality verbiage in which he wrote. He infected others with his interest and enthusiasm and was always first to give full credit to the achievements of others. — L. W. McCaskill

Book review

The Poisonous Plants in New Zealand

by H. E. Connor
Botany Division, DSIR

*New Zealand Department of Scientific and Industrial
Research Bulletin 99, Second revised edition 1977;
Government Printer. 247 pp. 16 colour photographs 36 pages
of line drawings. Price \$9.75.*

(Reviewed by Graham Dunbar)

*"My heart aches, and a drowsy numbness pains
my sense, as though of hemlock I had drunk,
or emptied some dull opiate to the drains
one minute past and Lethe-wards had sunk."*

The exact words are not as I remembered them but even so John Keats' impression of hemlock poisoning still holds more appeal than Connor's clinical account, that "In man there is a general and gradual weakening of muscular power; loss of sight may also occur, and death results from gradual paralysis." But the cold facts are that poisonings from plants are not usually poetic events. Besides, Henry Connor is foremost a scientist and even Keats would have been hard put to convey the poetic image for poisonings from more than 150 plant species!

Indeed, on first acquaintance with this second, revised edition of Mr Connor's book I found myself almost physically overcome by the sheer abundance of numbers of the plants included. Had we New Zealanders been so diverted by the absence of poisonous reptiles that we had overlooked the alternative possibility of being overcome by a "drowsy numbness," arising from the noxious contents of all these species? However, closer examination of the text restored some comfort in that it seems that many of the

plants which are listed as containing toxins have not so far been known to actually cause poisoning of man or beast in New Zealand. Poisonous plants too, in the context of this book, are not only those which are poisonous through ingestion, but include some poisonous on contact such as the native *Urtica ferox*, the tree nettle.

This really is an authoritative and scholarly book, and the lengthy introduction sets the stage. Under separate headings it discusses the historical background in New Zealand of plant poisonings in relation to livestock and to man. It lists the most important poisonous plants and also the major plants causing dermatitis. It discusses the question of toxicity and gives a general account of the main classes of plant toxins found in poisonous plants here, the variation in concentration of toxins and the more specific reactions of animals to these. Last, it lists those indigenous plant species in which toxicity has been tested by livestock feeding trials. That is to say, *controlled* feeding trials at Wallaceville. There have been many un-

controlled trials. As Mr Connor says, "careless disposal of garden waste is a common enough cause of livestock poisoning, and is often the main means of access of animals to such plants as rhododendron, Iceland poppy, lily of the valley tree, delphiniums and other toxic plants of horticulture. Exhortations to be careful with prunings, bulbs, and general garden waste seem to have little overall effect but must be repeated."

In the main body of the book by far the largest section is devoted to the listing and description of those flowering plants with poisonous properties. These are listed alphabetically by families and some are illustrated by excellent line drawings by Nancy M. Adams. The author says that in this second edition he has availed himself of "an opportunity to correct the errors and omissions of the first edition. To this end a section on fungi poisonous to man, and a section on blue-green algae toxic to livestock are presented." He also omitted many previously suspected plants.

The section on fungi has some interesting comments from another reference with regard to the edibility of fungi. Most of these comments indicate the fallibility of many of the oft-quoted criteria for safe eating. For example — "Appearance is *no* guide to edibility." "Green, red or white fungi are found among both poisonous and edible species." "Peeling of the cap does *not* mean edibility." The mushrooms may be the more colourful fungi, but far more devastating in its total effect in New Zealand has been the facial eczema fungus *Pithomyces chartarum*. The history and effects of this disease are well described.

Two small sections, on conifers, and on ferns and horsetails complete the descriptive section. Each has considerable importance. The conifers include yew, a plant responsible for poisoning in both livestock and man, while the ferns include bracken fern, one of the few poisonous and widespread native species.

Most tussock country residents in thinking of poisonous plants will incline towards the

natives bracken fern and tutu (tutu is the general common name for several species of the genus *Coriaria*). Connor says, "Tutu is the classical poisonous plant of New Zealand; some of the first animals introduced into New Zealand by Captain James Cook in the 18th Century were poisoned by it." It seems as if the lessons of Cook must often be relearned. Heresay has it that quite recently a Lincoln man suffered marked ill effects from unwise consumption of *Coriaria* fruits while on a hunting trip. While he shall remain nameless, it is reassuring to note that as he was *not* a plant scientist the mishap could not properly be put down to professional incompetence! Most of the plants in this book are however not native but are naturalised or cultivated, while "garden escapes and new weed introductions contribute the greatest risk for an increase in the number of toxic species." Although often relatively remote, tussock grasslands are far from free of toxic naturalised species. St John's wort and ragwort are two very important species affecting livestock, while lily-of-the-valley, laburnum, Jerusalem cherries and yew are not confined to suburban gardens in their danger to children.

Mr Connor clearly had the safety of children in mind as a factor in preparing the second edition, and hopes "that the warnings are clear enough to permit parents to protect their children from the hazards that are present among the plants around them." It is also a book for veterinarians and the farming community. This is not to say that it is an easy book to browse through, or one for the coffee table. It is a book to refer to when a doubt arises about a plant, and although at first sight the arrangement by alphabetical order of families may be intimidatory to the non-botanist, the excellent indexes to generic and common names on pages 31-34, as well as the larger general index make the search for a particular species quite simple.

There is an excellent glossary, and a long list of references for anyone minded for delving deeper. For most people this will be quite unnecessary. The facts are here in a useful and durable publication.

Authors

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Annual Report of the Tussock Grasslands and Mountain Lands Institute for the Year 1976 / 77

Committee of Management

During 1976, the Institute suffered from the death of Mr John S. Engel, nominee of the Director-General of Lands. His place was taken from November 1976 by Mr T. D. Mackenzie.

In February 1977 the Chairman of the Committee of Management, Mr A. S. Scaife, advised the committee that he did not wish to seek re-election as chairman although he did not wish to sever his membership of the Committee of Management. Mr J. M. Wardell was elected as chairman and Mr A. A. Innes was elected vice-chairman. Mr H. G. Hunt, secretary to the Committee of Management from its foundation in 1960, retired from his position as registrar at Lincoln College in August 1976. His successor is Mr G. A. Hay.

General features of the year's activities

The Committee of Management was obliged at the commencement of the year to approve a budget suspending the regular work programme of the Institute because of the level of Government funding. At the same time it pressed the case for revision of the Government arrangements for funding

the Institute. Towards the end of the year Cabinet resolved to transfer the funding for capital and administration of the Institute from Vote: Water and Soil Conservation to Vote: Lands and Survey.

Although the regular field work of research programme of the Institute was suspended, several activities were supported by contractual or other arrangements. Contracts were negotiated with Department of Lands and Survey to have the Glenthorne grazing behaviour study carried out as a masterate study in association with the Department of Range Management and to study riparian lands from two viewpoints, the influence of stream energetics and behaviour on channel and riparian stability, and the adaption of riparian vegetation itself. Work was continued on the contract to develop criteria for guiding the recreational use of mountain lands. The high altitude revegetation work in the drier mountains which had been deferred from the previous year was begun as a co-operative programme with divisions of DSIR, the field costs for the first year being met by DSIR. Lincoln College Research Committee made an advance of \$500 for travel to ensure that essential servicing of the Torlesse project could be maintained.

A considerable amount of time has been devoted to review of research and other ac-

tivities, especially in conjunction with the visits to the Institute of Professor John Burton and Dr Robert E. Dils. Extension activity has been carried out in a series of discussion days in four South Island centres. The remainder of staff time has been devoted to preparation of material for publication.

Progress of work of the Institute is reviewed here in the sectors in which it has been previously reported: Erosion, Resources, Revegetation, Management Systems and General Extension. It should be emphasised that these sector reports include projects from the regular work programme of the Institute and appropriate items from the other temporary or contractually supported works which have been listed above.

Erosion Sector

Torlesse co-operative programme:

Stream sediment results have been prepared for publication. From 1972 to 1976 the average annual sediment production rate was 127 tonnes or 33 tonnes per square kilometre of catchment. Of this total annual yield, about 80 percent has been delivered in about 1 percent of the time.

While the largest sediment yields are generally associated with the highest peak flows, there is also a periodicity of sediment movement which is very strongly related to its availability. Two storms, one in September and one in October, demonstrated the importance of sediment supply to sediment movement. Both storms peaked at 1300 litres per sec. In September sediment had been stored in the channel and the storm yield was 91,000kg. However, in October sediments were not stored within the channel and the storm yield was only 65kg. The programme which has monitored changes in the volumes of detritus held within the pool-riffle channel system has shown that sediments move "wave-like" through the channel. It is the presence or absence and the location of these waves that primarily determine whether a storm will yield a

significant quantity of sediment. In addition, there appears to be the possibility that sediment prediction equations grossly overestimated sediment yields. Relations between stream energy, rates of sediment transport and sediment sizes are aspects of this continuing study.

Even in conditions of "over-supply," there are important interactions between the movement of these "waves," the hydraulics of stream flow and the stability of riparian land. Because of their importance to land management and revegetation, these are subjects of current study under the appropriate research grant from the Department of Lands and Survey.

Liasion with catchment authorities:

South Canterbury Catchment Board:

The Institute has been assisting the South Canterbury Catchment Board with computer processing techniques to improve the value of information obtained from that board's erosion study of the Upper Orari catchment. Mr Lefever has designed a storage and retrieval system which, it is hoped, will allow board staff to better interpret the occurrence and significance of different types and forms of erosion.

Manawatu Catchment Board:

Mr Hayward has continued to act as advisor to the Manawatu Catchment Board's SE Ruahine investigation. The erosion and stream sediment studies are well ahead of schedule but hydrologic studies continue to be hampered by a lack of significant storms. Preliminary designs for a catchment control scheme are under way.

Resources Sector

Three studies were completed under this three-year research grant from the Department of Lands and Survey for the development of guidelines for assessing recreational potential of the high country.

Mr A. L. Bignell completed a masters degree study entitled "A Case Study in Comprehensive Outdoor Recreation Planning, Centred on the Lake Tekapo Region of New Zealand." The study outlines a concept for comprehensive outdoor recreation planning and applies it to the Lake Tekapo region. Based on information obtained in the summer of 1975/76, the study concluded that to maintain the quality of recreational experiences in the region, development should be restricted to small areas with high levels of control. Apart from specific conclusions relating to the Tekapo region, the study also included a critique of the methods used and their suitability for high mountain settings.

Miss Pauline Gibbons completed a diploma of natural resources study on winter visitors' attitudes to the recreational resources and environment of the Mackenzie Basin. The sample was small (170 persons) and was restricted to the August vacation ski season. Although it might not be truly representative of winter recreational users, it provides useful insights into visitors' perceptions of the region and their attitudes towards some aspects of its management and use. One interesting finding was that although visitors were chiefly from higher than average socio-economic groups, they preferred lower-grade accommodation such as youth hostels and motor camps. Another aspect of interest was the frequently expressed view that pastoral development and tree-planting would enhance the visual environment, even though one of the commonly noted characteristics of the environment was its open spacious character.

A third study entitled "Management Objectives for Resource Use in the Temple Stream Catchments" by J. J. Buwalda examined recreation among other resource management objectives. The information provided by this and by a complementary study on the evolution of recreational use in the Lake Ohau region by J. J. Davison is valuable basic information for the proposed manual "Guidelines for the Development of Recreation in Mountain Lands."

The study of the Mavora region in

Southland referred to in the last Annual Report had to be interrupted before its preparation for publication was complete. Further work on its editing has been recently resumed as part of the mountain recreation contract.

The Waitaki Man and the Biosphere programme supported by the National Commission for UNESCO was widely publicised through international notices of the first major report: "An Introduction to the Waitaki." Further promotion of this integrated programme has been made possible by additional funding from the National Commission for UNESCO and from the World Wildlife Fund (New Zealand), the latter to contribute to studies for biological conservation of water birds.

The director completed the review commissioned by the International Union for the Conservation of Nature and Natural Resources on the rational use of high mountains in pastoral systems. This work, along with the other theme papers, will be used as critical references for the forthcoming New Zealand Conference on High Mountains in November 1977.

The survey of utilisation of pastoral resources which was commenced by an FAO fellow, Sr Carlos Blanco-Fernandez, has been completed to the pilot stage of 40 runs by Mr E. J. Costello. It is hoped to enlarge this survey and to use results from it more explicitly to clarify pastoral development problems.

Revegetation Sector

With financial assistance from the Grasslands Division of the Department of Scientific and Industrial Research, a co-operator in the project, it was possible this year to begin the study of the ecology and improvement of montane and subalpine plant communities of the eastern Mackenzie Country. On the Grampian mountains, two sites, each of 2ha, have been fenced with the following broad objects of study:

1. To establish long-term areas of revege-

tation in depleted upper montane and subalpine zones of these drier mountains.

2. To monitor the changes in the vegetation, both exposed to grazing and protected from it.
3. To begin the introduction of native species (from seed, seedling plants and tillers) in conjunction with primary revegetation.
4. To study the phenology and ecology of the native plants present with the aim of better definition of management systems for vegetation improvement.

Two major plant communities have been enclosed at these sites: (a) *Chionochloa rigida*/*Aciphylla aurea* dominant community on a steep, west-facing slope at 1,460 metres altitude, and (b) a cushion plant/sparse blue tussock dominant community on a gently sloping surface at 1,760 metres altitude, the major cushion species being *Phyllachne rubra*, *Raoulia hectori* and *Pygmaea thomsoni*. Field work in this initial season following fencing has been mainly confined to the establishment of climate stations, survey of plant species present and notes on their phenology, and establishment of permanent vegetation transects and stereophoto position to record trends. A pilot trial was initiated with direct planting of *Chionochloa rigida* tillers.

In preparation for the next field season, plants of several native species have been raised at Lincoln from seed and tillers, for use in spring comparisons with direct seeding and tiller planting. Seed collections have been severely limited by a poor flowering at this altitude.

The Institute in the past has conducted soil/plant adaptability studies in the glass-house by measuring the response of native and low fertility tolerant introduced grass species to interacting lime, phosphorus and nitrogen treatments on a low fertility high-country yellow-brown earth. This year these studies were extended with a pot trial in which the native grasses *Festuca matthewsii*,

Poa colensoi, *Notodanthonia setifolia*, *Agropyron scabrum*, *Koeleria novo-zelandica* and *Deyeuxia youngii* have been compared with the introduced *Agrostis tenuis* (browntop) and *Anthoxanthum odoratum* (sweet vernal). The trial is not yet completed but to date sweet vernal and browntop have proved much superior to most native species in production at the control level of no added nutrients. These results are in line with an earlier trial which showed that browntop, Yorkshire fog and narrow-leaved fescue (*Festuca tenuifolia*) gave greater production at very low levels of phosphorus than did a high altitude strain of blue tussock. In the current trial, browntop and sweet vernal are more productive than the natives at most levels of added nutrients, although *Deyeuxia youngii* has produced at a level very close to the two exotics. With the exception of the *Notodanthonia* species where response was very slow, a relatively small amount of phosphorus on the natives almost doubled the production of leaf tissue. In contrast, phosphorus alone had little effect on the exotics. Browntop and sweet vernal showed a greater response to nitrogen than did the natives.

Management Sector

Grazing management

There have been seven grazing management topics in which the Institute has been involved over recent years. A brief review of the state of each of these follows.

The comparison of methods of sheep diet determination at Brooksdale at both low and high grazing pressures has been completed for a M.Agr.Sc. thesis by Mr John Stevens. He has demonstrated the worth of faecal cuticle analysis in comparison with examination of oesophageal extrusa and direct observation of sward.

Mr Stevens also maintained the Institute's contribution to the co-operative study at Cooper's Creek. His work there on comparison of diet of sheep on sunny and shady faces of improved tussock country has

demonstrated the significance of *Notodanthonia* species in the diet and the seasonal changes in preference in this North Canterbury situation.

Field work of the Glenthorne grazing behaviour study of sheep on free range has been completed under a contract from Department of Lands and Survey. Mr Peter Harris in a M.Agr.Sc. thesis has demonstrated the selection of more productive sites by sheep and their maintenance of relatively even grazing pressure over the summer grazing season by outward and inward migration as moisture content of herbage declines and recovers. A base of knowledge of sheep behaviour on this country has now been established from three years' observations against which any possible effects of topdressing and oversowing selection portions of the range can be studied.

The Mesopotamia seasonal spelling study has been continued by the co-operation of Mr Errol Costello and the director with Mr D. G. Clarke of the Biochemistry Department, Lincoln College. All important botanical components of semi-improved swards have now been evaluated for digestibility and biochemical constituents at two fertility levels and at several times of the year.

The co-operative study of the biochemical constitution of *Festuca novae zelandiae* (Fescue tussock) has been developed by Mr Ross Mackenzie in the Biochemistry Department in comparison with *Festuca matthewsii*. The measured change in distribution of sclerenchyma in fescue tussock as a consequence of improved soil fertility is now being experimentally examined in relation to biochemical constitution. The increased acceptability of fescue tussock to sheep following topdressing may now be explained but further research is needed to explain any improvement in digestibility that may accompany such change in acceptability.

The field study of the utilisation of fescue tussock and snow tussocks has not been proceeded with until more finance becomes assured for field work. The reconnaissance of insect damage in relation to grazing man-

agement history has been resumed by Dr White since his return from overseas leave but no intensification of field work has been possible under the financial conditions experienced.

Economic management

The Institute has begun the formal assembly of information on those aspects of management more expressly concerned with economic management. With the co-operation of the Department of Lands and Survey and the Valuation Department, Mr Kerr has collated most of the information in the light of physical classifications of pastoral resources and the Institute records on pastoral production. Consistent with previous Institute policy in such matters no information concerning individual properties will be published but where it is possible to derive lessons of public interest and benefit appropriate publications may be prepared.

Systems Sector

The work of publishing the 12 principal scientific papers deriving from the study of mineral composition of tall tussocks by Mr P. A. Williams has been continued since Mr Williams was appointed to Botany Division, DSIR.

Nitrogen transformations under tall tussocks have been studied by Mr G. D. McSweeney, Hellaby Fellow at the Institute in preparation for more detailed experimental work on mineral nutrition of tall tussocks. In this work Professor J. B. Robinson of the University of Guelph was able to co-operate during his visit last summer with the Microbiology Department of Lincoln College. The Hellaby Indigenous Grasslands Trust generously assisted this work by bearing the cost of all field travel in 1976/77.

The systems modelling on production consumption systems which Dr E. G. White began as a refresher leave programme with Natural Resources Ecology Laboratory in Colorado has been developed and modified

better to suit New Zealand conditions. The expansion of this systems research has been proposed in a recent submission for contract support in conjunction with the Agricultural Economics Research Unit at Lincoln College.

General Extension

Every effort was made during 1976/77 to avoid curtailing extension work in the face of financial stringency. Since taking up his duties as management officer in June 1976 Mr Kerr has established working relations with agencies concerned with tussock grasslands and mountain lands from Southland to Marlborough.

An innovation during 1976/77 was to hold four regional seminars at Queenstown, Blenheim, Lincoln and Timaru to which officers of all agencies were invited for a series of presentations and discussions. These seminars have been more fully reported in *Review*. It is intended that they should become an annual event in the same or similar form. Field days were participated in and lectures given at high-country section meetings. Formal liaison has been maintained with the Protection Forest Advisory Committee and with the Mountain Catchments Committee of the Soil Conservation and Rivers Control Council. Because of financial limitations it was not possible to respond to all invitations to visit individual run properties. Preparations have been made

for repeating the Pastoral Production Survey if sufficient funding is assured in 1977/78.

International Visits

Dr E. G. White spent nine months overseas during 1976 on refresher leave. Systems research constituted an important part of his overseas study, including a four-month working stay at the National Resources Ecology Laboratory in Colorado and a shorter working stay with Dr W. Moser at Alpine Forschungsstelle, Obergurgl, of the University of Innsbruck, Austria. He also gave several lectures on his research in population ecology and established working relationships in this field with other centres in North America, Europe and Japan.

The director visited the University of West Virginia to present an invited paper at the International Symposium on Hill Lands. This was followed by short visits to pasture research centres in Ohio and Pennsylvania and a week's visit to the Hill Farming Research Organisation in Scotland. The Institute deeply appreciates the interested encouragement which the director and staff, as well as members of its Committee of Management, have enjoyed from HFRO, its director and staff.

The Institute was favoured in this last year by a visit for several weeks from Dr Robert E. Dils from Colorado State University and Mrs Dils. During this period the Institute was also host for a shorter stay by Professor John Burton from the University of New England. These visitors were able to co-operate with Mr Hayward in the preparation and evaluation of a review of hydrological research in the tussock grasslands and mountain lands. This being Dr Dils' second sustained visit to the Institute, it was invaluable to the Committee of Management, director and staff in the review of the Institute's policy, goals and objectives. The fruits of this review are expected to be shown in the years ahead.

J. M. Wardell
for the Committee of Management



High-country production

K. F. O'Connor, Director

Several features of the current high-country pastoral production scene warrant attention. Many of these engage the attention of the Institute at the present time. The research efforts of other agencies are also directed in various ways at many of these topics but it is evident that there is no general cohesive understanding of many of the issues involved. The comments that follow are designed to provide a focus for efforts at such a more general understanding.

Current trends in high-country pastoral production

There has been widening interest in the recent pastoral production record of the high country. Complete enumeration surveys of production conducted by the late J. G. Hughes and his associates for the Institute for the years 1965/66, 1966/67, 1971/72 and 1972/73 indicate that substantial growth in high-country livestock numbers and in livestock output occurred in the net six-year period when the pastoral industry of the nation as a whole remained somewhat stagnant. Whether such growth has been maintained can only be surmised until these surveys are repeated over the next two seasons by the staff of the Institute.

The sample survey conducted annually by the Economic Service of the Meat and Wool Boards suggests that the high country has shared in some degree in the arresting of growth which has affected the national sheep industry in the last few years. A series of graphs is here presented of salient features of high-country production derived from that published source. (These values are, of necessity, compared on the basis of an "average" run, with no implication that any one run represents such an average.) It should also be carefully noted that small

variations in the sample of runs from one year to another may be associated with appreciable changes in values which do not necessarily reflect real changes in the population as a whole from which the sample is drawn. Such changes in sample size are noteworthy from 1968/69 to 1969/70 and especially from 1973/74 to 1974/75.

In Table 1 the changes from the mean for 1965/66 and 1966/67 to the mean of 1971/72 and 1972/73 are presented for several items of high-country pastoral farming from two sources — (i) the sample survey information from the Economic Service summarised in the foregoing figures, and (ii) the comparison for the two periods from 283 runs surveyed by Hughes (1974). It is evident from this table that there are some differences in the absolute values between the sample survey and what was virtually a complete enumeration survey. Trends shown by percentage change are, however, similar with the sample survey appearing slightly to overestimate sheep numbers. Noteworthy elements are relatively small increases over the net six-year period in numbers of sheep shorn and wool produced and substantial increases in cattle numbers. The increased production per hectare of meat shown from the Economic Service surveys is corroborated by substantial increases in livestock sales, especially of lambs and cattle, shown by Hughes (1974).

In the light of this corroboration and the apparent indicative validity of the Economic Service surveys, their evidence of failure to maintain growth in sheep numbers and wool production as shown in Figure 1 during the early 1970s is disturbing. It is evident from Figure 2 that the increase up to 1973/74 in total stock units per run has been brought about by an increase in cattle numbers.

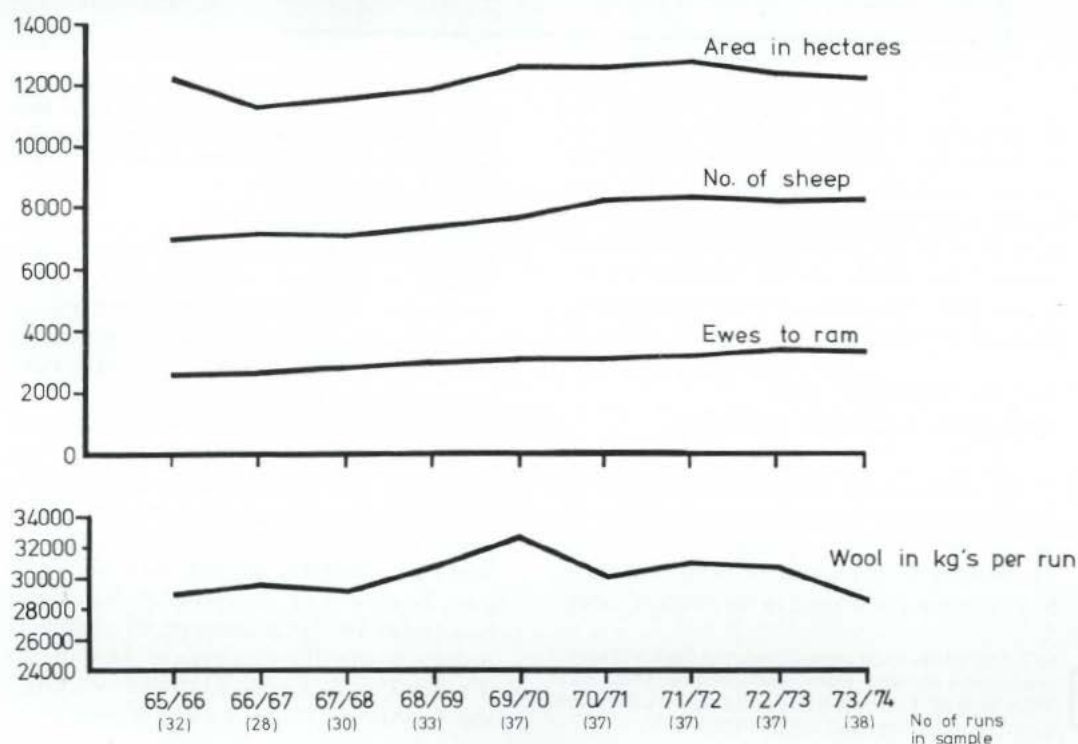
It is emphasised that the substantial change in sample size from 1973/74 to

Table 1: A comparison of high-country survey results

	NZM & W Boards' Economic Service Sample Survey			TGMLI Complete Enumeration Survey		
	1965/67	1971/73	% Increase	1965/67	1971/73	% Increase
Sheep numbers	6,944	8,238	18	5,534	6,040	9
Ewes to ram	2,440	3,256	33	2,394	2,865	20
Lambing percent	78	82	5	80	85	6
Cattle s.u's	535	1,424	166	941	1,860	98
Sheep s.u's	6,208	7,022	13	4,681	5,173	12
Total s.u's	6,743	8,446	25	5,622	7,033	25
Wool (kg)	29,325	30,589	4	21,243	23,086	9

1974/75, accompanied by a substantial change in average area, average total stock units and average labour units gives little basis for inference from these data from 1973/74 to 1974/75. This change in sample

was designed to bring the sample survey more in line with the situation for the whole population as in the "average" derived from the Institute periodic but complete enumeration survey. These Institute surveys are to



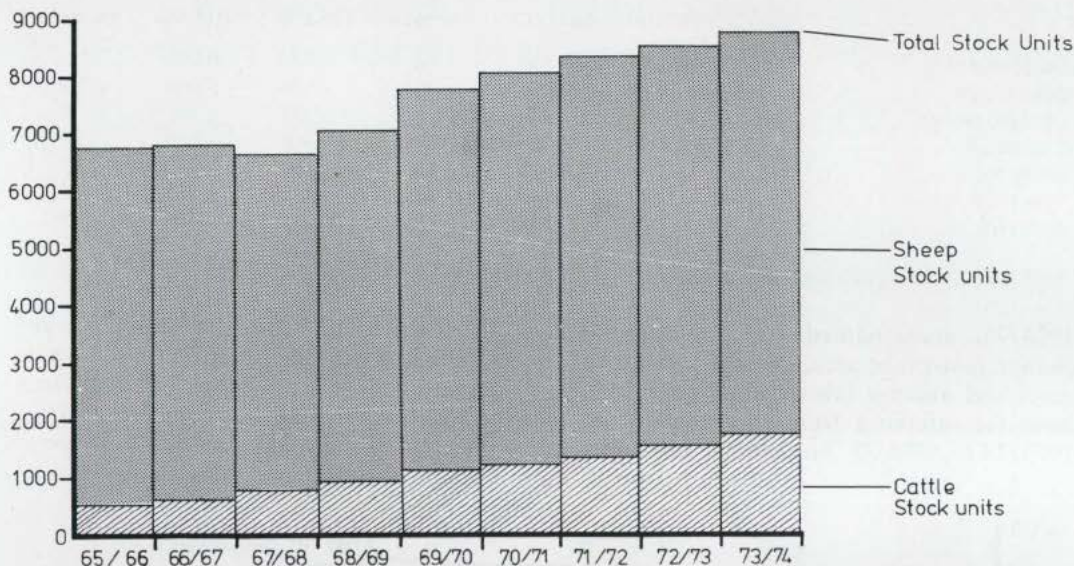
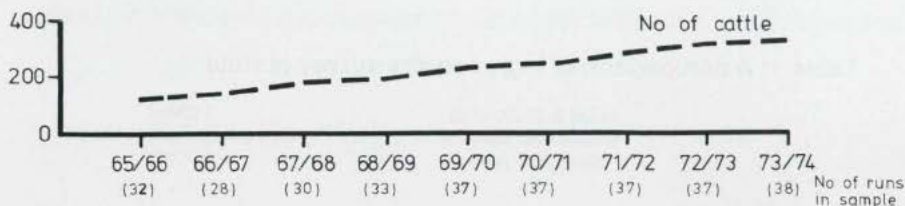


FIGURE 2: Mean run cattle numbers and sheep, cattle and total stock units, derived from New Zealand Meat and Wool Boards' Economic Service sample surveys of high-country runs 1965/66 to 1973/74.

be repeated over the next two seasons to establish the true current situation with greater confidence and precision. On the indications of the Economic Service results at least to 1973/74, it would be imprudent to assume that steady growth has been maintained in the sheep sector of the high-country pastoral industry.

Land utilisation and retirement of high country

The increase in livestock numbers and production from the high country which has been reported, for example, in sheep numbers in the Mackenzie in the last 30 years by O'Connor (1976) and in numbers of sheep

and cattle, wool and stock sales over virtually all high-country runs in the six years to 1972 by Hughes (1974) has been achieved on substantially reduced area. It is widely thought that this contraction of area has been brought about by the land retirement programme of the Soil Conservation and Rivers Control Council as an integral part of the water and soil conservation run plans administered by the catchment authorities. This programme has played a significant part. More than 100,000 hectares were shown as already retired in this programme as at 1 November 1972 in a summary by catchment district in the "Proceedings of Meeting on 'Future Use of Lands Retired from Grazing'" (Anon., 1973). Land retirement al-

FIGURE 1: Mean run area, sheep numbers and wool production derived from New Zealand Meat and Wool Boards' Economic Service sample surveys of high-country runs 1965/66 to 1973/74.

ready achieved by the water and soil conservation programme was revised up to some 240,000 hectares by 1976 (Gibson, 1977; Poole, 1977).

It has been pointed out by the present Director-General of Lands, in discussion at the November 1972 retired lands meeting (Anon., 1973, pp. 30-32), that in addition to some 135,000 hectares retired under run plans as at 31 March 1972, land which was still included under pastoral lease or pastoral occupation licence, there were some 244,000 hectares which had been excluded from Crown lease on lease expiry and had become vacant Crown land. It was also noted that there was a third category, considerable areas which were no longer stocked even though remaining within leases and not subject to formal run plans.

Hughes *et al.* (1974), after interviewing all high-country runholders, calculated the areas of high-country runs that were reported as used for cattle grazing and sheep grazing, alone and in combination, and of that which was reported as not used for grazing, although still retained in title. This last was found to be 568,431 hectares or 18 percent of the total 3,214,000 hectares occupied in high-country runs, as shown in Table 1b of Hughes *et al.* (1974).

It should be noted that the water and soil conservation programme summaries of land retirement (Anon., 1973; Gibson, 1977; Poole, 1977) include some land which is not part of the high-country runs enumerated by Hughes *et al.* (1974). It should also be noted that the Crown leases which expired so that 244,000 hectares of land became vacant Crown land may also have included considerable areas which were not part of the high-country runs as described and listed by Hughes. It is clear, however, from Hughes *et al.* (1974) that the total area reported as "not used for grazing" on high-country runs, some 568,000 hectares, is distinct from and additional to the 244,000 hectares of land no longer held under lease or licence. It is possible that land designated for retirement but not yet effectively retired may have been included in some cases as land "not used for

grazing." From this review, however, is it inferred that some 800,000 hectares that were grazed in the past, perhaps 20 or 30 years ago, are no longer grazed. It is further evident from Gibson's (1977) and Poole's (1977) summaries that no more than 400,000 hectares have been or are in the process of being retired under the water and soil conservation programme.

It seems important now, as it did in the 1972 retired lands meeting, to understand the ecological forces and the farming forces at work for the retirement of land. For this reason among others, the Institute has begun during the last year a pilot survey of pastoral utilisation on high-country runs to obtain more detailed information of seasonal use of different kinds of terrain, whether unimproved, partly improved or fully improved. It would be premature to draw bold conclusions from detailed analysis of grazing use from only 40 sample runs, 10 runs each from four of the seven broad zones into which Hughes *et al.* (1974) has classified the high-country runs. From this initial survey of pastoral utilisation, however, there is some support for the view that pasture development often leads runholders to keep their stock fenced in on developed country at times when, in earlier years they would have put them out on the tops. The provision of "off-site grazing" appears justified as a function of run planning, in order to avoid the need for regular use of lands in need of rest or retirement from grazing. What is also evident, however, is that pasture development in the montane zone, generally below 1,000m altitude, has not been readily achieved to a level where it can ensure provision of summer feed in drier than average years. It is understandable, therefore, that the runholder may wish to keep his options a little more open than what he fears is likely under an official water and soil conservation run plan.

The difficulty and cost of mustering is frequently cited as a reason for voluntary retirement of high-altitude country. The severity of losses of stock on such terrain is also suggested as a factor influencing land

retirement. Without a careful and unbiased interview procedure, it would be difficult to determine the importance of such factors. From analysis of the Economic Service's sample surveys, the amount spent on wages as a proportion of total farm expenditure is higher for the South Island high country than for any other class of sheep farm. Moreover, the amount of wages per stock unit on South Island high-country farms continues to remain higher than that on all classes of sheep farms other than South Island mixed-fattening farms. At the same time the gross income per stock unit tends to be lower on South Island high-country farms than on all other classes of sheep farms. In such circumstances, it would not be surprising if labour for extra high-altitude mustering and shepherding were reduced or diverted into more productive channels. During the last decade, the high-country runs sampled by the Economic Service have maintained a fairly steady four labour units per run. It is also noteworthy that over the last few years, when calculated stock losses have been published, there is little evidence in these surveys of any greater loss rate among sheep or cattle on high-country runs than on any other class of sheep farm, apart from a slight rise apparently associated with the snow of 1973. The resilience of high-country properties on which development was being practised has already been noted by Mars (1972) in commenting on the economic effects of the snow of 1967 on high-country properties.

No matter what the motivation of runholders, whether it be economics of farming or resource conservation, with or without an official plan, it is now plainly evident that there has been substantial reduction in the area of high country used for grazing. It is evident from the regional data of Hughes *et al.* (1974) that this reduction has been especially marked in those higher rainfall zones of the mountains. These same zones are also those which demonstrated least improvement in production from 1965/67 to 1971/73 (Hughes, 1974). It is also evident from examination of individual cases that

runholders vary greatly one from another in their motivation and ambition, even while occupying similar terrain. It would be a bold analyst indeed who would find a close relationship between actual land retirement and resource conservation among high-country runs generally.

Herbage productivity and livestock output

It is a special irony that so much attention has been given of recent years to the question of land retirement and so little to the matters of utilisation of herbage on land that is grazed by domestic stock. Runholders have spent increasing amounts of their own money, supplemented in some cases by Government grant, on topdressing, fencing, oversowing and the establishment of new pastures and crops, in response to the considerable volume of research evidence of their value. However, there is yet little evidence of concerted pursuit of clear objectives in pasture management or crop utilisation in the high-country. From the current pilot survey of pastoral land utilisation carried out by the Institute there are many examples of terrain on one run or on one part of a run supporting 10 to 20 times the stocking load that is carried on similarly treated terrain nearby. The truth of Dr Peter Sears' phrase "to grow grass you have to eat grass" has already been demonstrated experimentally in the high country (O'Connor and Clifford, 1966). In reviewing such work where the benefit of herbage production from periodic hard grazing over periodic lax grazing varied from 46 to 95 percent, Scott (1977) wrote: "Results to date suggest that the subdivision and rotational mob stocking implied should be objectives in high-country development." Preliminary results of the Institute's pilot survey show that many semi-intensively managed oversown hill pastures in the high country are now providing more than 60 stock unit months of grazing per hectare per year. Others with similar soils and topdressing history are providing fewer than six stock unit months

per hectare. It used to be an adage of Sir Bruce Levy concerning pasture development that until you had three sheep per acre, the sheep were working against you. Once you had three sheep per acre (90 stock unit months per hectare), the sheep were working for you. What such threshold should be in a high-country climate is a matter of speculation in default of measurement. In pastures as in international affairs, it seems that the rich get richer and the poor get poorer.

It is evident that subdivision fencing may be necessary but no amount of subdivision will suffice if these fences do not enclose stock. The evidence of McLeod (1974), on top of like lessons from earlier experiments in the Upper Waitaki (O'Connor, 1966), is that differences in herbage production between unfertilised and fertilised clover-oversown grasslands which were initially less than two-fold expanded under twice-yearly grazing to more than six-fold and even more than ten-fold in high rainfall years. At all three of McLeod's high-country sites and at all of the five earlier grazing experiment sites in the Upper Waitaki, sufficient herbage was produced in every year from moderately fertilised sites to provide 50 stock unit months per hectare of reasonably efficient grazing. In high rainfall years, the growth of herbage on all eight sites was sufficient to provide 140 stock unit months of grazing per hectare and in extreme cases more than 350 stock unit months per hectare!

Hughes (1974) demonstrated that in the six-year period from 1965/67 to 1971/73 the area of maintenance topdressing of paddocks increased by more than 100 percent to an average of 115 hectares per run, the area of maintenance topdressing of hill pastures increased by more than 50 percent to 155 hectares per run, the area of crops, new pastures and new lucerne increased by 80 percent to more than 50 hectares per run, and the area of new aerial oversowing and topdressing increased by nearly 500 percent to an average of more than 150 hectares per run! The detailed supplement to the 1973/74 Sheep and Beef Farm Survey (Economic Service, 1976) reveals that following the sa-

tisfactory income surplus of 1972/73, fertiliser usage in 1973/74 at 138.8 tonnes was higher per sample farm in the South Island high country than on any other class of sheep farm. Even on a stock unit basis, fertiliser usage on the sample high country runs stood at nearly 16 tonnes per 1,000 stock units, some 65 percent of the national all classes rate per 1,000 stock units. Runholders and their close advisers may well speculate whether this expenditure on pasture improvement and fertiliser can be an investment in the future of pastoral production unless it is matched by commensurate increases in livestock numbers.

More detailed Institute studies of relationship between outputs and inputs such as winter feed provisions, fertiliser use and hill pasture oversowing and topdressing for individual runs in different sectors of the Upper Clutha and the Upper Waitaki reveal that there are wide differences between sectors in the character of these relationships. These differences seem to be most closely related to the moisture regimes and assemblages of soils and landforms which differ from one high-country sector to another. Equally striking, however, is the wide difference in such values as fertiliser usage per 1,000 stock units between different runs in the same sector or district. Greater clarity will have to be sought in some of these puzzling issues before these interpretative studies can be of much use. It will be an added advantage if the impact of stock retention programmes can be included in such studies by the repetition of the Institute's high-country production survey over the next two years.

Climatic influences on herbage utilisation

There is widespread evidence throughout the high country that runholders have become more concerned about winter feed and especially about the relationship of cattle to winter feed. In addition to the expansion of forages already cited from Hughes (1974) and the evidence from

Hughes *et al.* (1974) that by 1972/73, 65 percent of runs were feeding supplements to ewes and 76 percent of runs were feeding supplements to hoggets, there is the evidence from the 1973/74 supplement (Economic Service, 1976) that 7.0 hectares per 1,000 stock units were devoted on sample high-country runs to hay and silage and the growing of winter feed. While this ratio approaches that of South Island hill country farms, it still does not match that of South Island lowland farm classes.

The reliance which runholders had hoped to place for wintering on oversown hill pastures has suffered some serious setbacks in recent years. In some cases, this has arisen from the failure of late summer and autumn rains. In other cases, it is associated with the rapid winter decline in herbage quality in open sward situations, as shown by Allan *et al.* (1976). In an increasing number of instances, it is being attributed by interviewed runholders to the heavier grazing of roughage by cattle, not simply by the reduction in roughage as such but also by the reduction in insulating hamper provided by tussocky growth (Scott, 1961; O'Connor, 1971). Some runholders are now making more determined efforts to manage oversown tussock blocks as special purpose winter feeding areas. More, however, seem to be increasing mechanisation for the handling of hay and silage. The high energy costs of these supplements are indicated from the returns which runholders have supplied to a pilot questionnaire on energy use on high-country farms.

At the present time there seems no clear prospect of low energy cost alternatives for winter supplementation. Perhaps the most important economies will be achieved by having more precise definition of minimal winter-feeding objectives.

The concern with provision for winter which characterises high-country farmers has probably served to reduce the attention given to climatic influences at other times of the year. Herbage production experiments under periodic grazing over the past 15 years have been recently reviewed (O'Connor,

1977) showing the dramatic variations from year to year in herbage production from oversown and topdressed high-country pastures. The significance of spring precipitation in governing these annual herbage yields has also been demonstrated, a feature reinforced by the dramatic results of irrigation experiments carried out in the Mackenzie Basin by Grasslands Division, DSIR (Scott *et al.*, 1975), and at Tara Hills, Oamaru, by the Ministry of Agriculture and Fisheries. In their brief review of irrigated performance and prospects, Kerr and Ives (1973) report levels of herbage production under irrigation sufficient to provide from 150 to more than 360 stock unit months per hectare.

Livestock carrying capacity is changed by an order of magnitude as a consequence of irrigation in all sectors of the high country from the semi-arid zones of Central Otago and the mid-Waitaki to more humid areas such as Grasmere and Godley Peaks. What is perhaps more important is the new freedom in livestock production planning that it gives to the farmer. Unirrigated pastures are especially erratic in summer and autumn production. This unreliability derives mainly from the erratic rainfall not just in summer and autumn but also in spring. Like any other practical farmer, the high-country runholder follows the McMeekan (1953) maxim of adjusting his flock demands to the seasonally controlled feed supply. He does this by control of the reproductive cycle. He plans lambing as early in the spring as he dares to avoid the risk of summer and autumn feed shortages and to try to ensure that his young stock have sufficient time to grow out to a weight where they can winter satisfactorily. Early spring feed, whether on irrigated or dry land pastures, is, however, controlled by temperature. The onset of spring growth is not controllable by man, although its effectiveness in producing herbage is in some degree influenced by soil fertility. In avoiding summer drought by lambing early, the farmer runs the risk of having the critical needs of the last weeks of gestation and early lactation arrive before the spring grass. Even

if he avoids this crisis, he still applies such high grazing pressure in early spring that peak spring pasture growth is retarded or reduced. Ironically, perhaps the most important influence of irrigation on the nutrition of high-country sheep flocks will be in making possible later lambing with autumn flushing for greater ovulation with greater consequential spring feed demands and greater likelihood of seasonal pasture growth to meet them.

The range resources of every high-country run are complex and no simple general system of resource development and utilisation can be promoted that will apply universally without modification. In many cases, the opportunities for irrigation development are not large. In many cases the avoidance of occasional severe summer drought will have to take the form of upward migration as it did in the early days of runholding. In such situations, the prospects are attractive for low fertiliser maintenance in pasture improvement using *Lotus major* in high altitude tall tussock grasslands. In this field, it is worth noting that the current successes of scientists of Grasslands Division of DSIR, Ministry of Agriculture and Fisheries, and of the Institute have had their early stimulus from the successful studies with *Lotus* by the Forest and Range Experiment Station staff of the New Zealand Forest Service in the revegetation of eroded high-altitude lands.

Planning and community action

It is very difficult to envisage how runholders could grapple unaided with the complexities of planning and execution for the pastoral development that is in prospect for each one of them. The human burdens of the city business and governmental executive are serious enough. When to the likes of these burdens are added the difficulties arising from vagaries of weather, the repeated failure of industrial relations in the meat-freezing industry, the competitive demands for attention from salesman, public official and mountain recreationist, and the peren-

nial problems of delivery of everything from tractor parts to fresh bread, then the high-country runholder is trapped in the misty gorges of modern industrial society like the rest of us. It requires great reliability, competence and trust in farm staff. It demands co-operation with neighbours, telephone operators, cartage contractors, bankers, stock agents and advisers. It demands great loyalty and understanding from a wife and family, the latter often too young to appreciate what it is that makes their father so distraught at the very time that they are busy telling what happened on the school bus. It is perfectly understandable that many runholders are reluctant to become trapped in development or show their caution either by nibbling at their opportunities or by diverting their energies into discussions of what the Government ought to do or stop doing.

The central problem for both runholders and the larger community is whether there is any option open but pastoral development. Concerning the runholder's own economic interest, inflationary pressures are increasingly serious for the non-developer, especially if he is not likely to share fully in the unearned increment of land value enjoyed by the freehold farmer. In many areas it is ecologically imperative to develop pastorally to avoid transformation of poor grasslands to shrublands of broom or other shrub weeds. It would seem from the adoption by both the principal political parties of at least the adage: "we must farm our way out of our national economic troubles" that it is in the national interest to develop farming wherever it is ecologically and economically satisfactory to do so. There are few genuinely established grounds for restraining pastoral development for the sake of promoting soil conservation, hydro-electric generation, tourism or any other possible saviours of national solvency. There are clearly land conditions where a combination of more intensive pastoral development with farm forestry would be better than attention to pastoral development alone. There are situations where deer farming would be a valuable adjunct to conventional livestock

production. But pastoral development is an imperative in every sector of the high country. Indeed, only by investing money productively and in genuine harmony with the capabilities of the environment are we likely to be able to afford the restoration or development of resources for aesthetic or any other purposes.

If then pastoral development is so humanly burdensome but so unavoidable, how is the nation to ensure that it should be done? As has been indicated earlier, planning is essential. Planning can only be effective for the objectives which are clearly and fairly kept before the planning agent. Hitherto the planning services which have been made available to runholders have been dominantly oriented to soil conservation objectives. Only a very clear-minded and determined pastoral farmer, dedicated to his own conservation and production objectives, has been in a position to evolve a genuine compromise plan that serves both

parties' objectives as fully and well as they can be served. New Zealand should be asking itself whether it can afford not to join its public services with the aspirations of runholders to plan for a fully productive pastoral future for the high country. It should also be examining whether its administration of such land resources and the conditions of tenure which it offers over them are designed to maintain the past or to facilitate the emergence of a future more in keeping with the ecologic and economic potential. It should be studying the wider conditions of social welfare in the high country with a view to promoting human settlement where it is socially desirable and economically and ecologically feasible. In such examinations and studies, it is imperative that rural communities take a fully active participative role. Only in such a way is it possible that planning for the future of the high country will be genuine planning for its people.

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