NOTES ON PROTECTION FORESTRY IN EUROPE

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INTRODUCTION

This paper presents some notes made during a tour of Europe in 1965 when, during the European summer, the writer worked for six months at the Federal Forest Research Institute, near Zürich, in Switzerland. This was followed by a five-week tour of organizations in Austria, Germany, France, and England, whose activities were in various ways allied to protection forestry. Notes made during this period in Europe were later summarized in a report to the N.Z. Forest Service (Cunningham, 1967), extracts from which are presented here.

MAPPING

Accurate contour maps are essential to good management of mountainlands. Variations in slope profoundly affect vegetation, climate, soils, erosion, and water run-off. Catchment studies, access surveys, and intensive revegetation or torrent control projects all require the detailed portrayal of slope that only a contour map can give. Switzerland is one of the world leaders in alpine cartography.

The use of air photographs for forest management is regarded as very important in Switzerland, and the Forest Research Institute there employs a forester on photogrammetric research. Most of the recent work is described by Kurth and Rhody (1962). Several developments may warrant further mention:

- A bracketed arm on parallel runners and holding stereo apparatus, to facilitate the study of different sets of stereopairs.
- Fine grid scales engraved within the eyepiece tube of a stereoviewer to permit direct assessment of small areas for comparative purposes.
- The "variable" stereoscope. This is a stereoscope with lateral freedom between the mirrors, so that a stereo image can be obtained although the scales of each photo may differ considerably.
- Photo restitution in the negative stage. This is a useful technique for rectification of photographs taken in hilly country. It depends on shaping and printing paper as nearly as possible to the original ground surface during printing.

In France, Professor P. Ozenda at the University of Grenoble has developed a relatively cheap method of colour printing vegetation maps. His large-scale vegetation typing follows the method of Gaussens, which relates colour with broad climate and vegetation classes; the lighter colours, yellow, red and orange, correspond

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to vegetation types of the warmer and drier regions, whereas humid and montane forests are expressed by darker colours such as blues and violets. Colour density varies to correspond with height of the vegetation.

**SEED AND NURSERY WORK**

Direct seeding of forest trees is not often practised in Switzerland and this appears to be the general rule in the European high country. The Swiss consider that good forest management requires establishment by planting.

Forest nurseries in Switzerland are generally small and dispersed, this being largely due to fragmented forest tenures. There is a growing tendency towards large centralized nurseries, but it is probable that small, local, lining-out nurseries will remain in use for many years because of the complications of altitude, spring flushing, and winter snow.

The production of compost is practised as a matter of routine in Swiss forest nurseries. The basic material is hardwood leaves and conifer needles collected locally. Some fertilizer is added (N, P, and K) and also mycorrhiza at a later stage. Equipment for grinding the material and measuring temperatures has been developed. The process takes about four months and costs are in the region of $NZ.3 per cubic yard which is sufficient to treat 50 sq. yd for about two years.

Planting in Switzerland may be carried out through the summer, and into autumn, but spring is the most satisfactory season. Potted plants are gaining favour in Switzerland and western Bavaria (and probably elsewhere) and are considered most important in alpine work.

In eastern Bavaria the Forest Service has maintained a large central nursery (at Laufen, near Teisendorf) since about 1915. This covers 100 acres, of which about 40 acres are used for seed orchards, 30 acres for raising tree stocks, and 30 acres to permit crop rotation. Annual production is about 1½ million plants, mostly *Pinus sylvestris*, *Larix decidua* and *Picea excelsa*, but includes also beech, oak, fir, alder, and poplar. Most of these trees are destined for mountain country and, as the nursery is at the relatively low altitude of 2,000 ft, the seedlings have to be held in check for some months between lifting and planting. For this purpose special cool-rooms were recently built. These rooms can store about 800,000 plants at a temperature just above freezing and a humidity of 95%. The seed extraction and storage building is on a grand scale in order to cope with variation in seed years; seed is cool-stored in airtight containers. There is a strict seed certification system.

**MYCOLOGY**

Mycorrhizas are given much attention for alpine re-afforestation in Austria and Switzerland.

At Imst (Austria) Prof. M. Moser runs a laboratory for the study and supply of mycorrhizas. Study includes Indol production, mycorrhizal strains, cultivation, and inoculation techniques. The laboratory supplies to nurseries on request suitable mycorrhiza strains from bulk cultures, chiefly for *Pinus cembra* and *Larix decidua* destined for planting on alpine sites.
Bulk cultures are grown in peat and vermiculite and, more recently, in water. The latter is an isotonic solution using sterilized air and water and magnetic agitators to permit mycelial development throughout the solution.

CLIMATOLOGY

(1) Precipitation

Dr J. Grunow is one of Europe’s leading authorities in the study of precipitation and the writer was pleased to have an opportunity to visit the meteorological station he directs at Höhenpeissenburg in Bavaria. One of his developments is the “fog catcher”, a wire mesh cylinder set above a raingauge to simulate the action of a plant in tapping the moisture in mist. This instrument is now mass produced by the Fuess company and is used in several countries. Studies to date suggest that mist increases precipitation value by about 30% in the European Alps and in some areas by over 100% (Grunow, 1964). Grunow is most emphatic that the orifice of a raingauge should be parallel with the slope, and has developed a device for conversion of gauges set horizontally. This theory is argued out fully in his 1953 paper, where he shows that the catch difference between “parallel” and horizontal orifices can vary by as much as 30%.

Totalizing gauges, particularly those set well above the ground to catch snow, run up against the problem of wind. Wind shields seen in the French and Swiss Alps were generally in the form of an inverted truncated cone, but at Höhenpeissenburg (where, presumably, wind problems are greater) suspended movable baffles are preferred and various types were being tested.

In his 1961 paper, Grunow describes a method of recording snow quantity (in terms of water content) by the use of radioactivity. The radioactive container is set at ground level and a geiger counter is suspended directly above at a height exceeding the expected snow depth. Wave emissions are influenced by the water content of the overlying snow and can be recorded directly or amplified and transmitted to a receiving station. French scientists had installed one of these at the Col de Porte, near Grenoble, but they had buried the geiger counter to protect it from fluctuating temperatures. This meant that a very strong support was needed to suspend the isotope with its half ton of lead screening.

Grunow demonstrated two novel methods of measuring rainfall intensity and duration which are worth a mention although they require a good supply of electricity. The intensity measurement is made by leading the water droplets between electrodes to complete a circuit and evaporate the water. The quantity of electricity thus used can be recorded directly on a chart. A similar principle is used for duration; a hexagonal roller turns once every minute so that each face is in turn parallel to the orifice. Each face is electrically wound so that contact of a raindrop or snowflake creates a short-circuit, producing an impulse on a time-chart. Both instruments are accurate down to the minute level or less. An outline is given in his 1961 paper.

Raindrop size is important in erosion studies. By automatically feeding a litmus-type paper under a rectangular orifice, and drying the paper electrically, a specific pattern is left for each raindrop or snowflake.
Grunow conducted trials of several types of recording raingauge, and suggested that a suitable type for New Zealand purposes (because it can handle snowfalls without having heating installed) is the instrument developed by the Fuess company in 1959. This incorporates a long (to collect accumulated snow) funnel, in which the weight of precipitation is recorded. An outline of this is given in his 1963 paper.

(2) Temperature and Humidity

Mercury in glass thermometers and clockwork thermographs for measuring temperature are largely being superseded in research work by constant recording with low voltage electronic equipment. Popular recording devices are the U.S. "Speedomax" which records 12 variables simultaneously, and various models of Philips, the latest of which can handle 24 variables.

The Meteorological Institute of the University of Munich, headed by Professor F. Möller, was the most advanced meteorological research organization encountered. Now that electronics is well established in the meteorological field, there is a close and productive liaison between this Institute and the physics department of the University. The Munich workers were converting impulses directly to a continuous stream of typewritten data, the millivolt recorders giving a visual pattern concurrently to permit a check on instruments.

The obvious next step is to get these impulses stored on tape for direct feeding to computer. This need has been met in England by the development of the Limpet Logger.

Dr A. Baumgartner (Bavaria) used mercury in glass minimum thermometers on a recent alpine study at Fichtelgebirge, setting the instruments in a special container which may be of some use in New Zealand—a sample device is held at F.R.E.S., Napier.

Swiss forest research workers sometimes use the method of sugar inversion to measure mean temperature over a period of several days or weeks. From a large stock solution, glass ampoules are filled, sealed, and frozen until required. After use the degree of sugar inversion (which is a function of temperature and time) is determined by polarimetry.

At Stillberg-Dischma in Switzerland, Rochat has developed an ingenious humidity instrument based on the hypsometer principle, and using thermistors. Readings are recorded electronically at the desired intervals.

A variety of devices has been developed for placing instruments at the various required heights above the ground. The most elaborate structure seen was at Col de Porte (France) where the aim is to keep all instruments a constant height above the surface (including snow). In winter this is achieved by a mechanical arm which each hour swings down and "feels" for the surface, if necessary adjusting the rig (on which instruments are carried) electronically to the correct height. At Weissfluhjoch (Switzerland) a screen containing meteorological instruments is manually wound up and down a steel tower depending on snow depth. Baumgartner's tower in a forest near Munich is 90 ft tall, and another Munich worker, Dr Roth, has a tower of 150 ft, up which instruments are placed in logarithmic progression.
Radiation

The study of solar radiation seems to be fashionable. At many stations where vegetation and microclimate are studied, pyranometers are a routine installation and record both reflected and direct light. At Col de Porte periodic air blasts are piped on to these instruments to blow off accumulations of snow.

Wind

Dr W. Nägeli of Switzerland, whose consuming interest has been the study of wind in relation to forestry, has extended his work to alpine environments at Stillberg-Dischma during recent years. He has developed a delicate recording anemometer of which the cups are made from halved table-tennis balls and which can record direction as well as velocity. These instruments are used even up to 6,000 ft, as the Swiss believe that even very slight air movements are important in alpine microclimatology. The high maintenance required on these instruments is a disadvantage, and although they overcome the inertia problem they fail to register wind peaks accurately. Heavier anemometers have the problem of inertia, and Dr Roth of Munich has attempted to overcome this by installing electric motors in each anemometer so that the base is continually turning, wind values being expressed by the difference between base revolutions and cup revolutions.

Although there is a stability in methods of measuring wind force and direction that contrasts with measurements of temperature, the two developments described above have little applicability to New Zealand protection forest problems. On the other hand, a recording anemometer (Type 1482) recently developed by Lambrecht appears to be close to our requirements. It is portable, solid, records direction and force continually for two months and can handle velocities up to 90 mph.

RE-AFFORESTATION AND REVEGETATION

Switzerland

Revegetation of eroding areas in Switzerland seems to have reached the happy stage of being more or less routine procedure handled by local foresters—presumably the result of a century of practice and experience in such work. Exploitation of mountainlands for grazing and agriculture had led, in the middle of the last century, to serious erosion problems. Between 1876 and 1956, 70,000 acres of new forest were established at a cost of $N.Z.16 million. From 1862 to 1956 an additional $N.Z.137 million was spent on works for the control of streams and rivers (Zurcher, 1959). The laws, established in the 1890s, prohibiting clearfelling of forest in Switzerland are still rigidly followed throughout the country, and play a major role in forest policy and management.

Re-afforestation studies by the Swiss Federal Forest Research Institute are conducted chiefly in two regions. On of these is in the southern province of Tessin where canker disease has destroyed extensive chestnut forests. In this instance a species trial programme is being conducted in a search for alternative tree species.
One of the most impressive species here is Douglas fir, which at age 6 is putting on height growths of 3 ft annually (rainfall is about 70 in.).

The second research area includes the alpine re-afforestation experiments run by the Swiss F.R.I. in the eastern canton of Grisons, above the ski resort of Davos. These are designed to cope with the problems of re-afforestation in areas of high snow avalanche frequency, at altitudes of up to 7,200 ft (the natural timber line). The localities are Davos-Weissfluhjoch and Stillberg-Dischma. At the latter site, intensive species trials have been established since 1960 with *Picea excelsa*, *P. omorika*, *Larix decidua*, *Pinus cembra* and *P. montana*. *Pinus contorta* has not been used; the only explanation the writer can offer for this omission is a native reluctance to introduce the plant from America. *Pinus mugo* was not used in these trials as it is unsuitable for avalanche protection, but it is quite widely used elsewhere for erosion control. At Stillberg-Dischma, the species trial study is coupled with an extensive examination of meso- and microclimates.

(2) Austria

In the vicinity of Innsbruck, the writer was shown a number of field projects by Dr H. M. Schiechtl, author of the book *Grundlagen der Grünverbauung*, one of the most comprehensive works on alpine revegetation. It was hoped to visit the Zillertal, a very large project where torrent control, avalanche control, and re-afforestation are combined in a massive effort to protect a 50,000 acre side valley of the Inn River, but a recent snowfall made such a visit impractical. Total cost of the Ziller project will be over $N.Z.6 million.

One of the most common techniques used by Schiechtl is called "buschlagen". This consists of willow cuttings about 3 ft long set horizontally into the slope so that only about 6 in. of stick protrudes. Such layerings are made on benches cut along the contour, at vertical intervals of about 3 or 4 ft. *Salix purpurea* or *S. incana* are frequently used, and sometimes also *S. nigricans*, *S. alba*, *S. daphnoides*, and *S. viminalis*. During the same season the area is sown with herbaceous plants — lupins, clovers, cocksfoot, and others — the idea being to have many species and to include a high (up to 40%) proportion of legumes. Planting is later carried out between the lines of willow cuttings; again a variety of species is favoured, a popular mixture being *Alnus incana*, *Pinus sylvestris*, and *Larix decidua*. A mixture of species appears to be favoured because it gives the resultant vegetation better protection from fire or disease and because it provides richer litter and builds up a better soil. Sometimes, if the slip is within a forest, *Alnus* alone is considered sufficient, as the conifers will "seed in" later.

On steep roadside cuttings, where tall vegetation is not always desirable, grass is established on the raw surface in the space of two months by lightly laying straw, criss-crossed, and fixing it in position with a non-toxic bituminous emulsion. On very hard sites, pegs and fine wire may also be used. On this is sown a rich grass mixture, sometimes with a basic fertilizer containing N, P and K.
Costs of this work vary with access; the roadside grasing ran from $N.Z.55 to $N.Z.100 per square chain and the re-afforestation of slips ran to $N.Z.1,000 or more per acre.

A wide range of examples of this work was examined, from roadside cuttings and fills which had been completely revegetated (with grass) in two months, to an old slip 16 years after planting — now an alder thicket in which conifers are appearing. The same methods are used satisfactorily on gully erosion and the gullies being treated appear to be no less difficult than those in New Zealand.

(3) Germany

In Bavaria, a recent snowfall prevented an inspection of work at the upper forest limit, but with Dr J. Karl, of Munich, forester for the Bavarian Water Control Institute, the writer visited the Halblech catchment near Füssen, in the Bavarian foothills. This is not their most eroded catchment, but it is one of their greatest flood hazards. Normal flow is 18 cusecs but floods of up to 700 cusecs may occur each summer, bringing down much shingle. Catchment area is 12,000 acres, of which 2% consists of erosion surface. (The comparable figure for the Tutaekuri catchment in Hawke’s Bay is 10%).

The rock is siliceous limestone, at first sight not unlike the harder phases of New Zealand greywacke. The erosion problem derives from the overburden of moraine conglomerate dating from the last ice age. The catchment is not particularly steep and was formerly forested (*Picea, Abies* and *Fagus*). During the past century it has been subjected to heavy grazing by cattle and deer. The deep-rooted but palatable trees (*Fagus* and *Sorbus*) were eliminated, to leave a forest of shallow-rooted *Picea*. Over the past 10 to 20 years considerable gullying and slumping has developed.

Management measures include the restriction of cattle to gentle slopes and the control of deer. Deer numbers had risen to about 3 per 100 acres following the decline of former predators (bear, wolf, lynx, wild cat); private hunting has now reduced this figure to between 1 and 2 deer per 100 acres. In addition, a $N.Z.3 million, 10-year anti-erosion programme was commenced in 1963. The first step was road construction up the main watercourses and around the tops. Large concrete check dams are being built in the main streams in the regions of stream bank erosion and, where such banks are less than a 50° slope, contour “buschlagen” is practised, using *Salix purpurea* and *Alnus incana*. Eroding tributaries are similarly treated, though here small log or stone dams replace concrete, and access is by rail trolley (short haul) or cableway (longer haul). Elsewhere in the area, planting of *Fagus, Abies, Acer, Sorbus* and poplar is undertaken to enrich the structure of the forest and retard the development of deep slumping.

Near Freiburg, Dr R. Zundel showed the writer a little of the Black Forest. He confirmed that local policy is to create mixed stands as a measure of protection, even though some of the hardwoods may not have a high economic value. Here (unlike nearby Switzerland) small area clear felling is practised, and so is the use of introduced trees; there are some fine stands of Douglas fir near Freiburg.
TORRENT CONTROL

(1) Switzerland

During weekends the writer examined with interest a great many structures for the stabilization of slopes and the control of torrents and rivers. Most significant, perhaps, was the observation that torrent control measures of some sort can be encountered in almost any tributary stream throughout the country.

(2) Austria

With Dr H. Aulitzky, chief of the Tyrolean Avalanche and Torrent Control Institute, various types of check dams for torrent control work around Innsbruck were examined. These are considered necessary prior to attempting control of gully erosion. To bring a single torrent under control may cost $N.Z.500,000 or $N.Z.1 million. In an attempt to bring costs down Aulitzky is experimenting with the construction of check dams and retaining walls simply by crane piling stones. This involves the use of more material than building with concrete or masonry, but it reduces labour costs. Total construction costs have been decimated, but the technique is not yet well developed. Access for heavy machinery is of course essential.

The annual expenditure on avalanche and torrent control in the Tyrol is about $N.Z.1 million on problem areas totalling some 80,000 acres. Total area of the province of Tyrol is about 6,000 square miles.

(3) France

From Grenoble a day was spent inspecting torrent control work near St. Jean-de-Maurienne, in the Arc Valley, a tributary of the Isere.

It snowed steadily all day and one learnt more of French hospitality than of protection forestry. In fact, the tour became a sort of sophisticated pub-crawl, a development which it would clearly have been undiplomatic to resist.

From ground observations, maps, photographs, and discussion, it was clearly demonstrated that in this area the French have a big torrent control problem—it is an area where Flysch, Lias, and Trias rocks are exposed between the harder schists and gneisses of the bordering mountains. One of the streams visited, the Pontamafry, has extensive slips and slumping in its upper headwaters as a result of the earlier removal of forest. It had been under control for half a century but in the winter of 1964-5 massive earth movements led to $N.Z.600,000 of damage to important road and rail links with Italy. About the same amount will be required to repair check dams, revegetate certain areas, and divert (by tunnel) much of the stream flow to an adjacent less vulnerable catchment.

The local climate and soil are reasonably favourable for reafforestation; the major problem is one of mechanical stabilization for the 20 to 50 year period necessary to re-establish the forests.
England

Hunting Surveys Ltd. (Hertfordshire) have recently completed several years' work on a survey and recommendations regarding severely eroded catchments in the Calabria region of Italy. The situation arose from deforestation and the problem now appears greater than that in New Zealand. Their report to the Italian Government made it clear that the construction of check dams was considered essential to the achievement of river control. This report also demonstrated the necessity for good maps and the need for ecological surveys in conjunction with intensive watershed management.

Huntings had also just completed a watershed management report for the West Pakistan Water and Power Development Authority (the Mangla Watershed Management Study). Erosion in the Mangla tributary is feeding much debris into the Jhelum river, for which a large hydro dam is planned. In order to control the Mangla, the report calls not only for stabilization structures and revegetation but also requires sweeping changes in local legislation, tenures, and social customs. Of particular interest was the design of tributary check dams (using local boulders) not unlike those available in New Zealand rivers.

DEER RESEARCH AND CONTROL

A Zürich botanist, Dr Klotzli, has studied the feeding habits of roe deer in Switzerland. Roe deer population in the Sihlwald beech forest, near Zürich, was said to be 8 per 100 acres, which (in this rolling topography with stable soils) is not enough to cause erosion, although it considerably influenced the botanical structure. The highest roe deer population in Canton Zürich was 12 per 100 acres. Less than 4, and preferably as few as 1 or 2 per 100 acres, was a desirable level for good forest management. Red deer are rare in this part of Switzerland.

The Director of the Swiss National Park, Dr R. Schloeth, has since 1958 been studying red deer in the east of Switzerland. As in Bavaria, the pattern seems to be a rise in the red deer population level dating from the early part of this century, owing to protection and the extinction of former predators. Elsewhere, deer control is chiefly a matter of regulating private hunters, but in the National Park all animals are protected. Here the red deer population is 4 per 100 acres (chamois, ibex, and other animals are also present). Although there are many erosion surfaces in the Park, there was little evidence that it resulted from the ungulate population, although they probably aggravate it slightly. The chief red deer problem is their winter raiding of surrounding farms. During winter Schloeth lures them into corrals and marks them for later observation, using leather collar bands interwoven with fluorescent nylon, and aluminium stamped ear tags. In a good winter he can handle up to 300 animals. Total number of red deer in the Park is 1,300; consistency of the annual assessment figures indicates a high order of accuracy.

In the Black Forest of Germany, Dr E. König is working chiefly on the protection of timber trees against red deer. The total cost of protection plus research is about $N.Z.0.40 per acre annually.
over the whole region. Some of König's work is concerned with protection of individual trees, for which he uses two methods:

(1) Damaging the bark and phloem over the browse range in order to stimulate early maturity of rough, unpalatable bark. This scarifying takes 2 to 4 minutes per tree.

(2) Spraying or brushing juvenile trees with a repellent. This is usually done in autumn and costs about $N.Z.0.05 per tree. The writer was shown two mechanical repellents—one was the bituminous substance used for erosion control; the other was a thick white paste of calcium hydroxide.

As in Switzerland, foresters in the Black Forest fence off small areas of newly planted trees (particularly palatables such as Fagus, Abies and Pseudotsuga) as a check against deer browsing. Areas involved are generally less than ¼ acre in Switzerland because of the selection system of management, and fences there are rarely over 5 ft tall. In the Black Forest fences may be 6 ft or more high, and areas involved may be 10 to 15 acres. Deer fencing of greater areas is not considered to be very effective (in Scotland much larger areas are deer fenced after planting).

In Baden-Wurtemburg, the State keeps a tight control over private hunting to keep the population constant at about 1 red deer per 100 acres. The annual deer population census (one of König's tasks) forms the basis of determining the number and locality of deer to be killed in the following season. The State also applies some control measures itself on occasion, but these are more in the nature of a culling operation.

König's annual census is derived from three sources: observations recorded by private hunters; observations by forest rangers, and direct counts during winter when the deer are hand-fed.

Hunting, once the sport of kings, is now the sport of rich industrialists and merchants. These wield considerable weight in politics and the impression is that foresters lean heavily on a Federal Republic law that limits animal numbers to an extent that will not jeopardize forestry or agriculture.

The position is not so good in the neighbouring state of Bavaria, where it seems that the Forest Service is embarrassed by its lack of control over deer hunting rights. As a matter of interest, a deer hunter in Bavaria, in addition to a nominal fee for his licence, must pay between $N.Z.40 and $N.Z.200 (depending on size) for each deer killed.

**SUMMARY**

Accelerated erosion occurs in the mountains of Switzerland, Austria, Germany and France. Although it is not so widespread as in New Zealand, it is regarded everywhere as a serious problem, and each country spends large sums of money to combat it.

The presence of erosion leads to the periodic, and usually unpredicted, passage of uncontrollable masses of water or snow, with associated debris, causing damage to property, communications, and sometimes loss of life.

In all instances examined, the problem seems to have arisen, in the first place, by deforestation. The actual erosion surfaces
have generally been initiated by fire, overgrazing, or winter snow avalanches.

The aim of most reparation work is to re-establish forest cover up to about 2,000 metres, which is the upper limit of natural tree growth. Grass or shrub cover is occasionally considered adequate, and sometimes even desirable, but generally a forest cover is regarded as the only satisfactory solution. Where winter snow avalanches occur, a forest cover is essential for control, and in such places is extremely difficult to establish.

In all cases involving gully or stream-bed erosion, and often on slip or scree faces, the construction of an artificial barrier is considered essential to arrest surface movement for sufficient time (several decades) to allow a new vegetation to become completely established. Construction of such check dams and retaining walls requires suitable access for men and materials, and consumes about 70% of the total project cost.

Indigenous trees in Europe generally have much slower growth rates at equivalent altitudes than many conifers introduced into New Zealand. This could be an important consideration in the application of European techniques to New Zealand problems.

Another important difference is that the New Zealand mountain climate is insular, whereas the climate of the European Alps is continental. One aspect of this difference is the greater winter snowfall experienced in the European Alps.

A third factor of ecological significance is that New Zealand mountains seem to experience more wind than their European counterparts. For example, at Weissfluhjoch, 8,000 ft, in Switzerland, wind gusts rarely exceed 50 mph, whereas at Makahu Saddle, 3,200 ft in the Kaweha Range, there are generally over 50 days per year when the wind exceeds 50 mph.

It is a valuable experience for a New Zealand forester to visit Europe and see multiple use as the mature outcome of forest management. This is particularly true in Switzerland where, although 90% of the forest area is used for timber production, federal legislation provides for all forest to be managed primarily for water conservation and for all forests to be available for recreation.

ACKNOWLEDGEMENTS

The writer is indebted to A. L. Poole and J. T. Holloway of the N.Z. Forest Service, and to Dr A. Kurth of the Swiss Federal Forest Research Institute, without the support of whom this venture would not have been possible.

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