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CONTENTS

SOME SUGGESTIONS FOR THE STUDY OF THE ENVIRONMENT

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Some type of regional survey is proving a convenient means of introducing secondary pupils to the section in the General Science course which asks for some studies of the immediate environment. Studies of the present environment can prove much more profitable and interesting if at the same time some attention is paid to the original plant covering and its special characteristics. Basing our approach on the results of the work of Cockayne we find that the vegetation of primitive New Zealand, from sea-level to between 3000 and 4000 feet consisted mainly of two great plant formations—forest and tussock-grassland. The presence of one or the other depended primarily on the rainfall and the number of rainy days but there were areas where other factors such as soil conditions and drying winds might override the factor of rain-fall.

The Forest

Taking the forest first we find that in spite of its great variety it falls naturally into two divisions:

1. Rain-forest proper or sub-tropical rain-forest.
2. Beech forest or subantarctic rain-forest.
   (Let us refrain from using the term "birch." There are no birches native to New Zealand.)

Between these two main groups there are intermediates connecting the two but there are vast areas occupied by pure forests of each class.

The beech forest is the easier to study. It has a less luxuriant undergrowth and a smaller number of species. In fact in some subalpine forests of mountain-beech there is little but beech, big trees, saplings and seedlings. But this lack of variety does not mean that the beech forests are any the less important. Both in the North and South Islands they occupy the main upper catchment areas of many of our major rivers and are vitally important as soil protectors and regulators of stream flow. Three of the species, too, silver, hard and red beech, are important sources of timber. Silver beech is used for furniture, motor bodies, farm implements, clothes pegs and casks and red beech is ideal for gates, fencing posts, mine props, stringers for bridges and the floors of railway trucks and lorries.

Coming to the subtropical rain-forest, what we usually mean when we talk about New Zealand bush, we will find on detailed study that it has a number of characteristics which place it in the same class as the rain-forest of tropical lands.

1. The forest is in several stories. Four can readily be recognised and these four layers provide a convenient means of grouping the individual species for study. They may be called (a) tall forest trees; (b) broad leaved layer (the main shade producers); (c) the shrubs; (d) the forest floor.

2. The trees are nearly all evergreen. Fuchsia, wineberry and some ribbonwoods are among the few exceptions.

3. The plants belong to many genera. In this respect compare our forest with that of other temperate countries e.g. a pine, a wattle, a eucalypt or an oak forest.

4. Many trees develop large buttresses at the base of the trunk.

5. The roots often extend far through the surface soil and may project above it.

6. Tall tree ferns and all kinds of herbaceous species are found everywhere.

7. Woody climbers with every possible kind of climbing organs are characteristics.

8. Where the air is constantly damp epiphytes or perching plants are common. (Distinguish between these and parasites.)

9. Some trees produce flowers on the naked trunks e.g., kohekohe, fuchsia, mahoe.

10. The forest floor, logs and trunks of trees are covered with filmy ferns, liverworts and mosses.

11. Lichen and mosses may hang from the twigs of shrubs.

12. There is usually a dense undergrowth of ferns, shrubs, seedling trees and sedges.

This similarity to a tropical forest can possibly be explained as Nature's attempt to provide a protection for the steep hillsides against the rainfall which is so often of tropical intensity.

As far as the effects of our civilisation is concerned one other characteristic of the New Zealand forest should be stressed: "In one respect, and in that one essential, the New Zealand forest differs from all others in that it came into being and developed to its present composition and structure in the absence of grazing and browsing mammals." Where opportunity offers study the local bush comparing that infested with deer or open to stock such as cattle and goats with similar bush from which animals are excluded.

Forests and Birds

Nor should the study of the forest birds be omitted. "Ancient New Zealand was above all else a land of birds; no other land mass so large has remained isolated so long and in no other area of any size have birds achieved terrestial domination." This state of affairs produced unusual results, one of them a dependence of the forests on the birds for their welfare. These forest birds have three main functions (a) keeping destructive insects in check. Of the 36 species of birds which are mainly forest dwellers 28 subsist either wholly or in part on insects. (c) Pollinating flowers of forest trees. Thirteen per cent of our bush plants are pollinated by birds; included among them are kowhai, the ratas, puriri, fuchsia, rewarewa and pohutukawa. (c) Distributing the seeds of forest trees. Sixty-five per cent of bush plants have fruits more or less succulent and thus attractive to birds. They include nearly all the important trees except the kauri, cedars and beeches.

FACTORS INFLUENCING THE COMPOSITION OF THE NATURAL FOREST.

3. **Latitudinal Change.** The two most striking boundaries are 38 degrees South below which we do not find kauri, puriri and pohutukawa, and 42 degrees South where true South Island forest begins.

b. **Altitudinal Change.** This is marked by an increase in rainfall, wind, snow and frost and a decrease in temperature. It brings a reduction in the number of species and also a reduction in stature. Latitude plays a part, too, in altitudinal distribution. South of 42 degrees pepper tree, mountain wineberry, broadleaf and others grow at sea level but only in montane forest in the North Island.

c. **Nearness to the Sea.** Here we get reduced stature and density of forest roof on account of the salt winds but the higher winter temperatures permit the growth of ngaio, karo, karaka, and others.

d. **Increase of Water in the Soil.** This may enable kahikatea or white pine to become dominant.

e. **Underlying Rocks.** Generally the nature of the underlying rocks has little influence. Rain-forest consists of the same species, at similar latitudes and altitudes whether the rock be greywacke, volcanic, limestone, or schist.

The Development of Forest

Every opportunity should be taken to study "second growth" bush because there we can get some understanding of that relentless fight which man has constantly to wage with Nature on bush-burn farms. What to the farmer are serious weeds, manuka, bracken fern, wineberry, fuchsia and so on are just a stage in the development of forest. In the shelter of such plants the tall forest trees will eventually become established, that is of course in the absence of the fire-stick, the grazing animal and the manure bag.

The Tussock-Grassland

A plant formation which has had such an important influence on the story of settlement as has the tussock country is worthy of study equally with the forests. Most South Island schools are within easy reach of modified tussock-grassland; North Islanders could gain first-hand knowledge of the plants by growing them in their gardens which are really essential to the effective teaching of General Science, Biology and the Agricultural subjects. Of an occupied area today of some 42,000,000 acres, over 14,000,000 acres are still in tussock on which graze millions of sheep of vital importance to our lowland farming economy. Nor is the function of the tussock as a soil protector to be lightly passed over.

Right through Marlborough, Canterbury and Otago the appearance of natural tussock-grassland changes very little. Whether the rainfall is 15 inches or 60 inches matters very little; the drying nor'west wind seems to be the major climatic factor. It is probable too that the story of its development as it can be seen today on a Canterbury river-bed is similar in other areas. First to appear on the stony bed as the receding river leaves it dry will be some of the willow-herbs or Epilobiums, easily transported because of their downy seeds. Also arriving quite early are seeds of Raoulia species. These may grow rapidly into large moss-like patches or cushions, very close to the ground and thus undisturbed by the high winds. Lichens, mainly dark grey in colour, soon creep over the stones and in between may grow harsh dry mosses.

At first there is no humus and very little soluble plant food. On sunny days the light is extremely bright, and the stones are very hot. Winds, usually dry, blow with great force. Winter frosts are severe; there may be 200 frosts a year.

In spite of these unfavourable conditions, the willow-herbs and Raoulias gain a footing. Gradually wind-borne silt is trapped by the leaves and stems and a cushion arises. A small shrub, Muehlenbeckia, and two kinds of piripiri may also form flat, creeping patches of vegetation. As the ground becomes more stable two or three of the leafless brooms may come in. Other plants likely to follow are an oxalis, a geranium, a prickly heath and a cudweed. As leaves and stems die and form humus and more silt is trapped, the fertility in and around these mats increases and other plants such as seedling tussocks become established. As these tussocks grow they will eventually almost touch each other. In the shelter provided by these tall, wind and drought resisting tussocks, would develop dozens of kinds of smaller grasses and herbs which would actually be living in a different climate (a micro climate) from the shelter plants above them.

Certain insects would enter the association, ants living under stones, caterpillars, grubs, and grasshoppers feeding on the roots, stems and leaves. Native birds such as quail, dotterel and pipit would make the area a feeding ground and nesting site.

But there were no grazing animals of any kinds, not even rodents.

The primitive grasslands of New Zealand will be found to fall into two classes:

1. **Low Tussock-Grassland,** which is dominated in the main by the medium-sized tussocks, the silver tussock (Poa caespitosa) and the hard tussock (Festuca novae-zelandiae). Both may be found together but usually one is markedly dominant, the "silver" on the lower, more fertile country, the "hard" where life is more severe. This association extends in some places from sea-level up to 5000 feet and in spite of the fact that it has been continually grazed by sheep for 90 years, has been burnt time and again, and is the home also of countless rabbits, it still seems to retain nearly all its original species. Some of these species which are worth more than cursory study are the common danthonias, one of them in other places covering vast areas of bush-burn country, blue-grass (Agropyrum scabrum), plume grass, the wild irishman or matagowrie (a spiny shrub which produces or dispenses with leaves according to the water supply), leafless brooms of several kinds, the cabbage tree or ti, the spear-grass or spaniard with its sharp bayonet-like leaves, and the tutu which has so often proved dangerous to stock.

2. **Tall Tussock-Grassland** receives its name from the height of the tussock which dominates it, either snowgrass, found on the hills and mountains, or red tussock which is at home where the soil is sour, the rainfall heavy and cloudy skies frequent. This latter is the type of tussock which grows so well on the volcanic plateau of the North Island at an altitude of 3000 to 4000 feet.

(In subsequent articles Mr McCaskill will trace the effects of civilization and its accompaniments on the forest and the tussock-grassland.—Ed.)

WHITE PIGS WITH RED COATS

P. G. Stevens Dip. C.A.C., Lecturer in Animal Husbandry.

These pigs, though somewhat of a mixture at present, have been aptly called Lincoln Reds. They are a combination of the Large White and Tamworth breeds. Both of these are old established as pig breeds go, dating back to the middle of last century. Both are English breeds but they are more or less used in all pig-producing countries. The Large White claims Yorkshire as its home while the Tamworth comes from further south—Staffordshire and Leicestershire.

Why bother, then, to mix two well-established breeds which are the result of painstaking work on the part of several generations of breeders? In the first place the mixing of the breeds is not as uncommon as might be suspected. In Canterbury we are familiar with the Corriedale, the result of mixing the Lincoln and English Leicester longwools and the fine-woolled Spanish merino. Indeed most modern breeds of livestock owe their present-day characteristics to borrowing more or less from other breeds and the general idea of borrowing a wanted characteristic from another breed is a sound breeding policy.

The Tamworth has always been popular in New Zealand. His hardiness or ruggedness has fitted in well with our idea of the conditions under which pigs ought to live. There is no doubt that the breed can take knocks in the shape of indifferent housing, lack of shelter and come through it all in a thriving condition. But it is essentially an early-maturing type of pig. This does not mean that it grows more rapidly than the other breeds but that it is marketable at light weights, that is at pork weights, say 100lb live weight and a carcase weight of about 70lb. If taken to heavier weights the amount of fat tends to increase disproportionately so that at bacon weight (200lb live weight and a carcase weight of 145lb) the average carcase has a high proportion of fat to lean and in addition fails to develop sufficient length. The pre-war description of our carcases on the English market was "Short and fat."

The Large White in New Zealand has never enjoyed the popularity of the Tamworth but in other bacon-producing countries it has long been the mainstay. The modern Danish bacon pig is a combination of Large White and native Danish pigs. Most English bacon pigs claim the Large White as their sire. Canada, today the most important bacon-exporting country, has used it extensively. It is essentially a bacon-type pig. In comparison with the Tamworth it is late maturing which means that at light weights it lacks sufficient fat for commercial use. Not until it reaches the bacon weight range is the fat in proportion to the lean. Its best marketable weights are about 200lb live weight and 145lb carcase weight. It has been suggested that as a breed it is not prolific and that it is a slow grower but records from pig herds on dairy farms show that growth rate and prolificacy for all the breeds are very similar.

However, it has one real disadvantage for New Zealand conditions—it is white and has an unpigmented skin. Under our usual pig-farming conditions pigs spend most of their lives in the open air. Alternating rain and sunshine do not show the white pig to best advantage. Rain means muddy conditions and a dirty white pig does not commend itself, while the summer sunshine leads to sunburn, particularly about the ears, and the sunburnt pig is a pitiful sight. We have, then, a red pig well-suited to our open-air conditions but with a capacity for early maturity which is a disadvantage in bacon production, and a white pig with a late-maturing bacon carcase as demanded by the best markets but a coat which makes him unpopular with the producers.

Why not then give the white pig a red coat? This satisfies the producer who still has his red pig and pleases the exporter because he is able to compete successfully with other exporting countries on the English bacon market. So we cross the Large White and the Tamworth. The foundation animals are of interest. The Large White boar was an imported animal bred by Cambridge University and was from a strain which had been selected for carcase quality and was intensely inbred. Two Tamworth sows were selected from the College herd. They were litter sisters but showed considerable variations in type.

The first cross pigs were all white—but not quite white as numbers of them showed some signs of tan if examined very carefully. There might be a few tan hairs in the eyebrows or maybe a shading of tan over the head or along the back or sometimes just a tan sheen when looked at in the right light. Of these first pigs one boar and several sows were selected and mated to produce the second generation. Our expectation was that about one quarter of each litter would be tan pigs, and three-quarters white or apparently white. This was realised and in an average litter of eight pigs two would be tan. But at this stage a previously unimportant characteristic became of prime importance. We had known that both breeds carried a spotting factor which expressed itself as black spots on various parts of the body, but we did not anticipate that in our second generation pigs this factor would break its previous bounds and give us black pigs, some black and white pigs, and some tan. (It was only lack of accommodation which prevented us from evolving an all black strain from our red-white foundation.)

However, we did get some all red sows but not enough to carry on with—boars, yes plenty of them—but we wanted only one or two boars and plenty of sows. So it became necessary to select some of the second generation white sows and gamble on their carrying the tan factor. One, known in her youth as Miss Gamble is noteworthy because of her first litter of ten pigs, five were white and five were tan. From this and her later litters came some of the most promising breeding pigs we have today. Red colour is no longer a problem; we have plenty of red pigs in all shades from light creamy tan to dark red. I may have stressed the colour problem too much. Its inheritance is relatively simple and within limits we knew what to expect but we had to get red pigs before we could proceed further.

While we were working on the colour problem the carcase quality aspect was not being neglected. All pigs not retained for breeding purposes were slaughtered at bacon weights and the carcase measured for carcase quality. It was by this means that we discovered that a handsome red son of Miss Gamble was leaving progeny of outstanding carcase quality. It was immediately promoted to pride of place as senior sire, a position he still holds. Meanwhile several of his sons are under test. Their progeny are being measured on the hooks for carcase quality to determine which will be the senior sire of the next generation.

All the pigs bred so far are descended from the original boar and two sows. Prolificacy, growth rate and general thrift have remained uniformly good. There is still plenty of variation within the strain so that selection is possible for many generations yet. At present, with the co-operation of some interested pig keepers we are aiming at multiplication of the stock we already have to obtain greater numbers of carcase quality measurements. It is intended, however, to add fresh inheritance and recently an unrelated strain of Large White has been added. Soon still another unrelated strain of Large White will be added. Both of these strains are of proved carcase quality.

We do not claim any originality in the method we have used. It is the classic method used by breeders to add to their own breed a desirable factor possessed by some other breed. Likewise the use of the progeny test and the selection of the breeding animals on the basis of the measured carcase quality of their progeny was employed by Denmark a generation ago. (And let us remember Denmark captured the English bacon market.) It is being used today by Canada and she has been the main source of pig meat for England during the war period.

It is a principle, this progeny test, which we must be prepared to apply to all our studs of pure-bred livestock if we are to increase the volume and improve the quality of our animal products. In this connection it is well to remember that only 15 per cent of our dairy cows are tested; we guess at the production of the remainder. It is well to remember that there is in operation a scheme which gives accurate information on the carcase quality of our pigs, but little use is made of it. In the stud sheep world we still guess fleece weights and assess carcase quality by eye judgment. How long can we afford to continue to breed along these lines?

HARDWOOD CUTTINGS

For the average secondary school class in horticulture, propagation by means of hardwood cuttings inserted in the open ground will be found to be the most satisfactory means of rapidly building up a stock of hedge plants, flowering shrubs and certain shelter trees. With first year classes it is advisable to concentrate on plants which are known to strike readily such as willows, poplars, Forsythia, Spiraea, Philadelphus, privets, berberis, Hebe (Veronica), Olearia and Senecio.

Cuttings should be taken from shoots which have ripened or are beginning to ripen, as in this type of wood the "callus" or healing tissue so necessary to root formation is more likely to develop. Two main types should be demonstrated. The "straight-branch" type is more suited to the deciduous plant such as poplar, willow and Forsythia. With a sharp knife cut pieces from 6 to 12 inches in length, making a clean short cut just above a node or bud at the top and just below a node at the base. With most evergreens the "side-branch" type is more likely to strike readily. In this case the side branches from 6 to 9 inches long are cut or pulled to take a "heel" or piece of the old wood and bark with it. Any ragged edges are then trimmed clean. With evergreens in both types of cuttings the leaves are carefully removed from the basal two-thirds.

The cutting bed should be deeply dug and thoroughly cultivated, mixing in sand and leaf-mould or well-rotted manure. Do not add lime; cuttings root better in an acid soil. Tramp the surface lightly and dig a perpendicular or slightly sloping trench to a depth two-thirds the length of the cuttings. Place an inch or more of sharp gritty sand in the bottom of the trench. Stand the cuttings with their base in the sand, replace a little soil and tramp firmly, repeating this operation until the trench is filled. The base of the cutting must be in intimate contact with the soil and the presence of air pockets may inhibit root formation. Leave the surface layer loose.

Cultivate between the rows in the winter, and, if hard frosts tend to lift the cuttings, tramp the soil firmly close to the rows. Make sure that the cutting bed does not dry out in the spring. New leaves are often produced before any roots have developed and many cuttings will die at this stage unless kept moist.

Much interest will be added to these operations if willow cuttings are placed in a jar of water with a little charcoal added and kept in the classroom. In the garden itself there should be planted a "life-history" row, a few cuttings being lifted at intervals of 3 to 4 weeks so that callusing and root development can be studied.

BACTERIA AND FUNGI IN EVERYDAY LIFE

I. D. Blair, M.Agr.Sc., Ph.D. (London), Lecturer in Microbiology.

(Concluded from April 1)

Points of General Technique

1. All glass materials and media must be sterile before use. Dishes must be thoroughly washed in hot soapy water and then rinsed in clean cold water. Sterilize dishes and tubes by keeping them in boiling water for 20 minutes or by baking them in a kitchen oven. For dry heat sterilization, a minimum of 160 degrees centigrade for 1 hour is required.

2. Agar media should be prepared first in a flask and then poured into test-tubes with sufficient in each for one petri plate. Sterilize the tubes of media under autoclave pressure or by prolonged boiling on three successive days.

Bung up the tubes with flamed cotton wool after filling and don't remove bungs until before pouring.

3. In pouring plates melt the agar if it is in solid form, and then lift cover no more than necessary to insert rim of tube. When agar on plate is surface solid, invert plates during incubation.

4. Lacto-phenol fungus mountant and stain.
Phenol (melt crystals) 100 grams, lactic acid 100 ccs., glycerine 100 ccs., distilled water 100 ccs., add 1% cotton blue, or erythrosine, or any bacterial stain.

Pieces of plant tissue and fungus growth can be macerated up in a drop of this and the stain will show up fungus mycelium, spores in contrast to plant cells. If examining fungus only (from cultures) water or glycerine can be used suitably as mountant.

5. Methylene blue stain for bacterial smear.
Methlyene blue 0.3 gram, ethyl alcohol 30 ccs. Dissolve and mix with 100 ccs. distilled water.

6. After using immersion lens in oil, lift microscope, remove lens, dip in xylol, rub clean with soft silk cloth.

7. Preserving plant material:
General preservative: Water 1 litre; Formaldehyde 40%, 25ccs.; ethyl alcohol 95%, 150 ccs.
To retain green colour: Ethyl alcohol 95% 1000 ccs. Glacial acetic acid 100 ccs. Formaldehyde 40% 100 ccs. Water 1000 ccs.
Add 1 cc. saturated copper sulphate to each 50 ccs. above.
To retain red colour: Water 1000 ccs. Formaldehyde 40% 25ccs. Zinc Chloride 50 grams. Glycerine 25 ccs. Dissolve zinc chloride in hot water; filter while hot; add other ingredients and decant clear liquid.

Place these solutions in suitable screw-top jars and add plant specimens washed free of dirt.

Dry specimens:. Press lightly between newspaper for two days. Change paper and press firmly for three days. Change paper and press firmly seven days. Mount on single sheets of drawing paper or bristol board.

Technical Advice: If any difficulty is encountered by the teacher regarding any technique referred to in this outline, refer to I. D. Blair, Lincoln College, P.B., Christchurch.

[It is hoped to make arrangements whereby teachers may be supplied by the College with slide or culture material suitable for elementary studies.—Ed.]

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