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THE SELECTION, COLLECTION AND CULTIVATION OF NATIVE PLANTS.

BY VICTOR DAVIES.

Notwithstanding the fact that our flora is one of the most interesting and fascinating in the world, few New Zealanders have even a remote knowledge of our plants, and this is particularly noticeable among our younger people.

COLLECTING.

The first difficulty when one desires to grow these native plants in a civilised garden is to obtain them; and the usual procedure is to go into the nearest bush (which often happens to be a scenic reserve where the taking of any plants is strictly prohibited), pull up numbers of trees, ferns, etc., from one to four feet in height, leave what are not required to wither, and bring home the remainder, probably in the back of the car, exposed to wind and sunshine, and eventually to plant them out direct in the position where it is desired to grow them. No thought is given to the difference in position, to the absence of shade to which they have been accustomed, and yet how disappointed the amateur gardener is when he finds his efforts all in vain, and his plants all dead. The result is: his enthusiasm often dies, too.

The first thing to remember, if the enthusiast wishes to collect his plants himself direct from their natural haunts, is to choose a calm day, as a drying wind is fatal to many choice varieties; also that the best time of the year is either late autumn or early spring; avoid the cold of mid-winter and the heat of summer. Secondly, choose small, hardy plants from 3in. to 6in. in height, preferably those growing on bush borders, on logs, or in elevated semi-shady positions. Take a sharp knife or trowel, make a clear cut around the plant, then lift carefully. If of a choice variety, tie up at once singly in moss, hessian or paper; if of a common kind, make into a small bundle with others, and wrap around with damp moss.

Having procured your plants, select a small nursery plot in which to grow them and to harden them in preparation for the changed conditions in which they will ultimately be grown. A moist, semi-shady spot, sheltered from wind, is ideal for this purpose. Where a natural shady spot is unprocurable, make one with green branches or hessian; and this shelter can gradually be removed as soon as the plants show signs of growth. Plant your plants as soon as possible, about 6in. to 8in. apart, and, if dry, keep them well watered. If planting has to

be delayed, keep them in an upright position, with the roots moist. Once allow your plants to become dry and failure awaits you. Leave the plants in this nursery plot until the following season; then wrench and plant them out in their permanent position.

Wrenching is an operation by which the roots are slightly shortened by cutting round the plants with a sharp spade. The best time to do this is during March or April. In a few weeks new white roots are formed and removal to the permanent position can safely be accomplished. By following these simple directions our native flora can be safely transplanted into our gardens. A much more satisfactory way is to go to a reliable nurseryman who grows the majority of his native trees from seed, and there select good, well-hardened, medium-sized trees, and plant as early in the season as possible. When one considers that many varieties take three or four years before being of saleable size, and are sold at from 2s. to 3s. 6d. each; it is easy to realise the advantage gained by this method.

PLANTING.

This is a most important point in tree culture. A tree put into a wrong position in unsuitable soil or planted badly will never prove satisfactory. Consider first your position as regards soil, winds, frost, proximity to coast, etc., and decide on what plants are suitable; then proceed to prepare your ground. Dig holes, larger than required, loosen up the bottom, add some old garden soil or leaf mould, and if very poor some bone meal, being careful to mix in any manure used and cover your soil. Then place your trees in position, taking care to plant about the same depth as previously; firm up well; avoid barking the trees if your foot is used, and finally leave a small hollow around to ensure their getting sufficient moisture and also to enable topdressing with good soil to be done if required. If large trees are planted place a stake on the windy side and tie with soft material. When planting inland trees of a tender nature, such as pohutukawas, puka, puriri and whau, it is necessary to protect them with a few branches, which should be removed as soon as the frosts are over. Never plant out poor or weakly trees, but put them into a sheltered nursery plot for a season.

SELECTION OF SHELTER.

This great factor is the cause of most failures with our New Zealand native plants. For instance, take a beautiful native plant that is seen growing in some specially selected spot or in its native habitat. It is impossible to expect this to grow in an open, exposed garden. Firstly take note from which direction your prevailing winds blow; see that you have your shelter in before you think about any choice of plants; this is even more particular if the garden is exposed to salt winds of our coastal sections.

If your section is a new one on which there is no shelter, the first thought would be of a suitable selection of hedges, New Zealand native trees only being mentioned here. On the north-western, west, and south sides high shelter is required; this of course, may shut out your view; however, it is impossible to have a good garden on exposed positions without shelter. For these positions plant karaka (*corynocarpus laevigata*), eight feet apart and about three to four feet from your boundary; between the karaka plant pohutukawa (*Metrosideros*

tomentosa). The karaka being an upright and quick grower will soon give shelter, finally showing a clean trunk, whilst the pohutukawa will be slower and more bushy, and if slightly trimmed when young, will remain well foliaged to the ground for a great number of years. As soon as the pohutukawa is giving sufficient shelter the karaka can be cut out and splendid high and beautiful shelter will remain. Karo (*Pittosporum crassifolium*), can be used in place of pohutukawa, and ngaio (*Myoporum lactum*), in place of karaka if preferred, pohutukawa being a tree which is severely cut by frost when young. This tree should not be planted more than a few miles inland. Matipo (*Pittosporum nigrescens*), and houhere (*Hoheria populnea*), northern lacebark would answer very well and give good shelter, growing from 12 to 20 feet high.

For low hedges the most popular native plant is golden ake ake (*Olearia forsteri*). This is useful and very quick-growing in all positions. Good sturdy bushy two-year plants should always be selected and, where a dense hedge is required, plant one foot apart. Flax (*Phormium tenax*), is also a good low shelter, but takes up a lot of room; this should be planted three feet apart. Totara (*Podocarpus totara*), makes a splendid hedge, but is rather slow; plant one and a half feet apart. If right on the coast, taupata (*Coprosma baueri*), is extremely hardy. Once your shelter is established then the shrubs may be safely planted. The following varieties are suitable:—

SELECTION OF SHRUBS.

For tall growing New Zealand shrubs and trees in an exposed coastal position; Pohutukawa, puka, cabbage tree, kauri, rewarewa, rangiora, Kermadec pohutukawa, kowhai, tarata, five-finger, southern rata and totara.

For a more sheltered position, good native tall shrubs and trees of easy culture are: Puriri, titoki, mamaku (the black tree fern), rimu, hinau, red beech, horoeka, lancewood, tanekaha, miro, mangaeo and whau.

For an exposed position, good low shrubs are: Koromiko (in variety), ake ake (in variety), leather leaf (in variety), flax (in variety), toru, manuka (in variety), korokia (in variety), Coprosma (in variety), brooms (in variety), and bronze rangiora.

For sheltered positions, suitable small shrubs would be: Golden tainui, ramarama, kaka-beak (in variety), mairehau, parapara, bronze panax, makamaka, variegated karaka, golden punga, double rose manuka, neinei and taranga (New Zealand daphne).

Good plants for growing in the shade are: Kohekohe (tall growing), kawakawa, tarutu (dwarf), horopito, Libertia (dwarf), silver tree fern, karo (tall growing), nikau, patete, Astelia (low growing), and waiuatua and hardy ferns.

For rockery work, the following are recommended: Celmisia (in variety), Veronicas, more correctly Hebe (in variety), New Zealand hare bell, rengarenga, New Zealand orchid (two varieties), Libertia (two varieties), Pratia angulata, mountain primula, river daisy, Helichrysum bellidioides, Nertera depressa, and Pimelia laevigata.

Climbers for trellis and screens; Puawhanga, kaiku, aka, Metrosideros diffusa, Clematis parviflora, and yellow rata.

FERNS.

New Zealand is famed all over the world for its beautiful ferns, and has adopted the fern-leaf as its national emblem. In this small country we have no less than 134 species, with an additional 30 varieties, a total of 164, of which 44 species and 16 varieties, total 60, are found only in New Zealand.

Ferns are one of our easiest plants to grow, and there are very few homes in which you will not find our parata-white (*Marattia fraxinea*), (horse-shoe fern), shiny leaf (*Asplenium lucidum*), or moku (*Asplenium bulbiferum*), growing well with very little attention.

To grows New Zealand ferns succesfully, however, the first thing is to try and imitate natural conditions, viz., perfect shelter and a moist humid atmosphere. With few exceptions, it is useless trying to grow ferns unless these conditions are adopted, and this can be done with very little trouble.

Select a position in the coolest spot in your garden, for preference against a bank or wall, then erect a fence of four plain wires, around the open sides of which lace thin manuka or macrocarpa branches. Put similar wires and scrub on the roof, slightly raising same to avoid the drip. If green branches are used, the fernery will appear too dark. However, this is a good fault, as the scrub will soon thin out and lose some of the smaller twigs. To make the erection of a semi-permanent nature, plant open growing native climbers, such as clematis, parsonsia, lawyer, etc., which will grow rapidly and bind the construction. Avoid heavy growing exotic climbers, such as doliohos, bignonias, etc.

Next secure a good supply of leaf mould, or failing this, very old decayed litter grass, leaves, etc., but avoid all ashes, lime, artificial or any fresh manure. Ferns require good drainage, and should be planted firmly, but shallow. Never allow the roots of a fern to be exposed to the sun or wind. If one cannot plant immediately after collecting, just heel in the plants in a damp position, or place under a wet sack, where they will keep perfectly fresh for a few days. Always cut off the fronds when transplanting a large fern if the roots are poor.

TREE FERNS.

These should have prominence in every garden. Manuku (*Cyathea* medullaris), the well-known black tree fern, will grow in almost any position, either dry or damp, providing it is not exposed to heavy frosts. The silver tree fern (*Cyathea dealbata*), requires a position out of the sun, but will grow in either a damp or dry locality. Another very hardy low-growing tree fern is weki-ponga (*Dicksonia fibrosa*), golden tree fern, which will grow in most localities and in practically any aspect, although, however, out of the winds the fronds will be much more beautiful.

In selecting tree fern, always choose a short, sturdy, well-hardened plant, for preference plants grown in the open. Avoid large plants that have been grown in the shade, as they very rarely make satisfactory plants.

SEEDS.

In sowing seeds of our New Zealand plants, care should be taken to get the seeds in as soon as possible after they are matured, as many of them will not be fertile after a few months, especially fine varieties like pohutukawa and rata.

For a seed bed, select a position where it is moist, free from drying winds, and is partly shaded. The soil should be well worked and with a good drainage. Plant all native seeds shallow; a good rule to remember is to cover them only their own depth with soil. Very fine seeds require sowing practically on the surface, with an extremely light sprinkling of sieved soil on top. Do not firm the soil down after planting, as this is apt to cause the soil to cake and crack should it become at all dry. For smaller lots of seed, pots, boxes or benzine tins may be used, care being taken to see that they have holes in the bottom and a good supply of litter over the holes, so as to secure perfect drainage.

Some of the fine seeds are difficult to water when newly sown, as it is so easy to wash the seeds away. To prevent this, take the pots or tins and immerse the lower portion in water for five minutes.

All seed receptacles must be shaded; the best method is to cover with a piece of dirty glass, which can be gradually lifted as the seedlings grow. Watering and shading are two most important points to remember in seed raising, as once germinating seeds get dry they are ruined. When raising in a green house give good ventilation and shade well. Some seeds germinate quickly, others often take twelve months. Very hard seeds, such as kowhai, should be put in boiling water before planting, as this will expedite germination

CONCLUSION.

Considering our native plants are thought so much of abroad, is it not only right that we should give them preference whenever possible in our home gardens and parks? There is a native plant suitable for every position where a plant will grow. Consider our Veronicas, of which we have nearly 200 native varieties, far more than all the rest of the world put together. Our puka (*Meryta sinclairii*), one of the rarest trees in the world, found growing only on the Three Kings and Taranga Islands; our giant forget-me-not from the Chatham Islands (*Myostidium nobile*), a plant growing two feet high and prized greatly in Britain; our giant maidenhair fern (*Adiantum formosum*), growing five feet high, often having over 1000 leaflets; the kauri (*Agathis australis*), the finest large timber tree known; and numerous other beautiful and rare plants that are native of this Dominion.

New Zealanders should be proud of our wonderful flora, and the only way to perpetuate this for future generations is to acquire a knowledge of our plants and grow them around our homes, our schools, and parks, so that our children will be brought up to know and to realise the natural beauties of our own wonderful country.

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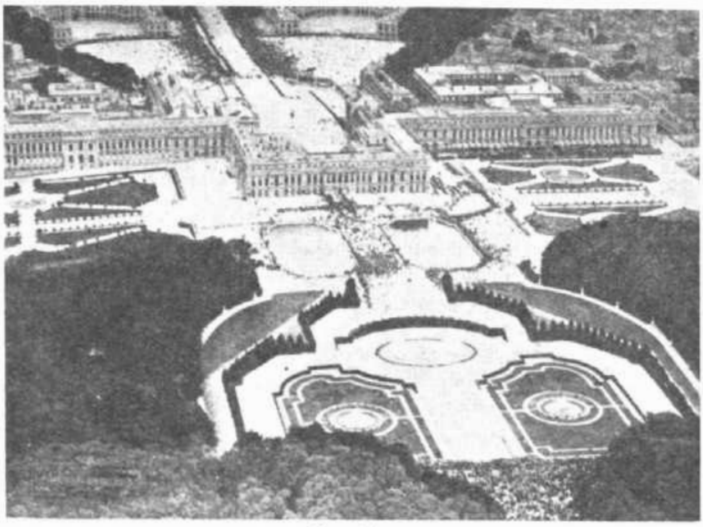
PARKS AND OPEN SPACES IN RELATION TO TOWN PLANNING.

By R. B. Hammond, A.M.T.P.I., Eng.

As the question of parks and open spaces is receiving more and more attention in this country some general observations on the subject might be of interest. Moreover it is perhaps not fully realised the importance of the town planning movement in connection with the subject.

During the next few years many town planning schemes will be in course of preparation throughout the country, and in these schemes we should see that sufficient open space is set aside for future generations. The policy in the past has often been to wait until an area was overcrowded and values had risen to a high figure before an attempt was made to secure an open space, with the result that in the more thickly populated districts of most of our large towns, owing to the tremendous cost of acquiring these open spaces, there are not nearly enough.

An adequate and well planned system of parks and recreation areas is an essential part of a scheme of town development and it will be interesting to note that under the Town Planning Act Local Authorities may, among other things, deal with the reservation of areas for recreation grounds, ornamental gardens, parks and children's playgrounds. The Act also provides for the reservation of areas of natural beauty and historical interest. In our schemes therefore the various open spaces, to meet both present and future needs, should be definitely located, and those areas of special beauty and interest should be set aside and made secure for all time.

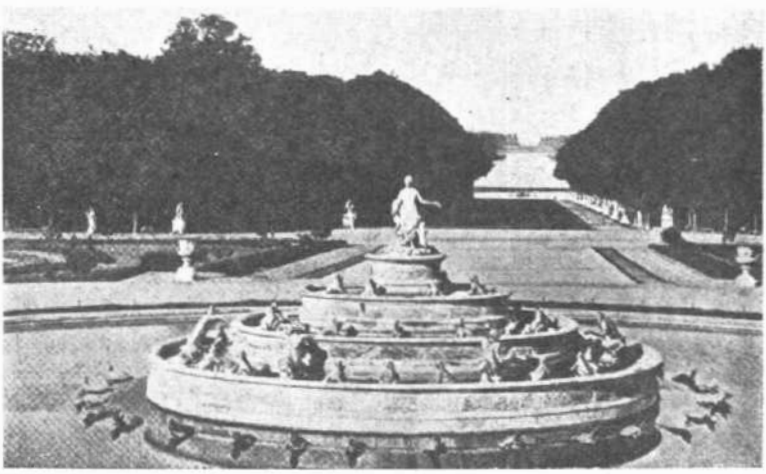


Versailles

SITE REQUIREMENTS AND DISTRIBUTION.

There are, generally speaking, four different kinds of open spaces: (1) natural parks; (2) developed parks and recreational areas; (3) formal town gardens or squares; (4) playgrounds. The problem of selecting sites for these open spaces calls for much careful study and expert guidance. While recreation grounds require stretches of level, well drained land, this is not essential for pleasure parks. It is often posible to select land for parks that is unsuitable for building purposes and therefore has very little value for such a use. This is rather important to keep in mind, as it affects the probable cost of the land. Waste, low lying land by a stream or river can often be adapted to park use and made most picturesque. Also parks do not require a great deal of road frontage (back land is always cheaper), and it suffices if sufficient view points are kept open to the streets to preserve a sense of spaciousness and beauty.

In reserving areas for natural parks their success depends much upon the topography and natural character of the scenery, but there will be found in most towns some striking natural scenery. Whether it be the finest view or the best scenery, these should be preserved



Versailles

for public enjoyment for all time. There is one kind of reservation we should always keep in view; where a town includes a river or stream, every effort should be made to at least reserve a strip along the banks for public walks. This reservation is nearly always picturesque. Let us secure what beauty spots there are while there is still the opportunity. It is not necessary to wait until there is money to develop them.

In addition to the larger parks these should be an adequate system of small open spaces developed throughout the town as resting places. A very pleasant small public garden can be made by planting a few shrubs and forming flower beds at road junctions and odd corners. Also the provision of playgrounds and gardens for the small children should not be lost sight of. These should be well distributed throughout the town at intervals of not more than half a mile apart. The best

playground is often formed out of an irregularly shaped piece of land at the back of the houses and away from the streets. Here the children can play in perfect safety under the supervision of the mother.

It is rather difficult to lay down any hard and fast rule as to what area in a town should be set aside as open space as conditions vary in different towns, but a good proportion would probably be about one-tenth of the whole area of the town.

TREATMENT OF PARKS.

Before commencing upon the planning of a park very careful consideration should be given to the question of treatment. The subject, however, is a very big one, and only the broader principles can be touched upon here, for to deal with the question in detail would fully occupy a separate article.

There are two distinct styles of park treatment, the "natural style," and the "formal style." The "natural style" is adopted where it is

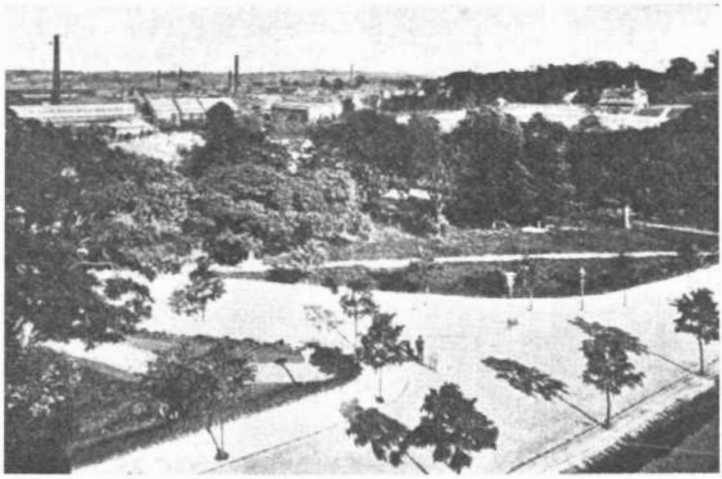
The Riverway, Boston

desired to copy or retain natural features and should apply generally to the larger parks and domains on the outskirts of the town. Parks treated in this style should impress us by their natural beauty, and here we should retain our native flora as far as possible. The "formal style" is generally adopted when designing small parks and squares near the centre of the town. In some parks of moderate size the two styles might safely be adopted by having informal surroundings to a formally treated central area, but this requires very careful treatment. The general principle should be, however, as we approach the centre of the town a more formal treatment should be adopted. The public square, for instance, should be quite formal in character.

The detail treatment to be adopted in the layout depends upon style, location, topography, use, and many other factors. Each park will call for special treatment. A thorough study of the topography is one of the first essentials. Care should be taken to make the paths fit the

contours of the site and lead to the vantage points and the various places of interest. They should lead by the most attractive route to bring into view all the landscape beauties. They should be a pleasure walk and ample opportunity given for loitering. With the pathways laid out there then remains the task of developing the beauty spots, the placing of statuary, the arrangement of flower beds, and grouping of trees and shrubs.

In addition to the public park we must not forget the house garden which is one of the most valuable of all open spaces, and every effort should be made for stimulating interest in the design and development of private gardens for they add so much to the amenity of our towns.



Factory Area, Bournville, showing Park Belt

THE PARK DESIGNER.

From the point of view of natural scenery and plant life we have many impressively beautiful parks in this country. That goes without saying. Can we say, however, that the majority of our parks are designed with artistic skill? If we could answer this question in the affirmative then there would be little need for me to deal with this subject. The more I see of our parks the more I am convinced of the need for raising the standard of park design. I wish to make it quite clear, however, that it is not on the quality of the scenery or upkeep that I speak, but on the design of our parks. How many of our parks have been laid out to any design at all?

It is too often thought that park development consists merely in the making of lawns, the formation of walks and the planting of trees, shrubs, and flowers. The arrangement, proportion, and composition of these things generally appears to be a matter of less importance.

Design is really the most important of all these elements that go to make up the park, and it is necessary that he who directs the work should have had a professional training in Landscape Architecture. The development of our parks cannot be left to the man who is

purely a horticulturist. He must be more than this. He must not only know and understand plant life, but he must know how to use it as elements in design. He must in a word be a Landscape Architect. This means that he must have a thorough knowledge of park design, as well as knowing a lot about horticulture and geology, if we are to expect beauty in the final results of his work. If a park is really to be a work of art, then it requires a person of trained imagination to develop it. The making of our parks should be carried out under the direction of the Landscape Architect in collaboration with the park superintendent.

The location of paths, the grouping of trees, providing proper settings for buildings and shelters, and the arrangement of recreation areas all involve problems in design. It should be the work of the Landscape Architect to give all these features proper study so that they will bear proper relation to each other.

THE FERTILITY OF THE SOIL.

Lecture By L. J. WILD, B.Sc., F.G.S., delivered before the Annual Conference, N.Z. Institute of Horticulture, July, 1927.

The general characters of soil such as texture, water holding capacity, and those connected with the time, manner and results of cultivation, are so obviously related to the mechanical composition of the soil, that a vast amount of measurement and analysis in this direction has been made, an amount that is out of proportion to the value of the knowledge so far gained.

The methods of mechanical analysis used have depended on the law connecting weight of particle with the rate of settling from water and have asumed (a) that weight is directly related to size, and (b) that the particles are approximately uniform and spherical in shape. The mode of expression of results has also tended to give the idea of sharp divisions between the various groups of soil particles, whereas as regards size the particles grade insensibly into one another.

The modern method of mechanical analysis has been worked out by Sven Oden and involves the continuous recording of the rate at which particles settle from a given depth of water. From this information a distribution curve is plotted showing the proportions of particles of a constantly diminishing diameter, and thus giving a much more accurate representation of this aspect of soil composition.

While new and improved methods of studying mechanical composition in the laboratory are being perfected, some altogether novel methods of measuring exactly some of the field relationships of soils are also being applied. For example, at Rothamsted the resistance of the soil to the plough has been measured by a special dynamometer, and some quite unsuspected differences—as much as 30 per cent.—in a small and apparently uniform field have been revealed. In a similar manner an advantage of the tractor has been shown in that an increased speed of work from 2½ to 4 miles per hour involves only an increased drawbar pull of 7 per cent.

In the chemist's viewpoint of soils, too, notable changes have come about. The larger particles (sand and silt), are regarded as being merely a skeleton or framework which supports the finest particles together with the colloidal matter that covers them and the soil solution that bathes them. As such, the coarser particles scarcely merit chemical study, even from the point of view of their relative solubility or rate of weathering. Interest for the present is focussed on the finest fraction—the clay—and the aforesaid colloidal matter, both organic and inorganic.

A mass of clay has familiar plastic properties and when wetted swells with the evolution of heat, shrinking on drying with the absorption of heat. It is more or less impervious to water—usually a strong disadvantage to the agriculturist though for one agricultural community in New Zealand it has had compensations. When water-races were first made across the Canterbury Plains to supply water to the settlers' stock, it was expected they would not hold the water when crossing districts of light soils. When the flood waters of the Waimakariri,

loaded with loess and glacial clay, were turned into them, however, the settling clay soon sealed up the bottom and made it water tight. When strongly heated, clay loses its characteristic properties—a brick is no longer clay, nor can any process of grinding and kneading with water make it such. A familiar illustration is obtained from the Canterbury Plains. The sod-and-gorse fence so characteristic of that area is good to-day after 40 years' service, but let a fire run through the gorse, and the clay sods thereafter rapidly crumble away.

Even the apparently simple relationship of a clay soil to water is, however, imperfectly understood. The practical man knows that he can safely continue to cultivate a clay soil that is increasing in wetness from a dry condition until it holds a given amount of water, say 25 to 30 per cent. But he dare not cultivate the same soil at the same degree of wetness if it is drying from a wetter condition or the result would be hard lumps or further drying. Cultivation, in fact, is still an art and not yet a science.

Let us consider some further properties of the clay portion of the soil. When shaken up with water some of the material remains in suspension almost indefinitely giving an opalescent suspension. With the aid of the ultra-microscope it is revealed that the particles are so small that they are in a state of constant motion, yielding, the physicist tells us, to the bombardment of the molecules of water. That is why the particles do not settle to the bottom; the suspension is stable. The physicist further tells us that the particles have a negative electric charge and thus repel one another, which further leads to the stability of the suspension. When salt solutions or certain acids are added to the suspension, however, the particles presently aggregate and settle to the bottom, a process that is called flocculation. In view of these properties clay is regarded as belonging to the class of substance called colloids —or to use the terms of the physicist, it is an electro-negative colloid, and is usually in the gel condition.

Flocculation in clay, however, presents some anomalies and contradictions. Especially notable is the fact that calcium hydroxide rapidly flocculates, whereas hydroxides as a general rule produce the opposite effect. The explanation, according to Comber, is that calcium enters into chemical combination with the colloidal surface of the clay particle forming a bulky precipitate.

Let us now see what the chemist has to say. Analysis shows that the finest particles separated from soil consists chiefly of a mixture of the acidic oxide SiO_2, and the basic oxides of alumina calcium, magnesium potassium and sodium, and there are said to be definite ratios in which these occur characteristic of fertile and infertile soils respectively. On treatment with solutions of certain salts, such as ammonium chloride and potassium nitrate, some of the basic oxides are replaced and the nature of the soil itself depends to some extent on the nature and quantity of the bases replaced. It is now fashionable to call these substances "the replaceable bases" and to regard the amount and character of them as determinative of soil fertility in its supply-of-plant-food aspect. In fact, a method based on this principle is displacing the old citric-soluble or so-called available plant food determination, which method had in any case been shown to be purely arbitrary by Prescott and others.

Russell states that generally where soils are neutral calcium and magnesium predominate among the replaceable bases; where they are acid all the bases are present; and where they are alkaline sodium and potassium predominate, the other bases being absent. There does not as yet seem to be a sufficient body of experimental data to warrant any wide generalisation, and in any case it is not clear that it would not be more correct to convert the principal clauses above into adverbial clauses, and say that where calcium and magnesium predominate the soils are neutral; where all the bases are present they are acid; and where sodium and potassium predominate to the exclusion of the others the soils are alkaline; and this is not saying very much.

This brings us to the question of soil acidity. The soil chemist has a difficulty in his work that is perhaps greater in amount and different in character from the difficulties that beset workers in most other fields of research. The difficulty is that of getting adequate control over his experiments because of the extraordinary complexity of the soil. The question of soil acidity affords a good illustration. To what is it due? I do not propose to discuss that important part of the soil, the organic matter, except to mention here that decomposing organic matter is known to produce substances of an acid nature. Since soils all contain decomposing organic matter it used to be supposed that this was the cause of soil acidity. The well known, much used, but little understood term "soil sourness" has been for long confused with, usually in fact regarded as synonymous with "soil acidity." But there are many soils in New Zealand that are well drained, well aerated, rather poor in organic matter, and generally regarded as sweet soils that are in fact acid to the test of the chemist and the physicist. Truog has also shown, as far back as 1916 that a soil may still be acid after all the organic matter has been removed, as, *e.g.*, by prolonged treatment with hydrogen peroxide. We now agree that soil acidity may be due either to organic acids or to acid properties of the clay, or to both these conditions. There is also an important distinction to be made between the total acidity of the soil, which may be considerable, and the intensity of the acidity which may not be sufficient to cause alarm; in fact, for some crops best results are obtained with slight acidity.

Time and the circumstances do not permit an excursion into the rather technical question of the theory of soil acidity. The accepted belief at present is that clay itself is compounded of a weak acid complex and the rather strong bases usually present in normal soils; that therefore it may be acid in a chemical sense, that is some of the acid may be unsaturated, without the soil being infertile. This explains why the various attempts to determine "lime requirement" have not been very successful, and why the percentage of calcium carbonate present in the soil has little bearing on fertility.

We may, however, consider briefly the bearing of some of these facts and theories on certain New Zealand questions. Southland soils are acid and many require liming; Canterbury soils are also acid, but do not respond markedly to lime. Southland soils have more organic matter (11.6 per cent loss on ignition compared with 8.1 per cent. for Canterbury), and presumably more organic acid; they suffer from the leaching effects of a much higher and more continuous rainfall, and lime has more work to do in the soil.

Of the exchangeable bases in Canterbury soils there is more aluminium than lime, and this may explain why soluble phosphates applied to them apparently cease to be available after a comparatively short time. The phosphates, if taken up by aluminium as aluminium phosphate, would, in a slightly acid soil, be less available than in a more acid one. Some years ago when studying Canterbury soils I found a great absorption of phosphate from solution by these soils. Basic superphosphate, in which the phosphoric acid has been more completely saturated with lime, has become more popular than acid superphosphate, though the latter is more soluble in water. The connection is not clearly established, but I have field evidence as well as laboratory data on the point. Quite recently in Wisconsin, Magistad has shown that aluminium phosphate is precipitated at a moderate degree of acidity at which calcium phosphate remains in solution. Fraps, in 1922, found in Texas some relationship between the amounts of phosphoric acid absorbed by soils and of iron oxide and alumina in them. The question is of great practical importance in a country that is importing rock phosphate at the rate of over 100,000 tons per year.

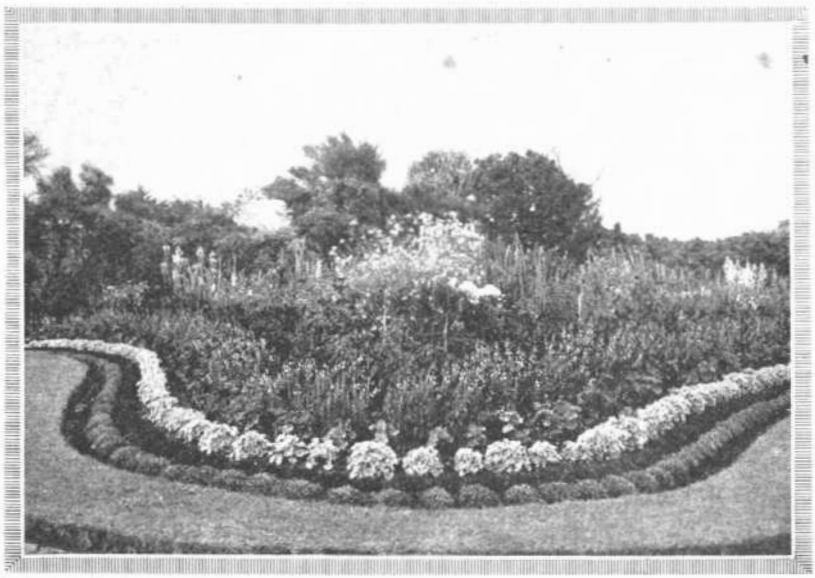
"The Fertility of the Soil" is a title suitable only for a course of lectures; the subject is too wide for a single address. The fertility of the soil is the soil's capacity to meet fully the ever-changing requirements of the plant for air, moisture and the materials of plant food, and to supply all this in what may be called a sanitary environment. It is not a fixed quantity that can be measured and expressed in definite terms, because it is constantly changing with changing meteorological conditions, with the operations of cultivation, with the growth of the plant itself and with the activities of the vast numbers of other living organisms in the soil. This last condition alone provides scope for the researches of specialists in many different branches. I can only mention it and at the same time express the opinion that much of the most valuable work of this century has been in such fields. I have in mind specially the Rothamsted work on partial sterilisation of soils which is of great practical interest to horticulturists and gardeners and which has yielded an understanding of practices that in themselves were appreciated by the ancients.

In conclusion let us welcome the wave of enthusiasm for research that has swept the country in recent years. I have already expressed the hope that the heart and soul of the new College of Agriculture will be the research institutes. They are needed. Our national boast of unexampled soil fertility cannot be made without qualification. The natural fertility has diminished and in places is still diminishing. In other places it never existed as a positive quantity. We dare not attempt cropping without artificial fertilisers; our grass lands are demanding the same in ever-increasing areas. Research is necessary in every manufacturing industry; it is equally necessary in agriculture; and perhaps first and foremost in the raw material from which all our primary products come—the soils of our country.

NOTES ON THE ROTORUA GARDENS.

By B. C. Aston, F.N.Z., Inst.

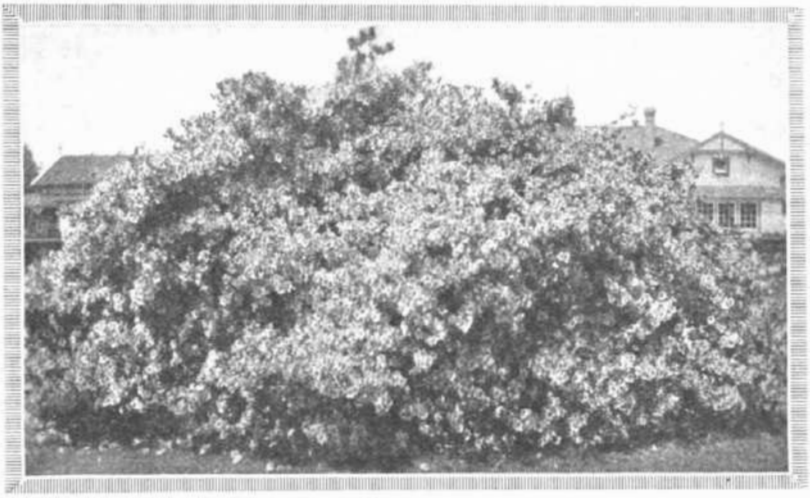
Situated in the most popular tourist resort in New Zealand in the heart of the Central Volcanic Plateau of the North Island, the Government public gardens at Rotorua are perhaps the most attractive in New Zealand. On a perfectly level stretch of land raised but a few feet above the level of Lake Rotorua, thirty-two acres of pumiceous sandy silt soil which previously supported an original vegetation of manuka (*Leptospermum scoparium*), New Zealand bracken fern (*Pteridium*), and very little else, has been quickly converted into lawns, game courts, paths and herbaceous borders, well backed with shrubs. All this work has been done within the past 30 years. The area within the grounds which surround the spa or bath house contains



Portion of one of the beautiful mixed borders.

many cold ponds and even some small geysers, blow holes and boiling mud springs. The pumice soil has proved an admirable one for the growth of all herbs, shrubs and trees which can withstand the winter at this altitude (915ft. above sea). Late frosts are sometimes a difficulty but generally the winters are mild.

To give some idea of the development of this feature of the Government Tourist Department's activities it may be stated that there are three-quarters of a mile of herbaceous border all backed by a growth of shrubs or trees. Every year 50,000 annuals or rooted cutings are bedded out to beautify these borders. There are 19 full size tennis grass courts, six full size tennis asphalt courts, seven croquet lawns



A giant Azalea in the Rotorua Gardens, believed to be one of the largest in cultivation.

(five full size and two small), three bowling greens, three acres of vegetable gardens and three acres of poultry runs. The product of the vegetable gardens and the poultry runs, which contain 300 fowls, is sent to the hospital and soldiers' sanatorium.

Only twelve men are employed under Mr. Willcox. The special horticultural feature of the Rotorua soil is the quick growth of all Azaleas and Rhododendrons. *Azalea mollis*, raised from seed, produces flowers in the third year and at four years is a shrub 2ft. 6in. Some of the Azalea shrubs which are planted round the lawns are of magnificent size and in early summer are a glorious mass of pink and white flowers. Pumice soil seems peculiarly suitable for all ericaceous plants; the beautiful *Gaultheria oppositifolia* is nowhere seen to greater perfection than when growing on pumice, and Mr. Tannock in his book, "Rock Gardening in N.Z.," p. 50, has recommended growing it in a pocket filled with pumice. Pumice indeed might be experimented with in other countries in the rearing of Rhododendrons from seed, and in the striking of Ericas from cuttings for which its peculiar texture and chemical composition render it eminently suitable. Mr. W. Willcox, the officer in charge of the Rotorua Gardens, has been most successful in raising Rhododendron plants from seed collected by Mr. Forrest in Asia, kindly sent me by Professor Wright Smith, of Edinburgh Botanic Gardens. All trees seem to thrive in these Bath House grounds as some well-grown Liquidamber, Tulip tree, Californian Redwood, and Ginko biloba show. Conspicuous border flowering plants quickly mature and grow taller and produce finer flowers than in English gardens; Gladiolus plants five months from seed are 3ft. in height, Salvia bonfire keeps its colour well and produces an abundance of seed which is saved year after year, Zinnias do wonderfully well keeping their colour and giving a great variety of colour to the borders. Antirrhinum, Phlox and marigolds all do very well, and speaking generally grow to a height of from 50 to 100 per cent. taller than the

heights mentioned in English catalogues. Gaillardias grow 3ft. to 4ft. high, and most plants come true to strain from seed. African marigolds, however, do not come true from seed owing to hybridising with other marigolds. Some of these hybrids are very beautiful. This instance of hybridisation is interesting because it provides an instance of successful natural crossing between plants belonging to different genera. Hollyhocks (growing 14ft.), and stocks are other favourites, giving life and colour to the gardens. Daphne mezereon grows rapidly

A fine specimen of the Liquidambar in the Rotorua Gardens.

The Tulip Tree (Liriodendron) at Rotorua.

and forms clumps 6ft. to 8ft. in diameter. Didiscus does splendidly. Dahlias of all kinds are raised from seed and grow 12 to 15ft. in a single season's growth. Cannas do remarkably well and provide a rich feast of colour.

Access through the grounds is gained by means of broad roads which are dressed with pumice. One of the curiosities of the management is that motor cars are allowed to drive through the gardens, and this is often done at a good pace; the pumice dust rises in clouds and has an injurious effect on plants near the roads, and is greatly to the discomfort of pedestrians. This laxity in favour of the motorist is in marked contrast to the rule at Kew and other great gardens of the world, where motorists are rigidly excluded. The photos show some very fine specimen trees, which, it must be remembered, are all under 30 years old. Californian redwood (*Sequoia sempervirens*), the liquidamber (*Styrax*), the tulip tree, the maidenhair tree (*Ginka biloba*), the New Zealand rimu pine (*Dacrydium cupressinum*), the Wisteria 40ft. high, grown since the King's (then Duke of Cornwall and York), visit in 1901, and the celery pines (*Phyllocladus trichomanoides*), are

much in evidence, and one of the most interesting horticultural demonstrations is that the rimu and other New Zealand pines, which normally require a nurse crop of scrub or small forest in their juvenile stage of first 50 years or so, may here be grown in the border with no shade protection. This is probably entirely due to the soil conditions, which are at the optimum for this class of tree.

Criticism which has been advanced against the organisation of this garden is that there is too much devoted to the old formal carpet bedding style of work. This is undoubtedly a just comment, but one that can only be removed by substituting modern horticultural ideals for the old-fashioned formal style of laying out pleasure gardens. It is in this aspect that the newer trained men may be expected to improve on their predecessors. The management of the Kew Gardens, handicapped as they are by proximity to London smoke and fog, and to hard winters, nevertheless excel in exhibiting colour, form, and scent in flowers grown in the open. This is due to taste as well as training, and it is precisely this taste which makes all the difference between the merely good and the excellent in landscape gardening.

NOTES ON THE AVOCADO IN NEW ZEALAND.

By Geo. A. Green.
Dominion Organiser of the New Zealand Institute of Horticulture.

It seems strange that a country like New Zealand, which has been settled by a European population for nearly 100 years, and has imported and acclimatised trees and plants from every Continent, and from the "Islands of the Seven Seas," should have neglected the Avocado for so long. There are no records that any Avocados were ever planted in New Zealand till within the last 20 years, and then most of those tried have been seedlings. The general impression seems to have been that the fruit was purely tropical, and that it was not suitable for the New Zealand climate.

Californian Experiences.—The success of Californian experiments with Mexican varieties and their hybrids, recently stimulated the State Horticultural Division, and a number of others interested in new plants to make a few introductions of this plant.

Climate of North New Zealand.—The portions of the North Island between latitudes 30 and 40 degrees, within which lies the citrus belt (largely on the coast), enjoy a comparative freedom from frost, varying from frost-free country to areas where occasional frosts are experienced up to 10 or 12 degrees. It is within this belt that the Avocados are being tried out.

Avocado Trees in New Zealand.—Most of the Avocado trees growing in New Zealand are seedlings, the only exceptions being a few trees in the Government Experimental Station at Tauranga, on the East Coast of the North Island, a few at the nursery of Mr. A. Allison, at Wanganui, on the West Coast and some few trees that he has distributed thereabouts.

Tauranga.—As far as can be gathered, the trees at Tauranga imported by the New Zealand Government a number of years ago are the only ones that have ripened fruit here. The named varieties at Tauranga are "Lyon," "Northrup," "Harmon," and "Mirserve." Of these the "Lyon" fruited at six years old, and "Northrup" at nine year old, "Harmon" has blossomed well for the past four seasons but has not set any fruit. The other variety has not blossomed yet. Mr. J. H. Davidson, who has charge of them, says that they are liked by his family, and when dead ripe make very appetising sandwiches. He reports that the seeds of the "Lyon" were sown and grew readily; they appear by foliage to be identical with the parent. The seedlings now in the third year are making excellent growth. Mr. Davidson reports that his older trees are growing on light, warm, sandy loam soil, and they have made wonderful progress. In the young stages manure does not appear to have any effect on the growth one way or the other, but possibly the case would be different when the trees are in full fruit. The frosts experienced are not more than 4 or 5 degrees, and the only tree affected by it has been "Mirserve." No disease has been noticed, the only pests have been thrips, which have been somewhat troublesome.

Wanganui.—Mr. A. Allison reports that he has had upwards of 10 years' experience in New Zealand with seedlings of the pure Mexican

type and that he finds that the lighter the soil the better they succeed. At the time of writing (March, 1927), he had several hundred seedlings of the Mexican variety, with one tree now 10 years old. All are doing well, being healthy and vigorous. The old Mexican seedling has flowered quite freely for several years now. Imported Mexican-Guatemalan hybrids planted out a little more than a year have now recovered and are growing vigorously and flowering freely. Mr. Allison reports that he has the following named worked varieties, most of which have flowered, but as yet none have produced fruit, *i.e.*, Calicente, Dorothea, Fuerte, Lyon, Mayapan, Northrup, Puebla, and Spinks. He is confident that the Avocados will be a success in the Dominion. It is of interest to know that at Mr. Allison's place frosts up to 10 to 12 degrees are often experienced in the winter.

Gisborne.—Mr. Geo. H. McIndoe, the Government Orchard Instructor, who is keenly interested in sub-tropical horticulture, informs me that in his district Avocado seedlings from Ceylon are growing satisfactorily. Others from Cook Island seed have not done so well, but it is suggested that the dry season may have accounted for this. There are four trees—seedlings of unknown origin—four years old in the Gisborne district which have stood 10 degrees of frost on three occasions without injury. All are healthy and vigorous and appear suited to the locality.

Auckland and Northwards.—Mr. W. Shaw, of Pohuehue, Warkworth, has been experimenting with seedling Avocados of both Mexican and Guatemalan origin for some years past. These are growing on somewhat heavy soil. At first they did well, but latterly they have not been growing so freely, and some have died out. Mr. Shaw is satisfied it is the soil conditions that are at fault. Mr. W. Poynton, of Epsom, Auckland City, has a few seedling trees five years old from the same stock as Mr. Shaw's. These with one exception are growing well. The largest is now about 12ft. high; the soil is light, well drained volcanic land, almost frost-free. This seems another indication that the Avocado requires a light, loamy, well-drained soil if it is to succeed. In the far North, where the Avocado should succeed best, the writer only knows of one tree. This is a seedling about 10 years old. It is growing in a warm, sunny spot free from all frosts. Its origin is unknown—someone brought a large fruit to New Zealand and from the stone this tree grew. It is not a particularly happy specimen, only about 6ft. high and is very yellow in colour, except for a few weeks in the middle of the summer, when it turns green. There appears to be no doubt that this variety is one from the tropics and wholly unsuited to the climatic conditions of North New Zealand.

Conclusion.—There would appear to be every chance of the better classes of Avocado hybrids as grown in the coastal lands of California succeeding well on the citrus belts of the North Island and in a few favoured spots in the north of the South Island of New Zealand. Considerable experimental work will, however, have to be carried out on varieties, soils and root stocks before the New Zealand-grown Avocado will find any considerable place in the fruit markets of the Dominion. Notwithstanding this, with the experience of California to guide us, the testing out and stablising of suitable varieties should only be a question of a relatively short time.

NEW ZEALAND (NELSON), ALPINE AND ROCK GARDEN SOCIETY.

Gardeners who are interested in the importation of flowering plants will be glad to learn that the New Zealand (Nelson), Alpine and Rock Garden Society has lately been successful in landing a consignment of over 400 different species and varieties of rock garden plants from England. This goes far to prove that, when proper precautions are taken, it is quite possible to obtain plants from abroad which hitherto gardeners had despaired of being able to acquire. The plants were packed in the Home nurseries on January 5, and opened out in Nelson on March 22, having thus remained in the cases nearly 11 weeks, the steamer having been delayed in Auckland a fortnight on account of the visit of the Duke and Duchess of York. Only three plants were dead, but the writer of this note would not anticipate that no further casualties might follow. Imported plants, though apparently healthy on arrival, sometimes do not survive the process of acclimatising. The cases came from three different nurseries, and they disclosed three different methods of packing. Anyone sufficiently interested in the matter may obtain details from the hon. secretary (Mr. Wilkinson), Nelson.

In addition to expert packing and quick transit, suitable temperature during the journey is a prime necessity for success. It is quite useless having the stuff sent with ordinary cargo; but it must be placed either in the ship's cool vegetable store or other similar compartment. If the plants leave England in January, they will be in the middle of their dormant period, and a further two months in cool storage will not disturb them greatly. Even the darkness of the packing case should not be unnatural to those species that come from anywhere near the snow line.

The society instructs the shipper to notify the nurserymen of the exact date of sailing, and the plants are packed and despatched so as to reach the shipping company with a day to spare. Among the 400 plants received are the following good things:—*Gentiana Crevidens*, a Japenese species with spikes of rich blue flowers; *Potentilla ambigua; P. flagelliformis*, another Japanese species, with downy foliage and large yellow flowers; *P. pygmaea*, with bronzy foliage; *P. tonguei*, a good alpine hybrid, with flowers of orange terra-cotta; *Dracocephalum japonicum*, a Japanese form with light blue flowers; *Linnaea borealis*, a rare and pretty native of British pine woods; *Mertensia primuloides*, a choice plant with flowers of intense blue, shaded turquoise and violet, with orange eye; *Morisia hypogaea*, a rarity from Corsica, emerald rosette with brilliant yellow almost stemless flowers; *Mimulus Lewisii alba*, a new plant in gardens, the snow-white flowers resembling large gloxinias; *Pentstemon Davidsonii*, the most brilliant of the alpini pentstemons, with grey leaves and flowers "the most astounding ruby-red"; *Pyrola rotundifolia*, one of the finest of the winter-greens, having waxy lily-of-the-valley flowers and delightful fragrance; *Saxifraga Myra*, a *Kabschia saxifrage* raised by the late Reginald Farrer, with large blossoms of warm cherry-red; *Soldanella montana*, the largest of a lovely race, with big, fringed lavender bells; *Adenophora Bulleyana*, a new bell-flower from China; *Adonis amurensis*, cousin of the

"Pheasant's Eye," from Manchuria; *Douglasia vitalana*, sometimes called *Androsace*, a close mat with clear gold flowers; and *Cotyledon simplicifolia*, which C. Elliott describes as resembling "grotesque willow-pattern catkin trees."

In addition to these there are numerous other saxifrages, campanulas, aubretias, auriculas, drabas, crodiums; fine new herbaceous plants in phloxes, irises, funkias, heleniums, hemerocallis, bocconia, etc., all of which will, in time, become available for distribution, along with the society's present collection to the members.

Mr. Wilkinson, the energetic secretary of the Nelson Rock Garden Society, reports under date of May 11, that he has just returned from Arthur's Pass (Otira), with a wonderful collection of over 1,000 native plants.

NOTES ON ENGLISH DAFFODILS, 1927.

COMPILED BY N. R. W. THOMAS.

The spring in England this year was late—so much so that varieties were estimated to be flowering two weeks later than usual.

The chief Shows were, of course, the London Daffodil Show on the 13th and 14th April, and Birmingham on the 21st and 22nd April.

The London fixture was remarkable for the great number of red cups shown. Firetail in particular being noted as "the variety of the Show," while "that extraordinary Mrs. R. O. Backhouse" attracted a great deal of attention. The prizes were fairly evenly divided amongst the better known growers though there were a few fresh names in the lists.

The Birmingham Show was a pronounced success from many points, but probably to none more than my old friend Guy L. Wilson, who secured one First Class Certificate, four Awards of Merit, as well as seven First Prizes, three Challenge Cups, the White Daffodil Trophy and three Medals.

Among the winners in the amateur classes at both London and Birmingham, was one of the erstwhile best known exhibitors in the Auckland district in the person of Mr. H. A. Marriner, late of Auckland.

"Loyalty," the Bi-colour Trumpet raised by Professor A. P. W. Thomas, was noted as being shown in good form by The Donard Nursery Co. at the London Show.

The Royal Horticultural Society is conducting trials of Daffodils at Wisley, and has selected certain varieties to be grown there as standards—it is hoped to be able to publish this list before long.

"Venetia," a well-known *Triandrus Hybrid*, was the first variety to receive (26/4/27) an Award of Merit "for cutting" from the Royal Horticultural Society, under the new regulations "as it has been on trial at Wisley."

Single Bloom classed at London and Birmingham respectively, resulted as under:—

1a Royalist (1)	Master Robert (2)	A 437 (1)	Brimstone (2)
1b Beersheba	Callirhoë	Beersheba	White Empress
1c Queen of Ulster	Seedling	?	?
2a Arvill	Valdimar	R.I.	112-23-18
self/			
2a Nx3602	Fortune		
red cups/			
2b Solario	Revenge	Olwen	98-23-18
no red/			
2b Nx4100	Tolvin		
red/			
3a Seraglio (1) &	(2)	Seraglio (1) &	(2)
3b King of Clubs	Therapia	Sacrifice	Sunstar
4a Mitylene	Suda	Mitylene 1 &	2
4b Honeymoon	Samaria	Samaria	St. Ilario
5 Harvestmoon	Icicle		
(Trumpet)			
5 (cup) Venetia	Madonna	Venetia	1058
6 Orange Glory		7 VI. 23	Flycap
7 Golden Goblet		Buttercup 1 &	2
8 Glorious Xerxes		Peerless	
9 Dactyl	Horace	Snow King	Dulcimer
10 B96	Rubina	Seedlings	

From the above lists it will be noted that the R.H.S. is gradually moving towards a further subdivision of the Incomps (Class 2) into those with or without red cups.

The slight difference between some of the classes was again emphasised when "Eskimo" received an Award of Merit from the R.H.S. as a White Trumpet; some of the members of the Narcissus Committee considered it a Giant Leedsii 4 (a).

Two First Class Certificates were granted, one each by the Royal Horticultural Society, and the Midland Daffodil Society, and both for that magnificent Leedsii (*Mitylene*) which is too well-known to need description. The awards went to Messrs J. L. Richardson and Guy L. Wilson.

Royal Horticultural Society awards were granted as follows:—
follows:—

Awards of Merit.

Granted to

Suda 4 (a)	Eskimo 1 (b)	Holland's Glory (Double)
Mephisto (*Barrii*)	St. Egwin (*Incomp*)	Scarlet Perfection (*Incomp*)
Therapia (*Barrii*)	Turin (*Barrii*)	Grackle (*Incomp*)
Venetia (*Triandrus*)	Mayflower III. (a)	

Certificate of Appreciation.

Engleheart's White Rose (Double).

Prelinminary Commendation.

Red Sea

Selected for Trial at Wisley.

Papyrus	Nanette	Snowsprite	Duddington
Kingsley Fairbridge		Penny-come-quick	
Mayflower		Pride of the Market	

MIDLAND DAFFODIL SOCIETY.

Awards of Merit.

Hopeful (*Incomp*)	Flava (*Incomp*)	His Excellency (la)
Queen of Ulster (lc)	Peggy Briscoe (*Incomp*)	Simple (Leedsii)
Snowsprite (Double)	Dactyl (*Poeticus*)	Ditty (*Poeticus*)
	Silver Rose (Double)	