THE SOILS OF SOUTHLAND AND THEIR POTENTIAL USES

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The pedologist should concern himself not only with mapping and classification of soils; he should examine the use to which soils are put and the changes that take place under varying kinds of use or misuse. The soil survey is only the starting point; it shows the physical, chemical and genetic characteristics of soils, their distribution and relationship to environment.

First of all we are interested in the nature of our soils in their undisturbed native state. We can then follow the changes that have taken place with changing farming techniques and try to predict desirable changes or modifications; changes which will not only improve the short term production from the soils, but enable us to maintain long-term, sustained-yield production. These principles apply equally in the mountains and on the plains.

Secondly we are interested in seeing that our soil resources arc used most efficiently; that usage of soils takes place in a logical way and that those concerned with economics are aware of the limitations of the soil as well as of its potentialities.

Thirdly there is the aesthetic viewpoint, perhaps not capable of strict scientific treatment but nonetheless a very important one to all of us as civilised people. There is no reason why our landscape should not be planned for pleasure as well as for profit.

THE SOILS OF SOUTHLAND

The basic soil pattern of Southland is fairly simple; there are three groups of soils delineated primarily by climatic factors.

I. Soils with seasonally dry climate (soils intermediate between yellow-grey earths and yellow-brown earths).

2. Soils with damp climate (yellow-brown earths).

3. Soils with wet climate (podzolised yellow-brown earths).

In addition to these soils, however, there are several others formed on rocks which differ greatly in composition, as well as soils formed on alluvial plains, soils formed on wet lands, etc., each having features that are important in terms of land use.

Soils with Seasonally Dry Climate

Soils of this group occur in the drier inland parts of Southland

where rainfalls range from 30 to 40 in. per annum and where the upper soil horizons dry out in summer. In the inland valleys droughts may occur in dry years, particularly on the porous stony soils of terrace land, but nearer the coast droughts are less frequent and short.

The soils are characterised by massive, compact subsoils (called pans), usually strongly mottled on poorly drained sites or weakly mottled on the drier free-draining sites. The shallow and stony soils on the higher terraces have a weakly to moderately developed pan which is an impediment to drainage. Topsoils are generally dark grey silt loams with weak to moderately developed nutty structure which is easily destroyed by frost and rain. Wind erosion. is a serious hazard on the lighter plains soils, In winter when topsoils are wet the treading of animals breaks down the structure. In summer rapid drying out of the soils produces a coarse, cloddy structure. Structure, porosity, and aeration are better under improved pasture today than under the low producing swards of ,a few decades ago, but appear to be poorer than'those of the virgin soils.

The soils with dry climate can be subdivided on the basis of variations in profile characters, topography, stoniness, etc., as follows.

If. Deep silt loams on terrace land (Dipton, Pukcmutu, Aparima, Otapiri soils): Most of these soils were poorly drained in their native state, but are now mostly drained. They may dry out in summer if drainage is too intensive.

lt. Shallow silt loams on terrace land (Kaweku soils) and stony loams (Plains soils). The shallow soils have compact, stony subsoils which impede drainage, but they dry out in summer. Irrigation may be beneficial. The stony loams are droughty and have weakly developed pans in gravels which may hold up water and cause waterlogging under irrigation.

lb. Brown silt loams on terrace land (Drummond soils) developed on basic sediments from Takitimu Mountains. They are fertile, have good moisture status, and are mostly well drained.

1r. Grey silt loams and heavy silt loams on rolling downs (Waimumu, Mossburn, Ohai soils), and more fertile silt loams (lr) (Waikoikoi, Crookston, Balfour soils),, the latter sub-class being drier than the former.

1 h. Grey silt loams on hilly land (Crookston hill soils, Mossburn hill soils): They are of medium to low fertility, very low in phosphorus and low in sulphur and molybdenum.

Soils with Damp Climate

They are widespread in the humid parts of Southland where

rainfall ranges from 40 to 60 in. per annum and where the soil rarely dries out. There are considerable variations in the properties of soils of this group due to variations in parent rocks, vegetation and topography.

Profiles are characterised by friable, usually free draining subsoils, and friable, weak to moderate nutty and crumb structured topsoils. They are thus physically more favourable for cultivation and plant growth than the soils with dry climate. However, they are mostly of low natural fertility because the higher rainfall leaches plant nutrients rapidly. Although the profile is free draining, some of the soils on the plains require drainage because of the slow drainage of the sediments underlying the soil profile. Their state of development ranges very widely from the intensively developed plains near Invercargill to the undeveloped tussock lands between Mossburn and Te Anau.

In Southland the soils with damp climate are divided into two sub-groups: the lowland and the highland soils.

Lowland Soils with Damp Climate

These occur on the plains and rolling land and lower altitude hilly and steep land up to about 2,500 to 3,000 ft altitude. They are mostly silt loams, but there are some areas in the interior where textures are lighter. Stony soils occur on some of the terrace land in the Waiau Valley and also on the moraines in the Te Anau district. In the Te Anau district and Waiau Valley the soils are formed on rocks which are somewhat different from those in other parts of Southland. They have been subdivided on leaching into moderately to strongly leached and very strongly leached.

Moderately ***to Strongly*** *Leached*

2f. Yellow-brown friable silt loams on terrace land (Waikiwi, Edendale, Wairaki soils).

2b. Brown friable silt loams on terrace land (Waimatuku soils).

2r. Yellow-brown friable silt loams on rolling land (Kaiwera, Southdown, Owaka, Mangapiri, Wairaki, Chaslands soils). Also more fertile silt loams (2r), (Orawia, Tuturau soils).

2h. Yellow-brown friable silt loams on hilly land (including shallow and stony soils), (Kaiwera, Owaka, Chaslands, Lillburn, Taringatura, Tuapeka, Pukekoma hill soils). Also (2h), more fertile hill soils (Kaihiku, Tuturau hill soils; Te Mara hill soils on calcareous rocks and Malakoff hill soils on basic volcanic rocks).

2s. Yellow-brown friable silt loams on steep land (Fairlight, Waikaia, Twinlaw steepland soils) liable to severe sheet and gully erosion if burned and overgrazed.

3f. Silt loams on terrace land with impeded drainage (Mokotua soils).

3r. Silt loams on rolling land (Waimahaka, Pourakino, Lillburn soils).

3h. Silt loams on hilly land mainly under forest and second growth (Waimahaka, Tawanui, Hauroko, Orepuke hill soils).

3s. Silt loams on steep land; weakly developed structure. Many areas eroded (Eglinton, Windley steepland soils).

3t. Stony soils on terrace lands; few small areas in Waiau Valley (Monowai soils).

3m. Stony soils on rolling moraines. Partly ploughable. (Tc Anau soils).

Highland Soils with Damp Climate

These occur on the mountains of inland Southland above altitudes of 2,500 to 3,000 ft to the zones of bare rock, ice, and snow, at 5,000 to 6,000 ft. They are mostly shallow soils ranging in texture from stony sands to stony loams with weakly developed structure and friable consistence. In their virgin state they carried a cover of snow grass, but with fire and grazing over the last 100 years much of the tussock cover has been destroyed. Large areas are now severely eroded.

Two units are shown on the soil map:

4h. Soils on hilly land; mainly schist (Teviot hill soils).

4s. Soils on steep land; mainly greywacke (Kaikoura, Takitimu steepland soils).

Soils with Wet Climate

These soils occur in the humid and super-humid parts of Southland where rainfall is more than 60in. per annum although in a few places as low as 50 in. They are formed under rimu, rata, kamahi, and beech forest on the lowlands and under tussock and alpine vegetation on the highlands. Fertility is low and drainage poor.

Only in a few places are these soils suitable for agricultural development; but even on the most favourable sites much drainage is necessary, and lime and fertiliser requirements are high. Most of the hilly land is still in native forest, much of it cut over for timber. Some of these forests are suitable for management on a sustained yield basis. The remainder, though of doubtful value as indigenous forest, may be suitable for exotic forestry development. They should in the meantime be left in forest.

Six units are recognised:

5f. Poorly drained soils on terrace lands (Tisbury soils).

5r. Soils on rolling and easy rolling land (Waimahaka, Hinahina, Tautuku soils).

5h. Soils on hilly land (Hinahina, Pukepahi, Tautuku, Trail, Kaka hill soils).

5s. Soils on steep and very steep land (Titiraurangi steepland soils).

5g. Wet soils on terrace land (Matauira soils).

The high mountains of Fiordland, above the forest line, have a cover of thin and stony soils with a "turfy" topsoil. They are less liable to erosion than the Highland soils with damp climate. Erosion is slight even where deer are established. They are mapped as Resolution steepland soils (6s).

Soils of River Flats

These soils occur on the floodplains and lower terraces of the main rivers of Southland. Many of the soils are deep, free draining silt loams to fine sandy loams, but shallow soils over stony alluvium occur in the Riversdale district and along the Oreti River.

Two units are shown.

7a. Recent soils with seasonally dry climate (Mataura soils).

7b. Recent soils with damp or wet climate (Wallacetown, Tuatapere soils).

Soils of Swampy Land

Soils of swampy land occur on the wet floodplains of rivers and streams, particularly near the coast. They are mostly of medium fertility, but drainage and river control are required before they can be developed to their potential as high producing grassland soils. Some areas are well suited to growing flax (*Phormium*) for fibre production. They are mapped as Makarewa soils (8).

Peaty Soils

Peaty loams and peat occur throughout the wetter lowlands of Southland in bogs and swamps. The peaty loams are suitable for development as pasture lands, but the peats of the raised bogs such as Seaward Moss are of very low fertility and so difficult to drain and manage that they are not considered suitable for development at this stage. Where these bogs have a deep sphagnum layer on the surface they may be suitable for industrial uses such as peat-moss litter. After the removal of sphagnum the more fertile lower swamp' peats and peaty loams may be suitable for development into grassland soils. The larger bogs are shown on the soil map as Otanomomo soils (9).

On some of the mountains there are blanket peat soils which are of no agricultural value, but are important as reservoirs of water and help to maintain good hydrological conditions in rivers. They should therefore be protected, at least those areas which

occur within the watersheds of the rivers flowing across the plains. They are not shown separately on the soil map.

Soils of the Coastal Sand Country

Sandy soils occur on the coastal sandhills between Riverton and Otara. Near the coast the dunes have weakly developed soils and are of little agricultural value. However, some of the older stabilised dunes in the Otatara district are suitable for development as grassland soils; small areas may bc suitable for cash crops such as potatoes. Only one unit is shown on the soil map-(10) (Riverton, Otatara, Omaui soils).

Bare Rock, Snow, and Ice

On the high mountains above the upper limit of soil cover at altitudes of 5,500 to 6,000 ft there are areas of bare rock, scree, snow, and icefields. These are shown on the soil map as 11.

SOILS AND LAND USE

On the basis of their properties the soils of Southland have been grouped into four broad land use classes, These are:

I. Soils suitable for mixed farming.
2. Soils suitable for grassland farming,
3. Soils suitable for economic forestry.
4. Soils not suitable for production forestry or agriculture.

Some soils could be placed in more than one class. However, in general the soils of any one class are not well suited to the uses of the class above but quite suitable to the uses of the class below.

1. Soils Suitable for Mixed Farming (1,049,000 acres)

The soils of this class have the following properties in common. They are, by and large, adequately drained; they are easy to cultivate and their major plant nutrient levels are in general higher than in the soil in its native state. They have properties which to a pedologist seem suitable for intensive mixed farming. Intensive grassland would still be the basis but cash cropping would play an increasingly important role.

The population of New Zealand is rising fairly rapidly and the demand for food crops is likely to double in the next 40 years. However, we are still importing some food crops, particularly wheat and cereal crops (including spirits) and all our sugar. Most of the several million pounds spent on importing these crops each year could be saved if we used our soil resources more fully. Many soils in Southland are suitable for growing rye and barley, and from these whisky can be made. The soils are suitable, and the climate is suitable, and the time is now ripe for the investigation of this industry. Three sub-classes are recognised:

1a Soils Suitable for Cereals/Grass Seed/Grassland

This sub-class comprises mainly soils with dry climate. Many of these soils were cropped with cereals in the eighties and nineties, both wheat and oats giving satisfactory yields, until the small natural reserve of fertility was depleted. Pasture quality and crop yields fell until the introduction of liming in the later nineties, but it was not until after the First World War that phosphatic fertilisers were used widely. It is possible that fertiliser requirements will become more complex, with continued high production, as the available supplies in the soils become depleted. Potash, and in the more distant future magnesium, may become necessary, as well as a wider range of trace elements. Where these soils have been intensively farmed the fertility levels are now higher than in the corresponding virgin soils. They should be capable of producing high yields of cereals and grass seeds, while at the same time carrying high levels of fat stock production. On the Winton Experimental Farm cereal crops are grown regularly and at the same time fat stock production is as high if not higher than on other farms on the same soils.

I b Soils Suituble for Cash Crops/Cereals/Grassland

This sub-class consists mostly of soils with damp climate and soils of the river flats. In the early days of settlement cropping never became as important on the soils with damp climate as it did on the soils with dry climate further inland. Oats were grown mainly for chaff. Wheat was never an important crop. Dairying became very important in some places, while large areas remained in red tussock until well into this century. Liming these soils was essential in developing pastures, but even so pastures deteriorated rapidly in quality. Phosphate was low throughout and in some areas cobalt deficiency prevented full development. Today potash deficiency is widespread and the farmer must budget for its general use in the future.

Where these soils have been intensively developed, then, we have soils with good tilth, good drainage, and high fertility; ideal soils for cash crop production. The properties of these improved soils suggest to me that they should be used for intensive mixed farming rather than fat stock only. They should be well suited to crops such as potatoes, sugar beet (for sugar), rye (for whisky and spirit), and to a lesser extent oats and wheat. The demand for market garden products will increase rapidly in the Invercargill district, and there are soils near Invercargill which are well suited to this kind of intensive utilisation. There is need also to zone the soils north of Invercargill strictly for farming, for if the city expands northward much valuable land will be lost to production.

Root crops grow very well on many Southland' soils, and the quality of Southland crops is well known. I have no doubt that with soils of this sub-class Southland could grow an increasing proportion of New Zealand's potato crop as the population rises.

Finally, there is sugar beet for sugar production. As long ago as 1870 the Government offered £10,000 for the first 100 tons of New Zealand produced sugar, The sugar beet industry is one which could possibly be successful in Southland. Sugar beet grows well here, and there are adequate areas of suitable soils, close to sites suitable for processing factories. The tops and the trash after extraction of sugar are suitable for stock fodder. Further, the Farmers' Co-op. Freezing Works has the steam-raising equipment which in the winter could be used for extracting raw sugar. There may be reasons why a sugar industry would not be economic, but from a soil point of view some serious investigations are necessary,

1c Soils Suitable for Root Crops/Grassland

This class is small in area and includes only the friable brown silt loams associated with soils with a damp climate near the coast where rainfall is too high for cereal crops. The soils are well suited to growing crops such as potatoes.

2. Soils Suitable for Grassland Farming (1,405,000 acres)

Large areas of soils suitable for grassland farming arc still in an undeveloped or partially developed state. More intensive development will bc straightforward on the ploughablc land, but on the non-ploughable land (bouldery moraines) there will be difficulties and development may be more costly than on the Southland Plains. The hilly and steep lands, where soil fertility is low present a challenge. Many of these soils have similar properties to the soils of lower land now carrying five sheep per acre, yet few hill soils carry more than one sheep per acre. Considerable advances have been made in the development of management systems for fertile hill soils in the North Island (Suckling, 1959). In Southland, however, hill soils are generally less fertile and the growing season shorter than in the North Island. There is need, therefore, for studies here of hill and steep land grass management.

The soils suitable for grassland farming have been divided into three sub-classes.

2a Ploughable Soils Suitable for Fat Stock Production

The soils in this sub-class have a high potential for increasing fat stock production as large areas are still in an undeveloped state. On these areas soil fertility is low and needs building up to much higher levels with fertilisers and more intensive grassland management.

2b Ploughable Soils Suitable for Fat Stock Production and Dairying

The soils of this sub-class occur in higher rainfall parts of Southland and also include some swampy soils requiring drainage. There is considerable scope for further grassland development in this sub-class.

2c Non-ploughable Soils Suitable for Fat Stock and Store Stock Production

This sub-class includes hilly and steep land which should be suitable for grassland improvement; also stony and bouldery soils on moraines in the Te Anau district.

3. Soils Suitable for Economic Forestry

On hilly and steep terrain there are considerable areas of soils of low fertility, which seem more suited to forestry than to agriculture. The areas are big enough for the long term development of large timber, paper and-pulp industries as well as supplying local needs. Although most forest development will be on a large scale, there is also much scope for small forest enterprises. In many of the inland valleys strips of trees are necessary, to lessen the danger of wind erosion, for example.

Soil erosion (sheet, scree and gully) is widespread on the mountains of inland Southland. This erosion is still active in many areas and the management practices leading to erosion are still in use. The carrying capacity of these soils is low and they are mostly too poor to respond to aerial topdressing or improvement. However, they are well suited to exotic forestry which would be a valuable addition to the economy of New Zealand. The upper altitude limit would be somewhere between 2,000 and 2,500 ft above which protection forests or grasslands should take over. Besides being of economic value, forests would help to regulate runoff and protect the soils from erosion.

The soils suitable for economic forestry are divided according to suitability for indigenous or exotic forestry.

3a Soils Suitable for Indigenous Forestry

This sub-class includes much derelict cut-over forest such as on the Longwood Range and Chaslands district. Most of these soils arc hilly, but small areas of flat, rolling and steep land arc included. The total area is 852,000 acres but not all is suitable for intensive management.

3b Soils Suitable for Exotic Forestry

This sub-class includes low fertility hill and steep-land soils which are either reverting to scrub and fern or are eroding under present management. Small areas of rolling land on sand country

are also included. Forestry would probably yield greater returns from these soils than pastoral use. The area is 707,000 acres.

4. Soils Not Suitable for Production Forestry or Agriculture (3,330,000 acres)

This class includes several different kinds of soil which do not seem to be of economic importance at present, or which'are unsuitable for production purposes. Most of Fiordland has been included in this category, even though in the future some local exploitation of forests may be possible. Also included are Alpine regions and most of the Highlands. Some of these soils are still being burned and grazed, but yields are very low. They should be retired from grazing and administered as protection grasslands or forests. Most of the soils in this class are on steep land or hilly land, but small areas of rolling land (highlands and parts of Fiordland) and flat land (river flats in Fiordland and Seaward Moss south-east of Invercargill) are included.

The large peat bogs of Seaward Moss have been included in this class, although there may be some likelihood of development after stripping off industrial peat moss. In their present state, however, they are not considered suitable for development.

There is growing need, as our population increases, and as land development spreads, to look at the aesthetic and recreational value of our landscape. It is no doubt economic to straighten rivers and dig large open drains across the land, but what will be the long-term effect of this on the fishing and wild-fowl resources? Is it necessary to drain every swamp and destroy all the breeding sites for wild-fowl? Is it not time to consider ways and means of increasing rather than depleting the wild-life resources? Now is the time to plan for the future recreational needs of the community. The productivity of Southland is surely high enough to allow areas of our soil resources to be set aside now for recreation and sport. If cereal cropping is to become a more important part of our agricultural economy, there is wide scope for the introduction of game birds such as pheasant, if suitable habitats are provided for breeding.

There is also great need to reserve a few sites of native vegetation and soils for scientific purposes. On several soils it is now almost' impossible to find an undisturbed site. It is in the interests of all that a few such sites be reserved; they need not be more than a few acres, but they would need protection from fire and grazing to be of most value to research workers.

Summary

There appears to be wide scope for expanded production of cash

crops on many soils in Southland without reducing stock numbers. There is also wide scope for development of new grasslands in the inland districts. Forestry can play a much greater part in the future without affecting agricultural development. Grasslands have played a major part in the development of Southland, and although they will continue to be of basic importance, there are other kinds of land use which deserve a place. Now is the time to broaden the scope of agriculture and to investigate new crops and industries based on the full use of soil resources.

References

Suckling, F. E. T., 1959: Pasture Management on Unploughable Hill Country at Te Awa. N.Z. *J. Agric. Res., 2: 488-543.*

DISCUSSION

Q. (I. L. Elliott): Why were the coastal swamps of Seaward Moss lumped in with the unproductive areas?

A. They are difficult to manage and drain and have very low fertility. They have a possible industrial use, which would remove the sphagnum peat and open the way to development of the underlying swamp peat. There are over 1,000,000 acres of tussock grasslands which can be developed more economically.

Q. Could Mr Cutler enlarge a little on the industrial use of peat areas?

A. In Ireland sphagnum peat moss is milled and exported to U.S.A. for horticultural uses. The returns from industrial use pay for agricultural development. Another use is as a fuel for power purposes but this would not apply here because of the hydro-electric potential.

Q. (Dr Sears) : What is the reason why the large area of dark green on the map must be forest rather than grass?

A. This class includes, firstly, 800,000 acres of strongly leached steep land soil under high rainfall. Some tussock land is also put into this class for similar reasons-high rainfall, weak soil structure and liability to erosion. Also there arc some areas in the upper catchments, where forest would provide better control of the water regime.

Q. Is the East Dome area typical of the country recommended for forestry?

A. East Dome is, but not Mid-Dome, which could be left as grassland and managed for more intensive use below the 2,500–3,000 ft level.

Q. (Dr K. O'Connor) : Why does Mr Cutler class Mid-Dome as suitable for intensive use, whereas East and West Dome, which have apparently caused less trouble in active erosion and in damage to lowlands arc recommended to be in forest?

A. The soils at Mid-Dome are naturally more fertile below 2,500 ft and their present condition is due to poor management. East and West Dome are eroding to some extent and are at present going downhill under pasture. I feel that they are just outside the border of soils suitable for pasture and should go into forest.

Q. (T. Burnside): Making stock ponds provides for the wild life. As this is a suhsidised work under Catchment Boards could it not provide for wild life in the future?

A. Yes, but I would like to see some of the swampland left in perpetuity.

Q. (Lamont): I understand that the sugar beet industry overseas thrives

under protection. Would the production of this crop in Southland bc sufficient to meet overseas competition?

A. The soils and climate of Southland are particularly suitable for this crop. They produce heavy crops of swedes already. Part of the industrial capacity for processing sugar beet is already here. Further economic investigation would, however, be necessary before such an industry could be contemplated..

Comment: (W. Faithful): Sugar beet was grown many years ago near Mataura. Yields were high and the beets were competitive in sugar content with overseas beets.

Q. (A. Harris): Concerning the author's emphasis on cash crops. Has he in mind an increase in the farmer's income or the improvement of animal health?

A. I have not considered health problems but merely the suitability of the soil.

Q. (C. E. Iversen): Mr Cutler mentions the possibility of controlling the water supply in valleys. I am interested to know what would happen to river valleys if the water supply were cut off.

A. If the soils were porous and droughty it would not make much difference. If the water tables were high they could be lowered by cutting off the water in the rivers.

Q. (Dr P. D. Sears): Could you give any more details, from your surveys, of the suitability of the soils for growing pastures. Are any trace element deficiencies likely?

A. Magnesium is not high in some soils away from 'the coastal areas. It is possible that with more intensive use deficiencies in this element or in trace elements may crop up. I think that the Department of Agriculture trials would pick up these deficiencies. Copper deficiencies are found on the peats under heavy liming. Cobalt deficiencies may become more extensive with more intensive pastoral use.

Q. They use a lot of lime in Southland. Is it to make money or get rid of money'?

A. It is a tradition to put on lime, partly to raise the pH. Lime has not much value as a fertiliser. It may make phcsphnte more available and does make molybdenum more available.

Q. (J. W. Woodcock): Should not the class I soils be named as those best for grassland farming?

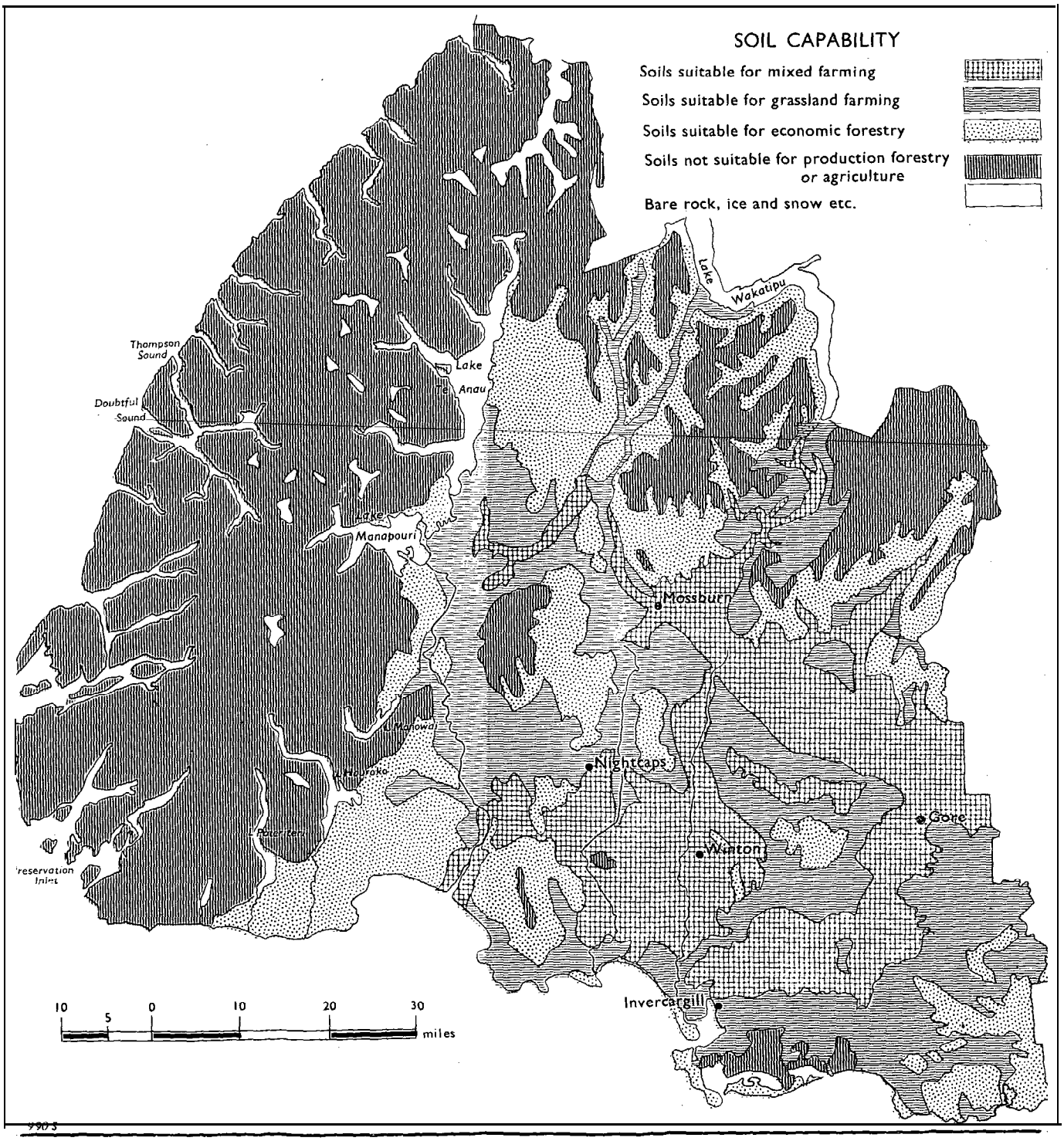
A. No, 1 should class them as suitable for mixed farming as this yields a higher economic return than grassland.

Q. (F. Henderson): Do soil surveys indicate that the soils of Southland require more lime than those in other parts of New Zealand?

A. Yellow-brown earths here are not more highly lcached than those in other areas. Drier soils are similar to those of Canterbury. By and large Southland soils are not different from soils elsewhere. Maintenance dressings worked out by Dr Dixon came to about 3–5 cwt per annum. A typical silt loam would require an initial application of 1-2 tons per acre. I should think that less would bc needed here than on heavier soils to the north under similar leaching.

Q. (T. Ludecke): Is the fertility of the "Forest" lands of Mr Cutler's survey high enough for economic forestry?

A. The fertility is high enough for establishment and growth. Some gain in yields may be derived from fertilisers. Little work has been donc on the needs of soils for forestry in this area. Perhaps fertilisers would be required on the second rotation.


SOIL CAPABILITY
Soils suitable for mixed farming
Soils suitable for grassland farming
Soils suitable for economic forestry
Soils not suitable for production forestry or agriculture
Bare rock, ice and snow etc.
Thompson Sound
Doubtful Sound
Lake Anau
Lake Manapouri
Lake Wakatipu
Mossburn
Nightcaps
Manowai
Wairaroko
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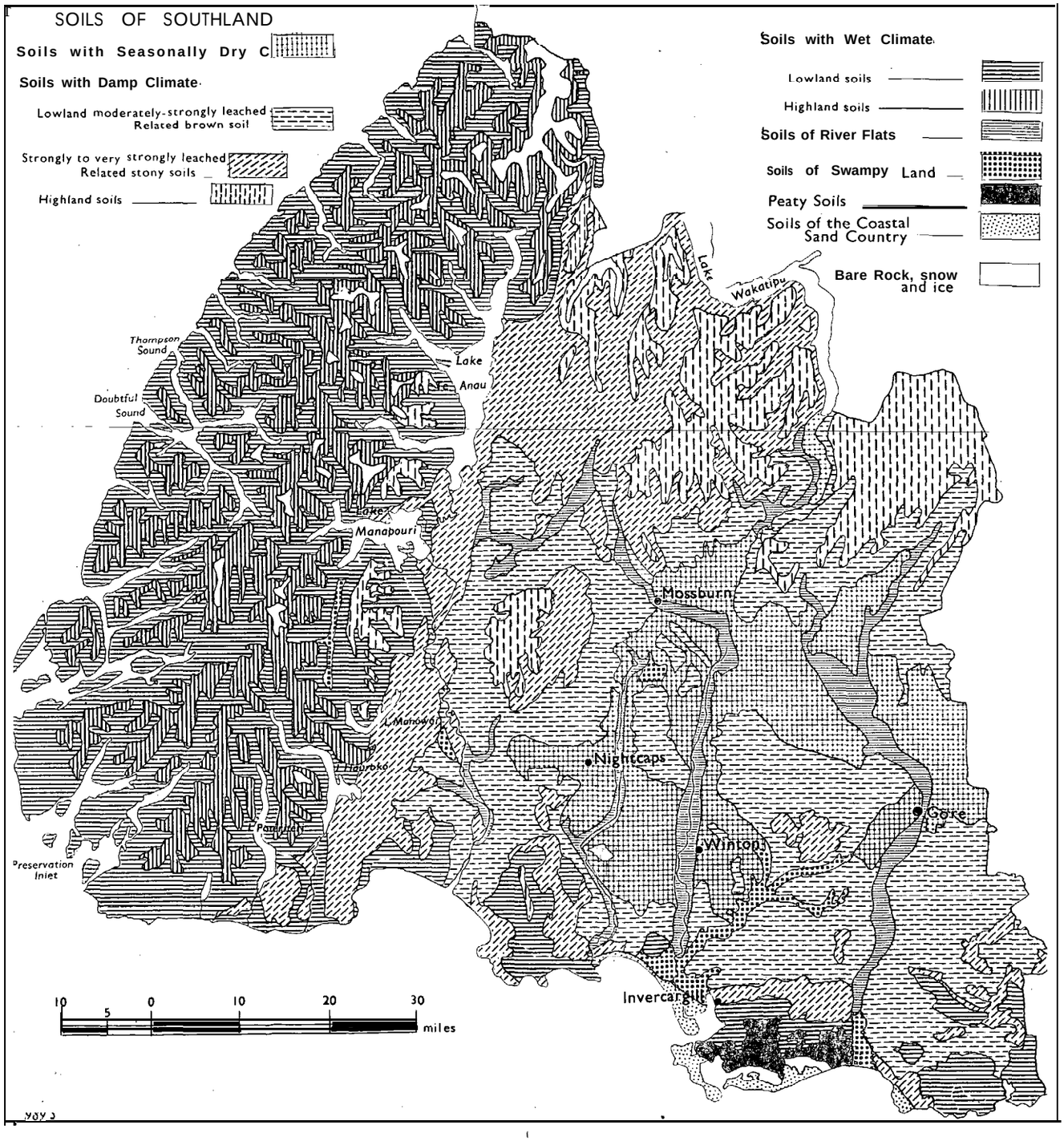
SOILS OF SOUTHLAND
Soils with Seasonally Dry C
Soils with Damp Climate
Lowland moderately-strongly leached Related brown soil
Strongly to very strongly leached Related stony soils
Highland soils
Soils with Wet Climate
Lowland soils
Highland soils
Soils of River Flats
Soils of Swampy Land
Peaty Soils
Soils of the Coastal Sand Country
Bare Rock, snow and ice
Thompson Sound
Doubtful Sound
Lake Anau
Lake Manapouri
Lake Wakatipu
Mossburn
Nightcaps
Gore
Wintop
Invercargill
Preservation Inlet
10 5 0 10 20 30
miles