The JOURNAL of THE SCOTTISH ROCK GARDEN CLUB

VOLUME XIV Part 2
No. 55

SEPTEMBER 1974

Editor P. J. W. KILPATRICK • 10 Eglinton Crescent • Edinburgh • EH12 5DD

Obtainable from
Dr. D. M. Stead • Esk Hause • Bishop's Park • Thorntonhall • Glasgow

Price to Non-Members **70p**, post free 75p

The JOURNAL of THE SCOTTISH ROCK GARDEN CLUB

VOLUME XIV Part 2
No. 55

SEPTEMBER 1974

Editor P. J. W. KILPATRICK · 10 Eglinton Crescent · Edinburgh · EH12 5DD

Obtainable from
Dr. D. M. Stead · Esk Hause · Bishop's Park · Thorntonhall · Glasgow

Office-Bearers for the Year 1974

Honorary President

Professor J. R. MATTHEWS, C.B.E., M.A., LL.D., F.R.S.E., F.L.S., V.M.M., Duncruib, Rosehill Crescent, Banchory, Kincardineshire

Honorary Vice-President

Sir GEORGE TAYLOR, D.SC., F.R.S., F.R.S.E., F.L.S., V.M.H., Belhaven House, Dunbar, East Lothian

President

Mr. ALFRED EVANS, Royal Botanic Garden, Edinburgh

Vice-Presidents

Mr. A. CAMPBELL, W.S., 40 Dick Place, Edinburgh, 9
Miss H. M. LOGAN HOME, Edrom Nurseries, Coldingham, Berwickshire
Major-General D. M. MURRAY-LYON, D.S.O., M.C., Ardcuil, Pitlochry, Perthshire
Mr. DAVID LIVINGSTONE, 3 Duddingston Gardens South, Edinburgh, 15
Dr. JAMES DAVIDSON, F.R.C.P., Linton Muir, West Linton, Peeblesshire
Mr. JOHN L. MOWAT, S.H.M., V.M.M., Craggan, Ceres, Fife
Mr. DAVID ELDER, 9 Christie Street, Dunfermline, Fife

COUNCIL

President

Mr. ALFRED EVANS, Royal Botanic Garden, Edinburgh

Vice-Presidents

Mr. DAVID LIVINGSTONE, 3 Duddingston Gardens South, Edinburgh, 15
Major-General D. M. MURRAY-LYON, D.S.O., M.C., Ardcuil, Pitlochry, Perthshire
Mr. JOHN L. MOWAT, S.H.M., V.M.M., Craggan, Ceres, Fife
Mr. A. CAMPBELL, W.S., 40 Dick Place, Edinburgh, 9

Ordinary Members

(*To retire in November* 1974)

Dr. PETER HARPER, 24 Orchardhead Road, Edinburgh, 16
Mr. ANGUS C. SMALL, 2 Kensington Drive, Giffnock, Renfrewshire
Dr. D. M. STEAD, Esk Hause, Bishop's Park, Thorntonhall, Glasgow
Mr. JAMES T. AITKEN, 75 Whitehouse Road, Edinburgh, 4

(*To retire in November* 1975)

Mr. J. D. CROSLAND, Treetops, Torphins, Aberdeenshire
Mr. J. DRAKE, Inshriach, Aviemore, Inverness-shire
Mr. ALFRED EVANS, Royal Botanic Garden, Edinburgh
Mrs. JILL SLEIGH, 18 Garscube Terrace, Edinburgh
Miss MARGARET THOMSON, 17 Craigdhu Road, Milngavie, Dunbartonshire

(*To retire in November* 1976)

Mr. M. G. ADAIR, 307 Churchill Drive, Glasgow G11 7HE
Mrs. B. B. CORMACK, 199 St. John's Road, Edinburgh 12
Dr. D. C. GRAHAM, 84 Caiystane Gardens, Edinburgh EH10 6SY
Mrs. E. IVEY, Northbrae, Courthill Street, Dalry, Ayrshire
Mrs. K. MITCHELL, 1 Muirfield Crescent, Dundee

Honorary Editor

Mr. P. J. W. KILPATRICK, 10 Eglinton Crescent, Edinburgh, 12

Honorary Publicity Manager

Mr. W. H. IVEY, Northbrae, Courthill Street, Dalry, Ayrshire

Honorary Publications Manager

Dr. D. M. STEAD, Esk Hause, Bishop's Park, Thorntonhall, Glasgow

Angus Group Seed Exchange, Hon. Manager

Miss J. HALLEY, 16 Abercrombie Street, Barnhill, Dundee

Honorary Curator of Davidson Slide Library

Mr. R. S. MASTERTON, M.R.C.V.S., Cluny House, Aberfeldy, Perthshire

Honorary Overseas Liaison Secretary

Mrs. K. S. HALL, 93 Whitehouse Road, Edinburgh, 4

Honorary Subscription Secretary

Mr. R. H. D. ORR, C.A., 70 High Street, Haddington, East Lothian

Honorary Treasurer

Mr. JOHN HALL, 19 Coquet Vale, Felton, Morpeth, Northumberland

Honorary Secretary

(Vacant)

Chairman of the Standing Committee of Group Conveners:

Mrs. D. M. STEAD, Esk Hause, Bishop's Park, Thorntonhall, Glasgow

Chairman of the Standing Committee of Show Secretaries:

MRS. S. MAULE, 578 Lanark Road West, Balerno, Midlothian

Auditor

Mrs. J. R. PONTON, C.A., The Gardens, Kirknewton, Midlothian

Contents

VOL. XIV PART 2 SEPTEMBER 1974

SRGC PUBLICATIONS

THERE is a wealth of useful information in back numbers of the Club's *Journals*. Current availability and prices are as follows:—

	Price per copy, post free to members		
Journal No.	*Pence*		*U.S. Dollars*
1 to 6	100	When available	2.60
7 to 14	40		1.05
15 to 17	100	When available	2.60
18 to 20	40		1.05
21	60		1.60
22 to 26	30		0.80
27	60		1.60
28	30		0.80
29	60		1.60
30 to 53	30		0.80
54 onwards	40		1.05
George Forrest Book	125		3.25

Stocks of the available *Journals* in the 1-35 range are becoming low and Members who wish to complete their runs should bear this in mind.

Waiting lists are kept for *Journals* not available now.

The Club will be glad to receive or buy *Journals* in the 1-35 range. Members who have good runs of the early numbers are asked to make provision for their useful disposal when their own need passes.

There is a demand for copies of "Dwarf Conifers" by Hillier and offers would be welcome.

All correspondence about publications should be addressed to the Hon. Publications Manager:—

Dr. D. M. STEAD,
ESK HAUSE,
BISHOP'S PARK,
THORNTONHALL,
GLASGOW G74 5AF.

Papers by the late Henry Tod

Ph.D., F.R.S.E., S.H.M.

As WILL be known to most Members of the Club, Henry Tod in the course of his work, formerly in the Department of Chemistry and latterly in the Department of Soil Science, Edinburgh and East of Scotland School of Agriculture, published many papers on the subjects of calcium and magnesium as they affect Rhododendrons. He also did research on nitrogen sources for Rhododendrons and on the causes of Chlorosis in that Genus.

These papers have appeared in various publications. It is thought appropriate that these should be collected and published together.

The Editor would like to express gratitude to the Editors of the Royal Horticultural Society's Rhododendron and Camellia Handbook, of the Alpine Garden Society's Quarterly Bulletin, and of the Gardeners' Chronicle/HTJ, in which these papers originally appeared, for permission to reproduce material which were published in their pages. Permission has also been granted by the Edinburgh and East of Scotland School of Agriculture and by Dr. Mary Tod.

High Calcium or High pH?

A Study of the Effect of Soil Alkalinity on the Growth of Rhododendron

(Reprinted from the *Journal* of The Scottish Rock Garden Club, April 1956)

IT IS well-known that almost all Rhododendrons and many other members of the Ericaceae will not grow on soils which contain free lime. As far as can be found in the literature, however, it is not known whether this is due to the alkalinity of the soil, i.e. a pH effect, whether the toxic action is due to calcium *per se*, or to a deficiency of some other element induced by the excess of calcium in the soil.

It seemed of interest to show whether this effect of a lime-rich soil was due to a high pH by producing alkalinity by a means other than lime, and accordingly the experiment here described was started in June 1950.

Hogenson (1906) reported an experiment where azaleas and Rhododendrons were potted up in a soil to which had been added lime in a proportion of 1:160. These failed completely, but if an equal amount of "sulphate of magnesia" was added to the mixture, the plants grew on normally. More recently Hills (1950) has reported similar findings, and recommends magnesium sulphate for the treatment of calcifuge plants which are showing yellowing of foliage and failure in the presence of lime in the soil. Coville (1923) reported the use of magnesium sulphate and also of aluminium sulphate with the same effect.

These findings suggested that fairly large does of magnesium were not harmful to rhododendrons, and that it might be possible to raise the pH very considerably using magnesium carbonate.

The species used was *Rhododendron davidsonianum*, one of the Triflorum series, quoted by Hanger (1949) as producing an optimum growth at about pH 5.7. The seedlings were kindly supplied by Mr. E. E. Kemp, Curator of the Royal Botanic Garden, Edinburgh.

The compost used was a mixture of an acid soil from an old felled wood, which was known to be very low in calcium, and ordinary granulated peat. Both soil and peat were riddled to avoid the inclusion of any coarse mineral matter which might break down to release nutrients and upset the balance.

The compost so made was divided into three lots. One (23 lb.) for the Control group, was used as made ; to the second batch of compost (22½ lb.) was added 85 gm. magnesium carbonate (pure, Ca-free) and to the third (of 24½ lb.) was added 153 gm. magnesium carbonate. These quantities of magnesium carbonate were calculated on the "Lime Requirement" figure found for the compost by the I.S.S.S. Titration Curve Method (1933), converting the Ca values to $MgCO_3$, to produce pH values of approximately 7 and 8.

To each of these batches was added one gram of pure diammonium phosphate to give the seedlings a reasonable chance of establishing themselves.

The pots used were of fireclay, eight inches in diameter and eight inches deep, cylindrical, and coated on the inside with bitumen paint to render them completely inert (Nicholas 1948). One seedling was planted in each pot, and the pots were kept watered with either rain water or else softened water.

SOIL RESULTS

In October 1950, after a period of time allowed for the compost to stabilise and reach an equilibrium, soil samples were taken with a fine auger from the pots and analysed, giving the following results:—

TABLE I

Treatment	*pH*	*Potassium*	*Phosphate*	*Exch. Ca.*
Control "O"	4.7	Medium Low	Very Low	0.25 m.e. per 100 gm. soil
I	6.8	Medium	Very Low	0.38
II	8.4	Medium	Very Low	0.36

The above variation in exchangeable Calcium is within sampling error, considering the heterogeneous mixture of peat and soil, etc.

After three and five years, the soil analyses were as follows:—

TABLE II

Control "O"	1953	5.2	Very Low	Very Low	0.87
	1955	5.3	Very Low	Very Low	0.81
I	1953	6.8	Low	Very Low	1.19
	1955	7.1	Low	Very Low	1.27
II	1953	7.9	Low	Very Low	1.05
	1955	7.8	Low	Very Low	1.15

There are two possible explanations for the rise in exchangeable Calcium. The first is that the greenhouse in which the pots were kept for the first two years or so was made of concrete, and possibly the rainwater from the roof was contaminated by the fresh concrete surface (it will be noted that there is no comparable rise from 1953 to 1955 as against 1950 to 1953), and secondly the decrease in the organic matter content of the compost due to normal oxidative changes in the compost.

PLANT RESPONSE

In such a poor mixture, strong free growth could not be expected, but all the seedlings made slow, steady progress. In each group the colour of the foliage was the normal green with no signs of the characteristic yellowing which occurs in soils of high pH.

Little difference could be seen between the treatments, though perhaps the branches were rather thinner in groups I and II. The approximate dimensions are given in Table III for the three groups. This year (1955) the plants flowered for the first time, the earliest being treatment "II", followed a week later by "I" and ten days after that the control group "O". In October the plants were cut off at ground level, dried and milled for analysis. The dry-matter weights are also given in Table III and they show that there was a certain depression of growth at the higher pH values which had been indicated by the rather thinner shoots mentioned above.

TABLE III
PLANT DIMENSIONS

Group		*Dry Weight*	*Height*	*Circumference*
"O"		8.2 gm.	11 in.	20 in.
		12.1	10	22
		14.7	11	21
		13.1	11	23
	Mean	12.0	11	21½
"I"		9.5	11	23
		9.1	10	22
		9.5	11	18
		10.0	12	19
	Mean	9.5	11	20½
"II"		7.5	13	14
		9.0	10	16
		6.7	9	16
		12.8	12	23
	Mean	9.0	11	17

The analytical findings for the three groups will be found in Tables IV and V, where they are expressed as in the Dry Matter and in the Silica-Free ash respectively, and these variations are shown graphically in Figs 1 & 2 on page 90. Analyses are given as well for tissues from a plant of *Rhodo. davidsonianum* grown under normal garden conditions for comparison, the soil pH being, however, somewhat higher.

TABLE IV
ANALYSES ON A DRY MATTER BASIS

	O	I	II	*Normal Garden Control*
Soil pH	5.3	7.1	7.8	5.9
%N	0.70	0.77	0.84	1.00
%CaO	1.27	0.83	0.70	1.24
%MgO	0.46	0.96	1.13	0.21
%K_2O	0.94	0.67	0.60	0.60
%P_2O_5	0.27	0.33	0.33	0.18
Mn (ppm)	1400	176	122	285

TABLE V

AS PERCENTAGES OF THE SILICA-FREE ASH

	O	I	II	*Normal Garden Control*
Soil pH	5.3	7.1	7.8	5.9
% Silica-free ash	3.93	3.31	3.06	2.49
%CaO	32.3	25.1	22.9	49.8
%MgO	11.8	28.8	37.0	8.60
%K_2O	23.9	20.3	19.7	24.1
%P_2O_5	6.85	9.95	10.8	7.22
Mn (ppm)	35,000	5,320	3,990	11,450

As a comparison with other Rhododendrons growing in a more or less naturalised state, Tables VI and VII show the comparison of group O and the normal garden control with specimens from a variety

TABLE VI

In the Dry Matter

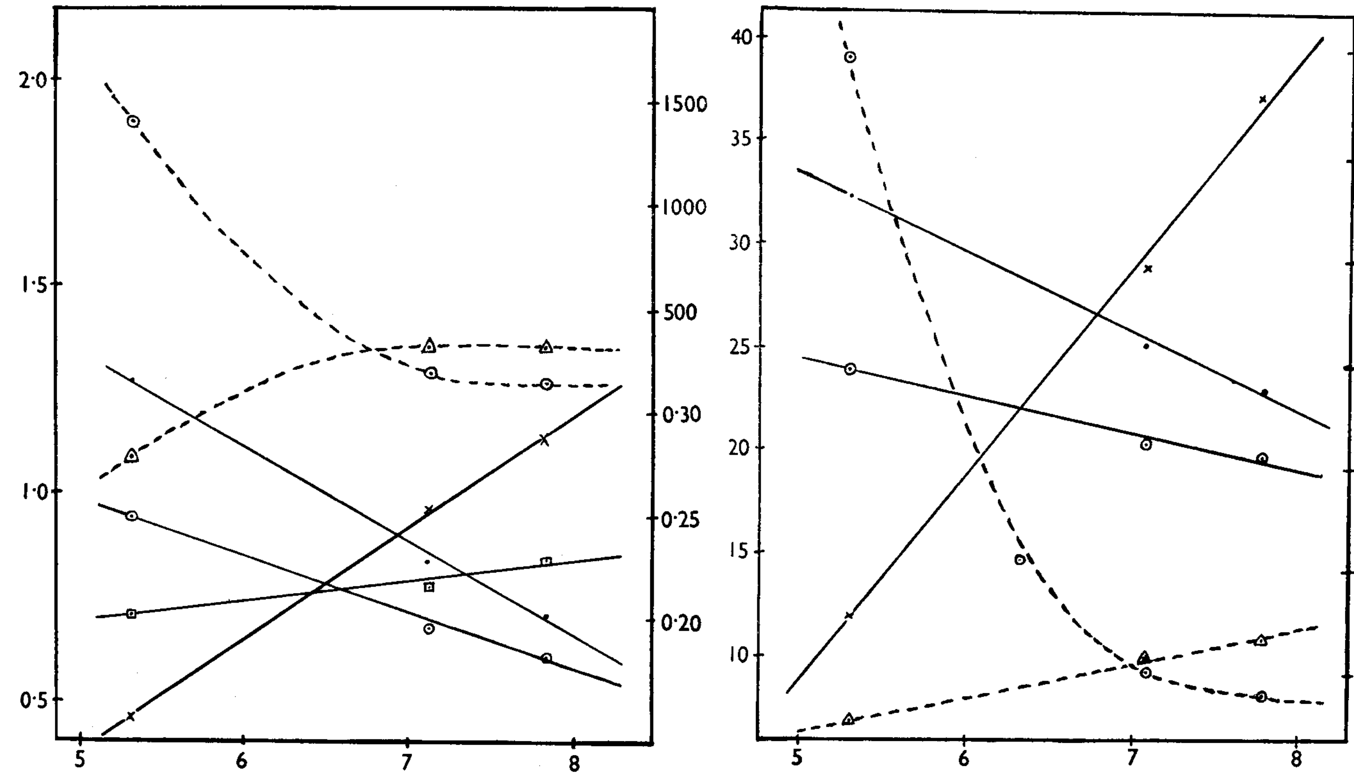
	Rhododendron ponticum							*Rhododendron davidsonianum*	
	A	B	C	D	E	F	G	"O"	*Garden*
Soil pH	4.5	4.9	5.3	5.5	6.0	6.3	—	5.3	5.9
%CaO	2.03	2.00	1.82	1.58	1.75	2.24	1.28	1.27	1.24
%MgO	0.55	0.66	0.79	0.78	0.58	0.53	0.91	0.46	0.21
%K_2O	1.15	1.12	0.88	0.91	1.03	1.15	0.94	0.94	0.60
%P_2O_5	0.20	0.23	—	0.12	0.48	0.27	—	0.27	0.18
Mn (ppm)	588	533	760	624	874	312	205	1400	285

TABLE VII

In the Silica-Free Ash

Soil pH	4.5	4.9	5.3	5.5	6.0	6.3	—	5.3	5.9
%S.F.A.	4.41	4.38	4.20	3.46	4.99	4.51	3.49	3.93	2.49
%CaO	46.0	45.6	43.3	45.7	35.0	49.7	36.6	32.3	49.8
%MgO	12.2	15.3	18.8	22.6	11.6	11.8	26,1	11.8	8.60
%K_2O	26.1	25.4	21.0	26.3	20.7	25.5	26.9	23.9	24.1
%P_2O_5	4.53	5.15	—	3.36	9.53	6.07	—	6.85	7.22
Mn (ppm)	13350	12150	18100	18000	17500	6940	5860	35000	11450

Sources of material: A Bush House, Midlothian ; B Tynninghame, East Lothian ; C Danskine, East Lothian ; D Balbeggie, Fife ; E Royal Botanic Garden, Edinburgh ; F Seafield, Midlothian ; G North of England.



KEY TO GRAPHS

FIGS. 1 & 2

Mn — CaO

P_2O_5 — K_2O

MgO

FIG. 1 ONLY

N

SCALES

Fig. 1. In the Dry Matter.

Left hand 0.5, 1.0, 1.5, 2.0 % CaO, MgO, K_2O, N.

Bottom 5, 6, 7, 8 pH.

Right hand 0.20, 0.25, 0.30 % P_2O_5

0, 500, 1000, 1500, ppm. Mn.

Fig. 2. In the Silica-Free Ash.

Left hand 10, 15, 20, 25, 30, 35, 40, % CaO, MgO, K_2O, P_2O_5

Bottom 5, 6, 7, 8 pH.

Right hand 5, 10, 15, 20, 25, 30, 35 $\times$ 1000 ppm. Mn.

of places over the East of Scotland, and one from the North of England. These are not strictly comparable, since they are from *Rhododendron ponticum* growing freely as almost completely naturalised "covert", but they may give an indication of the general mineral status of the experimental plants.

It will be seen from the foregoing analyses that the general mineral status of the experimental plants was within what are probably normal limits. For example, the phosphate figures show that the level in the high pH pots was as high, in fact higher, than in the normally-growing plants. This is probably due to a decrease in fixation as the pH increased. The manganese values are low, but evidently had not reached deficiency levels, for if this had been the case, leaf symptoms would have been visible, which they were not.

While the exchangeable calcium is raised in groups I and II, this is a very small increase compared with that which would be shown by a soil containing sufficient calcium to reach the same pH, where the calcium level would be in the order of 15 to 40 milli-equivalents per 100 gm. soil.

It would seem, accordingly, fair to say that the results show that for the three groups, of four plants each, of *Rhododendron davidsonianum*, soil pH values raised to what would be toxic levels, *if the raised pH were due to calcium*, had no serious ill effect on the growth of the plants, and that alkalinity *per se* is not the cause of the harmful effects produced by alkaline soils on "calcifuge" plants—at any rate in Rhododendron.

The writer's thanks are due to Mr. Kenneth Simpson, B.Sc., A.R.I.C., and his Staff for the soil analyses quoted in the text, and for his interest and help; also to Mr. Shearer McIntosh for the analyses of plant material.

REFERENCES

Coville, F. V. (1923). Amer. Hort. Soc. Bull. 1, 6.
Hanger, F. E. W. (1949). Rhododendron Year Book, p. 66 et seq.
Hills, L. D. (1950). The Propagation of Alpines, p. 72 (Faber).
Hogenson, J. C. (1906). Gard, Mag. (N.Y.) 4, 228.
International Society of Soil Science (1933), Smith, A. M. Trans. 2d Comm. I.S.S.S. Copenhagen 1933, *A*, 102.
Nicholas, D. J. D. (Long Ashton) 1948, Personal Communication.

Rhododendrons and Lime

Reprinted from the *R.H.S. Rhododendron and Camellia Year Book*, 1959

LIME has been the bugbear of rhododendron growers for a very long time, and many attempts have been made to elucidate the exact role that calcium plays. One of the difficulties has been to separate the effect of calcium *per se* and the effect of an alkaline soil, and it is only recently that any real light has been thrown on the question.

In 1956 the present writer (TOD, 1956) was able to show that rhododendrons could be grown in both neutral and frankly alkaline soils where the pH had been raised by the use of magnesium carbonate instead of calcium carbonate. A paper by LEISER (1957) provided an almost exact confirmation of this work from findings in the wild where *R. occidentale* was found growing at pH 7.6-8.6, the alkaline earth producing this being magnesium instead of calcium.

These results show fairly clearly that the harmful effects of lime most probably are not due to the high pH of calcareous soils, but are due to an effect of calcium itself. For many years attempts have been made to keep rhododendrons growing in areas of calcareous soil by the expedient of constructing beds of peat and/or leaf mould, of low pH, and isolating them as thoroughly as possible. Very frequently the large amount of work involved in this has been lost by the percolation of lime-rich soil-water into these beds with the usual catastrophic results. This has always seemed to the writer to suggest an effect of the calcium ion as opposed to a pH effect, for it is rather characteristic that the lime effect appears to occur more rapidly than the ''soil'' pH would be likely to change (from probably about 4.5-5 to over 7).

Recently two papers by FANNING (1957*a* and *b*) made this problem more difficult in one way and much clearer in another. He has shown that the leaves of hardwoods grown on calcareous soils are rich in calcium and that as they decompose, the proportion of calcium in the leaf-mould rises steeply. This shows why the unfortunate gardener on calcareous soil who makes up beds of local leaf-mould lands deeper and deeper in trouble—and explains many strange results hitherto inexplicable. As a result of these reports it can only be concluded that if built-up beds are to be constructed in calcareous areas for calcifuge plants they must be made up with (*a*) peat which is *not* fen peat (this latter may contain appreciable amounts of calcium) and (*b*) leaf-mould and soil imported from non-calcareous areas.

This "pure" calcium effect is a much more difficult problem to unravel as the action of calcium may occur in several different ways. The first way would be a simple poisoning of the plant by the calcium ion, in other words, a pure calcium toxicity. The other possibilities are induced deficiencies of other elements due to the presence of excess calcium—and it is extremely difficult to disentangle these conditions.

It would seem likely that the second set of effects is the more probable, since the picture shown on the leaves of rhododendrons "poisoned" by the lime is fairly typical of a deficiency of one or more trace elements. The first of these which strikes the observer is manganese deficiency as shown by the characteristic interveinal chlorosis, or marbling, shown on the leaf. Other leaves suggest magnesium deficiency —in fact a number of deficiency pictures are seen, and certainly the terminal symptom shown, an almost complete yellowish pallor, is indicative of severe iron deficiency.

It is known that calcium and magnesium are in many ways antagonistic to each other: in the presence of large excess of magnesium, little calcium is taken up by the plant, and the converse is also true. This was the basic principle used in the writer's investigation (TOD, 1956) where a soil which was naturally deficient in calcium was used, and a considerable excess of magnesium carbonate was applied. This had the effect of raising the pH and, at the same time, tending to depress the uptake by the plants of what little calcium was present.

HARTGE (1956) has collected the available data on the soils in which rhododendrons grow in their natural habitats and it seems likely that most of the reports of rhododendrons growing on limestone can be explained on one of two grounds. The first is that a humus layer has been formed overlying the calcareous soil which, with usually fairly high precipitation, remains acid and lime-free and the rhododendrons grow in this. This phenomenon is shown at a classic locus in Fife where a rich peat soil with a strong growth of calluna overlies a bed of strongly alkaline shell sand. In this case where, of course, the precipitation is low, the impedance to the movement of calcium into the peat is caused by a thin layer of clay, but in wetter areas the free downward movement of the water would have the same effect. This was very clearly shown at Minterne in Dorset, where the rainfall is of the order of 50 inches per year, fully double that of the Fife site. Here there is an area on the top of a chalk ridge, known as Minterne Seat, where the calcium has been leached by the rainfall leaving a very acid soil, pH 4.1, in which calluna and bracken are flourishing. In this case the calcium has been leached from the top soil and the fairly high precipitation has maintained the downward movement of the calcium and prevented upward diffusion of calcium from the chalk into the top soil.

The second is that the limestone is of a dolomitic type, that is, a magnesian limestone, and here the magnesium-calcium antagonism comes into play. Further, HARTGE (1956) quotes BLANK's finding that when dolomite weathers the calcium fraction is leached away first, so that the *proportion* of magnesium in the soil formed from the rock tends to rise and this, in itself, will tend to depress the uptake of the remaining calcium by the plant growing in such a soil.

If, however, one is dealing with regions of moderate rainfall with free drainage and available lime in the soil, these saving conditions will not operate, and hence the difficulty with rhododendrons on calcareous soils on the eastern side of the country. It may well be that in heavy rainfall areas on the west there are successful plantings of rhododendrons on *originally* calcareous soils where the grower has never suspected the presence of lime, as their health has been preserved by this heavy leaching.

The effect of excess lime in inducing manganese deficiency is notorious, especially in the presence of high levels of organic matter in the soil, which is, incidentally, characteristic of most "rhododendron soils", and lime also induces a deficiency of iron as is so often seen on fruit trees on calcareous soils.

With these points in view it seemed advisable to attempt to establish some "normal" values for the chemical composition of the rhododendron plant, and a number of samples of leaf material have been collected, with matching soil samples, from several gardens and areas of natural rhododendron growth. The writer would like here to express his thanks to LORD DIGBY for his kindness in making the material at Minterne available, and for his hospitality and interest in the work, and to the Curator of Benmore Botanic Garden, Argyllshire, for similar facilities, and also to numerous others who have helped with the provision of leaf and soil samples. In the table of analyses (Table I) the calcium, magnesium, potassium and phosphate values are expressed as milli-equivalents of the element per 100 g. dry matter, but iron and

TABLE I

Species	Ca	Mg	K	PO_4	Fe	Mn	*Soil* pH	*Locus*
ponticum	72.5	27.5	24.4	8.45	88	588	4.5	*A*
	71.5	33.0	23.8	9.73	64	533	4.9	*B*
	65.0	39.1	18.7	—	220	760	5.3	*C*
	56.5	39.1	19.3	5.07	114	624	5.5	*D*
	62.5	29.0	21.9	20.3	350	874	6.0	*E*
	80.0	26.5	24.4	11.4	204	312	6.3	*F*
	45.5	45.9	20.0	—	180	205	—	*G*
	65.3	21.5	22.3	9.28	81	279	4.5	*H*
	72.7	22.0	7.0	5.49	108	189	5.1	*J*
davidsonianum	44.5	10.8	12.8	15.8	218	285	5.9	*F*
	45.5	23.3	20.0	26.1	192	1400	5.3	Exper. soil
falconeri	73.8	27.0	16.8	21.1	165	1100	4.2	*E*
	115.0	26.0	7.6	10.6	94	2590	4.4	*H*
fortunei	77.9	23.0	17.1	9.71	84	1228	4.8	*L*
	81.5	19.0	14.9	9.70	90	530	5.5	*H*
hodgsonii	89.1	32.5	14.6	12.2	80	2311	4.7	*L*
	103.0	26.0	8.7	12.3	68	2720	4.5	*H*
irroratum	48.1	25.0	17.2	8.45	53	305	4.6	*L*
	36.5	16.5	7.4	7.18	49	144	5.2	*H*
calophytum	68.6	25.0	19.4	13.1	85	410	4.7	*E*
praestans	55.0	18.5	12.1	7.18	66	750	4.3	*H*
sidereum	59.6	17.5	11.3	7.59	61	763	4.3	*H*
sinogrande	58.9	21.5	13.4	9.28	88	492	4.4	*H*
triflorum	45.7	14.5	10.2	10.6	89	542	4.0	*K*
yunnanense	43.6	17.0	20.4	9.70	240	501	4.0	*K*

Locus: *A* Bush House, Midlothian; *B* Tynninghame, East Lothian; *C* Danskine, East Lothian; *D* Balbeggie, Fife; *E* Royal Botanic Garden, Edinburgh; *F* Seafield, Midlothian; *G* North of England; *H* Benmore Botanic Garden; *J* Ardcuil, Pitlochry, Perthshire; *K* Sunningdale Nurseries, Surrey; *L* Minterne, Dorset.

manganese as parts per million as the amounts are so very much smaller.

Table II gives the range of values found for healthy rhododendron leaves (from Table I), compared with the range found in the leaves of healthy woody plants quoted by WALLACE (1951) and as found in the College Laboratory. It will be seen that the levels for magnesium, potassium and phosphate tend to be lower than in the other plants, while the levels for iron and manganese are higher, a predictable finding since, in general, the pH values are lower in rhododendron soils, leading to a greater availability of these elements. By contrast the range for calcium in rhododendron lies much closer to the "other plants" range and this finding is quite striking when it is realized that

TABLE II

Element	*Wallace*	*College*	*Rhododendron*
Ca	57-157	32-180	36-115
Mg	20- 31	15- 70	11- 39
K	36-108	11- 64	7- 24
PO_4	18- 28	8- 34	5- 26
Fe	65-200	—	53-350
Mn	30- 64	20-300	144-2720

rhododendrons grow in acid soils, where the calcium content will usually be considerably lower than than in the soils in which the "other plants" grow at much higher pH levels. This would seem to suggest that the genus *Rhododendron* has greater facility for collecting calcium than the other genera, and the problem of the rhododendron in a calcareous soil may possibly be linked with an excessive uptake of calcium, leading to a general mineral imbalance.

Table III shows analytical figures for leaves showing severe deficiency symptoms. These were from plants growing in the Rhododendron House at the Royal Botanic Garden, Edinburgh, where the soil in the beds had become impregnated with lime derived, most probably, from the ashes applied to the paths between the beds. When

TABLE III

Species	Ca	Mg	K	PO_4	Fe	Mn	*Locus*
kyawi	61.4	53.4	25.9	11.8	214	12	*E*
nuttallii	62.5	41.8	15.3	3.8	56	23	*E*

the leaf samples were taken, the beds had just been re-soiled so that the soil pH values were not really relevant, and are not quoted.

As will be seen, the manganese figures are low in relation to the manganese range for rhododendron, but unfortunately it has not been possible to get normal leaf samples of these two rhododendrons for a comparison of "healthy" and "affected" for each species.

The great difficulty of an investigation such as this is that as soon as symptoms develop in a rhododendron, the grower tends either to move it or else to modify the soil in which it is growing or, more commonly, the symptoms appear on young plants where it is almost impossible to get enough leaf material for analysis. The writer would appeal most earnestly for any grower of rhododendrons who is troubled with this problem to get in touch with him as soon as possible. The number of leaves required for analysis is of the order of eighty for small-sized leaves, fifty medium-sized and twenty-five large.

The writer would like to express his thanks to Dr. DAVID PURVES and Mr. SHEARER MCINTOSH for the analyses of plant material and, as mentioned above, to all those who have been so helpful in giving access to plant material in their gardens. The identification of all the species quoted in this paper has been kindly verified by Mr. H. H. DAVIDIAN, B.Sc.

REFERENCES

Fanning, J. P. (1957*a*). *Gdnrs' Chron.*, **141**, 102.
Fanning, J. P. (1957*b*). *Ibid.*, **141**. 401.
Hartge, K. H. (1956). *Rhodod. und immergr. Laubgeholze Jb.*, 27.
Leiser, A. T. (1957). *Rhodod. Yearb.*, **11**, 47.
Tod, H. (1956). *J. Scott. Rock Gdn Cl.*, **5**, 50.
Wallace, T. (1951). *The Diagnosis of Mineral Deficiencies in Plants*, p. 34.

Mineral Deficiencies in Rhododendron

(Reprinted from the R.H.S. *Rhododendron and Camellia Yearbook*, 1961)

THIS NOTE is by way of being an "interim report" and is submitted for publication as the results reported are of rather an unsuspected nature.

The present writer appealed in an earlier article[1] for leaf and soil

[1]Tod, H. (1959) Rhododendron and Camellia Year Book p. 19.

samples from ailing rhododendrons, and this appeal was reprinted in the Society's Journal, from whence it reached some other gardening publications. The result has been a series of twenty-three sets of matching samples, the last five of which have been sent through the co-operation of Mrs. M. D. Bennett of Messrs. Geigy, Ltd.

These samples showed all sorts of variations of chlorosis of the leaf, with some very startling colour schemes in yellows, oranges and reds, but perhaps the oddest feature was that most of the senders commented that they had acid soils, and that there was no question of lime being the cause of the trouble. In sixteen of these cases the soil pH showed this to be true, the pH values ranging from 3.6 to 6.2, while six of the others were near to, or just past, neutrality.

This, then, was the first major surprise, as it has usually been assumed that leaf chlorosis in rhododendron is caused by a high lime content of the soil. The second unexpected finding was the real cause of the trouble which, in nineteen of the twenty-three was either magnesium deficiency (8 cases), potassium deficiency (2 cases), or combined magnesium and potassium deficiencies (9 cases). The six cases with high soil pH values were also interesting, for these also showed low magnesium and/or potassium levels as well as manganese deficiency as shown by the two values quoted in the earlier paper. These are given in the table of results (Table I) as "I" and "II", *R. kyawi* and *R. nuttallii.*

The difficulties arising in this problem are well shown by the samples numbered Rh. 12. These were sent from a garden in Cornwall, and the specimens sent were (i) a leaf sample of 'Pink Pearl' with matching soil, (ii) a magnolia leaf showing severe chlorosis, from the same part of the garden as (i), and (iii) a number of leaves of a variety of fruit trees and bushes in the kitchen garden, together with a matching soil sample. All of these showed much the same picture, very severe chlorosis, the leaves being almost completely yellow with only slight tinges of green close to the veins. The soils, however, showed pH values of 5.1 for (i) and 7.6 for (iii), in other words the picture in the first and second cases was due to a very severe magnesium and potassium deficiency as shown by the leaf analysis and in the third was a lime-induced deficiency of, most probably, manganese. (There was not enough leaf-material for analysis in (iii). If, now, matching soil samples had not been sent, and the garden soil had been assumed to be uniform throughout, one or other treatment would have most probably been quite wrong, according to where the soil sample had been taken.

TABLE I

Reference No.	Species or hybrid	Soil pH	Mg (m.eq. %)	K (m.eq. %)	Mn (ppm.)	Leaf condition	Deficiency*
Rh. 1	*thomsonii*	5.6	15.0	14.3	866	mottling, red, orange and yellow patches	Mg
2	*fortunei§ x*	4.9	19.2	6.7	153	chlorosis, very yellow	K
3	*ferrugineum § x*	6.5	4.2	14.3	n.e.	chlorosis	Mg
4	*ponticum x*	5.6	14.2	11.3	855	chlorosis, very yellow	Mg K
7	*ponticum x*	—	15.8	15.9	254	chlorosis	Mg K
8	*ponticum x*	5.5	11.7	20.5	428	very strong mottle	Mg
9	*ponticum x*	7.0	9.2	23.6	179	mottling and patches	Mg
10A	*ponticum x*	4.5	13.4	10.8	804	leaves pale green, brown interveinal mottle necrotic patches	Mg K
10B	*ponticum x*	4.1	17.5	17.9	1240	leaves pale green, orange, yellow, brown i.v. mottle and necrotic patches	Mg
10C	*ponticum x*	3.6	12.5	11.3	455	leaves pale green, brown and yellow mottle, necrotic patches	Mg K
12	*ponticum x*	5.1	12.5	4.6	187	leaves bright yellow, only faint green near veins	Mg K
26	*ponticum x*	5.8	13.2	8.2	107	chlorosis	Mg K Mn
27	*ponticum x*	5.3	9.9	9.2	212	chlorosis with necrosis	Mg K
28	*ponticum x*	5.8	11.5	1.5	69	chlorosis, leaves very yellow, a few pale green	Mg K Mn
29	*arboreum x maximum*	7.7	12.4	26.9	9	severe interveinal chlorosis, margins yellow	Mg Mn
30	*irroratum § x*	7.3	9.9	26.1	233	severe interveinal chlorosis	Mg
31	*thomsonii*	6.2	12.4	16.1	155	severe "tip burn" (necrosis)	Mg
32A	*campylocarpum x griffithianum*	4.1	14.2	20.7	645	interveinal chlorosis, spotting and patching, orange to yellow with mid-line necrosis	Mg
32C	*griffithianum x fortunei*	4.5	17.5	12.1	399	as last, but more extensive on leaf, marked necrosis	Mg K
34A	*irroratum § x*	5.9	18.3	5.6	354	severe interveinal chlorosis	K
34B	*fortunei § x*	5.7	17.5	7.2	489	severe interveinal chlorosis with necrosis	Mg K
35	*catawbiense x*	6.9	15.8	3.6	54	chlorosis	Mg K Mn
36	*catawbiense x*	7.2	15.8	5.9	162	chlorosis, orange colours, a little necrosis	Mg K
I	*kyawi*	alk.	53.4	53.4	12	severe interveinal chlorosis	Mn
II	*nuttallii*	alk.	41.8	15.3	23	severe interveinal chlorosis, slight tip necrosis	Mn

*The threshold values are given in Tod, 1959, for Mg, K and Mn

Photographs show that it is difficult to separate the leaf pictures arising on acid soils due to magnesium and/or potassium deficiency (Rh. 32C, 34A and B) and those shown in neutral or alkaline soils (I and II, 29, 30), but severe magnesium or potassium plus manganese deficiencies tend to show more irregular and highly coloured patterns. (Rh. 8, 12, 32A).

It is unfortunate that the black-and-white reproductions of the colour transparencies lose so much of these very striking leaf-colour changes. For this reason a separate column has been inserted in Table I listing the leaf condition verbally.

It is, perhaps, odd that more attention has not been given before this to the importance of magnesium in rhododendron, for the present writer quoted a number of relevant papers, and numerous other writers have similarly mentioned rather casually that magnesium "was of importance"—and left it at that.

Of the seven cases investigated where the soil pH was 6.9 or higher, *five* showed magnesium deficiency, and of these two showed added

TABLE II

Ref. No.	*Soil pH*	*Deficiency*		
9	7.0	Mg		
29	7.7	Mg		Mn
30	7.3	Mg		
35	6.9	Mg	K	Mn
36	7.2	Mg	K	
I	alk.			Mn
II	alk.			Mn

manganese deficiency, but only *two* showed manganese deficiency alone.

These results would seem to indicate that at neutral to alkaline soil reactions, magnesium is as important as manganese, and perhaps more so, and that "lime-induced chlorosis" may, in rhododendron, be more a manifestation of magnesium deficiency induced by the excess of calcium than a deficiency of other elements such as manganese or iron.

The question of iron levels in the plant is one fraught with very considerable difficulty from an analytical point of view. The problem is not really that of the *total* iron in the plant, for on soils of high pH this seems usually to be within normal limits, or even high. The real question is the proportion of the total iron which is in such a form *in the plant tissues* that it can be utilized by the plant. The discrimination between these two forms of iron depends purely on analytical techniques, and the final results depend on the method used. A consensus of the literature seems to indicate that the chlorotic leaf has a lower available iron content than the healthy; other equally reputable workers, however, using different techniques have obtained results which do not support this idea.

It would seem that these findings on magnesium deficiency, if they are really substantially supported by the results from further specimens now in hand, may offer a prospect of a relatively new line of attack on the problem of leaf-chlorosis in the genus *Rhododendron.*

The writer would like to express his thanks to Mr. Shearer McIntosh for the analyses of plant material, and to Mrs. M. D. Bennett of Messrs. Geigy Ltd., for her very helpful co-operation in obtaining samples of leaf and soil, and finally to Mr. H. H. Davidian, B.Sc., for checking the species or hybrid identifications.

Alpine Anthology

by ''RHINANTHUS''

(Reprinted from the Alpine Garden Society's Bulletin, Vol 30, 1962, p. 3).

AT ONE of the London Shows a year or two ago, a specimen of Farrer's ''Ancient King'', *Saxifraga florentula,* was exhibited, growing in a piece of tufa. The plant was clearly unhappy, being slightly yellow at the leaf extremities, and the exhibitor was taken to task for allegedly growing a lime-hating plant in a limestone medium. The exhibitor said nothing, because he felt that an excess of water was a more likely cause of the plant's appearance than lime poisoning from the tufa. Sure enough, at the Conference Show, the same plant appeared in the same piece of tufa—only this time in perfect health. Are we under a misapprehension about the lime content of this superlative growing medium?

Much has appeared in these columns in the past on this difficult subject, but it has always been of a rather trivial nature. It is thanks to Dr. Henry Tod that Rhinanthus is able to give the following facts which—if they permit no conclusions—lay the foundations for much interesting research.

Tufa is formed where a rock formation rich in lime is being leached out by water containing carbon dioxide (i.e. rainwater). This dissolves out the calcium carbonate by converting it into the more soluble calcium bicarbonate. The solution reaches saturation point, and when it is exposed to the air the carbonate is re-formed. This is the recognised mechanism for the formation of stalactites and stalagmites. If this deposit of carbonate is made on loose, open material—such as moss—it forms a crust thereon, and this, basically, is tufa. One theory runs that this formation of tufa is accelerated when the deposit forms on living plant tissues, because the plant abstracts excess carbon dioxide for its own use, thus hastening the change from bicarbonate to carbonate. Ultimately the plant tissue breaks down, and leaves the rather open rock formation of the tufa in the form of almost pure calcium carbonate. So far, then, we have a pure calcareous tufa—which is certainly not going to make our lime-hating *Saxifraga florentula* contented.

But supposing water from a rock formation rich in magnesium runs over the tufa? Then magnesium can replace calcium in the formation until a theoretical limit of 45% magnesium carbonate and 55% calcium carbonate is reached. In other words, dolomite is formed.

But it is claimed by at least one geologist that the process can work in reverse, i.e. that tufa can be formed from a rock formation consisting of magnesium carbonate, and that some of the magnesium carbonate can be replaced by calcium carbonate (derived from running water from another deposit rich in this mineral). So it would appear in theory that tufa can consist (*a*) of calcium carbonate, where magnesium carbonate has replaced some of the calcium right up the scale; (*b*) of magnesium carbonate, where calcium has replaced some of the magnesium right up the scale.

In other words, tufa can probably have almost *any* calcium:magnesium ratio, and calcium and magnesium are in many ways antagonistic to each other; in the presence of a large excess of magnesium, little calcium is taken up by the plant.

Now all this is extremely interesting, but Dr. Tod reports that in no textbook has he been able to find any data which supports a possible high magnesium content in tufa, though the theory is supported by the occasional practical evidence of lime-hating plants prospering in tufa. The theory must be tested in practice, and Rhinanthus is therefore writing to various members of the Society in an effort to procure a range of tufa samples from divergent sources. Dr. Tod has very kindly offered to have these analysed, and we will continue the story in a later *Bulletin.*

Tufa

(Reprinted from the Alpine Garden Society's Bulletin, Vol. 30, 1962, p. 242).

READERS may recall that in a recent Alpine Anthology there was a discussion on the possible reasons why calcifuge plants should live happily in tufa, which is, after all, a secondary limestone deposit. At the end of that note, Rhinanthus said that tufa samples would be collected for analysis, and this is a report of the results from the samples which various members sent in.

Unfortunately the results do not throw much light on this very perplexing problem, but they have produced an explanation of two very odd observations which one member has made. These are that he grew extreme calcifuges in contact with ''Bulwell Stone'', and that the local nurserymen top-dress their plants, calcifuges included, with chips of ''Bredon Limestone''. In the Table, samples A to I are tufas, while J is Bulwell Stone and K is Bredon Limestone.

	TOTAL					"EASILY SOLUBLE"				
						mg per 100 gm.				
	% Ca	% Mg	meq % Ca	meq % Mg	Ca/ Mg	Ca	Mg	Ca %	Mg %	Ca/ Mg
A	39.0	0.2	1950	17	115	21.2		0.054		
B	30.6	0.6	1530	50	30.6	15.8	0.20	0.052	0.030	1.7
C	37.2	0.2	1860	17	110	20.5		0.055		
D	37.0	0	1850	0	—	22.1		0.060		
E	38.8	0.2	1940	17	114	23.1		0.060		
F	38.8	0	1940	0	—	22.8		0.059		
G	39.0	0.2	1950	17	115	23.5		0.060		
H	37.2	0.4	1860	33	56.4	20.8		0.056		
I	39.2	0.2	1960	17	115	23.5		0.060		
J	16.0	9.5	800	793	1	12.5	7.0	0.078	0.088	0.89
K	21.2	13.3	1060	1108	1	16.0	8.3	0.076	0.062	1.23

The Table shows that Bredon Limestone is an extremely pure Dolomite of practically theoretical composition, while the Bulwell Stone is a less pure material, but again of nearly theoretical values, as is shown by the Calcium/Magnesium ratios in Column 5 of the Table, where the deviation from 1.00 of the ratio is within the limits of accuracy of the determinations of the components. This fits with the theory propounded in the Anthology (loc. cit.) for the high magnesium content is most probably keeping the calcium intake down to safe levels. The problem of the tufa is, however, far from clear. From the analytical results obtained from rhododendron growing under "ideal" conditions, and under conditions where severe chlorosis is produced, it would appear that the calcium/magnesium ratio in "ideal" conditions varies from about 1 to 4, while the "chloritic" conditions show ratios well above 4, though there is a low-value group, small in number, which still requires explanation, among the "chloritic" series. It will be noted that both the "total" and "easily soluble" ratios for J and K comply with these levels—and accordingly fit in with the existing theory.

It is unfortunate that no clear information has come from the analyses of the tufas—in fact the results make the situation even less comprehensible than before. It is hoped, however, that a study of the effect of varying calcium levels in sand cultures of rhododendrons now in progress may throw some light on the actual role of calcium in the "feed" to the calcifuge plant, for this particular trial will eliminate any possible interaction with the soil, the sand being totally inert.

Mystery of tufa and lime-hating plants

(Reprinted from the Gardeners' Chronicle/HTJ, September 5, 1969)

Tufa has for long provided a real "poser" for the soil scientist who is also a gardener. The problem is this: Why do lime-hating plants grow happily in tufa, which is principally calcium carbonate, but not in either chalk or limestone, which are also calcium carbonate?

For some years there was considerable confusion between two quite different materials which were both called "tufa". This was cleared up when one, a volcanic material, was called "tuff" and the other, a secondary calciferous deposit, was left as "tufa". This latter tufa varies between a soft, crumbly material and a rock-hard material. All tufas, however, are of a more or less porous nature.

There is little doubt that tufa is deposited on organic materials, e.g. grasses, small plants, mosses and perhaps occasionally fibrous, peaty material. As the tufa thickens and hardens, the plant material dies and decomposes, leaving the tufa as a porous "stone". I have seen this actual process in action in Nevada and collected a "juvenile tufa" (sample 13 in Table I) still with the grass and other plant leaves embedded in the mass.

It seemed at least possible that tufa as used in the garden was of a dolomotic nature, i.e. calcium carbonate in which up to half the calcium was replaced by magnesium, forming the double calcium magnesium carbonate $CaCO_3.MgCO_3$. If this were the case, it might explain the paradox as the high magnesium content would tend to reduce the "flooding" of the lime-hating plant with calcium.

I put forward this theory in the *Quarterly Bulletin* of the Alpine Garden Society,[1] and through the kindness of the Editor of the *Bulletin* and the Secretary of the Society I was provided with a number of specimens of tufa for analysis. A specimen each of "Bulwell Stone" and "Bredon Limestone" were also sent as both these were calcareous materials that were used locally in the Midlands in growing calcifuge plants.

These analyses were published in the AGS *Bulletin*[2] but subsequently I have added two specimens of American tufas, a fossil coral from Wyoming, another British tufa and some foamed slag, the material used for insulation in building which has a rather similar physical structure. The analyses of these materials are shown in Table I and the origin (where known) and the physical characteristics in Table II.

While only three of the tufas are free of magnesium, the ratio of calcium to magnesium in all but the "juvenile" tufa is too wide for the magnesium to have any marked effect, with the possible exceptions of sample 2, where the magnesium was "easily soluble", and sample 12, which was rather similar.

In the other samples the magnesium was not in the "easily soluble" state. Table I also shows that the Bulwell Stone, the Bredon Limestone and the Bald Ridge "fossil coral" are high-grade dolomites, though the Bulwell Stone is a less pure material. All three of these materials have nearly theoretical Ca/Mg ratios, the deviation from 1.00 in each

Sample No.	TOTAL % Ca	% Mg	Ca meq %	Mg meq %	Ca/Mg	"EASILY SOLUBLE" Ca mg per 100g	Mg mg per 100g	Ca % easily sol. of total	Mg % easily sol. of total	Ca/Mg
1	39.0	0.2	1950	17	115	21.2	—	0.054	—	—
2	30.6	0.6	1530	50	30.6	15.8	0.2	0.052	0.033	1.58
3	37.2	0.2	1860	17	110	20.5	—	0.055	—	—
4	37.0	0.0	1850	0	—	22.1	—	0.060	—	—
5	38.8	0.2	1940	17	114	23.1	—	0.060	—	—
6	38.8	0.0	1940	0	—	22.8	—	0.059	—	—
7	39.0	0.2	1950	17	115	23.5	—	0.060	—	—
8	37.2	0.4	1860	33	56.4	20.8	—	0.056	—	—
9	39.2	0.2	1960	17	115	23.5	—	0.060	—	—
10	39.0	0.0	1950	0	—	not enough in sample				
11	38.0	0.8	1900	67	28.4	15.0	—	0.039	—	—
12	37.5	0.2	1875	17	110	14.6	0.2	0.039	0.010	3.9
13	20.0	4.1	1000	343	2.92	11.6	2.0	0.055	0.049	1.12
14	29.0	0.8	1450	67	21.8	19.0	0.3	0.066	0.035	1.87
15	16.0	9.5	800	792	1.01	12.5	7.0	0.078	0.088	0.89
16	21.2	13.3	1060	1108	0.96	16.0	8.3	0.076	0.062	1.23
17	22.3	12.4	1115	1033	1.08	10.8	5.2	0.048	0.042	1.15
18	12.3	0.4	615	33	18.5	22.0	0.6	0.179	0.066	2.73

case (samples 15, 16 and 17) being probably within the limits of accuracy of the determinations of the calcium and magnesium content.

This would fit the theory proposed, for in the case of these materials the magnesium level would most probably limit the calcium uptake by calcifuge plants to safe levels.

I had shown in 1956[3] that rhododendrons can be grown at pH levels of 7 and 8.4 in complete health, provided that the pH is raised by magnesium carbonate, and this finding was corroborated by Leiser,[4] who found rhododendrons growing in the wild in serpentine soil (rich in magnesium) at similar pH levels. To study this ''dolomite'' question, through the kindness of Mr. F. C. Barnes and his party, who visited the Dolomites, I got a series of 18 soil samples from that area with notes of the flora growing on each soil.

Results

The results are shown in Table III. Of the 18 soils, five were strongly acid, five were mildly acid or neutral, and eight were alkaline. All but three show ''high'' levels of magnesium, and a study of the flora in relation to the pH values of the soils indicates that where the flora is calcifuge and the soil pH high, the soil is rich in magnesium.

There have been a number of reports of lime-hating (calcifuge) plants growing well in limestone and of successful rhododendron gardens in limestone areas. These may be explained in one or more of several ways. The first depends on the discussion by Blank[5] of the effect of the leaching of dolomite by rainfall, whereby the calcium is dissolved out and removed preferentially, giving a proportionate increase in the magnesium content of the soil, i.e. the decrease in the Ca/Mg ratio. This might account for the fact that calcifuge plants may grow well enough in areas where dolomitisation is not complete (see Table III).

Secondly, areas of low pH can be observed in calcareous regions, where pockets of soil may be isolated either by hard rock or by impervious clay from the surrounding soil. If the drainage of the pocket itself is very free, the soil may be almost completely leached of calcium. I have seen such a pocket of soil at pH 4.1, with heather and vaccinium growing strongly, on the top of a chalk down ; 6 ft. from the edge of this pocket the soil pH was 7.8 as would be expected in a calcarerous soil.

Thirdly, the calcium in some of the very hard, ancient limestones is much less freely available than in the younger, softer ones. Some of these older limestones are very resistant to weathering and have marked-

TABLE II

Sample No.	*Source*	*Physical Characteristics*
1	Gordale Scar	medium hard, moderately porous
2	Aust Cliff	soft, very porous
3	Via Gallia	very hard, not very porous
4	Mendip Hills	very porous, brittle
5	Gordale Scar	hard but brittle, not porous
6	Bodfari	porous and soft
7	Unknown, old fernery	very hard, moderately porous
8	Elsdon	porous and brittle
9	North Wales	very soft, porous
10	Unknown	very soft
11	Michigan, USA	fairly hard, moderately porous
12	St. Joseph River, Mich.	very soft, very porous
13	"Juvenile", Tonopah, Nev.	very soft, friable
14	Bodfari	soft and porous
15	"Bulwell Stone"	rock
16	"Bredon Limestone"	rock
17	Fossil Coral, Bald Ridge, Wyoming, USA	tubular, slightly porous, very hard
18	Foamed slag	moderately soft, very porous

TABLE III

Soils from the Dolomites

Calcium meq/100g soil	Magnesium meq/100g soil	Ca/Mg	pH	Predominant plant in flora
11.4	3.75	3.03	5.2	*Rhododendron hirsutum*
23.5	12.7	1.86	7.4	*Rhododendron hirsutum*
27.5	12.0	2.29	7.2	*Rhododendron hirsutum*
34.0	12.7	2.68	6.9	*Rhododendron hirsutum*
67.0	27.2	2.47	6.1	*Rhododendron hirsutum*
112.0	35.5	3.16	7.2	*Rhododendron ferrugineum*
87.5	26.8	3.27	7.1	*R. ferrugineum, R. hirsutum*
12.4	2.42	5.13	6.0	*Rhododendron ferrugineum*
22.0	11.0	2.00	7.2	*Erica carnea*
32.0	10.8	2.95	7.4	*Erica carnea*
77.5	28.6	2.71	6.6	*Arctostaphylos europaeus*
4.55	2.33	1.95	5.3	*Arctostaphylos europaeus*
22.5	5.75	3.91	5.9	*Vaccinium sp.*
4.90	2.33	2.10	5.3	*Loiseleuria procumbens*
33.0	11.9	2.77	6.5	*Loiseleuria procumbens*
5.57	2.17	2.57	4.8	*Loiseleuria procumbens*
45.5	17.0	2.68	6.4	*Rhodothamnus chamaecistus*
25.0	16.3	1.54	6.9	*Rhodothamnus chamaecistus, Erica carnea*

ly less effect on the soil surrounding and over them as regards lime content and soil pH.

Normal Ca/Mg ratio in soils 6-9	
Calcium in soil	low: less than 5 meq/100 g normal: 5-12.5 meq/100 g high: greater than 12.5 meq/100 g
Magnesium in soil	low: less than 0.5 meq/100 g normal: 0.5-3.3 meq/100 g high: greater than 3.3 meq/100 g

While these results and comments provide possible explanations for some of the anomalous findings mentioned, they still do not explain the original tufa problem. In an attempt to obtain some more definite results, a trial has been set up using young hybrid rhododendron plants which have already shown themselves to be lime-sensitive, and *Gentiana sino-ornata*, a strongly calcifuge species. These have been planted with their roots in contact with, and surrounded by, (*a*) limestone ; (*b*) tufa (sample 14), and (*c*) sandstone, the soil mixture used in the plastic pots being John Innes Potting Compost No. 2. The results will be reported if and when leaf symptoms develop.

REFERENCES

(1) Tod, Henry, in "Rhinanthus", Quart. Bull. Alp. Gard. Soc. 1962, 30, 3.
(2) Tod, Henry, ibid. 1962, 30, 242.
(3) Tod, Henry, Jour. Scot. Rock Gard. Club 1956, 5, 50.
(4) Leiser, A. T., Rhodo & Camellia Y.B. (RHS) 1957, p. 47.
(5) Blank, E., Handb. der Bodenkunde 1936, vol. II, p. 377.

Nitrogen Sources for Rhododendron

(Reprinted from Gardeners' Chronicle/HTJ, March 14, 1969)

IN THE course of my studies on chlorosis in rhododendron, I made several attempts to establish seedlings in sand cultures, using the nutrient solution described by Hewitt (1952) where the source for nitrogen was potassium and sodium nitrates. In each case, however, the seedlings died without making any growth.

A paper by van Tuil (1965) drew the writer's attention to earlier work by Cain (1952 and 1954). Both these workers showed that ericaceous and some other shrubs and trees developed severe chlorosis when nitrate was the nitrogen source, but remained healthy if the source was ammonium salts. It seemed possible that the failure of my rhododendron seedlings might be attributable to this cause.

A sand culture was established using as a medium a mixture of equal parts of quartz sand and vermiculite in 3 in. black plastic pots. Four separate nutrient solutions were used with the same nutrient levels in each, but varying in the nitrogen source and the solution pH. The latter was adjusted by the addition of N/2 sodium hydroxide solution. These solutions contained 8 milliequivalents (meq) N, 7 meq K, 4 meq P, 3 meq Mg and 5 meq Ca per litre.

Nutrient solutions:

A	Nitrogen from ammonium sulphate	pH 4.6
B	,, ,, ,, ,,	pH 7.6
C	Nitrogen from sodium nitrate	pH 4.6
D	,, ,, ,,	pH 7.6

Two seedlings of *Rhododendron macabeanum* were planted in each pot and stabilised by a surface coating of glass beads. The pots were randomised for position, and 80 ml nutrient solution was given to each pot per feed. These were given weekly for 10 weeks and fortnightly thereafter to 20 weeks, when the seedlings were measured for leaf area.

At this time all the seedlings in treatments C and D were either severely chlorotic or dead, and those which were alive had made little or no growth from their state at planting, when the leaf area of all seedlings was about 20-30 sq mm, that is, about 40-60 sq mm per pot.

Table I

Leaf area of Seedlings, sq mm

Treatments		*Replicates*	
A	1270	1764	1985
B	740	1103	1339
C	254	97 (1 dead)	88
D	25 (1 dead)	25 (1 dead)	0 (2 dead)

It will be noted that in treatment C (NO_3-N and low pH), growth, though very weak and unhealthy, did occur while in D (NO_3-N at pH 7.6) no growth had taken place, four out of the six seedlings having died ; the remaining two had stayed as they were planted in their first two leaves.

When the nitrogen was applied as ammonium sulphate at low pH (A), growth was definitely stronger than in treatment B, at the higher pH (7.6), though in both the growth was completely healthy and of a good deep green colour with the slight bronze flush and liberal growth of leaf hairs characteristic of the species.

It would seem that the most suitable nitrogen source for rhododendron seedlings is ammonium salts in an acid medium, nitrate having a seriously harmful effect. Harris (1968) has informed the writer that he has used ammonium nitrate as a feed for rhododendrons without harm ; presumably in this case the beneficial effect of the ammonium ion has overweighed the potentially harmful effect of the nitrate.

REFERENCES

Cain, J. C. (1952) *Proc. Amer. Soc. Hort. Sci.* 59, 161.

Cain, J. C. (1954), ibid. 64, 61.

Harris, F. J. (1968), Personal communication.

Hewitt, E. J. (1952), Sand and Water Culture Methods etc. Tech. Comm. C.A.B. no. 22.

van Tuil, H. D. W. (1965), *Vers. Landbouwk,* Onderz, 657.

Nitrogen Sources for Mature Rhododendrons

(Reprinted from the Gardeners' Chronicle/HTJ, March 5, 1971)

THE FIRST part of this study showed that ammonium salts in acid nutrient solutions were the most satisfactory nitrogen feed for seedling rhododendrons in sand culture, nitrogen in the form of nitrate salts producing little or no growth (*Gardeners' Chronicle*, March 14, 1969). It seemed of interest to see if the difference between the two forms of nitrogen source would be shown in mature plants as well as in the seedlings. Accordingly this longer trial was set up shortly after the commencement of the seedling trial.

The roots of 12 young but mature plants of *Rhododendron ferrugineum* were washed as free of soil as possible and they were then planted in a sand-vermiculite medium in plastic pots, being divided into four lots of three replicates.

Exactly the same technique was used as in the previously published study, the nutrient solutions being as described in the previous paper, adjusted similarly to give ammonium nitrogen at pH 4.6 and 7.6. and nitrate nitrogen at pH 4.6 and 7.6. Feeding with these complete nutrient solutions was given at 250 ml per pot weekly from June 1968 to October 1968 ; every four weeks to the end of March 1969 ; then fortnightly until the end of September 1969. Measurements of leaf colour were made by an independent observer with good colour discrimination, using the RHS Colour Fan.

Changes

Very shortly after the commencement of the feeds, changes in leaf colour began to appear, the plants receiving nitrogen as ammonium sulphate showing a deepening of the green colour of their leaves, while those receiving nitrate showed signs of paleness developing. These changes continued to progress until the onset of much colder weather, when the plants fed with nitrates showed signs of darkening of the leaves, the ammonium fed plants also deepening steadily in colour.

This change in leaf colour to darker shades had been pointed out to the writer by Mr. Davidian of the Royal Botanic Garden, Edinburgh, as a normal change of leaf colour in late autumn and winter weather. The colour change varies from species to species, being in some a bronzing and in others a deepening of the green colour.

Leaves Affected

By the beginning of April the foliage of both pH groups of ammonium plants had lightened appreciably in colour, while the plants receiving nitrate salts had developed some senescent or very severely chlorotic leaves. The average number of leaves affected per plant in the four groups was as follows: ammonium salts pH 4.6, 3 leaves ; pH 7.6, 3 leaves ; nitrate pH 4.6, 30 leaves ; pH 7.6, 6 leaves.

These leaves subsequently fell and, over the very hot, dry summer, the ammonium plants maintained a normal green colour, while the nitrate groups became severely chlorotic, although towards the end of the trial the group receiving ammonium nitrogen in alkaline solution were showing a tendency to develop a certain degree of chlorotic symptoms as well.

From June to April, the colour changes in the plants receiving ammonium nitrogen in both acid and alkaline nutrient solutions were similar ; only after the hot, dry summer weather from May to August did the plants receiving ammonium salts in a solution with a pH of 7.6 display a chlorotic tendency.

By contrast, the acid and alkaline nitrate nutrient solutions showed differing responses throughout the trial. Initially the chlorosis produced in the pH 4.6 nitrate group was, at 54 days, markedly more pronounced than in the pH 7.6 nitrate group. By contrast at 158 days, i.e. in November, the acid nitrate group had recovered most of their green colour as mentioned above, and at the later measurements of colour (286 and 432 days) showed much less chlorosis than in the alkaline nitrate plants. In this last group the chlorosis became progressively more severe until, at 432 days when the trial was concluded, the leaves were all of a pale yellowish-green shade. It is of interest to note that the alkaline ammonium group of plants by this time was also showing some chlorotic symptoms as mentioned earlier.

Several attempts were made to use the colour co-ordinates quoted in the Colour Fan so that a mathematical expression of the response of the replicates and the treatments could be given, but as the three values per colour represent three independent variables, only a three-dimensional solid figure could be used to express their changes and this was not practicable for publication. Accordingly a visually-sorted range of the actual matching colour-patches on the fan was made and the colour changes assessed from that.

Results

These two trials indicate that rhododendrons show the same phenomena as those quoted by van Tuil (1965) and Cain (1952, 1954), namely the development of chlorosis when the nitrogen source is nitrate, while remaining healthy when the source is ammonium salts. As in the former trial, the alkaline ammonium nutrient solution did not produce quite as satisfactory results as the acid one, but the first trial showed that these effects are far more drastic where seedlings are concerned as compared with mature plants, for in the former case either no growth or death was the result.

I would like to express my gratitude to my wife, Dr. Mary Tod, for carrying out the very accurate colour matching required in this trial.

REFERENCES

Cain, J. C. (1952) *Proc. Amer. Soc. Hort. Sci.* 59, 161.
Cain, J. C. (1954) ibid. 64, 61
Davidian, H. H. (1960) Personal communication.
van Tuil, H. D. W. (1965) *Vers. Landbouwk.* Onderz. 657.

Chlorosis in Rhododendrons

(reprinted from the *Gardeners' Chronicle/HTJ*, November 19 and December 5, 1971)

IT HAS been known for many years that calcifuge plants, when grown on calcareous soils, develop chlorosis and fail, but little investigation has been made into the causes of this condition.

It has been generally assumed that the effect is due to an iron deficiency induced by the calcium-caused alkalinity. In 1906 Hogenson (5) added lime in the proportion of 1:160 to soil and grew azaleas and rhododendrons in this mixture. For half of the plants he added to the mixture half this amount of sulphate of magnesia. The plants in the limed soils failed, the buds turning brown and dropping, while those in the soil further treated with magnesium sulphate flowered freely and grew on well.

This was followed by Grove's monumental investigation of the sensitivity of a wide range of species of rhododendron to lime, which was reported half-way through (2) but never completed owing to the death of the investigator.

As no information could be found in the literature of the levels of nutrient elements present in healthy rhododendrons, data were collected by obtaining leaf samples, accompanied by soil samples from near the root-ball of the plants and analysing the leaf samples for calcium, magnesium, potassium, phosphate, iron and manganese. The soil samples were analysed routinely for potassium and phosphate, as well as pH and loss-on-ignition (humus content), and a few for calcium.

Leaf and Soil Samples

The first set of these values was published (8) and the full data are given in Tables 1A, 1B and 1C, where the specimens are listed according to their taxonomic series.

TABLE 1A

Analyses of rhododendron leaves showing the ranges of values found in healthy plants

	Milliequivalents per 100 g dry matter				ppm in dry matter		No. of samples
Taxonomic series	Ca	Mg	K	PO_4	Fe	Mn	
Ponticum	45.5-80.0	21.5-39.7	18.7-24.4	5.5-11.4	64-350	189-874	9
Triflorum	43.6-45.7	10.8-23.3	10.2-20.0	9.7-26.1	89-240	285-1400	4
Irroratum	36.5-48.1	15.8-25.0	7.4-18.2	7.2-10.2	53-157	144-305	4
Fortunei	59.5-124.0	14.2-25.0	12.1-23.6	9.7-15.3	84-290	63-2100	7
Falconeri	68.0-115.0	15.8-32.5	7.6-20.0	10.6-21.1	68-333	730-2720	6
Grande	35.5-59.6	15.8-21.5	11.3-23.1	7.2-12.3	61-173	230-753	4
Fulvum	38.5-56.5	12.5-15.0	14.6-28.7	15.3-23.5	125-363	260-560	2
Barbatum	52.0-59.0	10.8-12.5	12.3-14.1	6.1-14.3	175-338	184-2600	2
Neriiflorum	34.5-45.5	16.7-18.3	14.6-16.7	10.2-12.3	126	1106-1588	2
Lacteum	52.5	16.7	20.0	17.4	183	347	1
Taliense	58.5	15.0	25.6	11.3	127	1580	1
Thomsonii	44.5	17.5	20.5	16.4	—	315	1
Campanulatum	53.5	25.0	23.6	15.3	—	840	1

TABLE 1B

Analyses of Soils from near the Roots of Rhododendron Plants in Table 1A

Taxonomic series	Available potassium milliequivalents	Available phosphate per 100 g soil	Loss on ignition per cent	pH	No. of samples
Ponticum	0.24-2.16	0.5-36.2	16-46	4.5-6.3	9
Triflorum	1.31-1.64	1.4-12.6	15-22	4.0-5.9	4
Irroratum	0.34-1.64	0.5-40.3	38-65	4.5-5.8	4
Fortunei	0.29-2.41	0.5-40.3	13-46	4.7-5.7	7
Falconeri	0.40-1.61	0.5-43.4	19-52	4.2-4.8	6
Grande	0.46-2.67	0.5-9.7	28-45	4.0-4.4	4
Fulvum	1.28-4.36	5.3-20.3	30-35	4.1-4.3	2
Barbatum	2.31-4.69	1.9-18.8	40-79	4.6-4.7	2
Neriiflorum	2.57-4.10	1.9-1.9	78-80	4.7-4.7	2
Lacteum	3.41	13.5	41	4.9	1
Taliense	9.92	12.1	79	4.5	1
Thomsonii	4.85	1.9	81	4.7	1
Campanulatum	4.10	1.9	81	4.6	1

Following on this, similar pairs of leaf and soil samples were obtained from rhododendrons which were showing chlorosis and general ill-health from many sources, the first results of this investigation being published (9) with a description of the leaf symptoms exhibited. These ranged from simple interveinal chlorosis or else yellow mottling of the leaf, to brilliant orange and red colorations of the leaf and finally to severe leaf necrosis.

The mineral deficiency most probably involved was deduced from a comparison of the leaf analysis with the values for normal plants in the same series which had been previously found. This same method has been used for the increased number of samples reported here. If the magnesium level alone was below the lowest recorded value for healthy plants, this was recorded as magnesium deficiency ; if the potassium value also was low, this was listed as a multiple deficiency, i.e. Mg and K. Table 2 was constructed on this basis, showing the

TABLE IC

Ten soils from Table IB showing the available calcium in the soil

Series	Soil pH	Available calcium meq per 100 g soil
Ponticum	4.5	6.9
Ponticum	5.1	2.1
Irroratum	4.6	2.0
Irroratum	5.2	4.6
Fortunei	4.7	3.1
Fortunei	4.8	4.0
Fortunei	5.5	6.8
Falconeri	4.4	0.9
Falconeri	4.5	0.8
Falconeri	4.7	4.4
Grande	4.3	0.4
Grande	4.4	1.2

number of cases of the various deficiencies found for the elements, and also considered in relation to the reaction of the matching soil sample.

In order to gain some information as to whether the chlorosis developed by rhododendrons on calcareous soils was due to the raised pH of the soil or to the level of calcium, a trial had been previously set up as follows.

Peat was added to a naturally acid soil, producing a mixture with a pH of 5.0. Magnesium carbonate was added to two portions bringing the pH to 7.0 and 8.4 Since nutrient levels were low in these mixtures, growth was not strong in the seedlings of *R. davidsonianum* which were planted in impervious pots. After five years during which watering was done with rain water, all the plants were alive and healthy. The only noticeable effect on growth was that the branches of the plants growing at pH 7.0 and 8.4 were slightly thinner than in the control group.

Corroborated

This trial was reported in 1956 (7) and was corroborated by a

TABLE 2

Mineral Deficiencies found in Chlorotic Plants

Deficiencies found in leaf tissue	Total number of leaf samples	Number of leaf samples from: acid soil	alkaline or neutral soil
Magnesium, simple deficiency	22	19	3
in multiple deficiency	33	17	16
Potassium, simple deficiency	7	6	1
in multiple deficiency	22	13	9
Manganese, simple deficiency	7	2	5
in multiple deficiency	26	9	17
Calcium, simple deficiency	2	2	0
in multiple deficiency	3	3	0
Total samples analysed	78	50	28

paper by Leiser (6) who reported finding *R. occidentale* growing in the wild at pH 7.6 to 8.6 in a magnesium-rich soil derived from serpentine. These results suggested that chlorosis was not solely due to the raised soil pH but was most probably related to the raised levels of calcium in calcareous soils.

Corroboration of the role of magnesium was found in the study of dolomitic soils published in the *Gardeners' Chronicle* in 1969 (10).

Table 3 gives the range of values found for healthy rhododendrons from Table 1A (page 17 *Gardeners' Chronicle/HTJ* of November 19) compared with the range found in the leaves of healthy woody plants quoted by Wallace (13) and as found in the laboratories of the Edinburgh School of Agriculture. It will be seen that the levels for magnesium, potassium and phosphate tend to be lower than in other plants, while the levels for manganese and iron are higher, a predictable finding since, in general, the pH values are lower in rhododendron soils, leading to a greater availability of these elements.

By contrast, the range for calcium in rhododendron lies much closer to the other plants range, and this finding is quite striking when it is realised that rhododendrons grow in acid soils where the calcium

TABLE 3

Range of mineral contents of the leaves of Rhododendrons and other Woody Plants (meq per 100 g DM)

Element	Woody plants, from analyses		Rhododendrons from Table 1A
	in Wallace	fr. labs. of Edin. Sch. of Agric.	
Calcium	57-157	32-180	36-124
Magnesium	20- 31	15- 70	11- 40
Potassium	36-108	11- 64	7- 29
Phosphate	18- 28	8- 34	5- 26
		parts per million	
Iron	65-200	—	53-363
Manganese	30- 64	20-300	63-2720

content will be considerably lower than in the soils in which the other plants grow at much higher pH levels.

In the course of these investigations a report was received of a garden in Hampshire, on the greensand, with a high rainfall, where rhododendrons and other calcifuge plants were failing ; the soil pH was found to range between 3.3 and 3.9. An application of 10 cwt. ground limestone per acre gave satisfactory results, the condition of the plants improving markedly. In this case the leaching loss of calcium had been expedited by the addition of peat and leaf mould. It seemed desirable to establish what level of calcium was necessary to rhododendrons to ensure normal growth, and a sand-culture trial was set up to investigate this.

Various Solutions

Actually two sand culture trials were carried out using levels of calcium in the nutrient solutions varying from nil to 25 mM* calcium. These represented levels found in normal soils, ranging from lime-free to calcareous, and each trial was maintained for a year. Variability in the first trial, which was set up using *R. rubiginosum* seedlings from open pollination, gave results which, though fairly clear, were confused by the differing types and rates of growth obtained, so the second trial

* milliMol—1/1000 of the molecular weight per litre. 1 mM = 2 milliequivalents.

was carried out with young plants of *R. concatenans* obtained from the Sunningdale Nurseries.

Normal Growth

In both trials normal growth was only obtained in the low-lime group (2.5 mM Ca), plants in both the lower and higher lime levels showing marked chlorosis. It was very striking that a very severe chlorosis developed in the groups receiving no calcium and 0.5 mM calcium, while the leaves in the 10 and 25 mM group were also severely chlorotic, being yellow and soft. They were produced freely but within two to three weeks they developed tip and edge necrosis, withered and dropped. The growth rate at 2.5 mM Ca was not so high, but the plants were healthy and remained so, with one exception discussed below. Root formation in the nil Ca group was very poor, good at the two intermediate calcium levels and weaker at 10 and 25 mM Ca.

In the 2.5 mM Ca treatment, however, a marked tip-burn of the leaves appeared. This tip-burn was present in the other treatments also, but the short life of the leaves made it more difficult to assess. The level of potassium in the nutrient solution was increased, producing an improvement in this respect. Ten months after the trial was begun, paleness of foliage (chlorosis) was very clearly marked at nil, 0.5, 10 and 25 mM calcium, while at 2.5 mM there were some small signs of an orange mottle on the older leaves, but growth was healthy and strong.

The findings from these two trials, though tentative, (they were backed up by tissue analyses of the plants) seem to indicate that rhododendrons will grow reasonably at calcium concentrations above 0.5 mM and up to 2.5 mM Ca, while below and above these limits, sufficiently serious chlorosis develops to impair growth. The failure at nil calcium is rather to be expected, but the free production of large, severely chlorotic and soft, short-lived leaves at the high levels is rather surprising as a visual symptom.

The five cases of calcium deficiency recorded in Table 2 occurring in acid soils suggest that in perhaps four other cases where the soil pH was extremely low, it may have been an additional factor ; most unfortunately these were examined before the possibility of calcium deficiency in a calcifuge plant was envisaged.

Side Effects

These sand cultures were conducted before those on the differing effects of nitrate and ammonium nitrogen were carried out and published in the *Gardeners' Chronicle/HTJ* (11 and 12) so that there may have been complicating effects due to nitrate which provided some of the nitrogen in the nutrient solutions ; this work will be repeated avoiding this particular point and will be reported at a later date.

It has usually been assumed that chlorosis in rhododendrons is caused by a high level of lime in the soil in which they are planted producing an iron deficiency in the plants. As a result of these ideas, treatment has usually been based on the administration of iron, either by foliar sprays, by injection, or, more recently, by the use of chelated forms of iron. The chelate generally used, Geigy (now Murphy) Sequestrene has proved very valuable and successful, but this does not necessarily clash with the conclusions of these investigations since it also contains magnesium sequestrene in considerable quantity.

Occurrence of Chlorosis

The findings reported in this paper show that chlorosis occurs as frequently on acid soils as on alkaline, and that, whether acid or alkaline, magnesium is about as often the probable cause of the chlorosis as is manganese or iron deficiency. In this investigation manganese has been taken as the standard element for deficiency conditions in alkaline soils as the estimation of iron is less reliable in plant material.

The importance of magnesium in rhododendrons has been largely overlooked in earlier work and it is suggested that in many ways it may well be the key element in problems of the health of rhododendrons, and probably calcifuge plants in general when one considers the results quoted by Hills (3 and 4) for gentians and various other calcifuges. The fact that in the majority of the cases investigated in this work where magnesium deficiency was found, a dressing of epsom salts with (or in some cases, without) a small simultaneous dressing of ammonium sulphate produced a very marked improvement and in most cases a return to full health, supports this suggestion.

It would seem likely that a number of the reports of rhododendrons growing well in limestone, of the liming of rhododendron beds, of the use of bone meal for rhododendrons and of successful rhododendron gardens in limestone areas may be explicable in one or more of several ways. The first depends on the discussion by Blank (1) of the effect of leaching of dolomite by rainfall whereby the calcium is removed preferentially, giving a proportionate increase in the magnesium content of the soil, i.e. a decrease in the Ca/Mg ratio. This might account for the fact that calcifuge plants may grow well enough in areas where dolomitisation of the rock is not complete.

Secondly, areas of low pH can be observed in calcareous regions where, by isolation of pockets of soil with very free drainage, there has been virtually complete leaching of calcium from the soil and, thirdly, the calcium in some of the very hard, ancient limestones is much less freely available than in the younger, softer ones.

It has been shown (Table 3) that rhododendrons growing in soils so low in calcium that ordinary shrubs would probably fail, can yet build up a calcium concentration in their tissues similar to a fruit-bush growing in a well-limed soil. This may indicate that the calcifuge plant has an exceptional ability to absorb calcium from the soil, and that if there is an abundance of calcium in the soil, the plant takes up so much so rapidly that the uptake of other elements is impaired, and that these various deficiency conditions arise in the plamt.

Magnesium Suppressed

The antagonism of calcium and magnesium is well-known and, in all probability, if this swamping does occur, one of the first of the nutrient elements to be suppressed would be magnesium, and this would account for the rather unexpectedly high number of cases of magnesium deficiency occurring on alkaline soils (Table 2).

As magnesium is readily leached from the soil, the number of simple magnesium deficiency conditions occurring on acid soils is explicable, and the real importance of these findings is that the treatment of many of these cases of chlorosis is extremely simple, namely, the application of magnesium salts over the root area—and this has been borne out by practical responses as mentioned above.

The possible role of calcium deficiency in heavy rainfall areas and extremely acid soils has been, unfortunately, only recognised quite recently, but the results of the two sand culture trials reported here tend to support the suggestion that it may be of real importance in a few, rather rare, cases. This has also been confirmed by a practical response as mentioned above.

Conclusions

In many cases chlorosis in rhododendron is produced by other causes than the presence of lime in the soil. Of the 78 samples of leaves and soil taken simultaneously, 50 were from acid soils and 28 from neutral or alkaline soils, yet all showed the types of chlorosis usually attributed to the presence of excess lime in the soil.

In 55 of these cases, magnesium deficiency was shown by analysis to be present, either as a single deficiency or as present together with other mineral deficiencies (referred to in Table 2 as multiple deficiencies) so that it may be suggested that magnesium deficiency is most probably the major cause of chlorosis in this genus.

In alkaline soils magnesium deficiency is present only slightly less frequently than is manganese deficiency (19 cases as against 22). Calcium deficiency has also been recognised as a further cause of quite serious chlorotic symptoms. This is likely to be a serious factor only in high-rainfall areas unless it occurs as an induced deficiency due to an excessive level of, for example, magnesium in the soil.

Acknowledgements

I would like to express gratitude to the various botanic gardens, and also private gardens that provided me with the material for this investigation ; to the horticultural press for their publicising the request for material for analysis ; to Mrs. Margaret Bennett, formerly of Geigy Ltd., for her co-operation in obtaining many of the samples of chlorotic material ; to Mr. H. H. Davidian for his help and co-operation throughout and particularly for identifying the species and hybrids involved in this study ; and finally to Dr. D. Purves and Mr. S. McIntosh of the Edinburgh School of Agriculture for their assistance with the analyses of plant material, and their colleagues in the department for the soil analyses.

REFERENCES

(1) Blank, E. *Handb. der Bodenkunde* v11, p. 377 (1936).
(2) Grove, A. Rhododendrons and lime. *Gard. Chron.*, pp. 426-428 (1927).
(3) Hills, L. D. Hope for lime-haters. *Gard. Illust., 64, 792* (1946).
(4) Hills, L. D. *The Propagation of Alpines*, p. 72, Faber (1950).
(5) Hogenson, J. C. Epsom Salts for azaleas. *Gard. Mag.* (NY), No. 5, p. 228 (1906).
(6) Leiser, A. T. *Rhododendron occidentale* on alkaline soil. *Rhodo. and Camellia YB* (RHS), p. 47 (1957).
(7) Tod, H. High calcium or high pH ? *J. Scot. Rock Gard. Club* 5, 50 (1956).
(8) Tod, H. Rhododendrons and lime. *Rhodo. and Camellia YB* (RHS), pp. 19 to 24 (1959).
(9) Tod, H. Mineral deficiencies in rhododendron, *ibid.* pp. 38-41 (1961).
(10) Tod, H Mystery of tufa and lime-hating plants. *Gard. Chron. and New Hort.* Sept. 5, pp 26-27 (1969).
(11) Tod, H. Nitrogen sources for rhododendron, *ibid.* Mar. 14, p. 26 (1969).
(12) Tod, H. Nitrogen sources for mature rhododendrons. *Gard. Chron./HTJ,* Mar 5, p. 33 (1971).
(13) Wallace, T. *The Diagnosis of Mineral Deficiencies in Plants.* HMSO, p. 34 (1951).

Some wild flowers of the Algarve

by MRS. M. McMURTRIE

THE ALGARVE, that little "Kingdom" of the south of Portugal, is an altogether delightful place. Although people are now discovering it and tourism is penetrating more and more deeply. there are many parts of the countryside and many little villages still unspoilt where life goes on placidly as it has done for centuries (fig. 27). And here we find, in the old almond and fig orchards, in the wild ground along the unfenced roads and tracks, and on the uncultivated rocky hillsides, much of its marvellous flora. Many of the plants are not hardy in Scotland, although some that would not survive in the north might quite possibly grow in sheltered southern areas or in alpine houses. Certainly in the latter the interesting little ophrys species will grow and flower. Already, in November, I find many of them are sending up strong rosettes of leaves, presently the flowering shoots will emerge and blooms will appear early in March.

Ophrys tenthredinifera, or the saw-fly orchid, is one I have grown successfully in a cool greenhouse. This sends up a flowering stem about 4-5 ins. high with 2-5 blooms and in its native habitat, dry sandy tracks through scrub-covered hillsides and even roadside verges, I have seen it grow rather taller. The flowers vary considerably in colour ; some have pale pink sepals tinged with green, others are bright carmine. One tends to think of ophrys as being unobtrusive and difficult to "spot" (and mostly they are), but this species can be quite showy where it grows abundantly.

Another attractive little ophrys is the yellow bee orchid, *Ophrys lutea,* which has more rounded flowers, with bright yellow side lobes (fig. 24). It grows in short turf, but I have also found it, taller and quite abundant, in longer grass under the shade of shrubs such as *Pistacia lentiscus*; *Quercus coccifera,* the hermes or holly oak, and *Jasminum fruticans.*

Ophrys speculum is distinctive with a large bright blue patch on the lip, outlined in orange-yellow, surrounded by a dark brown hairy margin ; the yellow and brown colours are repeated on the side lobes. It is also known as the 'Mirror Orchid and 'Mirror of Venus'. *Ophrys bombyliflora,* or the 'Bumble Bee Orchid', is much less conspicuous ; it has a square brown lip and brown side lobes and the petals and sepals

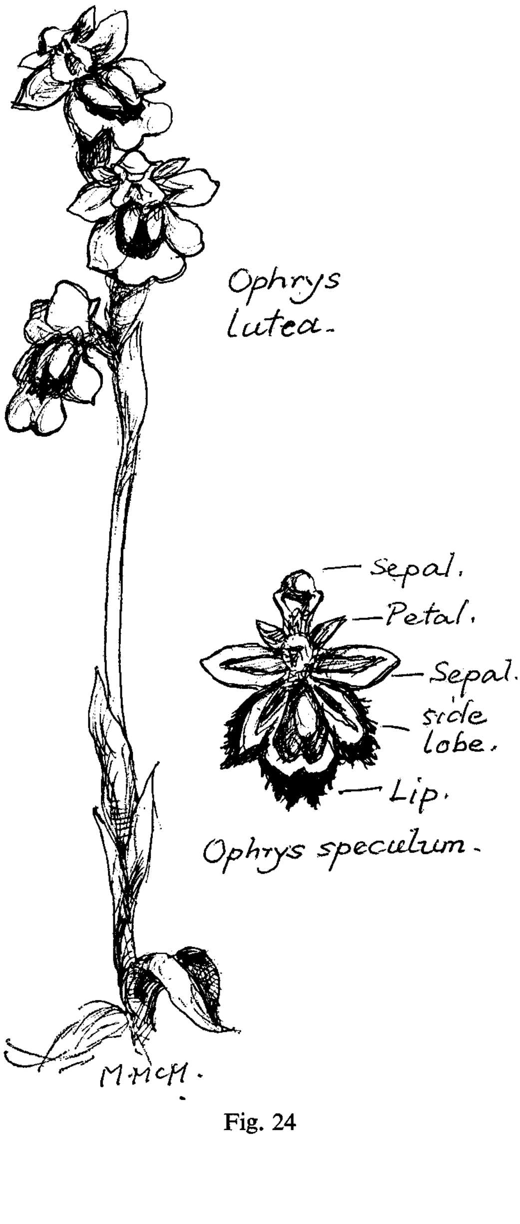

Ophrys
lutea.
Sepal.
Petal.
Sepal.
side
lobe.
Lip.
Ophrys speculum.
M.McM.

Fig. 24

are yellowish green. In most species there is a certain amount of variation in individual flowers. There are many species, those described being most common ; several others I have not yet identified, but I hope to do so as I have made careful watercolour drawings.

Other plants besides the fascinating ophrys succeed in an alpine house, and when they have increased one may experiment with specimens out of doors. The exquisite *Anagallis monelli*, with large gentian-blue flowers (its poor relations are *Anagallis arvenensis* and the well-known "Scarlet Pimpernel") is one of the most beautiful Algarve wild flowers, and a large patch in full bloom is an unforgettable sight. It grows on dry sandy places, such as roadsides, sandy banks and cliffs. *Paronychia argentea* forms a large spreading silvery mat, and is covered by masses of papery bracts in which the tiny flowers are hidden. It grows on sandy places near the sea ; I have tried planting it in an outdoor trough and it has survived two winters now. This is such a frost hollow that I often lose plants which other people cultivate without difficulty.

Lavandula stoechas, or French Lavender, might need some shelter. The flower-heads are composed of purplish over-lapping bracts, from which emerge the tiny, almost black, flowers arranged in neat lines, and at the top wave large purple plumes of enlarged bracts. It grows abundantly on hillsides among heath and gorse and cistus, and also in a more compact form on the windswept garigue at Sagres. Also growing here is *Armeria fasciculata* or *pungens*, the 'Spiny Thrift' ; it is larger than our sea-pink, and has pale silvery-rose flowers on long stems which rise from a dense cluster of grooved, glaucous, sharp-tipped leaves. Many more interesting plants grow in this wild region of harsh stony land stretching in from the cliff-tops ; they are flattened into low compact clumps by the fierce Atlantic gales. The whole area is often most fittingly described as a great natural rock garden.

Periwinkles are common in our own gardens, making excellent ground cover, and the Algarve species, *Vinca difformis*, is no exception. Its leaves and habit are similar, but the flowers differ in being pale blue and star-shaped. *Iris florentina*, the Orris Root of herbals, with large white blooms, needs plenty of space ; it looks very handsome edging many of the Algarve roadsides. Everyone who sees it would like to be able to grow that little charmer, *Iris sisyrinchium* (fig. 25); it has several small blue flowers on a stem, but they do not open till afternoon, when the day is "well aired", then, suddenly, the roadsides are blue with them! I cannot say how they would behave here in our less warm and sunny climate, but this is definitely a plant for the alpine house.

Many of the bulbs I saw growing wild are among our well-known rock plants, others we grow as house plants. There were *Tulipa australis* ; *Scilla monophylla* and *S. bifolia* ; *Muscari atlanticum* and *M. comosum* ; *Leucojum trichophyllum* ; *Narcissus tazetta, N. bulbocodium, N. papyraceous* (growing in large numbers in a damp ditch bordering a field), and the tiny, rare *N. calcicola,* whose flowers, 3 to 6 on a stem, and about the size of your thumb-nail, are deep yellow and very sweetly scented. About the most unusual plant that I found was the scarce

Fig. 25

Fig. 26

"brown bluebell", *Dipcadi serotinum* (fig. 26) ; it was growing on a grassy bank near the sea. It is more curious than beautiful, with brown or yellowish-brown bells.

Some of the cistus species would be very attractive in rock gardens in sheltered areas. *Cistus palhinhaii,* with flowers of purest white, is low and compact, growing as it does on the stormy Sagres garigue ; *Cistus crispus,* from 2 to 3 feet, with deep rose blooms, might be a hardier variety, as it grows on the high slopes of the Serra de Monchique. For a large rock garden *Cistus ladaniferus,* the gum cistus, with sticky aromatic leaves and large white flowers—sometimes with a maroon blotch—would be a good choice. There are also *Cistus salvifolius,* white ; *Cistus monspeliensis,* not so tall, with tiny white flowers, and *Cistus albidus,* magenta and grey-leaved, which flowered freely and continuously all last summer (1973) in my cool greenhouse. These last two, along with *Cistus ladaniferus,* all grow abundantly along roadsides, but the gum cistus also spreads over acres of hillsides and "covers the harsh soil with an airy cloud of immense white blossoms, like butterflies arrested in flight."

Life goes on placidly

Fig. 27

Show Reports

EDINBURGH AND MIDLOTHIAN

THE SHOW was held on Saturday 23rd March, in the Horsa Hut in the former Royal High School Buildings. Holding a one-day Show on a Saturday was an experiment which was popular and the hall was thronged with people, helped no doubt by a mention on the BBC's Scottish Garden radio programme and a beautiful day. There has been a lot of criticism of the Shows being too 'bunched', so the March date was decided on, partly to include the former Penicuik Show with the Edinburgh Show which enabled a range of plants to be exhibited which are not seen at the later Shows. So the Edinburgh Show will be a one-day Saturday Show next year, as this seems to be acceptable to competitors and visitors alike.

There were good entries in both Section I and Section II. Many interesting plants were on the benches, all of which unfortunately cannot be listed.

Section I:

The Corsar Challenge Trophy for 3 Pans Primula was won by Mr. D. Livingstone, with *Pp. pubescens, gracilipes* and *edgworthii.* The Carnethy Medal for 3 plants of different genera was won by Mrs. S. Maule with *Corydalis marschalliana, Synthiris lanuginosa* and *Soldanella montana.*

The Elsie Harvey Memorial Trophy for 3 new, rare or difficult plants in cultivation was won by Mr. Harold Esslemont with 3 Dionysias, and the A. O. Curle Memorial Trophy for 3 plants grown from seed by the exhibitor was also won by Mr. Harold Esslemont. Mr. John Main, Edinburgh, won first prize in the class for 1 pan grown from seed by the exhibitor, with a good plant of *Dionysia fretagii.*

Class 7, 3 pans suitable for the rock garden from Amaryllidaceae, etc., was also won by Mr. Esslemont with 3 pans of Fritillaria, and Mrs. J. Stead of Thorntonhall, Glasgow, was second. There were 5 entries in this class. Class 8, 2 pans as in Class 7, also had a good entry. This was won by Mr. Jack Crosland, Torphins, Aberdeenshire, with *Romulea libanoticum,* collected in the Lebanon, and *Erythronium dens-canis.* Fritillaria won second prize for Mrs. E. Ivey, Dalry, and third prize for Mr. Esslemont, Aberdeen.

As has been shown above, bulb entries were well represented as had been hoped, and there were good pans of *Narcissus cyclamineus* and tulips.

In the 2 pan Primula class there were 6 entries, first prize going to excellent specimens of *Pp.* 'Joan Hughes' and *allionii alba* in full flower. First prize for 1 pan Soldanella went to Dr. and Mrs. J. Good, Edinburgh, with a well-flowered pan of *S. carpatica.* There was a good entry of dwarf conifers, and in the classes for Ericaceae and Vacciniaceae, excellent plants of *Arcteria nana* and *Kalmiopsis leachiana* were shown. Mr. Bruce Robertson of Howgate, Penicuik, had a beautiful specimen of *Kalmiopsis leachiana*, and another entry of his, well worthy of mention in Class 41, 2 pans rock plants not eligible for the other classes, consisted of 2 North American plants, *Anemonella thalictroides rosa plena* and *Claytonia virginica* (fig. 30), plants not often seen on the show bench, and both charming.

The Boonslie Cup for a miniature garden was won by Mrs. Hart of Edinburgh with a well balanced collection of plants, and the Kilbryde Cup for an arrangement of cut flowers was won by Mrs. B. B. Cormack, Edinburgh, with an artistic arrangement of rock garden flowers and foliage.

Section II:

It pleases the Show Secretaries when there is a good entry in Section II, as it is from this source we get our exhibitors of the future. There was an excellent entry, and in most cases the plants were worthy of entry in Section I.

The Henry Archibald Rose Bowl was won by Mr. J. R. Johnstone, who had come all the way from Co. Durham, for 3 pans rock plants of easy cultivation grown in the open ground. In Class 54 Mr. G. Kirkpatrick, Edinburgh, showed a beautiful *Saxifraga oppositifolia*, and Mr. J. R. Johnstone *S. apiculata.* In Class 58 Mr. H. A. Milne of Edinburgh won with a splendid *Kalmiopsis leachiana*, not outclassed in Section I.

The Show Secretaries felt that the Show was a success, and we thank all the people who so generously gave of their time, and without whose help and support the Show could not run so smoothly.

Last but not least we thank the two Trade stands who contributed a lot to the Show with their plants for sale. We are glad to say they did a roaring trade, and were sold out at the end. They both won a Gold Medal, and were Ponton's Nursery, Kirknewton, Midlothian, and Edrom Nursery, Coldingham, Berwickshire.

S. Maule

B. B. Cormack

NEWCASTLE UPON TYNE

THE SECOND joint S.R.G.C. and A.G.S. Show was held in the Memorial Hall, Ponteland, Newcastle upon Tyne, on Saturday 6th April. There was an increase in the number of plants on show as compared with last year and exhibitors came from a wide area—Aberdeen, Edinburgh, Dumfries, Ayrshire, Lancaster, Yorkshire, Co. Durham, Teesside, Nottingham and Tyneside. Mr. A. Evans, President S.R.G.C., Mrs. S. Maule, Chairman of the S.R.G.C. Show Secretaries Committee, and Mr. M. Upward, Secretary of the A.G.S., were the judges.

Interesting plants on show were *Paraquilegia grandiflora*, which was considered the most meritorious plant in the Show and was awarded the Forrest Medal; several forms of Dionysia, which stirred the enthusiasm of viewers so much that one lady approached the Local Group Plant Sales table and said "I want one of those plants covered in yellow flowers to plant on top of a wall so that it will hang down"—optimist!; a very interesting *Primula rubra* hybrid, having large deep red flowers and having been originally a collected seedling; three pans of *Kalmiopsis leachiana*, two of which were 'le Piniec' form (fig. 27) and the other the type plant, the type plant being awarded the red sticker, being a larger plant and fully flowered.

Pulsatilla vernalis in a six-inch pan attracted much attention. There was also on show a nine-inch pan of *Saxifraga burseriana* which was ten years old and had been grown on from a small collected cutting found on the Schlern—unfortunately it was just past its best but the size of the flowers was quite remarkable. In the Ericaceae class there was a well-flowered plant of *Epigaea repans*, and the class for one plant endemic to New Zealand was well supported; first prize was awarded to *Pygmaea pulvinaris*.

A well arranged Trade Stand was provided by Mr. C. C. Hollett of Sedbergh and this was awarded the Gold Medal. In addition Miss Aitchison of Spindlestone arranged a display of rural crafts which also included some of her excellent paintings of Alpine flowers on crockery.

Five extremely hard working ladies of the Local Group provided refreshments all day as well as catering for a reasonably priced mid-day meal. A refreshing cup of coffee was available early in the morning so that competitors were able to indulge as soon as they had staged their plants. This I am sure was very much appreciated, particularly as many had travelled considerable distances.

Mr. Orr, Subscription Secretary, Mr. Kilpatrick, Editor, and Mr. Hall, Treasurer, made a point of visiting the Show; I hope the Tyneside welcome was sufficiently warm to encourage further visits in the future.

I would like to take this opportunity of saying 'thank you' to all concerned—particularly the exhibitors, without whom of course there would have been no Show. In 1975 the Show will be organised in accordance with the A.G.S. rules and a Farrer Medal will be available. The Show date will be 5th April 1975.

E. G. WATSON

PERTH

EXHIBITORS frae a' the airts converged on the Fair City on the morning of April 20th and after two hours of hectic staging and frantic arranging and re-arranging, with the accommodation finally taxed to the limit, it was indeed an orderly and colourful display which met the critical gaze of the judges—Messrs. A. Evans, R. S. Masterton and R. J. Mitchell—as they arrived to commence their adjudications. Later, they remarked on the very high standard of the exhibits and the resultant difficulty of their task.

The Alexander Caird Trophy, awarded as first prize in the six-pan class, went to Mr. H. Esslemont's exhibit consisting of *Androsace imbricata*, *Draba mollissima*, *Cassiope* 'Randle Cooke', *Glaucidium palmatum album*, *Rhododendron* 'Phalarope' and *Sarcocapnos rupicapna*.

Mr. J. D. Crosland won the Dundas Quaich in the three-pan class with *Androsace imbricata*, *Hormathophylla reverchoni* and *Pleione forrestii*.

The L. C. Middleton Challenge Trophy, which is awarded to the competitor gaining the highest number of points from First Prizes in Section I, was won by Miss G. L. Blackwood, whose entries included the only gentians in the Show.

The following plants were awarded Certificates of Merit: (1) Mr. J. B. Duff's *Cassiope lycopodioides*, eighteen inches in diameter and completely smothered in blossom. This particular plant has a longer bell than normally seen. (2) Mr. Esslemont's well known and wonderful *Draba mollissima* which has appeared at many a Show, often as a flowering plant but sometimes in the cushion class. For it to be still in perfect condition is indeed an indubitable testimony to the skill of the grower. (3) A second Certificate of Merit went to Mr. Esslemont, this time for *Androsace imbricata*, a delightful specimen which, ten years ago, would have brought forth gasps of astonishment, but the like of which we now expect this gentleman to produce for our admiration every year. (4) Mr. J. D. Youngson's *Lithospermum oleifolium*, perhaps the best example of this species ever seen at Perth Shows. The specimen was large, well-flowered, of a good blue colour, and the foliage looked exceptionally healthy for a plant which is normally notoriously disappointing in this respect. (5) Mr. Crosland's *Pulsatilla vernalis* with flowers of exceptional substance, the petals being backed with violet colour.

But it was Mr. Crosland's lovely pan of *Pleione forrestii* that the Judges finally decided should be awarded the Forrest Medal for the best plant in the Show. The pseudo-bulbs of this species of Pleione are still scarce and expensive, but the exhibitor claims it is easy to grow, and multiplies so that we can perhaps look forward to the time when it will be gracing and beautifying our Shows as often as its delightful relative, *P. pricei.*

Principal prizewinners in Section I, in addition to the aforementioned, and to whom we are grateful for supporting the Show, were Mrs. E. Ivey, Ayrshire, Mr. J. D. Main, Edinburgh, Mr. and Mrs. H. Taylor, Invergowrie, Mr. M. G. Adair, Glasgow, Mr. J. Sutherland, Inverness, Dr. and Mrs. J. E. G. Good, Midlothian, Dr. and Mrs. J. R. Gosden, Edinburgh, Mrs. J. Stead, Glasgow, Miss J. Halley, Dundee, and Mrs. S. Maule, Balerno.

The growing popularity of Fritillarias may make it necessary to consider introducing a separate class for this genus, which up to now has had to be exhibited in the large Liliaceae family class.

Amongst the plants which specially attracted my attention on the show benches because of their good quality or the fact that they are seldom exhibited, were:—

Primula reidii williamsii (Stead)
Cryptogramma crispa, the Parsley Fern (Taylor)
Celmisia sessiliflora, Potts form (Sutherland)
Petrophytum hendersonii. A large cushion with bigger than usual leaves and flowers (Adair)
Narcissus bulbocodium conspicuus. A large pan in excellent condition (Main)
Rhododendron 'Curlew'. An excellent yellow (Stead)
Rhododendron 'Phalarope' and *Rh.* 'Carmen' (Gosden)
Celmisia hieracifolia (Good)
Ptilotrichum pyrenaicum (Maule)
Oxalis obtusa (Ivey)
Trillium rivale (Crosland)
Erythronium revolutum 'White Beauty'. A large clump lifted from

the open garden and showing no signs of wilting at the end of the Show (Blackwood)

Ophrys speculum. The mirror orchid (Crosland)

Hylomecon japonicum (Taylor)

Dionysia balsamae (Main)

Lithophragma parvifolius (Sutherland)

The Class for a container of various rock plants arranged for effect was won by Mrs. H. Taylor.

We were glad to have some new competitors in Section II, although entries were not as many as we would like to see. The Bronze Medal for most points in this Section was won by Mr. G. Kirkpatrick, Edinburgh, to whom we offer our congratulations and hope to see more of him at Perth Show. Mrs. Ford of Eskbank also did well, with excellent strains of Primroses and Polyanthus. The entries from both Mr. and Mrs. Shirras, Inverness, were much appreciated.

The hours of decision-making finished, the Judges turned their attention to the other attractions of the Show, and awarded Medals to: (*a*) Mr. J. R. Aitken, of Orchardbank Nursery, for his Trade Stand so effectively decorating the hall platform, (*b*) the children of Kinnoull School who, under the tuition of our Show Secretary, had staged an exhibit of miniature gardens and painted Show posters, and (*c*) Mr. Lawrence Greenwood for a fine exhibition of eighteen pictures of Alpine Plants, grown and painted by himself.

J. B. DUFF

ABERDEEN—2nd and 3rd May 1974

SADLY, on this occasion, the Show went on without the genial presence of the former Show Secretary, the late Mr. A. D. Reid who, after a short illness, took leave of his many gardening friends on 26th February 1974. Members will recall his successful stewardship of the Show during the past three years, when standards of plants and of presentation fully maintained those of earlier years.

Alex Reid's critical appreciation and considerable knowledge of plants, particularly of the Ericaceae, in which he demonstrated a special expertise in cultivation, left a mark of respect among all of us who knew him. The absence this time of his beautifully grown, mature plants, was a loss to the Show.

In spite of a cold, wet, windy and sunless spell of weather, which did nothing at all to encourage plants or plantsmen, a nucleus of enthusiastic exhibitors, not to be deterred by such trials, produced an admirable display of plants. Yet another example of so much being owed by many to the few was demonstrated by the fact that over one hundred and fifty plants were staged by no more than eighteen exhibitors. It is a sober thought that, but for this handful of keen supporters, who rally to the Show in all circumstances, there would of course be no Show! Included in this number, we were delighted to welcome Mr. J. D. Main and his plants, all the way from Edinburgh. His eight fine entries gained for him no fewer than seven first prizes and included specimen plants of *Primula aureata, Cassiope* 'Muirhead', *Erinacea pungens, Androsace imbricata* and two notable pans of bulbs, *Narcissus bulbocodium conspicuus* and *Tulipa maximowiczii.* We congratulate him upon his successes, and express our warm thanks to him for making such a noteworthy contribution to the Show.

Once again, as so often in the past, Mr. H. Esslemont was the worthy winner of the Walker of Portlethen Trophy, gaining most points in the open Section, No. I, and including seven first prizes—a formidable combination of quality and quantity, which included fine examples of *Androsace imbricata,* which earned a Certificate of Merit, *Primula petiolaris,* the lovely white form of the Japanese *Glaucidium palmatum album,* the rare *Paraquilegia anemonoides,* and the temperamental *Shortia galacifolius.* Runner-up to this award was Mr. A. D. McKelvie, displaying a well grown series of plants including *Rhododendron* 'Carmen', *Rhododendron fastigiatum, Geum montanum, Lewisias tweedyi* and *cotyledon* hybrids.

Acting Show Secretary, Mr. J. D. Crosland, wishes to record thanks to all who so willingly gave their assistance, and by whose resolve the Show was a success; to the Show Stewards who attended daily, and in particular to Group Convener Mr. J. E. C. Pole and to Mrs. S. M. Simpson who gave much time and sustained effort to ensure that all went well.

Mr. Crosland's plants took several notable awards in the competitive classes. These included the Aberdeen Bronze Medal in Class 1, Open Section, for six rock plants, not more than two of any one genus — the plants were *Hormathophylla reverchonii, Anchusa caespitosa Androsace imbricata, Claytonia nivalis, Pleione limprechtii* and *Pleione pogonioides* (fig. 28). The ten-inch pan of *Pleione limprechtii* in this entry, carrying thirty-one open flowers, attracted the award of the Forrest Medal. Against keen competition from Mr. Esslemont and Mr. McKelvie, Mr. Crosland's entry in the three pan class also gained first place, with *Orchis purpurea* (collected in Sardinia in May 1973), *Daphne* *petraea grandiflora* and *Androsace imbricata*—the last-named plant, a six-inch dome of white flowers, also gaining a Certificate of Merit.

It was gratifying to note more competition in both the two and single pan classes, plants grown from seed, in each class won by Mr. H. Esslemont, respectively by rare plants *Androsace imbricata* and *Saxifraga florulenta*, followed by a flowering seedling of the delicate *Paraquilegia anemonoides*.

It takes several years of patient endeavour to build up good show plants, and two regular exhibitors whose plants increasingly impress both judges and spectators were in evidence again. Mrs. H. Blair, who showed a well grown *Cassiope lycopodioides* and *Arcterica nana*, and Dr. D. G. Hardy whose plants included a fine Scottish native prostrate willow—*Salix reticulata*, a colourful *Pulsatilla* hybrid and a well flowered *Saxifraga* 'Crystalie'.

Mrs. S. M. Simpson, last year's Bronze Medallist, Section II, showed a well flowered pot of *Trillium erectum* and a delicate contrast in the green flowered *Aquilegia viridiflora*. In its class, a very well flowered *Lewisia tweedyi* gained a first, and a Certificate of Merit for Mr. Crosland. *Gentiana acaulis* was well represented by well flowered specimens from Dr. G. A. Garton and Mr. A. D. McKelvie.

In Section II, the lead was taken by Miss A. M. Pittendrich, her entries claiming the Bronze Medal for the highest number of points in the section. Our congratulations to this member, whose entry included six first prizes and such eye catching plants as *Rhododendron* 'Elizabeth' and *Fritillaria meleagris alba*.

In the Junior Section, Two and Single Pan Classes, Miss Alison Hardy took first prize in both classes in keen competition with Miss Julie Sinclair. Congratulations to both of these young ladies and we hope they will renew their efforts again next year.

Once again, by courtesy of the Regius Professor of Botany, Aberdeen University, and thanks to the skills of Mr. F. G. Sutherland, Supervisor of the Cruickshank Botanic Garden, we enjoyed a splendid display of plants in variety, attracting the interest of expert and novice alike. Aberdeen Group recognise their indebtedness to Mr. Sutherland who, without fail, presents this outstanding Show feature each year. In recognition of the outstanding character of this display, the judges were pleased to award a Certificate of Merit.

This year we were privileged to have new company in Aberdeen Department of Parks and Leisure, whose colourful stand served as a fitting introduction to their new section, specialising in Alpine and

Rock Garden Plants, in Victoria Park, Aberdeen. Members will no doubt have noted this new source of interest and experience, and will wish to profit by this local enterprise.

Our two regular Trade supporters, Mrs. McMurtrie, Balbithan House, Kintore, and Messrs. Jack Drake, Inshriach, Aviemore, have an important back-up to the Show. Their service of plant sales, plus a great deal of practical guidance about plants and cultivation which they give during the course of the Show, is of inestimable value to members, and in fostering the Club's image to the public.

Additional to her Trade Stand and in spite of pressures upon her time, Mrs. McMurtrie created a simple but appealling stand of wild-flowers, supported by appropriate reference works, on the important and topical subject of the conservation of our native flora. No true rock gardener can accept with indifference the continuing assault upon our wildflowers, which threatens many with extinction.

Indicating an aspect of specialisation, one of our leading plantsmen, Mr. J. R. Aitken, devoted an entire non-competitive display to *Lewisias* and Show Auriculas. Illustrating the wide range of colour breaks among the many crosses of *Lewisia* hybrids, and the fascinating colour forms of the Show auriculas, the stand drew much attention and many questions.

The judges—Mr. A. Evans, the Club's President, and Mrs. S. Maule from Edinburgh, and our local judge, Mr. F. G. Sutherland—expressed their pleasure in judging a Show of such general high standard. Our thanks are due to them, and to all who willingly gave their support to the event.

J. D. Crosland

GLASGOW

That Spring had come early to the West of Scotland in 1974 was evident from the selection of plants on exhibition at the Glasgow Show on 10th and 11th May. Many exhibitors had watched plants earmarked as possible entries bloom and fade, the Primula enthusiasts being particularly despondent. In consequence the general appearance of the benches was rather different from that in former years ; indeed, the new range of plants exhibited added considerably to the interest of the Show.

The George Forrest Medal for the most meritorious plant in the Show was won by Mr. J. D. Crosland with an excellently flowered plant of *Daphne petraea grandiflora*.

Dr. D. M. Stead won the Henry Archibald Challenge Rose Bowl with *Ranunculus parnassifolius, Tulipa batalinii* 'Bronze Charm' and *Corydalis cashmeriana,* this last being one of several fine examples of this species on the benches.

The skill of Mr. Harold Esslemont was once more demonstrated in the class for three rock plants rare, new or difficult. His *Raoulia eximia, Saxifraga florulenta* and *Ranunculus paucifolius* gained for him the Wm. C. Buchanan Challenge Cup. It was in this class that Mr. Crosland's Forrest Medal-winning *Daphne petraea grandiflora* appeared, accompanied by *Phacelia dalesiana* and *Anchusa caespitosa.*

The Edward Darling Memorial Trophy for three dwarf rhododendrons was won by Drs. J. & C. Gosden with the hybrids 'Curlew' (*ludlowi* x *fletcherianum*), *hanceanum* x *keiskii,* and *pemakoense* x *davidsonianum.*

Having gained the most points in Section I, Mr. Bob Easton was awarded the Crawford Silver Challenge Cup, while in Section II the fine selection of plants shown by Mr. J. Mathison earned for him a Bronze Medal and the Wilson Trophy.

Attracting considerable attention on the benches were such plants as Mr. John D. Main's *Haastia pulvinaris* and, in the Scottish native class, Dr. Ernest Cormack's flowering *Loiseleuria procumbens.* Mrs. Joan Stead's three Primulas, *Pp. modesta, reidii* var. *williamsii* and *sinoplantaginea* were plants of great merit; the attractive *Androsace imbricata* and *Androsace cylindrica* x *hirtella,* shown by Mrs. Betty Ivey, and Mr. Crosland's *Androsace imbricata* also drew appreciative comments from visitors. Much admired were the two large pans of *Pleione limprichtii* and *Pleione pogonioides* exhibited by Mr. Crosland, as were the two *Cypripedium* species respectively shown by Mr. C. Simpson and Miss M. Nicolson.

Mr. Malcolm Adair had many well grown plants in the Show, of particular interest being his *Phyllodoce aleutica* and a fine cushion of *Petrophytum hendersonii.* A welcome reappearance on the show bench was *Omphalodes luciliae* shown by Dr. and Mrs. Good.

An encouragement to anyone diffident about attempting to grow plants from seed was the well flowered *Rhododendron racemosum* successfully grown by Mrs. F. Cochrane.

There was the usual large entry of Dwarf Conifers, the prizewinners in the three, two and one pan classes being, respectively, Dr. and Mrs. N. Holgate, Mrs. Betty Ivey and Mr. C. Simpson. Among the winning plants were *Cedrus libani nana, Picea abies 'nidiformis'* and *Chamaecyparis obtusa 'ericoides'.*

The Rhododendron Section was appreciably larger than in the past few years and despite the adverse climatic conditions afforded the usual colourful display. The winner of the Urie Trophy and the Rhododendron Challenge Trophy for the most points in the Section was Sir G. W. Pennington Ramsden, Muncaster Castle, Ravenglass, who, with *Rhododendron lindleyi*, also won the Sir John Stirling Maxwell Trophy for the best individual truss.

Mr. W. D. Davidson's *Rhododendron* 'Beauty of Littleworth' was awarded the prize for the best hybrid in the Show.

Mrs. Neil Rutherford's entries provided many prizewinners and her large bowl filled with magnificent blooms epitomised the beauty and colour of the Rhododendron Section.

The Trade stand of Messrs. J. R. Ponton, Kirknewton, carried its usual display of high quality plants. Attending the Show for the first time was Mr. Andrew Duncan, Milngavie, who brought a varied selection of garden furniture and containers, as well as indoor and garden plants. At both stands visitors found much to interest them.

With its topical theme of conservation, Miss M. Nicolson's miniature garden decorating the Show Secretaries' table was a source of interest and admiration. The Parks Department of Glasgow Corporation mounted a colourful array of pot plants which provided an eye-catching feature at one end of the hall. At the other end a display of 'Roses' on stamps presented by Miss Margaret MacIntyre was an equally popular feature.

The Show Secretaries are grateful to all who contributed to the success of the Show, to our President, Mr. Alf Evans, for his opening remarks, and to Mrs. Evans for so graciously presenting the Trophies.

M. G. Holgate

DUNFERMLINE

The Club's Show at Dunfermline on 24th/25th May was most encouraging in more ways than one. The general impression created was of a greatly improved general standard in the quality of the plants themselves along with what appeared to be a considerable increase in the number of plants ; few, if any, classes were without competition. Another very pleasing feature was the greatly increased number of new names appearing on the prize cards ; this is a happy omen for the future.

The 1st prize in Class 1, the Mrs. W. B. Robertson Challenge Cup, went to Dr. and Mrs. Good, Bonnyrigg, for very good plants of *Dode-*

catheon pauciflorum 'Red Wings', *Lewisia* 'Pinkie' and *Primula reidii*, while Miss Thomson, Cowstrandburn, came second with *Aquilegia bertolonii*, *Saxifraga cebennensis* and *Erodium reichardii* 'Rosea'. Mr. Main, Edinburgh, came first in Class 2 with a fine plant of *Haastia pulvinaris*, and Mr. Adair, Glasgow, second with a good *Phyteuma comosum*, while a fine *Lewisia pygmaea* 'Glandulosa' came third.

In Class 3 (native to Scotland) *Salix* x *boydii* came first, *S. reticulata* second, and *Mertensia maritima* third. Throughout all Section I many good plants were on view and competition was keen. In Class 5 *Primula rusbyi*, *P. williamsii* and *P. muscarioides*—all good plants—gained awards in that order. Classes 7, 8 and 9 between them carried 18 entries, and in Class 8 (lewisias) the entries were excellent, while the winning entry in Class 9 was a fine *Sedum spathulifolium* 'Capablanca'. The leading entry in Class 10 was a very excellent *Sempervivum arachnoideum* shown by Mrs. Cormack. The entries in Class 13 (Campanulaceae) were all good with a *Wahlenbergia serpyllifolia* 'Major' first, *Campanula aucherii* second, and *C. tridentata* third. A fine *Cotula atrata* 'Luteola' came first in Class 14, and in Class 15 an excellent *Leiophyllum buxifolium* caught the eye, followed by a good *Vaccinium delavayi*.

Class 16 was won by a superb *Oxalis obtusa* shown by Mrs. Ivey, and in Class 19, though not a prize winner, a dwarf form of the well-known *Rehmannia glutinosa* from North China was interesting. The entry in Class 21 (dwarf conifers) was the smallest I have seen in this class ; I wonder why! A well flowered *Petrophytum hendersonii*, followed by a fine *Daphne jasminea*, led the field in Class 22, while the leader in Class 23 was an excellent *Phlox adsurgens*. Mr. M. G. Adair was a worthy winner of the Carnegie Trust Trophy for most points in Section I.

Section II started off in good style with 4 entries in Classes 30 and 31 and 5 in Class 33, but rather tailed off after that. The Bronze Medal for most points was won by Mr. D. G. Williamson of Burntisland.

Section IV's opening class (43) must have been the keenest competed class in the Show with 5 entries of 3 pans each—and all were good plants. In Class 44 Miss Milburn came first with a fine *Globularia bellidifolia* and again in Class 45 with *Sedum roseum*. The cushion plant class (46) was won by Mr. and Mrs. Campion with a very excellent *Calluna vulgaris* 'Foxii Nana', and they were again first in Class 47 for 3 pans of Saxifraga. Class 49—for 3 pans Sedums/Sempervivums—produced 7 entries, first prize going to Mr. and Mrs. Campion ; these plants are always exceptionally well represented in Dunfermline.

In Class 53 Miss Milburn came first with an excellent *Dianthus* 'Whitehills', and in Class 64 there were 7 entries as opposed to the few in Class 21.

The award for most points in Section IV, the Institute of Quarrying Quaich, went to Mr. and Mrs. Campion, to whom, along with their able helpers, all praise must go for the excellent staging of the exhibits and also the thanks of the Club for an excellent Show.

The premier award of the Show, the George Forrest Medal, was given to an excellent *Lewisia* 'Pinkie' shown by Mrs. Maule.

J. L. MOWAT

Some Wild Flowers of Southern Indiana

by JAIME LASS

SOUTHERN INDIANA, where we lived for eight years, was a difficult place in which to garden.

The summers were long and oppressive, with violent storms and extended periods of drought, and, while on the average day the temperature was in the mid-80's (F.), it was nothing unusual for it to reach 105°, with the humidity standing at 80 or 90%.

In January, on the other hand, there was regularly a week when the thermometer fell to 20° below zero (F.). But January also had the odd day in the 60's (above zero), which, while a pleasant change for people, must have been rather a shock for plants. In February, a day of frost could be followed by one of 70°; and March and April, as a rule, brought both snow and 80° days. The latest frost I remember was on the ninth of May.

As may be imagined, the range of cultivated plants willing to put up with that sort of thing was somewhat limited compared to what we enjoy in Britain. Those of a sun-worshipping, annual persuasion were quite happy, but the most beloved and characteristic plants of British gardens, (except for roses), simply weren't seen.

One cause of the manic-depressive climate lies, I think, in Indiana's geographical position. The Atlantic is about 500 miles to the east; the Pacific roughly four times that distance to the west. Without the mitigating influence of an ocean, the weather (which generally travels from west to east), sweeps unchecked across 1,000 miles or so of prairie, behaving just as it pleases. Indiana is located in the east central lowland of the U.S., between Latitudes 37° 47′ and 41° 46′ north and Longitudes 84° 49′ and 88° 2′ west. It's bounded on the north by Michigan and Lake Michigan, on the west by Illinois, on the south by the Ohio River and Kentucky, and on the east by Ohio. Topographically, it's an undulating plain, ranging from 300 feet above sea level in the south-west to 1,250 feet above sea level in the east central part of the state. Monroe County, where we lived, is on approximately the same latitude as Lisbon.

The soil caused further problems, and its nature was partly the result of *not* having been pummelled by glaciers during the Last Ice Age. Northern Indiana, which was under the ice, is flat and fertile, but the southern third of the state, which escaped that chastening experience, is hilly, and the soil, (at least where we lived), was clay at its most miserably heavy, sticky and intractable.

After saying all this, I must add that the wild flowers didn't seem to mind a bit. The most interesting of them grew in the woods, with a thick insulation of leaf mould between them and the clay, and they coped with the climatic vagaries by having a short season and spending the rest of the year in decent retirement.

Until 170 years ago, when the white men began to arrive, the whole of southern Indiana was under dense forest. Many of the early settlers, in fact, travelled by ox-drawn sledge because of the difficulty of getting wheeled vehicles through the trees and undergrowth.

The majority of these settlers intended to farm, and their usual practice in clearing the land was to cut down the primeval trees and burn them where they fell. So effective were their activities that today very few of the original trees are left, and the characteristic landscape is now a patchwork of fields (man-made) and woods. Young trees, however, continue to spring up wherever a positive effort isn't made to keep them at bay.

The countryside is intimate and beautiful—a continuous series of low hills and small enclosed valleys (called hollers). Very little except trees grows in the high, dry woods on top of the ridges. The flowering plants live down the slopes and in the bottoms where they get shelter and moisture.

The native trees are nearly all deciduous, being chiefly: oaks (various species), beech (*Fagus grandifolia*), hickory (*Carya ovata*), walnut (*Juglans nigra*), sycamore (that is, *Platanus occidentalis*, not *Acer pseudoplatanus*, which is known in America as sycamore maple), sassafras (*S. albidum*), tulip (*Liriodendron tulipifera*), and maple (mainly *Acer rubrum* and *Acer saccharum*). There are also apples and persimmons (*Diospyros virginiana*), and those two ubiquitous small trees which deck the hillsides with pink and white in May—the red-bud (*Cercis canadensis*), and the dogwood (*Cornus florida*).

Invariably, the first wild flowers we found each year were *Dentaria laciniata* (fig. 29)—the toothwort. These began to appear in the first

Fig. 29 *Dentaria laciniata*

week in April, or even the last week in March. They're crucifers, with flowers about half an inch across, pale pink or pinky-white, in clusters. The leaves are lobed, with each of the leaflets long, narrow and sharply toothed. The plants we found were generally about six inches tall, although various wild flower books list them as being eight to fifteen inches.

The flowers are unspectacular, but we always welcomed them as the first signs of colour after the long, dreary winter. And, incidentally, they had the most extended season of any of the rather ephemeral woodland flowers, usually going on well into May.

About a week after the first appearance of the *Dentaria*, we'd begin to find *Claytonia virginica* (fig. 30)—the spring beauty. This is a low-growing plant (not more than a few inches tall), and a member of the Portulacaceae. The flowers, although bearing no other obvious resemblance (in the eye of the non-botanist, at least) have the same endearing shine as the *Portulaca*.

There are five petals, pale pink to white, with deeper pink lines

Fig. 27 *Kalmiopsis leachiana* 'M. le Piniec' *Photo* J. D. Crosland

Fig. 28 *Pleione pogonoides* *Photo* J. D. Crosland

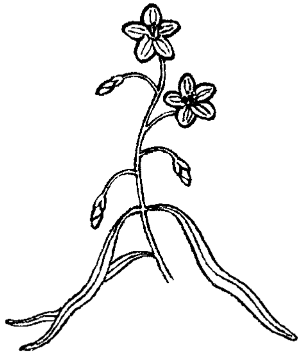


Fig. 30 *Claytonia virginica*

stencilled on them, and the whole flower, while only half an inch across, like the *Dentaria,* is both more showy and more loveable. The leaves are floppy and more or less strap-shaped, and they have the pleasing quality of not being out of proportion with the flowers.

Appearing at the same time as *Claytonia* was *Anemonella thalictroides* (fig. 31)—the rue anemone. This flower, dainty, modest and

Fig. 31 *Anemonella thalictroides*

altogether charming, was, I think, my favourite of all the spring flowers. In our woods, there was a steep hillside, sloping down to a stream, which every April was clothed with *Anemonella.*

The flowers are about three quarters of an inch across and extremely variable, so that growing within a few feet of each other we found flowers with five petals which were almost white, and flowers with eleven petals which were pale mauve, (on separate plants, of course), while in between grew every conceivable variation of both shade and petal number. According to wild flower books I've read, *Anemonella* grows six to eight inches tall, but those in our woods were generally only about four inches. The plant is in the Ranunculaceae but as far as good manners go, is obviously the white sheep of the family.

Another flower appearing at about this time (mid-April) was *Sanguinaria canadensis* (fig. 32)—the bloodroot. This is familiar enough

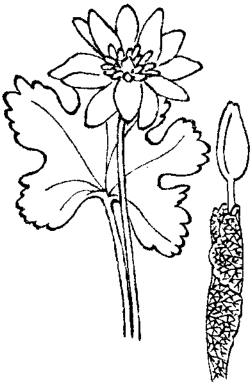


Fig. 32 *Sanguinaria canadensis*

in gardens here to need no elaborate description; but for those who have never grown it personally, I might mention two of its most pleasant habits. One is the way the flower stalk arises, with its leaf rolled protectively around it like a furled umbrella, (or perhaps, even less poetically, like a cigar), glaucous underside out; and the other is that when the flower is finished, the glistening white petals, having opened ever wider until they're reflexed, drop all at once, leaving a golden boss of stamens. It's a most satisfactorily tidy plant.

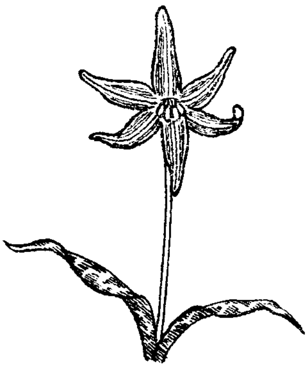


Fig. 33 *Erythronium americanum*

The showiest of the woodland flowers, and therefore the one we looked for most eagerly, regularly going down to the woods long before we could reasonably expect to find it, was *Erythronium americanum* (fig. 33)—the dogtooth violet.

The oblanceolate leaves, shining green, mottled with liver-coloured splotches (which sounds quite disgusting, but is actually beautiful, and not at all reminiscent of linoleum in a cheap restaurant, as perhaps my description suggests) began to arise in early April, but the flowers didn't appear until towards the end of the month, usually waiting for a warm rain, followed by a day or two of sunshine.

(Exactly the conditions, incidentally, which produced the edible mushrooms—morels—which had such a devoted following that for a fortnight each April-May strange cars were parked along our road and the woods swarmed with people bearing paper bags.

The biggest morel we ever found was not in the woods, but in a cemetery in Martinsville, Indiana. It was the size of my entire hand, and was growing near an impressive headstone erected to the memory of Miss Olive Branch and Miss Leafy Dell Branch. Readers who think I am making that up are invited to visit the cemetery and see for themselves.)

At any rate, to un-digress, the *Erythroniums* are members of the lily family. The younger plants produce one leaf and no flower; the older ones a pair of larger leaves and a single flower, the stalk reaching a height of perhaps four inches.

Unlike the plants mentioned so far, which all seem to prefer shady conditions, the *Erythronium* likes a certain amount of sun, at least during its growing season.

We had one spot in our woods, a little, flat-bottomed valley, threaded by a stream, which was a suntrap until mid-May when the beeches on the slopes above leafed out. Along the bottom, the *Erythroniums* grew so thickly that it was impossible to walk there without treading on them.

We had only the yellow *Erythronium* in our woods, but a few miles away I found both white and pink ones. Whether they were the same species, however, I don't know.

This was the one plant, by the way, which I never transplanted. The bulbs were buried so deeply, and connected to the outer world by a white stem of such inordinate length and fragility, that after a few tentative excavations I decided it just wasn't possible.

I *did* transplant specimens of all the other plants mentioned so far, and a good many of those described later in this article. (All, I hasten to add, from places where they were endangered—barring a few early, and successful, experiments with plants growing in our own woods.)

My rate of success must have been something like 99%—the one failure being *Lycopodium complanatum*—or ground pine. All the others, including some such as *Dicentra cucullaria* (fig. 34), which is reputed

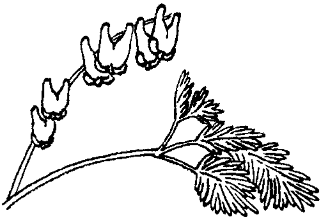


Fig. 34 *Dicentra cucullaria*

to bloom sparsely when removed from its original home, did splendidly. In moving them I had recourse to nothing but common sense—getting them out with as much earth around them as possible, replanting them as quickly as possible, in a place as like their original home as possible, and always taking an extra bucket of soil from where they were growing, so that they could be surrounded by it in their new home. They were replanted on the east side of our house, where they got shade and shelter from a wood about fifty feet away.

Back in our woods, as a background to the *Erythroniums*, along the shady slopes, grew *Podophyllum peltatum* (fig. 35)—the mayapple. This is a plant with large, palmate leaves, growing a foot or so tall,

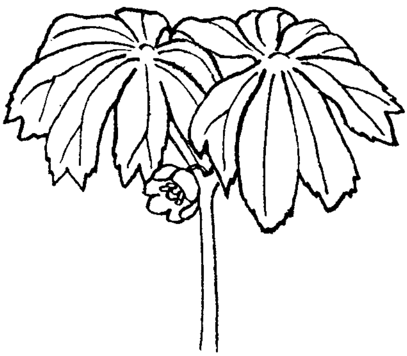


Fig. 35 *Podophyllum peltatum*

and surprisingly it's a member of the Berberidaceae. As with the *Erythronium*, the young plants put up a single leaf, the older ones a pair, with a fairly sizeable white flower depending from the fork between them, and generally hidden by the leaves themselves. This eventually becomes an edible fruit, although its seeds and the rest of the plant are poisonous.

I have a great affection, by the way, for lusty plants (like *Fritillaria*

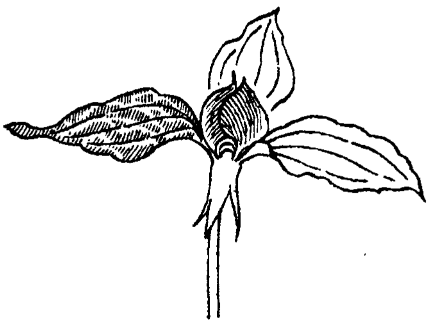


Fig. 36 *Trillium recurvatum*

imperialis) which come blasting up through the ground each spring, rather, (to use an American simile), like guided missiles emerging from their underground silos; leaving visible holes and arising with crumbs

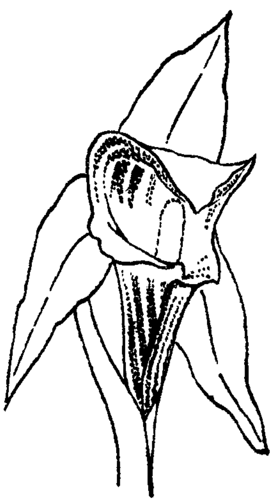


Fig. 37 *Arisaema triphyllum*

of earth still clinging to them. The mayapple does just that. The leaves rise up furled under a knuckle-like knob and gradually unfold into large, shining umbrellas.

In late April, the *Trilliums* appeared. One which grew in our woods was *T. recurvatum*. This is similar to *T. sessile*, reaching a height of about eight inches, with a splendid deep red-brown flower and leaves mottled with paler green. The chief difference, however, is in the sepals, which in *T. recurvatum* (fig. 36) curve down gracefully under the flower instead of embracing it.

Another plant with a tripartite leaf appearing in late April-early May was *Arisaema triphyllum* (fig. 37)—Jack in the pulpit. This is obviously an *Arum*, and is pleasantly and subtly dressed in shades of green. In October, (fig. 38) after the sheath and leaves have shrivelled

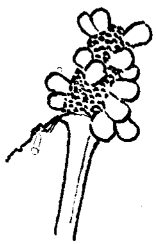


Fig. 38 *Arisaema triphyllum* (seedhead)

away, the spathe is studded (after the manner of an ear of maize) with brilliant, shining red seeds, or, to be more accurate, the seeds are within brilliant, shining red kernels.

Beginning in late April, we'd find *Dicentra cucullaria*—''Dutchman's breeches''. As a rule, it grew not in the woods but in sunnier spots just beyond the verge of the trees (fig. 34).

It's a charming plant, thought by some people to resemble a line of trousers hung out, upside down, to dry, but it has always reminded me irresistibly of an advertisement for an old-time dentist. The flowers are white, with the sexual parts yellow.

It's a member of the Fumariaceae, and has the typical pretty, finely-cut *Dicentra* leaf. The leaves make a feathery little mound, out of which the flower stalks arise.

By mid-May, the season of wild flowers was waning, but the woods were full of spectacular colour from the *Cercis canadensis* and *Cornus florida* which grew in great numbers everywhere. As they bloomed before most of the other trees had leafed out, their effect—large swathes of mauve-pink and white on the hillsides—was visible from afar.

By early June, however, the countryside was losing its youthful freshness and taking on the more ponderous appearance of summer. In the meadows, daisies (*Chrysanthemum leucanthemum*), blackberries, yarrow (*Achillea millefolium*), wild strawberries (*Fragaria virginiana*), pokeweed (*Phytolacca americana*), wild roses, elderberries (*Sambucus canadensis*), Queen Anne's lace (*Daucus carota*), butter-and-eggs (*Linaria vulgaris*), chicory (*Cichorium intybus*), and quite a few other flowers bloomed, but the overall effect of the summer scene was not one of flowers, but of rather heavy greenness.

One of the few flowers to bloom in the woods during the summer was *Impatiens biflora*—jewelweed, which grew to four and five feet and formed lush clumps along or actually *in* streams.

One has only to see this plant to recognize it instantly as a large relative of *Impatiens sultani*—busy Lizzie. The stems are juicy and translucent and the yellow or orange, spotted flowers depend like earrings from fragile pedicels, so that the least touch sets them trembling.

To see one of these plants, however, was to offer one's body up for the delectation of swarms of mosquitoes, which hung in the air over any body of water, no matter how small, and waited for anything mammalian to enter their spheres of influence.

Of course, mosquitoes were everywhere, but unless one went down into the woods, one was generally free of their attentions during the daytime. Night-time was something else, and for that reason Indiana houses are furnished with fine, wire-mesh screens over every aperture; a fact which led me, on first seeing British houses, to be struck by the thrilling indecency of all those open doors and windows.

Late summer brought a new crop of flowers to the meadows—milk-weed (*Asclepias*—probably *syriaca*), which is the food plant for the larvae of the splendid Monarch butterflies, butterfly-weed (*A. tuberosa*) and thistles (probably *Cirsium altissimum*), but the two plants which epitomized the end of summer for me were the ironweed (*Vernonia*—probably *altissima*) and the goldenrod (*Solidago*—about half a dozen species).

Goldenrod is, of course, a familiar garden flower here, but in America, although various of the more elegant nurseries advertise it in their catalogues, it's generally (because of its commonness, I suppose) regarded as a weed—and by hay fever sufferers as a vicious weed.

Beginning in late August, the meadows turn yellow with it, with here and there, standing head and shoulders above it, the noble *Ver-*

Fig. 39 *Vernonia* (seedhead)

nonia (fig. 39). This grows to about five feet and is crowned with a flat plate of deepest purple composite flowers.

It's a plant which I was disappointed not to find here, as it would I think, be a most perfect addition to the back of the autumn border. It's mournfully handsome even in decay, the seedhead being a delicate mauve-brown.

These two plants continued to bloom through September, when the wild asters, white and lavender, appeared in the woods.

Autumn really arrived in mid-October when the afternoon temperatures were still rising into the 80's, but the nights were at last becoming cool, (although often there wasn't an actual frost until November).

There were still flowers about, but one hardly noticed them for the trees. October in Indiana generally brings several weeks of brilliantly sunny, cloudless days, with the blue of the sky so intense as to be almost hurtful. Against this background, the trees begin to flame here

Fig. 40 *Rhus glabra* (seedhead)

and there, and the tide of colour soon sweeps across the landscape, nearly taking one's breath away.

It begins with the sumac (*Rhus glabra*) (fig. 40). This is similar in habit to the *Rhus typhina* often seen in gardens here, but as may be guessed, the stems, instead of being velvety, are shiny, and in colour reminiscent of that fascinating mixture of red and blue seen in *Rosa rubrifolia.*

Sumac, (which has the pleasant local name of shoe-make) is one of the first colonizers of neglected farmland, and as there are numerous small farms which have been deserted, owing to the poor soil, one finds many places where the sumac has taken over and turned the hollers to seas of deep red at this time of year. By the time most of the leaves have fallen, the large, plume-shaped seed heads are at their richest

The individual seeds are small, hard, and of a dull texture, but there are hundreds making up the head, and they're a wonderful, deep, vinous red. When picked, they hold the colour all winter.

Another great colonizer is *Sassafras albidum* (fig. 41). This makes a

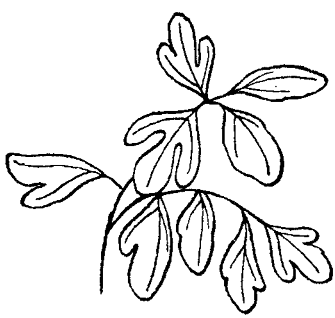


Fig. 41 *Sassafras albidum*

handsome tree, which may reach sixty feet. It has the habit, like the laburnum, of dropping its babies all about. Its leaves (which when young are delicious to chew) are mitten-shaped, and on the same tree one can find leaves with a left thumb, a right thumb, two thumbs, or none at all.

Sassafras is, along with the maples, the most brilliant autumn colourer of the trees, and as it's also probably the most commonly found tree in the area, it is, as it were, the star of the autumn show. It can be red, orange or gold, and in any of the colours is so magnificently incendiary that I'm sorry it isn't planted more often in Britain.

The tulip trees, (*Liriodendron tulipifera*) which can be much larger (up to 150 feet), and are by nature more stately than the sassafras, turn a uniform, warm, butter yellow.

The swamp maple (*Acer rubrum*) can turn either sulphur yellow or scarlet, and the sugar maple (*A. saccharum*) either of those two colours or a rich, deep orange.

One herbaceous plant which colours beautifully is *Rhus radicans*— or poison ivy. This is a great lurker in the undergrowth. The leaves in shape, resemble the grape ivy—*Cissus rhombifolia* and in October turn a flaming scarlet. Those who have the misfortune to be familiar with it would agree, however, that the beauty of its autumn foliage is hardly sufficient to justify its existence.

The common name comes from the fact that most people, on touching it, burst out in disgusting pustules, which itch fiercely and can turn a hitherto unobjectionable countenance into one huge, suppurating pimple in the space of an hour or so. And one doesn't even have to touch the plant in order to suffer the awful consequences. One can innocently pat one's dog, who has just been running through the woods—and, lo!—one's hand comes out in spots—or worse, one can pat one's dog and then absent-mindedly scratch one's nose or wipe one's brow, etc., etc. At any rate, poison ivy *does* have good autumn colour.

After the leaves have fallen, there are still interesting things to be found. *Celastrus scandens*—the bittersweet, is a sort of vegetable boa constrictor, which makes its living by strangling trees. In late October and November, when the bare branches of its hosts reveal its activities, it produces its stunning fruits—clusters of small, lacquered orange globes, which in time split open to show a brilliant red, fleshy interior.

After a frost, the persimmons ripen. They're the fruit of *Diospyros virginiana* and are beloved by possums and man alike. To gather them, one goes out and shakes the trees and the persimmons rain down. Like certain plums, they have a bitter skin, but a deliciously sweet pulp, and persimmon pudding is, like pumpkin pie, one of the delights of the season.

The tree can grow to seventy-five feet, although I've never seen one that tall. It's quite handsome, with ridged bark and an interesting branching structure, and I'm sorry that it isn't more commonly grown here.

The very last thing in the year to bloom is *Hamamelis virginiana*— the witch hazel. It seems to like the Indiana clay soil, because wherever one finds it, it's in great clumps. It prefers to grow at the edges of the woods, with trees at its back, but a certain amount of sunshine overhead.

The seedpods hang on for a whole year, so one finds last year's seeds and this year's flowers together. It blooms so late that often the first wet, quickly-melting snow of the winter falls on the flowers, although they're hardy enough to survive and bloom on a bit longer. When they finally fade, there is no more colour, except the sere, sad greys and browns of winter, for nearly five months until the *Dentaria* appear in the woods again.

Rock Gardening 'from the ground up' - XI

by Dr. HENRY TOD, F.R.S.E., S.H.M.

IN THE last part (X) of this series I was dealing with the Alpine House, and mentioned, amongst other points, ventilation. This is, of course, absolutely essential for the health of the plants and before leaving the subject I want to draw attention to an entirely new method of ventilation.

A few years ago when in his early eighties one of our earliest members (if not a founder member), Robert L. Scarlett, had to spend some considerable time convalescing in hospital and occupied it by devising two completely revolutionary methods of greenhouse ventilation. One of these necessitates very appreciable changes in the actual structure of the house, but the other is simplicity itself. The diagram (fig. 42) shows the principle involved. This is to hinge the ventilators in the side so that they open inwards from the bottom while the roof ventilators open outwards and upwards also from the bottom. This I have tried out myself using automatic ventilation control, though of course, it will work just as well with manual control.

In each case the actual movement of the ventilator from the closed position is the same, or more often, less than that of a normally hinged ventilator. It is perhaps noteworthy that the plants in the house immediately below the roof ventilators do not get "drenched with water"; the actual opening of the ventilator is, as I have said, not

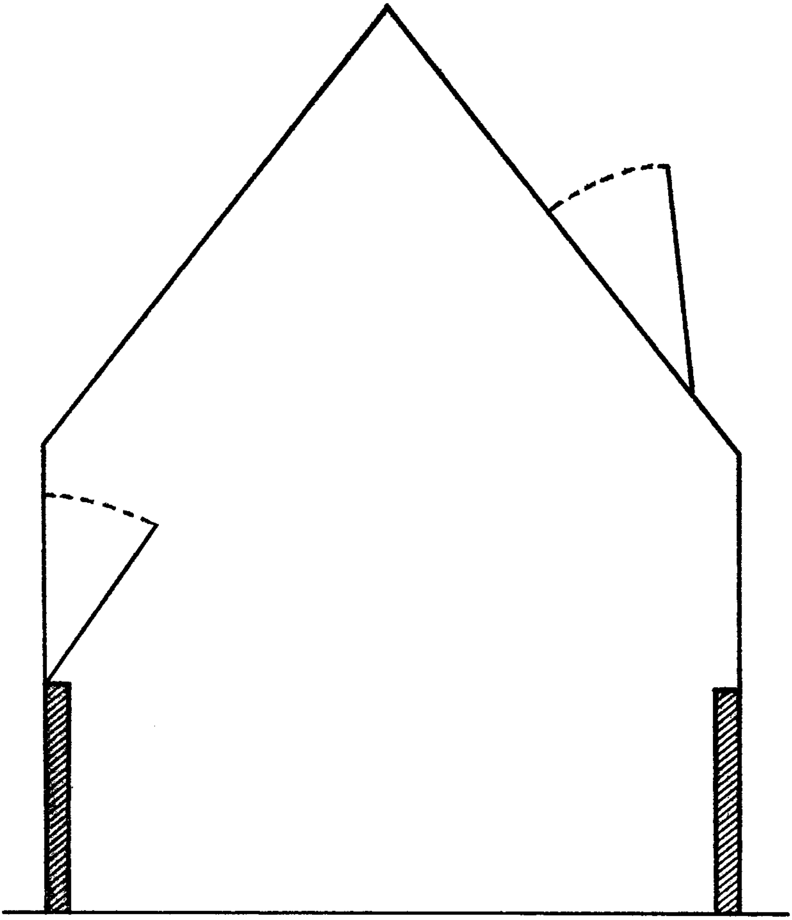


Fig. 42

necessarily wide, and, probably, the upward movement of the air through it deflects the rain.

I saw this in operation at Mr. Scarlett's house before changing my ventilators over, and was particularly struck by the fact that, though it was a very sunny, bitterly cold day, the temperature inside was fresh and buoyant. I have now had this in operation very satisfactorily for a couple of years and can thoroughly recommend it, as the house in which I made the change is appreciably 'fresher' than the house which has the normal method of ventilation. Unfortunately, though the trade was offered this design, they showed no interest whatever, and I feel that it is only Mr. Scarlett's due that he should be given the full credit for this and the other concepts. It had one very odd additional effect in that birds will very rarely enter a house so ventilated, whereas, as most of us know to our cost, they can and do cause havoc when they enter through normal ventilators.

This method of ventilation is, incidentally, a very very ancient one which was abandoned when windows which opened were introduced. Many primitive nomads still use it, the sides of their 'tents' having a top section of the wall overlying, but not joined to, the lower inner section. This coupled with a hole of some sort in the roof allows for the necessary change of air without producing draughts, but it took one of Mr. Scarlett's inventiveness to convert it to a practical method of greenhouse ventilation.

In Part VII I mentioned hardiness briefly, but at this point I think it is a question which must be looked at in more detail. It is an odd fact that many true rock plants, and some literal alpines in the strict sense of the word, are not, as we would say, hardy in the open rock garden, so that very evidently there are several factors involved.

As I mentioned in Part VII many of the Middle Eastern alpines succumbed, not in the severest part of the winter, but in the very late winter or early spring, when the temperatures were not down at their lowest level. Further, I have found that a number of true alpines from the Rocky Mountains are not hardy in our winters, though in their native haunts they are subjected to 0°F and lower, whereas in this part of the world (Central Scotland) a temperature of 2° or 3°F is quite a phenomenon.

There are these curious inexplicable cases where, presumably, some unknown factor is involved, but there are certain broad general factors which must be considered. The first of these is snow cover which, normally, occurs in mountainous regions and this snow layer acts as a very efficient thermal insulator. In our climate we tend to alternate erratically between cold and relatively mild weather, which prevents a steady snow cover occurring. In addition, a sudden warm spell in late February or early March may cause a dormant plant to 'move' toward growth and, if a sharp frost should follow, this can cause serious damage.

In mountainous areas such as the Rockies, Spring arrives suddenly, almost overnight, and *stays* ; the snow melts, the plants are exposed and they develop at a most astonishing speed. This development, however, is not checked by a sudden return of severe wintery conditions and I imagine that much the same occurs in almost all mountainous areas. The second major point is the question of dryness. Many plants such as some of the cacti grow at true alpine levels in Nevada where there is relatively little snow, but where, equally, the annual rainfall may be of the order of 2 or 3 inches, as opposed to our 25-45 inches or even more. This means, of course, that these plants can tolerate very severe frost because, at the same time, they are in very dry conditions.

The foregoing represent two different causes of winter tenderness, but there is a third group of true rock plants which come from rocky, mountainous areas which are, at the same time, not subject to severe winter frost. Plants from these areas may be just on the edge of hardiness, e.g. the hypericum family, or, for some obscure reason, they may be totally hardy, able to tolerate frost though they would never encounter it in their native habitat. All of these plants in the three groups will benefit from alpine house culture, those which succumb to winter damp can be kept dry even though the temperature can fall steeply. However, those which require a snow cover to keep up their temperature may still be at risk if they are subjected to severe frost under glass, while those which are on the margin of hardiness will likewise be protected by living in a frost free environment ; even though the temperature may fall to a degree or so above freezing point. This is, I might say, my principal reason for keeping my alpine house just frost free as opposed to the purists who, in my view, may well jeopardise valuable plants quite unintentionally.

The alpine house or alpine frame gives one a potential control of moisture which not even a cloche can give in the open ground, because of the lateral movement of moisture in the open soil. Accordingly, one can keep plants nearly dry over winter if this is their requirement, and likewise one can make certain of a free supply of moisture to plants which require it at a time when plants in the open ground might suffer from drought.

Plant Hunting in Mongolia
III. Alpines of Songino

by VLADIMIR VASAK

Songino is a special name for a valley. Originally it is a Mongholian name for a wild onion. Therefore such term used in geography is really uncommon. But one can comprehend it better if one knows of what importance for the life of the Mongholian (nomadic herdsmen) are all places where occurs the songino—*Allium altaicum* Pall. These are beautiful hills along the river Tuul, about 25 km westwards of the capital of Mongholia, Ulan Bator. This place belongs to the Mongholian-Daurian phytogeographic zone surrounding the Chentei Mountains. It is mostly of mountain dry steppes character.

On my way to Songino I had to take a bus from Ulan Bator going to the airport, where I landed on my first visit to Mongholia; this was on 8th August 1966. From the airport to Songino is more than 10 km, and I had to go by foot along the river Tuul among the hills with rocky parts, hollows, through some ravines, changed sometimes for a green meadow. But I have to say that I did not regret this uncomfortable way on foot, as I collected many seeds of nice and interesting plants, which I mention now.

The first plant was a thistle—*Cirsium esculentum* (Sievers) C.A.M., (Syn.: *Cnicus esculentus* Sievers), a Siberian-Mongholian species closely related to the European *Cirsium acaule* (L.) Scop. It is a nearly stemless thistle with 3-5 big flowers of purple-lilac colour and with thick, soft and edible roots. Its seeds I've found on a damp and green pasture. Its name—esculentum—it has got from its edible fleshy roots rich in insulin.

At the foot of the sheer rocks, not far from a blind branch of the river with limpid water, grew a yellow panboreal elecampane—*Inula britanica* L., in Mongholian 'Chonin-nud', that means a sheep's eye. It is our good acquaintance, living on numerous places of our sympathetic Northern Hemisphere. But the most valuable find of this on my way to Songino was a fertile plant of larkspur—*Delphinium grandiflora*. For a long time I have tried to find it mature with seeds, but up to this moment in vain, so the greater was my pleasure. It differs from other species of Delphinium and Aconitum I have found, as the seeds ripen in the first half of September; this, the most beautiful species of Mongholian larkspur, had only green capsules with white unripe seeds.

But let us return to my travelling. In the meantime I came to the buildings of Songino sanatorium. Just behind them were widespread areas of bushes, willows and various grasses and plants. Here I was very busy filling the bags with seeds and polythene bags with plants. At one meadow I found a garlic *Allium lineare* L., with the strap-leaves which is in Mongholian named ''gogod'', having pink petals. The Mongholians use this garlic fresh and also they dry it for using in soups and with meat. In neighbouring areas grew a nice ladybell—*Adenophora stenanthina* (Ledeb.) Kitagawa (Syn.: *A. marsupifolia* Fisch.) with its numerous light blue bells on its stems. It is a plant 30-60 cm high, but it looks quite slender as it has narrow leaves and a soft colour of flowers. It inhabits a big territory from Altai to Manchuria on steppe meadows, and it has many variants as it crosses easily with other species of this genus.

The green meadows and pastures situated between branches of the river Tuul were really nice, but I must say that I was attracted more with the banks of a river I crossed several times. The limpid water of the river seemed to be a fisherman's paradise; the reason there were so many fish is that most of the Mongholians do not eat them for religious reasons, something like the Muslims and pork meat, and as the tradition is respected, the fishes in Mongholia are happy and satisfied.

Along the scorched rocky slopes I went from one interesting plant to another. On one bank of the river at the willows twined a flame of *Clematis tangutica* (Maxim.) Korsh., with its big and decorative tufts of seeds. On the rocks here grew some uncommon but not too pretty shrubs of *Cotoneaster mongolica* Pojark., and also a wild almond—*Amygdalus pedunculata* Pall. (Syn.: *Prunus pedunculata* (Pall.) Maxim.) —in Mongholian called ''buils''. It is a very variable shrub both in form and size of its leaves and in the colour of its flowers, which are pinkish to white, etc.

In Songino I have collected the pods of widespread Mongholian pea-shrubs—*Caragana microphylla* (Pall.) Lam., ''ucher chargan'', i.e. cow's pea-shrub, and *Caragana pygmaea* (L.) DC. ''iaman chargan'', the sheep's pea-shrub. On rocky slopes there grew *Oxytropis oxyphylla* (Pall.) DC., a small plant, and in one small valley only about 500 m long I found some fertile plants of *Astragalus melilotoides* Pall.—in Mongholian named ''shuur'', that means broomlet, or ''dzeren

Fig. 44 Siberian larch in Songino *Photo.* V. Vasak

shilby'', i.e. antelope's shinbone—probably for its slim appearance. It is a tender high plant, looking like a sweet clover. Its pink flowers are very nice and so pleasantly sweet scented. As I have told already, it is a slim plant with slim leaves, slim stalks and slim bunches of slim pink flowers. As it is too slim, it cannot compete with *Astragalus tenuis* Turcz., which is widespread in the Daurian zone and in East Mongholia. It is also named a ''shuur'', i.e. a broomlet, which gives the character of its appearance. It is 30-50 cm high, with one or two paired leaves. Its pink flowers are in clusters of 5-8 blooms. The small pods in *A. tenuis* contain black seeds. Both these plants belong to sub-genus *Melilotopsis*; *Astragalus capilipes* Fisch. from N. China is also counted to this sub-genus (Gontscharov).

In Mongholia grow two species of *Lespedeza*: *L. hedysaroides* (Pall.) Rich. in some places in Chentei, and *L. dahurica* (Laxm.) Schindl.; this plant I know well from its culture in our country. Its white flowers are to be seen in July to September, and as *Lespedeza* is a plant of warmer zones, being sensitive to frosts, the *L. dahurica* in Songino slopes was so burned by frost. Most of its seeds were not ripe, only a few of them—thanks to the strong sun here—ripened fully. My collector's small soul was therefore satisfied and my bags became rich with seeds of *Lespedeza*.

Now I'd like to recall from Songino one lovely ornithological memory. On my plant hunting in the valley of the river I heard suddenly some curious sounds and at that moment I saw the exquisite birds resembling with their singing and long tails the tropical birds of paradise. These were dauric magpies—*Cyanopica cyanea*. And I must say that their clear blue colour struck the eyes—as its latin name confirms. I remember all at once this uproar stopped and I just comprehended why; from a blue sky alighted a live arrow—a falcon. I suppose that it was *Falco cherrug* or *F. sesalon*—you must kindly excuse me that I could not for sure identify this falcon flying. The falcon—for him unfortunately—has not succeeded here and flew away, and the magpies began twittering again, singing about how nice is the world.

A quite new species I found in Songino was *Alyssum biovulatum* N. Bush (Syn.: *A. sibiricum* N. Bush, *A. tortuosum* W. et K.), in Mongholian called ''shara demeg''—looking like an *Alyssum lenense*, and I must mention that similar species grow in Middle and Eastern Mongholia, in Siberia, in E. U.S.S.R. and also in arctic regions. *Alyssum biovulatum* grows on mountain steppes on a poor stony soil, and on stony slopes. It is somewhat smaller than *Alyssum lenense*, only 5-15 cm high and it has silvery green leaves overgrown by flattened heads. It is quite uncommon, small and sympatic plant. Sampson Clay (1937) states: ''*Alyssum sibiricum*, having the orange-yellow blossoms . . .''. It is comprehensible, if we remember its extensive area and its numerous variations.

I met here also *Rubia cordifolia* L. f. *pratensis* Maxim. (Syn: *R. pratensis* (Maxim.) Nakai), which stood with its 2 m long stalks on some shrubs of a currant *Ribes diacantha*. Even though it is not suitable for a rock garden it is an interesting plant. Before all it is used for dyeing, as are most madders. Its roots contain red pigment purpurin (Kavar 1958) and it may be used for the dyeing of carpets. Its roots are also used in Chinese medicine as a tonic (Burkill, 1935). Its roots have also some bacteriostatic effect (Monachino, 1956). It is widespread in Mongholia, E. Siberia, China, Korea and Tibet.

Ribes diacantha Pall.—in Mongholian called ''uchunesheg'', does prefer the steppe slopes, rocks and sandy banks of valleys of rivers. It has small leaves and red berries, something like *R. aureum*. Berries of *R. diacantha* are of very good taste; they are crunched and do have a stiff pulp. Their late ripening—in September—is appreciated, as other cultivated berries have by this time been eaten. I suppose that it is one of the plants of the future and that there will come a time when we shall see it even in gardens.

But the whole valley was not bare steppe. In places there grew woods of a larch which also grows in Siberia (fig. 44).

The last interesting plant of my story today is a nice *Saussurea salicifolia* (L.) DC., in Mongholian called ''bangstu'' or ''barzido''. Its original name in Latin is *Serratula salicifolia* L. It is really a very pretty plant at home in Mongholia, having stiff stalks 20-40 cm high, slim leaves which are white-haired on the reverse, and pink inflorescence, arranged in a shape of flattened heads. It grows on dry steppes. In Songino I have met it only on the dry and stony slopes. Its area covers part of Mongholia and of Siberia. I suppose that it would be suitable for cultivating in larger rock gardens, especially in those of week-end houses, as these are usually built on dry and sunny slopes, mostly without any possibility of watering.

I was in Songino on 15th September—two days before my return from Mongholia. I remember all my cases were full of seeds and plants, also my hotel room was full of seeds (I have dried there) and herbarium specimens. I had to prepare now all matters for the phytoquarantine service in order to get permission to export plant materials. My plant hunting in Songino was such a rehearsal of my goodbye to the Mongholian nature.

And now in addition a matter of personal interest. In the time which I have spent with my plant hunting trips in Mongholia on the rocky slopes under the effects of Mongholian sun and steppes, I have lost at least a tenth of my personal weight (77 to 70 kg). But I felt myself quite healthy and happy and I was ready to repeat such an expedition at the first opportunity; but the term of my Mongholian sojourn was regrettably over and I had to part from this distant and very interesting country. I shall close my article with the hope that I shall again have a chance to visit Mongholia in future once more.

Literature

Farrer: My Rock Garden, 1930

Farrer: The English Rock Garden, Vol. 1-11, 1937-1938

Grubov V. I.: Konspekt flory Mongolskoj narodnoj respubliki, 1955

Junatov A. A.: Kormovyje rastenija senokosov i pastbišč Mongolskoj narodnoj respubliki, 1951

Popov M. G.: Flora Srednĕj Sibiri., Vol. 1-11, 1957-1959

Obituary

HENRY TOD, Ph.D., F.R.S.E., J.P., S.H.M.

THE DEATH of Dr. Henry Tod on 16th May we record with great sorrow, deeply conscious of the loss of yet another great figure of our world of rock gardening.

Born in Edinburgh in 1908, he was educated at Edinburgh Academy and Edinburgh University, gaining a Ph.D. in Chemistry. He joined the staff of the Royal Edinburgh Hospital as a Biochemist until his appointment as Lecturer in Soil Science at the Edinburgh School of Agriculture, a post he held with distinction for 25 years. Extensive field-work on soil deficiencies in crops formed a major part of his work in the early years of his career in agriculture and this discipline became for him a deep and satisfying challenge and typically extended this avenue of research into his leisure activity the rewarding experience of growing rare and difficult plants to perfection.

A plant found thriving in someone's garden in circumstances seen to be abnormal was a matter for investigation and a source of great pleasure to reveal an explanation.

The genus Rhododendron was singled out for special consideration and research on the complex food-chain mechanism peculiar to the order Ericaceae. He freely gave the benefit of his research and wide knowledge to all who found the soil a mysterious medium.

In 1937 he was honoured by election as a Fellow of the Royal Society of Edinburgh and in that same year joined the Scottish Rock Garden Club, to become from the beginning a leading figure in the Club's forward movement.

He took an active part in the post-war regeneration period, as a member of Council, as a Show Secretary for Penicuik Show with its unique local Bulb Show atmosphere, as County Convener for Midlothian, as a member of the Edinburgh Show Committee, as an able lecturer and speaker, and not least his valuable contributions to the *Journal* and to many other gardening periodicals and learned publications.

In 1959-60 he undertook with distinction the formidable task of the Convenership for the Scottish Rock Garden Club in the joint negotiations with the Alpine Garden Society arranging the Third International Rock Garden Plant Conference to be held in April 1961.

This arduous task was not quite completed when further onerous duties were thrust upon him. The late David Wilkie, the President of the Club in 1960 and who was expected to preside over the Edinburgh phase of the International Conference, had to demit office for health reasons. Dr. Tod was elected President at that memorable time and completed his full term of office in 1963.

During the three years as President he fulfilled with great acclaim the strenuous duties of the appointment, visiting and lecturing at all the active Group headquarters. In the midst of this exacting period he found time and energy to accompany Dr. Carleton Worth in 1962 to the American Rockies in search of plants. This journey was so rewarding as to encourage him to undertake a plant-hunting expedition alone to Wyoming in 1965 with equally successful results. This journey provided material for articles and lectures for many subsequent years. The plants of the North American continent held for him a strong appeal and it is significant that at the Glasgow Show in 1946 a plant from that continent—*Douglasia laevigata*—was awarded a Forrest Medal, and again in 1955 his exhibit at the Dunfermline Show—

Kelseya uniflora, again from the American continent—won the same award. On very many occasions his skill as an expert grower and exhibitor was rewarded.

He was particularly interested in plants introduced by Dr. Peter Davis from Turkey, e.g. *Chrysanthemum harajanii*, *Tanacetum densum amani*, and a number of *Fritillarias* which he successfully grew from seed and brought to the Show bench in the Rare and Difficult Classes.

Once asked how one became a Show Judge, his reply seemed delightfully simple: "Just read as much as you can about plants and go on reading, and if in doubt read it all again and again"—but he was too modest to add the other important qualifications, all of which he possessed—the experience gained from growing the plants, the wealth of information gleaned from seeing the plants in their natural habitats, and the active participation researching into the principles of successful propagation.

It is therefore not surprising to find that he was always in great demand as a Show Judge, a role he greatly enjoyed. The Joint Rock Garden Plant Committee was formed late in 1954 and subsequently he was called to act upon this important committee.

The Royal Caledonian Horticultural Society in 1971 honoured Henry Tod for his contribution to horticultural advancement by awarding him their highest honour, the Scottish Horticultural Medal.

To his wife and daughters our deep sympathy and warm appreciation is offered.

In the Journal of the Royal Horticultural Society, Vol. XCVII, October 1972, Part 10, you will find an article Henry Tod chose to call "The Living Soil". It is commended for you to read this testimony of his abounding zeal to teach and to explain. It is for this quality he will be remembered.

W. R. A.

Subscriptions

Members are reminded that as from 1st October 1974 the annual subscription for an Ordinary Member is increased from £1 to £1.50 (U.S.A. rate $3.75). Family and Junior Membership rate will remain at 50p. Full details of the change of rate and date of payment to 15th October annually were set out on page 44 of the April 1974 *Journal.*

It will be greatly appreciated if members pay their subscriptions—at the new rate—promptly. The application form enclosed with this Journal can be used for the purpose. Payment by Banker's Order helps the Subscription Secretary enormously by ensuring prompt payment of subscriptions. In this connection he has needed to send out 692 reminders this year. The work of the Subscription Secretary is heavy enough without this additional burden and the money spent on stationery and postages could be put to much better use. We look to the full co-operation of members in the future.

Notice to those who have Covenanted

A Deed of Covenant in favour of the Club is binding for a period of at least 7 years and cannot be cancelled except by death.

Those paying under covenant by Banker's Order completed a special order instructing the Banker to make 7 payments only. There is no need for anyone covenanting to take any action except to return the annual amount in his or her Income Tax return.

First Interim Rock Garden Plant Conference 18th-22nd July 1976

As most members will know, this Conference is being held in Seattle, Washington, U.S.A., and is being organised by the North West Unit of the American Rock Garden Society and the Alpine Garden Club of British Columbia.

Plans are being made for Coach Tours to some of the Mountain Regions of Western U.S.A. before the Conference, and for a Field Trip to Victoria and Vancouver, British Columbia, immediately after it. We hope to have full details of the arrangements in time to print them in the *Journal* of April 1975.

By then we should also be able to give more information about travel plans for members who wish to attend the Conference. We hope to make a block booking on a direct flight from Prestwick to Vancouver, returning by the same route either two or three weeks later. Some of those who hope to go over would like to stay longer in Canada or U.S.A. and every effort will be made to arrange extensions for them.

The cost of the trip is at the moment uncertain, but the price of the return journey in July 1974 is about £125.00. Two years hence we can hardly hope that it will not have increased.

As soon as we have further information it will be sent to any members who are interested and hope to go to Seattle. Enquiries should be sent to:—

Mrs. K. S. Hall,
93 Whitehouse Road,
Edinburgh EH4 6JT.

Angus Group Seed Exchange

The 1973-74 distribution is at an end and seems to have been reasonably successful thanks to the patient work of the numerous donors of seed and the willing assistance of some members of the Angus Group.

It is interesting to note that the proportion of members who are finding it rewarding to raise alpines from seed is considerably larger than it was in 1967 when we last did the distribution. Very encouraging for the toilers in the exchange.

It is also interesting to note that the problem of misnamed plants has not yet been tackled. Hybrids, of course, will not come true, and some species are notoriously promiscuous, but there are a few plants which are inadvertently being perpetuated under the wrong name through the seed exchanges. Perhaps members who raise seed and find the plants wrongly named would send me a note of them; I have someone who would collate the findings and if we became convinced that the error was not just a slip, an article for the *Journal* on the plant might help to clarify the naming. The Editor would be delighted to print it.

May I remind those who intend to donate seed to the exchange that the packets must reach me by the 31st October. In the case of late ripening seed, a list of the names should be sent by that date, and the seeds forwarded as soon as possible.

Would 'new donors' please note that the seeds sent in must be cleaned; postage is too expensive to waste it on husks and rubbish, and we cannot undertake to do this for you.

All donors of seed and all overseas members will receive a seed list.

Home members who wish a list and are not donors should send a stamped addressed envelope, at least $8\frac{1}{2}$ ins. $\times$ $5\frac{1}{2}$ ins., or a stamped label if a suitable envelope is not available, to:—

Miss J. Halley,
16 Abercrombie Street,
Barnhill, Dundee, DD5 2NX

Applications for seed should be on the form provided in the seed list; these are dated on receipt and are dealt with in order. Priority is given to those who have contributed seed, and are dealt with in the following order:—

Overseas members who have contributed seed.
Home members who have contributed seed.
Overseas members.
Home members.

We are looking forward to a very busy winter and hope we will have your support.

Joyce Halley

Show Rules and Schedules

by D. M. MURRAY-LYON

WHY DON'T more people show? When I ask that question a common answer is—"I haven't got an alpine house, so what's the good?" Are there possibly grounds for such an answer? Do judges sometimes tend to favour plants in good condition despite the weather owing to having been grown under glass or polythene in alpine house, frame or cloche? Is too little attention sometimes given to a plant being "out of character" and "drawn" owing to having been given too much artificial protection? Are too many plants getting trophies and first prizes when they are in flower much before their natural flowering owing to being "forced", with the resultant distortion of character?

If the answer to any of these questions is yes, what should be done about it? Should plants grown under artificial protection be confined to special classes?

Plants not grown under such artificial conditions might possibly be allowed protection for a few days (say three or four) just to prevent them being spoilt, at this last stage, by weather—wind, rain, hail and so on.

I think the number of entrants for Section II (Beginners) might well be increased if more classes for plants grown in the open and lifted for the Show were included. Such classes seem to have steadily decreased during the last few years. The number of entries in Section II is, I think, quite a good indication of the health of a group.

From where are older exhibitors who give up showing to be replaced if there are few or no beginners? Show Rule 8 lays down that a plant must have been in the possession of its exhibitor for at least 3 months before the Show. This makes it possible for a plant, bought after the worst of the winter, to be shown at one of the later Shows. Six months should, I think, be substituted for three.

This, and other years, I have noticed quite a lot of plants on the show benches without any names. If you don't know the correct name of your exhibit then I suggest that, on the reverse of the show card, you put "Judges please name". I personally have done it with satisfactory results.

I have frequently heard knowledgeable members and judges say of a plant, "grossly over-potted". Has that question anything to do with judging? I doubt if it has much. Judges are assessing the condition of a plant. The Show Secretary, however, may well be concerned about the size of a pot. If he is, the remedy is in his own hands—in the schedule give the maximum size of pot allowed in the class. If an exhibitor lifts a valuable plant for a Show he is surely entitled to try and avoid damage to it by causing as little disturbance to roots and root ball as possible. I am not "getting at" judges or Show Secretaries; after all, I still belong to one of these categories myself and have in the past belonged to the other.

The Seedlist Handbook

THIS HANDBOOK has been received. It is published by Kashong Publications, Box 90, Bellona, New York 14415, U.S.A., at a price of Three Dollars, post paid.

Its purpose is stated "to be used as a guide in seed selection from the seed lists of the American Rock Garden Society, the Alpine Garden Society and the Scottish Rock Garden Club. Keyed references give at least one source for more information".

There are about 9,000 to 10,000 names of plants which have appeared in the seed exchange lists of the American Rock Garden Society from 1969-1973, from the Alpine Garden Society from 1970-1972, and from the Scottish Rock Garden Club from 1971-1973. There is a one-line description of each plant and one further reference to another publication. This latter reference is not likely to be of much help to the majority of our members since many of the 157 reference books are not likely to be available to the general reader. Some of these are catalogues of specialist nursery gardens in U.S.A.

The main merit of this handbook is that it gives a guide to the ultimate height of each plant. As must be expected, there are mistakes *Cassiope lycopodioides*, for instance, is shown as *C. lycopodoides*—but these must occur in any list of this nature.

In spite of the use of the emblems of this Club and of the Alpine Garden Society, the Handbook is not sponsored by either organisation.

Rules for a Society

by THOMAS HOGG: 1822

Any person desirous of becoming a member of this Society must be proposed by one of the members, and seconded by another at one of the regular meetings, and a written notice must be sent to that effect by the secretary to every member, stating the name and residence of the person so proposed; the election to take place by ballot the next succeeding show-day; such person will then be admitted a member, unless two black balls appear against him.

That each member's subscription be £1 11s. 6d. per annum.

Persons making use of any art, in order to deceive the committee, except that of merely dressing the flowers for the show, will be expelled by the Society.

That when special meetings are called to fix the show-days, or on other occasions, the secretary shall send written or a printed notice to each member, and all absentees shall forfeit two shillings.

That each member shall pay for a dinner ticket on the day the show is appointed.

That all flowers shall be in the room at one o'clock precisely, by the house clock, or they shall not be admitted; and that each member pay any demand for deficiencies the secretary may have against him previous thereto, or be expelled the society.

The committee, styled censors, umpires, or judges, three in number, to determine the prizes, shall be chosen by members present on the show-days, who shall declare if required that they have not seen or assisted in dressing any of the blooms since they were gathered or selected for show.

That if any member shall call the judgment of the censors in question, after the prizes are declared, he shall for such offence forfeit one guinea, or be expelled the society.

That no person be suffered to touch or handle the blossoms on show-days without the consent of the proprietor, under the forfeiture of twenty shillings.

That if any member shall create a quarrel, so as to disturb the harmony of the company on the show-days, his conduct shall become the subject of consideration at the next meeting, and a majority of the members then present deciding on its impropriety shall expel him the Society.

Soliloquy at a Show

by M. I. C. HARBORD

THE FORREST MEDAL award is the highlight of all our Shows, photographed and written-up even by the national press, who may not know what it is all about, let alone the sheer plantsmanship which brings that particular plant to such a peak of perfection. This standard, strived after, doggedly, by the perfectionists and looked at afar by most other members, is the star to which, hopefully, we hitch our barrowload of alpine plants. Someday, somehow, somebody like you or me will win the "Forrest". (There was, of course, the notable occasion when a newly-joined member swept the board at North Berwick, including the top award).

Everyone has a chance to win and the experts are always ready to demonstrate how to present a plant to look its very best: clean pot, plant and pot nicely balanced for size, fresh collar of chippings, damaged leaves and flowers carefully removed, neat label, etc., etc., the perfectionist's standard, which applies equally to all classes, even to the beginners' section.

People who have belonged to the Club for any length of time, and who live in an area putting on a good winter programme, have ample opportunity to learn the standards aimed at, but for the newest recruits, or potential recruits, it is somewhat confusing that the Forrest Medal nearly always goes to a perfect plant produced under alpine-house conditions, a cossetted bun, less resembling an alpine in the wild than a ballet dancer a climber performing an impromptu fling on the summit of the high mountain he has just conquered.

A good plant is good whether for alpine-house or garden, but there seems to be a cross-purpose of achievement when a rock *garden* club gives its highest award nearly always to an alpine-*house* plant.

So many people come to our Shows and admire the exhibits, stopping at the trade stands to buy a few plants to take home, obviously keen and interested, and when asked if they are members, reply, "Oh no, I've only got a small garden and I just grow things I like. I could never grow them like these. You see, I haven't got a greenhouse". This is depressing. Greenhouse forsoothe! Our late secretary, Mrs. Boyd-Harvey, produced some of her Forrest award plants under a mere roof over a stand and one of Jack Drake's wins was with a perfect pan of *Primula reptans* which he said had ''got pushed under a bush and been forgotten''. Some bush!

These examples are just to illustrate the problems, but it does seem that a distinction should be made in the award system before we become a club for alpine-house plants only. It is essential to have both open garden and alpine-house or frame to try our new, rare and difficult plants and discover if they are worthy of their place in the garden, the while keeping a few clones safe under controlled conditions.

Surely there could be a distinction for plants grown in the open and brought in not more than a week or ten days before the Show and for those under continuous controlled conditions of alpine-house culture?

But then, which class would be awarded the Forrest?

W. C. HENDERSON AND SON LTD. ST. ANDREWS