A Study of the growth form and behaviour of Yorkshire fog (*Holcus lanatus*) and of its dry matter production compared with perennial rye-grass (*Lolium perenne*), both with and without fertilizers.

by

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SECTION I

INTRODUCTION

New Zealand is a land of pastures and the greatest reliance is placed on them by farmers for the maintenance of their live-stock, which is the main source of national income. She is favoured by an equable climate and well distributed rainfall, which tends to keep her predominantly a grassland country. Every farmer should accept the aim expressed by Swift (1) to make "Two blades of grass to grow upon a spot of ground where only one grew before."

Hill country pasture development is of paramount importance in New Zealand and must be extended if we are to maintain the present standard of living of an increasing population. Calder (2) said that farm production must increase greatly in the next 20 years. "We will have three-million people for whom we must provide not only food, but also additional overseas exchange to maintain the standard of living of increasing population." High pasture production can only be maintained if suitable species of grasses are grown according to the soil fertility gradient. It is not uncommon for the high producing pasture species to lose their producing power where fertility falls below a certain level or where practices inimical to their best growth are followed. On poor hill-country, the presence of low fertility demanding species is felt, due to the fact that they provide feed for the stock where the high fertility demanding species cannot maintain themselves.

Yorkshire fog (Holcus lanatus) being suitable for a wide range of soil conditions, though generally regarded as a weed, is so widespread that it must of necessity provide a considerable amount of feed to the cattle and sheep grazing on pastures. It is said, and probably with some degree of truth, that a considerable amount of butter fat comes from Yorkshire fog in New Zealand, especially from some of the low-lying meadow-type pastures in the Waikato.

It is unquestionably a valuable grass under two conditions. Firstly in the grassing of drained peat swamps, Yorkshire fog is of great importance as a pioneer grass. The main prerequisite of this type of country (peat swamps) is consolidation, which is greatly facilitated by Yorkshire fog with its ease in establishment and due to its rapid binding effect and mat forming habit. It permits cattle to be run on this country with a consequent increase in consolidation and fertility.

Secondly it establishes well in low fertility country. On most of the poor hills with fair rainfall it is often well represented, especially on shady faces. Although it cannot be claimed as one of our highest producing species, nevertheless its contribution in the low yielding sward is valuable. Spillman (S) comments that in the vicinity of the Pacific Coast it forms a first-class meadowgrass on soils that consists of nearly pure sand.

Evidence from various sources would suggest that 'fog' is one of the few grasses to remain green and produce grazing during the winter, particularly in low fertility tussock country. In this type of country its winter production is well appreciated (Levy (4); Saxby (5)). The most interesting thing to note is that this grass continues to grow and produce throughout the year. Bearing in mind that Yorkshire fog tends to spread under lower fertility soil conditions, it is not surprising that total pasture production declines when this grass increases. The reason, most probably, lies in the management pactices which encourage its spread and not altogether with the productive potential of the grass itself.

Levy (4) ranks Yorkshire fog in his ecological requirement gradation tables as a moderate to low fertility demanding plant. It can grow under variable moisture conditions (swamp and water-logged conditions to an average soil moisture), and it can tolerate the light gradation from dense shade to open and sunny situations.

New Zealand has progressed a long way in grassland research. The progress can to some extent be credited to the wide range of trials conducted by the Department of Agriculture and the Grassland Division of the Division of Scientific and Industrial Research, particularly over the last quarter century. Most of the environmental requirements of individual pasture species have been resolved and farming practice aims to provide the most suitable conditions for the maximum production from the grass and clover species.

Yorkshire fog has also attracted some attention from the Research Workers. Plant Research Division, New Zealand (6) recommends that a good deal of preliminary testing of growth form, freedom from woolliness and dead bottom, palatability, rust resistance, persistency, etc. is necessary. Corkill (8), says that 'Grasslands' have examined Yorkshire fog collected from Te Awa, to determine the range of variation present, should work be undertaken on this species in future.

In view of the widespread distribution of Yorkshire fog throughout the grasslands of New Zealand, and the ignorance of Grassland workers regarding its behaviour it was felt that some investigation was warranted. A collection of 168 samples from North Island, South Island, Chatham Island and machine-dressed seed (from South Canterbury) was made through District Agricultural Instructors. Plants derived from the seeds were observed under the single plant spacing method. A study of the growth-forms and their behaviour in these plants constitutes the subject matter of this thesis. Selection work on the outstanding plants is at present carried out by the staff of the Field Husbandry Department, Massey Agricultural College.

In addition, a comparative yield trial was laid down to compare the productive capacity of Yorkshire fog with that of perennial rye grass.

SECTION II

REVIEW OF LITERATURE

PART I

(A) YORKSHIRE FOG, ITS DESCRIPTION AND AGRICULTURAL VALUE

Holcus lanatus is distributed through all parts of the British Isles, also throughout Europe, temperate Asia and N.W. Africa. It was introduced to various parts of U.S.A. from England with other seeds, Americans call it meadow soft-grass, velvet grass, salem grass, white Timothy and Velvet mesquit grass. In England it is known as "Yorkshire fog". The word 'fog' in this connection means 'the winter growth on meadows', and is possibly derived from the fact that in dull light the herbage assumes a greyish green appearance and owing to its hairy nature, holds moisture. It is most probable that it found its way to New Zealand through seed impurities or the early settlers with the experience of it in the permanent meadow of England might have brought it with an idea of growing it for hay.

(a) Botanical features

Yorkshire fog (Fig. 1) is a loosely to compactly tufted, soft, hairy perennial plant, growing 20 - 100 cm high. In all cases hairiness is a prominent feature. The sheaths and leaves normally are densely covered with soft hairs giving the plant a velvety touch. The sheath is split and has a slight keel. The veins of the sheaths are pink and contrast strongly with the white portions between. Ligules (L), are from 1 - 4 cm long, membranous and distinct, blunt and hairy and the free edge is frilled. Auricles are absent. Leaf blades become narrowed to a fine point, 4 - 20 cm long and are flat and vary from 5 - 10 mm wide. Panicles are lanceolate to oblong or ovate, very dense to rather loose, erect or nodding, whitish, pale green, pinkish or with a tinge of purple, 5 - 20 cm long. (Hubbard (9); Ward (10)).

(b) Floral behaviour and Seed Character

The spikelets (S) are oblong to elliptic or compressed, 4 to 6 mm long, falling entire at maturity. There are two flowers (FS) per spikelet, the lower one is bisexual (FL) and the upper one staminate only (ST). The glumes (G1 G2) are almost equal in length, or sometimes the upper one is longer and broader. Both the glumes are sharply keeled, with stiff hairs on the keels. The lower glume is narrowly lanceolate or oblong and one-nerved, the upper one is ovate to eliptic, usually tipped with an awn-like point up to 1 mm long and is three-nerved. The lower lemma (LL) is boat-shaped, blunt and awnless and there is an equally long palea (P_1). The upper lemma (L_2) is narrower, awned on the back near the tip, the awn being up to 2 mm long and becoming recurved upon itself when dry. The palea (P_2) is shorter than the lemma.

The "Seed" (CH) The term "seed" in grasses is applied to the caryopsis and the attached glumes. Flowering glumes enfold the seed and the colour of the "seed" varies from dark brown to yellowish brown. Frequently the caryopsis comes free from the glumes and is a silvery grey colour. (Hubbard (9), Ward (10)). See Fig. 1.

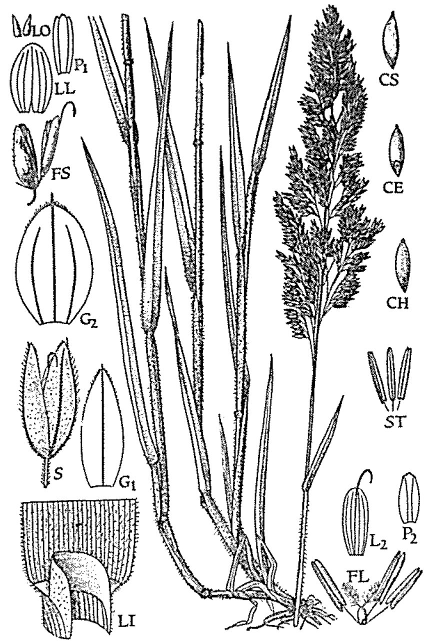
(c) Comparison with Holcus mollis

(i) Botanical Make-up

The only other common plant belonging to Holcus spp in New Zealand is creeping soft grass or creeping fog (Holcus mollis). (Fig. 2). Both are perennials and flower about the same time. H. mollis grows 20 - 100 cm high with tough creeping rhizomes, forming compact tufts or loose mats. Unlike Yorkshire fog it is able to spread below ground in addition to its ability, shared by Yorkshire fog, of being able to spread by stolons which root at the nodes. It is loosely to densely bearded at the nodes and the hairs on the sheath and blade are shorter and more dense. Other points of difference in florestic character from Yorkshire fog are (1) both its glumes are acute at the top and rather larger, (2) the lateral nerves of the upper glumes are closer to the keel than to the margin and (3) the awn of the upper flower which is more dorsally situated is longer and is rough throughout the entire length.

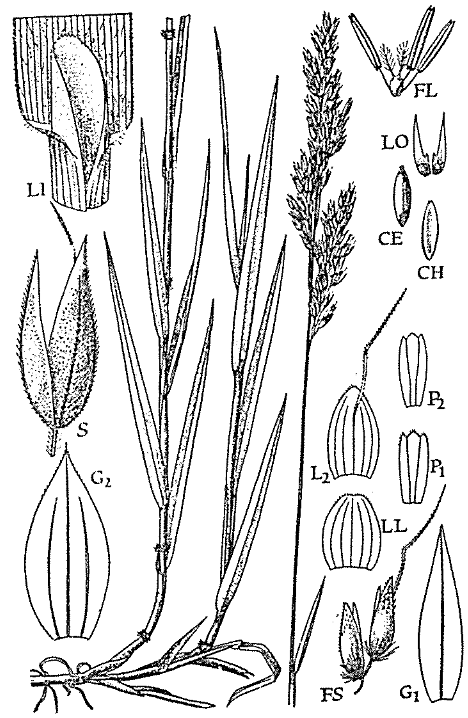
(ii) Difference in habitat of growth and use

H. mollis ((9) (11)) is less common and is generally found in shady places. It occurs under beech but is less common in ashwood. It can be found in other situations where the soil is shallow and liable to dry out. It forms one of the most



Holcus lanatus. Very common; grassland.

Fig. 1. YORKSHIREFOG (After Hubbard; 331)



Holcus mollis. Common; shaded places and arable land.

Fig. 2. ~~YORKSHIREFOG~~ Creeping fog (After Hubbard; 332)

common weeds of sandy arable land. In comparison, fog can grow on a wide range of soils (preferably in wet conditions), and is of better feeding value. Being a rhizomatous pland mollis has become a troublesome weed in sandy fields. Its eradication is extremely difficult. It is apparent that its ability to survive by means of its underground stem, to endure shade and also to grow to some height if mixed with other tall growing vegetation, enables it to compete very successfully with other plants.

Hubbard (9) states that investigations have shown that a sq. foot of infested sandy soil within 6" of the surface may contain up to 110 ft. of its rhizomes, the weight of which has been estimated at over $7\frac{1}{2}$ tons per acre.

Fenton (11) states that Holcus mollis may become a noxious weed but there are ways and means of holding it in check, as indicated by its absence in the field where cultivated root crops (potatoes, swedes) were grown or in the vicinity of rabbit burrows.

(d) Character of growth including leaf and colour

Turesson (12) has shown "by making collections of representatives of a particular species from devious and characteristic habitats and growing the plants thus collected as spaced individuals under one and the same set of uniform garden conditions, very striking differences in growth form and frequently also in more intimate morphological characteristics as between the representatives of various habitat are revealed." The variation in growth form, leaf character and colour arising out of the genotypical response of an ecospecies to a particular habitat are dealt with in more detail in the experimental findings of this thesis.

(e) Palatability

It is extremely soft and velvety and becomes conspicuous in a sward of darker-leaved grasses and it is logical that farmers should come to know it and be interested in its grazing value. It is still questionable whether it is worthy of cultivation anywhere or not? There is no doubt that this grass is unpalatable at certain times and stages of growth and it is also certain that it tends to be avoided where other palatable grasses are available.

Hilgendorf (13) states "Fog is eaten to a considerable extent, and it probably provides more fodder than it is usually credited with".

Percival (14) states that almost all hairy grasses are refused by stock and Yorkshire fog is in no way an exception to this. Stapledon (15) also supported this view that very hairy plants are not usually palatable, and it is this defect which probably more than any other, renders Yorkshire fog, relatively unpalatable to stock.

Beal (16) gives evidence that Yorkshire fog is undoubtedly unpalatable and in most of the old pastures of New England other species are kept closely cropped, whereas Yorkshire fog plants are often seen going to seed.

Thoms (17) states that plants such as Yorkshire fog and tall fescue, are unpalatable despite the fact that they may be highly productive and persistent with satisfactory chemical composition which would theoretically make them valuable components of seed mixtures.

From the above it would appear that Yorkshire fog is relatively unpalatable due to its hairiness. Evidences from various sources would suggest that it becomes as palatable as any other palatable species under certain circumstances. Percival (14) states that the hairiness in Yorkshire fog is more or less governed by the soil moisture content. In some parts of Holland and Eastern England, on damp soils, fog is less hairy than when grown in drier soils. Under this condition the grass is palatable and many cattle thrive upon it. A report from the Welsh Plant Breeding Station (18) shows that an interesting strain (S152) of Holcus lanatus, which shows remarkable paucity of hair has been selected. It is probable that however a glabrous form of Yorkshire fog through breeding could be developed, but further comment on this aspect is beyond the scope of this thesis.

There is evidence which points to the fact that even cocksfoot becomes unpalatable, even when young, where the water table is too high. Under such condition, Yorkshire fog was preferred to cocksfoot and observed to be cleanly grazed.
(Schneider-Klasberg, K (19); Leiese (20)).

Leiese (20) states that in North Sweden and Finland the effect of sunlight on palatability is well illustrated, where during the summer months, Holcus lanatus, normally unpalatable, is grazed as clean as "good" grasses. It is believed that the intensive sunlight of the North produced a higher sugar content which made the grass palatable.

Davies (21) says "when we go into the finer points of palatability, however, there are differences between the palatability of one species and another at any particular time, but these are more frequently to be correlated with stage and rate of growth." Blackman (22) observed Festuca ovina, Agrostis species and Holcus lanatus being preferred by the sheep only in their early stages of growth.

Some of the grassland workers support the view that Yorkshire fog would be more palatable under certain climatic conditions. Leiese (20) studied the influence of climate upon the sward of the pastures and meadows of the Island of Rugen in Germany. He observed that the climate seemed to affect palatability, in the case of some poorer herbage plants. There is some evidence to lead one to believe that the palatability of Yorkshire fog plants was increased by the use of phosphatic and nitrogenous fertilisers. (Hall etal (23)).

(f) Agricultural Value (Overseas Review)

Yorkshire fog commands a prominent place in pastures, particularly those in rundown hills, poor soils and acidic peat soils. Many workers are of the opinion that Yorkshire fog can be successfully introduced to the hill country and bring about an increased carrying capacity. Hubbard (9) comments that Yorkshire fog has some value, especially on poor soils in England where better grass would not grow.

Stapledon (24) commenting about Yorkshire fog for the improvement of hill grazings showed it to be remarkable both for the rapidity of its establishment and for the speed with which it grows away under proper manurial treatment. Armstrong (25) says that as pasture plants, the indigenous forms have some agricultural value, particularly in the poorer or upland areas in the moist districts of Britain. Robinson (26) says that although Yorkshire fog is considered as a weed in low-land grassland it is sometimes used successfully as a pioneer plant in the reclamation of very poor hill grasings. Stapledon (27) considers that Holcus lanatus, Anthoxanthum odoratum and Festuca rubra are useful species and can be successfully introduced up to 1,500' above sea level to improve the hill lands of Wales. A report from the Edinburgh and East of Scotland College of Agriculture (28) shows that the growth of Yorkshire fog in a cultivated area in Boghall Glen was remarkable and, due to its high-yielding capacity, it could be useful for reclaming this type of land. O'Connell (29) commented that in most of the hills in Kerry, so-called good grasses such as Festuca pratensis often never establish themselves on poor soils, whilst those described as useless, such as Holcus lanatus produce valuable fodder and good quality cattle live almost entirely on "poor" grass herbage. The suitability to poorer soils of Holcus lanatus and Trifolium repens was outstanding.

The comment from American workers is that Holcus lanatus has little forage value but it does better than any other grasses on poor soils (Hitchcock (30)). Roseveare (31) states that Holcus lanatus is cultivated in the mountains of Latin America, where it provides some green feed to the cattle.

Most of the workers have reported that Yorkshire fog is useful in the moist rather than in drier regions and is undoubtedly a good winter producer. Long (32) comments that on damp and poor land Yorkshire fog is readily eaten by cattle and they thrive upon it. It remains green during winter and can be of some value for winter grazing. Stapledon etal, (33) also commented that plants such as Yorkshire fog are decidedly winter green and provide a certain amount of green feed for sheep during the dead season. Mundy (34) reports that in the preliminary investigations with the object of establishment with other species on the wet veld soils, Yorkshire fog has yielded hopeful results. Hall etal (35) concluded, from observations on pasture trials in the Union of South Africa, that Yorkshire fog is one of the most promising winter grasses for the Eastern high veld. Heddle etal (36) classified the pastures of Boghall, Midlothian, into different types under the following headings (1) Moist flush pastures (2) Wet flush pasture (3) Short dry grass (4) Short grass with Blaeberry (5) Nardus Blaeberry, (6) Nardus with Blaeberry and (7) Nardus with under grass. Holcus lanatus falls into type (1) and they comment that it constitutes the most valuable herbage for sheep grazing in the Glen.

Some of the workers have credited Yorkshire fog with valuable features as a temporary expedient on peat land (Ogg, etal (37)). Hansen (38) classified the pastures of the North Sea coast of Schleswig-Holstein after studying soil, water table, climate and botanical composition. He puts Holcus lanatus in (C) group (moist condition) as a dominant young cattle-fattening species.

Stapledon, etal (39) conducted a test on the potentiality of production of different species under varying soil conditions. Yorkshire fog did very well under pond field conditions (poor medium, stony loam, with a tendency to be heavier and wetter towards the bottom third of the area.) The conclusion drawn from this test shows that Yorkshire fog must evidently be ranked as a potentially high producing species. Jones (40) groups species under two classes, (a) those which thrive best in the absence of the grazing animal and, (b) those which thrive best under the influence of grazing. *Holcus lanatus* falls in the (b). Baron Hay (41) says that Yorkshire fog, along with other species and *Lotus major* have given good results in the reclamation and grazing of Kangaroo grassland in Western Australia.

Conclusion

It is clear from the above review that Yorkshire fog has some value, especially on the poor land. It is endowed with the power of remaining productive during winter. It does well under moist conditions. It can be safely grown in those areas where water table is too high for most of the high-producing species. It appears to be persistent enough and maintains a steady production throughout the seasons.

(g) Agricultural Value (New Zealand Review)

It is possible that Yorkshire fog has a bright future for the development of the hill country in New Zealand. The Report of the Royal Commission into New Zealand Sheep Industry (42), recommends research into the development of better, more palatable and more nutritive strains of such poor grasses as . . . Yorkshire fog . . . , which will thrive under the dry and less fertile conditions which prevail in much of the hill country. King (43) says that the deterioration of the tussock country in New Zealand, caused by the indiscriminate burning, overstocking and overabundance of rabbits was more or less compensated for by the introduction of plants such as Yorkshire fog, sorrel, etc. Levy (4) says that Yorkshire fog has got greater value in the development of steep unploughable forested country owing to both its quick establishing and deep rooting nature.

Most of the workers have emphasised the inclusion of Yorkshire fog in the seed mixture intended for sowing hill country. Stainton (44) recommends the inclusion of Yorkshire fog in seed mixtures for hill country sowing after second growth burns. 4 lbs. of Yorkshire fog seed per acre could be included in the seed mixture as a pioneer establishing crop.

There is evidence to support that Yorkshire fog has good feeding value in New Zealand. Saxby (5) says that all New Zealand's milk and meat is not produced from the best pastures of rye grass and white clover alone. There are many thousands of pasture which contain high proportions of other grasses including Yorkshire fog, which produce considerable amounts of livestock-products.

Yorkshire fog acts as a pioneer crop for the consolidation of peat areas, due to its quick establishing, deep rooting and sod-forming nature. Allan (45) says that Yorkshire fog is a valuable grass in the early stages of reclaiming swamp lands, especially those of peaty nature. Hilgendorf (13) is also of the opinion, "it is a useful grass to sow to help to consolidate swamps."

That Yorkshire fog is an acid-tolerant grass is substantiated from the tables given by Davies (47). Adams (46), reasons as follows, "Let us consider an extreme case first - a very acid peat with a pH of 4. A good pasture can be established with 2 tons of lime per acre disced approximately 3 in. deep and another application of 2 cwt. per acre before sowing down. But one should not aim for a rye grass-white clover sward, because the pH of the top layer would be still slightly under 5, which is too acid for rye grass. Very good production can be obtained from a fog-white clover seed mixture. With the application of 3 cwt. of superphosphate and one of potash, a firm turf can be established and there is little danger that this sward will revert to fern or manuka.

If two tons of lime per acre is applied to an initial pH of 4 and a rye grass-white clover seed mixture sown, a good proportion rye grass grows in the winter, but its production is very low. Where the pH is suitable for rye grass, bad drainage might still hinder growth, due to lack of oxygen and nitrogen."

Though Yorkshire fog is not grown for seeds production, its seeds are available from cleanings from machine dressing. Figures supplied by the Census and Statistics Department, Wellington (48), show that the seed dressing centres of Christchurch and Timaru firms and Dunedin, Gore and Invercargill dressing plants accounted for 8,873 lbs. and 22,599 lbs. respectively. Information for exports is available since 1949, as the classification of grass-seed exports, prior to then, was restricted to 6 or 7 main varieties, no account being kept for minor varieties. No information is available on how these seeds are being used locally.

The figures for export are:-

Calendar Year	Weight (cwt.)	Value (£)
1949	565	915
1950	371	693
1951	321	675
1952	110	328
1953	198	621

(h) Summary of the Questionnaire

In view of the fact that Yorkshire fog has such a wide range and distribution in New Zealand pastures from first-class dairying pastures to poor hill-country pastures, and is regarded as a valuable species under certain conditions, it is felt that a study of the ecology of this species would be a valuable contribution to pasture research.

The first stage in such a study is the collection of seeds from as wide a coverage of the country as possible, followed by the growing of the plants resulting from this seed in an area for recording of plant characteristics.

Requests have been made to Instructors in Agriculture throughout the country to send seed heads of Yorkshire fog, together with details of locality and soil type from which collections were made. Opinions of individual Agricultural Instructors on fog as a pasture grass in the various districts were sought. Through a questionnaire, it was made possible to gather all the information that was needed.

A summary of the questionnaire pertaining to the opinions of Agricultural Instructors on Yorkshire fog as a pasture grass, is presented below and the details of information is provided in Appendix I.

The Summary is presented District-wise.

Manawatu

Fog has a limited value in flat country. Under heavy rainfall it is useful, provided it is kept under reasonably good grazing control. It carries much stock on hill country.

Wanganui

Very wide range of utility, and has got no value on farms where rye grass and white clover predominates.

Taranaki

It is useless under high fertility conditions, but contributes some feed on poor paddocks. It provides a fair amount of feed in Spring but becomes unpalatable in Summer. On many poor farms, most of the livestock products come from fog.

Waikato/Bay of Plenty

In most of the flat country, high producing species tend to dominate and Yorkshire fog is a useless weed. In heavy rainfall areas it is a dominant feature in run out pastures and plays an important part under good management. It also contributes a great amount to Autumn-saved pastures but would prefer it not to be present.

Gisborne

It has no value in Gisborne areas.

Northern Hawkes' Bay

It has got some value as pasture, particularly in damp areas.

Southern Hawkes' Bay

Its value is limited and land should carry ryegrass and white clover high-producing pastures.

Wairarapa

Fog appears in damp and wet areas, cattle graze it better than sheep. The early Spring growth seems to be palatable.

Horowhenua

In high-fertility conditions, fog is useless and has a smothering effect on clovers. Under such conditions, its presence is generally an indication of run out swards. However, it provides a certain amount of cover and grazing in rush-dominant flats.

Ashburton

It has got limited value.

South Canterbury

On the better class of land it is regarded as a weed. Under South Canterbury conditions, it is unpalatable and is definitely a weed grass of little value. However, it is recognised to be the best of the weed grasses and no doubt contributes useful feed. It has got no value in most of the Canterbury seed-producing farms and can be a troublesome weed.

Waimate

Fog has little value. It seems to be quite palatable in its early Spring growth.

Oamaru

It is a weed grass and appears after the depletion of good species and has some value.

Dunedin

It is a useful grass in early Spring. It has got much value as a pioneer plant in reclamation of tussock and unploughable hill country. On peaty soil it is dominant and has both economic value and a value in a development programme.

South Otago

It tends to dominate on run-out pastures and has got some value.

Southland

There is quite an appreciable amount of fog in Southland pastures, particularly in the older swards. It is grazed cleanly and can, therefore, be said to be a useful grass under these conditions. Its importance is felt on poorly-drained areas, and provides a certain amount of rough feed.

(B) REVIEW OF STUDIES ON "GROWTH FORM"

(a) Ecotype Concept

In cross fertilised pasture plants, very distinct variations in growth form with definite adaptation to particular environmental conditions are apparent. These variations in growth form are believed to be due to climate, soil, and the influence of man and his grazing animals (biotic factors) and therefore given rise to the terms, "climatic ecotype", Edaphic ecotype" and "Biotic ecotype."

This ecotype concept was proposed by Turesson (12) and was an attack on the species problem from an ecological stand-point. He states that purely genetical side of the "Species problem" is well understood, but no experiment has been done to delimit the differentiation caused by ecological factors. Thus he aims at an understanding of the Linnean species from an ecological point of view. Heretofore, the term ecotype proposed by him (12) is "an ecological unit to cover the product arising as a result of the genotypical response of an ecospecies to a particular habitat". This definition clearly delimits the species and ecospecies problem as 'the ecotypes are the ecological sub-units of the ecospecies, while genotypes are purely Mendelian subunits of the genospecies'.

The ecotype concept as proposed by Turesson is universally accepted with slight modification in the terminology. Turrill (49) proposes 'ecotype to cover the ecological sub-unit of the ecospecies arising as a result of the differentiation of the species-population in response to a particular habitat condition'. Gregor etal (50) interpret Turesson's definition and defines "the ecotype as a population distinguished by morphological and physiological characters most frequently of a quantitative nature; interfertile with other ecotypes of the ecospecies, but prevented from freely exchanging genes by ecological barriers. Spatially widely separated ecotypes may exhibit characters determined by genes restricted to the geographical regions in which they occur."

Gregor (51) in his publication on 'The Ecotype' argues on the basis of Mayr's (52) species definition 'species are groups of actually or potentially interbreeding natural populations which are reproductively isolated from other such groups' and further states that there is no biologically significant reason in adhering to Turesson's eco-prefix and why not call it a species as Mayr has done? However, he justifies Turesson's eco-prefix concept, apparently due to the fact that it does indicate a species which has been taxonomically delimited as a result of experimentation.

Cain (53) refers to the work of Danser (54) who also tried to delimit groups of individual as follows:-

'<u>Danser Concept</u>'	'<u>Turesson Concept</u>'
<u>Comparium</u> - possibility of hybridisation but the products are sterile or fertile.	Coenospecies
<u>Commiscuum</u> - can successfully exchange genes.	Ecospecies
<u>Convivium</u> - which is a population differentiated within the commiscuum and isolated by geographical influences.	Ecotype

Danser did not attempt to co-ordinate his conception with taxonomic usage and is not popular with taxonomists. However, on this concept Cain defines 'an ecotype as a convivium caused by ecological factors.'

Clausen (55) defines the ecotype as 'an ecological race, usually composed of considerable number of variable local populations existing within a given ecological zone.'

Other terms are also proposed, including cline concept. Huxley (56) defines the cline as an 'auxiliary taxonomic principle' or in other words 'character gradient.' Ecocline is defined as 'a cline apparently correlated with an observable ecological gradient' and on the basis of this concept ecotype is defined as a 'particular range on an ecocline.'

It is to be noted, however, cline and ecotype are not mutually exclusive concepts but merely express different ways of approaching the same problem. Gregor (57) emphasizes that both of these concepts are valuable aids to an understanding of the variation within species.

(b) Practical Application of the Ecotype Concept

Turesson (12) describes the occurrence of edaphic ecotypes. He found distinct and genetically stable forms on open woods, coastal sand dunes and cultivated fields.

Clausen, Keck and Hiesey (58) recognised five climatic ecotypes from the Californian population of Potentilla glandulosa. They grouped them as a Coastal Range ecotype, a foot-hill ecotype, a Midaltitude ecotype; a Sub-alpine ecotype and an Alpine ecotype.

Though this classification is based on the climatically differentiated habitats, Gregor (59) criticises thus - "the fact remains that, in one case, distance prevents intergrading, and in another, the separation is occasioned by abrupt edaphic changes." This discussion leads one to believe that climatic ecotype does not exist independently as it is influenced by some other environmental factors. However, Lawrence (60) grouped the Californian population of Deschampsia caespitosa on the basis of intra-ecotype differentiation and recognised three Californian ecotypes as Coastal; Upper Montane and Alpine. Collections were made in the first and the last case from sea level to 10,000 feet respectively. In the case of the upper Montane region, collections were made at 600 feet, 7,200 feet and 8,200 feet. It can be stressed, however, from Lawrence's work that intra-ecotype differences occur between races from widely separated geographical areas having distinct climates.

The limiting and selective effects of environmental factors on the ultimate types within a particular species is abundantly proved. The findings of most of the workers show that climatic, edaphic and biotic ecotypes are of common occurrence in all pasture species.

The first man to apply this concept in pasture species was Stapledon (61) who proved the existence of biotic ecotypes caused by various influences of man and his domestic animals. He made a study on the seeds and plants of cocksfoot collected from various habitats. He classified the plants on the basis of 'growth form' into six types, namely lax hay, dense hay, cups, tussock, spreading pasture and dense pasture types. He further classified the materials according to the habitat from which they were derived. He proved that particular types were associated with the various environments.

It is evident from the above work that when one studies in detail, an ecotypical response to man-imposed conditions, he soon realises how diversity of characters exist within a single species. The importance in ecotypical selection further lies in the recognition and investigation of the potential value of superior ecotypes, and if such an ecotype is a valuable one, it offers a rapid means of improvement in the quality of commercial seeds, as shown by the work of Levy and Davies (62) in New Zealand. They were able to sort out six types from the perennial ryegrass seeds collected from throughout New Zealand. This valuable piece of work led to the recognition of the superior material of such areas as Hawke's Bay and Poverty Bay and was certified for type.

In Australia Donald etal (63) classified the strains of subterranean clover and grouped them under four strains - Dwalganup (early); Bacchus Marsh (early mid-season); Mount Barker (mid-season) and Tallarook (late). The occurrence of ecotype in this case is attributed to be due to the fact that ecotypes were occurring in the Mediterranean region and were independently introduced to Australia. Another probable reason could be mutations which occurred during the few decades the species has been in existence in Australia. However, this work has demonstrated different strains of agricultural value which are already in commercial use.

(c) Limitation of 'Ecotype Concept'

Turesson (12) found plants of Succisa pratensis with a dwarf habit on salt meadow, but when cultivated under favourable conditions, some were observed dwarf and some were taller ecotypes which had suffered phenotypic dwarfing. This lead Turesson to use the term 'ecophene', which he defines as 'the reaction type - the ecotype called forth by the modificatory influences of extreme habitat.' It is probable that such material when wrongly selected may not give the true performance that one would expect from ecotypical selection.

Donald (64) states that the best of field ecotypes is variable material because it may vary under different farm conditions and management. It is also true that within the segregating population, a considerable range of types and degree of heterozygosity will still exist within the population.

Trumble and Cashmore (65) observed an absence of ecotypical selection in Australian Phalaris tuberosa. The reasons for the lack of this are attributed to the fact to (1) a limited quantity of original material, (2) the time factor only of 30 years, (3) a poor capacity for regeneration from seed on non-cultivated land; all resulting in a limited number of individuals. This work shows that ecotypes within a species can only be expected when the material is found in different habitat conditions for a very long time.

It is not necessarily a stable form of material that is obtained from ecotypical selection. Mention should be made of the selection of the 'Merkur' strain of red clover in Sweden, where strain resistance to eelworm attack and to Sclerotinia was obtained. The disadvantage in this selection lies in the fact that a stable strain could not be obtained which would give the same resistance during successive generations of seed increase.

In a recent publication, Gregor etal (66) comment, "Though the significance of the concept of the ecotype can be readily appreciated, the practical task of analysing and recording specific tolerance in terms of discrete ecotypes has made little progress in recent years."

After studying the rye grass population, they further state "any population which occurs within a defined habitat and which fails to exhibit the hereditary attributes generally associated with the prevailing conditions cannot rightly be regarded as an ecotype component." Furthermore, they mention the existence of different habitats in nature and include 'cultivar' which might have brought about the different 'growth form' within a species. They recognise the agro-ecotype (caused by cultural practices) and which in no way is equivalent to an ecotype in Turesson's sense, because two ecotypes of the same species cannot co-exist in one habitat.

It can be noted, however, from the above facts that the habitat factors are very much complicated and difficult to sort out so as to lead one to the recognition of discreet ecotypes.

PART II

(A) INFLUENCE OF FERTILIZERS ON THE LEAF PRODUCTION OF PERENNIAL RYEGRASS AND YORKSHIRE FOG

Greater emphasis is placed on phosphate and lime in fertilizing practices in New Zealand than on any other fertilizers. The reason for this is because phosphate and lime encourage the growth of clovers and also create the most suitable condition for the soil bacteria, both of which are able to make nitrogen available for plants in the form of nitrates. In general, phospha te and lime encourage greater bacterial activity which will fix more nitrogen directly from the air (non-symbiotic fixation); make the nitrogen on the dead vegetation and animal-droppings available to the plants and also encourage the growth of symbiotic nitrogen-fixing bacteria living on the roots of clovers.

Little work has been done in New Zealand in connection with the nitrogenous and complete fertilizers, for the reason that they are expensive and mainly unnecessary excepting in cases of extreme deficiency in the soil. However, an attempt is made to review the work done in New Zealand to study the effect of N alone and N in combination with P and K on pasture production, as they have a direct bearing on the present experiment.

Paterson etal (74) stated that dressing with nitrogen is generally claimed to stimulate growth and to give greater bulk, especially when applied in Spring to the hay crop, but in their experiment they did not find any appreciable increase in yield due to nitrogen in the form of blood.

Hudson etal (75) obtained the following results in their three years fertilizer trials.

P alone gave increased yield over the control as follows:-

1929-30	1930-31	1931-32
30%	36%	26%

N.P gave increased yield over the P alone as follows:-

1929-30	1930-31	1931-32
16%	10%	9%

N.P.K gave increased yield over N.P as follows:-

1929-30	1930-31	1931-32
7%	4%	7%

Presence of Sulphate of Ammonia increased soil acidity. However, use of lime counteracted its effect.

Hudson etal (76), in their further trials observed that the first application of Sulphate of Ammonia gave increased production but subsequent applications were of comparatively short duration and "slumped" the production. They recommended "the user of 1 cwt.of Sulphate of Ammonia per acre - or other nitrogenous fertilizers once every two or three years on the same pasture, for the production of 'out-of-season' grass, need have no fear of any appreciably bad effect following its use, so long as common sense management, and lime, phosphate, and/or potash, where necessary, are also used."

Askew etal (77) obtained the highest yield of pasture in mowing-trials at the Marsden Research Farm, Stroke, Nelson, by the use of a complete fertilizer. They further observed that where N is used annually in conjunction with phosphate, application of potash is necessary for optimum yield.

The works done in fertilizers trial with Yorkshire fog are reviewed below.

Hugues etal (78), studied the effect of varying amounts of superphosphate, potassium chloride, sodium nitrate and ammonium sulphate on the florestic character of the vegetation of irrigated hay-land at Craw. Botanical analysis revealed that N.P.K increased the number of grasses, legumes remained constant and slightly decreased other species. Holcus lanatus decreased under all treatments (NP, NK, PK) except when N alone was applied. Lolium prenenne also increased only in the presence of N.

(B) REVIEW OF WORKS ON THE PERFORMANCE OF YORKSHIRE FOG UNDER DIFFERENT MANAGEMENTS

Jones (79) observed that Yorkshire fog thrived best on undergrazed pastures. In mown area it thrived best when mown herbage was allowed to decay. In fact, Yorkshire fog did well under mowing rather than light grazing. He concluded "Yorkshire fog thrives best when subjected to a system of mowing, so long as there is sufficient undecayed or slowly decaying vegetable matter on or in the surface soil."

Lynch (80), observed less variation in the growth rate of Yorkshire fog throughout the year than that of many other species, and a greater winter production.

SECTION III

MATERIALS AND METHOD

PART I

A. Experimental layout

This area was not designed to allow for statistical evaluation of the results. A simple plan of layout was designed so as to accommodate all the seedlings required for observation without replication. The plan of layout is given in Fig. 3.a, 3b.

B. Experimental Area, its Preparation and Sowing

The experimental area was selected in the Field Husbandry demonstration plot, Massey Agricultural College. The area was 288' x 62' in size which could be fenced for concentrating the sheep in order to graze off the plants. The soil is classified as a Tokomaru silt loam (67), with many surface stones scattered through it. It was realized that the surface stones would be a hindrance to the intercultivation by the B.M.B. machine, so hand picking was resorted to. The area was level and well drained. The previous history of the area was that it had been under grass for a number of years and was in good pastures.

The field was ploughed in early September 1954 and then cultivated to a seed-bed prepared by the use of discs, harrows, leveller and roller. The whole field was divided into five traverses, each traverse consisting of 32 rows, excepting the fifth traverse in which case there were only 23 rows. There were 29 single-spaced plants in each traverse row planted two feet apart each way. This gave a total of 4,379 plants in the whole area.

Seeds from the samples sent in and collected locally were sown in seed boxes on 26/8/54. Out of 168 seed samples sown, 18 did not give sufficient plants to include in the sowing plan of the lay-out and were discarded. Transplanting was done by hand and was completed on 20th October, 1954. The general condition of the soil moisture was good and the grow th of the transplanted seedlings was rapid with few misses.

An initial dressing of fertilisers (2 cwt. super and 2 cwt. blood and bone and

LAYOUT OF PLOTS

No.	Traverse 1	Traverse 2	Traverse 3	Traverse 4	Traverse 5
1	1	37	73	109	142
2	2	38	74	110	143
3	3	39	75	111	144
4	4	41	76	112	145
5	5	42	77	113	146
6	6	43	78	114	148
7	7	44	80	115	149
8	8	45	81	116	150
9	9	47	82	117	151
10	10	48	83	118	152
11	11	49	84	119	153
12	12	50	85	120	156
13	13	51	86	121	158
14	14	52	87	122	159
15	15	53	88	123	160
16	16	54	89	124	161
17	17	55	90	125	162
18	19	56	91	126	163
19	20	57	92	127	164
20	21	59	93	128	166
21	22	60	94	129	166
22	23	61	95	130	167
23	24	62	97	131	168
24	26	63	98	132	+
25	27	64	99	133	+
26	28	65	100	135	+
27	29	66	101	136	+
28	30	67	102	137	+
29	32	69	103	138	+
30	34	70	104	139	+
31	35	71	106	140	+
32	36	72	108	141	+

Fig. 3a. Diagram showing the layout of the plots.

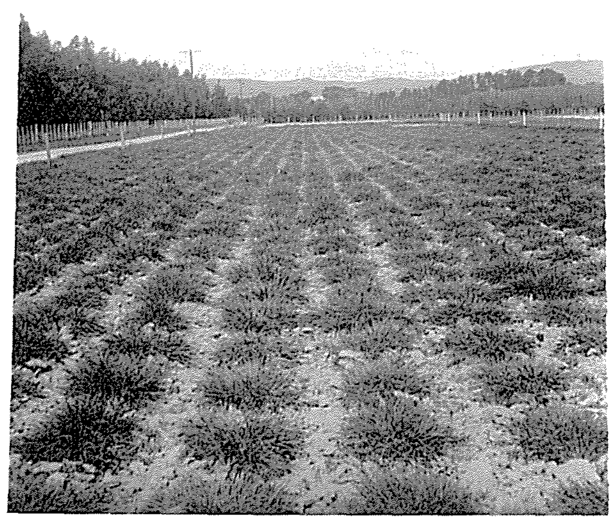


Fig. 3b. Photograph taken after the plants have attained maximum growth.

one cwt. of sulphate of ammonia and $\frac{1}{2}$ cwt. of 30% potash salts) was drilled lengthwise at the time of marking out the spacing for the plants. This was the only dressing given throughout the experimental period.

C. Experimental Procedure

The observations comprising Part I, as already mentioned, were not intended for statistical purposes as this trial was, in fact, a preliminary one to find the degree of variation that existed in the 4,597 Yorkshire fog plants derived from seeds collected from throughout New Zealand. This experiment covered an observational period of 14 months (Feb. 1955 to April 1956). It consisted of the following observations:-

(1) Growth form
(2) Recovery growth
(3) Rust infestation

(1) Growth form

Yorkshire fog is a perennial grass. There is a tendency to develop the maximum number panicle shoots during Oct. and Nov., under New Zealand conditions, otherwise barren shoots only are apparent for the rest of the year.

In studying the growth-form an aggregate of quantitative characters with potentialities is the prime importance. It is true, in the case of two distinct growth-forms "A" and "B", "A" will always differ from "B", but the range of differences is governed by geographical, climatic, edaphic and biotic conditions.

The classification of 4,579 plants of Yorkshire fog into "growth-form" types has been based on a study of the following contrasting charact eristics.

(1) Classification into "growth-form" groups

The classification groups are presented in four main vegetative "growth-form" groups into which it has been possible to classify Yorkshire fog plants. They are referred to as:-

a. Erect
b. Semi-erect
c. Semi-prostrate
d. Prostrate

a. Erect

Any plant throwing its shoot between 45 and 90° relative to the plinth of the ground is classified as an erect plant. (Figs. 4 and 5).

b. Semi-erect

Any plant throwing its shoot approximately at the angle of 45° from the plinth of the ground and may assume a cup shape, is classified as Semi-erect. (Fig. 6).

c. Semi-prostrate

Any plant throwing its shoot at 45° from the plinth of the ground and which tend to bend towards the ground is classified as Semi-prostrate. The centre may be erect. (Fig. 7).

d. Prostrate

Any plant throwing its shoot approximately parallel to the plinth of the ground, usually with open centre, is classified as prostrate. (Fig. 8).

This classification is based on the visual observations and some difficulty was experienced in classifying the semi-erect and semi-prostrate plants, however, the difficulty was overcome by sticking to the above standards.

(ii) Shape of the leaves

In most of the Yorkshire fog plants, variation in the shape of the leaves was observed. It was considered to be worthwhile to keep a record of the possible inter-relationship of the shape of the leaf with that of the growth form groups. It was not possible to measure the width of the leaf of each of the plants. However, an endeavour was made to classify visually the plants having the following shapes:-

B. Broad leaves flat

M. Medium leaves flat

N. Narrow leaves flat

Br. Broad rolled leaves

Mr. Medium " "

Nr. Narrow " "

"GROWTH-FORM" GROUPS

Fig. 4. ERECT.

Fig. 5. ERECT.

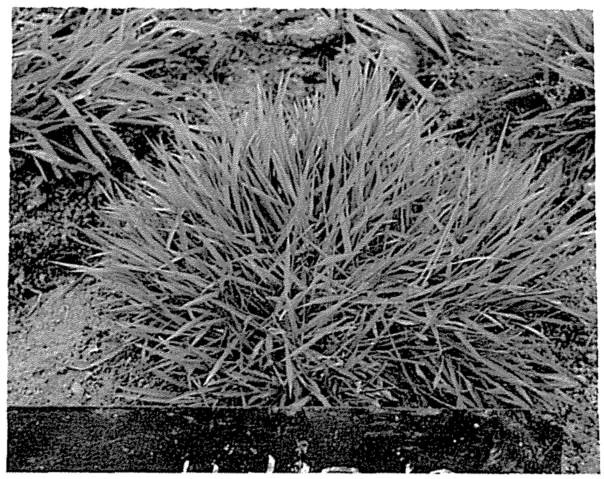


Fig. 6. SEMI-ERECT.

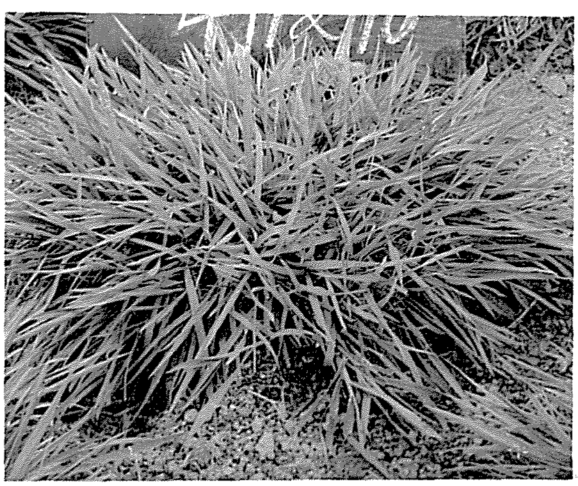


Fig. 7. SEMI-PROSTRATE.

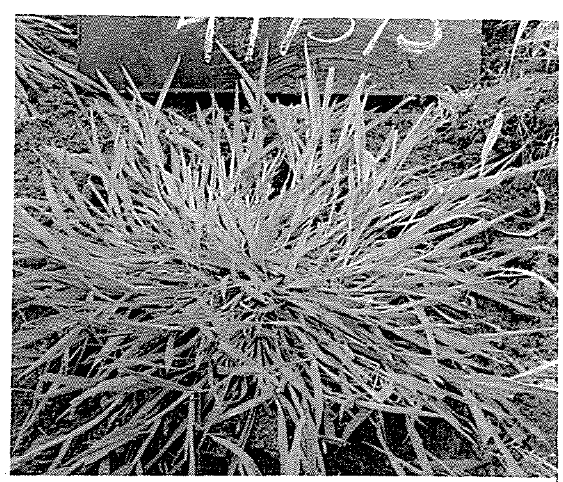


Fig. 8. PROSTRATE.

(iii) Colour of the plants

There was a distinct variation in the leaf colour. Three colour groups are apparent and are arranged under the following headings:-

X. Faint green

Y. Light green

Z. Dark green

(iv) Earliness and lateness in flowering

Range of flowering was very wide over the whole group of plants. It took three months for the whole of the plants under observation to complete flowering (4th Oct. to the end of Dec.). Plants were grouped as 'early type' which came into full bloom from 4th Oct. to 22nd Nov. 1955 and the rest were grouped as 'late type.'

(2) Recovery growth

Observations were not maintained on a fixed time period. They were undertaken only when it was felt that there was enough growth to give satisfactory observation data. After each observation, sheep were turned in. A mob of approximately 47 sheep for 24 hours could clean up the area evenly but the number of sheep and grazing time varied. However, an endeavour was made to keep the plants evenly grazed.

It was observed in almost all of the prostrate plants that sheep would not graze the prostrate portion of the shoots due to the fact that they were soiled during the process of grazing. It was realized that observations kept under such condition would tend to be biased and the tendency would be towards favouring the recovery growth for such type of plants.

A method was adopted to overcome this difficulty.

A circular disc of 10" diameter was placed over the plant and the portions that extended beyond the disc were chopped off with a sharp spade. (Fig. 9). All the plants were trimmed with the object of reducing the plants to approximately the same size and removing the portions which were not normally grazed by the sheep. The appearance of the plants after chopping off is given in the Fig. 10.

This operation was carried out once only and took one week to complete (28/4/55). It certainly did help in keeping an unbiased recovery growth record afterwards.

The system of marking was on a scale of 0-5 points, where 0 is no different from no recovery. One was given for slight recovery and two, three and four were given for fair, good and very good recoveries respectively. Five was given for the excellent recovery growth.

The accuracy of eye observations depends on the experience of the observers. Three trials conducted by Miller (68) indicated that random error for partly experienced observers were of the order of 0.5 to 0.7 and for more experienced observers, about 0.3 to 0.4 or less. I should say that occasionally experienced observers can be consistent in their estimates, but can be consistently above or below the average of their colleagues by as much as one point either way. I do not claim that eye observations on the recovery growth accorded here would be as accurate as those of the experienced observers. However, this was checked by periodical co-operative markings from Mr. W.A. Jacques, Senior Lecturer in Field Husbandry Department, Massey Agricultural College, which indicated conditions where bias was likely to arise.

Observations were made on the following dates during the 14 months growing period of the Yorkshire fog plants.

ITEM	FREQUENCY	DATES OF OBSERVATIONS
Observation of recovery growth after being grazed by sheep	8	28/2/55; 22/8/55; 22/11/55; 6/1/56; 15/3/56; 26/4/56; 31/6/56.

There was a big gap in keeping the observation in between Feb. 28, 1955 and August 22nd, 1955. This can be explained in that the late Summer was very dry and Autumn growth was late in starting. Also during this period the plants were trimmed back as already described.

(3) Rust infection

A record of rust infection was undertaken on 18/2/55 and the most susceptible

Figure 9

Chopping off the portion extending beyond the disc with a sharp spade.

Figure 10

Appearance of the plants after chopping off.

groups were found out. This was the date on which maximum infection was apparent.

PART II

A. GENERAL CONSIDERATIONS

In order to investigate the comparative seasonal leaf production between Yorkshire fog (Holcus lanatus) and perennial rye-grass (Lolium perenne) and the influence of artificial fertilisers upon leaf yield in these species, a field experiment was conducted. The behaviour of perennial rye-grass as influenced by artificial fertiliser treatments, is known and rye-grass was therefore used as a standard for comparison. Yorkshire fog is a species with unknown behaviour and it was hoped that this study would throw some light on its performance in relative leaf production.

It was felt that it would not be possible to gather the information on the above-mentioned two aspects from one experimental lay-out and therefore a subsidiary experiment was designed.

The following symbols ha ve been used for the species and combination of species plots and for the fertiliser treatments imposed on them.

Species and Combination of Species

1. Ba = perennial rye-grass (Lolium perenne)
2. By = yorkshire fog (Holcus lanatus)
3. Ac = white clover (Trifolium repens)
4. Bay = perennial rye-grass plus Yorkshire fog.

Fertiliser treatments

A. Presence of complete fertilisers

B. Absence of complete fertilisers.

B. THE EXPERIMENTAL AREA

The site selected for the experiment was on the Field Husbandry demonstration plots, Massey Agricultural College, and had been under pasture for three years. The history of the area for the four years period is as follows:-

History of the Experimental Area

Year	Crop	Fertilisers
1949/50	Pasture	
1950/51	Pasture	
1952/53	Pasture	
1954	Swedes	The area received two tons of lime per acre during Spring 1954. The swede crop was fertilised with 5 cwt. of Super per acre. The pasture was top-dressed with Super at the time of sowing down.

The soil of this area is classified as Tokomaru silt loam. The soil characters control the activity of the plant to a very great extent and a consideration of the physical and chemical composition is essential. As the chemical analysis is not available, only the mechanical analytical data from Robinson (75) are presented below.

Table

Mechanical analysis of 0-6 inch soil sample from a near-by experimental area. Percentage composition of oven-dry soil.

Coarse sand	Fine sand	Silt	Clay	Loss by Solution	Loss by Ignition
2.6	50.2	22.3	22.4	0.7	7.9

During September, 1955 a suitably uniform area of 1616.5 sq. ft. was selected and then cultivated to a seed-bed with discs, harrows, leveller and roller. The plots were then marked out by driving permanent pegs at the corner of each plot.

C. LAY-OUT OF MAIN PLOTS

The experiment was designed and laid out with the object of obtaining statistical analysis from leaf weights.

It was felt that six replications would give a good precision as indicated by the tables given by Cochran and Cox (69). A simple randomized block experimental design was employed using three crop-treatments.

The whole area (54'-6" x 29'-8") was divided into 18 plots, each plot having an area of 73.5 sq. ft. (16'-4" x 4'-6") along the outer boundaries of the experimental area and running the longer direction of the area between each plot was a 16" border (see plan of lay-out, Fig. 11a, b. The plots were marked by fixing permanent pegs in their four corners. Randomization of the crop-treatments in the respective plots was done by the use of tables of random numbers given by Snedecor (70).

Plot area was kept as small as possible and a rectangular shape as suggested by Paterson (71), was used. He recommends 1/80th of an acre plot for short growing crops. However, Glenday (7), suggested that if the co-variance of the results obtained by the observer tend to be uniform, the same accuracy can be obtained even from a plot size of 1/500th of an acre.

LAYOUT OF PLOTS

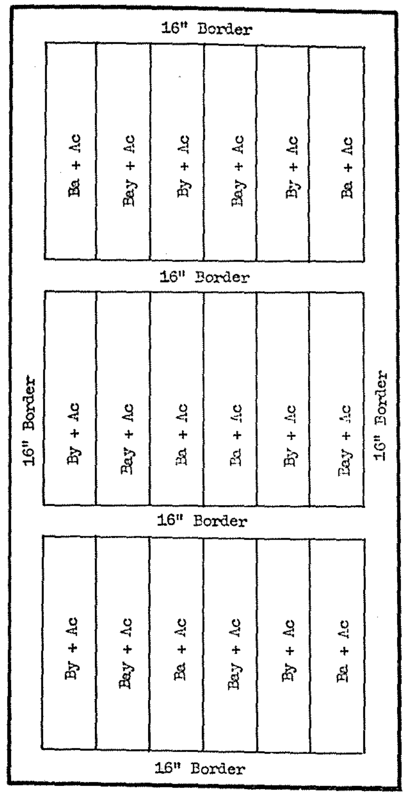


Fig. 11a. Diagram showing the layout of the main plots.

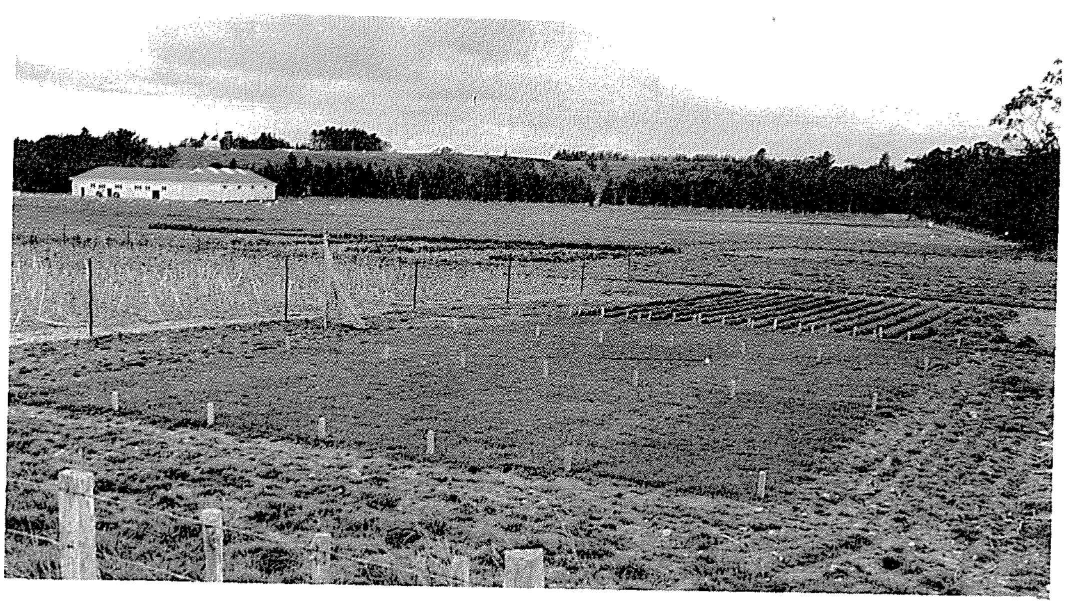


Fig. 11b. Photograph showing the layout of the main experimental plots.

D. SEED-RATE AND SOWING

It is well understood that plants when grown in a mixed association suffer from competition presumably due to the fact that some are light-demanding and some are shade tolerant. Levy (4) says that light plays a most important part in the establishment of pasture plants due to the fact that early establishers may often kill out the slowly establishing plants in the initial stage by excluding light. Even when plants are grown as pure species in an over-crowded population, they suffer competitio among themselves giving rise to the phenomenon "survival of the fittest and eliminatic of the weakest." It was felt that the seed-rate for each species as recommended in text-books for pastures would not be a correct criterion to assess the yield of plant which would have suffered such competition due to over-crowding.

Consequently, the following procedure for fixing the seed-rate per plot was adop ed and was expected to give an even distribution of healthy seeds. To achieve even distribution, wind interference was avoided and the broadcasting of the seed was done in calm and dry weather on 28/9/55.

Seed-rate

The germination tests were carried out for each species by the official Seed-Testing Station, Palmerston North. The results were as follows:-

Ba - 95%
By - 85%
Ac - 99%

The seed-rate was based on one viable seed per sq. inch of surface in the plot. The seed rate for each species per plot of 18'-4" x 4'-6", i.e. 10,584 sq. inch size was calculated as follows:-

Perennial rye-grass

In the sample of perennial rye-grass, it was found that one gram of the seed c tained 534 seeds (average of 8 counts.) Under field conditions, not all viable see will germinate, so an additional allowance of 25% was assumed to be adequate under controlled conditions of this sowing. The seed-rate calculated on the above given basis was -

$$(10,584 \times \frac{100}{95} \times \frac{1}{534}) + 25\% = 25.2 \text{ gms.}$$

Yorkshire fog

Similarly for Yorkshire fog containing 2,706 (averages of 8 counts) seeds per gram, with 85% germination + 25%, the seed-rate per plot was -

$$(10,584 \times \frac{100}{85} \times \frac{1}{2706}) + 25\% = 5.12 \text{ gms.}$$

Mixture

In case of the mixture of perennial rye-grass and Yorkshire fog, the seed-rate was half of individual crop seed-rate.

White Clover

White clover was sown on all plots at the rate of 2 lbs. per acre or 4 gms. per plot.

The respective seed quantities for the three crop treatments (Ba + Ac; By + Ac; Ba + By + Ac) were weighed out separately and were kept in small labelled bags. It was realised that an even distribution of seeds would not be possible with such small quantities, particularly with small seeds without the addition of a filler. Yorkshire fog seeds were mixed thoroughly with white clover seeds plus sufficient quantity of fine sand to enable even distribution. Seeds were broadcasted by hand and the operation was completed on 28/9/55. Then the seeds were covered with fine soil and the plot levelled with a hand rake.

An initial dressing of superphosphate was considered to be necessary and was intended primarily as a stimulant to the clovers. Each plot received super-phosphate, at the rate of 2 cwt. per acre, i.e., 7.6 oz. per plot was applied by hand just prior to sowing the seeds.

E. ESTABLISHMENT AND ROUTINE CARE

It took one month for the Yorkshire fog seedlings to be plainly visible, whereas rye-grass seedlings appeared in two weeks time. Clover growth was not visible up to two months time. On the seeding rates given the grasses were not expected to be able to combat the weeds. It was considered necessary to give a general hand weeding in order to maintain pure swards of the respective species. The most troublesome weeds were, fat-hen (Chenopodium album), twin-cress (Coronopus didymus) and black nightshade (Solanum nigrum) and also annual meadow grass (Poa annua) and dock (Rumex obtusifolium) were prevalent. It was found to be impossible to weed out night-shade and twin-cress by hand-pulling and a sharp-tipped cutlery knife proved satisfactory. Most of the fat-hen disappeared after the first mowing (20th Nov. 1955) which was not included in the record as it was meant primarily to check the growth of weeds.

It was observed after two months that white clover did not establish in the sward and, therefore, it was felt that a dressing with Nitro-green (20% N plus lime) after each cutting would be able to maintain the vigour of the grass. Plots were top-dressed with Nitro-green at the rate of 3.86 oz. per plot. It was noted that one plot of Yorkshire fog was detrimentally affected by the second application and the leaves appeared scorched. It is thought that the hairiness of the leaves were partly responsible for this and also there may have been slightly uneven distribution, which gave a patchy appearance of the plot. Consequently, top-dressing was stopped. It was considered advisable to discontinue the application over the summer period.

Surface stones were plentiful and they were picked up by hand.

F. SAMPLING PROCEDURE

The experiment was designed to allow the border areas around the plots to be mown first, leaving the exact area of each plot for trial purposes. See Fig. 11. In order to make the mower run in a straight line, a guide rope was extended along the outer edge of the border area and then the wheel of the mower was guided along it. This operation thus left the herbage only in the sampling plot of the size 75.5 sq. ft.

Each plot was then mown by running the outer-side wheel of mower parallel to the edge of the plot and about 10" from it. A second sample from the same plot was also taken so as to minimize the error variance. In this case, the sample was taken by running the wheel of the mower on the outer impression left by the wheel of the mower in the first cutting. Two samples each from an area of 16' - 4" x 16" were taken for all plots and the remaining herbage after sampling was concluded, was mown with the same mower and to the same height as that of the sampled area.

Green weight was determined for each sample as it was taken. It was clear that field weighing could not be accurate unless and until some protection against the air disturbance was afforded. Old gunny bags were stitched to the tripod stand, which served as a wind break and the weighing up to $^{1}/10$th of a pound with a spring balance was made possible (Fig. 12).

The hand mower was fitted with a covered grass-catcher in which all the mown herbage was collected (Fig. 13). Each sample immediately it was mown, was placed in a bucket, whose weight had been already adjusted on an adjustable spring balance.

It is well realized that green matter yield does not give a true picture of the total production of a sward as the moisture content in the green leaves is a variable factor which could be low on a sunny day and high under wet conditions.

Samples from each cut (2 per plot) were placed in moisture-proof plastic bags and removed to the laboratory for the determination of dry matter percentage. Approximately 100 gms. of green matter was drawn out and was placed in a metal-drying tray. It was weighed on E.F.A. triple beam balance, which could be read to an accuracy of

Fig 13. Photograph showing the hand mower fitted with grass-catcher in which all the mown herbage is collected.

Fig. 12. WEIGHING AND SAMPLING.
The tripod covered with gunny bags serves as a wind break. Samples of herbage for dry matter determination are collected in plastic bags as shown.

0.1 gram. Then it was placed in a 'WILCO' electric oven for 24 hours at 100°C. This method is recommended by the Committee of the New Zealand Institute of Chemistry for the standardization of plant Analytical Methods (72) for tissues such as leaves which are relatively low in soluble carbohydrates. The tin tray containing the dried grasses was removed to a desiccator allowed to cool for 15 minutes or so and the weight of the pan plus dry matter was determined. The procedure for calculating dry matter percentage in a given sample of green herbage is as follows:-

Weight of pan + green matter	=	a
" " " + dry matter	=	b
Weight of pan	=	c
Weight of green matter	=	(a – c)
Weight of dry matter	=	(b – c)

∴ the dry matter % in the sample

$$= \frac{b - c}{a - c} \times 100 = \%$$

In this case also two samples per plot were taken for the determination of dry matter percentage with an idea of minimising the error by increasing the number of samples. These two samples should give more or less constant figures and could be considered as a check.

With a view to having a record of comparative seasonal leaf production of Yorkshire fog and perennial rye-grass when grown singly or in association, mowing was carried out on the following dates:-

28th November, 1955
8th December, 1955
21st December, 1955
12th January, 1956
1st February, 1956
9th March, 1956
18th April, 1956
10th May, 1956
6th June, 1956
20th July, 1956
10th August, 1956.

G. SUBSIDIARY PLOTS

(1) Lay-out of the Plots

An experimental lay-out to provide statistical information on the response to the complete fertiliser treatments (presence or absence) as judged from the dry matter production of plants grown in rows, was designed. It was suggested by Mr.A.C. Glendy (7) that a split-plot design experiment with double replication within plots should give the statistical information that was needed. Furthermore in this design it was made possible to introduce an extra factor by dividing each main plot into a number of sub-plots. This design could provide sufficient information on the crop treatments and inter-action within fertilisers and crop-treatments, which are of greater interest than the fertiliser effect alone.

With the above considerations in mind, a split-plot design was chosen for this experiment. The main plots consisted of two levels of fertiliser treatment. These were arranged at random in 4 blocks. The sub-plots comprised three sowings of grass seed, namely -

1. Perennial rye-grass alone
2. Yorkshire fog alone
3. Perennial rye-grass plus Yorkshire fog.

Each of the main fertiliser treatment was split into the above three sowings. (See Fig. 14 a, b)

(2) Seed-rate and Sowing

In this experiment also the seed-rate was calculated on the basis of one viable seed to each ½" of distance along the row. Seed-rate per row of 24' length for each species works out . . .

$$(24 \times 12 \times 2) = 576.$$

An additional allowance of 25% was made for field germination and the calculated rate was accordingly increased to 720 seeds. For the mixture, the seed-rate was half of each individual crop seed-rate. Seeds were carefully counted for the sowing of

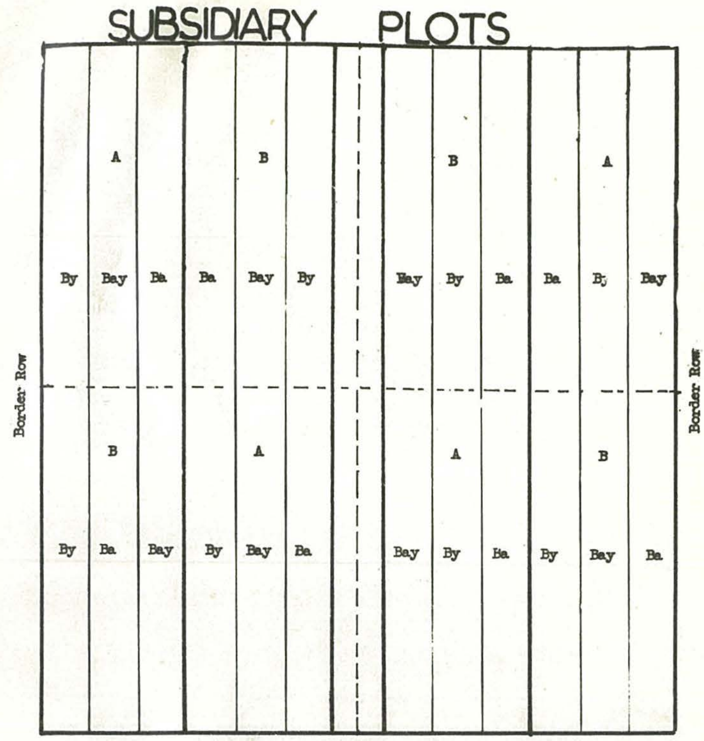


Fig. 14a. Diagram showing the layout of the subsidiary plots.

Fig. 14b. Photograph showing the layout of the subsidiary plots.

each row. Seeds were sown at approximately ½ an inch distance from seed to seed. In the case of Yorkshire fog, the seeds were mixed with fine sand and sown as evenly as possible along a shallow furrow opened in the line of the row.

The object of this experiment primarily being to see the comparative effect of fertilisers, a complete fertiliser was prepared by mixing N.P.K. at the rate of -

1 cwt. of Sulpha te of Ammonia/acre
2 cwt. of Superphosphate/acre
1 cwt. of Sulphate of Potash/acre

The actual amount of fertilisers used per row was -

1.9 oz. of Sulphate of Ammonia/plot
3.8 oz. of Superphosphate/plot
1.9 oz. of Sulphate of Potash/plot

After weighing, they were mixed thoroughly and divided into two equal parts. At the distance of 2½" on each side of the row, 3" deep furrows were opened with a spade and the two parts of fertilisers were evenly distributed along them. Then the seeds and fertilisers were covered with fine soil and the plot levelled with a hand rake. The sowing operation was completed on the same date (28/9/55) and under the same air conditions as in the plots in the main experiment.

(6) Establishment and Routine Care

In the case of perennial rye-grass, a distinct row of grasses was apparent after 15 days (13/10/55), whereas the fog plants took one month to be visible. Plant establishment in the Yorkshire fog row was not as even as was expected. It was felt necessary to fill-up the gap by transplanting seedlings from where they were too thick to where they were thin. Transplanting was carried out when the soil was damp and in the afternoon. Plants were lifted from the same row, without damaging their roots and filled-up the gap approximately giving a spacing of ½ an inch distance. This operation took two days to complete (7th and 8th November, 1955). Perennial rye-grass and mixed rows gave as even distribution of the plants as expected and did not require to be transplanted.

The experiment being to test the response of the grasses to fertilizer, a weed-free condition of the plots was desired. Weeding was done in the rows on 12th and 13th of November, 1955 and subsequently between the rows with a planet junior. Nitrogreen (20% N + lime) at the rate of 1 cwt. per acre was applied after each cutting.

(4) Sampling Procedure

Several cutting-implements were tried to enable an even and fast cutting of the plants in the rows. The scythe was fast but the losses of green herbage due to scattering was thought to interfere with the results. Sheep shears were used and found to be too slow. Finally an ordinary hand sickle was used which proved to be highly satisfactory and the whole area could be cut within a reasonably short time without any loss of green herbage.

The plants in each row were allowed to have sufficient growth to be conveniently cut off by the sickle. All the leaves of each plant were gathered together in one hand and then cut with the sickle. This ensured that the herbage was cut evenly to approximately two inches height and without loss. The weighing and sampling procedure was the same as described in the previous experiment (pages 39 & 40.)

Cutting was done on the following dates within the 12 months growing period of the plants -

~~[illegible] October, 1955~~
22nd December, 1955
20th January, 1956
16th February, 1956
25th March, 1956
1st May, 1956
25th June, 1956
[illegible] August, 1956

H. COMPILATION OF RESULTS

All the observations kept on the dry matter production were subjected to statistical analysis. The analysis of variance was done according to the method prescribed by Snedicor (70). Standard error of the mean was calculated from $\sqrt{\frac{VE}{n}}$, where VE is the error variance and n is the number of varieties for the particular treatment interactions. Wherever the 'F' test was significant, the following formula according to Paterson (71) was adopted for 't' test.

$$SE_m \times \sqrt{2} \times \text{'t'}$$

where SE_m = Standard error of the mean

't' = From Fishers table.

This value gives the significance of differences between any treatment totals, which are generally at the d.05 or d.01 level.

SECTION IV

EXPERIMENTAL FINDINGS

The abbreviations used in tables and texts are given below:

PART I

GROWTH FORM GROUPS

(1) a . . . . Erect plants

b . . . . Semi-erect plants

c . . . . Semi-prostrate plants

d . . . . Prostrate plants

In the text a and b are combined as 'erect groups' and c and d as 'prostrate groups.'

(2) Leaf Characters

B . . . . Broad leaf

M . . . . Medium leaf

N . . . . Narrow leaf

Br . . . . Broad rolled leaf

Mr . . . . Medium rolled leaf

Nr . . . . Narrow rolled leaf

(3) Colour of plants

X — Faint green

Y — Light green

Z — Dark green

(4) Earliness and lateness in flowering

E — 'Early type'

L — 'Late type'

(5) The results apply only to the classification of Yorkshire fog (*Holcus lanatus*) plants under the particular conditions

prevailing during the 14 months period of the trial.

(6) The results are presented under three sub-sectional headings -

(i) Growth form groups.

(a) Classification into growth form groups.

(b) Classification according to the shape of the leaves.

(c) Classification according to the colour of the plants.

(ii) Records on recovery growth in relation to the production of Yorkshire fog plants after being grazed by sheep.

(iii) Grouping of the rust-infected plants according to their sequence of occurrence in each growth form group.

PART II

In this experiment there are two experimental designs. The first one is to gather information on the dry matter production of the leaves from the three crop treatments, namely perennial rye-grass alone (Ba); Yorkshire fog alone (By) and a mixture (Bay) of the two grasses. The subsidiary experimental design is extended to gather information on the dry matter production by the above-mentioned crop-treatments as influenced by fertilizer applications. The results are separately presented for each experiment and the data collected from the observational record are subjected to statistical analysis.

If the results are not significant SE_m ± is given in each table and the trend in favour or against each treatment is presented. If significant results are obtained from the 'F' test, critical differences (C.D) between the treatments are determined by 't' test which gives the information on the superiority of any particular treatments over the others at a range of 5% or 1% level.

In the case of the subsidiary experiment, the analysis of variance table is given and the following levels of significance and their abbreviation are used:

-	:	Non-significant	:	-
5% level	:	Significant	:	S
1% level	:	Significant	:	SS

The results are presented under the following sub-sectional headings:

First Experiment

The performance of Yorkshire fog relative to perennial rye-grass and mixture under a series of cuttings during a 12 months growing period.

Subsidiary Plots

The performance of Yorkshire fog relative to perennial rye-grass and their mixture as influenced by the application of fertilisers under a series of cutting within a 12 months growing period.

PART I

(1) Growth form

(a) Classification into growth form groups

Following the principles adopted for the classification of the plants into growth form groups (pages 28 & 29), the following four groups of plants were observed and are presented in Table 1, arranged according to the frequency of occurrence of each growth form group, in each traverse. There were 165 plants missing and therefore, the results for each observational record are presented only from a total population of 4,214 plants. Detailed in formation regarding this classification into growth form groups, is presented in the Appendix II.

Table I

Grouping of plants according to "growth form" from a total population of 4,214 Yorkshire fog plants.

Growth Form Groups / Traverses	a	b	c	d	Totals
I	109	214	339	237	899
II	43	115	275	472	905
III	11	62	189	625	887
IV	3	29	252	588	872
V	3	29	181	438	651
Totals	169	449	1,236	2,360	4,214

From the TableI, it will be seen that there are as many as 2,360 prostrate plants, and the number of other group of plants being 1,236, 449, 169 for semi-prostrate, semi-erect and erect respectively. If we calculate the occurrence of each growth form group, in terms of percentage, their percentages will be 56% prostrate, 29.3% semi-prostrate, 10.6% semierect and 4.1% erect.

(b) Classification of the plant according to the shape of the leaves

Six distinct variations in the shape of the leaves were observed. They were classified according to four growth form groups thereby giving rise to 24 types of plants. The findings are presented in Table 2 and the detail~~ed~~ information is provided in Appendix III.

Table 2

Distribution of different shape of leaves in each growth form group from a total population of 4,214 plants.

Growth Form Groups / Leaf Shape Traverses	a (erect) B	a M	a N	a Br	a Mr	a Nr	b B	b M	b N	b Br	b Mr	b Nr	c B	c M	c N	c Br	c Mr	c Nr	[illegible]
I	13	75	21	-	-	-	20	154	30	-	7	3	87	166	54	-	24	8	[illegible]
II	6	36	1	-	-	-	6	102	4	-	2	1	111	112	28	7	16	1	[illegible]
III	1	10	-	-	-	-	7	45	5	-	4	1	50	118	19	-	19	3	[illegible]
IV	-	3	-	-	-	-	1	25	4	-	1	-	30	116	52	1	41	12	[illegible]
V	1	1	-	-	1	-	2	26	1	-	-	-	35	108	25	-	8	5	[illegible]
Totals	21	125	22	-	1	-	36	350	44	-	14	5	293	620	178	8	108	29	[illegible]

Theoretically the possible combinations would have been 24 types, but erect broad and narrow rolled as well as semi-erect broad rolled types were not observed in the population under observation and the presentation is only for 21 types.

The relationship between leaf shape and growth form is further considered in Tables 3 - 6.

Table 3

Erect plants having the following leaf shapes from a total population of 169 plants.

Leaf Shapes	Number of Plants	Percentages
B. Broad leaf	21	12.2%
M. Medium leaf	125	74.0%
N. Narrow leaf	22	13.2%
Br. Broad rolled leaf	0	0%
Mr. Medium rolled leaf	1	0.6%
Nr. Narrow rolled leaf	0	0%
Totals	169	100%

Table 4

Semi-erect plants having the following leaf shapes from a total population of 449 plants.

Leaf Shapes	Number of Plants	Percentages
B.	36	8.0%
M.	350	78.0%
N.	44	9.8%
Br.	0	0.0%
Mr.	14	3.1%
Nr.	5	1.1%
Totals	449	100%

Table 5

Semi-prostrate plants having the following leaf shapes from a total population of 1,256 plants.

Leaf Shapes	Number of Plants	Percentages
B.	295	23.7%
M.	630	50.1%
N.	178	14.4%
Br.	8	0.6%
Mr.	108	8.8%
Nr.	29	2.4%
Totals	1,256	100%

Table 6

Prostrate plants having the following leaf shapes form a total population of 2,360 plants.

Leaf Shapes	Number of Plants	Percentages
B.	629	26.7%
M.	951	40.3%
N.	284	12.0%
Br.	84	3.6%
Mr.	340	14.4%
Nr.	72	3.0%
Totals	2,360	100%

Considering percentage frequency of the leaf shapes of the four growth form groups a, b, c and d, it is clearly seen from the Table 3 and from Fig. 15, that out of 169 erect plants 12.2% were broad-leaved (see Fig. 17); 74.0% medium (Fig. 18) and 13.2% narrow-leaved (Fig. 19). From the erect plants broad-rolled and narrow-rolled-leaved plants were absent and the percentage of medium-rolled-leaved plants was only 0.6%. (Fig. 19a).

As can be seen from Table 4 and Fig. 15, from a population of 449 semi-erect plants, the frequency of occurrence of medium-leaved plants (Fig. 21) was the highest of any of the growth form groups (78%). The occurrence of other types of plant was 8.0% for broad-leaved (Fig. 20), 9.2% narrow-leaved (Fig. 22), and 3.1% of medium-rolled-leaved (Fig. 23). In this group of plants, the presence of 1.1% of narrow-rolled-leaved plants (Fig. 24) was observed and the broad-rolled-leaved plants were totally absent as in the erect group.

Table 5 and Fig. 15 provide information on the distribution of leaf shapes in a population of 1,256 semi-prostrate plants. In this group, the occurrence of broad-leaved (Fig. 25) and narrow-leaved plants (Fig. 27) was 23.7% and 14.4% respectively and was more than in the previous two groups. The percentage of medium-leaved plants (Fig. 26) was 50.1% which was less than the previous two groups. The other types were broad-rolled-leaved (Fig. 28) 0.6%, medium-rolled-leaved (Fig. 29) 8.8% and narrow-rolled-leaved 2.4%. (Fig. 29a).

The prostrate group (see Table 6) gave a higher percentage of broad-leaved plants (Fig. 30) than the erect and semi-erect groups and slightly more than that of the semi-prostrate group. The percentage of medium-leaved plants (Fig. 31) was decidedly below group a and b and slightly less than group c. The percentage of narrow-leaved plants (Fig. 32) was less than group c, and more than group a and b. The occurrence of rolled-leaved plants was more in this group and the broad-rolled-leaved (Fig. 33), medium-rolled-leaved (Fig. 34), and narrow-rolled-leaved (Fig. 35) were of the order of

3.6%; 14.4% and 5.0% respectively.

In order to give a clear idea of the growth form leaf shape combination, photographs are provided against each type with figure numbers and it is hoped that they will provide the information that is needed.

(c) Classification according to the colour of the plants

From the total population of Yorkshire fog plants, three distinct colour groups were apparent. A record on the variation of the colour of the plants in relation to their growth form groups was taken only once. The information is provided in Table 7 and detailed information in Appendix IV.

Table 7

Variation in colour of the plants in each growth form group from a total population of 4,214 plants.

Growth Form Groups	a			b			c			d			
Colour Groups / Traverses	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z	Totals
I	3	52	54	10	94	110	5	150	184	5	98	134	899
II	2	28	15	2	56	57	-	98	177	2	162	308	905
III	3	5	3	4	38	30	5	104	80	9	186	330	887
IV	-	-	3	-	20	9	3	104	145	1	135	452	872
V	-	3	-	2	24	3	3	90	88	3	144	291	651
Totals	8	88	75	18	232	199	16	546	674	20	825	1,515	4,214

From Table 7, the frequency of occurrence of plants for three colour variations for each growth form group is presented in Tables 8, 9, 10 and Fig. 16. In order to illustrate the two extreme cases of colour variation, e.g., faint green and dark green, a photograph is presented in Fig. 36.

Table 8

Numbers and percentages of erect plants having the following colour variations from a population of 169 plants.

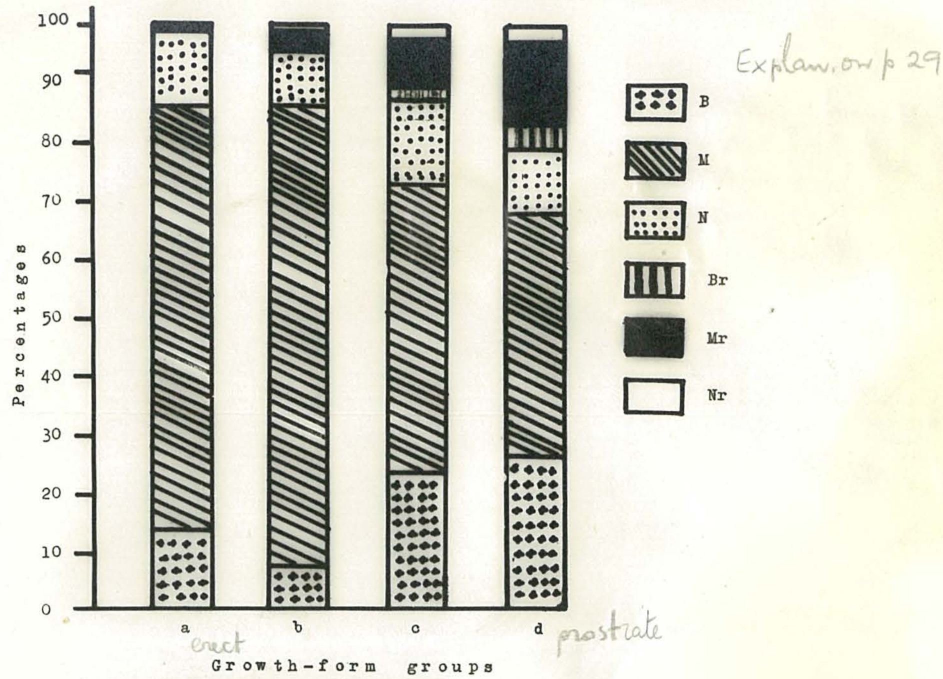


Fig. 15. Histogram showing the frequency of occurence of leaf characters within growth form groups from a total population of 4,214 yorkshirefog plants.

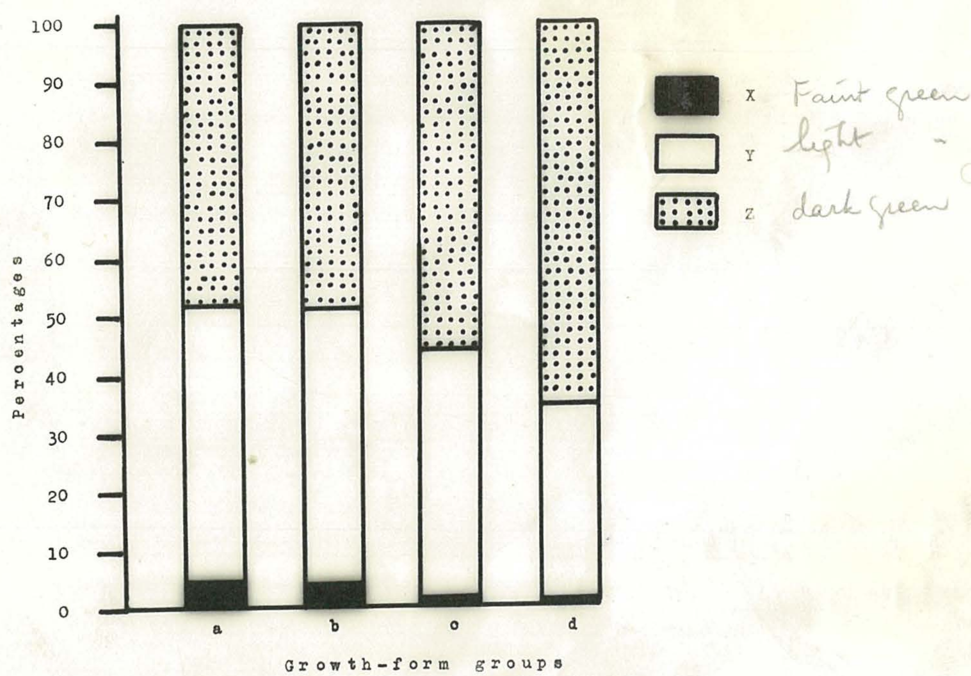


Fig. 16. Histogram showing the frequency of colour variation within growth form groups from a total population of 4,214 yorkshirefog plants.

Fig. 17. Erect, broad flat leaved.

Fig. 18. Erect, medium flat leaved.

Fig. 19. Erect, narrow flat leaved.

Fig. 19a. Erect, medium rolled leaved.

Fig. 20. Semi-erect, flat broad leaved.

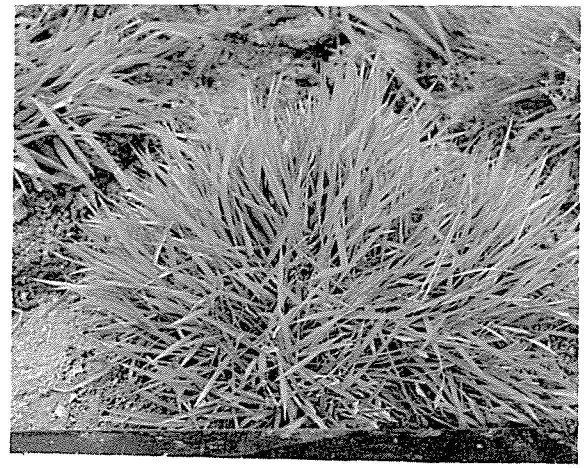


Fig. 21. Semi-erect, flat medium leaved.

Fig. 22. Semi-erect, flat narrow leaved.

Fig. 23. Semi-erect, medium rolled leaved.

Fig. 24. Semi-erect, narrow rolled leaved.

Fig. 25. Semi-prostrate, broad flat leaved.

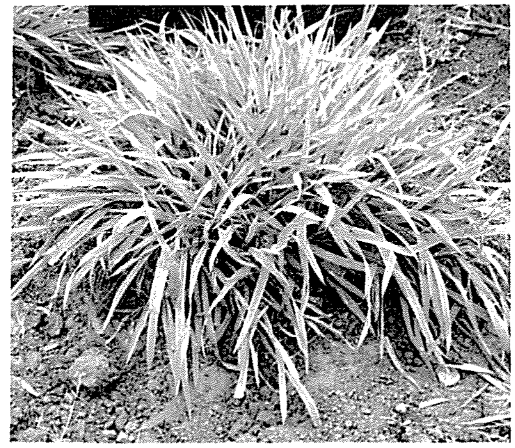


Fig. 26. Semi-prostrate, medium flat leaved.

Fig. 27. Semi-prostrate, narrow flat leaved.

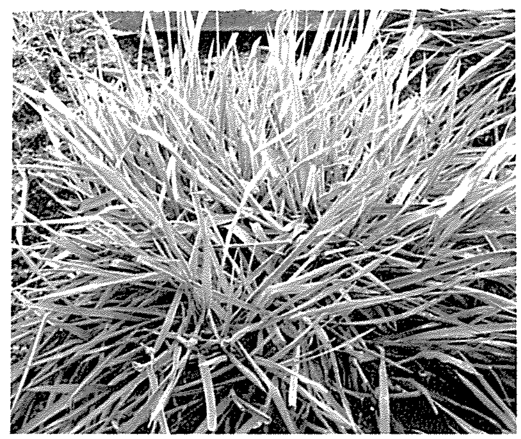


Fig. 28. Semi-prostrate, broad rolled leaved.

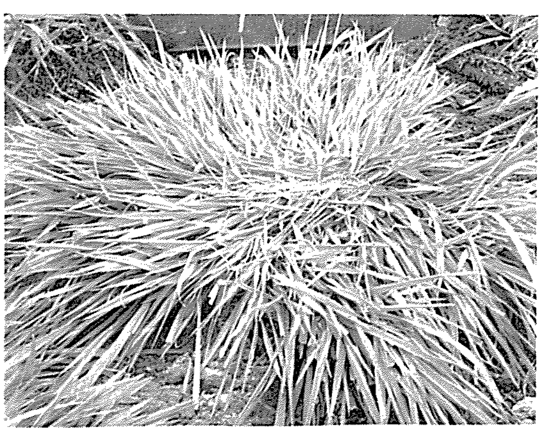


Fig. 29a. Semi-prostrate, medium rolled leaved.

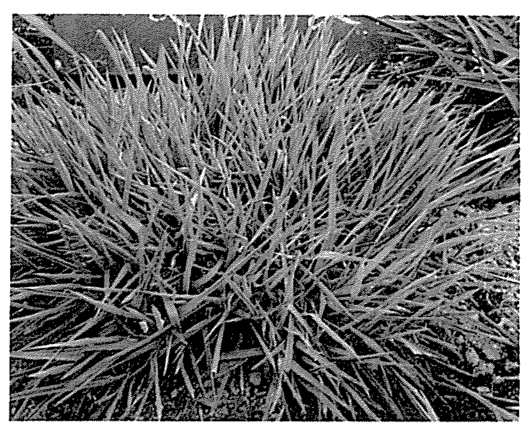


Fig. 29b. Semi-prostrate, narrow rolled leaved.

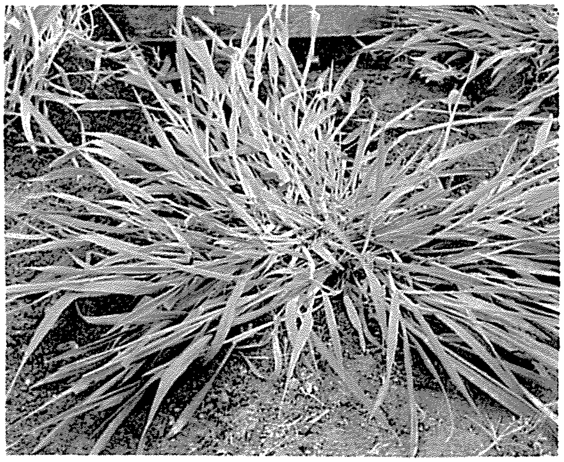


Fig. 30. Prostrate, broad flat leaved.

Fig. 31. Prostrate, medium flat leaved.

Fig. 32. Prostrate, narrow flat leaved.

Fig. 33. Prostrate, broad rolled leaved.

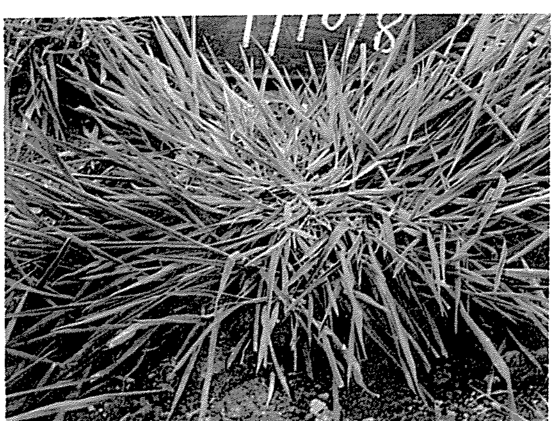


Fig. 34. Prostrate, medium rolled leaved.

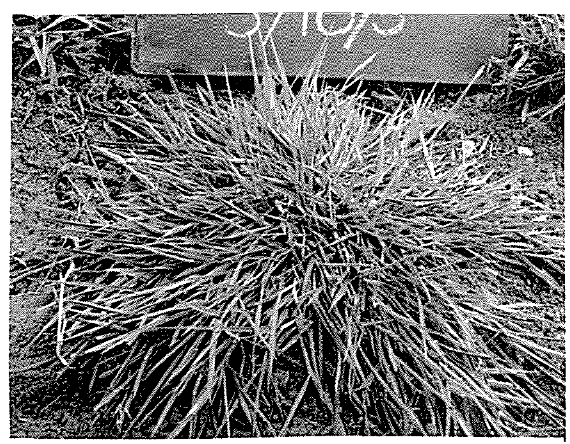


Fig. 35. Prostrate, narrow rolled leaved.

Figure 36. Extreme cases of colour variation - faint green and dark green.

Colour groups	Number of Plants	Expressed in %
X. Faint green	8	4.7%
Y. Light green	88	52.1%
Z. Dark green	73	43.2%
Totals	169	100%

Table 9

Numbers and percentages of semi-erect plants having the following colour variations from a population of 449 plants.

Colour groups	Number of Plants	Expressed in %
X	18	4.0%
Y	232	51.6%
Z	199	44.4%
Totals	449	100%

Table 10

Numbers and percentages of semi-prostrate plants having the following colour variations from a population of 1,236 plants.

Colour groups	Number of Plants	Expressed in %
X	16	1.3%
Y	546	44.2%
Z	674	54.5%
Totals	1,236	100%

Table 11

Numbers and percentages of prostrate plants having the following colour variations from a population of 2,360 plants.

Colour groups	Number of Plants	Expressed in %
X	20	0.9%
Y	825	34.8%
Z	1,515	64.3%
Totals	2,360	100%

It is apparent from the above Tables and Fig. 16, that the frequency of occurrence of dark green-coloured plants increased as they assumed the prostrate type of growth and more light-coloured with the erect groups of plants. Even so, there was only 4.7% of faint green-coloured erect plants. The percentages for the other growth form group were 4.0%, 1.3% and 0.9% for semi-erect, semi-prostrate and prostrate respectively, (see Tables 8, 9, 10, 11 & Fig. 16). The percentage of light green-coloured plants was higher in the erect groups and the order was 52.1%, 51.6%, 44.2% and 34.8% for erect, semi-erect, semi-prostrate and prostrate respectively. (See Tables 8, 9, 10, 11 and Fig. 16). The percentage of dark green-coloured plants was observed to be more in the prostrate groups than in the erect groups, the order being 64.3%, 54.5%, 44.4% and 43.2% for prostrate, semi-prostrate, semi-erect and erect groups, respectively, (see Tables 11, 10, 9, 8, and Fig. 16).

It is interesting to note that the variation in colour in Yorkshire fog plants is more or less linked with growth form groups.

(d) Lateness and Earliness in Flowering

With a view of having a clear cut distinction between the 'early' and 'late' type of Yorkshire fog plants within each growth form group, a record at the time of flowering was obtained and is presented in Table 12. Detailed information is provided in Appendix V.

Table 12

Grouping of Yorkshire fog plants into 'early' and 'late' types for each growth form group.

Growth Form Groups	a		b		c		d		
Early or late Types / Traverses	E	L	E	L	E	L	E	L	Totals
I	95	14	153	61	232	107	119	118	899
II	22	21	51	64	115	160	216	256	905
III	6	5	31	31	103	86	368	257	887
IV	3	-	11	18	104	148	257	331	872
V	1	2	21	8	83	98	192	246	651
Totals	127	42	267	182	637	599	1,152	1,208	4,214

The colour variations for each growth form group as seen from the Table 12 and the percentages from its individual population are determined and presented in the Tables, 13, 14, 15 and 16.

<u>Table 13</u>

'<u>Early</u>' or '<u>Late</u>' type of plants having <u>erect</u> growth, from a population of 169 plants and their percentages.

Type of Plants	Number of Plants	Expressed in %
E. Early	127	75.2%
L. Late	42	24.8%
Totals	169	100%

<u>Table 14</u>

'<u>Early</u>' or '<u>Late</u>' type of plants having <u>semi-erect</u> growth, from a population of 449 plants and their percentages.

Type of Plants	Number of Plants	Expressed in %
'E'	267	59.5%
'L'	182	40.5%
Totals	449	100%

<u>Table 15</u>

'<u>Early</u>' or '<u>La te</u>' type of plants having <u>semi-prostrate</u> growth, from a population of 1,256 plants and their percentages.

Type of Plants	Number of Plants	Expressed in %
'E'	637	51.5%
'L'	590	48.5%
Totals	1,256	100%

<u>Table 16</u>

'<u>Early</u>' or '<u>Late</u>' type of plants having <u>semi-prostrate</u> growth, from a population of 2,360 plants and their percentages.

Type of Plants	Number of Plants	Expressed in %
'E'	1,152	48.8%
'L'	1,208	51.2%
Totals	2,360	100%

In the erect groups, there are proportionately more 'early' type plants than in the prostrate groups. The percentages for erect group and semi-erect group being 75.2% and 59.5% respectively and were higher than the 51.5% and 48.8% for the semi-prostrate and prostrate groups (see Tables 13, 14, 15 & 16.)

On the other hand, in the prostrate groups a higher percentage of 'late' type of plants was present; the percentages being of the order of 51.2%; 48.5%; 46.5% and 24.8% for prostrate, semi-prostrate, semi-erect and erect respectively. The percentage of 'late' type plants was the highest from the prostrate groups and lowest from the erect groups (see Tables 16, 15, 14 & 13.)

(ii) Records on recovery growth in relation to the production of Yorkshire fog plants after being grazed by sheep.

Seven observations were kept on recovery growth of Yorkshire fog plants during their 14 months growing period. The recovery growth is arranged according to the growth form groups, with the object of seeing the performance of each growth form group under normal grazings by the sheep. No manures and fertilizers were applied except an initial dressing at the transplanting time and the dung and urine returned by the sheep during the grazing period. The first record kept on recovery growth is presented in Table 17.

Table 17

Recovery growth of each growth form group after the first grazing by sheep. Taken on 28/2/55.

Growth Form Groups / Traverses	a	b	c	d
I	3.3	3.7	3.6	3.7
II	2.5	3.2	3.7	3.9
III	2.9	3.2	3.5	3.5
IV	2.8	2.8	3.4	3.3
V	3.0	2.9	3.4	3.2
Overall Averages	2.90	3.16	3.52	3.52

NOTE: Scored on a basis of 0 - 5 points.

It will appear from Table 17, that the recovery growth is markedly less for the erect group of plants than any other growth form group. It can be explained that the erect growing plants a re cleanly grazed by the sheep and the reason well might have been that the erect plants took time to recover. But as already mentioned on page 30 the prostrate plants were less efficiently grazed, particularly the prostrate portion and this would have introduced bias in favour of the prostrate groups. To correct this, the ungrazed portions of all plants were trimmed on 22nd August, 1955.

Table 18

Recovery growth of each growth form group after the second grazing and trimming.

Growth Form Group Traverses	a	b	c	d
I	2.3	2.2	2.1	1.9
II	1.8	2.1	1.8	1.6
III	1.8	2.0	2.1	1.9
IV	1.1	2.7	2.7	1.8
V	3.0	1.9	2.2	1.8
Overall Averages	2.00	2.18	2.18	1.80

NOTE: Scored on a basis of 0 - 5 points.

It will be seen from the table 18 that the recovery growth from each growth form group is substantially the same with slightly more from the semi-erect & semi-prostrate groups than the erect and prostrate groups.

Table 19

Recovery growth of each growth form group after the third grazing by sheep. Taken on 22nd November, 1956.

Growth Form Group Traverses	a	b	c	d
I	2.5	2.6	2.5	2.4
II	2.6	2.7	2.7	2.6
III	2.9	3.2	3.0	2.9
IV	2.6	3.5	3.3	2.9
V	2.3	2.3	2.9	2.7
Overall Averages	2.58	2.86	2.88	2.70

NOTE: Scored on a basis of 0 - 5 points.

There is not much difference in the recovery growth attained by each group of plants in this observation and insufficient to warrant comment.

Table 20

Recovery growth of each growth form group after the fourth grazing. Taken

Growth Form Groups Traverses	a	b	c	d
I	2.1	2.1	2.0	2.0
II	1.8	2.0	2.0	1.8
III	2.2	1.7	1.7	1.6
IV	1.7	1.6	1.6	1.4
V	1.5	1.3	1.7	1.7
Overall Averages	1.86	1.74	1.80	1.70

NOTE: Scored on a basis of 0 - 5 points.

Table 21

Recovery growth of each growth form group after the fifth grazing. Taken on 15th March, 1956.

Growth Form Groups Traverses	a	b	c	d
I	1.5	1.5	1.4	1.4
II	1.1	1.2	1.2	2.2
III	1.1	1.0	1.0	0.9
IV	1.1	0.8	0.8	0.8
V	1.0	0.9	1.3	1.2
Overall Averages	1.14	1.08	1.14	1.1

NOTE: Scored on a basis of 0 - 5 points.

Here again no real differences are evident.

Table 22

Recovery growth of each growth form group after the sixth grazing. Taken on 26th April, 1956.

Growth Form Groups Traverses	a	b	c	d
I	1.6	1.7	1.7	1.7
II	1.5	1.6	1.7	1.6
III	1.5	1.5	1.6	1.7
IV	1.2	1.3	1.2	1.1
V	1.42	1.44	1.52	1.48
Overall Averages				

NOTE: Scored on a basis of 0 - 5 points.

There is not much difference in this sixth recovery growth observation between the growth form groups.

Table 25

Recovery growth of each growth form group after the seventh grazing. Taken on 31st June, 1956.

Growth Form Groups / Traverses	a	b	c	d
I	1.7	1.8	1.7	1.7
II	1.2	1.4	1.5	0.9
III	1.4	1.2	1.1	1.0
IV	1.5	1.0	1.0	1.0
V	1.5	0.9	1.4	1.5
Overall Averages	1.46	1.26	1.34	1.22

NOTE: Scored on a basis of 0 - 5 points.

From this last observation it is seen that the highest recovery growth was obtained from group a and c and the lowest from group b and d.

Although little difference is apparent in most of the recovery growth records, group c has given the highest recovery growth all throughout.

(iii) Grouping of the Rust-infected plants according to their sequence of occurrence in each growth form group.

The record on rust-infection was obtained once only during the time of maximum infection. The finding is presented in Table 24 and the detail information is given in Appendix VI.

Table 24

Rust-infection of each growth form group observed on 18/2/55.

Growth Form Groups / Traverses	a	b	c	d
I	3.6	3.7	3.8	3.8
II	4.0	3.7	3.9	4.0
III	4.3	4.5	4.3	4.3
IV	4.0	4.0	4.6	4.5
V	3.0	4.6	4.3	4.4
Overall Averages	4.12	4.08	4.18	4.20

NOTE: Scored on the basis of 0 - 5 points.

It can be seen from the Table 24, that all growth form groups were equally infected. Although the record was made visually, on the scale of 0 - 5 points, still it shows the infection was very heavy, no matter if the plants were from erect groups or prostrate groups. The effect of this rust did not last for a long time as it disappeared after two grazings. Almost all plants were affected to a greater or lesser degree.

PART II

The performance of Yorkshire fog relative to perennial rye-grass and mixture under a series of cuttings during a 12 months growing period.

There were three crop treatments, namely, perennial rye-grass grown alone, Yorkshire fog grown alone and a mixture of these two. The data obtained from the six replications at the first cutting are presented in Table 25.

Table 25

Dry matter production in lbs. by the three crop treatments in the first cutting (28th Nov. 1955).

Replications / Treatments	I	II	III	IV	V	VI	Totals
Rye alone A.	0.318	0.407	0.315	0.416	0.258	0.390	2.102
Fog alone B.	0.306	0.222	0.461	0.420	0.249	0.256	1.914
Mixture C.	0.385	0.389	0.425	0.378	0.278	0.397	2.250

Results not significant

ERROR VARINCE ± 0.0041.

Table 26

Dry matter production in lbs. by the three crop treatments in the second cutting (8th Dec. 1955).

Replications / Treatments	I	II	III	IV	V	VI	Totals
Rye alone A.	0.265	0.141	0.205	0.261	0.154	0.270	1.296
Fog alone B.	0.258	0.269	0.218	0.316	0.346	0.329	1.716
Mixture C.	0.263	0.273	0.204	0.245	0.225	0.336	1.546

Results not significant

ERROR VARIANCE ± 0.002

Table 27

Dry matter production in lbs. by the three crop treatments in the t hird cutting (21st Dec. 1956).

Replications / Treatments	I	II	III	IV	V	VI	Totals
Rye alone A.	0.195	0.252	0.246	0.225	0.187	0.345	1.450
Fog alone B.	0.244	0.275	0.306	0.271	0.299	0.262	1.657
Mixture C.	0.266	0.275	0.281	0.271	0.226	0.345	1.664

Results not significant

ERROR VARIANCE ± 0.0012

Table 28

Dry matter production in lbs. by the three crop treatments in the fourth cutting (12th Jan. 1956).

Replications / Treatments	I	II	III	IV	V	VI	Totals
Rye alone A.	0.192	0.265	0.290	0.205	0.266	0.320	1.532
Fog alone B.	0.164	0.355	0.298	0.255	0.241	0.259	1.528
Mixture C.	0.352	0.312	0.266	0.205	0.299	0.261	1.675

Results not significant

ERROR VARIANCE ± .0024

Table 29

Dry matter production in lbs. by the three crop treatments in the fifth cutting (1st Feb. 1956).

Replications / Treatments	I	II	III	IV	V	VI	Totals
Rye alone A.	0.160	0.156	0.156	0.213	0.152	0.166	1.003
Fog alone B.	0.131	0.212	0.244	0.222	0.199	0.150	1.158
Mixture C.	0.168	0.218	0.252	0.221	0.184	0.144	1.187

Results not significant

ERROR VARIANCE ± [illegible]

Table 30

Dry matter production in lbs. by the three crop treatments in the sixth cutting (8th March, 1956).

Replications / Treatments	I	II	III	IV	V	VI	Totals
Rye alone A.	0.168	0.151	0.175	0.156	0.156	0.168	0.974
Fog alone B.	0.129	0.119	0.108	0.159	0.145	0.145	0.785
Mixture C.	0.165	0.175	0.248	0.174	0.184	0.146	1.092

Results significant @ 5%

ERROR VARIANCE Sm ± .0006

C.D @ 5% = .169

order = C A B

N.B. Bar above the letters indicates no significant difference and below significant difference.

In this sixth cutting the analytical data revealed significance for the first time. The mixture gave significantly higher (5% level) dry matter production than Yorkshire fog alone but not for perennial rye-grass alone, despite a slightly higher dry matter figure.

Table 31

Dry matter production in lbs. by the three crop treatments in the seventh cutting

Replications / Treatments	I	II	III	IV	V	VI	Totals
Rye alone A.	0.099	0.129	0.206	0.209	0.137	0.118	0.898
Fog alone B.	0.102	0.145	0.156	0.084	0.064	0.080	0.631
Mixture C.	0.112	0.158	0.141	0.147	0.266	0.145	0.819

Results not significant

ERROR VARIANCE Sm ± .0009

Table 32

Dry matter production in lbs. by the three crop treatments in the eighth cutting (10th May, 1956).

Replications / Treatments	I	II	III	IV	V	VI	Totals
Rye alone A.	0.176	0.144	0.150	0.195	0.183	0.159	0.967
Fog alone B.	0.174	0.152	0.147	0.106	0.117	0.133	0.829
Mixture C.	0.147	0.170	0.150	0.161	0.165	0.119	0.912

Results not significant

ERROR VARIANCE ~~Sm~~ ± .0005

Table 33

Dry matter production in lbs. by the three crop treatments in the nineth cutting (6th June, 1956).

Replications / Treatments	I	II	III	IV	V	VI	Totals
Rye alone A.	0.129	0.136	0.123	0.102	0.105	0.056	0.651
Fog alone B.	0.114	0.084	0.128	0.083	0.090	0.114	0.615
Mixture C.	0.135	0.158	0.123	0.078	0.104	0.097	0.655

Results not significant

ERROR VARIANCE ~~Sm~~ ± .0005

Table 34

Dry matter production in lb s. by the three crop treatments in the tenth cutting (26th July, 1956).

Replications / Treatments	I	II	III	IV	V	VI	Totals
Rye alone A.	0.052	0.077	0.093	0.066	0.069	0.068	0.425
Fog alone B.	0.082	0.135	0.150	0.066	0.095	0.092	0.620
Mixture C.	0.082	0.117	0.093	0.073	0.103	0.082	0.550

Results significant @ 5%

ERROR VARIANCE ~~Sm~~ ± .0002

C.D @ 5% = .110

Order = B <u>C A</u>

There was a significant difference between treatments at 5% level. Yorkshire fog alone and the mixture gave significantly higher yields than perennial rye-grass alone. Though there was a slight trend of higher yield from Yorkshire fog alone than mixture, the difference was not significant.

Table 35

Dry matter production in lbs. by the three crop treatments in the eleventh cutting (19th August, 1958).

Replications / Treatments	I	II	III	IV	V	VI	Totals
Rye alone A.	0.040	0.077	0.079	0.075	0.054	0.050	0.375
Fog alone B.	0.081	0.122	0.141	0.105	0.112	0.125	0.682
Mixture C.	0.078	0.091	0.084	0.098	0.080	0.066	0.497

Results significant @ 1% level

ERROR VARIANCE = ± .0002

C.D. @ 5% = 0.110

@ 1% = 0.156

Order @ 5% = B C A

Order @ 1% = B C A

N.B. Bar above the letter indicates no significant difference and below significant difference.

Fog alone gave higher yield than rye-grass alone and also gave higher yield than mixture @ 1% level. There was no significant difference between the mixture and rye-grass alone @ 1% level but there was a significant difference @ the 5% level.

With a view of finding out the total dry matter production of each crop treatment during its 12 months growing period, the figures from the eleven cuttings are totalled up for each crop treatment and subjected to statistical analysis. The analytical data are presented in Table 36.

Table 36

Total dry matter production in lbs. from each crop treatment, from eleven cuttings during its twelve months growing period.

Replications / Treatments	I	II	III	IV	V	VI	Totals
Rye alone A.	1.794	1.905	2.036	2.125	1.715	2.118	11.691
Fog alone B.	1.765	2.098	2.319	2.065	1.977	1.928	12.153
Mixture C.	2.111	2.316	2.267	2.051	1.964	2.138	12.847

Results not significant

ERROR VARIANCE Sm $\pm$ .016

From Table 35, there is a trend to show that the total production of dry matter from the mixture and from fog alone was higher than perennial rye-grass grown alone, but there was no statistical difference. There was very little if any difference in the total production of dry matter between mixture and fog alone.

Separation of each species from the mixture

In order to find out the species contributing most to the mixture, two hand full of fresh samples each of the sample from the mixture plot were taken after every cutting. The grasses weeds were separated and weighed on a Triple Beam Balance. The percentage obtained for each species and weeds is presented in Table 37.

Table 37

Percentages of species and weeds in the mixture from each cutting.

Cuttings	% of Perennial Rye-grass	% of Yorkshire fog	% of Weeds
1st cutting	65%	24%	11%
2nd cutting	64%	26%	10%
3rd cutting	64%	25%	11%
4th cutting	75%	17%	8%
5th cutting	75%	18%	7%
6th cutting	76%	20%	4%
7th cutting	79%	18%	3%
8th cutting	78%	18%	4%
9th cutting	76%	20%	4%
10th cutting	69%	28%	3%
11th cutting	68%	30%	2%

In the first cutting perennial rye-grass contributed 65% and Yorkshire fog 24% and with a maximum contribution from the weed was 11%. In the fourth cutting, the contribution from perennial rye-grass was 75%, from fog 17% and from weed 8%. The rye-grass remained high and the fog around 20% until the 9th cutting. For the final two cuttings rye-grass was down to 69 and 68% and the fog had risen to 28 and 30%. The weed contribution decreased progressively from 11% to 2% throughout the experiment.

From the above findings, it can be said that contribution from rye-grass is more during Spring and Autumn, whereas fog contributed to the maximum during Winter, despite the percentage of contribution from perennial rye-grass was double all throughout for all the seasons. The presence of weed was only felt during the first three or four cuttings and the percentage was reduced with the higher number of cuttings.

SUBSIDIARY PLOTS

The performance of Yorkshire fog relative to perennial rye-grass and their mixture as influenced by the application of fertilizers under a series of cutting within a 12 months growing period.

The information on the effect of fertilizers on the crop treatments in general and their individual performance of each crop treatment and their interaction in particular, was obtained from the statistical analysis of dry matter production.

Six cuttings were taken during their twelve months growing period and observational data for each cutting were subjected to statistical analysis and are presented below. Details of statistical analyses are provided in Appendix VII.

Table 38

Dry matter produced in lbs. by three crop treatments individually, and also the influence of the fertiliser treatment and their interaction. First cutting, (20th Dec. 1956).

Analysis of Variance

Source of Variation	Sums of Squares	Degrees of freedom	Mean Square	F value	F required 5%	F required 1%	Result
Blocks	0.082	3	0.027	3.592	9.28	29.46	N.S
Fertilisers	0.159	1	0.159	20.92	10.13	34.12	S.
Error (1)	0.023	3	0.007				
Crops	0.385	2	0.192	22.64	3.88	6.93	SS.
C X F (Inter)	0.001	2	0.005	0.588	"	"	N.S.
Error (2)	0.105	12	0.008				
Total	0.755	23					

Treatment means are -

<u>Fertilizers</u> A . . . 1.267

B . . . 1.104

<u>Crop treatments</u>

Ba . . 1.285

Br . . 1.038

Bry . . 1.256

Fertilizer treatments: For significance @ the 5% level, difference must exceed 0.105.

Crop-treatments: For significance @ the 5% (1%) level, difference must exceed 0.098 (0.137).

Discussion of Table 38.

1. In this 1st cutting, the presence of fertilizer gave significantly higher yields @ the 5% level than the control.

2. Perennial rye-grass alone and the mixture gave higher yields @ the 1% level than fog alone. There was no difference between the mixture and perennial rye-grass alone.

3. The interaction between the fertilizer and crop treatments was not significant.

Table 39

Dry matter production in lbs. by three crop treatments individually, also the influence of presence or absence of the fertilizer in these crop treatments and their interaction; second cutting (20th Jan. 1956.)

Analysis of Variance

Source of Variation	Sums of Squares	Degrees of freedom	Mean Square	F value	F required 5%	F required 1%	Result
Blocks	0.059	3	0.019	0.575	9.28	29.46	N.S
Fertilizers	0.058	1	0.058	1.757	10.13	34.12	N.S
Error (1)	0.101	3	0.033				
Crops	0.005	2	0.002	1.000	3.88	6.93	N.S.
C X F (Inter)	0.002	2	0.001	0.500	"	"	N.S.
Error (2)	0.030	12	0.002				
Total	0.255	23					

Treatment means are -

Fertilizer . . . . A . . . 0.752
B . . . 0.654

Crop-treatments . Ba . . 0.684
By . . 0.716
Bay . . 0.709

Discussion of Table 39

In this second cutting none of the treatments showed significant difference. The interaction between crop and fertiliser treatments was also non-significant.

Table 40

Dry matter production in lbs. by three crop treatments individually, also the influence of presence or absence of the fertiliser in these crop treatments and their interaction; Third cutting (16th Feb. 1956).

Analysis of Variance

Source of Variation	Sums of Squares	Degrees of freedom	Mean Square	F value	F required 5%	F required 1%	Result
Blocks	0.453	3	0.151	11.615	9.28	29.46	S
Fertilizers	0.039	1	0.039	3.000	10.13	34.12	N.S
Error (1)	0.040	3	0.013				
Crops	0.496	2	0.248	31.000	3.88	6.93	SS
C X F (Inter)	0.012	2	0.006	0.750	"	"	N.S
Error (2)	0.103	12	0.008				
Total	1.143	23					

Treatment means are -

Fertiliser . . . . A . . . 1.248

B . . . 1.163

Crop-treatments . Ba . . 1.050

By . . 1.398

Bay . . 1.175

Crop-treatments: For significance @ the 5% (1%) level, difference must exceed 0.096 (0.134).

Discussion of Table 40

1. Presence or absence of fertiliser did not show any significant difference in the general yield of the grasses.

2. Yorkshire fog alone gave higher yields than the mixture or perennial rye-gr

alone @ the 1% level; the mixture gave higher yields than rye-grass alone @ the 5% level.

3. The interaction was non-significant.

Table 41

Dry matter production in lbs. by three crop treatments individually, also the influence of presence or absence of the fertilizer in these crop treatments and their interaction; Fourth cutting (25th March, 1955).

Analysis of Variance

Source of Variation	Sums of Squares	Degrees of freedom	Mean Square	F value	F required 5%	F required 1%	Result
Blocks	0.351	3	0.117	10.636	9.28	29.46	S
Fertilizers	0.027	1	0.027	2.454	10.13	34.12	N.S
Error (1)	0.035	3	0.011				
Crops	0.275	2	0.137	15.222	38.8	6.93	SS
C X F (Inter)	0.021	2	0.010	1.111	"	"	N.S
Error (2)	0.115	12	0.009				
Total	0.827	23					

Treatment means are -

Fertilizer	A	1.061
	B	0.994
Crop-treatments	Ra	0.877
	Ry	1.098
	Ray	1.109

Crop-treatments: For significance @ the 5% (1%) level, difference must exceed 0.102 (0.143).

Discussion of Table 41.

1. Presence or absence of fertilizer did not show any significant difference.

2. Mixture and fog alone gave higher yield than perennial rye-grass alone at 1% level. There was no significant difference between the yield of the mixture

and of fog alone.

3. Interaction gave non-significant result.

<u>Table 42</u>

Dry matter production in lbs. by three crop treatments individually, also the influence of presence or absence of fertilizer in these crop treatments and their interaction; Fifth cutting (1st May, 1956).

<u>Analysis of Variance</u>

Source of Variation	Sums of Squares	Degrees of freedom	Mean Square	F value	F required 5%	F required 1%	Result
Blocks	0.028	3	0.0093	0.639	9.28	29.46	N.S
Fertilizers	0.155	1	0.1550	10.479	10.13	34.12	S
Error (1)	0.044	3	0.0146				
Crops	0.072	2	0.036	9.000	3.88	6.93	SS
C X F (Inter)	0.016	2	0.008	2.00	"	"	N.S
Error (2)	0.053	12	0.004				
Total	0.364	23					

Treatment means are -

<u>Fertilizer</u> . . . . A . . . 1.694 1.094

B . . . 0.909

<u>Crop-treatments</u> . Fa . . 0.920

Ry . . 0.969

Fay . . 1.054

<u>Fertilizer treatments</u>: For significance @ the 5% level, difference must exceed 0.155.

<u>Crop-treatments</u>: For significance @ the 5% (1%) level, difference must exceed 0.071 (0.108).

<u>Discussion of Table 42</u>.

1. The presence of fertilizer gave higher yields @ the 5% than absence of fertilizer.

2. The mixture gave higher yields than perennial rye-grass alone @ the 1% level or

higher than fog alone @ the 5% level. There was no significant difference between fog and perennial rye-grass alone.

3. The interaction between these two treatments did not show any significant difference.

Table 43

Dry matter production in lbs. by three crop treatments individually, also the influence of presence or absence of the fertilizer in these crop treatments and their interaction; Sixth cutting (25th June, 1958).

Analysis of Variance

Source of Variation	Sums of Squares	Degrees of freedom	Mean Square	F value	F required 5%	1%	Result
Blocks	0.336	3	0.112	4.869	9.28	29.46	N.S.
Fertilizers	0.112	1	0.112	4.869	10.13	34.12	N.S
Error (1)	0.071	3	0.023				
Crops	0.005	2	0.001	0.119	3.88	6.93	N.S
C X F (Inter)	0.025	2	0.012	1.428	"	"	N.S
Error (2)	0.101	12	0.008				
Total	0.649	23					

Treatment means are -

Fertilizer . . . . A . . . 1.050

B . . . 0.902

Crop-treatments . Ba . . 0.989

By . . 0.989

Bay . . 0.969

Discussion on Table 43.

In this 6th cutting none of the treatments showed significant difference. Interaction was also non-significant.

As in the previous experiment, to find the total dry matter produced by each crop-treatment individually and the influence of the fertilizer on the dry mat-production by these crop-treatments in general, the figures for 6 cuttings are totalled up and subjected to statistical analysis. The data thus obtained are presented in Table 44.

<u>Table 44</u>

Total dry matter production from 6 cuttings.

Source of Variation	Sums of Squares	Degrees of freedom	Mean Square	F value	F required 5%	F required 1%	Result
Blocks	2.046	3	0.682	1.015	9.28	29.46	N.S
Fertilizer	3.077	1	3.077	4.578	10.13	34.12	N.S
Error (1)	2.016	3	0.672				
Crops	1.079	2	0.539	13.146	3.88	6.93	SS
C X F (Inter)	0.022	2	0.011	0.268	"	"	N.S
Error (2)	0.489	12	0.041				
Total	8.731	23					

Treatment means are -

<u>Fertilizer</u> . . . . A 6.448

B 5.733

<u>Crop-treatments</u> . Fm . . 5.862

Fy . . 4.137

Fmy . . 4.182

<u>Crop-treatments</u>: For significance @ the 5% (1%) level, difference must exceed 0.021 (0 .020).

<u>Discussion of Table 44.</u>

1. There was no significant effect due to the presence of fertilizer in the total dry matter production.

2. The mixture gave higher yields than fog alone or perennial rye-grass alone @ the 1% level. Fog alone also gave higher yields than perennial rye-grass alone at/the 1% level in the total dry matter production. There was no significant difference in the interaction.

<u>Separation of each Species from the Mixture</u>

As in the previous experiment, the amount of each species contributing to the mixture was determined by the separation of a portion of the sample. As the grasses in this experiment were grown in rows entirely weed free, conditions were maintained. The results obtained after separation are presented in Table 45.

<u>Table 45</u>

Percentages of each species in the mixture from the six cuttings.

Cuttings	% of Rye-grass	% of Yorkshire fog	% of Weeds
1st cutting	62%	38%	Nil
2nd cutting	66%	34%	"
3rd cutting	65%	35%	"
4th cutting	63%	37%	"
5th cutting	60%	40%	"
6th cutting	59%	41%	"

In this experiment, contribution from Yorkshire fog is more than in the previous experiment. In the first cutting, the contribution from fog was 38% and the rye-grass 62%.

It changed little through the course of the trial and the variation would be well within the sampling error.

SECTION V

DISCUSSION

PART I

In this experiment, the variation within the Yorkshire fog plants caused by the 'growth form' factor is sought for. The variation within the plant species is reflected in having different growth forms which is the out-come of the modelling process of the environment throughout the ages.

It is not considered that the classification of Yorkshire fog plants into four main growth form groups would give a clear-cut grouping, however, it is realized that it will give a basis for the recognition of the group of plants which possibly could be superior over the others and thus would lead one to recognize pasture types of Yorkshire fog plants. Similar work has been done by Stapledon (61) on cocksfoot, Levy and Davies (62) on Rye-grass and white clover; Donald etal (63) on sub-clover but it is not expected from the present limited work to give as detailed information on Yorkshire fog as that obtained by the above-mentioned workers in the respective grass and clover species. However, with the present work it is hoped to get a basis for finding out the superior types of plants from their performances under a detailed study.

A. Classification according to growth form groups

Four groups of Yorkshire fog plants are observed according to their growth form. In the findings there are more prostrate-groups of plants in the total population under study than erect-groups. It can be seen from Appendix I, that most of the erect plants are either from fence line or roadside habitats, where the influence of stock is not extensive and the prostrate groups are from grazed pastures. This principle does not seem to hold good in all cases because if we examine Traverses III & IV (Appendix II), it will be seen that almost all plants belong to prostrate groups, no matter whether they are from fence line or grazed pasture. Stapledon (61); Levy and Davies (62) proved that the growth form of the plants is directly associated with the long term effect of the biotic factor. In view of the lack of information on the origins of the plants in the trials no views are expressed on this factor. If we try to analyse and co-relate the ecological factors causing variation within plant species, proposed by Turesson (12) as 'an ecological unit to cover the product arising as a result of the genotypical response of an ecospecies to a particular habitat', it is felt that it would not be appropriate to discuss this concept in relation to the present experiment as the duration of the experimental period is only one and a half years and nevertheless, nothing could be said without knowing the breeding ability and the expression of classified characters of Yorkshire fog plants in the second generation of seed multiplication. Gregor etal (66) after working for many years with the ecological variation within plant species, comment 'though the significance of the concept of ecotype can be readily appreciated the practical task of analysing and recording specific tolerance in terms of discreet ecotypes has made little progress in recent years.'

Bearing these difficulties in mind, the object is only focused to find out the variation within Yorkshire fog plants according to growth form groups which are clearly illustrated in Figures 4, 5, 6, 7 and 8.

According to the 'growth form' grouping of the plants, the characteristic habitat of each is discussed below.

<u>Erect-groups</u>

The plants are erect growing with a smaller number of tillers than the prostrate groups. Most of the plants are short-lived. The adverse influence of stock is very great on these groups as there is the tendency of the stock to eat the crown, which is above the ground, and cause severe defoliation without giving the plants ample chance to form new tillers. The root system of these type of plants not being a permanent accessory, for each growing season after defoliation, a new root system develops from the base of the crown or immediately below the soil surface. Where they are chewed down to the crown, drying wind, intense light and temperature hinder the development of new roots and eventually the plants die (Levy (4)). In this experiment also it was observed that most of the erect plants died back during summer which may have been due in part to the above reasons. The influence of temperature appears to be great in these plants. Mitchell (81) states 'if temperatures are high, a severe defoliation not only checks the development of new tillers but also causes the existing ones to stand very erect. In this position a much higher proportion of the shoot is liable to be removed at a subsequent grazing thus increasing adverse effect on tillering.'

It would seem on first thoughts that Yorkshire fog, being unpalatable (Percival (14); Stapledon (15); Beal (16); Thomas (17)) would be a safeguard against over-grazing. The review of work on the agricultural value of Yorkshire fog (pages 9 - 11) clearly indicates that it has no value in those places where high-producing species do well, but in most of the peat country and hill country it is a pioneer grass (Saxby (5); Levy (4); Stapledon (57); Robinson (26)) and under certain conditions becomes as palatable as "good" grass. (Schneider-Kleeberg (19); Hall etal (25); Lesle (20); Blackman (22)).

Thus it would appear, that although Yorkshire fog in general can play a worthwhile part in the poorer types of land as a pioneer species, it should eventually be replaced by high-producing species when the fertility of the land has been built up. However, as regards the erect groups, in view of their disadvantages under heavy grazing, they show little promise as a pasture species.

<u>Prostrate groups</u>

If the extreme case of the prostrate group is considered (Fig. 8), most of the plants have open centres and almost all tillers run parallel to the ground, much is not grazed by the stock because of soiling during grazing. If such plants are grown in association with other species, they would have a smothering effect due to their spreading habit. On the other hand, if the characters of the semi-prostrate plants (Fig. 7) is studied, they seem to have some value as pasture plants, because of the centre growth of the erect tillers which can provide a fair amount of feed to the stock, nevertheless, the outer tillers tend to bend towards the ground but not as much in the prostrate group; and therefore are not soiled so severely. Again, the tillers are not chewed down to the crown as much as the erect type and consequently may be a more persistent pasture type. It can be seen from the recovery growth records that the highest growth was in this group of plants.

If the leaf characters of this group are studied, it is improbable that all the six types (broad flat leaved; medium flat leaved; narrow flat leaved; broad rolled leaved; medium rolled leaved and narrow rolled leaved plants) can be regarded as suitable pasture types. In this group also there are early and short-lived plants. However the plant illustrated in Fig. 26 is regarded as being an ideal type with flat medium leaves, multi-tillering, erect growth of tillers in the centre and the side tillers bending towards the ground. As compared to other plants this plant is less hairy and more succulent. It was observed to be cleanly grazed in each grazing and the recovery growth was also fast enough to ensure a luxurious growth for the next grazing.

<u>Classification according to leaf shapes</u>

There was a great deal of variation in the shape of leaves of Yorkshire fog plants. Broadly, two leaf shape types, mainly flat and rolled were [redacted] evident. Flat-leaved plants seem to be more promising for pastures than the rolled-leaved plants. Most of the rolled-leaved plants carry more hairs than those with flat-leaved, which apparently do not make the plants palatable to the stock. The rolled-leaved character appears to be adopted by the plants from drier regions and probably have taken the rolled shape of the leaves to adjust their water requirement by cutting down transpiration. These plants do not appear to be succulent and if they could survive in the drier hill country would form a persistent ~~species~~ Strain but would lack palatability.

From Table 2, it will appear that the rolled-leaved character is generally associated more with prostrate groups than with erect groups. The logical reasoning appears to be that the prostrate-groups are long-lived and to stand the adverse conditions, would have assumed the rolled-leaved shape, whereas erect-groups are early and the survival depends not on persisting for a longer period but on early reseeding.

From Table 12, it can be seen that a greater percentage of the early flowering plants are from erect-groups. Stapledon (61) also observed the same occurrence in cocksfoot plants and found the early plants to be short-lived. It is therefore, very likely that the early plants in Yorkshire fog are short-lived, and this is borne out by the fact that even from the prostrate-groups most of the early plants died after [redacted]seeding.

B. Records on recovery growth in relation to the production of Yorkshire fog plants after being grazed by sheep.

The records taken on recovery growth after the plants were grazed by sheep, show that there was not much difference in the growth attained by each growth form group. However, it was observed that the highest growth was from group C.

Erect plants were cleanly grazed but after fourth grazings, due to the effect of grazings coupled with high temperatures most of the plants died. Those plants which were living gave a very poor recovery growth. In fact, many plants had one or two living tillers left.

The ideal temperature for the tiller development of Yorkshire fog plants seem to be 65 to 70°F. Mitchell (82) at Grassland Division, found the effect of temperatures on the following aspects, on Yorkshire fog plants -

Maximum percentage increase in dry weight	60°F
Maximum weight of tissue formed on a major stem	70°F
Maximum percentage increase in tiller number per day.	70°F

The recovery growth of Yorkshire fog plants during winter scored high points, but during summer the growth was very poor for each growth form group which is probably due to the effect of high temperatures.

C. <u>Grouping of the rust-infected plants according to their sequence of occurrence in each growth form group.</u>

The appearance of rust seems to be seasonal. Godwin (33) recorded heavy infestation by the uredo and teleuto spore stages of the rust in *Holcus lanatus*. In the present experiment, it was observed to be heavy during February, 1955, but disappeared after the autum rains. It was again apparent during summer 1956 but did not last for a long period. The effect of rust my be to reduce the palatability of the plants to the stock, but even plants heavily infested with rust could recover relatively quickly.

Rust infection has been recorded as a factor affecting the leaves of Yorkshire fog but per se has not been studied.

PART II

Discussion on the relative seasonal dry matter production by the three crop-treatments.

The primary object of this trial was to measure the performance of Yorkshire fog and compare it with perennial rye-grass and a mixture of these two species. It is well realised that the results obtained from such a short duration trial would need to be retested. Moreover, the cutting times were not well spaced and a satisfactory picture of the seasonal production could not be formed. However, it is hoped that the informations on the performance of fog as a pasture plant may prove of value.

The outcome of eleven cuttings from this trial is presented in Table 46 and the seasonal production for each treatment in Figure 37.

Table 46

Relative production of dry matter in lbs. by three crop-treatments for eleven cuttings within their growing period of twelve months.

Cuttings	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	Total
Dates / Treatments	28th Nov. 1955	8th Dec. 1955	21st Dec. 1955	12th Jan. 1956	1st Feb. 1956	9th Mch. 1956	18th Apr. 1956	10th May 1956	6th June 1956	20th July 1956	19th Aug. 1956	
Rye grass alone	2.102	1.296	1.450	1.532	1.005	0.974	0.898	0.987	0.651	0.425	0.375	11.691
Yorkshire fog alone	1.914	1.716	1.657	1.528	1.158	0.785	0.631	0.829	0.613	0.620	0.682	12.135
Mixture	2.250	1.546	1.664	1.675	1.187	1.092	0.819	0.912	0.655	0.550	0.497	12.847

(1) Perennial rye-grass

It can be seen from Table 46 and Fig. 37 that the first grass to come away in the sward was perennial rye-grass. The maximum production from this grass was during November. There was a sharp decline in production during the early part of December and a rise in the later December and January cuttings. It seems possible that the rise in production during January may have been due to the wet season, as the rainfall (see

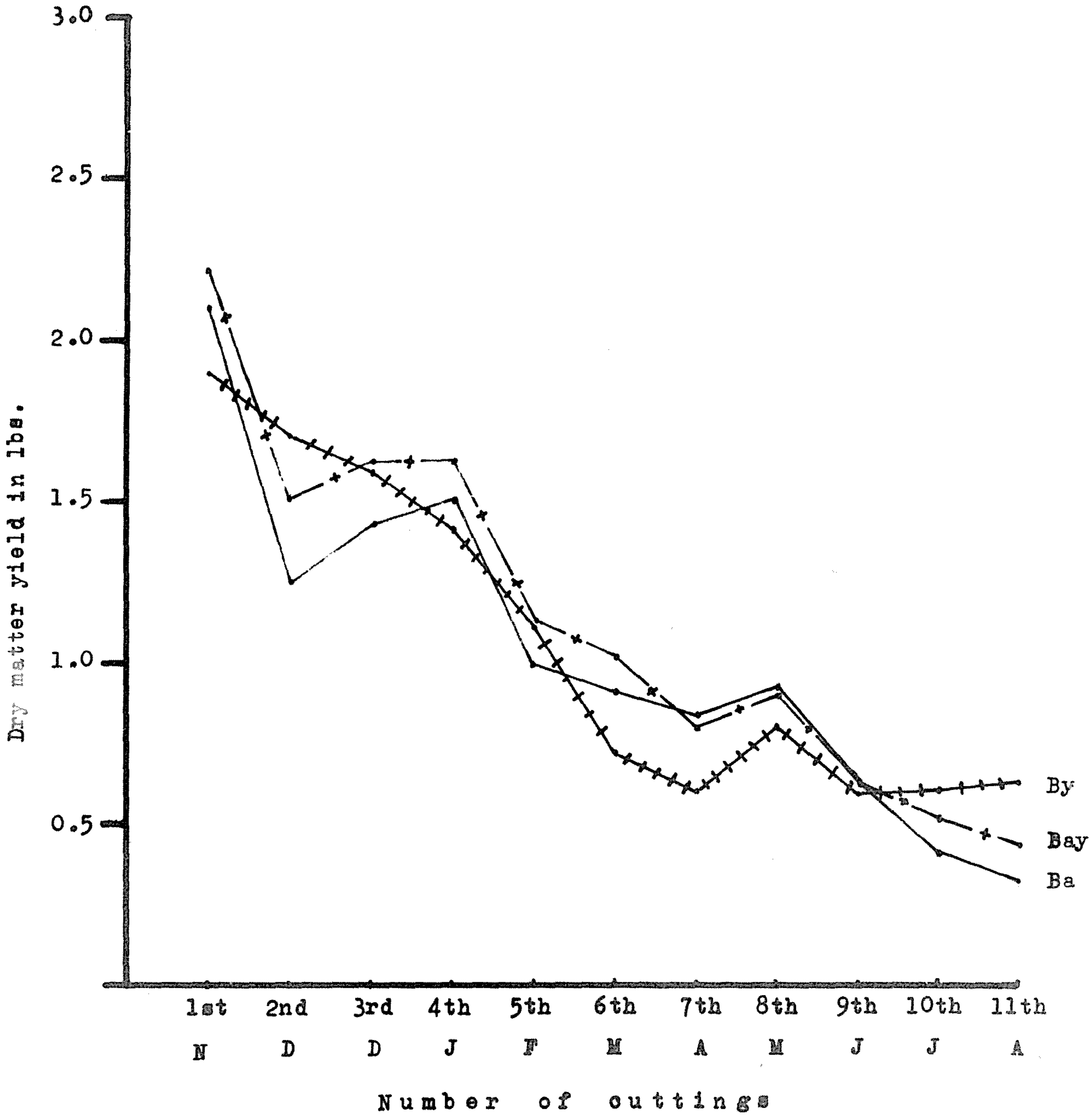


Fig. 37. Graph showing the dry matter production in lbs by each crop-treatment at every cutting.

Appendix VIII) for this month was above normal. Lynch (80) observed at Marton that maximum production from rye-grass occurred in October and November and a marked falling off in production took place during December, January and February. In this t rial also there was a rapid decline in production during the months of February and March, which may be due to dry weather as the temperatures were above average and the rainfall well below the average (see Appendix VIII). During June, July and August, the production from this grass went down to the lowest which seems to be due to the fact that it is not a winter producer.

(2) Yorkshire fog grown alone

The seasonal productive capacity of fog alone as compared to the other crop-treatments is well portrayed in Fig.37. It is clearly seen that the decline in production of fog from November to December is not so marked as that of the rye-grass, but the statistical analysis did not show any significant difference (for details of statistical analysis see Appendix IX). The production of fog during the months of January and February declined which may be due to high maximum temperature which reached 75°F and 72°F respectively. Mitchell (82) observed that the ideal temperatures for the maximum production from fog are from 65°F to 70°F. The production was further reduced in March and April and this could possibly be accounted for to the excessively dry conditions during March (despite rainfall above average during the month of April). In the May cutting, the production rose, followed by a decline in the yield obtained during the month of June. Fog gave higher production during July and August cuttings than either of the other two treatments, which may be due to the fact that fog is a winter producer. (Levy (4); Saxby (5); Stapledon (55); Lynch (80)).

It was also observed that in the 10th and 11th cuttings, fog gave significantly higher yields than perennial rye-grass @ the 5% and 1% levels respectively. (For details of statistical analysis, see Appendix IX).

(3) Perennial rye-grass and fog grown as a mixture

The mixture gave a higher production from the later part of December to April than any of the two species grown singly, but there was no significant difference excepting in the March cutting (6th cutting) in which the yield from the mixture was higher than fog alone at the 5% level. In May and June cuttings, there was not much difference between any of the treatments. In the winter production (July and August) the mixture gave significantly higher yield than perennial rye-grass alone at the 5% level.

From Table 36, it can be seen that the contribution from perennial rye-grass to the mixture is about double the contribution from fog throughout. However, the percentage of contribution was greater from rye-grass during Spring and Autumn, whereas fog contributed to its maximum during winter. The above findings show that it may be possible to grow fog with perennial rye-grass and by doing so increase the winter production of the sward.

The statistical analysis of the total production from these three crop-treatments for eleven cuttings does not show any significant difference, so no comments are warranted.

SUBSIDIARY PLOTS

This trial also provides information on the performance of Yorkshire fog in relation to other crop-treatments; but as the cuttings were taken approximately at intervals of three months and the method of sowing was also different from the previous experiment, it is felt that information thus obtained from this trial would not be comparable to that of the previous trial; so no attempt is made to discuss this aspect. Cowkill (8) is also of the opinion that no comparative study of any grass could be made from different trials if the method of sowing and cutting intervals ar e different. However, the object of this trial being to seek information on the effect of fertiliser on the crop-treatments and their interaction if any, the discussion is confined to these aspects.

The influence of fertiliser on the dry matter production by three crop-treatments and their interaction

The response from the complete fertiliser application was obtained in the first cutting, which gave higher production of dry matter @ the 5% level over the control. This finding is in agreement with that of Askew etal (77). The application of calnitro following on the complete fertiliser did not show any significant difference in the production of dry matter over the control excepting in the 5th cutting. The statistical analysis for the total production for 6 cuttings also did not show any significant increase over the controls. From this it would appear that the application of nitrogen may not be economical for the production of grasses after every cutting. Hudson etal (76) observed that applications of sulpha te of ammonia "slumped" the production. Paterson etal (74) also observed the same effect of nitrogen in the form of blood.

It would appear from the above that the effect of nitrogen is not economical on the production of dry matter by the grasses. Furthermore, there was no significant interaction between the crop-treatments and fertiliser treatment, which shows that the presence of fertiliser did not influence the dry matter production of individual crop-treatment.

SECTION VI

SUMMARY AND CONCLUSIONS

PART I

The summary of the results and the conclusions reached during the course of the experiment are given below.

1. A basis for the classification of the Yorkshire fog plants into growth form groups was evolved.

2. Yorkshire fog plants were classified into four growth form groups as follows:-

   a. Erect

   b. Semi-erect

   c. Semi-prostrate

   d. Prostrate

3. From the total population of 4,214 Yorkshire fog plants the percentages were 56% prostrate, 29.3% semi-prostrate, 10.6% semi-erect and 4.1% erect.

4. Leaf characters in relation to the growth form groups were studied. Six types of leaves were observed in each growth form group excepting erect and semi-erect groups in which case there were only four and five types respectively.

5. Broadly two leaf shape-types were discerned, namely flat and rolled. The rolled leaved character was more associated with prostrate groups than with erect groups.

6. Early flowering plants were observed to have a higher mortality over the period of the trial. From the total population, the percentage of early flowering plants was more in erect-groups than in prostrate-groups.

7. From the erect-groups, plants were early and some were short-lived, whereas a higher percentage of plants from prostrate-groups was late and longer- lived.

8. The recovery growth record did not show any marked variation in the recovery growth attained by each growth form group excepting that the growth form group C was highest all throughout the observational period.

9. The only record maintained on rust infection showed that rust infection is seasonal and the intensity of infection during the Season was the same in all growt form groups.

PRACTICAL CONSIDERATION

Nothing could be concluded with a study for such a short duration, however, the growth form groups classification shows that the extreme groups a and d as well as b may not have much promise as a permanent pasture plants. On the other hand, group c being persistent and multi-tillering with tillers running from erect to almost parallel to the ground may not suffer unduly from the influence of stock grazing and possibly would be able to remain productive in permanent pastures. It is likely that the rolled leaved plants, no matter from which growth form groups they are derived, may not have any prominent place in the seed mixture as they lack palatability and the leaf production from this type of plant is very low. The ideal pasture type of plants would appear to be present in group c.

PART II

1. Eleven cuttings were taken during the twelve months growing period of perennial rye-grass alone, fog alone and a mixture of these two species.

2. Perennial rye-grass gave a higher production during Autumn than fog alone or the mixture, but there was no significant difference.

3. Winter production from fog was higher than perennial rye-grass alone @ the 5% (in the 10th cutting) and 1% (in the 11th cutting) level.

4. The mixture also gave significantly higher production than perennial rye-grass alone during winter (10th & 11th cuttings) at the 5% level.

5. It is probable that fog may have a place in association with rye-grass, particularly to increase winter production, in peat land or in hill country.

6. The analysis of the total of the eleven cuttings did not show any significant difference in the dry matter production by these three crop-treatments.

SUBSIDIARY PLOTS

1. The application of complete fertilisers gave higher dry matter production at the 5% level over the control.

2. Subsequent application of nitrogen did not show any significant difference in the dry matter production over the control, excepting in the 5th cutting.

3. The statistical analysis for the total of six cuttings also did not show any significant effect of fertiliser over the control.

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APPENDICES

APPENDIX I

ANALYSIS OF YORKSHIRE FOG SAMPLES

1-17 on 6/1/54; 1a-9a on 27/1/54; 1b-11b on 8/2/54.

Massey College Code No.	Serial No.	
1	1	Collinson Drive, past entrance to parking area.
2	2	" " opposite old playing fields.
3	3	F.H. fence line, seed store. Dead leaves, poor plant.
4	4	" " " green leaves, better plant.
5	5	Open drain in F.H. plots. Early ripening heads.
6	6	Hort. area, near F.H. drain. Strong growing plant.
7	7	Ditto.
8	8	Burke area, neglected grass over fence from F.H. plots
9	9	Ditto.
10	10	Ditto.
11	11	Dry bank behind F.H. plots.
12	12	Burke area, a round water trough.
13	13	Nursery. Small, dry, compacted ridge by drain.
14	14	" Single plant in raised hummock.
15	15	" Single plant showing little dea d leaf at base.
16	16	" Single plant, early flowering, many heads, little leaf.
17	17	" Single plant, much green leaf with little dead base.
18	1a	Burke area behind F.H. plots.
19	2a	Nursery. Plant with much green leaf.
20	3a	" Plant with small leaves and small heads.
21	4a	" Plant with large leaves and large heads.
22	5a	" Small heads, much green leaf.
23	6a	" Early flowering plant retaining green leaf.
24	7a	" Early flowering, erect, heavy seeder, much green leaf.
25	8a	" Narrow leaves, dense plant, few and small heads.
26	9a	Burke area, plant from Terrace gully sides.
27	1b	Nursery. Cushion plant, late flowering, very small heads.
28	2b	" Early, with some late flowers.
29	3b	" Small-headed type, very matty.
30	4b	" Small heads.
31	5b	Hort. area. Late flowering plant.

APPENDIX I -- Continued

Massey College Code No.	Serial No.	
32	6b	College grounds
33	7b	F.H. Plots, ditch. Late flowering plant.
34	8b	Same as 31 above.
35	9b	Orchard. Late flowering, small heads. Good plant.
36	10b	Nursery. Big heads, t hick stalks.
37	11b	Orchard. Small heads, late flowering, few flowers, good plant.

APPENDIX I - Continued

Code No.	Serial No.	Locality	Date Collected	Soil Type	Conditions	Importance
MANAWATU						
38	20.53	Palmerston North			Dry. Trent Avenue	
39	50.53	Glen Oroua	24/1/54	13	Roadside	Dominant
40	45.53	Tua Paka			Sutherlands, Tua Paka	
41	44.53	Tua Paka			Hillside	
42	52.53	Ohakea	25/1/54	12	Roadside	Dominant
43	31.53	Linton	20/1/54	122 steep	Hillside	Minor
44	53.53	Clydesdale	25/1/54	23	Roadside	Dominant
45	51.53	Rongotea	26/1/54	13	Dairy pasture	Minor
46	46.53	Clifton Ter.				
47	19.53	Palm. North			Wet. Chaytor St.	
48	23.53	Massey Coll.	Late leafy	plant	from clover area	
49	27.53	Tokomaru	13/1/54	107	Dairy pasture	Tends to dominant.
WANGANUI						
50	32.53	Marton			Edge of wheat field	Dominant
51	105.53	Wangaehu Vall.	19/2/54	29h	Hard grazed hill	Minor
52	96.53	Raetihi	11/2/54	65	Mixed hill;roadside	Minor
53	26.53	Matarawa	14/1/54	13b	Poorly grazed past.	Dominant
54	25.53	Putiki	14/1/54	Sand	Poor pasture	Minor
55	10.53	Wanganui Town	11/1/54	1b	Roadside	Minor
TARANAKI						
56	112.53	Strathmore	25/2/54	67bH	Topdressed hill pasture	Minor
57	110.53	Ngaere	15/1/54	68	S.R. rye/white past.	Minor
58	111.53	Toko	12/2/54	106	Poorly drained br/top	Co-domin.
59	40.53	Inglewood	15/1/54	69	Pasture	Fairly dom.
60	39.53	Tongaporutu	14/1/54	2	River flat, closed hay	Sub-domin. to paspalum

APPENDIX I – Continued

Code No.	Serial No.	Locality	Date Collected	Soil Type	Conditions	Importance
WAIKATO/BAY OF PLENTY						
61	30.55	Punga Punga Val. Taumarunui	14/1/54	Marauri sand-silt	Roadside	Semi-domin. in old past.
62	28.55	Taringamutu	15/1/54	" "	Pasture closed hay	"
63	29.55	Owhango	14/1/54	Awhango sandy silt	Rolling hillside	"
64	116.55	Ngaruawahia	19/1/54	122B	Hill pasture	Minor
65	117.55	Aotea, Raglan	21/1/54	62 gh	Easy rolling	"
66	41.55	Putaruru	22/1/54	Tirau sandy loam	Roadside	Co-dominant
67	42.55	Matamata	22/1/54	Waihou sandy loam gravelly sub-soil	Roadside uncultivated section	Co-dominant
68	47.55	Galatea	14/1/54	14b	Roadside	Sub-dominant
69	49.55	Rerewhakaitu	21/1/54	5b	"	"
70	48.55	Ngakuru	21/1/54	18	"	"
71	45.55	Tauranga	21/1/54	107g	Drained swamp	"
GISBORNE						
72	56.55	Bushmere	4/1/54	Waipaoa heavy silt loam	Flat road-side	Minor
73	58.55	Manutuke	8/1/54	Manutuke heavy silt loam	Flat Pasture	Minor
74	57.55	Ormond	28/12/53	Waihirere heavy silt loam	Flat Roadside	Minor
75	55.55	Hexton	23/12/53	Makauri clay loam	Flat Pasture	Minor

APPENDIX I - Continued

Code No.	Serial No.	Locality	Date Collected	Soil Type	Conditions	Importance
HAWKE'S BAY						
76	80.55	Takapau	22/1/54	39	Improved pasture running-out	Minor
77	78.55	Maraetotara	27/1/54	Maraetotara sandy loam	Roadside	Minor
78	75.55	Pukahu	12/1/54	9	Waste area in lucerne stand	Co-dominant
79	77.55	Argyll	26/1/54	28a	Roadside	Minor
80	79.55	Haumoana	13/1/54	25	Roadside	Co-dom. with Indian Doub.
81	76.55	Waipawa	13/1/54	60a1	Roadside	Minor
SOUTHERN HAWKE'S BAY						
82	24.55	Fertiliser plots Rata				
83	86.55	Mangahei	26/1/54	29H	Hill	Minor
84	85.55	Raumati	26/1/54	77b	Hill pasture	Minor
85	84.55	Maharahara	25/1/54	78b	Dairy pasture rolling foothills	Co-domin.
WAIRARAPA						
86	6.55	Solway	25/12/53	75	Roadside	Minor
87	11.55	Pirinoa	12/1/54	15c	Roadside	Minor
HOROWHENUA						
88	54.55	Raumati South		Sand	Non-grazed sand 100 yds. from sea.	
89	74.55	Otaki	25/1/54	76a	Dairy pasture for hay. Flat/rolling terrace	Minor
90	70.55	Lower Hutt	20/1/54	Judgford silt loam	Hill pasture	Minor
91	71.55	Levin	21/1/54	76	Pasture	Minor
92	72.55	Paraparaumu	20/1/54	Makara stony loam	Roadside	Minor

<u>APPENDIX I - Continued</u>

Code No.	Serial No.	Locality	Date Collected	Soil Type	Conditions	Importance
93	73.53	Chau West	21/1/54	107	Pasture, drained peat	Dominant
NELSON						
94	16.53	Port Hills Nels.	16/12/53		Steep hill waste	Minor
95	17.53	Stoke	21/12/53	Waimea stony silt loam	Ryegrass pasture	Minor
96	18.53	Lower Moutere	21/12/53	Moutere gravel wash	Headland of timothy paddock	Sub-dominant
MARLBOROUGH						
97	21.53	Kaikoura (A.W.H.)				
CHRISTCHURCH						
98	22.53	Port Hills (A.W.H.)				
99	38.53	Cass	15/1/54	[illegible] (Saline)	Roadside	Minor
100	9.53	Lake Ellesmere	7/1/54	M2a	Unploughed headland	Dominant
101	7.53	Bankside	7/1/54	W2s	Pasture	Minor
102	59.53	Hororata	7/1/54	R2s	Roadside (flat)	Minor
103	8.53	Irwell	6/1/54	TR½	Pasture	Dominant
104	60.53	Hororata	7/1/54	MK3r-F	Roadside (downs)	Minor
ASHBURTON						
105	113.53	Fairton	19/1/54	Lismore shal. silt loam	Roadside	Minor
106	114.53	Wakanui	30/1/54	Silt	Ashburton Road bank	Minor
107	115.53	Winchmore	30/1/54		Roadside	Minor
SOUTH CANTERBURY						
108	54.53	Milford (Geraldine)	15/1/54	Wakanui silt loam	In wheat crop	Very minor
109	109.53	Temuka	11/1/54	Peaty silt loam complex	Old pasture	10%
110	105.53	St. Andrews	5/1/54	Claremont silt loam	Flat, Old pasture	Minor
111	104.53	Fairlie	8/1/54	" "	Old pasture, rolling downs	Minor

APPENDIX I - Continued

Code No.	Serial No.	Locality	Date Collected	Soil Type	Conditions	Importance
112	100.55	Bluecliffs	5/1/54	63	In S.R.Rye seed crop	Minor
113	101.55	Albury	1/2/54	Tp 35	Rough pasture river flat	Minor
114	102.55	Salisbury	30/1/54	TuS	Wheat crop rolling downs	Minor
115	94.55	Pleasant Point	26/1/54	TpS	Flat good pasture	Minor
116	92.55	Seadown	26/1/54	W 3	Flat good pasture	Minor
117	93.55	Sutherlands	26/1/54	TuS	Flat good pasture	Minor
118	91.55	Arowhenua	26/1/54	W 2	Flat good pasture	Minor
119	90.55	Taiko	26/1/54	Tu 3	Downs pasture	Minor
120	95.55	Pleasant Point	26/1/54	Tp 3	River flats	Minor
121	82.55	Lake Pukaki	21/1/54	Omarama	Fescue tussock hill 1750	Minor
122	81.55	Lake Pukaki	21/1/54	Omarama	Fescue tussock on downs shady face 1800	Minor
123	83.55	Lake Tekapo	27/1/54	Omarama	Lake side	Minor
WAIMATE						
124	97.55	Studholme	Early Jan.	Claremont silt loam	Pasture	Minor
125	98.55	Morven	" "	Lismore stony silt loam	In lucerne	Dominant
126	99.55	Waihao Downs	Late Jan.	Waikakahi clay loam	Hill Pasture	
OAMARU						
127	65.55	Duntroon	27/1/54	Lismore stony loam	Runout pasture (very dry area)	Weed
128	66.55	Coalpit Hill	28/1/54	Timaru silt loam	Old pasture	Semi-domin.
129	61.55	Herbert	26/1/54	Opua silt loam	Pasture (old)	Semi-domin.
130	63.55	Hilderthorpe	27/1/54	Lismore stony loam	Roadside	Common
131	62.55	Airedale	27/1/54	Timaru silt loam	Roadside	Minor
132	68.55	[illegible]	30/1/54	[illegible] stony loam	Riverbed	Common

APPENDIX I - Continued

Code No.	Serial No.	Locality	Date Collected	Soil Type	Conditions	Importance
133	64.53	Peebles	27/54	Papakaio silt loam	run out pasture	Minor
134	67.53	Enfield	28/1/54	Kauru silt loam	Roadside	Weed
DUNEDIN						
135	88.53	Nasby	3/2/54	Stony loam	Roadside (2000' under 20" rain)	Co-domin.
136	106.53	Woodside	13/1/54	Y.B.E.	Pasture - No responsive area	Minor
137	107.53	Harvey's Flat	25/1/54	Warepa transiti.	Pasture (No responsive area)	Minor
138	108.53	Harvey's Flat	25/1/54	Warepa Transitional	Unimproved hill	Major
SOUTH OTAGO						
139	87.53	Puerua	8/2/54	Warepa silt loam	Run out pasture (Treated with Mo)	Dominant
140	89.53	Waiwera South	10/2/54	Clydevale silt loam	Mont red clover seed crop	Minor
141	69.53	Clifton	28/1/54	Te Houka silt loam	Roadside	Co-domin.
142	37.53	Tuapeka West	20/1/54	Tuapeka silt loam	Roadside	Co-domin.
143	35.53	Beaumont	20/1/54	Clutha soil	Roadside	Co-domin.
144	36.53	Greenfield	20/1/54	Clydevale silt loam	Fair pasture	Minor
145	33.53	Kuumo Siding	18/1/54	Warepa silt loam	Roadside	Minor
SOUTHLAND						
146	12.53	Longbush	8/1/54	Waikiwi Y.B.E.	Roadside	Dominant
147	13.53	Seaward Downs	8/1/54	Edendale Y.B.E.	Pasture	Minor
148	14.53	West Plains	7/1/54	" " ?	Roadside	Co-domin
149	15.53	West Sutherland	7/1/54	Orepuki Y.B.E.	Hill, roadside	Dominant
150	118.53	Otama (Gore)	19/3/54	Ty	Roadside	Sub-dom.
151	119.53	Croydon (Gore)	19/3/54	5 W.K	Rough Pasture	Sub-dom.
152	120.53	Chatham Is.				

<u>APPENDIX I</u> - <u>Continued</u>

Code No.	Serial No.	Locality	Date Collected	Soil Type	Conditions	Importance
155	121.53	Rangiora	15/1/54	Temuka silt loam	Roadside	Minor
156	124.53	" West Eyreton	14/1/54	Tai Tapu " " sandy loam	Fence line	"
158	126.53	"	28/1/54	Kaiapoi	Roadside	"
159	127.53	Rangiora, Kaiapoi	29/1/54	silt loam Templeton	Cosfoot crop	"
160	128.53	Rangiora, Horrelville	14/1/54	silt loam Kaiapoi	Roadside	"
161	129.53	Rangiora, East Eyreton	15/1/54	silt loam Temuka	"	"
162	130.53	Rangiora, Woodend Cosfers Creek	15/1/54	silt loam Andrews	Fence line	?
163	131.53	Rangiora, Oxford	18/2/54	silt loam Springston	Pasture	"
164	132.53	Rangiora, Chedder Valley	1/2/54	Shallow silt loam	Fence line	"
166	134.53	Woodend district	1952/53	Mostly Temuka silt l oam	M/D ex. grassline South Canterbury	"
166	"	"	"	"	"	"
167	135.53	Dargaville Demonstration farm	20/1/54	Kaipara clay	Pasture	"
168	136.53	"	26/1/54	Te Kopuru sand	"	"

GROWTH FORM GROUPS

APPENDIX II

TRAVERSE I							a	b	c	d
1	- a b a c	b b a - a	b b - b b	b c a a c	b a c b b	a b d a	9	12	4	1
2	a b b c c	a c d c c	b c b b a	c b c b a	c c c c c	d c c b	4	8	15	2
3	c d a a c	a b a c d	c c c a d	d c c c c	c a a c c	c b d c	7	2	15	5
4	b c a a b	a c b c a	a c b c d	b a c c c	a c b b c	b d a c	8	8	11	2
5	c d d d d	c c c d c	c c c c c	d c c d c	c d c d b	d a c a	2	1	16	10
6	b b a c b	a c c c d	b a b c b	b c d a c	b b b c c	b d a b	5	12	9	3
7	c c a a a	c a a c a	a c b d b	a c c a a	b b b c b	b b c a	11	8	9	1
8	a a c c d	b a d b b	b c d b d	a c d c c	b b b b d	a c c c	5	9	9	6
9	a b a d c	c d a c a	a c c b c	c b a d d	d d a d d	c d b c	7	4	9	9
10	b d c d d	b d d b d	c c b c d	c d b c c	d c d b d	c c d b	-	7	10	12
11	b a d d b	c d c b c	b c b b b	c b b b a	c b d b a	c c a b	4	13	8	4
12	a a d a b	a c d b d	a b a a b	b c a c b	b b d b d	a b b a	10	11	3	5
13	b d c c c	a d c d d	d b d d d	d c c d c	b c c b c	c b d c	1	5	12	11
14	a b b c c	a d b b c	c c d c d	b d c b c	d c b b a	c b a b	4	10	10	5
15	c a c c a	c c b d d	d c d d c	a a b b c	c c a c c	d d c c	5	3	14	7
16	c c a c d	c a d c c	d c d c c	b c c b d	c c c d c	b d d c	2	3	16	8
17	d d c b c	d d d d c	c c c b c	- b b c c	c c c c c	c b b b	-	7	15	6
19	b c c c c	a c d c d	c c c b b	b b c d c	d c c d a	c b c d	2	6	15	6
20	d a c b b	c c c c d	d d c c b	b b c d c	c c d b d	b c c c	1	7	14	7
21	b d b c d	d d d b b	a b c d d	- c d c c	b c c d c	d c d d	1	6	9	12
22	a a c a a	b b b b d	a a c a c	- - - - -	- - - - -	- - - -	7	4	3	1
23	c a c c a	c b b b b	c c c b b	d c c b c	c c c c b	c c b c	2	9	17	1
24	c a d d d	- b a c c	c c c c b	c c d d c	c c c c d	c c c b	2	3	17	6
26	c d d d d	- d d d a	c d d b d	d c b d b	c c d c c	d c c d	1	3	9	15
27	b a c c c	c c d d c	c c c d c	c c b c d	- d c d a	d d b -	2	3	14	8
28	a b b c a	c b b d d	d d b b d	a c c c b	b b d d d	c c b c	3	9	8	8
29	d d b b d	b c d b d	c d d d c	c c c c d	c b c d d	c c d c	-	5	12	12
30	a a d b c	d d b d d	c c b b b	c b b b c	b b c c c	c b b b	2	13	9	5
32	c c b c d	c c b b a	d b d d c	c c d d d	c c c d c	c c d -	1	4	14	9
34	c c c b d	b b b b d	d d d b d	d - d - d	d d d d b	d d b -	-	8	3	15
35	d c d c d	- b b d d	d c c c a	b b d d d	d c b d d	d d d d	1	5	6	16
36	c b b c b	d d d d d	d d d d d	b d - b d	d c c d d	d d d d	-	5	4	19
							109	214	339	257

APPENDIX II (Contd.)

TRAVERSE II

							a	b	c	d
37	c d d b c	c c c c c	c c c b c	c c d d c	c c d c c	d - c d	-	2	19	7
38	b b d d c	d c c d d	d c c d d	c d b a a	c d c c d	a c d d	3	3	10	13
39	d d b c c	d b d b a	c b d b a	b a a d d	d c b d d	b c a c	5	8	6	10
41	d b c d c	d d d d d	d d c d c	- d d d d	b c d d d	c c b d	-	3	7	18
42	a c c c d	d b d d c	d d d d d	d d b b c	d d c d c	b c d c	1	4	9	15
43	c c d b a	c d c d c	d d d c c	- d c c c	c d d b d	d c c c	1	2	14	11
44	b b c b d	c c d d c	d d - c b	c d d c c	c d d d b	b c b c	-	7	11	10
45	d c d d d	b c c b c	- d c c d	c c d c d	d a a b b	d a d d	3	4	9	12
47	d c d c a	c c c a b	c c c c c	c d d c c	d d c d d	c d b a	3	2	15	9
48	c d d b a	d d d d d	d d d d c	d d c c d	c c d d b	d c c c	1	2	9	17
49	a b b a d	d c c c b	d d c c c	c d c c c	d b c b d	c c d b	2	6	15	8
50	- c d c d	c d b c d	d d a a d	d d d d c	d d d d d	d c b c	2	2	7	17
51	d b d d c	d d d d c	d d d d d	d d d d d	- d c b d	d c d b	-	3	4	21
52	d d d a d	b d d d d	d b d a d	d d d d b	d d d d d	c c c d	2	3	3	21
53	d c c a b	d c c d d	d c c d d	d d b d d	d - d d c	c a d b	2	3	8	15
54	d d c d c	d d d d d	c d b d c	c c d d d	d d c d b	d d d c	-	2	8	19
55	d c d - -	c d c a b	d c c d d	b - d b d	d d d d b	d d d d	1	4	5	16
56	d d d d d	d d c d c	d d d d d	c d c d d	d d d a d	d d d d	1	-	4	24
57	c a d b b	c b b - b	b b a c b	c c d c c	a c b b c	d c b b	3	12	10	3
59	c c d c b	b c c d d	c - d c d	c a d c d	c d b d c	a d - b	2	4	11	10
60	c c c c d	c d d d c	d c c d d	c d d d d	c d d d -	d d d d	-	-	10	18
61	c c c c d	d d d d d	d c c d d	d d b d c	d d d b c	d c b d	-	3	9	17
62	d c d c d	c d d c d	c d d c d	d d b d d	c b b d c	d b d c	-	4	9	16
63	c c b c d	c d c d d	c d d c c	d d d d c	d b d d b	d d d d	-	3	9	17
64	c d c c -	b b b d c	b d c c b	d d d a c	d d c d -	d a b c	2	6	9	10
65	c d c d d	c c d c d	d c c c d	d d d d b	d d c c d	c d d d	-	1	11	17
66	c d d c d	c d d d c	c c c d d	b b d c d	b a d d a	d d d b	2	4	8	15
67	d b d b d	- c c d d	d d d b b	b a b a b	b d d b b	a d c c	3	10	4	11
69	a - c d d	d d d c d	- a a d d	d d d d c	c c c c d	c d d c	3	9	9	15
70	b c - a b	c d c b d	b c d - d	d c c b d	d d c d d	d c d c	1	5	8	15
71	c d d d d	d d d b d	b d d - d	d d d c c	d d d d d	d c c d	-	2	5	21
72	d d d d d	d d d d d	d d d d d	d d d d d	c b d d d	c d d d	-	1	2	26
							45	115	275	472

APPENDIX II (Contd.)

TRAVERSE III

							a	b	c	d
73	b - d d d	b d d d c	b d b d b	c b d c d	c c d c c	d a b d	1	7	7	15
74	c c - d c	d d - b d	c b d c d	d d d d c	c d c c c	d c c b	-	3	12	12
75	d d c c -	d c c d d	c b d a d	d d c b c	d d d d d	d d d b	1	3	7	17
76	d - d d -	c d c d d	d d d d d	d d d d b	d d b d d	d d b d	-	3	2	22
77	c c b c c	d b d c c	d c d b d	d d d d d	d c d b a	b d d c	1	5	9	14
78	d d d d d	d d d d d	d c d d d	c d c d c	d d d d d	d d d d	-	-	4	25
80	d d d d d	d b c d d	d d d d d	a d d d d	c d d d d	d d d c	1	1	3	24
81	d b c c c	c b d c d	c c d c d	d c c b c	b d d d a	d b b d	1	6	11	11
82	d c d d d	c d d d c	d d d d d	a c d d d	d - d d d	d d c d	1	-	5	22
83	d b b d c	d d d d b	d d d d d	c d c c d	d c d d d	d d d d	-	3	4	22
84	b b d d d	c d d c c	d c d b d	b d d d c	d d c b c	d d c d	-	5	8	16
85	c - d d d	b d c c c	c d d c c	c d d d d	d d d d d	d c c d	-	1	10	17
86	b d d d d	d d c c d	c d d c b	d c d b d	d d c c d	d c b d	1	4	8	16
87	d b d - c	d d b d d	d d d d d	c d d b c	b d c c c	a b d d	1	5	6	16
88	d d d c d	- d d - d	d d - d d	d c d d d	d d d d d	d d - d	-	-	2	25
89	d d d d d	d d c c d	d d d d d	d d d d d	b d d - d	d d d d	-	1	2	25
90	c a - d d	d d d d -	c d c d d	d d d d -	d d d d -	d d d d	1	-	3	21
91	d d d d d	d d d d d	d d - - d	d d d d d	d d c c d	c d c d	-	-	4	23
92	c c c c d	d d d d c	c d d d d	d d d d d	d d d d d	c c c d	-	-	9	20
93	d d c d d	c d d c d	d d d c d	d d d d c	d d d d c	d d b c	-	1	7	21
94	d d d d c	c d - d d	c d d c c	d d d c d	d c c d -	d c d -	-	-	9	17
95	d d c d c	c d d c d	d c c d d	d d c d d	c d d d d	d d d d	-	-	8	21
97	d b d d c	d d b d -	b d d c d	c c d a c	d d d c c	b d d d	1	4	7	16
98	d c d b d	d d d - c	d d d d d	d d c d d	d d d d d	d d - -	-	1	3	22
99	d d d c d	- d - a c	d d d d d	- d d c -	c c d c d	d d b -	1	1	6	16
100	d d d d d	d d d d d	d d c d d	d d d c d	d d - c c	d b d d	-	1	4	23
101	d d d d d	d d c d d	d d d d d	c d d d -	c d d d d	d d c c	-	-	5	23
102	d d d d d	d c d d d	d d d d d	d - d d d	d d d d c	d d d d	-	-	2	26
103	d d b - d	c d d d d	- d d c c	d d d d c	d d b b c	d d b c	-	4	6	17
104	d d d d d	c d d c c	d - d d d	d d c d d	d d d d c	d d d d	-	-	5	23
106	c d b d d	d d d c c	d d d d d	d d d d d	d c c c d	c c d d	-	1	8	20
108	- - d d d	d d d d d	d - d d d	b d d d c	d c d d b	d d d c	-	2	5	21
							11	62	189	625

APPENDIX II (Contd.)

TRAVERSE IV

							a	b	c	d
109	d d d d d	c c d d d	- c c c -	c d d - c	c d c d c	d d c d	-	-	11	15
110	d c d d c	c c d d c	c d - c -	- d d c d	d c d c c	d d d d	-	-	11	15
111	d c c d c	d c d d d	d d c c -	- c c d c	d c c c c	d d c d	-	-	14	13
112	d d c d c	d d d d d	d d d c d	- d c d c	d c d d d	c d d d	-	-	7	21
113	- d d c b	d d d d c	c b d c d	d d d d -	d d d d d	- d d -	-	2	4	19
114	d c d d d	c d c d d	d c - d d	d d d d d	d d - d d	d d d d	-	-	4	23
115	d d d d d	d c d b -	d d d d d	- d d d c	d d d d d	d d d d	-	1	2	24
116	c d d d d	d d d d d	c d d d c	d d d d d	d d c d d	d d d d	-	-	4	25
117	d d - d d	d d d d d	d d d d d	d d d d d	c d d d b	c d d c	-	1	3	24
118	d d c c c	d c d d d	c c d d c	- d d d d	d d c d c	d d c d	-	-	10	18
119	d d d d d	d d d d -	c c d d d	d c c d d	c d d c d	c d d d	-	-	7	21
120	c c b d c	c d d d c	d d d b d	c d d d -	c c c d d	d d c d	-	2	10	16
121	c c c d d	d d d c d	d c d c d	- d d d d	d - d d d	d d d d	-	-	6	21
122	d c d d d	d d c d d	d d d d d	d d d d d	d c d d d	- d d d	-	-	3	25
123	c c c d d	d c d d c	d d - d d	c - c c d	c d d c d	c - - -	-	-	11	13
124	d d d d d	c d c - d	d c d c d	d d c d d	d c d d c	d d d -	-	-	7	20
125	- c c d d	d d d b c	d d d d -	d d c d -	d d d d c	d d d c	-	1	6	19
126	c d - c c	c d c c c	d d c d c	d d c d d	c c d d d	d d d d	-	-	12	16
127	d c c c c	d d d d d	d d c d c	d d c - c	b c d d d	- d d c	-	1	10	16
128	d c c - d	d c d d d	d d b c d	d a c - a	c a d d d	d d d d	3	1	6	17
129	d d d d -	d c c d d	d c d d d	d d d d d	d c d d d	d d d d	-	-	4	24
130	b d c d d	d b - d b	d c d d c	d d d c d	b d d b b	c - d c	-	6	6	15
131	b - d - d	- c c d d	d d d - c	c d d c b	b b c c c	d d d d	-	4	8	13
132	d d - d d	d d d d c	d c d d d	d d c - d	d d d d d	b d c c	-	1	5	21
133	- d d c c	d d d d d	d - c - d	d d d b c	d c c d d	c d d c	-	1	8	17
135	- c d d d	d d d d d	d c d d d	d c d d d	d d c c d	c c d d	-	-	7	21
136	d d d c c	d c c d d	d c c c c	c d c c d	d d c c d	d b d c	-	1	14	14
137	c d c d d	d d d b d	d c c c d	c c c c d	d c d d d	c d d d	-	1	11	17
138	d d d d d	d d d d d	c d d c c	d d d d d	d c c c d	d d d d	-	-	6	23
139	c d c c b	d b c d b	d d c c d	d d b d d	c c c c d	c c c c	-	4	14	11
140	c c - d d	c c b c d	c c d d d	d c d d c	d c d b c	d c - -	-	2	12	12
141	c c d d d	c c c c d	d d d c d	d d d c d	- c d d d	d d d d	-	-	9	19
							3	29	252	588

APPENDIX II (Contd.)

TRAVERSE V

							a	b	c	d
142	d d c d d	d d d b d	d c c d c	c d c c d	d d d d c	d c d c	-	1	10	18
143	d d c d d	d c d c d	d d d d d	d d d d -	d d d c c	c c d d	-	-	7	21
144	b d d d d	d c d d d	b d d d c	d d b c d	d d c c d	d d d d	-	5	5	21
145	d d d d c	d c d d d	d d d c d	d d d d d	d d - d d	d d d d	-	-	5	25
146	c c d c d	c d c b d	c c d d c	d d d b c	c c c b d	d c d c	-	5	14	12
148	c d d d d	d d d c c	d c d d d	d d c c d	d b d d d	d c d d	-	1	7	21
149	d c d d d	d d d d d	d d c d d	d d c c d	c d d d d	c d b d	-	1	6	22
150	c d d d d	d d d c c	- d c d c	d a c d c	c c c d c	d c d d	1	-	12	15
151	d d d d d	d d d d d	c d d d d	d d d d c	- b d d c	d c d d	-	1	4	25
152	d d d d d	d d d d c	d d d d d	d d d b d	d d d d -	d d d d	-	1	1	26
153	c d c c d	b c d d d	c b b c c	d c c d d	b c d a c	d d d c	1	4	12	12
156	d d d d d	c c b d d	d d c d -	c b c c d	d c c c d	d d - d	-	2	9	16
158	b c d d d	d d d d d	d d d b d	d d d d d	d d c d d	d c d d	-	2	5	24
159	c c c d c	d d d b c	c c c c d	c d c c c	d c d c b	d d c c	-	2	17	10
160	d d d d d	d c d d d	d c d d d	d c d d d	d c d c d	d d d c	-	-	6	25
161	d d d d d	d d d d d	d c c c c	d b d d d	d c d c d	d d c d	-	1	7	21
162	d d d b d	d - - c d	c c c d c	d·d d - -	d d d d d	d c d d	-	1	6	18
163	d d c d d	d d c d d	d d d d c	d c c d d	c c d d -	d d d c	-	-	8	20
164	d d c d d	d c d c d	c c d c d	d d c d d	c d c c c	d d d d	-	-	11	18
166	c c c d c	d d d d c	c d c d c	d d d d c	d c d c d	d d - d	-	-	11	17
166	d a d c d	d d b d d	c d c c d	b c c d c	d d d c d	- c - d	1	2	9	15
167	d c d d c	d c d d c	d d b d d	d d d d d	d b d b d	d d d -	-	5	4	21
168	d c d d d	c d c c c	d d d d d	d d c d d	c c d c d	d d b d	-	1	9	19
							5	29	181	438

LEAF CHARACTERS

APPENDIX III

TRAVERSE I

							a						b						c						d						
							B	M	N	Br	Mr	Nr	B	M	N	Br	Mr	Nr	B	M	N	Br	Mr	Nr	B	M	N	Br	Mr	Nr	
1	- a b a c - B B B N	b b a - a N M N - N	b b - b b N N - B M	b c a a c M N M N N	b a c b b M M B N M	a b d a M M M M	2	4	3	-	-	-	2	6	4	-	-	-	1	-	3	-	-	-	-	1	-	-	-	-	26
2	a b b c c N N M M M	a c d c c N Nr N N N	b c b b a M Nr Nr N N	c b c b a N M M M M	c c c c c M N N Mr M	d c c b Mr N N N	-	1	3	-	-	-	-	4	3	-	1	-	-	5	7	-	1	2	-	-	1	-	1	-	29
3	c d a a c Nr M N N N	a b a c d N M M M M	c c c a d M M M M M	d c c c c M M N M M	c a a c c B M M M Mr	c b d c N M Mr Nr	-	3	4	-	-	-	-	2	-	-	-	-	1	8	3	-	2	1	-	4	-	-	1	-	29
4	b c a a b M M M M M	a c b c a M M M M M	a c b c d M Mr M N N	b a c c c M M M Mr M	a c b b c M M M M M	b d a c Mr M M M	-	8	-	-	-	-	-	6	1	-	1	-	-	9	-	-	2	-	-	1	1	-	-	-	29
5	c d d d d N Mr Mr Mr M	c c c d c Mr M N B N	c c c c c Mr Mr N N M	d c c d c Mr Mr Mr Mr Mr	c d c d b M B B M N	d a c a Mr M Mr M	-	2	-	-	-	-	-	-	1	-	-	-	1	3	5	-	7	-	2	2	-	-	6	-	29
6	b b a c b M M B B M	a c c c d M M M M Mr	b a b c b N M M N M	b c d a c M M Mr M M	b b b c c M M M M M	b d a b M B B M	2	3	-	-	-	-	-	12	-	-	-	-	1	7	1	-	-	-	1	-	-	-	1	1	29
7	c c a a a M M M B M	c a a c a N B M M N	a c b d b N N N N M	a c c a a N M M M M	b b b c b M M M M M	b b c a N B M M	2	6	3	-	-	-	1	6	1	-	-	-	-	7	2	-	-	-	-	-	1	-	-	-	29
8	a a c c d M N M N M	b a d b b M M B M Nr	b c d b d N M Mr M M	a c d c c M N Mr M M	b b b b d N M M M M	a c c c N M M B	-	3	2	-	-	-	-	6	2	-	-	1	1	6	2	-	-	-	1	3	-	-	2	-	29
9	a b a d c M M M N M	c d a c a N Mr N B B	a c c b c M M N M M	c b a d d M N M M N	d d a d d M B N B M	c d b c N M B N	1	4	2	-	-	-	1	2	1	-	-	-	1	3	5	-	-	-	2	4	2	-	1	-	29
10	b d c d d M N M M Nr	b d d b d Nr N Mr N M	c c b c d N M Mr M M	c d b c c N M N Nr M	d c d b d N Nr N M Mr	c c d b Mr M M M	-	-	-	-	-	-	-	4	1	-	1	1	-	5	2	-	1	2	-	5	4	-	2	1	29
11	b a d d b M N M M M	c d c b c M N M N M	b c b b b N M N M M	c b b b a M M N N B	c b d b a N M M M M	c c a b M N N N	1	1	2	-	-	-	-	6	7	-	-	-	-	6	2	-	-	-	-	3	1	-	-	-	29
12	a a d a b B B M M M	a c d b d M M Mr M M	a b a a b N M M M M	b c a c b N N M M M	b b d b d N M Mr B N	a b b a M M M M	2	7	1	-	-	-	1	8	2	-	-	-	-	2	1	-	-	-	-	2	1	-	2	-	29
13	b d c c c M N M M N	a d c d d M M Nr Mr M	d b d d d N M Mr M M	d c c d c M M M Mr N	b c c b c M M N M Mr	c b d c M M M M	-	1	-	-	-	-	-	5	-	-	-	-	-	7	3	-	1	1	-	6	2	-	3	-	29
14	a b b c c M M N N M	a d b b c M M N M M	c c d c d M Mr M Mr Nr	b d c b c M B N Mr Mr	d c b b a M Mr Mr Mr M	c b a b M M M M	-	4	-	-	-	-	-	5	2	-	3	-	-	4	2	-	4	-	1	3	-	-	-	1	29
15	c a c c a N M N N B	c c b d d B M Mr Mr N	d c d d c N N N M M	a a b b c M M M M Nr	c c a c c M N M M B	d d c c Br M N N	1	4	-	-	-	-	-	2	-	-	1	-	2	4	7	-	-	1	-	2	3	1	1	-	29
16	c c a c d M M M M M	c a d c c M M M M M	d c d c c M M M Nr M	b c c b d M M M M N	c c c d c M N N M N	b d d c M M M M	-	2	-	-	-	-	-	5	-	-	-	-	-	12	3	-	-	1	-	7	1	-	-	-	29
17	d d c b c B B Mr M M	d d d d c N M Nr M M	c c c b c M M Mr M M	- b b c c - M M M M	c c c c c M B N M M	c b b b N M M N	-	-	-	-	-	-	-	6	1	-	-	-	1	10	2	-	2	-	2	2	1	-	-	1	28
19	b c c c c M M M M M	a c d c d M B M M B	c c c b b B B B M M	b b c d c N M B M B	d c c d a M M M B M	c b c d M M M M	-	2	-	-	-	-	-	5	1	-	-	-	6	9	-	-	-	-	2	4	-	-	-	-	29
20	d a c b b M M M M M	c c c c d B B B B B	d d c c b M B B B M	b b c d c M M B B M	c c d b d B B B M M	b c c c M B B B	-	1	-	-	-	-	-	7	-	-	-	-	12	2	-	-	-	-	4	3	-	-	-	-	29
21	b d b c d M M M M M	d d d b b B M M M N	a b c d d B B B B M	- c d c c - B N B B	b c c d c M M M M M	d c d d B M M B	1	-	-	-	-	-	1	4	1	-	-	-	4	5	-	-	-	-	4	7	1	-	-	-	28
22	a a c a a M M M M M	b b b b d M M M M M	a a c a c M M M M B	- - - - -	- - - - -	- - - -	-	7	-	-	-	-	-	4	-	-	-	-	1	2	-	-	-	-	-	1	-	-	-	-	15
23	c a c c a M M M M M	c b b b b B B M M M	c c c b b M B B M M	d c c b c B B B B B	c c c c b B M B B M	c c b c M M M M	-	2	-	-	-	-	2	7	-	-	-	-	9	8	-	-	-	-	1	-	-	-	-	-	29
24	c a d d d M M M M M	- b a c c - M M M M	c c c c b B B M M B	c c d d c M M M M M	c c c c d B B B M M	c c c b M B B M	-	2	-	-	-	-	1	2	-	-	-	-	7	10	-	-	-	-	-	6	-	-	-	-	28
26	c d d d d M B B B B	- d d d a - M B M M	c d d b d B B B B B	d c b d b B M M B B	c c d c c B M B M M	d c c d B B B B	-	1	-	-	-	-	2	1	-	-	-	-	4	5	-	-	-	-	15	2	-	-	-	-	28
27	b a c c c M N B B B	c c d d c M M B B B	c c c d c B B B B B	c c b c d B M M B B	- d c d a - B B B M	d d b - B B B -	-	1	1	-	-	-	1	2	-	-	-	-	11	3	-	-	-	-	8	-	-	-	-	-	27
28	a b b c a M M M M B	c b b d d B M M M M	d d b b d N Br M M N	a c c c b M B M B M	b b d d d M B B M B	c c b c Mr Mr M M	1	2	-	-	-	-	1	9	-	-	-	-	3	3	-	-	2	-	2	3	2	1	-	-	29
29	d d b b d Mr M M M N	b c d b d M Mr B M B	c d d d c Mr M M N N	c c c c d M M N M M	c b c d d B M N Nr M	c c d c B B B B	-	-	-	-	-	-	-	5	-	-	-	-	4	3	3	-	2	-	3	5	2	-	1	1	29
30	a a d b c M M M M M	d d b d d B M M M N	c c b b b M B B B M	c b b b c B N B N B	b b c c c Mr B B B B	c b b b B B B B	-	2	-	-	-	-	7	3	2	-	-	1	7	2	-	-	-	-	1	3	1	-	-	-	29
32	c c b c d M M M M M	c c b b a B M M M M	d b d d c B M M B M	c c d d d B N M M B	c c c d c B B B B B	c c d - B M M -	-	1	-	-	-	-	-	4	-	-	-	-	7	6	1	-	-	-	4	5	-	-	-	-	28
34	c c c b d M M M M M	b b b b d M M M M B	d d d b d M B M M B	d - d - d B - M - B	d d d d b M M B B M	d d b - B N M -	-	-	-	-	-	-	-	8	-	-	-	-	-	3	-	-	-	-	8	6	1	-	-	-	26
35	d c d c d M M M M M	- b b d d - M M M Mr	d c c c a M M B B M	b b d d d M M Br N N	d c b d d B M M M N	d d d d B N M B	-	1	-	-	-	-	-	5	-	-	-	-	2	4	-	-	-	-	3	7	4	1	1	-	28
36	c b b c b M M M M M	d d d d d B M B Mr B	d d d d d Nr N N M B	b d - b d M B - M M	d c c d d B B M N N	d d d d M M M B	-	-	-	-	-	-	-	5	-	-	-	-	1	3	-	-	-	-	7	6	4	-	1	1	28
							13	75	21	-	-	-	20	154	30	-	7	3	87	166	54	[illegible]	24	8	69	103	33	3	23	6	899

TRAVERSE II

APPENDIX III (Contd.)

No.							a B	a M	a N	a Br	a Mr	a Nr	b B	b M	b N	b Br	b Mr	b Nr	c B	c M	c N	c Br	c Mr	c Nr	d B	d M	d N	d Br	d Mr	d Nr	
37	c d d b c	c c c c c	c c c b c	c c d d c	c c d c c	d - c d	-	-	-	-	-	-	-	2	-	-	-	-	1	13	5	-	-	-	2	3	2	-	-	-	28
	M N N M N	M N N M N	M M M M M	M N M M M	M M M M M	B - B B																									
38	b b d d c	d c c d d	d c c d d	c d b a a	c d c c d	a c d d	-	3	-	-	-	-	-	3	-	-	-	-	6	4	-	-	-	-	12	1	-	-	-	-	29
	M M B M B	B B B B B	B M M B B	M B M M M	B B M B B	M B B B																									
39	d d b c c	d b d b a	c b d b a	b a a d d	d c b d d	b c a c	2	3	-	-	-	-	3	2	2	-	1	-	2	4	-	-	-	-	7	2	1	-	-	-	29
	B M MrM M	N N B B B	M N M B B	M M M B B	B B M B B	B M M B																									
41	d b c d c	d d d d d	d d c d c	- d d d d	b c d d d	c c b d	-	-	-	-	-	-	-	2	-	-	-	1	2	3	1	-	1	-	8	2	5	-	2	1	28
	B M N N M	N MrB B B	MrMr B B	- M B B N	M M B N N	MrM NrM																									
42	a c c c d	d b d d c	d d d d d	d d b b c	d d c d c	b c d c	-	1	-	-	-	-	-	4	-	-	-	-	5	1	2	-	-	1	11	2	1	-	1	-	29
	M N M B B	B M B B B	N M B B B	B MrM M Mr	B M N B B	M B B B																									
43	c c d b a	c d c d c	d d d c c	- d c c c	c d d b d	d c c c	-	1	-	-	-	-	-	1	1	-	-	-	10	4	-	-	-	-	6	3	1	1	-	-	28
	B M B M M	B B B B B	BrB B B B	- M M B M	B M M N B	N B M B																									
44	b b c b d	c c d d c	d d - c b	c d d c c	c d d d b	b c b c	-	-	-	-	-	-	1	6	-	-	-	-	6	3	-	-	2	-	3	2	1	3	1	-	28
	M M B M N	B MrM MrB	B B - Mr B	B M B B B	M BrBrBrM	M M M M																									
45	d c d d d	b c c b c	- d c c d	c c d c d	d a a b b	d a d d	-	3	-	-	-	-	-	4	-	-	-	-	3	6	-	-	-	-	8	2	1	1	-	-	28
	M B B BrB	M M B M M	- MrM M B	M B B M M	B M M M M	B M B B																									
47	d c d c a	c c c a b	c c c c c	c d d c c	d d c d d	c d b a	-	3	-	-	-	-	-	2	-	-	-	-	7	1	3	2	2	-	4	3	1	1	-	-	29
	M B B MrM	M B BrM M	B B B B N	N B N N B	M B MrMrM	BrB M M																									
48	c d d b a	d d d d d	d d d d c	d d c c d	c c d d b	d c c c	1	-	-	-	-	-	-	2	-	-	-	-	2	5	1	-	1	-	5	6	2	2	2	-	29
	B M N BrB	B BrBr MB	MrM M N M	MrB M M M	MrM M M M	B N M B																									
49	a b b a d	d c c c b	d d c c c	c d c c c	d b c b d	c c d b	-	2	-	-	-	-	-	6	-	-	-	-	9	3	-	1	-	-	5	1	-	2	-	-	29
	M M M M B	B BrB B M	BrBrB B B	M B M B M	B M B M B	B M M M																									
50	- c d c d	c d b c d	d d a a d	d d d d c	d d d d d	d c b c	-	2	-	-	-	-	-	2	-	-	-	-	1	4	2	-	-	-	10	2	3	-	2	-	28
	- M MrM M	M M B M M	M M B B B	MrB B M M	B B N B B	B B N B																									
51	d b d d c	d d d d c	d d d d d	d d d d d	- d c b d	d c d b	-	-	-	-	-	-	-	3	-	-	-	-	2	2	-	-	-	-	7	8	3	-	3	-	28
	MrM B N M	N M M B M	M M MrMrM	B M B M M	- B B M B	N B B M																									
52	d d d a d	b d d d d	d b d a d	d d d d b	d d d d d	c c c d	-	2	-	-	-	-	-	3	-	-	-	-	2	-	1	-	-	-	11	4	5	-	1	-	29
	M N N M N	N N M B B	B M MrM M	B B N B M	B M B B B	B B N B																									
53	d c c a b	d c c d d	d c c d d	d d b d d	d - d d c	c a d b	-	2	-	-	-	-	-	3	-	-	-	-	2	4	-	1	1	-	5	11	1	-	-	-	28
	B M MrM M	M M B M M	M BrB M M	M M M M B	M - M B M	M M N M																									
54	d d c d c	d d d d d	c d b d c	c c d d d	d d c d b	d d d c	-	-	-	-	-	-	-	2	-	-	-	-	-	5	1	1	1	-	6	8	1	-	4	-	29
	M MrMrB Br	MrM M N M	M B M MrM	M M MrB M	B B M N M	M B M N																									
55	d c d - -	c d c a b	d c c d d	b - d b d	d d d d b	d d d d	1	-	-	-	-	-	-	4	-	-	-	-	4	1	-	-	-	-	6	8	-	-	2	-	26
	M B B - -	M M B B M	M B B M B	M - MrM B	M B MrM M	B B M N																									
56	d d d d d	d d c d c	d d d d d	c d c d d	d d d a d	d d d d	-	1	-	-	-	-	-	-	-	-	-	-	5	1	-	-	-	-	6	11	5	-	4	-	29
	M N MrB M	M MrM N B	M MrM B M	B B B M B	B B N M M	M M M M																									
57	c a d b b	c b b - b	b b a c b	c c d c c	a c b b c	d c b b	-	3	-	-	-	-	-	12	-	-	-	-	4	6	-	-	-	-	-	-	3	-	-	-	28
	M M N M M	M M M - M	M M M B M	M M N B M	M M M M B	N B M M																									
59	c c d c b	b c c d d	c - d c d	c a d c d	c d b d c	a d - b	1	1	-	-	-	-	-	3	-	-	1	-	4	5	2	-	-	-	7	2	1	-	-	-	27
	M M B N M	M B B B N	M - B M B	N B M M B	B B M B B	M M - Br																									
60	c c c c d	c d d d c	d c c d d	c d d d d	c d d d -	d d d d	-	-	-	-	-	-	-	-	-	-	-	-	4	4	-	2	-	-	9	6	2	1	-	-	28
	M BrB BrB	B B B B M	M M B N N	M B B BrB	B M M B -	M M M B																									
61	c c c c d	d d d d d	d c c d d	d d b d c	d d d b c	d c b d	-	-	-	-	-	-	-	3	-	-	-	-	5	3	-	-	1	-	9	4	2	2	-	-	29
	M B B B Br	N M M N B	B B B B Br	B B M B M	M M B M Mr	B M M B																									
62	d c d c d	c d d c d	c d d c d	d d b d d	c b b d c	d b d c	-	-	-	-	-	-	-	4	-	-	-	-	5	2	1	-	-	-	10	3	1	2	-	-	29
	B M B B M	B B BrM M	M B BrB B	B M M B B	B M M N M	B M B B																									
63	c c b c d	c d c d d	c d d c c	d d d d c	d b d d b	d d d d	-	-	-	-	-	-	1	2	-	-	-	-	3	5	-	-	1	-	10	4	2	-	1	-	29
	M B M B M	M B MrMrM	M B M M M	B B B N B	B M M B B	B B B M																									
64	c d c c -	b b b d c	b d c c b	d d d a c	d d c d -	d a b c	-	2	-	-	-	-	-	5	1	-	-	-	3	3	3	-	-	-	2	4	3	-	1	-	27
	M MrM N -	M M N M B	M B N N M	M N M M M	M N B N -	B M M B																									
65	c d c d d	c c d c d	d c c c d	d d d d b	d d c c d	c d d d	-	-	-	-	-	-	-	1	-	-	-	-	2	7	-	-	2	-	3	10	3	-	1	-	29
	M M MrM M	M M B M M	M B M M B	M M N N M	B M MrM Mr	B M M N																									
66	c d d c d	c d d d c	c c c d d	b b d c d	b a d d a	d d d b	1	1	-	-	-	-	-	4	-	-	-	-	3	2	1	-	2	-	1	10	3	-	1	-	29
	B M M MrM	N N N N M	M B B M M	N N B MrMr	M B N N M	M M M M																									
67	d b d b d	- c c d d	d d d b b	b a b a b	b d d b b	a d c c	-	3	-	-	-	-	1	9	-	-	-	-	2	2	-	-	-	-	1	7	1	-	2	-	28
	B M N M M	- M B M M	M MrMrM M	M M M M M	M M M B M	M M M B																									
69	a - c d d	d d d c d	- a a d d	d d d d c	c c c c d	c d d c	-	2	1	-	-	-	-	-	-	-	-	-	2	4	3	-	-	-	4	3	6	-	2	-	27
	M - M N N	B N N N N	- M N N M	B B M B N	N B M M M	B MrMrM																									
70	b c - a b	c d c b d	b c d - d	d c c b d	d d c d d	d c d c	-	1	-	-	-	-	-	5	-	-	-	-	4	2	1	-	1	-	2	8	1	-	2	-	27
	M M - M M	M M MrM B	M B M - M	MrB M M M	M B N N M	M B MrM																									
71	c d d d d	d d d b d	b d d - d	d d d c c	d d d d d	d c c d	-	-	-	-	-	-	-	2	-	-	-	-	2	1	1	-	1	-	8	7	3	-	3	-	28
	B B M B M	M M B M B	N B Mr- M	MrM B B N	B N N N M	NrM MrB																									
72	d d d d d	d d d d d	d d d d d	d d d d d	c b d d d	c d d d	-	-	-	-	-	-	-	1	-	-	-	-	1	1	-	-	-	-	9	10	1	3	3	-	29
	M B B B M	M B BrBrB	BrM MrMrM	M B M B B	B M MrM B	M N M M																									
							6	56	1	-	-	-	6	102	4	-	2	1	111	112	28	7	16	1	195	157	65	18	38	1	905

TRAVERSE III

APPENDIX III (Contd.)

		a						b						c						d						
		B	M	N	Br	Mr	Nr	B	M	N	Br	Mr	Nr	B	M	N	Br	Mr	Nr	B	M	N	Br	Mr	Nr	
73	b - d d d b d d d c b d b d b c b d c d c c d c c d a b d M - B B N M M B M M M MrM B M B M MrM B M M N M M B M M B	-	1	-	-	-	-	-	7	-	-	-	-	1	5	1	-	-	-	7	2	2	-	2	-	28
74	c c - d c d d - b d c b d c d d d d d c c d c c c d c c b B B - M M B M - M N B M B M M M MrM M B M M B B Mr B M MrM	-	-	-	-	-	-	-	3	-	-	-	-	6	4	-	-	2	-	3	7	1	-	1	-	27
75	d d c c - d c c d d c b d a d d d c b c d d d d d d d d b M M B M - M M MrB M M M M M M B N M M B M B M M N M M B M	-	1	-	-	-	-	-	3	-	-	-	-	2	4	-	-	1	-	4	11	2	-	-	-	28
76	d - d d - c d c d d d d d d d d d d d b d d b d d d d b d Br- M N - M MrB B M B B M M B M M N B M B B M N Mr N B M M	-	-	-	-	-	-	-	3	-	-	-	-	1	-	1	-	-	-	8	7	4	1	1	1	27
77	c c b c c d b d c c d c d b d d d d d d d c d b a b d d c B N M M B B M B M B M B B M B B BrB N B B M M B M M N B M	-	1	-	-	-	-	1	4	-	-	-	-	4	4	1	-	-	-	9	2	2	-	1	-	29
78	d d d d d d d d d d d c d d d c d c d c d d d d d d d d d M M M M M N M M M N M M MrB N Mr M MrM M M B N N N M M M M N	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	1	-	2	14	7	-	2	-	29
80	d d d d d d b c d d d d d d d a d d d d c d d d d d d d c M B N M B M N B MrN N MrB N B M N M M M B BrN N M M B N M	-	1	-	-	-	-	-	-	1	-	-	-	2	1	-	-	-	-	5	9	7	1	1	1	29
81	d b c c c c b d c d c c d c d d c c b c b d d d a d b b d N N M M M M MrN M M N N N M M M N N M M M M N M M M M M N	-	1	-	-	-	-	-	4	1	-	1	-	-	7	4	-	-	-	-	6	5	-	-	-	29
82	d c d d d c d d d c d d d d d a c d d d d - d d d d d c d M N B M M M N N N M N M M M M M MrM B Mr Br- MrMrM M M MrB	-	1	-	-	-	-	-	-	-	-	-	-	-	2	1	-	2	-	3	9	6	1	2	1	28
83	d b b d c d d d d b d d d d d c d c c d d c d d d d d d d M B MrB Mr M M B MrM MrM M M M MrMrM M M B N N B B B M M B	-	-	-	-	-	-	1	-	1	-	1	-	-	1	2	-	1	-	7	10	1	-	2	2	29
84	b b d d d c d d c c d c d b d b d d d c d d c b c d d c d B MrM M M MrM M N Mr B B B B Br M M MrM B B BrM M Mr B MrM N	-	-	-	-	-	-	2	2	-	-	1	-	2	2	1	-	3	-	4	7	1	2	2	-	29
85	c - d d d b d c c c c d d c c c d d d d d d d d d d c c d M - MrM M N M N N B M MrMrM N M N N M M N MrM M Mr B B M M	-	-	-	-	-	-	-	-	1	-	-	-	2	5	3	-	-	-	1	8	3	5	-	-	28
86	b d d d d d d c c d c d d c b d c d b d d d c c d d c b d B M M MrM B B M MrM B M MrM M M M M B Mr M M M B B M M B M	1	-	-	-	-	-	3	1	-	-	-	-	2	5	-	-	1	-	2	11	-	-	3	-	29
87	d b d - c d d b d d d d d d d c d d b c b d c c c a b d d MrM M - Mr M M N MrM M M M M M N N N M M M B M M Mr M MrM M	-	1	-	-	-	-	-	4	-	-	1	-	-	3	1	-	2	-	1	10	3	-	2	-	28
88	d d d c d - d d - d d d - d d d c d d d d d d d d d d - d B B N M M - M B - B B B - B B B M M B N B B BrBrM MrM - Mr	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	12	5	2	2	2	-	25
89	d d d d d d d c c d d d d d d d d d d d b d d - d d d d d M B NrMrB N N B MrM M MrB M M M M B B M M B M - M B B MrM	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	1	-	8	11	2	-	2	2	28
90	c a - d d d d d d - c d c d d d d d d - d d d d - d d d d B M - MrB MrMrB Mr- B N M B B M M M N - MrM M B - MrM M M	-	1	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	5	8	2	-	6	-	25
91	d d d d d d d d d d d d - - d d d d d d d d c c d c d c d B B M M M M M M N M M M - - Mr MrM M M M M M M M B M M M B	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	4	17	-	-	2	-	27
92	c c c c d d d d d c c d d d d d d d d d d d d d d c c c d M M M M Mr N M M MrM M MrMrB M NrM M N M M M M M M M M M B	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	2	12	1	-	5	-	29
93	d d c d d c d d c d d d d c d d d d d c d d d d c d d b c N M M MrN M B M M M M M B M Mr M M B B Mr M MrMrB B M B M M	-	-	-	-	-	-	-	1	-	-	-	-	1	5	-	-	1	-	6	9	2	-	4	-	29
94	d d d d c c d - d d c d d c c d d d c d d c c d - d c d - B B B N M M B - M M M B M M M M M B MrM M B M M - B M B -	-	-	-	-	-	-	-	-	-	-	-	-	1	7	-	-	1	-	8	8	1	-	-	-	26
95	d d c d c c d d c d d c c d d d d c d d c d d d d d d d d M Mr B M M M M M Mr N M M M M M M M M B M M M B B N B M M	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	5	12	2	-	2	-	29
97	d b d d c d d b d - b d d c d c c d a c d d d c c b d d d M NrM N M MrMrM N - M Mr M M NrM M M M N M M M M M M MrB M	-	1	-	-	-	-	-	3	-	-	-	1	-	6	1	-	-	-	1	8	2	-	2	3	28
98	d c d b d d d d - c d d d d d d d c d d d d d d d d d - - M M B M M B M Mr- M B M B M M MrMrM M B B B M M B M M - -	-	-	-	-	-	-	-	1	-	-	-	-	-	3	-	-	-	-	8	11	-	-	3	-	26
99	d d d c d - d - a c d d d d d - d d c - c c d c d d d b - MrM M M Mr - Mr- M M MrMrM NrN - M B Mr- M M MrM M MrMr- -	-	1	-	-	-	-	-	1	-	-	-	-	-	5	-	-	1	-	1	5	1	1	4	4	24
100	d d d d d d d d d d d d c d d d d d c d d d - c c d b d d B B M M B B M M M M M N M MrM MrMrB M M M N - M M N M MrM	-	-	-	-	-	-	-	1	-	-	-	-	-	4	-	-	-	-	5	14	-	-	4	-	28
101	d d d d d d d c d d d d d d d c d d d - c d d d d d d c c N M M M M M B M M B MrMrMrB B B M M M - M M B B M NrB M M	-	-	-	-	-	-	-	-	-	-	-	-	1	4	-	-	-	-	7	11	1	-	3	1	28
102	d d d d d d c d d d d d d d d d - d d d d d d d c d d d d M B B B B B B BrBrBr B B B B B M - B B M B B B MrB MrMrM Mr	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	15	4	-	3	3	1	28
103	d d b - d c d d d d - d d c c d d d d c d d b b c d d b c M B M - M M M M M B - M M M M B B N M M B B M M Mr BrMrM Mr	-	-	-	-	-	-	-	4	-	-	-	-	-	4	-	-	2	-	6	8	1	2	-	-	27
104	d d d d d c d d c c d - d d d d d c d d d d d d c d d d d M B B N M M M MrM M B - M M Mr MrN M B M MrB N M M M MrB B	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	7	8	3	-	5	-	28
106	c d b d d d d d c c d d d d d d d d d d d c c c d c c d d N MrN N N N N NrNrNr MrN N N Mr N MrN N Mr N M NrM M M N N N	-	-	-	-	-	-	-	-	1	-	-	-	-	3	2	-	-	3	-	1	13	-	1	5	29
108	- - d d d d d d d d d - d d d b d d d c d c d d b d d d c - -MrM M M MrM M M Mr-M M M M M M B N M M MrM M B N M M	-	-	-	-	-	-	-	2	-	-	-	-	-	2	1	-	-	-	2	14	1	-	4	-	26
		1	10	-	-	-	-	7	45	5	-	4	1	30	118	19	-	19	3	158	279	78	18	71	21	887

APPENDIX XII (Contd.)

TRAVERSE IV

		a						b						c						d						
		B	M	N	Br	Mr	Nr		M	N	Br	Mr	Nr	B	M	N	Br	Mr	Nr	B	M	N	Br	Mr	Nr	
109	d d d d d c c d d d - c c c - c d d - c c d c d c d d c d MrB M B Mr M M BrM M - M M M - M B Mr Nr M Mr N B M B MrM M	-	-	-	-	-	-	-	-	-	-	-	-	-	9	1	-	-	1	5	4	-	1	5	-	26
110	d c d d c c c d d c c d - c - - d d c d d c d c c d d d d MrMrMrB N M N MrMrB M Mr- N - - MrMrM B MrMrMrM Mr BrBrM M	-	-	-	-	-	-	-	-	-	-	-	-	1	4	3	-	3	-	2	2	-	2	9	-	26
111	d c c d c d c d d d d d c c - - c c d c d c c c c d d c d B B M B B MrMrMrM B B B B N - - N M MrN M M M M M B B N M	-	-	-	-	-	-	-	-	-	-	-	-	3	6	4	-	1	-	7	3	-	-	3	-	27
112	d d c d c d d d d d d d d c d - d c d c d c d d d c d d d M M N NrM MrMrNrMrN MrM N N Mr - N M MrMr MrN B B B N M N M	-	-	-	-	-	-	-	-	-	-	-	-	-	2	4	-	1	-	3	5	4	-	8	1	28
113	- d d c b d d d d c c b d c d d d d d - d d d d d - d d - - M N B N MrM M B M M M M M M B B B Mr - M M M B Mr - M M -	-	-	-	-	-	-	-	1	1	-	-	-	1	3	-	-	-	-	5	10	1	-	3	-	25
114	d c d d d c d c d d d c - d d d d d d d d d - d d d d d d MrB B MrMr M MrM MrB MrM - B B MrM M M B B N - M N MrMrN Br	-	-	-	-	-	-	-	-	-	-	-	-	1	3	-	-	-	-	6	4	3	1	9	-	27
115	d d d d d d c d b - d d d d d - d d d c d d d d d d d d d NrB M B Mr M M B N - MrM Mr, MrMr- M BrB N MrBrMrMrMr MrBrMrBr	-	-	-	-	-	-	-	-	1	-	-	-	-	1	1	-	-	-	4	4	-	4	11	1	27
116	c d d d d d d d d d c d d d c d d d d d d d c d d d d d d M B M B M BrM MrM B MrB M B Mr M B MrN M M M N BrM MrB B B	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	-	9	10	1	2	3	-	29
117	d d - d d d d d d d d d d d d d d d d d c d d d b c d d c MrM - MrB MrMrMrMrMr B MrM M M BrM MrM M M MrMrMRM MrMrMrB	-	-	-	-	-	-	-	1	-	-	-	-	1	1	-	-	1	-	2	7	-	1	14	-	28
118	d d c c c d c d d d c c d d c - d d d d d d c d c d d c d BrBrMrMrB B M M MrMr M M N N Nr - MrMrM B M MrM MrM MrB B Mr	-	-	-	-	-	-	-	-	-	-	-	-	2	5	-	-	5	-	3	3	1	2	9	-	28
119	d d d d d d d d d - c c d d d d c c d d c d d c d c d d d BrBrBrM M M M B Nr - M M MrMrMr MrN M B Br M M M NrMr MrM M M	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1	-	2	-	2	9	-	4	6	-	28
120	c c b d c c d d d c d d d b d c d d d - c c c d d d d c d M MrN N M MrN M M M M NrMrM M NrM MrM - M M M M M N B M Mr	-	-	-	-	-	-	-	1	1	-	-	-	-	7	-	-	2	1	1	8	3	-	3	1	28
121	c c c d d d d d c d d c d c d - d d d d d - d d d d d d d MrM NrNrM NrMrMrM B NrMrM M Mr - M M M Nr Mr- MrMrM M BrN N	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	2	1	1	7	2	1	5	5	27
122	d c d d d d d c d d d d d d d d d d d d d c d d d - d d d B BrBrMrMr BrB MrB Br BrMrMrM M M M MrB Mr MrB M N Mr - MrM M	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1	-	4	7	1	6	7	-	28
123	c c c d d d c d d c d d - d d c - c c d c d d c d c - - - N MrMrMrM B MrB MrM M Br- B B M - B MrMr N M MrB Mr Mr - - -	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	-	5	-	4	3	-	1	4	1	24
124	d d d d d c d c - d d c d c d d d c d d d c d d c d d d - BrB MrBrBr N B B - B B MrMrB N MrMrN MrB B M MrNrMr MrN Br-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	2	-	2	-	6	-	2	4	7	1	27
125	- c c d d d d d b c d d d d - d d c d - d d d d c d d d c -MrM B Mr B MrNrMrMr MrMrMrN - M B M Mr- M MrM MrMr NrMrBrMr	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-	-	3	1	3	3	1	1	8	3	26
126	c d - c c c d c c c d d c d c d d c d d c c d d d d d d d MrM - N Nr M M N B N N B N M M BrBrM B Br N M N MrMr MrM M Br	-	-	-	-	-	-	-	-	-	-	-	-	1	4	5	-	1	1	2	5	2	4	3	-	28
127	d c c c c d d d d d d d c d c d d c - c b c d d d - d d c MrM B NrB B MrBrM B NrB NrB B MrBrMr- N M M B B M - B M Mr	-	-	-	-	-	-	-	1	-	-	-	-	3	2	1	-	2	2	7	3	-	2	3	1	27
128	d c c - d d c d d d d d b c d d a c - a c a d d d d d d d M B M - M M M M M N N N M N N B M N - M N M B M N MrM M M	-	5	-	-	-	-	-	1	-	-	-	-	1	2	3	-	-	-	2	9	3	-	1	-	27
129	d d d d - d c c d d d c d d d d d d d d d c d d d d d d d M B M M - B N N M N M B N MrMr N B N N M M B B MrMr M M M B	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2	-	-	-	5	10	5	-	4	-	28
130	b d c d d d b - d b d c d d c d d d c d b d d b b c - d c M N M B N M M - M N M M M M N M B N B N M B M M M M - M N	-	-	-	-	-	-	-	5	1	-	-	-	1	3	2	-	-	-	3	8	4	-	-	-	27
131	b - d - d - c c d d d d d - c c d d c b b b c c c d d d d M - M - Mr - M B M M M M M - N N MrB N M M M M M Mr N M B Mr	-	-	-	-	-	-	-	4	-	-	-	-	-	3	4	-	1	-	2	7	1	-	3	-	25
132	d d - d d d d d d c d c d d d d d c - d d d d d d b d c c M N - M M M N MrN M N M M M M MrMrM - N M M M N M M B M N	-	-	-	-	-	-	-	1	-	-	-	-	-	4	1	-	-	-	1	11	6	-	3	-	27
133	- d d c c d d d d d d - c - d d d d b c d c c d d c d d c - MrM N M B N M M M M - M - Mr M MrN M M M M M B Mr M N B B	-	-	-	-	-	-	-	1	-	-	-	-	1	6	1	-	-	-	3	7	3	-	4	-	26
135	- c d d d d d d d d d c d d d d c d d d d d c c d c c d d - MrMrMrMr BrNrB NrMr MrMrMrMrNr MrB NrNrMr MrMrN MrMr N NrNrMr	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	1	3	1	-	-	1	10	9	28
136	d d d c c d c c d d d c c c c c d c c d d d c c d d b d c M MrMrM M NrM MrM M MrB NrM B M MrM M Mr MrMrNrM Mr NrM M M	-	-	-	-	-	-	-	1	-	-	-	-	2	9	-	-	2	1	-	3	1	-	8	2	29
137	c d c d d d d d b d d c c c d c c c c d d c d d d c d d d M MrN NrMr MrM N M M B M M M B M N M MrB B N BrB Br N M M M	-	-	-	-	-	-	-	1	-	-	-	-	-	6	4	-	1	-	4	5	2	2	3	1	29
138	d d d d d d d d d d c d d c c d d d d d d c c c d d d d d M M M B N MrMrN M Mr MrMrMrB N N B M M B M M N N B N MrMrM	-	-	-	-	-	-	-	-	-	-	-	-	1	1	3	-	1	-	4	8	4	-	7	-	29
139	c d c c b d b c d b d d c c d d d b d d c c c c d c c c c N M MrMrM M M M M M MrB MrM Mr B MrB MrMr MrB M M M M N M M	-	-	-	-	-	-	1	5	-	-	-	-	1	7	2	-	4	-	2	4	-	-	3	-	29
140	c c - d d c c b c d c c d d d d c d d c d c d b c d c - - M M - M N NrM M M M N M M B M M M B M M MrM M M M M M - -	-	-	-	-	-	-	-	2	-	-	-	-	-	10	1	-	-	1	2	8	1	-	-	1	26
141	c c d d d c c c c d d d d c d d d d c d - c d d d d d d d M M N N B M N B N N M B N M N M B N M M - B N M M N N N N	-	-	-	-	-	-	-	-	-	-	-	-	2	5	2	-	-	-	3	5	11	-	-	-	28
		-	5	-	-	-	-	1	25	4	-	1	-	30	116	52	1	41	12	108	182	64	30	168	27	872

APPENDIX III (Contd.)

TRAVERSE V

		a						b						c						d						
		B	M	N	Br	Mr	Nr	B	M	N	Br	Mr	Nr	B	M	N	Br	Mr	Nr	B	M	N	Br	Mr	Nr	
142	d d c d d d d d b d d c c d c c d c c d d d d d c d c d c MrM M M B N M MrM Nr M MrMrB M M M M MrMr M BrMrNrNr NrM M N	-	-	-	-	-	-	-	1	-	-	-	-	-	5	1	-	5	1	2	7	1	1	4	5	29
143	d d c d d d c d c d d d d d d d d d d - d d d c c c c d d M M M M B N M NrM M M MrM M Mr MrB M M - M M N M M B M B M	-	-	-	-	-	-	-	-	-	-	-	-	1	6	-	-	-	-	3	12	2	-	3	1	28
144	b d d d d d c d d d b d d d c d d b c d d d c c d d d d d M B MrM M M M B B M M N B B N M M M B N M M M M N M M B N	-	-	-	-	-	-	-	3	-	-	-	-	1	3	1	-	-	-	5	11	4	-	1	-	29
145	d d d d c d c d d d d d d c d d d d d d d d - d d d d d d M MrB M N N M M M Nr M M M M M -N NrN N Mr MrN - B B NrN B Nr	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	4	9	5	-	3	4	28
146	c c d c d c d c b d c c d d c d d d b c c c c b d d c d c M NrNrN M NrM M M Nr M NrNrNrNr NBNrM N M N M M M M NrM NrN	-	-	-	-	-	-	-	2	1	-	-	-	-	7	3	-	-	4	-	4	-	-	-	8	29
148	c d d d d d d d c c d c d d d d d c c d d b d d d d c d d B N M M B M B M M M N M M M M B M M M M M M N M M M M N M	-	-	-	-	-	-	-	1	-	-	-	-	1	6	-	-	-	-	3	15	3	-	-	-	29
149	d c d d d d d d d d d d c d d d d c c d c d d d d c d b d B N N B N NrM B M N M M M M B N N M M N B M M M M N N M M	-	-	-	-	-	-	-	1	-	-	-	-	1	3	2	-	-	-	4	10	7	-	1	-	29
150	c d d d d d d d c c - d c d c d a c d c c c c d c d c d d B M M B M N M B N B - M B M M N M B M M M M B B B NrN B B	-	1	-	-	-	-	-	-	-	-	-	-	6	4	2	-	-	-	5	7	2	-	-	1	28
151	d d d d d d d d d d c d d d d d d d d c - b d d c d c d d M M M B N M N M M M M B M B N M M N B N - M M B B N N B M	-	-	-	-	-	-	-	1	-	-	-	-	1	1	2	-	-	-	6	12	5	-	-	-	28
152	d d d d d d d d d c d d d d d d d d b d d d d d - d d d d B MrB M M N M N MrB M M M M N M B N M M M M B Mr- B B M B	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	7	12	4	5	-	-	28
153	c d c c d b c d d d c b b c c d c c d d b c d a c d d d c B N M B M M B B M B M M M N M M B B M N M MrMrMrB M M M M	-	-	-	-	1	-	-	4	-	-	-	-	6	5	-	-	1	-	2	8	1	-	1	-	29
156	d d d d d c c b d d d d c d - c b c c d d c c c d d d - d M M B M M M M M M M B M M M - M M M M M M M M M M B M - B	-	-	-	-	-	-	-	2	-	-	-	-	-	9	-	-	-	-	4	12	-	-	-	-	27
158	b c d d d d d d d d d d d b d d d d d d d d c d d d c d d M B M B Mr B MrB M Mr M M MrM M B M M M M M M M M M M N M M	-	-	-	-	-	-	-	2	-	-	-	-	1	1	1	-	-	-	4	16	-	-	4	-	29
159	c c c d c d d d b c c c c c d c d c c c d c d c b d d c c M M B B B N N B M M M MrB B Mr M M M M B M M M M N M B M B	-	-	-	-	-	-	-	2	-	-	-	-	6	10	-	-	1	-	3	5	1	-	1	-	29
160	d d d d d d c d d d d c d d d d c d d d d c d c d d d d c B B M B M M M Mr M M MrM MrM M M B M MrMr N M B B B M MrB B	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	-	6	10	1	-	6	-	29
161	d d d d d d d d d d d c c c c d b d d d d c d c d d d c d M M M M M M M B B M M M M N N B M B M Mr MrM M M M M M M M	-	-	-	-	-	-	-	1	-	-	-	-	-	5	2	-	-	-	4	15	-	-	2	-	29
162	d d d b d d - - c d c c c d c d d d - - d d d d d d c d d M M M B M M - - M B B M M MrM B M B - - M M M M M M M M M	-	-	-	-	-	-	1	-	-	-	-	-	1	5	-	-	-	-	3	14	-	-	1	-	25
163	d d c d d d d c d d d d d d c d c c d d c c d d - d d d c M B N M B MrM M B Mr B MrM M M MrN M B M B B M N - MrB M M	-	-	-	-	-	-	-	-	-	-	-	-	2	4	2	-	-	-	5	8	2	-	5	-	28
164	d d c d d d c d c d c c d c d d d c d d c d c c c d d d d MrMrMr M N B M M M Mr M M M M M N N M MrMr MrB N N B M B M N	-	-	-	-	-	-	-	-	-	-	-	-	1	6	2	-	2	-	3	8	3	-	4	-	29
166	c c c d c d d d d c c d c d c d d d d c d c d c d d d - d M M M B N N M M M N M B M M M B B B M M M M M MrB B B - N	-	-	-	-	-	-	-	-	-	-	-	-	-	8	2	-	1	-	8	7	2	-	-	-	28
166	d a d c d d d b d d c d c c d b c c d c d d d c d - c - d B B MrM B B M M M M M B M B M M M M MrM M M M M M - M - N	1	-	-	-	-	-	-	2	-	-	-	-	1	8	-	-	-	-	4	8	1	2	-	-	27
167	d c d d c d c d d c d d b d d d d d d d d b d b d d d d - B M MrB N M M M M M B B M M Mr N M M MrM B M M M B M M M -	-	-	-	-	-	-	-	3	-	-	-	-	-	5	1	-	-	-	6	11	1	-	3	-	28
168	d c d d d c d c c c d d d d d d d c d d c c d c d d d b d B N M M M N M M N B M M B M N M M M B Mr B M B M B B B B B	-	-	-	-	-	-	1	-	-	-	-	-	2	4	5	-	-	-	8	9	1	-	1	-	29
		1	1	-	-	1	-	2	26	1	-	-	-	35	109	25	-	8	5	99	230	46	6	40	17	651

COLOUR GROUPS

APPENDIX IV

TRAVERSE I

							a X	a Y	a Z	b X	b Y	b Z	c X	c Y	c Z	d X	d Y	d Z
1	- a b a c	b b a - a	b b - b b	b c a a c	b a c b b	a b d a	-	5	4	-	6	6	-	2	2	-	-	1
	- Y Y Y Y	Y Y Y - Y	Z Z - Z Y	Z Z Y Z Z	Y Z Y Z Y	Z Z Z Z												
2	a b b c c	a c d c c	b c b b a	c b c b a	c c c c c	d c c b	-	2	2	-	3	5	-	5	10	-	1	1
	Z Z Y Z Y	Y Z Z Z Z	Z Y Z Y Y	Z Z Z Y Z	Y Z Z Y Y	Y Z Z Z												
3	c d a a c	a b a c d	c c c a d	d c c c c	c a a c c	c b d c	-	3	4	-	1	1	1	4	10	-	5	-
	Z Y Y Y Z	Z Y Z Y Y	Z Y Z Z Y	Y Z Z Y Y	X Y Z Z Z	Z Z Y Z												
4	b c a a b	a c b c a	a c b c d	b a c c c	a c h b c	b d a c	-	4	4	-	4	4	-	4	7	-	1	1
	Z Y Y Y Y	Y Y Y Z Z	Z Z Y Z Y	Z Y Y Z Z	Z Y Z Y Z	Z Z Z Z												
5	c d d d d	c c c d c	c c c c c	d c c d c	c d c d b	d a c a	-	-	2	-	-	1	-	2	14	-	2	8
	Z Y Z Z Z	Z Z Z Z Y	Z Z Z Y Z	Z Z Z Z Z	Z Z Z Z Z	Y Z Z Z												
6	b b a c b	a c c c d	b a b c h	b c d a c	b b b c c	b d a b	-	4	1	2	8	2	-	4	5	-	-	3
	Y Y Y Y Y	Y Y Z Z Z	Y Y X Z Z	Y Z Z Z Z	Y Y Y Y Y	X Z Y Z												
7	c c a a a	c a a c a	a c b d b	a c c a a	b b b c b	b b c a	-	10	1	1	2	5	-	1	8	-	1	-
	Z Z Y Y Y	Y Y Y Z Y	Y Z Y Y Y	Y Z Z Y Y	Z Z Z Z Z	Z X Z Z												
8	a a c c d	b a d b b	b c d b d	a c d c c	b b b b d	a c c c	1	1	3	-	5	4	-	3	6	-	3	5
	X Z Z Z Z	Y Z Z Y Y	Y Y Z Z Y	Z Z Y Z Z	Z Z Y Z Y	Y Z Y Y												
9	a b a d c	c d a c a	a c c b c	c b a d d	d d a d d	c d b c	-	6	1	-	2	2	-	5	4	-	3	6
	Y Z Y Z Z	Y Z Y Y Y	Y Y Z Y Z	Z Y Y Y Z	Z Y Z Y Z	Y Z Y Y												
10	b d c d d	b d d b d	c c b c d	c d b c c	d c d b d	c c d b	-	-	-	-	3	4	-	4	6	-	5	7
	Y Z Z Y Z	Y Z Z Z Z	Y Y Z Y Y	Z Z Z Z Y	Y Z Y Y Z	Z Z Y Z												
11	b a d d b	c d c b c	b c b b b	c b b b a	c b d b a	c c a b	-	1	3	-	4	9	-	4	4	-	-	4
	Z Z Z Z Z	Y Z Y Y Y	Z Y Z Y Y	Z Z Y Z Y	Z Z Z Z Z	Z Z Z Z												
12	a a d a b	a c d b d	a b a a b	b c a c b	b b d b d	a b b a	-	-	10	-	3	8	-	1	2	-	2	5
	Z Z Y Z Z	Z Z Z Y Z	Z Z Z Z Y	Z Y Z Z Z	Z Z Y Z Z	Z Y Z Z												
13	b d c c c	a d c d d	d b d d d	d c c d c	b c c b c	c b d c	-	1	-	-	2	3	1	6	5	-	2	9
	Y Y Y Y Y	Y Z Z Z Z	Z Y Z Z Y	Z X Z Z Z	Z Z Y Z Z	Y Z Z Y												
14	a b b c c	a d b b c	c c d c d	b d c b c	d c b b a	c b a b	-	1	3	-	4	6	-	3	7	-	2	3
	Z Z Z Y Z	Z Z Z Y Z	Y Y Z Z Y	Z Y Z Y Z	Z Z Z Y Z	Z Z Z Y												
15	c a c c a	c c b d d	d c d d c	a a b b c	c c a c c	d d c c	-	4	1	-	1	2	1	8	5	1	5	1
	Z Y Y Z Z	X Y Z X Z	Y Y Y Y Y	Y Y Z Y Z	Y Y Y Y Y	Y Y Z Z												
16	c c a c d	c a d c c	d c d c c	b c c b d	c c c d c	b d d c	-	-	2	-	1	2	-	9	7	1	2	5
	Y Y Z Y Z	Z Z Y Z Y	Z Z X Y Y	Z Z Y Y Z	Z Z Z Z Y	Z Y Z Y												
17	d d c b c	d d d d c	c c c b c	- b b c c	c c c c c	c b b b	-	-	-	1	3	3	1	12	2	2	2	2
	Y Y Y Y Y	Z Y Z X Y	X Y Y Y Y	- Y X Y Y	Y Y Y Y Z	Z Z Z Z												
19	b c c c c	a c d c d	c c c b b	b b c d c	d c c d a	c b c d	-	2	-	-	3	3	1	8	6	-	1	5
	Z Y X Y Y	Y Y Y Z Z	Y Z Y Y Y	Z Y Z Z Y	Z Z Z Z Y	Z Z Y Z												
20	d a c b b	c c c c d	d d c c b	b b c d c	c c d b d	b c c c	-	1	-	1	3	3	-	11	5	-	2	5
	Z Y Y Z Y	Y Y Y Y Z	Y Z Y Y Z	Y Y Z Y Y	Y Y Z Z Z	X Y Z Z												
21	b d b c d	d d d b b	a b c d d	- c d c c	b c c d c	d c d d	-	1	-	1	2	3	-	2	7	-	5	7
	Y Z Z Z Z	Z Z Y Z Z	Y X Z Y Z	- Y Y Z Z	Y Y Z Y Z	Z Z Z Y												
22	a a c a a	b b b b d	a a c a c	- - - - -	- - - - -	- - - -	2	-	5	1	-	3	-	2	1	-	1	-
	Z Z Z X X	Z X Z Z Y	Z Z Y Z Y															
23	c a c c a	c b b b b	c c c b b	d c c b c	c c c c b	c c b c	-	1	1	1	5	3	-	10	7	-	1	-
	Y Z Z Z Y	Y Y Y X Y	Y Y Y Y Z	Y Y Z Z Y	Y Z Y Z Y	Y Z Z Z												
24	c a d d d	- b a c c	c c c c b	c c d d c	c c c c d	c c c b	-	-	2	1	-	2	-	4	13	-	1	5
	Z Z Z Z Z	- Z Z Z Y	Z Z Z Z X	Z Z Z Y Z	Y Y Z Z Z	Z Y Z Z												
26	c d d d d	- d d d a	c d d b d	d c b d b	c c d c c	d c c d	-	1	-	-	2	1	-	4	5	-	4	11
	Z Y Z Y Z	- Z Y Z Y	Z Y Z Z Z	Z Z Y Z Y	Y Y Z Y Z	Z Z Y X												
27	b a c c c	c c d d c	c c c d c	c c b c d	- d c d a	d d b -	-	2	-	-	2	1	-	6	8	1	6	1
	Z Y Z Z Y	Z Z Y Y Y	Y Z Z Y Y	Y Z Y Z Y	- Y Y Y Y	X Z Y -												
28	a b b c a	c b b d d	d d b b d	a c c c b	b b d d d	c c b c	-	1	2	-	2	8	-	4	14	-	5	3
	Z Z Z Z Y	Z Z Y Z Y	Y Z Z Z Y	Z Y Z Y Y	Z Z Y Z Y	Y Z Z Y												
29	d d b b d	b c d b d	c d d d c	c c c c d	c b c d d	c c d c	-	-	-	-	5	-	-	4	8	-	7	5
	Y Y Y Y Y	Y Z Z Y Y	Y Y Y Y Z	Z Z [illegible]	Z Y Y Z Z	Y Z Z Y												
30	a a d b c	d d b d d	c c b b b	c b b b c	b b c c c	c b b b	-	1	1	-	6	7	-	2	7	-	2	3
	Y Z Z Y Z	Z Z Y Y Y	Z Y Y Y Z	Z Z Y Z Y	Y Z Z Z Z	Z Z Z Z												
32	c c b c d	c c b b a	d b d d c	c c d d d	c c c d c	c c d -	-	-	1	-	3	1	-	10	4	-	5	4
	Y Y Y Y Y	Y Z Y Y Z	Z Z - Y Y Z	Y Y Y Z Z	Y Y Z Y Z	Y Y Z -												
34	c c c b d	b b b b d	d d d b d	d - d - d	d d d d b	d d b -	-	-	-	1	4	3	-	3	-	-	8	7
	Y Y Y Y Y	Y Z Z Z Z	Z Y Z Y Z	Y - Z - Y	Z Y Y Z Y	Y Y X -												
35	d c d c d	- b b d d	d c c c a	b b d d d	d c b d d	d d d d	-	-	1	-	2	3	-	-	6	-	2	14
	Z Z Z Z Z	- Y Z Z Z	Z Z Z Z Z	Z Y Y Y Z	Z Z Z Z Z	Z Z Z Z												
36	c h b c b	d d d d d	d d d d d	b d - b d	d c c d d	d d d d	-	-	-	-	3	2	-	3	1	-	12	7
	Y Y Y Y Y	Y Z Y Y Y	Y Y Y Y Z	Z Y - Z Z	Y Y Z Z Z	Z Y Z Y												
							3	52	54	10	94	110	5	150	184	5	98	134

APPENDIX IV (Contd.)

TRAVERSE II

							a			b			c			d	
							X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
37	c d d b c Z Z Z Y Z	c c c c c Z Z Z Z Z	c c c b c Z Z Z Y Y	c c d d c Z Z Z ZZ	c c d c c Y Z Z Y Z	d - c d Z - Z Z	-	-	-	-	2	-	-	3	16	-	-	7
38	b b d d c Y Y Y Y Y	d c c d d Z Y Y Z Y	d c c d d Z Z Y Y Y	c d b a a Y Y Y Y Y	c d c c d Z Z Z Z Y	a c d d Z Y Y Y	-	2	1	-	3	-	-	6	4	-	9	4
39	d d b c c Z Z Y Z Z	d b d b a Y Y Z Y Y	c b d b a Z Y Y Z Y	b a a d d Z Y Y Y Z	d c b d d Y Z Z Z Y	b c a c Y Y Y Z	-	5	-	-	5	3	-	1	5	-	5	5
41	d b c d c Z Y Z Y Z	d d d d d Z Z Z Z Z	d d c d c Z Z Z Z Y	- d d d d - Z Z Z Z	b c d d d Z Z Z Z Z	c c b d Z Z Z Z	-	-	-	-	1	2	-	1	6	-	1	17
42	a c c c d Y Z Z Y Z	d b d d c Y Y Y Y Z	d d d d d Z Y Y Y Y	d d b b c Z Y Y Y Y	d d c d c Y Z Z Z Y	b c d c Z Z Y Y	-	1	-	-	3	1	-	5	5	-	11	4
43	c c d b a Z Z Y Z Z	c d c d c Z Z Z Z Z	d d d c c Z Y Z Z Z	- d c c c - Z Z Z Z	c d d b d Y Z Y Z Y	d c c c Z Z Z Y	-	-	1	-	-	2	-	2	12	-	4	7
44	b b c b d Z Z Z Z Z	c c d d c Y Z Z Z Z	d d - c b Z Z - Z Z	c d d c c Z Z Z Z Y	c d d d b Y Z Z Z Z	b c b c Y Z Z Z	1	-	-	-	1	6	-	3	8	-	-	10
45	d c d d d Z Y Z Z Y	b c c b c Y Z Z Y Y	- d c c d - Z Z Z Z	c c d c d Y Z Z Z Y	d a a b b Z Y Y Z Z	d a d d Y Y Z Z	-	3	-	-	2	2	-	3	6	-	3	9
47	d c d c a Y Y Z Z Y	c c c a b Z Z Z Z Y	c c c c c Z Z Z Y Z	c d d c c Y Y Z Y Z	d d c d d Y Z Z Z Y	c d b a Z Z Z Y	-	2	1	-	1	1	-	4	11	-	3	6
48	c d d b a Z Z Z Y Y	d d d d d Z Z Z Z Z	d d d d c Z Z Z Z Z	d d c c d Z Z Z Y Z	c c d d b Y Z Y Z Z	d c c c Y Z Y Z	-	1	-	-	1	1	-	3	6	-	2	15
49	a b b a d Y Z X Y Y	d c c c b Y Y Y Y Y	d d c c c Y Y Z Z Z	c d c c c Z Y Z Y Z	d b c b d Z Z Y Z Z	c c d b Z Z Z Y	-	2	-	1	2	3	-	5	8	-	5	3
50	- c d c d - Z Y Z Z	c d b c d Z Z Y Z Z	d d a a d Y Y Z Z Z	d d d d c Z Z Y Y Z	d d d d d Z Z Z Z Z	d c b c Z Z Z Z	-	-	2	-	1	1	-	-	7	-	5	12
51	d b d d c Z Y Z Z Z	d d d d c Y Z Y Z Y	d d d d d Y Z Z Z Z	d d d d d Z Z Z Z Z	- d c b d - Y Y Z Y	d c d b Z Z Y Z	-	-	-	-	1	2	-	2	2	-	6	15
52	d d d a d Z Y Y Y Z	b d d d d Y Z Z Y Z	d b d a d Z Z Z Y Z	d d d d b Z Y Z Z Y	d d d d d Z Z Z Y Y	c c c d Y Y Z Y	-	2	-	-	2	1	-	2	1	-	7	14
53	d c c a b Z Y Y Y Z	d c c d d Z Z Y Y Z	d c c d d Z Z Z Z Z	d d b d d Z Y Z Z Y	d - d d c Z - Z Z Z	c a d b Z Z Y Z	-	1	1	-	-	3	-	3	5	-	4	11
54	d d c d c Y Z Z Y Z	d d d d d Y Z Z Z Y	c d b d c Y Z Z Z Z	c c d d d Z Z Z Y Z	d d c d b Z Y Z Z Z	d d d c ZY Z Z	-	-	-	-	-	2	-	1	7	-	8	11
55	d c d - - Z Y Y - -	c d c a b Z Y Y Z Y	d c c d d Y Z Z Z Z	b - d b d Y - Y Z Z	d d d d b Z Z Y Z Y	d d d d Y Z Z Z	-	-	1	-	3	1	-	2	3	-	6	10
56	d d d d d Y Z Z Z Z	d d c d c Z Z Z Z Y	d d d d d Y Y Y Y Y	c d c d d Z Z Y Z Y	d d d a d Y Z Z Z Z	d d d d Z Z Y Z	-	-	1	-	-	-	-	2	2	-	9	15
57	c a d b b Z Y Z Y Z	c b b - b Z Y Y - Z	b b a c b Z Z X Y Z	c c d c c Z Z Z Y Z	a c b b c X Z Y Y Z	d c b b Z Y Y Y	2	1	-	-	7	3	-	3	7	-	-	5
59	c c d c b Y Y Y Y Z	b c c d d Z Y Y Z Z	c - d c d Z - Y Y Y	c a d c d Z Y Y Z Y	c d b d c Y Z Z Z Y	a d - b Y Z - Z	-	2	-	-	-	4	-	8	3	-	5	5
60	c c c c d Y Y Y Y Z	c d d d c Y Z Y Y Z	d c c d d Y Y Y Z Y	c d d d d Z Z Z Z Z	c d d d - Y Y Z Y -	d d d d Z Y Y Z	-	-	-	-	-	-	-	8	2	-	8	10
61	c c c c d Z Y Z Z Y	d d d d d Z Z Z Z Z	d c c d d Z Y Z Y Z	d d b d c Z Y Z Y Y	d d d b c Z Z Y Z Z	d c b d Z Z Y Z	-	-	-	-	1	2	-	3	6	-	5	12
62	d c d c d Z Y Z Z Z	c d d c d Z Y Y Z Z	c d d c d Z Z Z Z Z	d d b d d Z Y Y Z Z	c b b d c Y Z Z Z Z	d b d c Y Z Y Z	-	-	-	-	1	3	-	2	7	-	5	11
63	c c b c d Z Z Z Y Z	c d c d d Y Y Y Y Y	c d d c c Z Y Z Y Z	d d d d c Z Y Y Y Y	d b d d b Z Y Z Z Z	d d d d Y Z Y Z	-	-	-	-	1	2	-	5	4	-	9	8
64	c d c c - Y Y Z Z -	b b b d c Y Y Y Y Y	b d c c b Y Y Y Z Y	d d d a c Z Z Z Z Z	d d c d - Y Z Z Z -	d a b c Y Y Z Z	-	1	1	-	5	1	-	3	6	-	5	5
65	c d c d d Z Z Y Y Y	c c d c d Z Z Z Y Z	d c c c d Z Z Z Z Z	d d d d b Z X Z Y Y	d d c c d Y Z Z Y Z	c d d d Z Z Z Z	-	-	-	-	1	-	-	3	8	1	4	12
66	c d d c d Y Z Z Y Y	c d d d c Y Z Z Z Z	c c c d d Z Y Y Z Y	b b d c d Z Z Z Y Z	b a d d a Y Y Z Z Z	d d d b Z Z Y Z	-	1	1	-	1	3	-	6	2	-	3	12
67	d b d b d X X Y Y Z	- c c d d - Y Y Z Y	d d d b b Y Z Z Y Y	b a b a b Z Y Y Y Y	b d d b b Z Y Z Y Z	a d c c Y Y Z Z	-	3	1	1	6	3	-	2	2	1	5	5
69	a - c d d Y - Z Z Z	d d d c d Z Z Z Z Y	- a a d d - Z Z Z Z	d d d d c Z Z Z Z Z	c c c c d Z Y Z Z Z	c d d c Z Z Z Z	-	1	2	-	-	-	-	1	8	-	1	14
70	b c - a b Z Y - Z Y	c d c b d Z Z Z Z Y	b c d - d Z Z Y - Z	d c c b d Z Z Z Y Z	d d c d d Z Z Z Z Y	d c d c Z Y Z Y	-	-	1	-	2	3	-	3	6	-	4	9
71	c d d d d Y Y Z Z Z	d d d b d Z Y Z Y Y	b d d - d Y Z Y - Y	d d d c c Z Z Y Y Z	d d d d d Y Z Z Z Z	d c c d Z Y Y Y	-	-	-	-	2	-	-	4	1	-	8	13
72	d d d d d Z Y Z Z Y	d d d d d Z Y Y Y Y	d d d d d Y Z Z Z Y	d d d d d Z Y Z Y Y	c b d d d Y Y Z Z Z	c d d d Z Y Z Z	-	-	-	-	1	-	-	1	1	-	12	14
							2	28	13	2	56	57	-	98	177	2	162	308

APPENDIX IV (Contd.)

TRAVERSE III

							a			b			c			d		
							X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
73	b - d d d Y - Y Y Z	b d d d c Y Y Z Z Y	b d b d b Z Y Z Z X	c b d c d Y Y Y Z Y	c c d c c Y Z Z Y Z	d a b d Z Y Z Z	-	1	-	1	3	3	-	4	3	-	6	7
74	c c - d c Z Z - Z Z	d d - b d Z Z - Z Z	c b d c d Y Z Z Z Z	d d d d c Y Z Z Z Z	c d c c c Z Z Z Z Y	d c c b Y Z Y Z	-	-	-	-	-	3	-	5	9	-	2	10
75	d d c c - Z Z Y Z -	d c c d d X Z Y X Z	c b d a d Y Y Z Y Z	d d c b c Z Z Y Z Y	d d d d d Z Z Z Y Z	d d d b Z Y Y Y	-	1	-	-	2	1	-	5	2	2	3	12
76	d - d d - X - Z Z -	c d c d d Z Z Z Z Z	d d d d d Y Z Y Z Z	d d d d b Y Y Z Y Z	d d b d d Y Z Y Y Z	d d b d Y Y Y Z	-	-	-	-	2	1	-	-	2	1	9	12
77	c c b c c Y Z Z Z Y	d b d c c Y Y Z Z Y	d c d b d Z X Z Y Z	d d d d d Y Y Z Z Y	d c d b a Z Y Y Y Z	b d d c Y Z Y Y	-	-	1	-	4	1	1	5	3	-	6	8
78	d d d d d Z Z Z Z Z	d d d d d Z Y Z Z Z	d c d d d Y Z Y Y Z	c d c d c Y Y Z Y Z	d d d d d Z Y Z Z Y	d d d d Z Z Y Z	-	-	-	-	-	-	-	1	3	-	9	16
80	d d d d d Y Y Y Z Y	d b c d d Z Y Y Y Z	d d d d d Z Y Y Z Z	a d d d d X Z Y Y Y	c d d d d Y Z Z Z Z	d d d c Z Y Z Z	1	-	-	-	1	-	-	2	1	-	11	13
81	d b c c c Z Y Y Y Y	c b d c d Z Y Y Y Z	c c d c d Y Y Z Y Z	d c c b c Z Y Y Y Y	b d d d a Y Y Z Z X	d b b d Y Z Y Z	1	-	-	-	5	1	-	10	1	-	3	8
82	d c d d d Y Z X Y Z	c d d d c Z Y Y Y Z	d d d d d Y Y Y Z Y	a c d d d Z Y Z Y Y	d - d d d Y - Z Y Y	d d c d Y Z Y Y	-	-	1	-	-	-	-	2	3	1	16	5
83	d b b d c Z Y Z Z Z	d d d d b Z Y Z Y Y	d d d d d Y Y Y Y Y	c d c c d Y Y X Y Y	d c d d d Y Z Y Y Y	d d d d Y Y Y X	-	-	-	-	2	1	1	2	1	1	16	5
84	b b d d d Z Y Y Z Z	c d d c c Z Z Z Y Z	d c d b d Z Z Z Z Z	b d d d c Z Z Z Y Y	d d c b c Z Z X Z Z	d d c d Z Y Y Z	-	-	-	-	1	4	1	3	4	-	3	13
85	c - d d d Z - Y Z Y	b d c c c Y Z Y Y Y	c d d c c Y Z Z Z Z	c d d d d Y Z Z Y Z	d d d d d Y Z Y Y Z	d c c d Y Z Y Z	-	-	-	-	1	-	-	6	4	-	7	10
86	b d d d d Y Z Y Y Z	d d c c d X X Y Y Z	c d d c b X Z X Y Y	d c d b d Z Z Y Y Y	d d c c d Z Z Z Y Y	d c b d Y Y Y Y	-	1	-	1	3	-	1	5	2	2	7	7
87	d b d - c Z Y Z - Y	d d b d d Y Z Y Z Z	d d d d d Z Z Z Z Z	c d d b c Z Z Y Y Z	b d c c c Y Y Y Y Z	a b d d Y Y Y Z	-	1	-	-	5	-	-	3	3	-	3	13
88	d d d c d Y Y Z Z Y	- d d - d - Z Y - Y	d d - d d Y Z - Z Y	d c d d d Y Z Y Y Z	d d d d d Y Y Y Z Y	d d - d Y Z - Y	-	-	-	-	-	-	-	-	2	-	16	7
89	d d d d d Y Z Z Z Y	d d c c d Y Y Y Y Z	d d d d d Z Y Z Z Y	d d d d d Y Y Y Y Z	b d d - d Y Z Z - Z	d d d d Z Y Y Y	-	-	-	-	1	-	-	2	-	-	13	12
90	c a - d d Z Z - Z Y	d d d d - Z Z Z Z -	c d c d d Y Z Y Y Y	d d d d - Z Z Z Z -	d d d d - Y Z Z Y -	d d d d Y Z Z Z	-	-	1	-	-	-	-	2	1	-	6	15
91	d d d d d Z Z Y Y Y	d d d d d Z Y Y Z Z	d d - - d Z Z - - Z	d d d d d Z Y Z Y Y	d d c c d Z Y Z Z Y	c d c d Y Z Y Z	-	-	-	-	-	-	-	2	2	-	10	13
92	c c c c d Y Y Y Z Y	d d d d c Z Z Z Y Y	c d d d d Z Y Y Y Y	d d d d d Z Y Y Z Z	d d d d d Z Y Y Z Y	c c c d Y Z Y Z	-	-	-	-	-	-	-	6	3	-	11	9
93	d d c d d Z Z Y Z Z	c d d c d X Z Y Y X	d d d c d Y Z Y Y Z	d d d d c Y Y Y Y Y	d d d d c Z Z Z Y Y	d d b c Y Y Y Y	-	-	-	-	1	-	1	6	-	-	11	10
94	d d d d c Z Y Y Z Y	c d - d d Z Y - Z Z	c d d c c Y Y Z Y Z	d d d c d Z Y Z Y Y	d c c d - Y Y Y Z -	d c d - Z Y Y -	-	-	-	-	-	-	-	7	2	-	8	9
95	d d c d c Z Z Z Y Z	c d d c d Z Z Z Z Y	d c c d d Y Z Z Y Z	d d c d d Z Z Z Z Y	c d d d d Z Y Z Z Z	d d d d Z Z Y Y	-	-	-	-	-	-	-	-	8	-	8	13
97	d b d d c Z Y Y Z Y	d d b d - Y Z X Z -	b d d c d X Z Y Z Z	c c d a c Y Z Z Y Y	d d d c c Z Z Z Y Y	b d d d Y Z Y Z	-	1	-	2	2	-	-	5	2	-	4	12
98	d c d b d Y Z Y Y Y	d d d - c Y Y Z - Y	d d d d d Y Y Y Y Y	d d c d d Y Y Y Y X	d d d d d X Y Y Y Y	d d - - Y Y - -	-	-	-	-	1	-	-	2	1	2	18	2
99	d d d c d Z Z Z Y Z	- d - a c - Z - X Z	d d d d d Z Z Z Z Z	- d d c - - Y Z Y -	c c d c d Y Z Y Y Y	d d b - Z Z Y -	1	-	-	-	1	-	-	4	2	-	3	13
100	d d d d d Y Y Z Z Y	d d d d d Y Y Y Y Z	d d c d d Z Z Y Z Z	d d d c d Z Z Y Y Z	d d - c c Y Y - Y Y	d b d d Y Y Z Z	-	-	-	-	1	-	-	4	-	-	11	12
101	d d d d d Z Z Y Z Z	d d c d d Y Y Y Z Y	d d d d d Z Z Z Y Y	c d d d - Y Z Z Z -	c d d d d Y Z Y Y Z	d d c c Y Y Y Y	-	-	-	-	-	-	-	5	-	-	10	13
102	d d d d d Z Y Y Y Z	d c d d d Z Y Y Y Y	d d d d d Y Z Y Y Y	d - d d d Y - Y Y Z	d d d d c Y Y Y Z Y	d d d d Z Y Z Z	-	-	-	-	-	-	-	2	-	-	17	9
103	d d b - d Z Y Z - Y	c d d d d Z Y Y Y Z	- d d c c - Y Y Z Z	d d d d c Y Z Y Y Z	d d b b c Y Y Z Z Y	d d b c Y Y Y Y	-	-	-	-	1	3	-	2	4	-	14	3
104	d d d d d Y Z Z Y Z	c d d c c Y Z Z Z Z	d - d d d Y - Z Y Z	d d c d d Z Z Z Y Z	d d d d c Z Y Z Z Z	d d d d Y Z Y Y	-	-	-	-	-	-	-	1	4	-	9	14
106	c d b d d Y Z Z Y Z	d d d c c Z Y Z Z Z	d d d d d Z Z Y Z Z	d d d d d Z Z Z Z Z	d c c c d Z Z Z Z Z	c c d d Z Z Y Y	-	-	-	-	-	1	-	1	7	-	5	15
108	- - d d d - - M Y Y	d d d d d Z Z Z Z Z	d - d d d Z - Y Y Y	b d d d c Y Y Z Y Y	d c d d b Z Y Z Y Z	d d d c Y Y Z Z	-	-	-	-	1	1	-	2	1	-	11	10
							3	5	3	4	38	20	5	104	80	9	136	330

TRAVERSE IV

APPENDIX IV (Contd.)

								a			b			c			d	
							X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
109	d d d d d Y Y Z Y Z	c c d d d Z Z Z Y Y	- c c c - - Z Y Z -	c d d - c Z Z Z - Z	c d c d c Y Y Z Y Z	d d c d Z Z Z Z	-	-	-	-	-	-	-	2	9	-	7	8
110	d c d d c Z Z Z Z Z	c c d d c Z Z Z Z Z	c d - c - Y Z - Z -	- d d c d - Y Y Z Y	d c d c c Y Z Z Y Z	d d d d Z Z Z Z	-	-	-	-	-	-	-	5	8	-	4	11
111	d c c d c Z Z Y Z Y	d c d d d Z Z Z Z Z	d d c c - Z Z Z Y -	- c c d c - Z Y Z Z	d c c c c Z Y Y Z Y	d d c d Y Z Y Y	-	-	-	-	-	-	-	8	6	-	2	11
112	d d c d c Z Y Z Y Z	d d d d d Z Z Z Z Z	d d d c d Z Z Y Y Z	- d c d c - Z Z Y Y	d c d d d Y Z Z Z Z	c d d d Y Z Z Z	-	-	-	-	-	-	-	3	4	-	5	16
113	- d d c b - Z Y Y Z	d d d d c Z Z Z Y Z	c b d c d Y Z Z Z Z	d d d d - Z Z Z Z -	d d d d d Z Z Z Z Z	- d d - - Z Z -	-	-	-	-	-	2	-	2	2	-	2	17
114	d c d d d Z Y Z Y Z	c d c d d Z Z Y Y Z	d c - d d Z Z - Z Z	d d d d d Z Z Z Z Z	d d - d d Y Z - Z Z	d d d d Z Z Z Z	-	-	-	-	-	-	-	2	2	-	3	20
115	d d d d d Z Z Y Z Z	d c d b - Y Z Z Y -	d d d d d Z Z Y Z Z	- d d d c - Y Z Z Z	d d d d d Z Z Y Y Z	d d d d Z Z Y Z	-	-	-	-	1	-	-	-	2	-	7	17
116	c d d d d Z Z Y Z Z	d d d d d Z Z Y Z Z	c d d d c Z Z Z Z Y	d d d d d Z Z Z Z Z	d d c d d Z Z Y Z Z	d d d d Z Z Z Z	-	-	-	-	-	-	-	2	2	-	2	23
117	d d - d d Z Z - Z Z	d d d d d Z Z Z Z Z	d d d d d Z Z Y Z Z	d d d d d Z Z Y Z Z	c d d d b Y Z Z Y Y	c d d c Z Z Z Y	-	-	-	-	1	-	-	2	1	-	3	21
118	d d c c c Z Z Y Z Y	d c d d d Z Z Z Y Z	c c d d c Y Z Z Z Y	- d d d d - Y Y Y Y	d d c d c Y Z Z Y Z	d d c d Y Y Y Z	-	-	-	-	-	-	-	5	5	-	9	9
119	d d d d d Z Z Z Z Z	d d d d - Z Z Z Z -	c c d d d Z Z Z Z Y	d c c d d Z Z Z Z Z	c d d c d Z Y Z Y Z	c d d d Z Z Y Y	-	-	-	-	-	-	-	1	6	-	4	17
120	c c b d c Y Y Z Y Y	c d d d c Z Z Z Z Z	d d d b d Z Z Z Y Z	c d d d - Z Y Z Z -	c c c d d Z Z Z Z Y	d d c d Z Z Z Z	-	-	-	-	1	1	-	3	7	-	3	13
121	c c c d d Y Y Z Z Z	d d d c d Z Z Z Y Y	d c d c d Z Z Z Z Z	- d d d d - Y Z Z Z	d - d d d Z - Z Z Y	d d d d Z Z Z Z	-	-	-	-	-	-	-	3	3	-	3	18
122	d c d d d Z Y Y Z Z	d d c d d Z Z Z Y Y	d d d d d Y Z Z Z Z	d d d d d Z Z Z Z Z	d c d d d Z Y Z Z Y	- d d d - Y Y Z	-	-	-	-	-	-	-	2	1	-	7	18
123	c c c d d Z Z Z Z Y	d c d d c Y Z Z Z Z	d d - d d Z Y - Y Y	c - c c d Z - Y Z Z	c d d c d Z Z Z Y Y	c - - - Y - - -	-	-	-	-	-	-	-	3	8	-	6	7
124	d d d d d Z Z Z Z Z	c d c - d Y Z Y - Z	d c d c d Z Z Y Y Z	d d c d d Z Z Z Z Y	d c d d c Y Z Z Z Y	d d d - Z Z Z -	-	-	-	-	-	-	-	4	3	-	3	17
125	- c c d d - Z Z Y Z	d d d b c Y Z Z Y Y	d d d d - Y Z Z Y -	d d c d - Z Z Y Z -	d d d d c Z Z Y Z Y	d d d c Y Z Z Y	-	-	-	-	1	-	-	4	2	-	6	13
126	c d - c c Z Z - Z Z	c d c c c Z Z Z Z Z	d d c d c Z Z Y Z Z	d d c d d Z Z Y Z Z	c c d d d Z Z Z Z Z	d d d d Z Z Z Z	-	-	-	-	-	.	-	2	10	-	-	16
127	d c c c c Z Z Z Z Z	d d d d d Y Y Z Z Z	d d c d c Y Z Z Z Y	d d c - c Z Z Y - Z	b c d d d Z Z Y Y Z	- d d c - Z Z Y	-	-	-	-	-	-	-	3	7	-	5	11
128	d c c - d Z Z Z - Z	d c d d d Z Z Z Z Z	d d b c d Z Z Z Z Z	d a c - a Y Z Y - Z	c a d d d Y Z Y Z Z	d d d d Z Z Z Z	-	-	5	-	-	1	-	2	4	-	2	15
129	d d d d - Z Z Z Z -	d c c d d Z Y Z Z Z	d c d d d Z Z Z Z Z	d d d d d Z Z Z Z Z	d c d d d Z Z Z Z Z	d d d d Z Z Z Z	-	-	-	-	-	-	-	1	5	-	-	24
130	b d c d d Y Z Z Z Z	d b - d b Z Z - Z Z	d c d d c Y Z Z Z Z	d d d c d Z Z Z Z Z	b d d b b Y Z Z Y Y	c - d c Z - Z Z	-	-	-	-	3	3	-	-	6	-	1	14
131	b - d - d Y - Y - Z	- c c d d - Z Z Z Z	d d d - c Z Y Z - Z	c d d c b Z Y Z Y Y	b b c c c Y Y Z Z Z	d d d d Z Z Y Z	-	-	-	-	4	-	-	1	7	-	4	9
132	d d - d d Z Z - Y Y	d d d d c Y Z Z Z Z	d c d d d Z Z Z Z Z	d d c - d Z Z Z - Z	d d d d d Z Z Z Z Y	b d c c Y Z Z Z	-	-	-	-	1	-	-	-	5	-	5	16
133	- d d c c - Z Z Y Z	d d d d d Y Z Y Y Z	d - c - d Y - Z - Z	d d d b c Z Z Z Y Y	d c c d d Z Y Y Z Z	c d d c Y Y Z Y	-	-	-	-	1	-	-	6	2	-	5	12
135	- c d d d - Y Z Y Y	d d d d d Z Y Z Z Z	d c d d d Y Y Y Y Z	d c d d d Z Y Y Y Y	d d c c d Y Y X Y Y	c c d d X Y Z Z	-	-	-	-	-	-	2	5	-	-	12	9
136	d d d c c Z Y Z Y Y	d c c d d Z Z Z Z Z	d c c c c Z Y Y Y Z	c d c c d Z Z Y Y Z	d d c c d Y Z Y Y Z	d b d c Y Z Y Z	-	-	-	-	-	1	-	9	5	-	4	10
137	c d c d d Z Z Z Z Z	d d d b d Z Z Z Y Z	d c c c d Z Y Z Z Z	c c c c d Z Y Z Z Z	d c d d d Z Y Z Y Z	c d d d Y Z Z Y	-	-	-	-	1	-	-	4	7	-	2	15
138	d d d d d Y Z Y Z X	d d d d d Z Z Z Z Z	c d d c c Y Z Y Z Y	d d d d d Y Y Z Z Z	d c c c d Z Z Y Y Z	d d d d Z Y Y Z	-	-	-	-	-	-	-	4	2	1	7	15
139	c d c c b Y Z Z Y Y	d b c d b Z Y Z Z Y	d d c c d Z Y Y Y Z	d d b d d Z Z Y Y Z	c c c c d Y Y Y Y Z	c c c c Z Y Z Y	-	-	-	-	4	-	-	10	4	-	2	9
140	c c - d d Y Z - Z Z	c c b c d Z Z Y Z Z	c c d d d Y Z Z Z Y	d c d d c Z Y Z Z Y	d c d b c Z Y Z Y Y	d c - - Z Z - -	-	-	-	-	2	-	-	6	6	-	1	11
141	c c d d d Z Y Z Z Y	c c c c d Z Z Y Z Z	d d d c d Y Z Z X Z	d d d c d Z Z Y Z Y	- c d d d - Z Y Y Z	d d d d Y Y Z Y	-	-	-	-	-	-	1	2	6	-	9	10
							-	-	5	-	20	9	5	104	145	1	135	452

APPENDIX XV (Contd.)

TRAVERSE V

							a			b			c			d		
							X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
142	d d c d d Z Z Y Z Y	d d d b d Z Y Z Y Z	d c c d c Y Z Z Y Y	c d c c d Y Y Y Z Z	d d d d c Z Z Z Z Z	d c d c Z Y Z Z	-	-	-	-	1	-	-	5	5	-	5	13
143	d d c d d Z Z Y Y Y	d c d c d Z Y Z Y Z	d d d d d Y Z Y Z Y	d d d d - Z Y Y Z -	d d d c c Y Y Z Z Y	c c d d Y Z Z Z	-	-	-	-	-	-	-	5	2	-	9	12
144	b d d d d X Y Z Y Z	d c d d d Z Y Z Z Z	b d d d c Y Z Z Z Z	d d b c d Z Z Z Y Z	d d c c d Z Z Y Y Z	d d d d Y Y Z Z	-	-	-	1	1	1	-	4	1	-	4	17
145	d d d d c Z Y Y Z Z	d c d d d Y Z Z Z Z	d d d c d Z Z Z Y Z	d d d d d Y Z Z Z Z	d d - d d Y Z - Y Z	d d d d Z Z Y Y	-	-	-	-	-	-	-	1	2	-	8	17
146	c c d c d Z Z Z Z Z	c d c b d Z Y Z Y Z	c c d d c Y Z Z Z Z	d d d b c Y Y Z Z Z	c c c b d Y Y Z Y Z	d c d c Z Z Z Z	-	-	-	-	2	1	-	3	11	-	3	9
148	c d d d d Y Z Y Y Z	d d d c c Z Z Y Y Z	d c d d d Z Z Y Z Y	d d c c d Z Z Y Z Z	d b d d d Y Y Z Y Z	d c d d Z Z Y Z	-	-	-	-	1	-	1	3	4	-	8	13
149	d c d d d Y Y Z Z Z	d d d d d Y Z Y Z Y	d d c d d Y Z Y Z Z	d d c c d Y Y Z Z Z	c d d d d Z Z Y Y Y	c d b d Z Z YY	-	-	-	-	1	-	-	2	4	-	11	11
150	c d d d d Y Z Z Y Y	d d d c c Z Z Z Y Y	- d c d c - Y Y X Z	d a c d c Z Y Y Y Y	c c c d c Y Y Z Y Y	d c d d Y Z Y Z	-	1	-	-	-	-	-	9	3	1	7	7
151	d d d d d Y Z Z Z Y	d d d d d Z Z Z Z Y	c d d d d X Z Z Z Z	d d d d c Y Y Z Z Z	- b d d c - Y Z Y Z	d c d d Y Y X Z	-	-	-	-	1	-	1	1	2	1	7	15
152	d d d d d Y Z Z Z Y	d d d d c Y Y Y Z Z	d d d d d Z Z Z Z Y	d d d b d Z Y Z Y Z	d d d d - Y Z Z Z -	d d d d Z Z Z Y	-	-	-	-	1	-	-	-	1	-	9	17
153	c d c c d Y Z Y Z Z	b c d d d Y Y Y Z Z	c b b c c Z Y Y Z Y	d c c d d Z Y Y Z Y	b c d a c Y Z Z Y Z	d d d c Y Z X Z	-	1	-	-	4	-	-	6	6	1	3	8
156	d d d d d Z Y Z Y Y	c c b d d X Z X Z Y	d d c d - Z Z Y Z -	c b c c d Y Y Z Y Y	d c c c d Z Z Z Y Y	d d - d Z Z - Z	-	-	-	1	1	-	1	4	4	-	6	10
158	b c d d d Y Y Y Y Y	d d d d d Y Z Y Z Y	d d d b d Y Y Z Y Y	d d d d d Z Y Z Z Z	d d c d d Z Z Y Z Y	d c d d Y Z Y Y	-	-	-	-	2	-	-	2	1	-	14	10
159	c c c d c Z Z Y Z Y	d d d b c Y Z Z Y Z	c c c c d Z Y Y Y Z	c d c c c Z Z X Y Z	d c d c b Z Y Y Y Y	d d c c Y Z Y Z	-	-	-	-	2	-	1	9	7	-	3	7
160	d d d d d Z Z Z Z Z	d c d d d Z Y Z Z Z	d c d d d Z Y Z Y Z	d c d d d Y Z Y Z Z	d c d c d Z Y Y Y Z	d d d c Y Z Y Y	-	-	-	-	-	-	-	5	1	-	6	17
161	d d d d d Z Y Y Y Y	d d d d d Y Z Z Y Z	d c c c c Z Y Y Y Y	d b d d d Z Y Z Z Y	d c d c d Z Z Z Z Y	d d c d Z Z Y Z	-	-	-	-	1	-	-	5	2	-	8	13
162	d d d b d Z Y Z Z Z	d - - c d Z - - Y Z	c c c d c Z Z Y Z Z	d d d - - Z Z Y - -	d d d d d Y Y Z Y Z	d c d d Z Y Z Z	-	-	-	-	-	1	-	3	3	-	5	13
163	d d c d d Z Y Z Z Z	d d c d d Z Z Y Z Z	d d d d c Z Z Z Y Y	d c c d d Y Z Z Z Z	c c d d - Y Y Y Z -	d d d c Y Y Y Z	-	-	-	-	-	-	-	4	4	-	7	13
164	d d c d d Z Y Z Y Z	d c d c d Z Y Y Y Z	c c d c d Y Y Y Y Y	d d c d d Z Z Z Z Z	c d c c c Z Y Y Y Z	d d d d Z Y Y Z	-	-	-	-	-	-	-	7	4	-	8	10
166	c c c d c Z Y Y Z Z	d d d d c Z Z Z Z Z	c d c d c Z Y Z Z Z	d d d d c Z Z Z Z Z	d c d c d Z Y Z Y Y	d d - d Z Y - Z	-	-	-	-	-	-	-	5	6	-	3	14
166	d a d c d Z Y Z Z Z	d d b d d Z Z Y Z Z	c d c c d Z Z Y Y Z	b c c d c Y Z Y Z Y	d d d c d Z Z Z Y Y	- c - d - Y - Y	-	1	-	-	2	-	-	6	3	-	2	13
167	d c d d c Y Z Z Z Y	d c d d c ZZ Z Z Z	d d b d d Z Y Y Z Z	d d d d d Y Z Z Z Y	d b d b d Z Y Z Y Z	d d d - Z Z Z -	-	-	-	-	3	-	-	1	3	-	4	17
168	d c d d d Z Z Z Y Y	c d c c c Z Z Z Z Z	d d d d d Z Z Z Z Z	d d c d d Z Z Z Y Z	c c d c d Z Z Z Z Y	d d b d Z Z Y Z	-	-	-	-	1	-	-	-	9	-	4	15
							-	3	-	2	24	3	3	90	88	3	144	291

'EARLY' OR 'LATE' PLANTS

APPENDIX V

TRAVERSE I

							a L	a E	b L	b E	c L	c E	d L	d E
1	- a b a c	b b a - a	b b - b b	b c a a c	b a c b b	a b d a	6	3	10	2	4	-	1	-
	- L L E L	L E E - E	L L - L L	L L L L L	L L L L L	L E L L								
2	a b b c c	a c d c c	b c b b a	c b c b a	c c c c c	d c c b	-	4	3	5	6	9	2	-
	E L L L L	E E E L E	E L E E E	L E E L E	L E E E E	E E E E								
3	c d a a c	a b a c d	c c c a d	d c c c c	c a a c c	c b d c	-	7	-	2	10	3	2	3
	E E E E E	E E E L E	E E L E L	L L L L L	L E E E L	L E E L								
4	b c a a b	a c b c a	a c b c d	b a c c c	a c b b c	b d a c	-	8	4	4	1	10	1	1
	L E E E L	E E L E E	E E E E E	L E E E E	E L E E E	E L E E								
5	c d d d d	c c c d c	c c c c c	d c c d c	c d c d b	d a c a	-	2	-	1	3	11	6	4
	L E E L L	E E L E E	E E E E E	L E E E E	L L L L E	L E L E								
6	b b a c b	a c c c d	b a b c h	b c d a c	b b b c c	b d a b	-	5	2	10	1	8	2	1
	E E E E E	E E E E L	E E E E E	L E E E E	L E E E L	E L E E								
7	c c a a a	c a a c a	a c b d b	a c c a a	b b b c b	b b c a	-	11	2	6	3	6	1	-
	L E E E E	E E E E E	E L E L E	E E E E E	E E L L L	E E E E								
8	a a c c d	b a d b b	b c d b d	a c d c c	b b b b d	a c c c	-	5	2	7	1	8	3	3
	E E E E E	E E L E L	E L E E L	E E E E E	L E E E L	E E E E								
9	a b a d c	c d a c a	a c c b c	c b a d d	d d a d d	c d b c	-	7	2	2	2	7	2	7
	E E E E E	E E E E E	E L L L E	E L E L L	E E E E E	E E E E								
10	b d c d d	b d d b d	c c b c d	c d b c c	d c d b d	c c d b	-	-	1	6	3	7	5	7
	L L E E E	E E E E L	L E E E L	E E E L L	L E E E L	E E E E								
11	b a d d b	c d c b c	b c b b b	c b b b a	c b d b a	c c a b	-	4	3	10	1	7	1	3
	L E E E E	E L E E L	E E E E E	E E L E E	E E E E E	E E E L								
12	a a d a b	a c d b d	a b a a b	b c a c b	b b d b d	a b b a	1	9	-	11	-	3	2	3
	E E E E E	E E E E E	E E E L E	E E E E E	E E L E L	E E E E								
13	b d c c c	a d c d d	d b d d d	d c c d c	b c c b c	c b d c	-	1	-	5	1	11	8	3
	E E E E E	E L E L L	L E E L E	L E L L E	E E E E E	E E L E								
14	a b b c c	a d b b c	c c d c d	b d c b c	d c b b a	c b a b	-	4	-	10		10	3	2
	E E E E E	E E E E E	E E L E L	E L E E E	E E E E E	E E E E								
15	c a c c a	c c b d d	d c d d c	a a b b c	c c a c c	d d c c	1	4	-	3	6	8	2	5
	L E L E E	E E E E E	E E E E E	E E E E L	E E L L L L	L E L								
16	c c a c d	c a d c c	d c d c c	b c c b d	c c c d c	b d d c	-	2	-	3	-	16	5	3
	E E E E E	E E E E E	L E E E E	E E E E L	E E E L E	E L L E								
17	d d c b c	d d d d c	c c c b c	- b b c c	c c c c c	c b b b	-	-	-	7	-	15	2	4
	E E E E E	L E E L E	E E E E E	- E E E E	E E E E E	E E E E								
19	b c c c c	a c d c d	c c c b b	b b c d c	d c c d a	c b c d	-	2	2	4	2	15	2	4
	L E E E E	E E L E E	L E L E E	E E E L E	E E E E E	E L E E								
20	d a c b b	c c c c d	d d c c b	b b c d c	c c d b d	b c c c	-	1	1	6	8	6	5	2
	E E L L E	E E L E L	L L L L E	E E L L L L L E E L		E E E E								
21	b d b c d	d d d b b	a b c d d	- c d c c	b c c d c	d c d d	-	1	3	3	4	5	9	3
	L L L L L	E L L E L	E E L E L	- E L L E	E E E E L	L E L L								
22	a a c a a	b b b b d	a a c a c	- - - - -	- - - - -	- - - -	2	5	1	3	2	1	-	1
	L L L E E	E L E E E	E E L E E											
23	c a c c a	c b b b b	c c c b b	d c c b c	c c c c b	c c b c	1	1	3	6	4	13	1	-
	E L E E E	E L E E E	E L E E E	L E E L L	E E E E E	L L L E								
24	c a d d d	- b a c c	c c c c b	c c d d c	c c c c d	c c c b	-	2	1	2	2	15	3	3
	E E L L L	- L E E E	L E E E E	L E E E E	E E E E E	E E E E								
26	c d d d d	- d d d a	c d d b d	d c b d b	c c d c c	d c c d	-	1	1	2	3	6	8	7
	E E E E E	- L L L E	E E E E E	L E L L E	E E L L L	L E L L								
27	b a c c c	c c d d c	c c c d c	c c b c d	- d c d a	d d b -	-	2	1	2	15	1	8	-
	E E L L L	L E L L L	L L L L L	L L E L L -	L L L E	L L L -								
28	a b b c a	c b b d d	d d b b d	a c c c b	b b d d d	c c b c	2	1	9	1	7	1	4	4
	L L E E E	L L L L L	E E L L L	E L L L E	L L L E E	L L L L								
29	d d b b d	b c d b d	c d d d c	c c c c d	c b c d d	c c d c	-	-	1	4	2	10	2	10
	E E E E E	L L L E E	E E E E E	E E E E L	L E E E E	E E E E								
30	a a d b c	d d b d d	c c b b b	o b b b c	b b c c c	c b b b	1	1	3	10	3	6	3	2
	E L L E E	L E E L E	E E E E L	L E L L L	E E L E E	E E E E								
32	c c b c d	c c b b a	d b d d c	c c d d d	c c c d c	c c d -	-	1	-	4	6	8	4	5
	L E E L L	L E E E E	L E E E E	E L L L E	E L L E E	E E E -								
34	c c c b d	b b b b d	d d d b d	d - d - d	d d d d b	d d b -	-	-	2	6	-	3	10	5
	E E E E L	E E E L E	E L E L L	L - L - L	L L E E E	L L E -								
35	d c d c d	- b b d d	d c c c a	b b d d d	d c b d d	d d d d	-	1	3	2	4	2	8	8
	E L L L E	- L L L L	L L E L E	L E E L L	L E E E E	E E L E								
36	c h b c b	d d d d d	d d d d d	b d - b d	d c c d d	d d d d	-	-	1	4	3	1	3	16
	E E E L E	E L E E E	E E L E E	L E - E E	L L L E E	E E E E								
							14	95	61	153	107	232	118	119

TRAVERSE II

							a L	a E	b L	b E	c L	c E	d L	d E
37	c d d b c	c c c c c	c c c b c	c c d d c	c c d c c	d - c d	-	-	2	-	17	2	6	1
	L L L L L	L L L E E	L L L L L	L L L L L	L L L L L	L - L E								
38	b b d d c	d c c d d	d c c d d	c d b a a	c d c c d	a c d d	-	3	2	1	2	1	10	3
	E L E L L	L L L L L	L L L L E	E L L E E	L L L L L	E L L E								
39	d d b c c	d b d b a	c b d b a	b a a d d	d c b d d	b c a c	2	3	8	-	6	-	10	-
	L L L L L	L L L L L	L L L L L	L E E L L	L L L L L	L L E L								
41	d b c d c	d d d d d	d d c d c	- d d d d	b c d d d	c c b d	-	-	1	2	5	2	9	9
	L L L L L	E E L E L	E E L L E	- L L L L	E L E E E	L E E E								
42	a c c c d	d b d d c	d d d d d	d d b b c	d d c d c	b c d c	-	1	3	1	6	3	8	7
	E L L L L	E L E L E	E L E L L	L E L E L	E L L E E	L L L E								
43	c c d b a	c d c d c	d d d c c	- d c c c	c d d b d	d c c c	-	1	-	2	9	5	9	2
	E L L E E	L L L L E	L L L L L	- L E L E	E L E E E	L L L L								
44	b b c b d	c c d d c	d d - c b	c d d c c	c d d d b	b c b c	-	-	4	3	6	5	5	5
	E L L L E	L E L L E	E E - L L	E L E L L	L E L L L	E E E E								
45	d c d d d	b c c b c	- d c c d	c c d c d	d a a b b	d a d d	3	-	3	1	7	2	12	-
	L L L L L	L E L L E	- L L L L	L L L L L	L L L L E	L L L L								
47	d c d c a	c c c a b	c c c c c	c d d c c	d d c d d	c d b a	1	2	1	1	10	5	7	2
	L L L L E	L L L L L	E E E L E	E E L L L	L L L L E	L L E E								
48	c d d b a	d d d d d	d d d d c	d d c c d	c c d d b	d c c c	1	0	1	1	3	6	6	11
	L L L E L	E L L L L	E E E E E	E E L E E	E E E E L	E L E E								
49	a b b a d	d c c c b	d d c c c	c d c c c	d b c b d	c c d b	1	1	5	1	9	4	7	1
	L E L E L	L E E L L	E L L L L	L L L L E	L L E L L	L L L L								
50	- c d c d	c d b c d	d d a a d	d d d d c	d d d d d	d c b c	2	-	2	-	7	-	15	2
	- L L L L	L L L L E	L L L L L	L L E L L	L L L L L	L L L L								
51	d b d d c	d d d d c	d d d d d	d d d d d	- d c b d	d c d b	-	-	3	-	3	1	18	3
	L L L E L	L L L L L	L L E E L	L L L L L	- L L L L	L E L L								
52	d d d a d	b d d d d	d b d a d	d d d d b	d d d d d	c c c d	2	-	3	-	2	1	14	7
	E L L L L	L E L L L	L L E L E	E L L L L	L L L E E	L L E L								
53	d c c a b	d c c d d	d c c d d	d d b d d	d - d d c	c a d b	1	1	1	2	4	4	6	9
	L E L L L	E L E L E	E E L L E	L E E E L	L - E E L	E E E E								
54	d d c d c	d d d d d	c d b d c	c c d d d	d d c d b	d d d c	-	-	1	1	5	3	9	10
	L L L L E	L E E L L	L L E E L	L L E E L	E E E E L	E E L E								
55	d c d - -	c d c a b	d c c d d	b - d b d	d d d d b	d d d d	1	-	2	2	-	5	7	9
	E E E - -	E E E L L	L E E L E	E - E L E	L L E L E	L E L E								
56	d d d d d	d d c d c	d d d d d	c d c d d	d d d a d	d d d d	-	1	-	-	4	-	19	5
	L L E E L	L L L L L	L L L L L	L L L L L	E E L E L	E L L L								
57	c a d b b	c b b - b	b b a c b	c c d c c	a c b b c	d c b b	-	3	9	3	8	2	1	2
	L E E E L	L L L - L	L L E L L	E E L L L	E L E L L	E L L E								
59	c c d c b	b c c d d	c - d c d	c a d c d	c d b d c	a d - b	2	0	2	1	5	6	5	5
	E L L E E	L E L E L	L - E L E	E L L L E	E E L L E	L L - L								
60	c c c c d	c d d d c	d c c d d	c d d d d	c d d d -	d d d d	-	-	-	-	8	2	8	10
	E E L L L	L L E L L	E L L E L	L L E E E	L L E L -	E E E L								
61	c c c c d	d d d d d	d c c d d	d d b d c	d d d b c	d c b d	-	-	-	3	3	6	12	5
	E E L L L	L L E L L	L L E E L	L L E E E	E L L E E	L E E E								
62	d c d c d	c d d c d	c d d c d	d d b d d	c b b d c	d b d c	-	-	-	4	1	8	3	13
	E L L E E	E E E E E	E E L E E	E E E E L	E E E E E	E E E E								
63	c c b c d	c d c d d	c d d c c	d d d d c	d b d d b	d d d d	-	-	-	3	1	9	4	13
	E E E E E	E E E E E	E E E E E	E L E E E	E E E L E	L E E L								
64	c d c c -	b b b d c	b d c c b	d d d a c	d d c d -	d a b c	-	2	3	3	5	4	6	4
	E E E L -	E L L L E	E L L L E	E L L E L	E L E L -	E E L L								
65	c d c d d	c c d c d	d c c c d	d d d d b	d d c c d	c d d d	-	-	-	-	4	7	9	8
	E E L E E	L L E E L	L E E E L	E L L E L	L L E E L	L L E E								
66	c d d c d	c d d d c	c c c d d	b b d c d	b a d d a	d d d b	-	2	1	3	-	8	1	14
	E E E E E	E E E E E	E E E E E	E E E E E	E E E E E	E E L L								
67	d b d b d	- c c d d	d d d b b	b a b a b	b d d b b	a d c c	3	-	2	8	4	-	-	11
	E E E E E	- L L E E	E E E E E	E L E L E	E E E L L	L E L L								
69	a - c d d	d d d c d	- a a d d	d d d d c	c c c c d	c d d c	1	2	-	-	4	5	12	3
	E - L L E	L L L E E	- E L L L	L L L L L	E L E E L	E E L L								
70	b c - a b	c d c b d	b c d - d	d c c b d	d d c d d	d c d c	1	-	2	3	5	3	5	16
	E L - L E	L L E L L	E E E - L	E L L L L	E L E E L	E L L L								
71	c d d d d	d d d b d	b d d - d	d d d c c	d d d d d	d c c d	-	-	-	2	-	5	5	21
	E E E E E	E L L E L	E E E - E	L E L E E	E E E E E	E E E E								
72	d d d d d	d d d d d	d d d d d	d d d d d	c b d d d	c d d d	-	-	1	-	1	1		
	E E E E E	E E E L E	E L E E E	E L E E L	E L E E E	L E L E								
							21	22	64	51	160	115	256	216

APPENDIX V (Contd.)

TRAVERSE III

							a		b		c		d	
							L	E	L	E	L	E	L	E
73	b - d d d	b d d d c	b d b d b	c b d c d	c c d c c	d a b d	1	-	6	1	6	1	4	9
	E - E L E	L E E E E	L L L E L	L L E L L	L L E L L	L L E E								
74	c c - d c	d d - b d	c b d c d	d d d d c	c d c c c	d c c b	-	-	-	5	6	6	4	8
	E L - L E	L E - E L	E E E L E	L E E E L	E E L E L	E L E E								
75	d d c c -	d c c d d	c b d a d	d d c b c	d d d d d	d d d b	-	1	-	5	-	7	1	16
	E E E E -	E E E E E	E E E E E	E L E E E	E E E E E	E E E E								
76	d - d d -	c d c d d	d d d d d	d d d d b	d d b d d	d d b d	-	-	1	2	1	1	15	9
	E - L E -	E L E E L	E L L E L	L L L L L	L L E L E	E E E L								
77	c c b c c	d b d c c	d c d b d	d d d d d	d c d b a	b d d c	-	1	2	5	6	5	9	5
	L E L E L	E E L L L	L L L E L	L L E L E	L L E E E	L L E E								
78	d d d d d	d d d d d	d c d d d	c d c d c	d d d d d	d d d d	-	-	-	-	4	-	25	2
	L L L L L	L L L L L	E L L L L	L L L L L	E L L L L	L L L L								
80	d d d d d	d b c d d	d d d d d	a d d d d	c d d d d	d d d c	1	-	1	-	2	1	25	1
	L L L L L	L L E L L	L L L L E	L L L L L	L L L L L	L L L L								
81	d b c c c	c b d c d	c c d c d	d c c b c	b d d d a	d b b d	1	-	6	-	10	1	9	2
	E L L L L	L L L L L	L L L L L	L E L L L	L L L L L	L L L E								
82	d c d d d	c d d d c	d d d d d	a c d d d	d - d d d	d d c d	1	-	-	-	5	2	16	6
	E L L L L	E L E E L	L L L L L	L L L L L	L - L L L	E E E E								
83	d b b d c	d d d d b	d d d d d	c d c c d	d c d d d	d d d d	-	-	1	2	2	2	15	7
	L L E L L	L L E L E	L E L L L	L L E L E	L E E L L	L E E E								
84	b b d d d	c d d c c	d c d b d	b d d d c	d d c b c	d d c d	-	-	5	-	8	-	11	5
	L L L L L	L L L L L	E L E L L	L E L L L	L L L L L	L E L E								
85	c - d d d	b d c c c	c d d c c	c d d d d	d d d d d	d c c d	-	-	1	-	10	-	9	8
	L - L L L	L E L L L	L E L L L	L L L E E	E L L E E	E L L L								
86	b d d d d	d d c c d	c d d c b	d c d b d	d d c c d	d c b d	-	1	-	4	-	8	-	16
	E E E E E	E E E E E	E E E E E	E E E E E	E E E E E	E E E E								
87	d b d - c	d d b d d	d d d d d	c d d b c	b d c c c	a b d d	-	1	4	1	6	-	15	1
	L L L - L	L L L L L	L L L L L	L E L L L	E L L L L	E L L L								
88	d d d c d	- d d - d	d d - d d	d c d d d	d d d d d	d d - d	-	-	-	-	2	-	19	14
	L L L L E	- E E - E	E L - E E	E L E L E	L E L L E	E L - E								
89	d d d d d	d d c c d	d d d d d	d d d d d	b d d - d	d d d d	-	-	1	-	2	-	15	10
	L L L L E	E E L L L	L L L E E	E L E L E	L L L - L	E L E L								
90	c a - d d	d d d d -	c d c d d	d d d d -	d d d d -	d d d d	-	1	-	-	1	2	8	15
	L E - E L	L L E E -	E E E L L	E L E E -	E L L E -	E E E E								
91	d d d d d	d d d d d	d d - - d	d d d d d	d d c c d	c d c d	-	-	-	-	5	1	7	16
	E E L E E	E E E L E	E E - - E	L L E L L	L E E L E	L E L E								
92	c c c c d	d d d d c	c d d d d	d d d d d	d d d d d	c c c d	-	-	-	-	1	8	4	16
	L E E E E	E L E E E	E L E E E	L E E E E	L E E E E	E E E E								
93	d d c d d	c d d c d	d d d c d	d d d d c	d d d d c	d d b c	0	0	1	-	6	1	9	12
	L E L L L	L E E L L	L E L L L	E E E E E	E E E L L	E L L L								
94	d d d d c	c d - d d	c d d c c	d d d c d	d c c d -	d c d -	-	-	-	-	1	8	7	10
	L L E E E	E E - E L	E E E E E	E L E E E	E E L L -	L E L -								
95	d d c d c	c d d c d	d c c d d	d d c d d	c d d d d	d d d d	-	-	-	-	2	6	2	19
	E E L E E	E E E L E	E E E E E	E E E E E	E E E E E	E L L E								
97	d b d d c	d d b d -	b d d c d	c c d a c	d d d c c	b d d d	-	1	-	4	-	7	2	14
	E E E E E	E L E L -	E E E E E	E E E E E	E E E E E	E E E E								
98	d c d b d	d d d - c	d d d d d	d d c d d	d d d d d	d d - -	-	-	-	1	-	5	1	21
	E E L E E	E E E - E	E E E E E	E E E E E	E E E E E	E E - -								
99	d d d c d	- d - a c	d d d d d	- d d c -	c c d c d	d d b -	1	-	-	1	-	6	7	9
	L E E E E	- E - L E	L E L L L	- L L E -	E E E E E	E E E -								
100	d d d d d	d d d d d	d d c d d	d d d c d	d d - c c	d b d d	-	-	-	1	1	5	5	18
	E L E E L	E E E E E	L E E E E	E E E L E	E E - E E	L E E L								
101	d d d d d	d d c d d	d d d d d	c d d d -	c d d d d	d d c c	-	-	-	-	1	4	2	21
	E E L E E	E E E E E	E E E E E	L E E E -	E E L E E	E E E E								
102	d d d d d	d c d d d	d d d d d	d - d d d	d d d d c	d d d d	-	-	-	-	-	2	2	24
	E E E E E	E E E E E	E E E E E	E - E L E	E L E E E	E E E E								
103	d d b - d	c d d d d	- d d c c	d d d d c	d d b b c	d d b c	-	-	-	4	-	6	2	15
	L E E - E	E E E E E	- E E E E	E L E E E	E E E E E	E E E E								
104	d d d d d	c d d c c	d - d d d	d d c d d	d d d d c	d d d d	-	-	-	-	-	5	6	17
	E L L E E	E E E E E	L - E E E	L L E E E	E E L E E	E E E E								
106	c d b d d	d d d c c	d d d d d	d d d d d	d c c c d	c c d d	-	-	1	-	1	7	5	15
	E L L E E	L E E E E	E E E E L	E E E L E	E L E E E	E E L E								
108	- - d d d	d d d d d	d - d d d	b d d d c	d c d d b	d d d c	-	-	1	1	1	2	12	9
	- - E L E	E E L L L	L - L L L	L L L L E	E L E E E	E L E E								
							5	6	31	31	86	103	257	368

APPENDIX V (Contd.)

TRAVERSE IV

							a L	a E	b L	b E	c L	c E	d L	d E
109	d d d d d	c c d d d	- c c c -	c d d - c	c d c d c	d d c d	-	-	-	-	5	6	8	7
	L L L E L	L E E E E	- E L L -	L L L - E	E E L E E	L L E E								
110	d c d d c	c c d d c	c d - c -	- d d c d	d c d c c	d d d d	-	-	-	-	-	11	5	12
	E E E E E	E E E E E	E L - E -	- L E E L	E E E E E	E E E E								
111	d c c d c	d c d d d	d d c c -	- c c d c	d c c c c	d d c d	-	-	-	-	9	5	6	7
	L E E E L	E L E L L	L E E L -	- L L L E	E L L L L	E L E E								
112	d d c d c	d d d d d	d d d c d	- d c d c	d c d d d	c d d d	-	-	-	-	1	6	4	17
	E E L E E	L E E E E	E E E E L	- L E E E	E E E E E	L E L E								
113	- d d c b	d d d d c	c b d c d	d d d d -	d d d d d	- d d -	-	-	-	8	2	2	7	12
	- L E E E	L L E L L	E E E L E	E E E E -	E L L E E	- L E -								
114	d c d d d	c d c d d	d c - d d	d d d d d	d d - d d	d d d d	-	-	-	-	2	2	6	17
	E L L L E	E L E E E	E L - E E	E E E E E	L E - E E	L E E L								
115	d d d d d	d c d b -	d d d d d	- d d d c	d d d d d	d d d d	-	-	1	-	2	-	17	7
	L E E LE	L E L L -	E L L E L	- L L L L	L L L L L	L E L E								
116	c d d d d	d d d d d	c d d d c	d d d d d	d d c d d	d d d d	-	-	-	-	4	-	21	4
	L E L L L	E L L L L	L L L L L	L L L L L	L L L E L	L L L E								
117	d d - d d	d d d d d	d d d d d	d d d d d	c d d d b	c d d c	-	-	-	1	-	5	6	18
	L E - E E	E L L E E	E E L E E	E L L E E	E E E E E	E E E E								
118	d d c c c	d c d d d	c c d d c	- d d d d	d d c d c	d d c d	-	-	-	-	9	1	17	1
	L EL E L	L L L L L	L L L L L	- L L L L	L L L L L	L L L L								
119	d d d d d	d d d d -	c c d d d	d c c d d	c d d c d	c d d d	-	-	-	-	4	5	15	6
	L EL E E	L L L L -	L L L L L	L L L E E	E E L E L	E L L L								
120	c c b d c	c d d d c	d d d b d	c d d d -	c c c d d	d d c d	-	-	2	-	10	-	15	-
	L L L L L	L L L L L	L L L L L	L L L L -	L L L L L	L L L L								
121	c c c d d	d d d c d	d c d c d	- d d d d	d - d d d	d d d d	-	-	-	-	5	1	17	4
	L L L L L	L E L L L	L E L L E	- L L L L	E - L L L	L L L E								
122	d c d d d	d d c d d	d d d d d	d d d d d	d c d d d	- d d d	-	-	-	-	2	1	20	5
	L L L L E	L L L L L	L E L E E	L L L E L	L E L L L	- L L L								
123	c c c d d	d c d d c	d d - d d	c - c c d	c d d c d	c - - -	-	-	-	-	9	2	11	2
	L L L L L	E L L L L	L E - L L	L - E L L	L L L E L	L - - -								
124	d d d d d	c d c - d	d c d c d	d d c d d	d c d d c	d d d -	-	-	-	-	2	5	1	19
	E E E E E	L E E - E	E E E E E	E E E E L	E E E E L	E E E -								
125	- c c d d	d d d b c	d d d d -	d d c d -	d d d d c	d d d c	-	-	-	1	3	5	6	15
	- E L EE	L L E E E	E E L L -	E E L E -	EE E L E	E L E L								
126	c d - c c	c d c c c	d d c d c	d d c d d	c c d d d	d d d d	-	-	-	-	8	4	10	6
	L E - L L	L E L E L	L L E E E	E L E E L	L L L L L	L L L E								
127	d c c c c	d d d d d	d d c d c	d d c - c	b c d d d	- d d c	-	-	1	-	7	5	12	4
	E E E L L	L E L E L	L L L L L	L L L - L	L L L L L	- L E E								
128	d c c - d	d c d d d	d d b c d	d a c - a	c a d d d	d d d d	-	5	1	-	4	2	17	-
	L L E - L	L L L L L	L L L E L	L L L - L	L L L L L	L L L L								
129	d d d d -	d c c d d	d c d d d	d d d d d	d c d d d	d d d d	-	-	-	-	1	5	8	16
	E E E E -	E L L E E	L E L L E	E L E L E	E E L E E	E E E L								
130	b d c d d	d b - d b	d c d d c	d d d c d	b d d b b	c - d c	-	-	6	-	5	1	14	1
	L L L L L	L L - L L	L L L L L	L L L L L	L L L L L	L - E L								
131	b - d - d	- c c d d	d d d - c	c d d c b	b b c c c	d d d d	-	-	5	1	4	4	7	6
	E - L - L	- E L E E	E L L - L	L E L E L	L L E E L	L L E L								
132	d d - d d	d d d d c	d c d d d	d d c - d	d d d d d	b d c c	-	-	1	-	5	2	15	6
	E E - L L	L L L L L	L E E L L	L L E - E	L L E E L	L L L L								
133	- d d c c	d d d d d	d - c - d	d d d b c	d c c d d	c d d c	-	-	1	-	6	2	5	12
	- E E E E	E E E E L	E - E - E	L L E L L	E L L E E	E L L L								
135	- c d d d	d d d d d	d c d d d	d c d d d	d d c c d	c c d d	-	-	-	-	6	1	15	6
	- E E E L	L L E E E	L E L L L	L L E L L	L L E L L	L L E L								
136	d d d c c	d c c d d	d c c c c	c d c c d	d d c c d	d b d c	-	-	-	1	7	7	9	5
	E L L E E	E L E L L	E L L E L	L L L L L	L L L E E	E L E E								
137	c d c d d	d d d b d	d c c c d	c c c c d	d c d d d	c d d d	-	-	1	-	8	5	15	2
	L L L L L	L L L L L	L L L L L	L L L L L	L L L L L	L L L L								
138	d d d d d	d d d d d	c d d c c	d d d d d	d c c c d	d d d d	-	-	-	-	5	5	9	14
	L L L L L	L L L L L	E L E L L	L L L L L	L E E E L	L L L L								
139	c d c c b	d b c d b	d d c c d	d d b d d	c c c c d	c c c c	-	-	-	4	6	8	7	4
	L L L E E	L L L L E	E L E E L	L L E L E	E E L E L	E E L E								
140	c c - d d	c c b c d	c c d d d	d c d d c	d c d b c	d c - -	-	-	1	1	8	4	2	10
	L L - E L	L E L E L	E E L L L	L L L L E	L E E E L	L E - -								
141	c c d d d	c c c c d	d d d c d	d d d c d	- c d d d	d d d d	-	-	-	-	5	6	5	14
	E E L L L	E E E E L	L L L E L	L L L E L	- E L L L	L L L L								
							-	5	18	11	148	104	331	257

APPENDIX V (Contd.)

TRAVERSE V

							a		b		c		d	
							L	E	L	E	L	E	L	E
142	d d c d d	d d d b d	d c c d c	c d c c d	d d d d c	d c d c	-	-		1	5	5	5	13
	E E E E E	L L L E E	L L L E L	E E E E E	E L E E L	E E E L								
143	d d c d d	d c d c d	d d d d d	d d d d -	d d d c c	c c d d	-	-	-	-	7	-	18	5
	L E L E L	L L L L E	L L L L L	L L L L -	L L L L L	L L L L								
144	b d d d d	d c d d d	b d d d c	d d b c d	d d c c d	d d d d	-	-	1	2	4	1	12	9
	L L L L E	L L E L L	E E L E L	L L E E E	E E L L L	L L E E								
145	d d d d c	d c d d d	d d d c d	d d d d d	d d - d d	d d d d	-	-	-	-	1	2	15	10
	L E L L E	L L L L E	E E L E L	L L E E E	E E - L L	E L L L								
146	c c d c d	c d c b d	c c d d c	d d d b c	c c c b d	d c d c	-	-	-	3	2	12	-	12
	L L E E E	E E E E E	E E E E E	E E E E E	E E E E E	E E E E								
148	c d d d d	d d d c c	d c d d d	d d c c d	d b d d d	d c d d	-	-	1	-	6	1	14	7
	E L L L E	E L E L L	L L E L L	L E L L L	E L L L E	L L L L								
149	d c d d d	d d d d d	d d c d d	d d c c d	c d d d d	c d b d	-	-	-	1	4	2	14	8
	E L L L L	L L E E E	L L E L L	E L L E L	L L L E L	L E E E								
150	c d d d d	d d d c c	- d c d c	d a c d c	c c c d c	d c d d	1	-	-	-	7	5	11	4
	L L L L L	L L E L E	- L E E L	L L L E E	L E E L L	L L L E								
151	d d d d d	d d d d d	c d d d d	d d d d c	- b d d c	d c d d	-	-	1	-	3	1	15	8
	L E E L L	E L L E L	L L E E L	E L L L E	- L L L L	L L E L								
152	d d d d d	d d d d c	d d d d d	d d d b d	d d d d -	d d d d	-	-	-	1	1	-	19	7
	L L L E L	E L L L L	E E L L L	L L E E E	L L L L -	E L L L								
153	c d c c d	b c d d d	c b b c c	d c c d d	b c d a c	d d d c	1	-	-	4	3	9	3	9
	E E E E E	E E E L E	L E E E E	L E L E E	E L L L E	E E E E								
156	d d d d d	c c b d d	d d c d -	c b c c d	d c c c d	d d - d	-	-	1	1	7	2	14	2
	L L L L L	L L L E L	L L L L -	L E E L L	L L L E L	E L - L								
158	b c d d d	d d d d d	d d d b d	d d d d d	d d c d d	d c d d	-	-	-	2	1	2	4	20
	E L E L E	E L L E E	E E E E E	L E E E E	E E E E E	E E E E								
159	c c c d c	d d d b c	c c c c d	c d c c c	d c d c b	d d c c	-	-	1	1	11	6	9	1
	E L E L E	L L L L E	L L E L L	L L L L L	L L E E E	L L L L								
160	d d d d d	d c d d d	d c d d d	d c d d d	d c d c d	d d d c	-	-	-	-	2	4	8	15
	E L L L E	E E L E E	E L E E E	L E L E E	E E E E E	L L E L								
161	d d d d d	d d d d d	d c c c c	d b d d d	d c d c d	d d c d	-	-	-	1	5	2	16	5
	L E E L L	L L L L L	E L L L L	L E L L L	L E E E L	E L L L								
162	d d d b d	d - - c d	c c c d c	d d d - -	d d d d d	d c d d	-	-	1	-	5	1	11	7
	L E E L L	L - - L L	L L L L L	L L E - -	L L L L E	E E E E								
163	d d c d d	d d c d d	d d d d c	d c c d d	c c d d -	d d d c	-	-	-	-	4	4	5	15
	L L L L L	E L E E L	L L E L E	E L E L L	E E L E -	E L L L								
164	d d c d d	d c d c d	c c d c d	d d c d d	c d c c c	d d d d	-	-	-	-	-	11	-	18
	E E E E E	E E E E E	E E E E E	E E E E E	E E E E E	E E E E								
166	c c c d c	d d d d c	c d c d c	d d d d c	d c d c d	d d - d	-	-	-	-	4	7	7	10
	L E E L E	E E L E L	E L L E E	E E E E E	L L E E L	L E - L								
166	d a d c d	d d b d d	c d c c d	b c c d c	d d d c d	- c - d	-	1	1	1	7	2	15	-
	L E L L L	L L L L L	E L E L L	E L L L L	L L L L L	- L - L								
167	d c d d c	d c d d c	d d b d d	d d d d d	d b d b d	d d d -	-	-	1	2	4	-	19	2
	E L L L L	L L L E L	L L E L L	L L L L L	L L L E L	L L L -								
168	d c d d d	c d c c c	d d d d d	d d c d d	c c d c d	d d b d	-	-	-	1	5	4	12	7
	L L L L L	E L E E L	E E L L E	E L E E L	L L E L L	L L E E								
							2	1	8	21	98	83	246	192

RUST INFECTION

APPENDIX VI

TRAVERSE I

							a	b	c	d
1	- a b a c	b b a - a	b b - b b	b c a a c	b a c b b	a b d a	27	51	17	5
	- 5 4 5 4	5 4 5 - 5	5 5 - 5 5	5 5 5 2 5	5 4 5 5 5	5 5 5 5				
2	a b b c c	a c d c c	b c b b a	c b c b a	c c c c c	d c c b	20	56	69	8
	5 4 4 5 5	5 5 5 5 5	5 5 5 5 5	5 5 5 5 5	4 4 5 4 4	5 5 5 5				
3	c d a a c	a b a c d	c c c a d	d c c c c	c a a c c	c b d c	24	5	52	20
	4 4 5 5 4	5 5 5 5 5	4 1 5 4 5	4 4 2 5 5	2 5 5 1 2	5 2 2 5				
4	b c a a b	a c b c a	a c b c d	b a c c c	a c b b c	b d a c	30	55	45	9
	5 5 5 5 4	5 5 5 5 5	5 5 5 4 5	4 2 4 4 5	5 4 4 4 4	4 4 4 4				
5	c d d d d	c c c d c	c c c c c	d c c d c	c d c d b	d a c a	6	2	47	55
	5 5 5 5 5	5 2 5 5 4	2 2 5 5 4	5 5 5 5 1	2 1 4 5 2	4 5 5 5				
6	b b a c b	a c c c d	b a b c b	b c d a c	b b b c c	b d a b	15	56	55	9
	5 5 5 5 2	5 5 5 5 2	5 5 4 4 5	5 2 2 5 4	2 5 4 4 5	5 5 5 5				
7	c c a a a	c a a c a	a c b d b	a c c a a	b b b c b	b b c a	54	26	37	4
	5 4 4 2 2	4 5 5 5 5	5 5 2 4 4	5 5 5 5 4	4 4 2 5 5	5 4 1 4				
8	a a c c d	b a d b b	b c d b d	a c d c c	b b b b d	a c c c	24	35	55	25
	4 5 5 4 4	5 5 4 5 5	5 5 5 5 5	5 4 2 5 5	5 5 4 4 5	5 5 5 5				
9	a b a d c	c d a c a	a c c b c	c b a d d	d d a d d	c d b c	31	14	59	41
	5 5 5 5 5	4 5 5 4 5	4 4 4 2 4	4 4 5 5 5	5 4 4 5 5	5 4 5 5				
10	b d c d d	b d d b d	c c b c d	c d b c c	d c d b d	c c d b	-	30	42	55
	4 5 5 5 4	5 5 5 4 4	5 4 5 5 5	5 4 4 4 4	5 5 5 4 5	2 5 5 4				
11	b a d d b	c d c b c	b c b b b	c b b b a	c b d b a	c c a b	15	58	54	16
	5 5 5 5 5	4 4 5 5 5	5 5 4 4 4	5 5 4 5 2	5 5 2 5 5	4 5 5 4				
12	a a d a b	a c d b d	a b a a b	b c a c b	b b d b d	a b b a	31	45	15	21
	5 5 5 5 5	4 5 5 5 5	5 5 5 5 5	4 4 1 4 4	4 5 5 5 5	5 5 4 5				
13	b d c c c	a d c d d	d b d d d	d c c d c	b c c b c	c b d c	5	17	51	45
	5 4 5 4 5	5 4 4 4 4	5 5 5 2 2	5 5 4 5 5	4 5 5 2 5	5 5 5 5				
14	a b b c c	a d b b c	c c d c d	b d c b c	d c b b a	c b a b	17	43	40	19
	4 4 4 5 5	5 4 5 4 2	2 5 4 4 4	4 5 5 4 5	4 5 4 4 4	4 5 4 5				
15	c a c c a	c c b d d	d c d d c	a a b b c	c c a c c	d d c c	17	9	45	25
	2 5 4 5 5	2 5 5 5 5	5 4 5 5 4	5 5 5 5 2	5 4 5 2 5	5 5 5 4				
16	c c a c d	c a d c c	d c d c c	b c c b d	c c c d c	b d d c	7	11	54	34
	4 4 4 4 5	5 5 4 4 4	4 4 5 5 5	5 1 5 5 4	5 5 5 5 5	5 5 4 5				
17	d d c b c	d d d d c	c c c b c	- b b c c	c c c c c	c b b b	-	21	46	18
	5 4 5 5 5	5 5 5 2 5	5 4 5 5 5	- 5 2 5 2	2 2 4 1 4	2 2 5 5				
19	b c c c c	a c d c d	c c c b b	b b c d c	d c c d a	c b c d	8	25	58	25
	4 5 5 5 5	4 4 5 4 5	4 4 5 4 4	5 5 5 5 4	4 5 5 5 4	5 5 5 5				
20	d a c b b	c c c c d	d d c c b	b b c d c	c c d b d	b c c c	4	21	43	25
	5 4 5 5 5	5 5 4 5 4	4 5 5 5 5	5 5 5 5 4	5 5 4 4 2	2 5 5 2				
21	b d b c d	d d d b b	a b c d d	- c d c c	b c c d c	d c d d	5	31	56	47
	4 4 4 5 5	5 5 5 4 2	5 4 4 5 5	- 5 5 5 5	5 5 4 5 5	4 4 5 4				
22	a a c a a	b b b b d	a a c a c	- - - - -	- - - - -	- - - -	23	15	8	5
	4 5 5 4 4	5 5 4 5 5	5 5 5 5 2							
23				d c c b c	c c c c b	c c b c	7	35	76	5
24	5 4 5 4 5	4 5 4 4 4	5 5 5 5 5	5 5 5 2 4	4 5 5 4 5	4 4 5 5				
	e a d d d	- b a e e	e e e e b	e e d d e	e e e e d	e e e b				
26	5 4 5 5 5	- 5 5 5 5	5 5 1 5 5	5 1 5 5 5	5 3 5 5 5	5 5 5 5	9	11	59	25
27	5 5 5 5 5	- 5 4 4 5	5 5 5 4 5	5 5 5 5 5	5 5 5 5 5	5 4 5 5	3	12	58	65
28	5 5 4 5 5	5 4 5 5 5	5 5 4 5 5	5 5 5 5 5	- 5 4 5 5	5 5 5 -	10	15	64	58
29	4 5 5 1 5	4 4 5 4 4	4 5 5 5 5	4 5 5 4 5	5 4 4 4 4	4 5 5 5	13	44	31	55
30	4 5 5 5 5	4 5 4 5 4	4 5 5 5 5	5 5 5 5 5	5 4 5 5 5	4 5 5 5	-	25	54	55
32	4 5 5 5 5	5 5 5 5 5	4 5 4 4 5	4 5 5 5 4	4 5 5 4 4	4 5 5 5	7	54	59	21
34	5 5 4 4 4	5 5 4 4 4	5 4 5 5 5	5 5 4 4 4	5 5 5 5 5	5 4 5 -	4	16	55	59
35	5 5 4 4 5	- 5 5 5 5	5 5 5 5 5	4 - 5 - 4	5 5 5 5 4	5 5 5 -	-	24	10	41
36	5 5 4 2 2	- 5 5 4 5	5 5 5 5 5	2 1 - 5 5	2 2 5 4 5	5 4 4 4	3	14	18	54
	4 5 2 5 5	2 5 5 5 5	5 5 5 2 2	5 1 - 5 2	4 5 5 2 5	5 4 5 5	Σ -	18	17	60
							402	812	1239	910
							3.6	3.7	3.8	3.8

TRAVERSE II							a	b	c	d
	5 4 5 3 5	5 5 5 5 5	5 5 5 5 5	5 5 5 5 5	5 4 5 5 5	5 – 5 5		8	60	26
37	c3 d5 d3 b5 c4	c4 c5 c5 c5 c4	c4 c2 c5 b5 c5	c5 c5 d4 d5 c4	c4 c4 d4 c4 c3	d4 –3 c4 d4	15	9	35	46
38	b5 b4 d5 d4 c4	d4 c4 c5 d5 d4	d4 c4 c5 d4 d5	c5 d5 b5 a5 a5	c5 d5 c5 c4 d5	a5 c3 d5 d5	16	31	25	41
39	d5 d5 b5 c4 c5	d5 b4 d4 b5 a4	c5 b4 d4 b5 a5	b– a5 a5 d5 d4	d4 c4 b4 d4 d5	b5 c4 a2 c4	–	9	26	69
41	d4 b5 c3 d5 c3	d5 d5 d5 d4 d4	d5 d4 c5 d4 c5	–4 d4 d4 d5 d5	b5 c5 d5 d5 d4	c5 c5 b5 d5	4	16	37	56
42	a4 c5 c5 c4 d4	d4 b5 d5 d5 c5	d4 d5 d5 d5 d4	d– d4 b5 b5 c5	d5 d4 c5 d4 c5	b5 c5 d2 c5	4	8	60	46
43	c5 c5 d4 b4 a4	c4 d4 c4 d5 c5	d4 d5 d– c4 c4	–5 d4 c5 c5 c4	c5 d4 d4 b5 d4	d4 c4 c4 c4	–	20	46	40
44	b5 b5 c3 b5 d4	c4 c5 d3 d5 c4	d– d4 –5 d5 b5	d5 d5 d5 d5 c4	c5 d5 d5 d5 b5	b5 c5 b5 c4	11	15	33	48
45	d5 c4 d3 d3 d5	b5 c3 c2 b4 c4	–5 d5 c5 c5 d4	d4 d5 d5 d5 d5	d5 a4 a5 b5 b5	d4 a4 d4 d5	12	8	49	33
47	d4 c4 d4 c5 a5	c5 c5 c4 a5 b5	c5 c5 c4 c4 c4	c4 d5 d5 c5 c4	d5 d5 c5 d5 d5	c5 d5 b2 a4	5	6	35	70
48	c4 d4 d3 b1 a5	d5 d4 d4 d5 d2	d5 d5 d5 d5 c5	d5 d4 c4 c5 d5	c4 c5 d4 d4 b4	d5 c5 c5 c3	5	21	53	53
49	a– b5 b3 a5 d4	d4 c5 c5 c5 b5	d5 d5 c4 c5 c4	c5 d5 d4 c4 c5	d5 b5 c4 b5 d5	c5 c5 d5 b4	9	8	29	74
50	–5 c5 d3 c3 d5	c5 d5 b3 c5 d5	d5 d5 a4 a5 d5	d5 d5 d5 d4 c5	c4 d4 c5 d5 d5	c5 c5 b5 c3	–	11	16	84
51	d4 b4 d4 d5 c4	d4 d5 d5 d4 c5	d5 d4 d5 d4 d4	d4 d5 d5 d5 d5	–5 d4 d5 d5 d4	d5 c5 d5 b5	9	15	15	91
52	d4 d2 d3 a5 d5	b5 d3 d3 d4 d5	d4 b4 d5 a5 d5	d4 d5 d5 d5 b	d4 d– d5 d5 d5	c5 c5 c5 d4	6	7	26	58
53	d3 c3 c3 a4 b3	d3 c3 c3 d4 d3	d4 c4 c5 d5 d3	d5 d4 b5 d5 d3	[illegible]	[illegible] b	–	10	29	60
54	d3 d5 c5 d– c–	d3 d5 d4 d5 d3	c5 d4 b5 d3 c3	c5 c– d5 d5 d5	d4 d4 d5 d4 b5	d4 d5 d4 c3	3	12	18	61
55	d5 c4 d3 –5 –4	c5 d5 c4 a4 b4	d5 c5 c5 d5 d5	b5 –5 d4 d5 d5	d5 d4 d5 d5 b5	d5 d5 d5 c5	5	–	17	112
56	d4 d3 d4 d3 d3	d3 d4 c3 d– c3	d5 d4 d4 d3 d5	c5 d4 c5 d4 d4	d4 d5 d5 a2 d5	d5 d4 d4 d5	11	40	35	12
57	c5 a5 d3 b3 b4	c5 b4 b4 –2 b3	b5 b– d5 c2 b4	c4 c5 d5 c5 c5	a4 c5 b5 b5 c5	d3 c4 b– b2	8	16	40	40
59	c3 c4 d4 c3 b4	b5 c5 c5 d5 d5	c3 –5 d5 c4 d5	c5 a5 d5 c5 d5	c5 d5 b5 d4 c–	a4 d5 –5 b5	–	–	38	66
60	c4 c4 c5 c5 d3	c5 d4 d5 d4 c5	d4 c5 c5 d4 d5	c5 d5 d5 d4 d5	c5 d5 d3 d4 4–	d4 d5 d4 d5	–	15	40	75
61	c5 c4 c5 c5 d4	d5 d5 d5 d5 d5	d5 c5 c5 d5 d4	d5 d4 b4 d4 c5	d5 d5 d5 b4 c5	d5 c5 b4 d5	–	19	40	72
62	d4 c4 d5 c3 d5	c5 d4 d4 c5 d5	c5 d4 d5 c2 d5	d4 d4 b5 d5 d5	c4 b3 b3 d5 c5	d5 b5 d4 c5	–	18	27	78
63	c3 c5 b4 c4 d–	c5 d5 c5 d5 d5	c5 d5 d5 c5 c3	d5 d5 d5 d5 c5	d3 b5 d5 d4 b–	d5 d5 d5 d5	10	26	41	47
64	c5 d4 c3 c3 –3	b3 b3 b3 d5 c5	b5 d4 c3 c3 b4	d5 d2 d3 a3 c5	d5 d3 c5 d3 –5	d4 a5 b5 c3	–	5	37	64
65	c5 d5 c4 d5 d4	c5 c d5 c5 d4	d4 c5 c5 c5 d3	d3 d3 d5 d5 b5	d3 d4 c5 c5 d5	c5 d3 d5 d2	9	11	36	64
66	c3 d3 d3 c3 d3	c– d3 d d3 c3	c5 c4 c5 d5 d4	b4 b5 d4 c5 d3	b5 a4 d4 d4 a4	d5 d5 d4 b4	15	57	20	40
67	d5 b– d4 b5 d3	–5 c5 c5 d5 d5	d– d5 d5 b5 b4	b4 a4 b4 a5 b5	b5 d5 d5 b4 b4	a4 d4 c5 c5	15	–	40	69
69	a5 –5 c– d5 d5	d5 d5 d4 c4 d5	–3 a5 a5 d– d4	d3 d5 d3 d5 c5	c5 c5 c5 c5 d5	c5 d5 d4 c5	5	22	35	61
70	b2 c5 –5 a b5	c4 d3 c5 b5 d3	b5 c3 d3 – d4	d3 c5 c4 b3 d3	d4 d5 c5 d5 d5	d5 c5 d4 c5	–	8	17	77
71	c5 d4 d4 d3 d4	d3 d5 d3 b4 d5	b4 d3 d4 –5 d3	d5 d4 d5 c5 c5	d5 d5 d3 d5 d4	d4 c5 c5 d5	–	5	9	100
72	d d d d d	d d d d d	d d d d d	d d d d d	c b d d d	c d d	175	451	1069	1911
							~~4.0~~	5.7	5.9	4.0

TRAVERSE III

APPENDIX VI (Contd.)

No.	Entries	a	b	c	d
73	b - d d d b d d d c b d b d b c b d c d c c d c c d a b d				
	5 - 5 5 5 4 4 4 4 3 5 1 5 5 2 5 5 5 5 5 5 5 5 4 5 5 5 5 5	5	25	26	48
74	c c - d c d d - b d c b d c d d d d d c c d c c c d c c b				
	5 5 - 4 5 5 5 - 4 4 4 4 4 5 5 5 4 5 5 5 5 5 5 5 5 5 5 5 5	-	15	47	50
75	d d c c - d c c d d c b d a d d d c b c d d d d d d d d b				
	5 5 5 5 - 5 5 5 4 5 5 4 5 5 5 5 4 4 4 4 4 5 5 4 4 5 5 4 4	5	12	28	79
76	d - d d - c d c d d d d d d d d d d d b d d b d d d d b d				
	5 - 5 5 - 5 5 5 4 5 5 4 5 5 5 5 5 5 5 5 5 5 5 4 5 4 5 5 4	-	15	8	95
77	c c b c c d b d c c d c d b d d d d d d d c d b d b d d c				
	4 2 5 5 4 5 5 5 5 4 4 5 4 5 5 4 4 4 5 5 4 5 5 4 5 5 4 5 5	5	21	39	65
78	d d d d d d d d d d d c d d d c d c d c d d d d d d d d d				
	5 5 4 4 5 5 5 5 5 4 5 5 5 5 5 5 1 5 5 4 5 5 5 5 5 5 5 4 5	-	-	19	117
80	d d d d d d b c d d d d d d d a d d d d c d d d d d d d c				
	5 5 5 4 5 4 4 3 4 4 5 5 5 5 5 4 5 5 4 5 5 5 4 4 5 5 5 5 4	4	4	12	105
81	d b c c c c b d c d c c d c d d c c b c b d d d a d b b d				
	4 4 4 5 4 4 4 4 5 2 5 2 4 5 4 5 4 5 5 4 5 4 5 5 5 4 5 4 5	5	25	43	44
82	d c d d d c d d d c d d d d d a c d d d d - d d d d d c d				
	5 5 4 5 5 5 4 4 2 5 5 4 4 5 5 5 4 4 5 4 5 - 5 5 5 4 5 4 5	5	-	25	95
83	d b b d c d d d d b d d d d d c d c c d d c d d d d d d d				
	5 5 4 5 5 5 5 5 5 5 5 5 4 4 5 5 5 5 5 4 5 4 3 4 4 4 5 3 4	-	12	174	99
84	b b d d d c d d c c d c d b d b d d d c d d c b c d d c d				
	5 5 4 5 5 4 5 4 4 4 5 5 5 5 4 5 4 5 4 5 5 4 2 5 5 5 5 4 5	-	24	55	70
85	c - d d d b d c c c c d d c c c d d d d d d d d d d c c d				
	5 - 5 5 5 5 3 4 5 4 5 5 5 5 3 4 5 5 5 5 5 4 5 5 5 5 5 5 5	-	5	45	78
86	b d d d d d d c c d c d d c b d c d b d d d c c d d c b d				
	4 4 5 5 4 4 5 4 5 5 4 4 5 5 4 5 4 5 5 4 4 5 5 4 5 5 4 5 5	3	18	31	72
87	d b d - c d d b d d d d d d d c d d b c b d c c c a b d d				
	4 4 4 - 4 4 4 4 4 4 5 5 5 4 5 4 4 5 4 5 5 5 5 5 4 4 4 - 5	4	21	25	72
88	d d d c d - d d - d d d - d d d c d d d d d d d d d d - d				
	3 2 4 3 4 - 3 3 - 3 3 5 - 5 2 2 3 5 4 3 3 5 5 - 4 2 4 - 5	-	-	6	75
89	d d d d d d d c c d d d d d d d d d d d b d d - d d d d d				
	3 2 5 5 5 5 3 5 5 5 5 4 5 2 4 5 5 4 4 5 5 5 5 - 5 5 5 5 4	-	5	8	102
90	c a - d d d d d d - c d c d d d d d d - d d d d - d d d d				
	5 5 - 4 5 4 4 4 4 - 4 5 4 5 5 5 4 4 2 - 5 5 4 5 - 5 3 3 3	31	-	11	77
91	d d d d d d d d d d d d - - d d d d d d d d c c d c d d d				
	5 5 3 4 5 5 5 5 4 5 5 4 - - 5 5 5 5 3 4 4 4 4 5 5 5 5 5 5	-	-	17	99
92	c c c c d d d d d c c d d d d d d d d d d d d d d d d d d				
	5 5 4 4 4 5 4 5 4 4 4 4 4 5 5 5 5 4 5 4 4 5 5 5 4 5 5 4 4	-	-	34	80
93	d d c d d c d d c d d d d c d d d d d c d d d d c d d b d				
	4 2 4 4 4 44 544 4 4 4 5 4 5 4 4 4 5 5 5 5 5 4 5 4 4 5	-	4	25	35
94	d d d d c c d - d d c d d c c d d d c d d c c d - d c d d				
	5 4 4 4 5 4 4 - 5 5 4 4 2 5 4 4 5 2 4 5 5 4 4 4 - 5 5 5 -	-	-	37	56
95	d d c d c c d d c d d c c d d d d c d d c d d d d d d d d				
	5 5 4 5 5 4 5 4 5 5 5 5 5 5 4 5 5 5 5 5 4 5 5 5 5 5 5 4 5	-	-	37	98
97	d b d d c d d b d - b d d c d c c d a c d d d c c b d d d				
	5 4 4 5 4 5 5 4 5 - 5 4 5 4 5 5 5 5 5 5 5 5 5 4 4 5 4 2 4	5	18	31	71
98	d c d b d d d d - c d d d d d d d c d d d d d d d d d d d				
	5 5 5 5 5 5 4 5 - 4 5 5 4 5 4 5 4 4 4 5 5 5 4 5 4 4 4 - -	-	5	11	89
99	d d d c d - d - a c d d d d d - d d c - c c d c d d d b -				
	4 5 5 5 5 - 5 - 5 5 5 5 5 4 5 - 5 5 5 - 4 5 5 5 5 5 5 4 -	5	4	29	78
100	d d d d d d d d d d d d c d d d d d c d d d - c c d b d a				
	5 5 5 4 5 4 5 5 5 5 5 5 5 4 5 5 4 4 5 5 4 4 - 5 5 4 4 5 5	-	4	20	105
101	d d d d d d d c d d d d d d d c d d d - c d d d d d d d d				
	5 5 5 4 5 5 5 5 5 5 5 4 4 5 5 5 5 5 5 - 5 5 5 5 5 5 4 5 4	-	-	24	107
102	d d d d d d c d d d d d d d d d - d d d d d d d c d d d d				
	5 4 5 5 4 5 5 5 5 5 5 4 5 5 5 5 - 5 5 5 4 5 5 5 5 4 5 5 4	-	-	10	122
103	d d b - d c d d d d - d d c c d d d d c d d b b c d d b c				
	5 5 4 - 5 5 4 5 5 5 - 4 5 5 4 4 5 5 5 5 5 5 4 5 5 5 5 4 5	-	17	29	80
104	d d d d d c d d c c d - d d d d d c d d d d d d c d d d d				
	5 5 5 5 5 4 4 5 5 4 5 - 5 5 5 4 5 5 5 5 5 4 5 4 4 5 5 5 5	-	-	20	106
106	c d b d d d d d c c d d d d d d d d d d d c c c d c c d d				
	5 5 5 4 4 5 5 5 5 5 5 5 5 5 5 5 5 4 5 5 2 5 5 5 4 5 4 5 5	-	5	39	77
108	- - d d d d d d d d d - d d d b d d d c d c d d b d d d c				
	- - 4 4 5 5 5 5 5 5 4 - 4 4 4 4 5 5 5 5 4 3 4 5 5 5 4 4 4	-	9	92	95
		47	285	797	2673
		4.3	4.5	4.5	4.3

APPENDIX VI (Contd.)

TRAVERSE IV

							a	b	c	d
109	5d 5d 5d 5d 5d	5c 4c 5d 5d 4d	– 4c 4c 5c –	5c 5d 5d – 5c	5c 5d 5c 5d 4c	4d 5d 5c 5d	–	–	51	68
110	5d 5d 4d 4d 5d	4c 4c 5d 5d 4c	4c 5d – 4c –	– 5d 5d 3d 4d	5d 4c 4d 5c 5c	5d 4d 5d 5d	–	–	46	66
111	4d 5c 4c 5d 5c	5d 5c 5d 5d 4d	5d 4d 4c 5c –	– 5c 5c 5d 5c	5d 5c 5c 5c 5c	4d 4d 4c 5d	–	–	67	60
112	5d 5d 5c 5d 5c	5d 5d 5d 5d 5d	5d 5d 5d 5c 4d	– 5d 5c 5d 5c	4d 4c 4d 5d 4d	5c 5d 5d 5d	–	–	34	101
113	– 4d 5d 5c 5b	5d 5d 4d 5d 5c	5c 5b 4d 5c 5d	5d 5d 4d 4d –	5d 5d 5d 5d 5d	– 5d 5d –	–	10	20	84
114	5d 5c 5d 5d 5d	5c 5d 5c 5d 4d	5d 4c – 5d 5d	5d 5d 5d 5d 5d	5d 5d – 5d 4d	5d 5d 5d 4d	–	–	19	112
115	5d 5d 4d 5d 5d	4d 5c 4d 5b –	5d 5d 4d 5d 5d	– 4d 4d 5d 2c	5d 5d 4d 4d 5d	4d 4d 4d 5d	–	5		107
116	5c 4d 4d 4d 4c	5d 5d 4d 4d 4d	4c 4d 4d 4d 5c	4d 4d 5d 4d 5d	4d 5d 4c 4d 4d	5d 4d 4d 4d	–	–	18	104
117	4d 5d – 5d 5d	5d 5d 5d 5d 5d	4d 4d 4d 4d 5d	5d 5d 5d 5d 5d	5c 5d 5d 5d 5b	5c 5d 4d 5c	–	5	15	106
118	4d 4d 5c 4c 5c	5d 5c 4d 4d 4d	5c 4c 4d 5d 5c	– 5d 4d 4d 5d	4d 4d 4c 4d 4c	5d 5d 4c 5d	–	–	45	73
119	5d 5d 5d 5d 5d	5d 5d 5d 5d –	5c 5c 5d 4d 5d	1d 5c 5c 5d 5d	5c 4d 5d 4c 5d	5c 4d 4d 5d	–	–	32	91
120	4c 5c 4b 5d 4c	5c 5d 5d 5d 5c	5d 5d 5d 5b 4d	4c 4d 4d 5d –	5c 5c 5c 5d 5d	5d 4d 4c 4d	¼–	9	44	75
121	5c 5c 5c 5d 5d	5d 5d 4d 5c 5d	5d 5c 5d 5c 5d	– 4d 4d 4d 5d	5d – 5d 5d 5d	5d 4d 5d 5d	–	–	30	100
122	5d 5c 5d 5d 5d	5d 5d 4c 4d 4d	5d 5d 4d 4d 5d	5d 4d 4d 5d 5d	5d 5c 5d 5d 5d	– 5d 5d 5d	–	–	14	116
123	5c 5c 5c 5d 4d	3d 5c 4d 5d 5c	5d 5d – 5d 5d	5c – 4c 5c 5d	4c 5d 5d 4c 5d	5c – – –	–	–	52	59
124	5d 5d 5d 5d 5d	4c 5d 4c – 5d	5d 5c 4d 5c 4d	4d 5d 4c 5d 5d	5d 5c 4d 4d 5c	4d 5d 4d –	–	–	32	95
125	– 5c 5c 4d 5d	5d 2d 4d 5b 5c	5d 5d 4d 4d –	5d 5d 5c 5d –	5d 5d 5d 5d 4c	5d 5d 4d 5c	–	5	27	85
126	5c 4d – 4c 5c	5c 4d 5c 4c 5c	5d 5d 5c 2d 5c	4d 5d 5c 5d 5d	5c 4c 5d 4d 5d	4d 5d 4d 4d	–	–	57	66
127	5d 5c 5c 5c 5c	4d 5d 5d 5d 5d	5d 4d 5c 5d 4c	4d 5d 5c – 4c	5b 5c 5d 5d 5d	– 2d 4d 4c	–	5	45	71
128	5d 4c 4c – 4d	5d 5c 5d 5d 4d	5d 5d 4b 3c 4d	5d 5a 5c – 5a	5c 4a 5d 5d 5d	4d 5d 4d 4d	12	4	26	75
129	5d 4d 5d 2d –	5d 5c 5c 4d 5d	5d 4c 5d 5d 5d	5d 5d 5d 5d 5d	5d 5c 5d 5d 5d	4d 5d 5d 5d	–	–	19	108
130	5b 4d 5c 5d 5d	5d 3b – 2d 5b	4d 4c 5d 4d 4c	5d 5d 5d 5c 5d	5b 5d 5d 4b 4b	4c – 4d 4c	–	20	22	58
131	4b – 5d – 5d	– 1c 4c 5d 5d	4d 4d 5d – 4c	4c 5d 5d 5c 5b	4b 5b 5c 5c 5c	4d 4d 4d 5d	½	16	34	56
132	4d 5d – 5d 5d	5d 4d 5d 5d 5c	5d 5c 5d 5d 5d	5d 5d 5c – 5d	4d 4d 4d 4d 4d	5b 5d 5c 5c	–	5	21	92
133	– 5d 4d 5c 5c	5d 5d 5d 5d 5d	5d – 5c – 5d	5d 5d 5d 3b 5c	4d 5c 5c 4d 4d	4c 4d 4d 5c	–	5	39	72
135	– 5c 5d 5d 5d	5d 5d 5d 5d 5d	5d 5c 5d 5d 5d	5d 5c 5d 4d 5d	5d 5d 5c 5c 5d	5c 4c 5d 5d	–	–	34	98
136	5d 5d 5d 5c 5c	5d 5c 5c 5d 5d	5d 5c 5c 5c 5c	4c 4d 4c 4c 5d	5d 5d 5c 5c 5d	5d 5b 5d 5c	–	5	65	69
137	4c 4d 5c 5d 5d	5d 5d 5d 5b 5d	5d 5c 4c 5c 5d	4c 5c 5c 5c 5d	5d 4c 4d 4d 5d	5c 4d 5d 4d	–	5	51	76
138	4d 5d 5d 5d 5d	5d 5d 5d 5d 4d	5c 5d 4d 5c 5c	5d 5d 4d 4d 5d	5d 4c 5c 5c 5d	5d 5d 5d 4d	–	–	29	103
139	5c 5d 5c 5c 5b	5d 5b 5c 5d 5b	5d 5d 5c 5c 4d	5d 5d 4b 5d 4d	5c 5c 5c 5c 3d	5c 5c 5c 4c	–	19	69	51
140	5c 5c – 5d 5d	5c 5c 5b 5c 5d	5c 5c 4d 5d 5d	4d 5c 5d 5d 5c	5d 5c 5d 5b 5c	5d 1c – –	–	10	58	58
141	5c 5c 5d 5d 4d	4c 5c 5c 5c 4d	5d 5d 4d 5c 5d	5d 5d 5d 3c 5d	– 5c 5d 5d 3d	5d 5d 4d 4d	–	–	40	88
							40	124	1165	2658
							4.0	4.0	4.6	4.5

APPENDIX VI (Contd.)

TRAVERSE V

							a	b	c	d
142	d d c d d 3 3 4 5 5	d d d b d 5 5 5 4 4	d c c d c 4 3 5 5 4	c d c c d 4 4 4 5 5	d d d d c 5 5 5 5 5	d c d c 3 4 5 5	-	4	45	76
143	d d c d d 4 5 5 4 3	d c d c d 3 5 5 4 4	d d d d d 4 5 4 4 5	d d d d - 5 5 2 5 -	d d d c c 3 5 5 4 5	c c d d 4 5 5 5	-	-	52	97
144	b d d d d 5 5 5 5 4	d c d d d 5 5 4 5 5	b d d d c 5 5 5 4 4	d d b c d 5 5 4 5 4	d d c c d 4 4 5 4 4	d d d d 5 5 4 5	-	14	35	95
145	d d d d c 5 5 5 5 5	d c d d d 5 5 5 5 5	d d d c d 5 4 4 5 4	d d d d d 4 4 4 5 5	d d - d d 5 5 - 4 5	d d d d 5 5 5 5	-	-	15	118
146	c c d c d 4 5 5 5 5	c d c b d 5 5 5 5 5	c c d d c 5 5 5 5 5	d d d b c 5 5 5 5 5	c c c b d 5 4 4 4 5	d c d c 5 5 5 5	-	12	65	60
148	c d d d d 5 5 5 5 4	d d d c c 5 4 4 4 4	d c d d d 5 5 4 4 5	d d c c d 4 5 5 5 5	d b d d d 5 5 5 5 4	d c d d 4 5 5 5	-	5	33	97
149	d c d d d 5 5 5 5 5	d d d d d 5 5 5 4 4	d d c d d 5 5 5 4 5	d d c c d 5 5 5 4 5	c d d d d 5 5 5 5 4	c d b d 5 5 5 5	-	5	29	106
150	c d d d d 5 5 4 4 5	d d d c c 5 5 4 4 5	- d c d c - 5 5 5 4	d a c d c 5 5 5 5 5	c c c d c 4 5 4 5 5	d c d d 4 0 5 5	5	-	51	60
151	d d d d d 5 5 5 5 5	d d d d d 5 5 5 4 5	c d d d d 5 5 4 4 5	d d d d c 5 5 5 5 5	- b d d c - 5 5 5 4	d c d d 4 5 5 5	-	5	19	111
152	d d d d d 5 5 5 4 4	d d d d c 5 5 5 5 5	d d d d d 5 5 5 5 4	d d d b d 4 5 4 5 4	d d d d - 4 4 5 5 -	d d d d 4 5 5 4	-	5	3	118
153	c d c c d 5 5 5 4 5	b c d d d 5 4 5 5 3	c b b c c 2 4 5 4 5	d c c d d 5 3 4 5 4	b c d a c 5 4 5 5 5	d d d c 5 4 5 4	5	19	47	50
156	d d d d d 5 5 4 5 5	c c b d d 5 4 5 4 4	d d c d - 5 5 4 4 -	c b c c d 4 5 4 4 5	d c c c d 5 5 4 4 5	d d - d 5 4 - 5	-	8	59	73
158	b c d d d 5 5 5 5 5	d d d d d 4 5 5 4 5	d d d b d 5 5 4 4 5	d d d d d 4 5 5 5 5	d d c d d 5 4 5 4 4	d c d d 5 5 4 5	-	9	15	110
159	c c c d c 5 5 5 5 4	d d d b c 5 5 5 4 5	c c c c d 4 5 5 5 5	c d c c c 5 5 5 5 5	d c d c b 5 5 5 5 5	d d c c 5 5 5 5	-	7	77	49
160	d d d d d 5 5 4 5 4	d c d d d 4 4 5 5 4	d c d d d 5 5 5 4 5	d c d d d 5 5 5 5 5	d c d c d 4 4 5 4 4	d d d c 4 5 4 5	-	-	25	93
161	d d d d d 5 5 5 5 4	d d d d d 4 5 5 5 5	d c c c c 2 5 5 5 4	d b d d d 5 5 5 5 4	d c d c d 5 4 5 5 4	d d c d 5 5 2 5	-	5	50	84
162	d d d b d 5 4 5 4 5	d - - c d 5 - - 4 5	c c c d c 5 4 5 4 4	d d d - - 4 5 5 - -	d d d d d 4 4 4 5 4	d c d d 5 5 4 5	-	4	27	73
163	d d c d d 5 5 4 5 5	d d c d d 5 4 5 5 5	d d d d c 4 5 4 5 5	d c c d d 5 5 5 5 5	c c d d - 5 5 4 4 -	d d d c 5 5 5 5	-	-	39	91
164	d d c d d 5 5 5 5 5	d c d c d 5 4 4 5 5	c c d c d 5 5 5 4 5	d d c d d 5 5 5 5 5	c d c c c 5 5 5 5 4	d d d d 4 4 5 5	-	-	52	85
166	c c c d c 4 4 4 5 4	d d d d c 5 5 5 4 4	c d c d c 5 4 4 5 4	d d d d c 5 4 5 4 4	d c d c d 5 4 5 2 2	d d - d 5 5 - 5	-	-	45	63
166	d c d c d 4 5 5 5 5	d d b d d 5 5 4 5 5	c d c c d 5 4 4 2 5	b c c d c 5 5 5 5 4	d d d c d 4 4 5 4 5	- c - d - 4 - 4	5	7	54	58
167	d c d d c 5 5 2 4 4	d c d d c 4 5 5 5 5	d d b d d 5 5 4 4 4	d d d d d 4 4 5 5 5	d b d b d 5 2 4 5 4	d d d - 4 5 4 -	-	11	13	85
168	d c d d d 4 5 5 5 4	c d c c c 5 5 4 5 5	d d d d d 5 4 5 5 5	d d c d d 5 5 5 5 5	c c d c d 5 5 4 4 4	d d b d 0 4 3 4	-	5	57	75
							15	125	780	1954
							5.0	4.6	4.3	4.4

APPENDIX VII

2 X 3 SPLIT-PLOT DESIGN

1st Cutting

Crop Treatments	With Fertilizers: Blocks I	II	III	IV	Crop treatment total for fertilized plots	Without Fertilizers: Blocks I	II	III	IV	Crop treatment total for unfertilised plots	Crop treatment total for fert. & unfert. plots.
Rye alone	1.366	1.348	1.333	1.407	5.454	1.111	1.214	1.226	1.339	4.890	10.344
Fog alone	1.260	0.874	1.181	1.067	4.382	1.065	0.854	0.856	0.906	3.681	8.063
Rye & Fog mixture	1.425	1.170	1.380	1.393	5.368	1.134	1.060	1.225	1.260	4.679	10.047
Total	4.051	3.392	3.894	3.867	15.204	3.310	3.128	3.307	3.50[illegible]	13.250	28.454

2nd Cutting

Crop treatments	With Fertilizers: Blocks I	II	III	IV	Crop treatment total for fertilised plots	Without Fertilizers: Blocks I	II	III	IV	Crop treatment total for unfertilised plots	Crop treatment total for fert. & unfert. plots
Rye alone	0.750	0.664	0.866	0.706	2.986	0.546	0.634	0.549	0.758	2.487	5.473
Fog alone	0.676	0.636	0.895	0.814	3.021	0.725	0.663	0.565	0.760	2.711	5.732
Mixture	0.771	0.629	0.872	0.748	3.020	0.598	0.610	0.603	0.840	2.651	5.671
Totals	2.197	1.929	2.633	2.268	9.027	1.867	1.907	1.717	2.358	7.849	16.876

APPENDIX VII (Contd.)

3rd Cutting

Crop Treatments	With Fertilizers: Blocks I	II	III	IV	Crop treatment total for fertilized plots	Without Fertilizers: Blocks I	II	III	IV	Crop treatment total for unfertilized plots	Crop treatment total for fert. & unfert. plots
Rye alone	0.954	0.928	1.251	1.184	4.317	0.729	1.067	1.108	1.180	4.084	8.401
Fog alone	1.450	1.188	1.577	1.547	5.762	1.248	1.209	1.544	1.420	5.421	11.183
Rye + Fog mixt.	1.045	0.965	1.500	1.393	4.901	1.101	0.981	1.219	1.203	4.504	9.405
Total	3.447	3.081	4.328	4.124	14.980	3.078	3.257	3.871	3.803	14.009	28.989

4th Cutting

Crop Treatments	With Fertilizers: Blocks I	II	III	IV	Crop treatment total for fertilized plots	Without Fertilizers: Blocks I	II	III	IV	Crop treatment total for unfertilized plots	Crop treatment total for fert. & unfert. plots
Rye alone	.986	.671	.860	.975	3.492	.842	.826	.772	1.083	3.523	7.015
Fog alone	1.056	1.056	1.380	1.175	4.667	.812	.958	1.078	1.272	4.120	8.787
Rye + Fog mixt.	1.112	.891	1.383	1.192	4.578	1.010	1.037	.943	1.302	4.292	8.870
Total	3.154	2.618	3.623	3.342	12.737	2.664	2.821	2.793	3.657	11.935	

APPENDIX VII (Contd.)

5th Cutting

Crop Treatments	With Fertilizers: Blocks I	II	III	IV	Crop treatment total for fertilized plots	Without Fertilizers: Blocks I	II	III	IV	Crop treatment total for unfertilized plots	Crop treatment total for fert. & unfert. plots.
Rye alone	1.085	.947	.998	1.045	4.075	.819	.798	.792	.876	3.285	7.360
Fog alone	1.082	1.928	1.148	.995	4.151	.931	.955	.882	1.038	3.806	7.957
Rye + Fog mixt.	1.152	1.100	1.134	1.216	4.604	.765	1.025	.945	1.092	3.827	8.431
Total	3.319	2.975	3.280	3.256	12.830	2.515	2.778	2.619	3.006	10.918	

6th Cutting

Crop Treatments	With Fertilizers: Blocks I	II	III	IV	Crop treatment total for fertilized plots	Without Fertilizers: Blocks I	II	III	IV	Crop treatment total for unfertilized plots	Crop treatment total for fert. & unfert. plots
Rye alone	1.344	0.872	1.026	0.972	4.214	1.060	0.886	0.661	0.928	3.535	7.749
Fog alone	1.237	1.030	0.954	0.949	4.170	1.215	0.869	0.795	0.870	3.749	7.919
Mixt.	1.204	1.185	1.041	0.787	4.217	1.007	0.795	0.820	0.918	3.540	7.757
Total	3.785	3.087	3.021	2.708	12.601	3.282	2.550	2.276	2.716	10.824	23.425

APPENDIX VIII

	Air Temps. °F.				Rainfall Ins.		Rain Days No.		Sunshine Hours		24-hr. wind run	
	Highest Maximum	Lowest Minimum	Actual Mean	28 yr. Mean	Actual	Mean	Actual	Mean	Actual	Mean	Actual	Mean
Aug. 1955	57.1	42.9	50.0	47.7	3.81	3.55	25	16.7	110	152	87	154
Sept. 1955	59.6	44.7	52.2	50.4	1.34	2.81	15	15.7	109	141	94	157
Oct.	64.5	46.6	55.5	53.9	3.60	3.68	14	16.1	185	156	129	162
Nov.	65.4	49.5	57.5	56.8	2.91	3.18	12	15.0	165	180	94	168
Dec.	70.7	52.4	61.5	60.6	2.10	3.46	6	13.8	215	197	132	161
Jan. 1956	75.0	59.1	67.1	63.4	5.46	3.25	18	13.0	154	208	107	171
Feb.	73.7	56.1	64.4	62.5	2.25	2.96	11	11.0	157	179	128	159
Mar.	69.2	49.5	59.3	60.8	0.81	2.59	12	10.7	185	173	116	144
Apr.	69.8	56.5	63.1	56.8	4.79	3.36	21	13.6	95	155	110	134
May	60.2	49.1	54.8	51.0	3.31	3.29	17	14.9	109	122	155	126
June	57.3	42.4	49.8	47.2	5.58	4.31	17	17.1	75	96	195	116
July	54.1	40.3	47.2	46.2	5.25	3.09	19	16.4	89	100	113	124
Aug.	55.9	39.6	47.9	47.7	3.61	3.55	19	16.7		152		154
Sept.	60.2	42.9	52.4	50.4	2.30	2.81	10	15.7		141		157

APPENDIX IX

SIXTH CUTTING

The data for the dry matter production by each crop treatment are given in Table 30

Analysis of variance

Source of Variation	s.s.	d.f.	variance	F	Result
Blocks	0.002	5	0.0004	0.666	n.s.
Treatments	0.008	2	0.004	6.666	s
Error	0.006	10	0.0006		
Total	0.016	17			

TENTH CUTTING

The data for the dry matter production by each crop treatment are given in Table 34

Analisis of variance

Source of Variation	s.s.	d.f.	variance	F	Result
Blocks	0.003	5	0.0006	3.000	n.s.
Treatments	0.003	2	0.0015	7.500	s
Error	0.002	10	0.0002		
Total	0.008	17			

ELEVENTH CUTTING

The data for the dry matter production by each crop treatment are given in Table 35

Analisis of variance

Source of Variation	s.s.	d.f.	variance	F	Result
Blocks	0.002	5	0.0004	2.000	n.s.
Treatments	0.008	2	0.004	20.000	s.s
Error	0.002	10	0.0002		
Total	0.012	17			