

Symposium Proceedings

ROAD VERGES

THEIR FUNCTION & MANAGEMENT

Edited by,

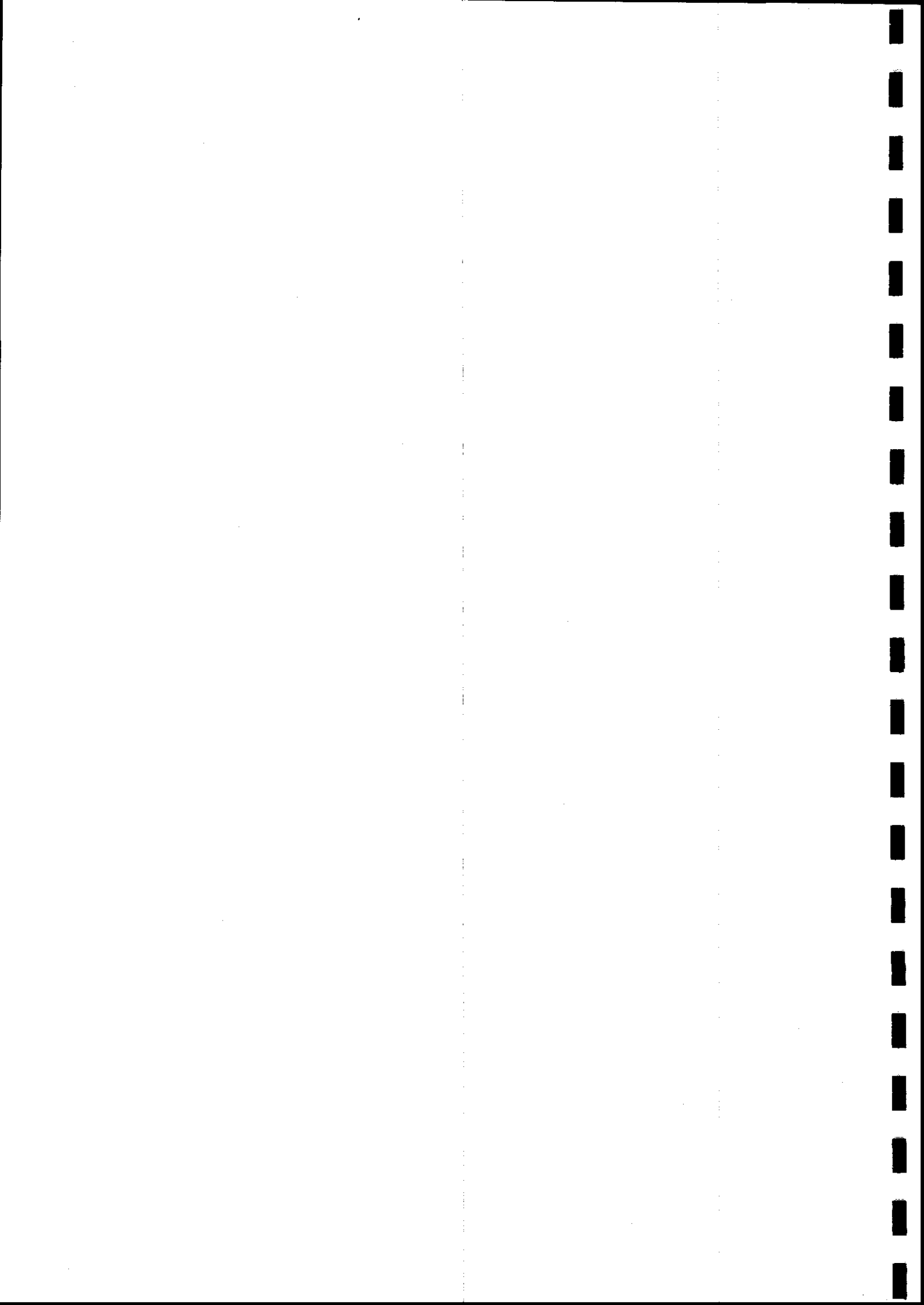
J. M. Way.

The Commonwealth Hall
16-20 Craven Street,
London WC2.

Friday 14th March. 1969

2nd Impression 1975

**MONKS WOOD EXPERIMENTAL STATION
(THE NATURE CONSERVANCY)**



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The interest and encouragement of Mr. J. D. FRYER and members of the British Weed Control Council (now amalgamated into the British Crop Protection Council) is gratefully acknowledged.

Thanks are due for invaluable secretarial assistance from Mrs. R. DUFFEY and Mrs. M. HAAS.

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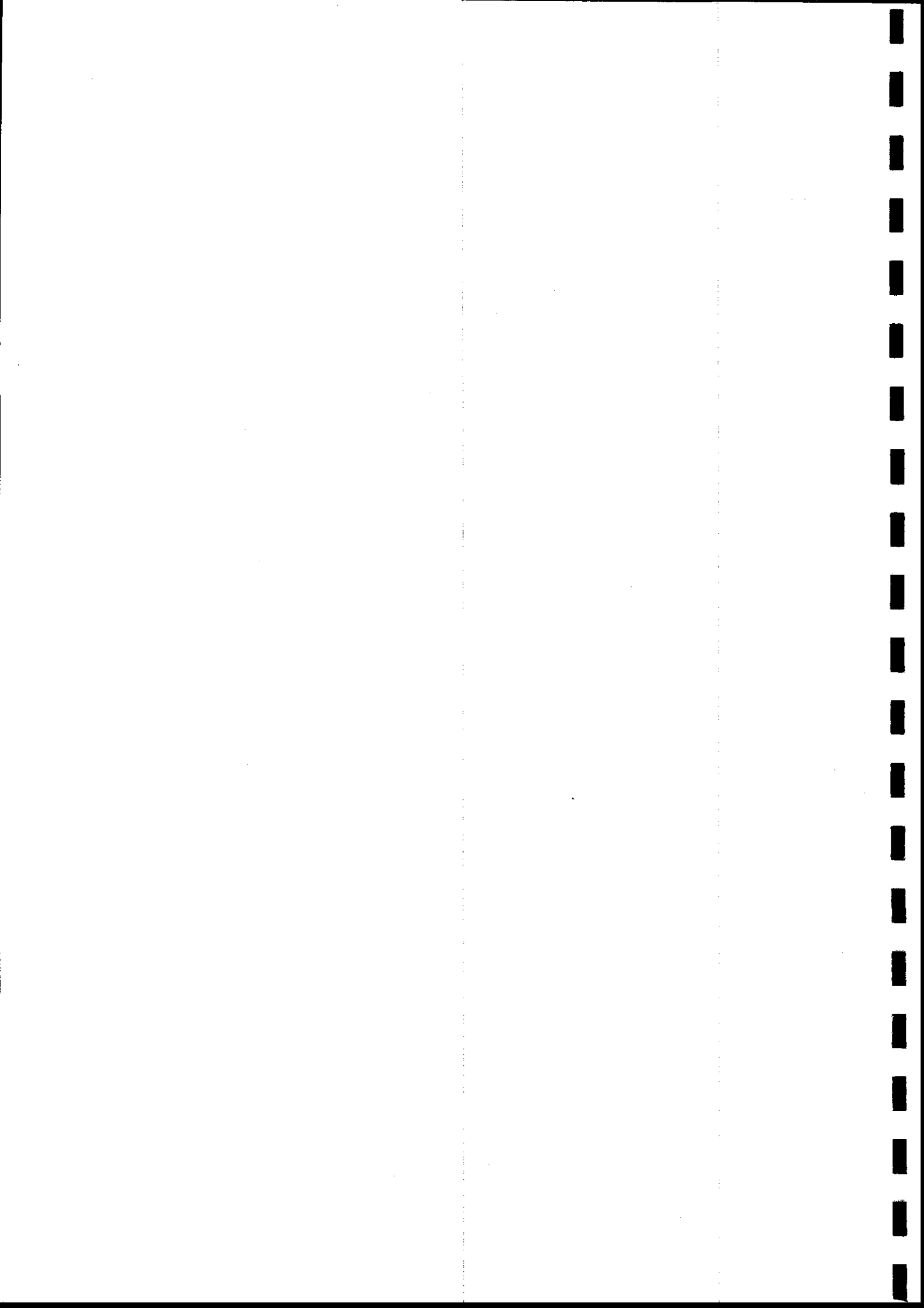


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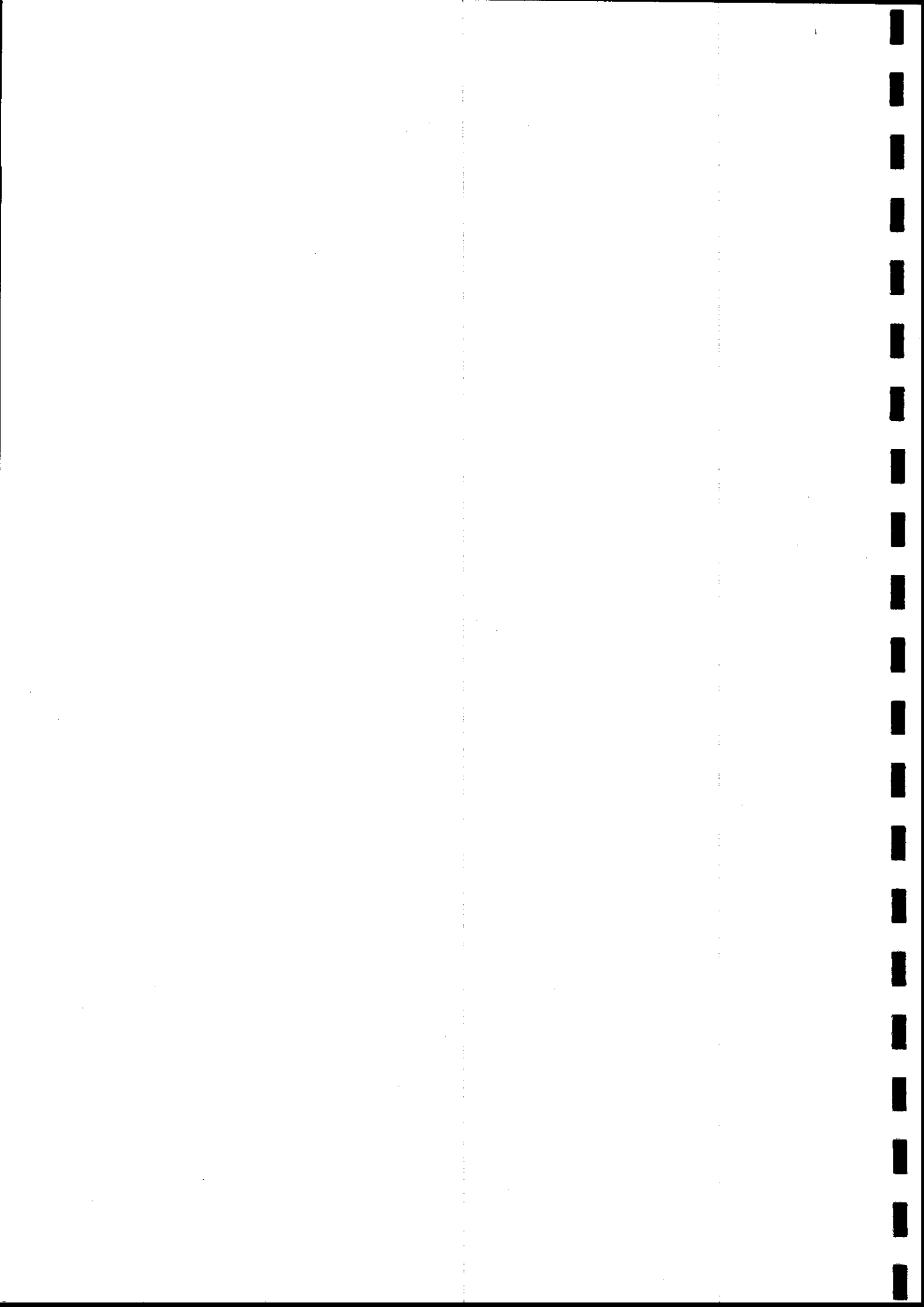
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SUMMING UP
W. E. LANE ESQ.



OPENING ADDRESS

THE LORD NUGENT OF GUILDFORD P.C.

How much do Road-side Verges matter? Most people would say "not much"! In fact, their appearance is taken for granted as completely as the daylight at dawn. But I have no doubt that if a universal policy of chemical spraying was applied similar to the USA where verges have a uniformly depressed look, there would be an outcry from all over the country demanding the restoration of the natural beauty of our verges.

In this small country almost every kind of road-side verge is found, from the flower-decked banks of Devon and Cornwall to the flat grass verges of East Anglia. The problem is to find methods of maintenance to control the verge growth acceptably in the interests of traffic, amenity and farming and within the limited financial resources available from the already overburdened ratepayer.

This Symposium is designed to help Highway Authorities find the right answer to this problem in their respective and varying localities: the British Crop Protection Council and Monks Wood Experimental Station of the Nature Conservancy are to be congratulated on organising it. The range of distinguished, expert speakers in the programme will ensure the success of this end. I believe that it will also attract the interest of the farming world from the practical viewpoint of crop husbandry management and weed control, and the rural protection societies' interest from the point of view of the preservation of amenity.

The most powerful influence in our lives to-day is the phenomenally rapid rate of change; road-side verges are subject to this dynamic influence just like the rest of life. In the past decade major changes have been taking place:

1. The traditional method of maintenance by the hand labour of a lengthsman is already extinct in some counties and rapidly disappearing in others.
2. Mechanical and chemical methods, with inevitably different and sometimes drastic ecological influences, are replacing them.
3. Large scale mechanical farming has developed in all the most suitable parts of the country, and has necessitated the widespread removal of ditches and hedges in those areas.
4. The nation is well on the way to becoming 100% car-owning and is therefore increasingly dependent on the appearance of roads for their amenity and recreation.
5. A brand new, national system of motorways is in course of development and itself presents a complete new range of road-side verge problems.

The implications of these and other factors will be examined to-day by our team of experts speakers in order to provide the most up-to-date scientific information on every aspect of the subject. I am sure that Highway Authorities will find this objective approach helpful in evolving their policies for coping with the massive task in their respective counties. We all have an interest in helping them to find the right answers.

ROAD VERGES AND LANDSCAPE

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What do we mean by "Road Verges and Landscape"? Verges in this context are taken to mean all the land, whether grassed or planted, between the road itself and the boundary fence, including the earthworks. The general theme is the visual impact of these verges on the driver, and the extent to which their design and maintenance can help to relate the road satisfactorily to its surroundings, and thus achieve that stamp of inevitability which is one of the hallmarks of good design.

Ideally, no part of the road except the carriageway itself and the structures would register to the driver as something man-made. You should feel not that you are on a narrow imprisoning track, cut off from the open country by earthworks, mown grass, consciously designed planting and an obvious fence, but rather that you are moving unimpeded through the countryside which comes right up to you on either side, so close that you can almost lean out and touch it.

This is an ideal and like most ideals it is rarely attainable. When it is approached, even with many imperfections, there is a feeling of harmony and of identification with the countryside which can be exhilarating.

Nowadays good geometric design can be taken for granted on new major roads. This does not mean, of course, that a line which fits the topography can always be devised, because invariably there are other limiting factors to contend with, cost and planning requirements to name two of them. Whether or not the chosen route fits the ground well, the verge is the physical link between the road and its surroundings, and it has an important function to perform. It offers an opportunity, a last chance in fact, to unite the relatively inflexible road with the often wildly varying contours of the adjacent ground.

If the treatment is crude, to the driver the apparent width of the road will be the road surface plus the verge and fences—all the obviously "contracted" road. Add unsympathetic planting, and his attention will be held within this corridor, so that concentration on the foreground view will soon lead to boredom and danger. At its best the road will appear to stop at the back of the hard shoulder and the rest will be part of the countryside beyond. The road is then just a narrow ribbon slipping smoothly through the countryside and the driver's view is as wide as the horizon.

The road is inevitably a disruptive element in the landscape. Relating it satisfactorily to the complicated, small scale jigsaw of the typical English countryside through which it cuts a narrow swathe is one of the major problems of road landscaping.

The way in which the earthworks are handled is of paramount importance. As a general rule, the more smoothly they can be contoured the less artificial they will look and the more closely the road will fit into the landscape, but one must not miss opportunities for dramatic treatment in appropriate places, such as rock cuttings.

The cost of the earthworks is a substantial part of the total cost of building a road, and flattening slopes for aesthetic reasons, or with the object of returning them to agriculture, involves a heavy increase in capital costs. It is by no means easy to guarantee that a farmer will be willing to take back a small piece of land over which there has been a constant passage of heavy vehicles, even though it has been fully reinstated.

Extensive earthworks are unavoidable on a motorway, because of the frequency of the bridges which take it under or over every other road, every railway, river, pipe line, etc., in its path. There are about five bridges in every two miles on the average, so that all the time a profile must be contrived which ensures the necessary vertical separation at crossing points. This is one of the most immediately apparent differences between motorways in England and in some parts of the continent, where they often run for considerable distances at ground level, with very few bridges to interrupt the road's easy relationship with its surroundings.

A smooth, flowing fence line, inconspicuously sited, and avoiding the skyline wherever possible, will be less distracting than one which jerks its way up and down the slopes, and it is easier to achieve if the earthworks are smooth. Not only the alignment, but the type of fence is important; the standard timber one which looks well in most parts of the country may be out of place on bare downs or high fells, where a lighter, more open design, probably of slim metal posts and wire, may look better.

Without going into the many problems of grass maintenance and the advantages and disadvantages of spraying or cutting, it is evident that if the grassed verges are to look right in different types of country with varying soil and climatic conditions, then maintenance requirements will vary.

As with planting, grass should look appropriate to its surroundings. Closely mown grass, which looks entirely natural on the chalk downs where sheep are grazing the grass outside the fence, would look hopelessly inappropriate in birch, gorse and bracken country. Nature cannot be left to organise this, however, because soil and drainage conditions within the fence line may be vastly different from those found on the undisturbed land outside, and the fence also eliminates the influence of the farmer, his machines and his grazing animals. Skilled maintenance is needed to achieve compatibility, and it should be considered at the design stage, as a part of the overall landscape plan. A reasonable guide, to avoid a too tidy, too sophisticated appearance, is to let the grass be as rough as is compatible with its surroundings. This will give a wide range of habitats for the most hard-pressed of our flora and fauna which depend on the roadside verges for their survival.

There are two particularly important factors which must influence the planting of any road—the speed of the road and the type of country through which it is passing.

Taking speed first, let us turn for a moment to the slow, winding typically English minor road. The main difference between it and, say, a motorway is that it is almost totally dominated by its surroundings. Its alignment was dictated, probably centuries ago, by the topography, not by a 70 m.p.h. design speed. The engineering standards are low, and you do not find the scars, because there are no earthworks. Here the main object of any planting, particularly after road improvements, will be to preserve the dominance of the surroundings, the local pattern of trees, hedges, woods and so on, and bring it right up to the road without interruption. The scale of planting will be small because of the slow speeds. Single trees can be appreciated, and even closely spaced trees, which would irritate on a fast road. One is able, also, to appreciate the texture and quality of a mixed hedge and small groups of wild flowers.

This is one end of the scale. Now what happens as speed increases? Immediately the relationship between the road and its surroundings change. From being dominated by its setting, the road begins to impose itself more and more on its surroundings as it becomes less flexible and the earthworks increase. The planting now has a more complicated job to do than on the slow road. It has to reconcile, in effect, the speed of the road with the landscape.

To understand this we must look at the type of country (this and the speed of the road being the two main factors influencing planting), to see how the reconciliation can take place.

Among scattered woodlands it will be necessary to balance the succession of open and closed views, planting to heal the torn edges of the woods and keeping the open stretches clear.

On heath or moor there will be a chance to use the local vegetation rather than grass, to avoid an unnatural strip of bright green on either side of the road.

On the downs it may be a case of not planting (how important it is to know when not to plant, when planting would be mere decoration), but of shaping the earthworks to merge as smoothly as possible into the flowing contours. Here of course the alignment must be faultless. Ideally the only planting needed might be a clump or two of beech in a strategic position, almost certainly off the road where we do not own the land and cannot plant. To be realistic, though, some scars are unavoidable and if they are conspicuous they will need to be masked by planting.

These are a few examples. Basically what we are still trying to do in each case is to bring the countryside, of whatever type, right up to the road, as in the case of the minor roads. Because we are viewing it at speed, however, the planting must be on a grander scale, still linking with the local planting pattern, framing the views, healing any unavoidable scars, but always bold enough for any desired effect to last long enough to make its impact—groups of trees rather than single specimens, larger gaps through which a view is to be seen, contrast in the texture of grass arising from varied maintenance techniques rather than the interest of groups of wild flowers.

Our greatest problem here is that we are limited to such a narrow strip in which to plant, in which to try to counterbalance the linear effect of the road. For this reason any odd scraps of land which we can acquire beyond the normal boundary are doubly useful, so long as they are in a position where planting is appropriate. All the time we want to plant outwards to form a link with the surrounding countryside, but always we are pulled back by the fence line. Road landscaping, so far as planting is concerned, is about 80% a matter for the local planning authority—we can only plant within our boundary: they can plant within the view.

Whatever the type of country there is one fundamental rule—the plants selected should be natives or those which have been with us long enough to be accepted as native, and preferably those species actually growing in the locality. There is no place on rural roads for exotics, the cherries and laburnums which scream “suburbia” whenever they burst into flower, each in its turn a gaudy gatecrasher.

It is hoped that as the newly planted groups of trees become established it will be possible to bring in the shrubs and herbaceous plants which normally associate with them, either by planting or by natural regeneration encouraged by careful maintenance, so that in time the larger stands of trees will become, in effect, areas of natural woodland.

One of the most striking features of the English countryside is the wide variety of scenery and vegetation, several dramatic changes often succeeding one another within a short distance. A journey southwards from London can take you from the London Basin across Bagshot Sands, Chalk Downs, Greensand Ridges to the Wealden Clay within 20 miles.

Landscaping, and planting in particular, which is in sympathy with the locality, helps to preserve and emphasise these regional differences. They in turn can be a source of great pleasure to any driver who has eyes to see.

Unfortunately many people are peculiarly sensitive to the sight of anything which is not conventionally beautiful, and would screen from sight most of the things which, although not attractive in themselves, give interest and depth to a view. We are not living in Arcadia, and how dull it would be to drive through hundreds of miles of unrelieved prettiness. We are fortunate that there is so much to see, towns, villages, churches, even power stations—the list is endless, not forgetting the infinite variety of the countryside itself. All can be brought into the road landscape. The only views to block out are those which are mean or depressing. Acres of back gardens are about the worst, followed by the clutter of factories seen from the rear, and parked cars in quantity. For the rest the views should be seen and enjoyed. If there is an occasional shock, so much the better. The view of Luton from the M1 is scarcely beautiful, but it is a welcome sight and a milestone on a long journey back to London.

In the long run the cost, engineering difficulties and technical achievements of roadbuilding are forgotten and we shall judge our roads by the quality of our experience as we travel along them.

THE BOTANICAL IMPORTANCE OF ROADSIDE VERGES

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INTRODUCTION

In this paper the roadside verge will be defined as the area of grassland or tall herbage, ditch and hedge, which lies between the made-up carriageway, and some other kind of vegetation beyond the highway boundary, such as woodland, pasture or arable field. We are not concerned here with areas like moorland and heath where the roadside is a part of the general vegetation of an area.

ORIGIN

Roads and roadside verges have arisen in two ways. They have either evolved from "Natural" tracks, or they are "Man-made Roads" which have been superimposed on the landscape. Natural tracks were not made, but grew as the need arose. The earliest were probably made by animals and led from grazing area to watering-place.

Some of the first tracks used by man in Britain were tracts rather than tracks. Tracts up to 1/2 mile wide, like the Icknield Way, which ran along the dry and open country of the chalk ridge from Wiltshire to Norfolk. The passage of men and their grazing flocks over a wide area, created and then maintained an open, slightly disturbed chalk grassland throughout the varying width of this ancient route.

When first the Romans and later the Anglo-Saxons came down from the high land and made clearings for their villas and villages in the forest, the communities were connected by tracks which followed the zig-zag field boundaries near the houses, but straightened out to pass over the common grazing near the boundary of the "Parish". The courses of rural roads in England to-day are in the majority of cases, still those that originated from these natural tracks: they are extremely ancient, and so are the verges which run beside them.

Few new roads were created between Saxon times and the middle of the eighteenth century. The "Open Field" system continued, but gradually, and particularly following the Enclosure Acts of 1750-1850, hedges were planted which separated the highway and its verge from the surrounding vegetation. Until that time the verge had been a part of the original native vegetation somewhat modified by disturbance from driven cattle, galloping horses, and, from the 16th Century onwards, periodic cutting up and rutting by wheeled vehicles. After Enclosure of the neighbouring fields the verge remained but the surrounding grassland, of which it had once been a part, frequently went under the plough.

The first "Man-made Roads" in Britain of lasting significance were those built by the Romans. Their construction created local disturbance, but the main constituents of the turf which re-established itself with the passage of time and under the influence of grazing animals was derived from the grassland which stretched away on either side.

Some new roads were created by the Enclosure Acts. These "Awarded" roads were over 40 feet in width. They occur, for example, on the Cambridgeshire Chalk, where they are noteworthy for their wide verges. They were commonly laid across heath sheep-walk similar in vegetation to that found on nearby Newmarket and Royston Heaths to-day.

It is only in this century, and largely in the last 20 years, that there have been further planned roads in rural areas. The network of by-passes and motorways which is now creeping mile by mile over the landscape has not evolved from it. The verges are man-made and develop from sown grasses and herbs and a mixture of initially annual and later perennial species which have survived the upheaval of the road making operations.

The distinction between the verges of "Natural" and "Made" roads is gradually being eroded. Every widening scheme, every straightened bend destroys an old verge and replaces it with a new. Every kill by herbicides of broad-leaved herbs decreases the variety of the old verge and pushes it towards the relative monotony of the new.

IMPORTANCE

i. General

The general botanical importance of roadside verges is at its greatest in lowland arable England. In many areas the verge represents the last vestige of the grasslands which existed before the modernisation of agriculture. Permanent pasture remains only where the plough and the dragline cannot reach, and both reach further yearly. In this setting the roadside verge which crosses all the geological formations, runs up hill and down dale, is wet and dry, flat or sloping, sunny or sheltered, provides a complete picture of the native grassland vegetation of the country. Destroy this and we destroy part of our heritage, as irreplaceable as the Parish Church or the village stocks. In many parts of lowland England the rich pastures of the past, gay with Buttercups and Oxeye Daisies can only live on now along roadsides which are unploughed and unsprayed.

ii. Particular

Roadside verges have always differed somewhat from the surrounding vegetation because of the disturbance factors caused by passing traffic referred to earlier. There are in the British flora a number of restricted grassland herbaceous species which are found outside our islands mainly in central and southern Europe, where their natural habitat is dry, open grassland. They migrated to Britain after the retreat of the ice 10,000 years ago when an open, treeless, grassland was our natural vegetation, but, when the climate here changed and the land became covered in forest, these species were only able to survive naturally in open sites like cliff-faces and river-banks, which the trees could not dominate. There they remained until the advent of Neolithic man who began, by his nomadic way of life, to disturb the chalk ridges and recreate, artificially, the conditions there which these species needed for survival. Man, the road-user, allowed the species to spread further and has gone on maintaining these open conditions until the present day.

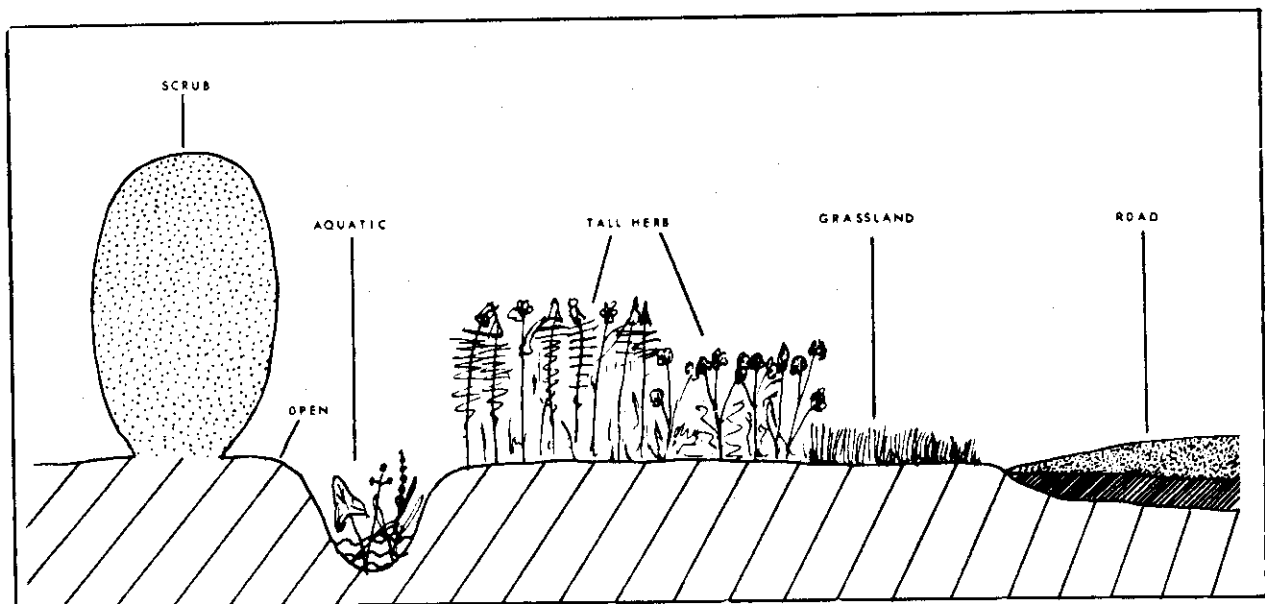
Three examples of these species occur on roadsides in Cambridgeshire. The Perennial Flax (*Linum anglicum*) reaches its southern limit on a verge of the Icknield Way near Hinxton, but it also occurs on the Gog Magog hills beside another Roman Road, the Via Devana. Further north in Lincolnshire it is entirely a roadside plant, once more associated with Roman roads.

The Spring Cinquefoil (*Potentilla tabernaemontani*) is a good example of a species which is native in dry, open, limestone grassland, and which survives in the artificially created conditions of the verge of a C road near West Wrating. This is almost certainly a very ancient Natural Road which forms a Parish boundary throughout its length.

The Spanish Catchfly (*Silene aotites*) is a rare species of sandy open habitats confined to the Breckland of East Anglia. The heaths on which it once grew abundantly in that area are being destroyed by ploughing: the only site for the plant remaining in Cambridgeshire is a roadside bank on a C road near Chippenham.

The primary importance of verges as relics of native grassland has been stressed, but this is not their only botanical interest. In a recording scheme recently devised for the Society for the Promotion of Nature Reserves, 9 major classes of habitat were recognised in lowland Britain; Forest, Scrub, Tall Herb, Reed-beds, Grassland, Moss-dominated areas, Open habitats, Aquatic habitats and Agricultural habitats: five of these (Scrub, Tall Herb, Grassland, Open habitats and Aquatic habitats, Fig 1) can occur on an ideal roadside where the verge is backed by a hedge and a ditch. Furthermore, elements of three others may frequently occur: (a) where shaded verges pass the sites of present or former woodland, elements of a forest flora, Primroses and Wood Violets, Anemones and Celandines spill out into the grassland; (b) where farm tracks cross the verge the special flora of wet ruts and trampled ground establishes itself; (c) in the Fens of eastern England the wide drainage ditches by the roadside develop into reed-beds at a late stage of their maintenance cycle.

Fig. 1. Habitats represented on an ordinary road verge.



Man as a road-user not only created habitats for existing native species to survive, but he brought species with him which have added to our flora. Many of them have been with us so long that we fail to realise their alien origin. The White Dead-nettle (Lamium album) may have been introduced by the Romans. It is a familiar plant of waysides and walls in England, but painstaking work by Miss Ann Conolly has shown that in Wales it is almost entirely confined to roadsides.

Many roadside treasures originated as plants in gardens which have long since disappeared. Thence came Elecampane (Inula helenium) and the Dusky Cranesbill (Geranium phaeum).

This great variety of native species, supplemented by species from alien sources, means that roadside verges are the richest single habitat for wild plant species in the country. In a county like Cambridgeshire with a total flora of flowering plants and ferns of 1,260 species, 520 (41%) have been recorded growing within the road verge region, in the broad sense.

During the period 1954-1962 the Botanical Society of the British Isles (B.S.B.I.) carried out a scheme to map the flora of the British Isles. The basis of the work was the presence or absence of each of our 1,700 British species of higher plants in the 10 km squares of the national grid. The results were published in The Atlas of the British Flora (Perring and Walters, 1962). The work was so complete that, particularly for the less common species, it is possible to state in objective terms which are the rarest species in Great Britain. During the last 2 years the staff of the Biological Records Centre at Monks Wood, with the assistance of the County recorders of the B.S.B.I., have been carrying out a more detailed study of the rarest 300 species so that we know their exact localities, the sizes of their populations and the nature of the habitat where they are to be found in the majority of cases.

The study has revealed that at least 27 of the 300 rarest species occur on roadside verges (Table 1).

TABLE 1

Very rare plants occurring on roadside verges. For species underlined verges are the main, and in some cases the only, habitat.

| | |
|-----------------------------|---------------------------------|
| Allium babingtonii | Hypochaeris maculata |
| Aristolochia clematitis | <u>Linum anglicum</u> |
| Artemisia campestris | <u>Melampyrum arvense</u> |
| Asarum europaeum | <u>Muscari atlanticum</u> |
| <u>Beta trigyna</u> | <u>Orobanche caryophyllacea</u> |
| <u>(Bupleurum falcatum)</u> | Phleum phleoides |
| Carex filiformis | <u>Phyteuma spicatum</u> |
| Carex montana | <u>Pyrus cordata</u> |
| Cynoglossum germanicum | Salvia pratensis |
| Epipogium aphyllum | Scrophularia scorodonia |
| Erica ciliaris | Silene otites |
| Herniaria glabra | Stachys germanica |
| Himantoglossum hircinum | Tetragonolobus maritimus |
| | Verbascum pulverulentum |

Each of these species occurs, on the average, in only 10 localities throughout the British Isles. Thus it can be seen that even if only one of the roadside verge populations of one of these species were lost, it would represent a high percentage of the total population of that species in Great Britain. In the case of Bupleurum falcatum it WAS the only habitat, for this plant which grew on one roadside in Essex, became extinct in Britain after road works in 1955. We must hope that the knowledge of the whereabouts of the sites of particular rarities on the part of responsible authorities will ensure that no similar losses occur in the future.

THE POTENTIAL IMPORTANCE OF MADE ROADS

The 'Made Roads' of the past have already been mentioned: the Roman Roads and the Enclosure Roads, particularly the former, now have verges of considerable importance. But there are other roadside verges which have not yet been mentioned which were made little over a hundred and twenty years ago; these were the verges of the iron roads, the railways. Their embankments were the greatest earthworks built in Britain since the Early Iron Age. Naturalists have long appreciated the importance of prehistoric earthworks; in Cambridgeshire, for example, the pre-Saxon Devil's and Fleam Dykes are the most important sites for chalk grassland plants in the county, both are designated as Sites of Special Scientific Interest. In the last few years naturalists have begun to appreciate the value of the railway embankments and cuttings, and are acquiring stretches of abandoned railway lines as Nature Reserves, because of their rich variety of plant and animal life. As Dony (1953) wrote about a Bedfordshire cutting "The large railway cutting known as Stanbrook Summit and the baulk covering the tunnel adjacent to it provide plant associations not to be found elsewhere in the county". Will another author 100 years hence be writing in the same terms about the banks of the M1 which runs parallel to Stanbrook Summit only a dozen miles to the south-west? Not unless we can reproduce the conditions which prevailed in creating such variety on railway banks. Some of these conditions were:

1. At the time of their construction the railways passed through a landscape in which natural vegetation was more frequent than it is today. There was ample opportunity for the spread of propagules of wild plants to new habitats.
2. Seed mixtures for sowing embankments, if they were used at all, were of native grasses and were adulterated by the seeds of many wild species of broadleaved plants.
3. The embankments were fenced from cattle but were grazed by rabbits, which maintained a short sward and created disturbance by burrowing, until their populations were severely reduced by myxomatosis.
4. The embankments were periodically burned either by design, or by chance sparks from passing steam locomotives. The burning was uneven and thereby produced variety in the development of the vegetation.

In sum, these conditions allowed the establishment of a native flora and, by variety of treatment (accident) produced the richness in species which made them most interesting and diverse today.

The conditions prevailing in the establishment of motorway verges cannot be the same as far as the landscape is concerned, neither can we, nor would we wish to, bring back the rabbit as an uncontrolled grazing machine, but we can surely do something about the mixtures we sow and the management which follows. We should seek sources of natural seed and, when it has been sown, ensure a variety of treatment with the machinery available by varying the timing and frequency of operation. Above all we must get away from the idea of a roadside verge as a lawn: that way lies monotony and botanical purgatory. If we wish to make the most of our opportunities for the verges of the future we must seek the right seed mixtures and the right management now.

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ROAD VERGES—A LOCAL RESPONSIBILITY FOR CONSERVATION

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Brighton, Sussex

Dr Perring has emphasised the importance and value of roadside verges in the conservation of wild flowers. Largely as a result of the rapid changes in local geology and variations in past land-use patterns in the British Isles, the biological interest of roadside verges often differs very markedly both from county to county and also within the same administrative area. For this reason it is important that the management of road verges should be based on sound knowledge of local conditions, if the maximum benefit from the point of view of wildlife conservation is to be attained.

The principal local voluntary bodies concerned with the conservation of nature and landscape are the County Conservation or Naturalists Trusts. Over the last ten years the number of County Trusts has increased to the point at which the existing 37 now cover the whole of England, Wales and Scotland. In the majority of cases a Trust covers a single County but in some, such as the West Midlands Trust, the Lake District Trust and the West Wales Trust, two or three counties may be covered by a single organisation. In these cases the Trusts have county branches operating in each constituent county. In Scotland the Scottish Wildlife Trust also has a number of local branches. Conversely a single Trust may cover several administrative counties such as in Lincolnshire, East and West Sussex and the Ridings of Yorkshire.

The Trusts, which are incorporated, non-profit making voluntary bodies, are concerned with all aspects of conservation, including land-use planning and environmental education as well as the management and establishment of nature reserves. At the present time they own or manage about 400 nature reserves totalling some 35,000 acres. Each Trust works in close co-operation with other statutory and voluntary organisations concerned with conservation in its area such as the Forestry Commission, National Trust, National Farmers Union and amenity societies. Particularly close co-operation is maintained with the staffs of the Nature Conservancy's Regional Offices, whose advice and assistance are always readily available.

The Trusts are represented nationally by the County Trusts Committee of the Society for the Promotion of Nature Reserves (S.P.N.R.). This committee, established in 1958 at the request of the 6 Trusts then in existence, acts as the national mouthpiece of the County Trust organisation and maintains a small permanent secretariat. It is further serviced by an Advisory Group on Administration and Finance, and also by the S.P.N.R.'s Conservation Liaison Committee on which all the main conservation bodies in the country are represented.

The extent to which the value of County Trusts is accepted and recognised by local authorities is indicated by the fact that they are now represented on seven of the nine County Countryside Committees, and on nine of the sixteen Countryside Sub-Committees so far established by County Councils.

The general policy of road verge management as well as the conservation of stretches of verge of special interest is of particular concern to the County Trusts, and successful agreements have already been negotiated by several Trusts with their local authorities on both these aspects of verge management.

Most of the early agreements on general verge management policy were aimed at limiting the use of herbicide sprays, in order to reinforce the Ministry of Transport and Civil Aviation's circular of August 1955, restricting the use of phenoxyacetic acid herbicides to trunk and class I roads and to certain dangerous corners on class II roads. At least 15 agreements of this kind were negotiated between Trusts and local authorities, but with the now almost universal use of mechanical means of verge maintenance these have been rendered largely unnecessary. Nevertheless, the Trusts would like to see the Ministry's arrangement extended to cover all herbicides, including maleic hydrazide. So far as the general management of verges is concerned, conservation interests favour a policy that achieves a degree of ecological diversity that is commensurate with the Highway Authority's duty to ensure safety and maintain the carriageway. That these two are far from being incompatible has been successfully demonstrated in a number of counties.

Later contributors will deal with the merits of the different types of verge management. A 'three-tier' system, involving a strip 3ft–5ft wide nearest to the road and cut regularly, backed by a wider belt cut in mid-summer and early autumn with the vegetation fringing the hedge not cut until the early autumn, has already been suggested by several authors including Moore (1967) and Perring (1967). This is a satisfactory arrangement where the nature of the verge permits and together with hedge and ditch it results in the most diverse habitat complex that is likely to be achieved. A general management policy similar to this has already been tried in some counties, such as West Sussex, and altogether there are now in operation about ten agreements between Trusts and local authorities limiting the timing and frequency of cutting on secondary and minor roads. Additional advantages of a management procedure of this kind are that on most soils it creates ecological conditions that are generally unfavourable to the development of most species scheduled in the Weeds Act, (1959), it prevents the encroachment of woody perennial species onto the verge and it is aesthetically pleasing.

Where roadside verges are of particular conservation interest, they require special management in order to maintain and enhance their value. It is suggested that in every administrative area, where this has not yet already been done, the Local Authority and the County Trust should now co-operate in the production of schedules of verges of interest with proposals for their management.

The first stage should be for the County Trust to draw up detailed schedules of the verges of interest in the County that are considered of sufficient importance to warrant special protection, not only of plant species, but of insects, birds and mammals as well. These schedules should include:

1. details of the locality, including parish, grid reference, side of the road and its class,
2. the length of the verge and its mean width,
3. the nature of the interest,
4. possible threats to the site,
5. present management,
6. proposed management

The position of the verges should also be marked on large scale maps. The Trust should then discuss with the County Surveyor the schedules together with the management proposals, and, when these have been agreed the division of responsibility for the management of the verges should be decided. Most Trusts now operate their own conservation corps and even those without a formal corps can always call upon voluntary labour to carry out conservation management tasks. Whether or not the entire management of the protected verges is left to the Trust or whether this is shared with the County Surveyor's Department or carried out entirely by the local Authority must be a matter to be decided by those immediately involved. What is important is that the division of responsibility should be clearly defined. The design of marker posts and who is responsible for their installation also needs to be decided. Once the sites and their management have been agreed with the County Surveyor it is then necessary to establish close liaison between the Trust and the various District Surveyors involved, and for the practical management problems to be discussed on the ground with the Highway Authority staff. In the case of those counties fortunate enough to possess County Countryside Committee with non-Council representation, the initiative for the verges survey and management may well come from that Committee. The County Trust will undertake the task of periodically visiting the scheduled verges in order to ensure that the agreed management policy is being adequately carried out, to assess the effectiveness of the management and to advise accordingly on any changes in the management prescription that seem indicated. Periodic meetings between the Highway Authority and the Trust to review the progress of the scheme will also ensure that any difficulties that arise are rapidly ironed out. Again, where it exists, the County Countryside Committee provides the obvious medium for ensuring the smooth running of the scheme.

At the present time about 21 Highway Authorities have some form of agreement with their County Trust on the management of stretches of roadside verge of special interest. In Lincolnshire for example the Trust has had for several years very successful agreements in operation with both the Lindsey and Kesteven Countryside and Highway Committees. The Trust produced, in collaboration with the Regional Staff of the Nature Conservancy, maps and schedules of the sites which set out details of location, interest, current management, possible threats and proposed management. On their part the Highways Department have agreed to consult the Trust and the Regional Officer of the Nature Conservancy in the event of any schemes that might affect the verges and to erect marker posts to identify the verges on the ground. In all there are now 24 verges protected in Lincolnshire by these agreements, 14 in Lindsey and 10 in Kesteven and they include not only some of the most northerly sites in Britain for many limestone species of plants but also the most northern British breeding colony of the Chalkhill Blue butterfly, *Lysandra coridon*. Many other counties have similar schemes in operation. The Berkshire, Buckinghamshire and Oxfordshire Trust negotiated an agreement with the Buckinghamshire County Surveyor as long ago as 1964 and more recently has completed a similar scheme in Oxfordshire (Southam, 1967). The Sussex Naturalists Trust have agreements with the County Surveyors of both East and West Sussex. Here the Trust has appointed a 'Verges Officer' to co-ordinate the activities of the Trust representatives responsible for keeping a 'watching brief' over the scheduled verges in different parts of the County, and to be responsible for liaison with the various District Surveyors. In Sussex there are 57 protected verges, 30 in East and 27 in West Sussex, giving a total length of 10.1 miles of protected roadside.

In Scotland the Scottish Wildlife Trust submitted a paper on the conservation of plants on roadside verges to the County Surveyors Society (Scottish Branch) in 1967. As a result the Society has agreed to co-operate as fully as possible with the Trust over the management of verges of special interest if the Trust provides the various County Surveyors with the necessary schedules of important sites.

The ultimate success of these agreements between County Surveyors and the Trusts depends on adequate liaison with the District Surveyors and an understanding by the men carrying out the verge maintenance work of what is required. County Trusts are particularly well placed to carry out this kind of liaison and to provide the necessary advice, as their regional representatives possess the necessary local knowledge backed by advice from the Trust's Scientific or Conservation Officers. In addition it means that there are people more or less constantly on the spot to report progress at each site.

The importance of roadside verges in wildlife conservation in a countryside that is becoming progressively more intensively used is now indisputable. Theoretical ecologists have long maintained that one of the inevitable and fundamental concomitants of a land policy, that results in decreasing diversity, is an increasing degree of environmental instability. Recently the basis of this concept has been subjected to more rigorous experimental and theoretical analysis, eg Leigh, (1965). It now seems clear that two of the most important constituents of ecosystem stability are a maximal number of links in the community food web and a high biomass. In general both these features are reduced with increasing agricultural intensity and in this situation the importance of maintaining adequate and diverse edge habitats, including roadside verges, assumes special significance.

The correct management of roadside verges is an aspect of countryside planning of high importance. Details of management will inevitably differ from district to district and close co-operation between Highway Authorities and local organisations, such as the County Trusts, will ensure that management policies will be arrived at most appropriate and beneficial to the particular area. Edge habitats, such as hedgerows and roadside verges, should be regarded not only simply as refuges for our fast diminishing wildlife but also as a feature essential for the maintenance of an acceptable and necessary degree of stability in the countryside as a whole.

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ROAD VERGES AND THE FARMER

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... And over the hedge from the road verge there is, usually, a farmer.

This farmer's legal rights on the verge are variable. In all modern road developments they are small, for highway authorities invariably purchase the land from hedgerow to hedgerow. But on older roads he may actually own, or be tenant of, the verge, each frontager's rights sometimes extending even to the middle point of the metalled carriageway. Alternatively ownership may be vested in the Parish, the earlier highway authority, depending on the Parish award.

In the past this was of some importance, for the road verge held a distinct, if minor, place in the rural economy. The herbage of the road verge could be harvested either by the owning farmer or by a lessee of the parish authority, always eager to augment its slender revenues.

This harvesting normally consisted in taking one or more cuts of hay, or in grazing. Occasionally one hears of less usual exploitations such as the 'geese-lettings' in the Lincolnshire fenland, the parishes there letting the right to graze flocks of geese during their long cross-country waddle to market.

Grazing rights could be of some importance especially in a time of drought. Their management presented few problems in those days. There was little disturbance—a few local carts and waggons, the carrier two or three times a week, local farmers in their gigs, and occasionally the squire or the parson in his carriage. And control of the animals could be secured by "an ould boy to tent 'em" at the cost of a few pence a day.

Nowadays all this has been changed, like so many other aspects of our lives, by the coming of the internal combustion engine. All legal and traditional rights on the road verges have been over-ridden by the demands of road-safety.

No longer can the flow of traffic be impeded by cattle wandering all over the place, though the grazier still has the right to drove cattle along the roads. I have noticed in my own village that one small farmer, who has parcels of land a mile apart, seems to take a great deal longer to move his dairy herd from one to the other in a dry time, than he does when there is a good growth of grass!—and droving them nowadays is not done by an 'ould boy' (who in any case would be too expensive) but by the farmer himself at the wheel of his motor-car. Nor is it any longer good enough to rely on a succession of independent frontagers to keep down tall growth on the verges and so give clear vision ahead to motor traffic.

Management of the road verge has therefore been taken over by the highway authorities. But the frontagers still make use of the verges in several ways. If the strict legality of what they do were ever gone into, it is probable that they would often be judged to be exceeding their legal rights. But in the splendid spirit of British compromise working tolerances have been achieved which, though they might not stand up in a court of law, leave everybody reasonably happy. Many farmers, for example, when weather and a lull in the general work of the farm allow, make some rough and not very valuable hay of the grass left by the council's cutters. Probably they are guilty of theft from somebody, but at least the verge is tidied up and nobody complains. In districts where sugar beet is grown it is common practice to clamp the roots on the roadside after they are carted off the fields, awaiting permits to go to the factory for processing. This is becoming less common as mechanical systems of loading the lorries are developed, and growers are finding it necessary to lay down rafts of concrete to save the machines from sinking into the mud. But it is still not uncommon to see these clamps and it is done in a spirit of give-and-take. The farmer has no legal right to site his clamps on the road verges, but in my own county of Lindsey, provided he keeps the edge of his clamp three feet from the carriageway, does not site it near a corner so as to obscure the vision of oncoming traffic, clears up the mud that inevitably falls on the adjacent road surface, puts up "MUD ON ROAD" notices while clamping is going on, and tidies up the site after the beet has all been sent to the factory, the highway authority looks the other way (though not without sideways glances to see that he does all these things properly). Finally the farmer has, of course, access across the verge to the gates of his roadside fields, any necessary 'booning' with stone being tolerated.

As well as rights, or at least permissions, the frontager has obligations. Almost invariably he is responsible for the roadside hedge, with any trees standing in it, and its accompanying ditch. Where the verge is narrow, an overgrown hedge or the lower branches of trees may encroach on the highway and become a hazard to passing vehicles. He must keep them trimmed back and keep the hedge low near corners to allow good vision ahead. If he uses a mechanical hedge-trimmer or ditch-digger he may work it on the road verge, but is responsible for clearing away the thorns and for spreading the spoil from the ditch so that there is no hazard to road safety. Often, where there is a traffic hazard, frontagers give pieces of land to the council to allow the hedge to be set further back on a corner, the council planting a new length of hedge or providing fencing.

Because he has these obligations, the farmer often keeps a sharp look-out (many conservationists think too sharp a look-out) on the obligations of the highway authority and demands more verge management than is biologically desirable. I shall probably be drummed out of the N.F.U. for saying this, but I wonder sometimes whether this attitude has its roots in the farmer's feeling of his own shortcomings. In the past farmers took pride in the tidiness of their farms; they were 'hedge-proud' and were often compelled by the terms of their tenancies to trim every yard of hedge every year, layer them every seventh year, and keep all their ditches grassed out annually. In these days of greatly reduced farm staffs (and 20,000 regular workers a year are leaving the land) these standards are becoming more and more difficult, indeed impossible, to maintain. But even if he himself is slipping from Father's and Grandfather's standards, he doesn't see why everyone else should not be kept up to scratch. Or the motive may simply be the more mundane one that, if he's going to make a bit of rough hay off the road verge, he might as well make a decent quantity from the full width rather than just a bit from a narrow strip alongside the tarmac.

The problem of weeds spreading to agricultural land from road verges is being dealt with by Mr Chancellor in another paper. Although of course, no farmer would tolerate a healthy bed of thistles on one of his verges, this is not, I think, an area of conflict that looms very large in the farmer's mind.

Finally, a whole new set of problems has arisen from the greater accessibility of the countryside to the modern townsman. It is interesting to reflect how recent these problems are. Up till the recent past the countryside was really very inaccessible. It was possible for the villager to go with the common carrier to the local town and get back home the same night. But the other way round was extremely difficult without an overnight stay, except for the tiny minority who had their own transport. For there was no public service in those days except along main routes.

Nowadays, as private ownership of cars and motor-cycles spreads down throughout the population, many thousands of townspeople like to visit the countryside. When they get there they find that they are barred from most of it by private ownership. So perforce they make use of the roadside verges for picnicking and so on, and inevitably they leave behind them the detritus of their invasion. The bottle thrown carelessly over the hedge to break and cut the feet of stock in the adjacent field. The plastic bag that blows away and stops up the gut of some unfortunate cow. The piece of metal or wire that is baled up along with the hay and either breaks the baler or is eaten the following winter by a bullock. The improperly damped picnic-fire or carelessly thrown away cigarette that catches the roadside hedge on fire. All these are very real problems to the roadside farmer and their only solution lies in greater public awareness of the dangers.

ROAD VERGES—HAMPSHIRE N.F.U. EXPERIENCE IN 1968

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Historical Background

The problem of the uncut verges in the County first officially came to the notice of the Hampshire N.F.U. as a result of a Resolution from the Petersfield Branch. The background to the Resolution was an interview on television with the County Surveyor, when the interviewer posed questions on the Council's *Verge Cutting Policy*, how it was to be implemented and what effects it would have. Knowing the tremendous immediate reaction to mass media weapons such as television it was no surprise that the matter came up that same evening at an N.F.U. meeting. As the decision not to cut verges was a County one, obviously it was right and proper that the County Branch of the N.F.U. should discuss the matter with the authorities.

Meeting with Hampshire County Council

The N.F.U. Secretary and I, as Chairman, were deputed to meet the County Surveyor and inform him of the concern felt by the agricultural population. Trying to be reasonable and fair and representing a responsible body, we asked the County Council what had been decided and why. As money is an eternal problem with which we as farmers, and the N.F.U. as a voluntary organisation are all too familiar, we guessed the answer to the second part of our question first! It seemed that the Hampshire County Council had been told to trim their budget quite ruthlessly, a fate suffered by many other local authorities, and it certainly appeared to us that the Roads and Bridges department were required to bear a heavy section of this cut-back in expenditure, although we are not competent to say how and where the budget should have been cut back. The situation seemed to be further aggravated by certain measures contained in the Budget. It would appear to us as ratepayers, that the decision to cut down on certain expenditure was short sighted in the extreme. The four main points at issue were decisions—

- a. Not to cut road verges in the County—this meant that the cutting, when it was done, would cost considerably more, due to the extra amount of dead growth, overgrown bramble etc. that would need to be cut.
- b. No new white lines or cats eyes—this just meant that twice as much would need to be done in 1969.
- c. No new sign posts—similar answer to (b) above.
- d. No litter collections—surely a retrograde step. Everyone has been imploring the public to use litter bins and 'Keep Britain Tidy'. Now it appeared that some of the accumulated litter would not be collected.

Returning to the financial background, there were two aspects which we as farmers and laymen could not understand. We were told that as a result of not cutting verges a considerable number of men would become redundant. Was this so? Was any Hampshire County Council road worker put out of his job? In one case in particular we know of staff being taken on. Did the suggested redundancy not take place and were any losses merely normal retirement and wastage? Certainly we did not hear any of the Employees' Organisations criticising the Hampshire County Council for putting their employees out of work! The second point concerns the Hampshire County Council machinery—tractors, grass cutters, ditching machinery and the like. If this machinery was owned by a farmer or a contractor he would have to allow an annual figure for depreciation, whether the machine was used or not. From the information we were given, it would appear to us that the Hampshire County Council made no depreciation allowance for any machine that might rust out rather than wear out!

The Farmers' Concern

Why were the farmers' concerned, just how genuine was this concern and now that the decision is out of the political cockpit, what lessons can be learned?

The farmers' concern can genuinely be said to cover the following:

- a. First and foremost SAFETY

The one word 'Safety' covers a multitude of different aspects—the safety of small children walking to school on overgrown verges where it was possible that they might be unseen by traffic; the safety of farmers and farm workers using the narrow lanes made narrower by the overgrown grass; the dangers of driving stock along these overgrown lanes; the dangers of warning signs being hidden by weed growth. Sight lines on bends were certainly much less useful as a result of interference of vision by the weeds. We know of one case where the Coroner saw fit to criticise the Authorities on the grounds that the overgrown verges were a contributory hazard in a fatal accident. We do not know the facts of the case so we are not in a position to comment—but what we would say is that the Coroner's remarks were indicative of the dangers.

- b. GOOD HUSBANDRY

The uncut Hampshire verges will leave their mark on Hampshire Farming for many years to come—one year's seeds—seven year's weeds—it may not be completely true today with modern weed killers but the amount of weed seed, in particular dock and ragwort, will surely make their presence felt in many unwanted places during 1969 and a number of subsequent years too. By allowing these noxious weeds to seed—and the 1959 Weeds Act defines noxious weeds as docks, thistles and ragwort—the County Council were of course breaking the law. We found the Ministry of Agriculture reluctant to use their powers under the Weeds Act. Many farmers felt strongly on this matter—they felt that the Ministry would willingly take on some poor struggling peasant farmer but they did not relish a brush with such a powerful body as the Hampshire County Council. *In the long run, on the Fawley by-pass I believe the County Council did cut some of the seeding docks but by the time they took action most of the seed was ripe and cutting merely served to shake out the remaining seed.*

c. DRAINAGE

The unparalleled wet autumn and winter of 1968, and the run off from all the roads made heavy demands on roadside ditches. Many of these were quite incapable of dealing with the surface water they were required to carry for the simple reason that their sides were overgrown with vegetation and the actual capacity for water carrying was considerably reduced. This caused widespread flooding of farm land and whilst we recognise that the abnormally wet winter would have led to flooding anyway, I submit that this was aggravated by the uncared for state of roadside ditches. I saw, again with concern, that the Coroner in an adjoining county saw fit to criticise the Authorities there because their ditches were unkempt; this in turn had led to flooding on a road which, said the Coroner, was a contributory factor to another fatal accident. How often can I and must I stress that Safety was the biggest worry of the farming community.

The Legal Position

The legal position regarding ownership of roadside verges seems very much to be lost in the mists of antiquity and I believe that if you went to half a dozen leading Counsel for their opinions on this vexed subject you might well get half a dozen different answers! I think that the fairest way of looking at it is to say that County Councils can be regarded as 'Occupiers' of the verges as part of the road system which enables the Subjects of her Majesty The Queen to travel from point A to point B. County Councils are all too ready to grant various public bodies the rights to lay such things as telephones, gas, water, sewerage etc. in the verges and to allow such actions as shot blasting for seismic surveys. Surely they would not be so liberal with their powers if they did not think that they were the rightful owners of the verges? If I may just touch on a thorny subject—in 1965 the farming community felt that they were being singled out by the Government for particularly unfair treatment. Part of our answer was a massive public relations campaign which included roadside posters. Hampshire County Council Roads and Bridges staff were quickly on the scene to confiscate the stakes and the posters placed on the verges, which they claimed had been erected on their property. Is the County Council in such a favourable position that it can choose to own or not to own the verges at will just as it suits them? I think not. I think that the position will be clarified in the future where new roads are made or where widening operations are carried out, since we are suggesting to our members that when the County Council contracts with them for the purchases of land necessary, the farmer concerned should make a condition of the sale a clause to the effect that the County Council will assume full responsibility for the care and maintenance of the verges of the new road.

Where do we go from here?

In 1969 the Hampshire County Council, we are told, are proposing to spend the same amount of money on cutting roadside verges as they spent in 1967. I am not an economist but as a practising farmer I would like to suggest that with the fall in the purchasing power of the £ only 80%—85% of the work will come within the budget provisions. I am well prepared to be proved wrong with my guesstimate! Another factor to be remembered is that the verges to be cut in 1969 will have a year's growth to be cut in addition to the normal season's growth. This must impede the progress of the cutter and add considerably to the costs of cutting any particular stretch. Where the County Council have cut odd stretches they admit that their costs have increased considerably. In correspondence with the County Council in the summer and autumn we continually made this point on the basis of 'a stitch in time saves nine'.

Reaction from the General Public

In the summer the Hampshire N.F.U. Executive accepted, albeit very reluctantly, that little good would be achieved by pressing the Council to do any major cutting in 1968. We therefore changed our tactics and in letters to the press we suggested that rural dwellers should bring pressure to bear on their County Councillors to ensure that provision was made in the 1969 County Council budget to allow for a return to roadside verge cutting. Speaking in general, the response was sympathetic and very much in agreement with the Safety and Good Husbandry case we made. There were a few people who took the extreme opposite view—they wanted to see the roadside verges uncut to allow for natural flora and fauna to flourish. To these people we would say Safety and Good Husbandry must come first. I would also say that there are plenty of public footpaths across farm land, plenty of bridle ways, Countryside Parks, woodlands etc., where the interests of those whose concerns are flora and fauna can be catered for quite adequately.

THE LAW ON INJURIOUS WEEDS

Legislation on injurious weeds dates from the Corn Production Acts of 1917 and 1920 and further provisions were introduced under a number of subsequent Acts. In July 1959 the previous enactments were repealed and all the provisions consolidated in the Weeds Act, 1959. The injurious weeds to which the Weeds Act applies are:

| | |
|---------------------------|-----------------------------|
| <u>Cirsium vulgare</u> | (Spear Thistle) |
| <u>Cirsium arvense</u> | (Creeping or field Thistle) |
| <u>Rumex crispus</u> | (Curled Dock) |
| <u>Rumex obtusifolius</u> | (Broad-leaved Dock) |
| <u>Senecio jacobaea</u> | (Ragwort) |

and additional weeds may be prescribed by regulations.

The Minister has power under the Act to serve notice on an occupier of land requiring him, within the time specified in the notice, to take such action as may be necessary to prevent the injurious weeds from spreading. An occupier who unreasonably fails to comply with the requirements of such a notice is liable, on summary conviction, to a fine not exceeding £75, or for a second or subsequent offence, not exceeding £150; the Minister may also enter on the land and take the necessary action to prevent the weeds from spreading, recovering the cost of doing so from the occupier.

Since 1939, there have been changes in the delegation of the Minister's powers. At present the councils of county boroughs exercise the delegated powers on non-agricultural land within their areas, the Minister's divisional executive officers the powers on non-agricultural land outside the county boroughs, and the county agricultural executive committees on agricultural land within their areas.

From the WEED CONTROL HANDBOOK, 5th edition 1958, Eds. J. D. Fryer & S. A. Evans, Volume 1 (Principles). Blackwell Scientific Publications, Oxford and Edinburgh. With acknowledgements.

ROAD VERGES – THE AGRICULTURAL SIGNIFICANCE OF WEEDS AND WILD PLANTS

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Roadside verges have a rich and varied flora, which is derived in part from the plants that inhabited the once extensive marginal areas of scrub and rough grassland separating cultivated land from forest. The gradual expansion of agriculture over the years combined with the felling of forests has resulted in many of these plants being confined to less extensive habitats, such as roadsides, where they can find conditions suitable to their requirements. A number of these species are biennials, e.g. Cow Parsley (*Anthriscus sylvestris*), Garlic Mustard (*Alliaria petiolata*), Rough Chervil (*Chaerophyllum temulentum*), having a life-span of two seasons which is incompatible with being an arable weed and also rarely met with in pasture weeds. However, there are on roadsides other species of plants, of various life-spans, that have weedy characteristics and that are weeds of varying agricultural importance. It is the purpose of this paper to consider whether these weedy plants constitute a threat to agriculture or whether, like the relic biennials that grow with them, they are seeking sanctuary from the ever-increasing demands of man upon the countryside.

In order to assess the agricultural significance of roadside plants it is necessary to determine first what species occur there that are potentially weeds of farm land, then their capability of spreading into adjacent agricultural land and thirdly, if they can spread in, how important they are as weeds. To find out which weedy species occur in roadside a survey was carried out by the Botany Section of the Weed Research Organisation. Because time was limited only two localities were investigated; Oxford (mixed farming and wetter) and Chelmsford, Essex (more arable and dryer). Within a 20-mile circle around each centre, 50 lengths of roadside were assessed by recording the names and degree of abundance of all weedy plants. Only sites (selected at random) where the soil had not recently been disturbed were recorded, because disturbed soil encourages plants that do not persist in and are not characteristic of established roadside verges. Each site was 20 yards long, but varied in width to include the whole verge. The Oxfordshire sites were assessed in August and the Essex ones in October 1968. To avoid bias in selecting plants for listing, it was decided that it would be easiest and fairest to record too many rather than too few species and to include 'weeds' of all man-managed situations and not only agricultural weeds. However, although these plants all have weedy characteristics to a greater or lesser extent, their importance as weeds, implying a status as an economic pest, varies considerably.

a. Weeds present in the roadsides

The results of the survey are given in Table 1, which shows the percentage occurrence of species in each locality and as a percentage of the occurrences, the number of times that each species was common to abundant. The commonest species were frequent in both localities, but verges in other parts of the country may of course differ greatly, depending on soil, climate and other environment factors.

b. Methods of spread of weeds found in the roadsides

Although methods of plant dispersal are frequently listed in botanical works it is difficult to obtain any data on the degree of success obtained through different methods. Over a quarter of the plants in Table 1 are dispersed by wind to a greater or lesser degree. Dandelion (*Taraxacum officinale*) has a pappus of hairs attached to the seed, which enables it to be blown to any distance (Small, 1918; Ridley, 1930). However, seeds with a pappus do not always travel indefinite distances. One experiment in New Zealand (Poole & Cairns, 1940) showed that few seeds of Ragwort (*Senecio jacobaea*) travelled further than 40 yards. Other species merely have flattened fruits, eg Hogweed (*Heracleum sphondylium*), which are perhaps blown a few feet, while others, eg Broomrape (*Orobanche minor*) have no wind-catching adaptation, but the seeds are carried a long way because they are so light and are carried like dust in air currents.

Birds too undoubtedly play a part in seed dispersal. It was once thought that finches and other birds were very useful because they ate and destroyed the seeds of cornfield weeds, but it has been shown (Collinge, quoted by Ridley, 1930) that some seeds escape digestion and pass through the birds uninjured and so are distributed by them. Pigeons, for instance, have yielded viable weed seeds, eg Charlock (*Sinapis arvensis*), Docks (*Rumex* species), Cleavers (*Galium aparine*) and Knotgrass (*Polygonum aviculare*), from their droppings (Ridley, 1930). A few weed seeds can then pass unharmed through some birds. Where do the birds deposit these seeds? The question of whether seed-eating birds excrete during flight is apparently not very well known. It is suggested (Ridley, 1930) that they do, especially if startled. If they do so normally then there is a good chance that the seeds will be dropped into a field, but if they evacuate only when perched on a branch then the chances are that the seeds will be deposited in a hedgerow, where they would be of little importance to agriculture. However, it has been noted (Long, 1968) that overhead power lines can serve as substitute branches, as shown by the concentrations of wild oats occurring under them, and these lines do of course pass over fields. Birds may therefore be of some importance in dispersing some weeds.

Weeds can also spread by their own unaided efforts. Creeping perennials are among the worst weeds of agriculture, and there are 20 species of plants in Table 1 that spread by creeping roots or stems. The distance of spread varies, eg Couch Grass (*Agropyron repens*) can creep up to 10 feet 10 in. in a year (Raleigh et al, 1962), while Creeping Thistle (*Cirsium arvense*) can reach up to 40 ft a year (Rogers, 1909). The danger of these plants spreading from roadsides will depend upon whether a ditch or other barrier is present between the weed and the field or not. A deep ditch may prove an insuperable obstacle to weeds with subterranean creeping parts such as Perennial Sowthistle (*Sonchus arvensis*), but to others that creep large distances above ground, such as Bellbine (*Calystegia sepium*), it may not.

A few weeds have hooked fruits, seeds or flower heads, which can catch on clothing, animal fur or wool and so get dispersed. The main example in Table 1 is Cleavers (*Galium aparine*), which has hooked bristles on its seeds. Although frequent in hedges it is not all that common in fields, which might suggest that there may be different races of the plant, some of which are incapable of surviving as an arable weed; this is possibly also true of *Arrhenatherum elatius* (Oat-grass) and its bulbosum (Onion Couch) variety.

From this brief survey of dispersal methods it appears possible that seeds or vegetative parts of weeds can and undoubtedly do get into fields from roadside verges. It requires of course only one seed of a self-fertile weed or one rhizome of a perennial to start an infestation.

TABLE 1

The occurrence and frequency of weeds in roadside verges around Oxford and Chelmsford

| | Species | Percentage Occurrence | | Percentage of Sites where frequent | |
|-----|-----------------------------------|-----------------------|----------|------------------------------------|----------|
| | | OXFORD | CHELMS'D | OXFORD | CHELMS'D |
| 1. | <i>Arrhenatherum elatius</i> | 94 | 86 | 56 | 34 |
| 2. | <i>Urtica dioica</i> | 88 | 92 | 62 | 80 |
| 3. | <i>Heracleum sphondylium</i> | 88 | 88 | 30 | 32 |
| 4. | <i>Taraxacum officinale</i> | 82 | 68 | 6 | 6 |
| 5. | <i>Agropyron repens</i> | 80 | 86 | 36 | 50 |
| 6. | <i>Anthriscus sylvestris</i> | 78 | 90 | 28 | 52 |
| 7. | <i>Trifolium repens</i> | 76 | 62 | 16 | 16 |
| 8. | <i>Rubus</i> spp. | 64 | 74 | 16 | 20 |
| 9. | <i>Achillea millefolium</i> | 62 | 62 | 12 | 12 |
| 10. | <i>Cirsium arvense</i> | 62 | 74 | 24 | 18 |
| 11. | <i>Galium aparine</i> | 62 | 20 | 18 | |
| 12. | <i>Convolvulus arvensis</i> | 56 | 10 | 30 | 2 |
| 13. | <i>Plantago lanceolata</i> | 52 | 38 | 10 | 12 |
| 14. | <i>Ranunculus repens</i> | 50 | 2 | 16 | |
| 15. | <i>Plantago major</i> | 50 | 24 | 2 | 6 |
| 16. | <i>Rumex crispus</i> | 34 | 14 | | |
| 17. | <i>Lamium album</i> | 34 | 16 | 4 | 8 |
| 18. | <i>Holcus lanatus</i> | 32 | 24 | 2 | 14 |
| 19. | <i>Rumex obtusifolius</i> | 30 | 30 | 2 | 2 |
| 20. | <i>Ranunculus acris</i> | 26 | 64 | | 44 |
| 21. | <i>Matricaria matricarioides</i> | 20 | 2 | | |
| 22. | <i>Glechoma hederacea</i> | 20 | 12 | 2 | 4 |
| 23. | <i>Medicago lupulina</i> | 18 | | | |
| 24. | <i>Sonchus asper</i> | 18 | 10 | 2 | |
| 25. | <i>Tragopogon pratensis</i> | 16 | 2 | | |
| 26. | <i>Polygonum aviculare</i> | 16 | | 2 | |
| 27. | <i>Epilobium hirsutum</i> | 14 | 44 | 6 | 18 |
| 28. | <i>Cirsium vulgare</i> | 14 | 24 | | |
| 29. | <i>Artemisia vulgaris</i> | 14 | 4 | | |
| 30. | <i>Geranium pratense</i> | 12 | | | |
| 31. | <i>Poa annua</i> | 10 | 56 | | 4 |
| 32. | <i>Silene alba</i> | 10 | 6 | | |
| 33. | <i>Agrostis stolonifera</i> | 10 | 28 | 4 | 12 |
| 34. | <i>Picris echioides</i> | 8 | 12 | 2 | 2 |
| 35. | <i>Chamaenerion angustifolium</i> | 8 | 2 | | |
| 36. | <i>Carduus acanthoides</i> | 8 | 2 | | |
| 37. | <i>Papaver rhoeas</i> | 8 | | | |
| 38. | <i>Avena fatua</i> | 6 | | | |
| 39. | <i>Calystegia sepium</i> | 6 | 8 | 4 | 2 |
| 40. | <i>Sonchus arvensis</i> | 6 | | 2 | |
| 41. | <i>Cerastium holosteoides</i> | 6 | 2 | | |
| 42. | <i>Tripleurospermum inodorum</i> | 6 | 2 | | |
| 43. | <i>Pastinaca sativa</i> | 4 | | | |
| 44. | <i>Sisymbrium officinale</i> | 4 | | | |
| 45. | <i>Lapsana communis</i> | 4 | 10 | | |
| 46. | <i>Arctium minus</i> | 4 | 2 | | |
| 47. | <i>Equisetum arvense</i> | 4 | 6 | 2 | |
| 48. | <i>Arctium lappa</i> | 2 | | | |
| 49. | <i>Orobanche minor</i> | 2 | | | |
| 50. | <i>Ononis repens</i> | 2 | | | |
| 51. | <i>Geranium dissectum</i> | 2 | | | |
| 52. | <i>Deschampsia caespitosa</i> | 2 | | | |
| 53. | <i>Juncus inflexus</i> | 2 | 2 | | |
| 54. | <i>Armoracia rusticana</i> | 2 | 4 | | |

TABLE 1 (Continued)

| Species | Percentage Occurrence | | Percentage of Sites where frequent | |
|----------------------------------|-----------------------|----------|------------------------------------|----------|
| | OXFORD | CHELMS'D | OXFORD | CHELMS'D |
| 55. <i>Pteridium aquilinum</i> | 2 | | | |
| 56. <i>Silene vulgaris</i> | 2 | | | |
| 57. <i>Senecio vulgaris</i> | 2 | 2 | | |
| 58. <i>Raphanus raphanistrum</i> | 2 | | | |
| 59. <i>Papaver dubium</i> | 2 | | | |
| 60. <i>Allium vineale</i> | 2 | | | |
| 61. <i>Rumex acetosa</i> | | 14 | | |
| 62. <i>Ranunculus bulbosus</i> | | 12 | | |
| 63. <i>Juncus effusus</i> | | 6 | | |
| 64. <i>Angelica sylvestris</i> | | 6 | | |
| 65. <i>Cirsium palustre</i> | | 4 | | |
| 66. <i>Sinapis arvensis</i> | | 2 | | |
| 67. <i>Ulmus procera</i> | | 2 | | |
| 68. <i>Stellaria media</i> | | 2 | | |
| 69. <i>Senecio jacobaea</i> | | 2 | | |

c. The agricultural importance of weeds found on roadsides

Of the arable weeds Couch Grass (*Agropyron repens*) is probably the most important. By competition it can reduce crop yields (Bandein & Buchholtz, 1967) and it is an alternative host to *Ophiobolus graminis*, the 'take-all' disease of wheat. It is virtually ubiquitous in agricultural land, which is due in some measure to its rhizomes coming in at field margins. Other important arable weeds, eg Knotgrass (*Polygonum aviculare*), Corn Poppy (*Papaver rhoeas*), Wild Oats (*Avena fatua*), Scentless Mayweed (*Tripleurospermum maritimum* ssp. *inodorum*), Wild Radish (*Raphanus raphanistrum*), Charlock (*Sinapis arvensis*), Groundsel (*Senecio vulgaris*) and Chickweed (*Stellaria media*), although often common on newly-sown roadside verges and for one or two seasons after sowing, are infrequent on undisturbed well-established ones.

Of grassland weeds, Creeping Thistle (*Cirsium arvense*) is the most frequent and of greatest importance. Its far-creeping roots can easily invade fields, especially cultivated ones. It is easily controlled by herbicides in arable land, but poses problems in grassland. Being dioecious (ie. having separate male and female flower plants) it only occasionally produces seed, and for some reason the pappus often separates from the seed in the head and blows away alone, so contrary to popular belief the seeds are not wind-dispersed. Other important weeds of grassland, eg Rushes (*Juncus* species), Bracken (*Pteridium aquilinum*), and Ragwort (*Senecio jacobaea*), were uncommon in the surveyed roadsides (Table 1); but are locally important elsewhere. Broad-leaved Dock (*Rumex obtusifolius*) is, however, frequent and can invade grassland. Successful invasion of established grassland is encouraged for most species by poor management: Ragwort, for example, is considered to be symptomatic of neglect (Fryer & Chancellor, 1956). Woody plants from the hedges can also invade grassland, although any significant establishment of these plants in agricultural land would invariably be due to poor management.

There are two additional weeds which are worth mentioning although not occurring in Table 1. Coltsfoot (*Tussilago farfara*) is a common rhizomatous weed that frequently colonises grit heaps on roadsides. It produces wind-borne seed and is often a problem in arable land. Japanese Knotweed (*Polygonum cuspidatum*) is also rhizomatous, but far less common. It grows mainly in Wales and the south-west of England, but occurs widely elsewhere as well. Its aerial stems, which grow to 8 feet, are potentially a nuisance on roadsides.

To find a road verge with a great density of weeds and an adjacent field containing the same weeds in lesser density would constitute the only evidence of roadside weeds invading agricultural land. This situation was looked for, but proved very hard to find. A field of barley was found where there were Wild Oats (*Avena fatua*) both in the field and on the verge; but there were many Wild Oats in the field and very few on the verge. It was therefore almost certain that the weed was spreading outwards from the field and not inwards from the verge. No other evidence of movement in either direction was observed; but this does not of course rule out its occurrence.

It appears then that although a number of weeds of agricultural importance do occur in roadsides, and some are very frequent, they do not in general constitute a serious threat to agriculture. Nevertheless they are a potential source of infestation should local conditions become favourable to their establishment and spread. The greatest danger perhaps is presented by creeping perennial weeds that have wind-borne seed, eg. Perennial Sowthistle (*Sonchus arvensis*) and Coltsfoot (*Tussilago farfara*). *Sonchus arvensis*, from the Survey data, occurs at a density of about five plants per mile of roadside around Oxford and not at all around Chelmsford. However, the most frequently quoted danger—thistledown from Creeping Thistle—is invariably harmless for the seeds are left behind in the flowering head.

ACKNOWLEDGEMENTS

Acknowledgement is made to Mr T.W. Cox and Miss M.J. Taylor for their help in carrying out the roadside surveys.

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VERGES AND THE HIGHWAY

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1. The highway

For several centuries the public have enjoyed, under Common Law, rights over the highway, which has been described as "a perpetual right of passage for the Queen and all her subjects". This description is important because I think there is a great deal of misunderstanding as to what a highway is and what the powers and duties of a highway authority are. The public highway is in a sense an abstraction; the description makes no assertion as to ownership and no public rights subsist except the right of passage as a general rule. It is, nevertheless, a most important right, even if it has been somewhat modified in recent years by legislation and orders prescribing limitations as to the manner of its use, such as, for example, by the making of traffic regulation orders, in order to meet the requirements of the motor age.

2. Different categories of public highways

Public highways may be divided into six principal categories, viz.:-

- a. Motorways: These roads are generally the responsibility of the Minister of Transport and Civil Aviation who is the highway authority. They are a special class of highway and differ in several important respects from all other classes of road, particularly as to the types of traffic permitted to use them, eg cyclists, pedestrians and animals on foot are specifically prohibited from using motorways. The maintenance of motorways is generally carried out by the County Councils through whose areas they run, as agents for the Minister.
- b. Trunk Roads: These are national (long distance) routes which, like the motorways, are the responsibility of the Minister of Transport and Civil Aviation as the highway authority. Improvements to and maintenance of trunk roads are, however, generally carried out by County Councils (or County Borough and in some cases Borough or Urban District Councils) as agents for the Minister.
- c. Principal and Non-principal Roads: These are the classified and unclassified roads for the most part under the control of County Councils as highway authorities. (In some urban areas the powers and responsibilities of the highway authorities devolve upon County Borough Councils and in some cases and for some classes of road upon Borough and Urban District Councils, but as we are concerned here with what I think is a predominantly rural problem I shall confine my remarks to roads under the control of County Councils.)
- d. Non-maintained highways: These are highways over which there are public rights of passage for vehicles but which nevertheless have not been taken over as publicly repairable roads.
- e. Bridle roads: These, as the name implies, are rights of passage for horses and their riders.
- f. Footpaths: Here the right of passage is, of course, on foot but it should be noted that a public footpath may co-exist with a private vehicular right. It should also be noted that at Common Law the existence of a major right of passage, eg. by vehicles, establishes the existence of all other minor rights of passage, viz. as a bridle way and footway, along that highway.

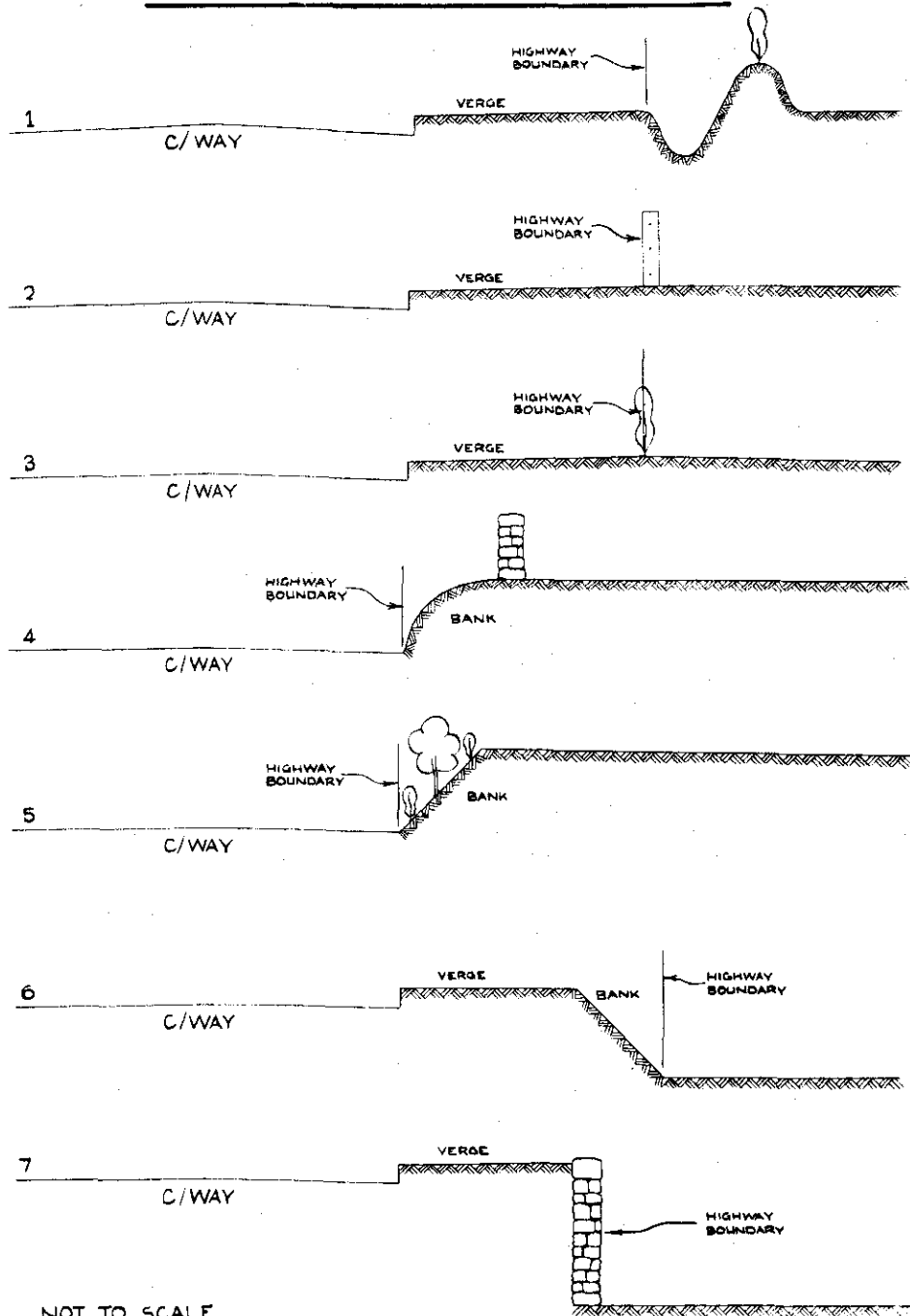
The Countryside Act, 1968, has introduced some changes in the law concerning rights of way, notably by establishing a "byway" as a new classification, but with which I do not think we need be concerned here.

3. Principal features of a public highway

Generally speaking, the highway comprises a metalled way (the carriageway), one or two footways or verges and a system of surface water drainage either by means of ditches and offlets from the metalled way or piped drains and gulleys, or various combinations of each of these features.

The extent of the highway, i.e. its boundaries, varies according to its layout: typical cases are illustrated in Fig. 1 which shows the verges in relation to the remainder of the right of way.

TYPICAL HIGHWAY BOUNDARIES



NOT TO SCALE

FIG. 1.

In this connexion it should be noted that the right of passage extends over the entire width between boundaries. Any ditches and boundary hedges do not, except in rare cases, form part of the highway. The ditches, even where they assist in the drainage of the highway are, in general, the responsibility of the owner or occupier of the adjoining land, and not of the highway authority.

Similarly, the common presumption is that the soil over which the highway runs is (except where it has been specifically conveyed to the highway authority) the property of the owner of the adjoining land up to the centre of the highway. This fact, which underlines the conception of the highway as a right of passage, is often the cause of misunderstanding amongst the general public and not infrequently with the owners of adjoining lands, but is of considerable importance when considering the powers and responsibilities of the highway authority. Of these, the most important is the preservation of the right of passage and the prevention of its obstruction or closure to such use. In this connexion it should be noted that no obstruction can be permitted without specific statutory authority—structures such as roadside seats and bus shelters being exceptions conditionally permitted by statute. Statutory undertakings, i.e. the electricity, gas and water boards, P.O. Telephones and sewerage authorities have, however, statutory powers for the placing and maintenance of their apparatus in the highway.

4. Maintenance of verges

The principal requirements of a verge maintenance policy are:—

- a. to ensure the proper surface water drainage of the highway;
- b. to provide a footwalk or refuge for pedestrians (not necessarily paved);
- c. to prevent obstruction by overhanging trees or hedges, both within the width of the highway and for visibility;
- d. to provide visibility at bends and junctions;
- e. to control those weeds listed in the Weeds Act, 1959;
- f. to preserve and where possible to improve the amenities of the road and the adjoining countryside.

Generally speaking, these objects are achieved by the annual siding out of the edges of the carriageway to prevent herbaceous encroachment on to the metalled surface; by keeping drainage offlets open; by the regular cutting of the grass (generally three or four times between April and October); by endeavouring to ensure that the owners or occupiers of adjoining lands trim or prune their hedges or trees on the boundaries of the highway; by spraying noxious weeds with selective weed killers, generally 2,4-D formulations, where necessary; and by the planting of trees and shrubs in suitable positions in the roadside verges.

As mentioned in 3 above, the highway authority is under a duty to ensure that the highway is kept free of obstruction. Whilst this presents few difficulties in the case of motorways, trunk and county roads, the lack of use of many of our old green lanes sometimes necessitates large-scale clearance of brushwood and saplings, often over considerable areas, and can be a very expensive operation whether carried out by mechanical cutting alone or by cutting and spraying with 2,4,5-T or similar chemicals. Quite apart from the obstruction caused by such growth, its clearance is often necessary in order to eliminate cover and breeding ground for rabbits and other pests in the interests of good husbandry of the adjoining land.

The duties of a highway authority in the maintenance of its roads are well defined in a decision of the House of Lords in 1915, acting in its judicial capacity, which states:—

“It is the duty of road authorities to keep their public highways in a state fit to accommodate the ordinary traffic which passes or may be expected to pass along them. As the ordinary traffic expands or changes in character so must the nature of the maintenance and repair of the highway alter to suit the change”.

Road traffic in this country is currently increasing at between 5% and 8% compound per annum—it may well double within the next decade and this, coupled with the vastly improved performance of the modern motor vehicle, necessitates considerably increased sightlines at bends, junctions and on vertical curves. This requires larger radius curves, wider verges on the inside of bends and at junctions and an appreciable increase in the ratio of grass to metalled areas. Some typical layouts applicable to main roads are shown in Figs 2a and 2b.

FIG. 2 (a) VISIBILITY ON BENDS – TYPICAL LAYOUT

NOT TO SCALE

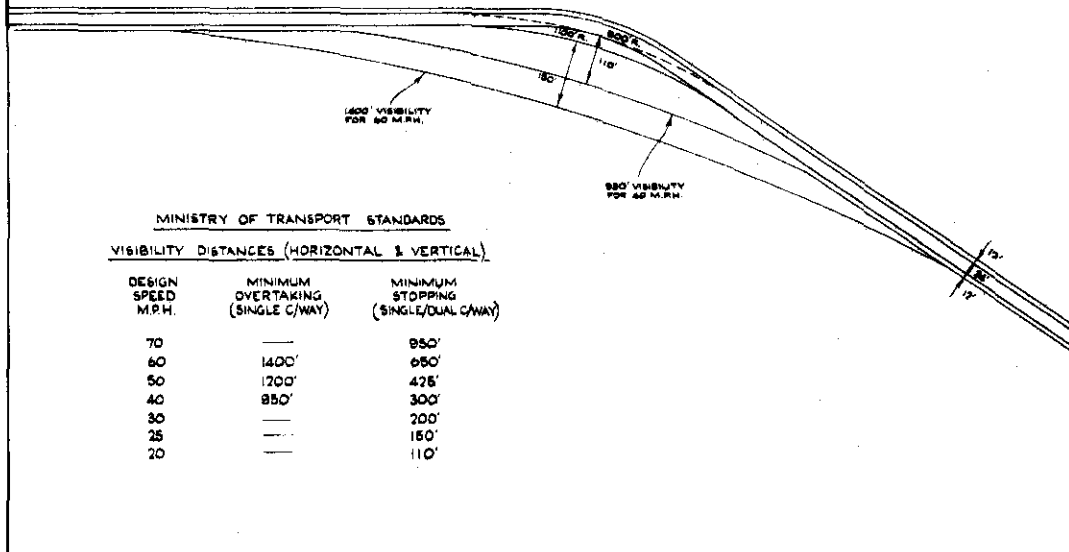
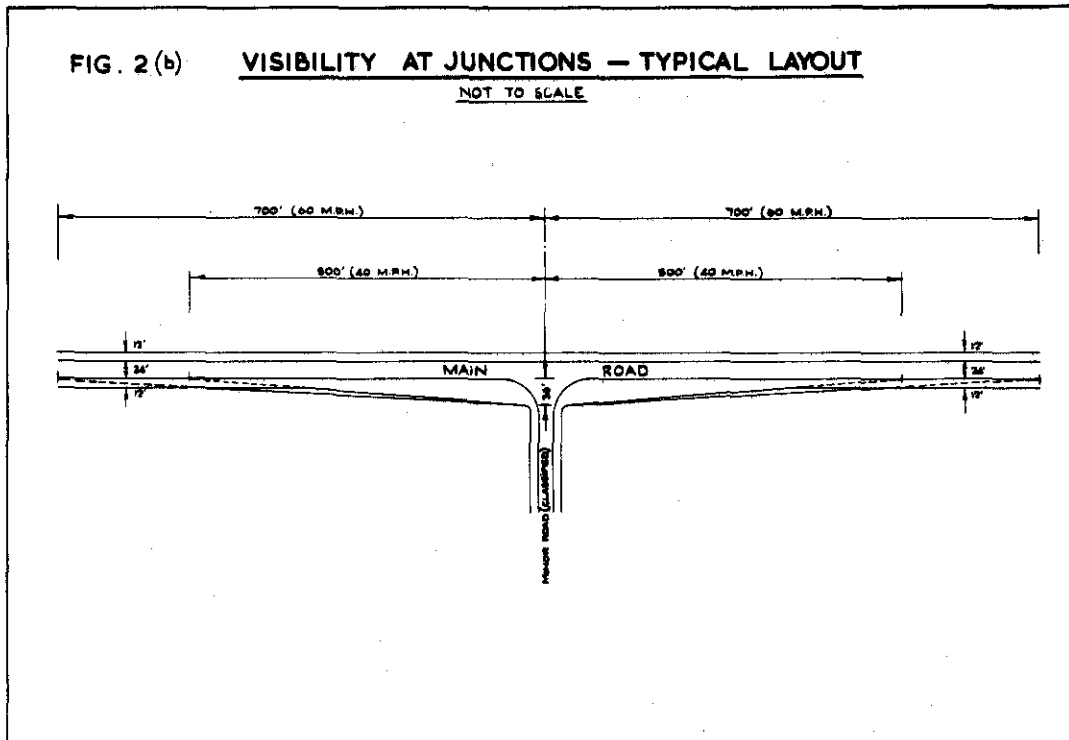


FIG. 2 (b) VISIBILITY AT JUNCTIONS – TYPICAL LAYOUT

NOT TO SCALE



I think it will generally be agreed that it would be very foolish to spend considerable sums of money on the engineering works involved in achieving these standards without at the same time making the necessary arrangements for these standards to be maintained by proper verge management. This means that trees or shrubs which would interfere with visibility should not be planted within the designed sightlines and that any herbage must be kept sufficiently low by mowing over the entire width concerned. On straight sections of road these considerations do not, of course, apply and in such cases it will generally be sufficient to cut one swathe width of grass adjoining the kerb or channel for the convenience of pedestrians. It will also be possible to plant trees and shrubs, having due regard to their future growth and spread and to the possibility of a falling leaf problem and associated risk of skidding accidents in the autumn.

It should be noted that trees and herbage naturally growing on the highway belong to the owner of the soil, ie the owner of the adjoining land, up to the centre line of the highway. This does not, of course, apply to trees or shrubs planted by the highway authority under the statutory powers and which remain in their ownership.

5. The extent of the problem

There are approximately 120,000 miles of surfaced public highways in the English counties and I estimate that there are about 300,000 acres of roadside verge under the control of the highway authorities. Although no official figures are available for the cost of verge maintenance for the country as a whole, taking the figures for my own county as a guide I estimate that this will be of the order of £5 to £10 per acre, or between £M1.5 and £M3 per annum. This probably represents between 5% and 15% of the total cost of general maintenance according to the class of road. As, however, geological and climatic conditions—particularly rainfall—vary so much over the country, these figures must be treated with some reserve and are given simply as some indication of the proportions of the problem.

The necessity to reduce costs on maintenance and the considerably reduced labour force available in the post war years have stimulated the mechanisation of this work, and have resulted in the virtual disappearance of the lengthsman and his replacement by special purpose machines and mobile maintenance gangs. Whilst I do not think that there can be any doubt but that the old village lengthsman responsible for his own three or four miles of road—which he often treated as his own personal property!—was a most effective method of maintenance, the post-war situation has made this system quite impossible to maintain except in certain areas. Whilst acknowledging the inevitability of this development, I would like to take this opportunity of paying tribute to the men who did this job in all weathers throughout the year and whose disappearance from the rural scene is, I am sure, a matter of regret to many of us. The improved machines and methods which have been developed for this work in recent years have, however, ensured that essential maintenance has not been neglected and, from a purely technical point of view, has possibly been improved.

6. Amenities

The preservation and improvement of amenities in relation to highway maintenance is a subject on which very diverse opinions are held. On the one hand, the maintenance of the "built-in" engineering standards to which I have referred tends towards an urban neatness which will be anathema to some, whilst on the other hand the wish to preserve the verge in a "natural" state with wayside plants allowed to grow, flower and seed without interference, can produce serious problems from the road safety point of view, an obvious example being the Cow Parsely which monopolises considerable areas of roadside verge in the spring and which seriously interferes with visibility on bends and at junctions. Whatever one's personal views on this, one must bear in mind the fundamental purpose of the highway as a right of passage—and implicitly a safe right of passage—for all road users. If we can at the same time preserve and where possible enhance its appearance, then this is clearly a most desirable objective.

Although the engineering considerations referred to in 4 above apply to all roads, it is clearly unnecessary, and indeed undesirable, to adopt the same standards required on a main road carrying a considerable volume of fast traffic, on a minor country lane. In such cases, provided due regard is paid to visibility at junctions and bends, and provided the motorist adjusts his speed to the conditions (which may or may not be a justifiable assumption), amenity should, in my view, be given a heavy weighting and the system of maintenance on these roads organised towards that end. This is, I suggest, largely a matter of common sense and of dealing with each case (or area) on its merits; by paying due attention to any unique or interesting local features and by co-operation with local naturalists and organisations interested in the countryside.

High amongst amenity considerations is the question of roadside planting, for which the principal requirements are:—

a. Amenity:

- i. screening unattractive features, and in some cases mollifying the inevitable geometry of road design.
- ii. 'framing' attractive views and features.
- iii. providing contrast and relieving boredom.
- iv. noise abatement.

b. Safety:

- i. the prevention of dazzle caused by headlamps by night and on east/west roads by the rising and setting sun.
- ii. the provision of snow and wind breaks.
- iii. planting to indicate summits and bends from a distance.
- iv. planting of hedges in the central reserve of dual carriageways and as barriers at the tops of embankments.
- v. stabilisation of banks and cuttings by root action.

c. Points to be avoided:

- i. obstruction of sight lines
- ii. hazards caused by falling leaves or branches.
- iii. icy patches caused by shading, particularly from the south side of the road (particularly important on east/west roads).
- iv. damage to the metalled surface and drainage of the road by tree roots, eg Poplars.
- v. interference with overhead and underground services (see 3 above).

Whilst it is now common practice to incorporate tree and shrub planting schemes on major road improvements, there is in my view considerable scope, and much to be said, for planting on existing roadside verges, provided this is done with due regard to the prevailing vegetation of the area, and to satisfactory arrangements being made for maintenance.

In my own county, a policy of tree planting was adopted four years ago with the object of encouraging Parish Councils to plant and maintain trees on the highway (for which they have the necessary powers under Section 82 of the Highways Act), subject to the consent of the County Council and of the owner of the adjoining land. Under this scheme the Parish Council may either themselves provide and plant trees or sponsor a private individual who wishes to do so, subject to their accepting responsibility for planting, protection and future maintenance and to the types and positions of these trees being agreed with me beforehand.

Whilst it might be argued that this is something which the highway authority itself ought to do, I think there is a very real advantage in leaving this kind of enterprise to Parish Councils who, even if their means are slender, are possibly in the best position to exercise a proprietorship and interest in the appearance of their own locality, provided some control is retained from the engineering and aesthetic points of view.

In this paper I have attempted to describe the problem of verge maintenance from the point of view of the highway authority and have suggested in very general terms the basis of a policy of verge maintenance and management. The details of such a policy and its implementation are, of course, a matter for each individual authority in the light of its resources of money, men and machines and the importance which it attaches to the various factors outlined above.

MANAGEMENT OF VERGES

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We have already heard details of the interests of landscape architects, conservationists and farmers in the management of road verge vegetation, and it is my view that these interests are not incompatible with those of the engineer and, indeed, must be reconciled if the valuable heritage of our countryside is to be maintained.

During the last five or six years there has been a rapid reappraisal of the whole concept of verge maintenance which has resulted from:—

- a. Mechanisation (caused by the loss in the available man-power).
- b. The economies effected by the use of mechanical equipment.
- c. A considerable reduction in the funds now available for highway maintenance of all types, and a new sense of cost effectiveness in the minds of those responsible for highway expenditure.

Highway verges in this country consist of three main types, (a) new verges such as those associated with motorways, (b) well established verges and (c) verges in urban areas. Clearly there is a need to adopt different standards for these three groups from several view points but they have the following engineering functions in common:—

1. To maintain the stability of the road structure, that is by ensuring that slopes and cuttings are not subjected to erosion or "slips". To prevent vegetation from encroaching on the carriageway or obscuring kerb lines and interfering with passing pedestrians and vehicles.
2. To provide adequate visibility at bends and junctions.
3. To allow light and air to the road surface thus avoiding deterioration from continuous dampness, and preventing icy conditions during periods of sub-zero degree (C) temperature in the winter.

Let us then consider the engineering considerations in more detail for each of the three groups of roads previously mentioned.

Motorways are constructed with gentle gradients and for this reason there are many cuttings and embankments. Even where the route has been carefully located from the visual aspect, newly constructed banks are a scar on the landscape and it is, therefore, vital to achieve a rapid growth of vegetation to prevent erosion by wind and rain and to prevent the occurrence of bank "slips". As motorways are not always constructed at the best time of year for grass sowing, it has become necessary to devise some artificial means of achieving a quick growth of grass and in recent years the method known as "hydroseeding" has been widely used. The exponents of this method claim that the advantages include a considerable extension of the times in a year in which seeding may take place, that there is no need to provide a layer of top-soil on which to sow the seed, that broad-leaved vegetation is retarded until the grass has become established and that the total cost of seeding is reduced. The method employed is to apply a mixture of grass seed and fertiliser in a jet of water sprayed on the slopes to be treated, followed by the application of a layer of straw or glass fibre made tacky with a small quantity of bitumen emulsion. The cost of this work is approximately 6d. per square yard, which compares favourably with the cost of providing top-soil and seeding to the Ministry of Transport specification at approximately 1s. 2d. per square yard, or 2s. 6d. per square yard for the provision of turf. The choice of seeds in the hydroseeding mixture is made with regard to the indigenous grasses of the area and the need to achieve a strong turf to stabilise the bank.

Whilst the need to consider local conditions has been acknowledged by the Minister's advisers in the past, the current Ministry of Transport's specification for grass seed (Ministry of Transport, 1963) states that "unless otherwise specified the mixture shall consist of the following:—

| | |
|-----------------------------|----------|
| Perennial rye grass, S.23 | 60 lbs |
| Red fescue, S.59 | 20 lbs |
| Smooth stalked meadow grass | 10 lbs |
| Crested dogs tail | 12 lbs |
| White clover, S.100 | 10 lbs |
| ----- | |
| Total | 112 lbs" |
| ----- | |

The 50% of rye grass included in this mixture gives very little chance to the shorter growing grasses or to other plants and creates a considerable and unnecessary grass cutting problem for the maintenance engineer. Other specifications of shorter growing grasses have been used quite successfully by my Council at lower costs and one wonders why the Ministry clings to this outdated formula.

New verges, particularly those on slopes, cannot be cut by tractor mounted equipment for the first two or three seasons without damage to the verge or danger to the plant operator. As a result of experience gained in this problem when the M1 Motorway was constructed through Leicestershire in 1964, it would seem that lightweight mowers using either the rotating blade or flail principle of widths up to 50" are most suitable for this task. Cylinder mowers were found to suffer considerably from the presence of stones on newly constructed verges with the result that overall costs were unreasonably high due to repair bills and a high incidence of standing time due to breakdowns. The costs of grass cutting by rotating blade and pedestrian flail mowers were in the region of £5 per acre. Once the grass slopes have become stable with the establishment of a good turf, it is possible to use heavier, more powerful and wider cutting equipment with reduced unit costs. An agricultural tractor suitably modified using a rear mounted flail mower has been found most successful resulting in a unit cost of approximately 50s. 0d. per acre/per cut.

Grass on its own is, of course, only part of the landscaping of a new motorway; engineers have for many years undertaken tree planting schemes as part of new highway construction work. In the early 1930's this sometimes took the form of ornamental trees and shrubs more suitable for gardens than for the open country and often quite out of keeping with the natural arboriculture and flora of the area. This kind of planting tends to highlight the existence of the engineering works whereas both engineers and landscape architects try to blend the highway into the surroundings. Whilst this form of planting is now rarely adopted, many eminent engineers agree that tree planting on motorways in recent years has often been on an unnecessarily large scale and out of keeping with the arboriculture of the area. The distinguished landscape architect, Mr Clough Williams-Ellis (Williams-Ellis, 1967), author of the Ministry of Transport publication "Roads in the Landscape", describes and illustrates a number of tree planting schemes including the M1 at Lutterworth in Leicestershire, and commends it as an example to others. This type of selected planting in groups at random is both acceptable to the maintenance engineer and inexpensive.

On the M1, the mass planting of motorway verges to forestry plantation scale is practised even in the open countryside of Leicestershire, in fact on the 38 miles of motorway through the County, over 125,000 trees have been planted, which is very nearly two trees for every yard of the motorway. I fear that the effects of this scale of planting will be very serious in years to come from the highway engineering considerations of shadow, wet leaves, fire risk, and accidental collision.

In addition to the establishment of trees, careful thought is being given in collaboration with the Leicester Trust for Nature Conservation and the Nature Conservancy to the introduction of certain species of indigenous wild plants onto the motorway banks. As this matter is still in its early stages of discussion and has only the approval in principle of the Ministry of Transport's Divisional Road Engineer, I am not able to give any further details on this matter at the present time.

The category of "well established verges" forms the major proportion. Here the engineer has to maintain what already exists, which is by definition "natural flora indigenous to the geographical area". The engineering and financial considerations suggest higher standards for trunk roads carrying heavy volumes of traffic than for narrow, lightly trafficked country lanes, and for this reason, the following policy has been adopted by my County Surveyor as from the Spring of 1968.

1. Trunk and Principal roads. The first 6 foot width of verge shall be cut three times per season (approximately April, June and August) wider cuts to take place for visibility purposes. The remaining width of verge lying between a hedge of ditch and the 6 foot referred to above to be cut every second year sometime after the end of June.
2. Class 11 roads (non-principal) and more heavily trafficked Class 111 roads, the first 6 foot width of verge to be cut twice per season unless necessary for visibility purposes, the remaining width to be cut once every second year after the end of June.
3. All other roads, the first 6 foot width of verge to be cut once per season unless necessary for visibility purposes, the remaining area of verge to be cut once every third year.

This policy does not meet with unqualified approval from all directions; some sections of the community seek higher standards. It will, of course, take several years for the effects of this strategy to take full effect and this is a matter of great interest to us in the County. The adoption of the standard has to some extent predetermined the type of cutting equipment to be used, in as much as we shall have to deal with grass and vegetation ranging from that which is cut three times each year, to once every three years, and I am of the opinion that the flail mower is the only machine available to us at the present time, that is capable of this task at an economic cost.

Dr F. H. Perring (Perring, 1967) of the Nature Conservancy, in an address given to the Institute of Highway Engineers and reprinted in the Journal of the Institution in December, 1967, makes reference to the disadvantages of the reciprocating or agricultural type mower and conversely, to the advantages of flail mowing in that it achieves a more finely cut grass with more even distribution of the grass cuttings. Furthermore, I would like to point out that the reciprocating mower is often not capable of cutting vegetation in one pass at the height of the growing season and would certainly run into great difficulty cutting verges only once every three years.

The cost of mowing a 6 foot (two swath) width by side mounted tractor flail is approximately 62s. 6d. per mile. Back verge mowing is, of course, more expensive and costs about 100s. per acre.

In 1968, the percentage of highway maintenance money spent on grass cutting in Leicestershire was of the order of 1½%. The work was carried out by tractor mounted equipment working on predetermined routes worked out for maximum efficiency by Work Study personnel.

This brings me to the chemical control of roadside vegetation. There are three types of chemical used—total herbicides, selective herbicides (including brushwood killers) and grass growth-retarding compounds.

Total herbicides for such tasks as spraying kerb lines to kill vegetation that would otherwise obscure the edge of the carriageway can be either the root absorbed or foliage absorbed variety. In practice, it is usual to use the root absorbed variety, applied in solution or water suspension using large droplets as a precaution against "drift". The cost of this treatment is approximately £4 per mile and has some degree of persistence not obtained with foliage absorbed chemicals.

Selective herbicides such as MCPA and others designed specifically to control noxious weeds have, in my view, little use for general application on roadside verges and are normally confined to small areas infested with the weeds listed in the Weeds Act, 1959. The cost of this type of treatment is in the order of £4 per acre, but can be more than double this figure if the chemical is applied by hand lance under awkward conditions.

Brushwood killers such as 2,4,5-T are also selective and can be used economically for such tasks as clearing green lanes and bridleways of scrub growth (Chadwick, 1961).

Grass growth-retarding chemicals such as Maleic Hydrazide (MH) have been considered in great detail for roadside verge control purposes, and the experiment at Bibury in Gloucestershire is the best documented study of the effect of these chemicals. This experiment will be referred to in detail by Dr Willis, the next speaker, but see also Yemm and Willis (1962), Willis and Yemm (1966). The cost of using growth-retarding chemicals is approximately £15 per acre if applied by tractor mounted equipment. It must be appreciated that the weather conditions at the time of spraying and for approximately 18 hours after spraying are critical. However, in spite of the high cost, this treatment can be economic for such areas as high banks too steep for mechanical mowing, but up to now it has been necessary to add selective weed killers to the grass growth-retarding agent MH. It must be remembered that the stability of steep banks can be adversely affected if deep rooted vegetation is eradicated, which may occur as a result of the use of the selective weed killers.

The ethics of chemical control of roadside verges must also be considered, and I suggest that the long term effect of these chemicals on both the indigenous flora and fauna of the verges is to a certain extent unknown, and in Leicestershire, the policy is to restrict the use of chemicals to control noxious weeds. In general, the use of herbicides for the control of roadside vegetation was the subject of a Ministry of Transport Circular (No 718 of 31 August, 1955) addressed to Councils for the guidance of Highway Authorities. This document, which had been agreed with the Nature Conservancy, as a result of experiments made by them, the Agricultural Research Council and the Road Research Laboratory, laid down a number of conditions that Highway Authorities were asked to observe in the use of sprays on road verges.

The last category of verge referred to is the urban verge. Here, there is a need for higher standards and this, in turn usually requires a different type of machine and more regular cutting. Mowing in urban area is, of course, a very different problem to mowing in rural areas as verges are usually narrower, there are more obstructions in the form of road signs, bus stops and other street furniture, and for this reason smaller equipment of lighter weight similar to that used during the early stages of grass maintenance on new motorways is used. As, however, these verges are established and generally free of stones, the use of the cylinder mower becomes an economical proposition at between £2 and £2 10s. per acre, for regular cutting at intervals of three or four weeks when the grass is not allowed to exceed 6 inches in height between successive mowings.

In conclusion, I would like to record my appreciation to my Chief, Mr R. R. W. Grigson, for his advice in the preparation of this paper, and for his permission to take part in this Symposium.

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ROAD VERGES—EXPERIMENTS ON THE CHEMICAL CONTROL OF GRASS AND WEEDS

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Introduction

With advance in knowledge of the effects on vegetation of growth-retarding and herbicidal substances, improvements in the formulation of these chemicals, and the rising costs of maintaining roadside verges by traditional cutting procedures, chemical spray techniques have been progressively adopted for the effective and economic control of plant growth along roadsides. The need for good visibility for the road-user can be met by means of growth-retarders which restrict the height of the vegetation, and weeds can be reduced or eliminated by selective weed-killers. Of particular value for the control of roadside vegetation is the combination of the growth-retarder maleic hydrazide (MH) with the selective herbicide 2,4-dichlorophenoxyacetic acid (2,4-D); a mixed spray of this composition applied annually leads to a grassy sward which is largely weed-free and remains short throughout the growing season.

The use of chemical sprays raises many important considerations: among these are the effectiveness of the treatment; the effect of the application; the effect of different spray constituents on plant growth; the duration of the effects of spraying; and, of particular significance with regard to nature conservation, the long-term effects of spray treatments on the ecology of verges, many of which form important and distinctive habitats for plant and animal life. A sequence of progressive change results from long-continued spraying, and a new community structure, often of contrasted nature to the former semi-natural vegetation, is gradually developed. Of considerable interest are the degree of permanence of the new community structures resulting from the sprays and the rate at which former vegetation can re-establish on cessation of spraying.

Information on these aspects is available from study of the vegetation on verges near Bibury, Gloucestershire. In this experimental site closely controlled spraying has been undertaken over a considerable number of years and detailed records of the vegetation made from 1958 to the present. A summary of the main findings is presented here; fuller accounts of earlier observations have already been given (Yemm and Willis, 1962; Willis and Yemm, 1966).

Experimental Procedure

A sequence of 28 plots, each about 22 yds long and 3-5 yds wide, was established in fairly uniform vegetation developed on the Oolite of the Cotswolds along the wide verge of Akeman Street, near Bibury, Gloucestershire. Records were made once a year (in July) or three times annually (spring, summer and autumn) of height and flowering, and subjective assessments were made of the relative bulk of the different components of the vegetation of the whole plots, and of quadrats permanently marked within them (Yemm and Willis, 1962).

Eight plots not sprayed served as controls; the remaining plots were sprayed with MH only, 2,4-D only or MH + 2,4-D once a year in early April, mid April or early May. After treatment successively for four years (1958-61), certain plots were not subsequently sprayed so that reversion of the vegetation could be studied.

Commercial preparations of MH ('Regulox') and 2,4-D ('Vergemaster') were used. MH was applied at 5lb amine salt in 80 gal water/acre, and 2,4-D was applied as an acid-in-oil emulsion of the oil-in-water type at 3 gal (of 12.5% wt/vol 2,4-D) in 80 gal water/acre (about 1¼ miles of a 6ft width of verge). The combined MH + 2,4-D spray was a mixture of the two preparations at the rates given. For spraying, a boom with cone-type nozzles for high volume application at low pressure was employed.

The Vegetation of the verges

In the experimental site the vegetation of the untreated verges normally forms a fairly complete cover and is dominated by coarse grasses and tall herbaceous plants such as Hogweed (Heracleum sphondylium) and Cow Parsley (Anthriscus sylvestris). The composition of this vegetation varies only little from year to year, and grasses and broad-leaved plants usually contribute about equally to the bulk of the vegetation. All of the dominant plants flower freely, the tall forms reaching over 4 ft in July, when the average height of the vegetation is approximately 3 ft. Table 1 shows that in 1968 the vegetation of the unsprayed plots was fairly diverse (averaging 27 species/plot), but that False Oat grass (Arrhenatherum elatius) and Umbellifers (Hogweed and Cow Parsley) made up over two-fifths of the bulk of the vegetation.

The effects of maleic hydrazide

Areas sprayed with MH only developed at first a fairly short grassy sward with abundant Creeping Fescue (Festuca rubra) and Meadow grass (Poa pratensis); the large tufted False Oat and to some extent Cocksfoot (Dactylis glomerata) were reduced. Although MH has limited herbicidal powers, Umbellifers were adversely affected and considerably reduced.

Table 1

The effects of a range of spray treatments on the composition of the vegetation of roadside verges at Bibury.

The figures give percentage relative bulk (average values) of the chief components of the vegetation in mid July 1968, and are based on assessments of the whole plots. Verges treated with MH only and MH + 2,4-D were sprayed once annually from 1958 to the present, and with only 2,4-D only from 1959 onwards. Reversion plots were sprayed annually with the MH + 2,-D from 1958-61 inclusive, but have not been sprayed since 1961.

| Treatment | Control (unsprayed) | MH only | 2, 4-D only | MH+ 2,4-D | MH + 2, 4-D then reversion |
|--|------------------------|------------|----------------|--------------|-------------------------------|
| Number of plots | 8 | 2 | 2 | 6 | 3 |
| Couch Grass (<i>Agropyron repens</i>) | 7.5 | 11.2 | 12.5 | 2.2 | 5.8 |
| False Oat (<i>Arrhenatherum elatius</i>) | 15.6 | 1.3 | 3.8 | 0.9 | 12.5 |
| Cocksfoot (<i>Dactylis glomerata</i>) | 5.6 | 5.0 | 6.3 | 5.2 | 3.7 |
| Creeping Fescue (<i>Festuca rubra</i>) | 3.4 | 20.0 | 25.0 | 8.3 | 0.3 |
| Meadow Grass (<i>Poa pratensis</i>) | 7.2 | 6.3 | 36.3 | 74.2 | 7.0 |
| All grasses | 43.1 | 45.0 | 96.2 | 91.3 | 36.7 |
| Cow Parsley (<i>Anthriscus sylvestris</i>) | 11.2 | 0.1 | 0.1 | 0.1 | 7.5 |
| Hogweed (<i>Heracleum sphondylium</i>) | 14.7 | 0.5 | 0.6 | 0.1 | 10.8 |
| Plantain (<i>Plantago lanceolata</i>) | 0.1 | 20.0 | 0 | 0 | 0 |
| All broad-leaved plants | 56.9 | 55.0 | 3.8 | 8.7 | 63.3 |
| Average number of species | 27 | 29 | 15 | 14 | 18 |
| Average height of vegetation (ins) | 29.3 | 12.5 | 17.5 | 7.8 | 35.0 |

Flowering of grasses was almost completely suppressed, and vegetative growth held substantially in check. After spray treatment for 3-4 years, False Oat became a minor component of the vegetation, Creeping Fescue increased further at the expense of Meadow grass, and several low-growing dicotyledonous herbs became plentiful, notably Ribwort Plantain (Plantago lanceolata), Crosswort (Galium cruciata) and Creeping Thistle (Cirsium arvense). In 1968, as shown in Table 1, Creeping Fescue and Plantain (which was very sparse in the other plots) dominated the vegetation, which strongly contrasted and was rather more diverse than that originally present. A number of low-growing annuals, eg. Buxbaum's Speedwell (Veronica persica), Chickweed (Stellaria media), invaded the sprayed areas.

The effects of 2,4-D

Repeated annual sprays of 2,4-D only resulted in the progressive reduction and extinction of broad-leaved plants and the development of a more uniform and shorter vegetation than that of the unsprayed plots. Dicotyledons resistant to 2,4-D such as the Field Scabious (Knautia arvensis) persisted, but grasses became very strong dominants. However, important gradual changes occurred in the grass components; Meadow grass and Creeping Fescue increased very substantially whereas False Oat was much diminished (Table 1). Flowering of the grasses was somewhat reduced; this feature, coupled with the decline of False Oat and tall Umbellifers, accounted to a large extent for the shorter vegetation.

The effects of MH combined with 2,4-D

When MH and 2,4-D were used together, their effects supplemented and reinforced one another. A very short and uniform grassy sward resulted, from which some dicotyledonous plants were completely eliminated; others, such as Hogweed and Cow Parsley, were reduced to negligible proportions. Good control was given of troublesome agricultural weeds such as Creeping Thistle, Sow Thistles (Sonchus spp.), Docks (Rumex spp.) and Stinging Nettle (Urtica dioica), as well as of annuals. Of the broad-leaved plants, only Bindweed (Convolvulus arvensis), which develops sufficiently late in the season to escape the major effects of the spray, persisted in appreciable quantity. Spraying led to the progressive spread and overwhelming dominance of Meadow grass, which constituted about three-quarters of the vegetation in 1968 (Table 1), in some areas being almost the only component. Creeping Fescue, which like Meadow grass has underground rhizomes, increased to some extent, but was usually of minor importance relative to the Meadow grass which formed a thick mat. False Oat was reduced nearly to the point of extinction, being severely diminished even by the first spray treatment. Also adversely affected by the spray were Couch grass (Agropyron repens), which has shown a decline in recent years, and Cocksfoot; the latter, however, often recovered from the effects of the spray and made appreciable growth towards the end of the season. Flowering was almost entirely suppressed, and the vegetation remained quite short throughout the year (it was only about one-quarter of the height of the vegetation of the untreated areas in July 1968).

Reversion of sprayed areas

Cessation of the MH only spray treatment led to gradual changes in the vegetation in the direction of its former composition. Loss of Creeping Fescue was to some extent paralleled by an increase in False Oat, and with the progressive re-establishment of tall vegetation, including large Umbellifers, many of the low-growing plants which colonized and become successful under the spray regime were suppressed or eliminated. In particular, considerable reduction in Plantain and Crosswort was evident. After reversion for seven years False Oat, Hogweed, and Cow Parsley *once more* made up (as in the control plots) over two-fifths of the bulk of the vegetation; in striking contrast were the MH-treated plots where these plants constituted only one-fiftieth of the total (Table 1). Most of the plants flowered well in the year spraying was stopped, and made good growth in height then, although the vegetation was somewhat shorter than that of unsprayed areas.

The community dominated by Meadow grass developed under the influence of the combined MH + 2,4-D reverted gradually, on cessation of spray treatment, to a vegetation quite similar to that of the control plots. Meadow grass was progressively reduced to a relative abundance similar to that of the unsprayed areas (see Table 1) and False Oat increased fairly uniformly to become the dominant plant. Couch grass also showed some increase, whereas Creeping Fescue declined. The large changes in the grass components consequently involved a loss of the shorter, finer-leaved species and in an increase in the taller, coarser forms. Dicotyledonous plants gradually re-established, some mainly from seed and some mainly by vegetative spread from adjoining areas. However, it was not until five years after spray treatment ceased that Hogweed and Cow Parsley became widespread once more, and even after seven years the vegetation of the reverted areas was substantially less diverse than that of the control areas (Table 1). Apart from this feature, the vegetation of the reversion plots after five years was like that formerly present. Many of the plants flowered quite freely in the year in which spraying was stopped and, as in the reversion plots of the MH only series, the height of the vegetation soon became similar to that of the unsprayed areas.

The effects of time of spray

To investigate the influence of the time of spraying with MH only and with MH + 2,4-D some plots were treated in the first week in April, some a fortnight later, and others a further two weeks later in early May. Only small effects of time of spraying were found with regard to the changes in composition of the vegetation brought about by the sprays. In all of the MH only plots Creeping Fescue increased markedly and False Oat declined. Similarly in areas treated with MH + 2,4-D the sequence of change was largely independent of time of spraying; in all the plots a pronounced increase of Meadow grass was found, and also a decrease of False Oat.

The most obvious differences resulting from time of spray treatment were seen in the height of the vegetation; the differences were found to depend appreciably on the season and weather conditions during spraying. Usually only little growth had occurred by the time of the earliest spraying but, particularly in some seasons, substantial growth can have taken place by early May, the latest spraying date investigated. The effect of the spray was to hold the vegetation in check from the time of its application for a considerable period. Consequently by early June the height of the vegetation of the early sprayed plots was often only about 4 inches, compared with about 10 inches for the late sprayed plots, much of this growth having been made before spray application. Later in the season, differences in height evened out, because resumption of growth set in first in the early sprayed areas whilst the vegetation of the later sprayed plots was still held substantially in check. In all of the spray treatments, however, the height of the vegetation at the end of the season was only about half that of the control (unsprayed) areas (Table 2).

Table 2

The effect of time of application of the combined spray MH + 2,4-D on the height of roadside vegetation at Bibury.

The figures give average heights, in inches, based on three series of plots in 1960.

| Mean height on: | 9 April | 12 July | 26 September |
|------------------|---------|---------|--------------|
| Date of spraying | | | |
| 4 April | 4.2 | 11.5 | 13.7 |
| 19 April | 4.3 | 8.3 | 12.0 |
| 2 May | 3.5 | 9.5 | 12.3 |
| Not sprayed | 6.4 | 26.6 | 24.6 |

The management of road verges by means of spray treatment

The use of chemical sprays to restrict the height of roadside vegetation and to eliminate noxious weeds compares favourably with other methods of verge maintenance, all of which must inevitably result in some departure from the normal flora and fauna of the untreated verge. Fortunately the widely used growth-retarder MH and selective herbicide 2,4-D are relatively non-toxic to animals (cf. the destructive action of flail machines), although the fauna is in time affected by changes in the vegetation brought about by spray treatment. Good control of plant growth on verges can be achieved by a single application of the combination MH + 2,4-D in spring (as indicated above, some flexibility in time of spraying is permissible). Generally treatment of a band 6 ft wide is adequate (a greater width may be required on bends where vision is much restricted), and at standard rates of application the cost of the mixed materials is about £5 per mile of 6 ft sward (cf. the high labour costs involved in cutting several times a year, especially if carrying is also needed). If a very high standard of control of length of grass is required throughout the year, a second spray of MH may be applied 12-14 weeks later than the first application of the combined materials in the spring.

Conditions at the time of spraying influence its effectiveness. As the substances involved are absorbed by the plant largely through the shoot system, and especially by the leaves, penetration is extensive in spring when new growth begins and young leaves unfold. A moderately humid atmosphere and moist soil favour absorption, but heavy rain tends to wash the spray materials off the plants. However, recent advances in formulation have led to the development of materials which are weather proof to a considerable extent. Strong winds increase the hazards of drift, although the high volume application recommended minimizes this danger.

As discussed above, verge treatment with MH + 2,4-D leads to a short grassy sward of pleasant appearance in which the fine-leaved rhizomatous Creeping Fescue and Meadow grass are prominent, and the larger tussock formers False Oat and Cocksfoot are diminished. Several factors may be involved in the differential susceptibility of the grasses to the spray materials. The greater sensitivity of the taller, tufted grasses may result partly from their tussock habit and wide leaves which catch and absorb the materials extensively and also partly from the greater exposure of buds to the spray as compared with those of species with rhizomes.

The action of MH is to stop flowering and to check vegetative growth, suppressing cell division at the growing points; grasses remain short and only rarely flower. The findings detailed above indicate that MH, used alone, leads at first to the development of a sward with much Creeping Fescue, the narrow waxy leaves of which are not easily wetted. However, the combined spray (MH + 2,4-D) results in a vegetation dominated by Meadow grass, which, with repeated spray treatment continues to increase in abundance over a considerable number of years. There are some indications that Creeping Fescue is more sensitive to 2,4-D than Meadow grass, and the somewhat quicker recovery of the latter from the effects of the combined spray may promote its more rapid spread into bare areas resulting from the loss of dicotyledonous plants and the reduction of other grasses. The development, under the influence of MH + 2,4-D, of a short grassy turf largely free from broad-leaved plants, and in which Meadow grass and Creeping Fescue are abundant, is of widely spread occurrence in Great Britain (where both grasses are common and generally distributed) and also on the Continent; there the more drought-resistant Fescue may be present in some localities (eg in Belgium, Germany, Austria) in greater proportion than found at Bibury.

The ecological effects of spray treatment are of substantial interest. The roadsides and the diminishing hedgerows support characteristic assemblages of plants and animals which strongly merit conservation. For this reason the width of the sprayed verge should not be greater than that compatible with the need for visibility; then the original, usually more diverse, flora and fauna can persist in the unsprayed part of the verge immediately adjoining the hedge. Furthermore the gradation of height from the low treated sward to the tall vegetation of the ditch and hedgebank creates a range of conditions which may favour some organisms and enhance their success. While the herbicidal action of MH is small, and MH alone can ultimately result in greater diversity of the roadside flora, 2,4-D and other selective herbicides such as MCPA and Mecoprop adversely affect many dictyoledonous plants, some of which may be rarities. However, where a stretch of verge is known to support a population of a rare species special arrangements for preservation may be sought and spraying precluded at the particular site.

Another important ecological consideration is the *persistence* of the effects of spray treatment. The direct effect of MH and 2,4-D on growth and flowering is essentially for a single season, but the reversion of the vegetation to its original status is, like the changes in vegetation composition which arise from spraying, spread over a number of years. The Meadow grass sward, especially when pure and thick, which is gradually developed under the influence of MH + 2,4-D, is difficult for other species to invade, especially by those whose seed production is limited and germination poor. Quickest to re-establish are those plants, such as False Oat, which spread from the very small quantities which survive spray treatment.

Control of woody growth on verges is required from time to time. For this purpose the herbicide 2,4,5-trichlorophenoxyacetic acid is effective, and may be used as an emulsion containing two parts of 2,4,5-T to one part of 2,4-D low volatile ester. If bushes are cut during the winter, and the stumps treated with this brushwood spray in February, March or April, regrowth is prevented.

Acknowledgements

I am much indebted to Professor E. W. Yemm for collaboration throughout the recording of the vegetation of the Bibury plots, to Mr V. F. Woodham who undertook the spray treatment and Burt, Boulton & Haywood Ltd. who supplied the materials.

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ROAD VERGES—RESEARCH ON MANAGEMENT FOR AMENITY AND WILDLIFE

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The vegetation of road verges has got to be managed, not only for highway engineering reasons but also for conservation and amenity reasons. If they are not managed the grass verges will turn to scrub, or where scrub and hedges already exist they will grow out of control and certainly lose their amenity if not their conservation value. Although we have been considering in the other papers presented at the symposium all kinds of vegetation between the edge of the road and the highway boundary, the major management problem in most parts of the country at the present time is the control of the growth of grass, tall growing herbaceous plants and noxious weeds.

From a conservation point of view the aim is diversity of habitat in order to encourage the greatest variety of wild animals and plants. However, in any one place once a suitable form of management has been evolved, it will be important to try to apply the same management from year to year. Many plants and animals have quite strict requirements for a place to live, and a community that has been built up over a period of years under one form of management can quickly be destroyed by another. The communities of wild plants of grass verges that exist now, and whose conservation is so important, have evolved under particular forms of management over many years. We can try to simulate these forms of management with the powerful machines and growth active chemicals that are now replacing hand labour, grazing and hay making. We can also use these new tools to create different conditions and new communities of plants and animals. In addition we have the opportunity on the new verges to manage them in such a way that they contribute something real to the countryside.

Amenity is not only visual but also includes tracks and paths for riding and walking, areas for picnicking and similar activities. It is a common experience that areas that look ill-kempt attract vandalism and dumping of rubbish. Nature when left to herself is rarely tidy and not necessarily attractive. For instance, dense stands of once attractive flowering plants become withered and brown as the seeds develop and ripen. Nevertheless if the plants are cut as soon as the flowers go over, there will be no seed for succeeding generations. To cut the plants at this time might be good amenity but it would be bad conservation. The visual aspects of amenity are subjective but in any given situation many people will agree on what is acceptable and certainly on what is not.

Management for amenity and conservation has got to be designed within the framework of the economics of highway maintenance, the capabilities of machines, the weather, time and labour available. Management of verges is an expensive business and from a strictly economic standpoint shows no return. It will therefore be desirable to evolve management proposals that make the minimum demands on highway authorities and yet which provide the greatest variety of wildlife habitats of acceptable amenity standards. Within this broad framework, however, there are likely to be some situations where greater expense and effort is required than highway authorities would normally be prepared to consider. Some economic value can be put on the conservation of particular plants and animals, or in preserving places of especial beauty, and we should be (and often are) prepared to pay for this. Likewise in the interests of conservation we should be prepared for limited periods of time to put up with reduced amenity in order to enable plants to seed or birds to nest.

The Nature Conservancy is supported by Government funds and is officially responsible for giving advice at a National level on the conservation of wild life. It has been involved in the question of management of road verges, particularly in respect of the use of chemical weedkillers, since the early 1950's. Early Conservancy work was published by Balme (1954, 1956); co-operation between the Conservancy, the A.R.C. Unit of Agronomy at Oxford and the Road Research Laboratory resulted in the production in 1955 of the Ministry of Transport's Circular 718, for the guidance of Highway Authorities about the use of weedkillers in controlling roadside vegetation. It is hoped that the research work now being undertaken by the Conservancy and other organisations will lead to a revision of this leaflet, to take account of developments in machinery and chemicals since that time.

The work by the Conservancy on roadside verges now falls under three headings

- i. Management experiments
- ii. Survey work on the physical structure and conservation value of verges
- iii. Through Naturalists' Trusts, the Botanical Society of the British Isles (B.S.B.I.) and other organisations, the cataloguing of road verge sites of particular conservation importance.

Management experiments

A. Country Roads. Two experiments have been in progress on the effects of a range of management practices since 1965. This year (1969) the plots are about to be treated in the same way for the fifth year running. The treatments are listed below. (Table 1).

TABLE 1

Treatments applied to experimental plots on road verges
in Cambridgeshire and Huntingdonshire

| | | Operation in third week of: | | | | | |
|-----|--|-----------------------------|-----|------|------|--------|-----------|
| | | April | May | June | July | August | September |
| 1. | Untreated | | | | | | |
| 2. | Untreated | | | | | | |
| 3. | Maleic hydrazide | spray | | cut | | | |
| 4. | Maleic hydrazide and cut later | spray | | | | | |
| 5. | Maleic hydrazide and 2, 4-D | spray | | | | | |
| 6. | Maleic hydrazide and 2, 4-D; cut later | spray | | cut | | | |
| 7. | 2, 4-D | spray | | | | | |
| 8. | 2, 4-D and cut later | spray | | cut | | | |
| 9. | Flail twice | | cut | | | cut | |
| 10. | Flail five times | | cut | cut | cut | cut | cut |
| 11. | Haymower twice, cuttings raked | | cut | | | cut | |
| 12. | Haymower 5 times, cuttings raked | | cut | cut | cut | cut | cut |
| 13. | Haymower twice, cuttings NOT raked | | cut | | | cut | |
| 14. | Haymower five times, cuttings NOT raked | | cut | cut | cut | cut | cut |
| 15. | Rotary mower twice | | cut | | | cut | |
| 16. | Rotary mower five times | | cut | cut | cut | cut | cut |
| 17. | Haymower once | | | cut | | | |
| 18. | Haymower once | | | | cut | | |
| 19. | Spare | | | | | | |
| 20. | Spare | | | | | | |

Each treatment plot is 6 ft wide and 20 yds long, and is repeated four times in a statistical layout. One experiment is on Oxford clay in Huntingdonshire and the other on a chalk soil southeast of Cambridge. The botanical composition of the swards at the two places is different, and the chalk site is naturally richer in herbaceous plants. Records are taken monthly of the mean height of the vegetation and of the species of plants in flower, including grasses. In July/August assessments are made of the relative abundance of the plant species by means of presence/absence recording in forty 15 cm square quadrats per plot. In addition photographic records are made and also subjective assessments of the amenity ('attractiveness') of each plot. These experiments are of a long term nature, and although gross differences between the different treatments are now becoming apparent, the vegetation has not yet 'settled down' to a more or less stable situation, in the way that the plots at Bibury may now be assumed to have done after ten years of the same treatment.

There has not been the well marked decline in tall tufted grasses or increase in rhizomatous grasses as a result of application of maleic hydrazide (MH), that was described by Yemm & Willis (1962) over a similar period of time at Bibury. MH has consistently reduced flowering in grasses and in growth of the culm (flowering stem) but effects on the general height of the vegetation (see below) have worn off in most seasons six to eight weeks after treatment. Effects of 2,4-D have been to reduce the number of broadleaved flowering plants. The haymower has generally not cut so evenly or so closely as either the flail or rotary cutter. Both the latter machines and especially the flail have sometimes created bare patches. These have, however, usually been rapidly colonised by low-growing creeping plants. In general there are quite obvious visible differences between many of the treatments but, because it is the growth of the plants that has been affected rather than the actual composition of the flora, especially the dominant grasses, it is difficult to describe these differences in precise botanical terms. Nevertheless, as one might expect, certain species or groups of plants with particular ecological preferences are becoming more common in some treatments compared to others. Thus low growing plants such as Creeping Buttercup (*Ranunculus repens*), Birdsfoot-trefoil (*Lotus corniculatus*), White Clover (*Trifolium repens*), Hop Trefoil (*T. campestre*) have become more common in the plots where the vegetation is kept shorter throughout the season. In the taller plots the Composites Hardheads (*Centaurea nigra*) and Greater Knapweed (*C. scabiosa*), the Field Scabious (*Knautia arvensis*), the umbellifers Cow Parsley (*Anthriscus sylvestris*) and Hogweed (*Heracleum sphondylium*) have been favoured. It is worth noting that the umbellifers and composites are usually very valuable food plants for a wide range of insects including bees and also for some birds—eg Goldfinches and Linnets, whilst other birds feed on the insects. In the completely unmanaged plots the agricultural weeds *Creeping Thistle* (*Cirsium arvense*) and *Bindweed* (*Convolvulus arvensis*) have become common.

The height of the vegetation in selected treatments for the Cambridgeshire site in 1967 are shown in Figs 1 and 2.

Fig 1. Mean height of vegetation in selected treatments sprayed with MH and 2,4-D. Cambridgeshire 1967

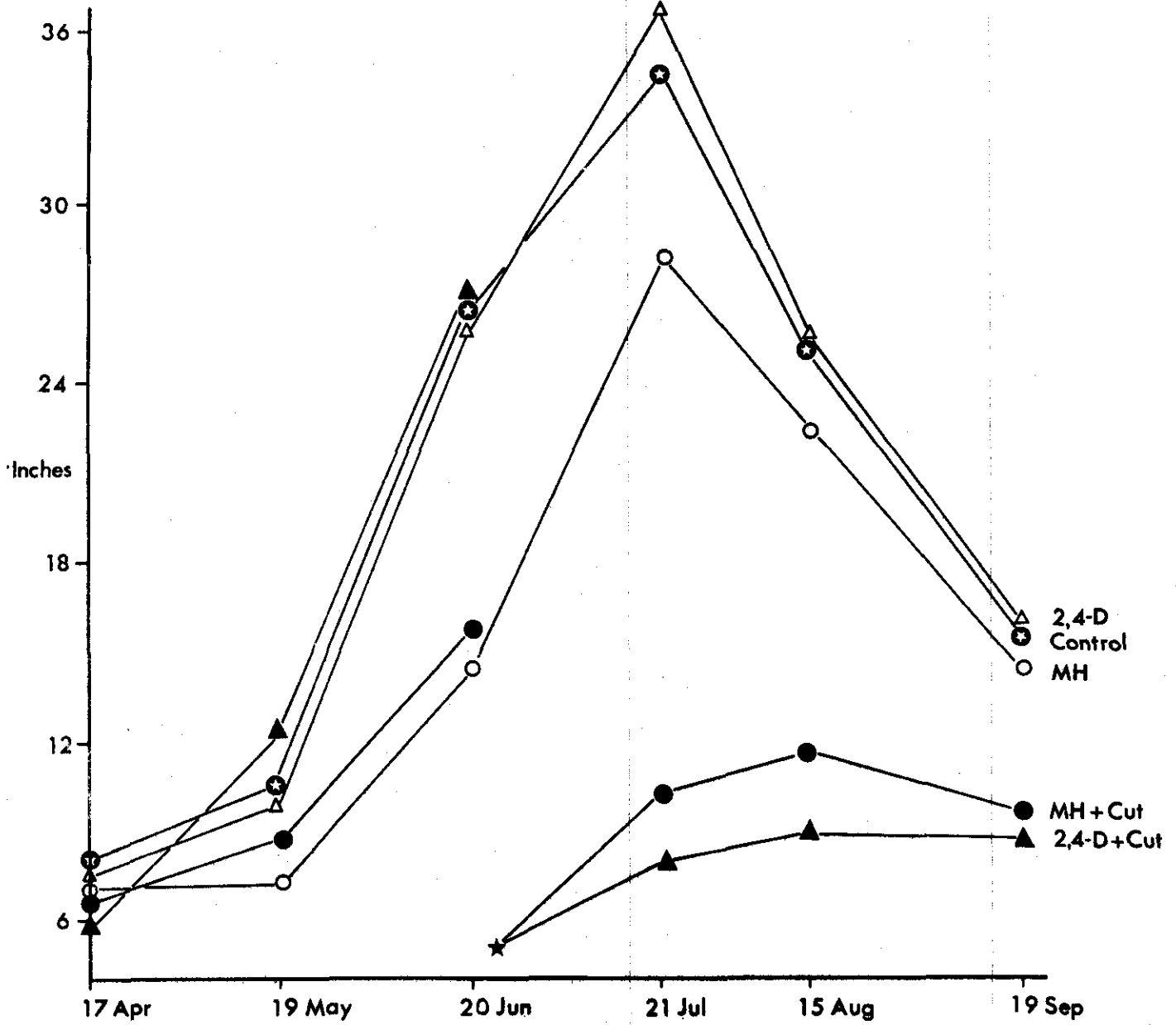


Fig 2. Mean height of vegetation in selected treatments cut with a haymower and the cuttings raked off. Cambridge 1967.

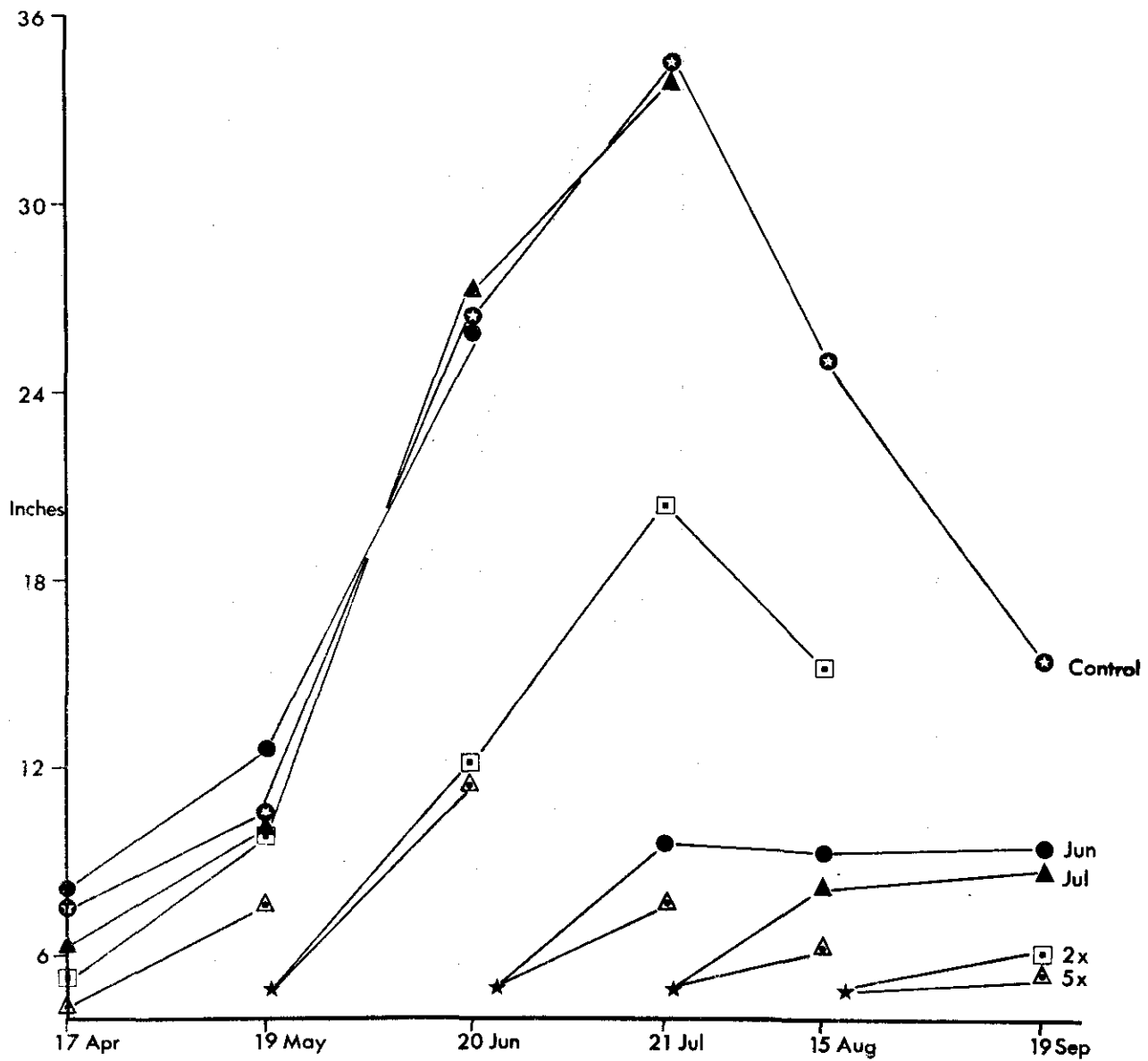
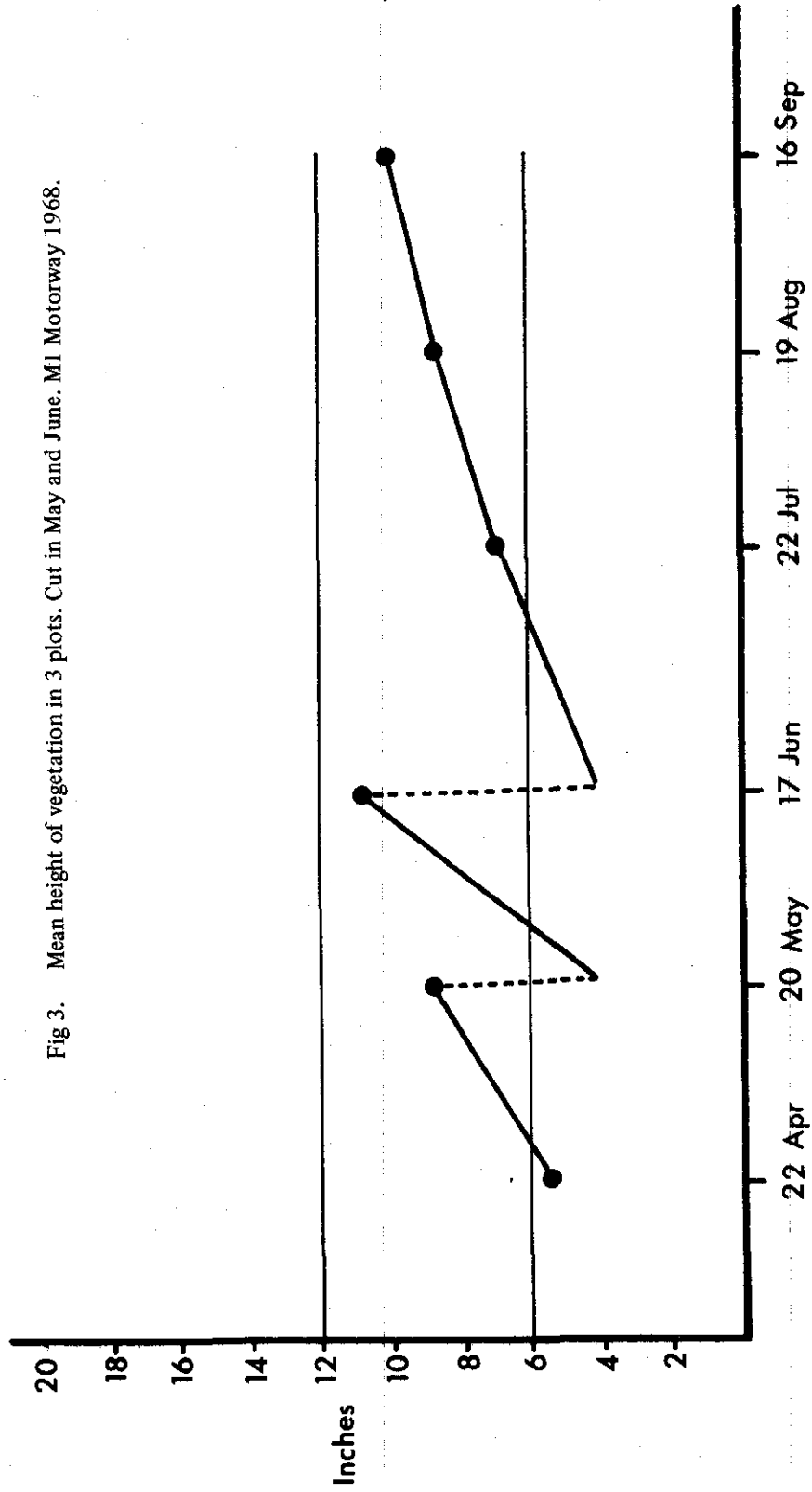


Fig 3. Mean height of vegetation in 3 plots. Cut in May and June. M1 Motorway 1968.



In both figures the curves for the untreated plots are the same and show growth to a maximum height in the middle of the season followed by a gradual collapse mainly caused by wind and rain. Of the chemical treatments (Fig 1) maleic hydrazide depressed growth for 6-8 weeks after which there was some resumption; however if the MH treatment was followed by a cut 8 weeks after application there was little further growth. In these experiments there was no effect on growth from 2,4-D (or additional effect where it was combined with MH) and the effects of cutting 8 weeks after application of 2,4-D were the same as cutting once in June (Fig 2). With these two treatments and the single cut in July (ie Treatments 8, 17 and 18) no further cut during the season was necessary to prevent growth of more than 12 in. but a visibility hazard would exist in the early part of the season. Where the grass was cut five times at monthly intervals it is interesting to note the drop-off in the rate of growth following each cut. Where the grass was cut in May there was a considerable effect lasting through the season to the second cut in August. Where it is not desired to protect spring flowering plants such as Cowslip (*Primula veris*) and a height of vegetation of 12 in. is tolerable, a single cut in May by itself or followed by another cut in June might well be all that is necessary. From a conservation point of view it would of course be desirable to time the cuts to avoid the peak flowering and fruiting periods of the herbaceous plants present. The results presented here are for one year only and it should be noted that the pattern of growth has varied in detail from year to year depending upon growing conditions.

B. Motorways. A further experiment was set up in 1968 on the embankments of the M1 in Leicestershire, where 20 randomised treatments are repeated at three sites between Lutterworth and Shepshed. The treatments are shown below (Table 2) and are all made by flail machines except when the banks are too wet, when rotary cutters are used.

TABLE 2

Treatments applied to experimental verges on the M1 Motorway in Leicestershire.

| | Cut in third week of: | | | | |
|----|-----------------------|-----|------|------|-----------|
| | April | May | June | July | September |
| 1 | X | | | | |
| 2 | X | X | | | |
| 3 | X | | X | | |
| 4 | X | | | X | |
| 5 | X | X | X | | |
| 6 | X | X | | X | |
| 7 | X | | X | | X |
| 8 | X | X | X | | X |
| 9 | X | X | X | X | X |
| 10 | | X | | | |
| 11 | | X | X | | |
| 12 | | X | | X | |
| 13 | | X | X | X | |
| 14 | | X | X | | X |
| 15 | | X | | X | X |
| 16 | | X | X | X | X |
| 17 | | | X | | |
| 18 | | | | X | |
| 19 | | | | | |
| 20 | | | | | |

These banks are a sample of the hundreds of acres of recently established grassland associated with the current road building programme. As no economic use seems likely for this land, management sympathetic to the conservation of wildlife would be justifiable. This experiment is again of a long term nature. Records being taken at the moment are of height of the vegetation and of plants in flower in the different treatments at monthly intervals. In due course, when the vegetation has 'settled down' to the effects of the treatments more detailed analyses will be made of the botanical composition.

C. Discussion. Very few grasses have leaves longer than 30 cm (12 in.); notable exceptions amongst common road verge species are found in the genus *Festuca* (fescues), also Cocks-foot (*Dactylis glomerata*), False Oat-grass (*Arrhenatherum elatius*), Timothy Grass (*Phleum pratense*) and Tor Grass (*Brachypodium pinnatum*). The choice of an acceptable height of vegetation by Highway Authorities is therefore fairly critical, because if it is possible to prevent the development of the culm (flowering stem) by cutting or the use of MH, subsequent growth of leaves of the majority of grasses is unlikely to exceed 12 in. This height is recommended for many situations on trunk roads and motorways by the Ministry of Transport (1968). As shown (Fig. 1) it is possible to keep to this height by the use either of a single spray of MH in April and a subsequent cut about mid-May, or (Fig 3) by a cut in May and another in June. However if a height of 6 in. is the maximum permissible, this can only be achieved by very frequent cutting of the leaves of the plants, perhaps every three weeks or so at the beginning of the season (Fig 2). It should be noted that these observations probably apply to the Midlands and eastern parts of the country but not necessarily to the wetter parts of the west. Also that they apply to verges or parts of verges where the height of the vegetation has to be controlled. From a conservation point of view, many broadleaved plants are flowering during the months of May and June and this is not the best time to cut them. One hopes, therefore, that where height of vegetation is not important, management can be arranged to avoid the main flowering and seeding period for many plants.

Surveys

A survey was made in 1967 of the physical structure and flora of a sample of road verges in England and Wales. It is hoped that it will be possible to relate the botanical composition of these sites to the management that they have received in the past; thus providing additional information about the effects of different types of management on the development of plant communities. This work is being extended by members of the B.S.B.I. and other organisations to whom we are most grateful. Further survey work is planned to relate the vegetation of road verges and other boundary situations with the weed flora of agricultural land. This is important in relation to the pressures from farmers on Highway Authorities to manage verges to control or eliminate agricultural weeds. The status of these plants on verges and their significance there as sources of seed or propagules for infestation of farm land has not been studied in any detail. There are, however, reasons for supposing (see Chancellor in this symposium) that they may not be so important as is often made out.

Cataloguing

The work of the Conservancy in collecting data from Naturalists' Trusts and other organisations about verges of especial interest has been mentioned by Perring (this symposium), and there is no need to discuss it further here.

Conclusions

It has to be remembered that different species of grasses and other plants respond differently to different management treatments, especially in relation to time, and that geographical and climatic factors will also modify the effects. What we hope to do from our experiments is to show the sort of effects that may occur and to indicate how they might apply in general. As diversity is our aim there is no question of our making general blanket proposals—each area ought to be managed in the way that gives the most favourable result. This is a counsel of perfection but it does point the need for close liaison between Highway Authorities and local conservation and amenity organisations. In this work, because of their special knowledge of the wildlife of their own areas, the County Naturalists' Trusts should play a leading part, and many are already doing so.

In conclusion it is a pleasure to acknowledge the interest and help of the Cambridge and Isle of Ely, the Huntingdon and Peterborough and the Leicestershire County Councils, together with the Ministry of Transport, with whose co-operation the experiments referred to in this paper are being made.

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MORNING SESSION

Sir GEORGE TAYLOR. In opening the morning Session Sir George referred to the work of the Landscaping Advisory Committee of the Ministry of Transport. The Committee's principal concern was with the new motorways and trunk roads which were causing drastic disturbance in the countryside but at the same time creating new environments. A great challenge to the Committee was presented by the large areas associated with the intersections on these roads, sometimes as much as 30/70 acres, and with the grass verges. It was their deliberate policy, endorsed by the Ministry, to restrict planting to indigenous species and to discourage any unnecessary planting. The vistas of the countryside opened up by the new roads should not be obscured and the roads themselves should be married as fully as possible into the countryside. As far as herbaceous plants were concerned it was the object of the Committee to ensure that natural vegetation was encouraged by management and if possible increased by deliberate effort. Seeds of wild plants could be sown on slopes but the emphasis again must be on indigenous species. It was very satisfactory to know that numbers of wild plants, for instance primroses and cowslips on the M1, had spread in naturally. He was aware that all the Committee's policies had not been fully successful but he believed that their efforts should be more widely known than they were.

Lord NUGENT of GUILDFORD then welcomed delegates to the symposium and gave his opening address.

Mr M.R. PORTER presented his paper and said that the ideas expressed there on how an ideal road in its various contexts should look, should be kept in mind as a background to the other ideas being put forward by later speakers. However, the most important factor of all was road safety for the road user. On minor roads small improvements sometimes led to higher speeds and demands then followed for further improvement. These attracted a different kind of road user and a different class of traffic. In these circumstances the local inhabitant was likely to suffer as well as general conservation and amenity interests. The design and maintenance of highway landscaping was largely a matter of good manners, looking to see what was already there and repeating it, perhaps on a bolder scale. Diversity of design to suit the local countryside, so that the road itself became less conspicuous when seen from the outside and more interesting and safe for the driver, was most likely to satisfy the majority of interested parties. Care should be taken in the formulation of maintenance proposals to avoid imposing too many different programmes and techniques on the responsible authorities.

Mr Porter showed a number of slides. One of these showed a verge with the edge next to the hard shoulder cut frequently, progressing through less frequently cut zones to a state where natural regeneration of scrub and trees was beginning to occur. This was contrasted with a similar length where the grass cutting had followed hard, unsympathetic lines, thus increasing the man-made look of the whole area. An old railway cutting at Twyford with mature trees and an attractive woodland ground flora might be the model for some road verges of the future. A series of slides of German motorways emphasised the need to retain the wide open character of certain landscapes, where tree planting would be contradictory and out of scale. In another situation full use of an area of woodland had been made to give the maximum feeling of the road being in and part of the wood. However, in many cases it was often not advisable to save trees along a motorway unless they occurred in sufficient quantity and it was reasonably certain that they would survive the disturbance caused by engineering works; it was usually more important to get the contours right and then replant as necessary. Mr Porter briefly surveyed the problems of minor roads and the especial vulnerability of banks, hedges and stone walls which are likely to be replaced by post and rail fences or by wire. The need for a positive approach to landscaping was emphasised in a final slide of a multi-intersection clover-leaf crossing, which might cover up to 100 acres in the future, with all its implications for conservation, management and amenity.

Dr F.H. PERRING, in introducing his paper, stressed the difference between old verges associated with ancient roads and the newly created verges associated with modern developments. In both cases he pointed out the conservation importance of these areas and mentioned dumping, hedge removal and the use of aggressive grass species in seed mixtures as being unfavourable in this context. Management of the verges was important and the encouragement of a diversity of habitats by varying the type and frequency of management operations was to be encouraged and could probably be done in such a way as to satisfy all parties. He spoke about the number of nationally rare plant species that occurred on road verges and the importance of conservation organisations liaising with the highway authorities for their protection. In addition, County Naturalists' Trusts were drawing up schedules of verge sites of general importance for conservation in their own counties. So far some 300 miles had been selected, mostly for assemblages of wild plants, in a number of English counties and Lothian in Scotland.

Mr D. T. STREETER also spoke of the importance of road verges for conservation and stressed that the main object of verge management should be to enhance the local character of the verge from amenity and conservation points of view, whilst meeting the requirements of the highway authority for the maintenance of the road and safety of its users. As management was a local problem it was important that local organisations and particularly the County Naturalists' Trusts should work closely with the County Surveyors' departments. The need for local co-operation was emphasised by the fact that it was quite impossible to have a general policy for the management of verges throughout the British Isles because of the great diversity of environmental factors; and also because the objectives of management were so varied in different parts of the country. Mr Streeter hoped that all County Trusts that had not so far completed the survey of verges of conservation importance, mentioned by Dr Perring, should now do so and start to make arrangements for establishing schedules of management for these areas. Once the schedules had been agreed it was necessary that there should be the fullest understanding and co-operation on the ground between the people concerned.

Mr R, J, WHITE, putting the farmers' viewpoint, said that farmers as the inhabitants of rural areas who were proud of their countryside felt a very real concern about the state of the verges. He appreciated that his written paper dealt only with an occurrence in one year and that maintenance problems usually were concerned with happenings over a number of years. The consequence of not cutting the Hampshire verges in 1968 had been unsightly and unsafe and had encouraged the growth of broad-leaved dock. He was glad to know that the Nature Conservancy and the Ministry of Transport were concerned about what was happening on road verges but doubted that farmers had really thought about them as being sanctuaries for rare plants. His own view was that the 20 acres or so of internal tracks and bridle paths on his own 900 acre farm were probably much more of a sanctuary for wildlife.

Mr R, J, CHANCELLOR in presenting his paper gave additional evidence of successful weed dispersal occurring in his garden, 1/3 acre in extent. Over six years, three separate plants of Perennial Sowthistle (*Sonchus arvensis*) became established from wind-borne seed. Assuming a 10% establishment rate, this gave a total of fifteen viable seeds of this species falling on each acre in each year in the Oxford area. Sowthistle and Coltsfoot (*Tussilago farfara*)—another creeping perennial weed with wind-borne seed—were potentially the most harmful weeds occurring on roadsides. Most other agricultural weeds in road verges were either uncommon or lacked efficient dispersal methods, but verges were none-the-less possible sources of infestations.

Dr BRUCE CAMPBELL (Editorial Adviser, The Countryman) said that although the well-being and alertness of the driver must be the first care of the road planner, more topographical signs would help to make long stretches of motorway more interesting, particularly for passengers.

Sir GEORGE TAYLOR said that this question had been considered by the Minister's Landscaping Committee, who were in favour of more signs to identify localities, but their suggestion had not so far been accepted.

Mr PORTER referred to another aspect of this question. He was often asked to screen things which people felt were ugly, but a view of, for instance, Luton from the M1, or a power station, helped the driver to locate himself, and added an interest to the route. It was also sometimes difficult to screen houses backing onto a motorway, because to do this adequately would cut out light from them.

Mr R, C, JENNINGS (Technical Manager, Chipman Chemical Co., Ltd.,) commented on the abundance of weeds and poor maintenance of the grass sward on the early sections of the M1 where no chemical sprays had been used, compared to the more park-like appearance on later sections in Leicestershire and Nottinghamshire. These sections were treated with chemicals and gang mown. Mr Porter in his paper seemed to infer that the latter approach to management was undesirable but was it not a fact that these verges were more aesthetically attractive as a result.

Mr A, P, DUNBALL (Horticultural Adviser, Ministry of Transport) replied that the later sections of the M1 illustrated the Ministry of Transport's changing policy on verge maintenance and weed control. The earlier policy had been to keep grass cutting to the minimum to encourage development of the native flora, but rapid invasion by weedy species of newly sown verges had necessitated a change of plan. More recent instructions were to cut the grass as frequently as possible in the first two or three years, together with the use of herbicides, to produce a tight clean sward. When this was achieved frequency of grass cutting could be reduced without the danger of an invasion of docks and thistles.

Mr J, D, LEEFE (Lindsey Project for Improvement of the Environment) raised the question of planting beyond the highway, suggested by Mr Porter. With the advent of the Countryside Act and its provisions for tree planting, was there not now a great opportunity for local authorities to prepare supplementary planting schemes in conjunction with the adjacent owners, the Countryside Commission and road landscape advisers, to give a better landscape? Emphasis had been placed on the importance of verges as a national heritage to a future 100% car-owning public. Could use be made of the Countryside Act to provide grants for extra land for picnic places for the public, in addition to other amenities provided on main roads, possibly in suitable instances associated with verge nature trails?

Mr PORTER agreed that there were great possibilities for local authorities to prepare supplementary planting schemes, but funds might not be available.

Sir GEORGE TAYLOR said when trunk roads were planned, the government tried to acquire parcels of land suitable for planting, but that the Ministry of Transport's powers to plant only extended to land actually possessed by them. The Ministry did, however, try to get the sympathy of the adjacent landowners to ensure that the roads were landscaped into the countryside.

Mr R, J, S, HOOKWAY (Countryside Commission) said that there appeared to be powers in the Countryside Act for a wide range of creative landscaping using Government funds. However, there was considerable competition for these funds and agreement about individual schemes had to be reached with local authorities. The authorities might be loathe to take on small schemes of the sort being suggested which could involve them in a lot of effort for a small result. However, he agreed with Mr Leefe's suggestion for the creation of amenity areas and nature trails along roadside verges so long as they did not involve a safety hazard and could be adequately managed. There was great potential here for public authorities to make agreements with private landowners for creative landscaping, thereby not only contributing to the countryside but also to the individual landowners's holding. In addition if the management could be carried out by the farmer or landowner, possibly in return for payment, this would materially reduce the authority's costs and there would be less likelihood of conflict over the form of management. If agreements of this sort could be encouraged it was possible that local authorities would be interested and a great deal of progress might be made.

Mr ALEC LIVINGSTON (Council for the Preservation of Rural England) stressed the economic importance of tourism and the pleasure tourists got from the sight of wild plants in flower in the roadside verges. Attractive verges were an integral part of the English countryside and probably had a greater effect on people than was commonly realised.

Miss F. PALMER (Berks, Bucks and Oxon Naturalists' Trust) expressed concern about the removal of hedges during widening operations on minor roads, without any sign of subsequent replanting. She suggested that this problem could be faced by planting coppice trees, which would not require as much trimming and would perhaps bring some revenue when cut. She asked who would be responsible for this sort of replanting and the maintenance of it.

Mr C. R. CHADWICK said County Councils would be responsible except on motorways and trunk roads. A good deal of this was in fact being done.

Mr WHITE said that he thought the farmers' attitudes towards prairie farming were changing: many farmers were now planting hedges and would welcome roadside hedges for protection of stock and crops.

Mr W. J. CHAFFE (County Surveyor, Devon County Council) asked Mr Chancellor whether there was any prior means of treatment of soil to control broad-leaved dock during the construction of new roadworks, chemical control later being difficult and expensive.

Mr CHANCELLOR said that reference should be made to the Weed Control Handbook.

Dr S. R. J. WOODSELL (Berks, Bucks and Oxon Naturalists' Trust) said that roadside verges could act as Nature reserves for weeds especially as it had been indicated that they were relatively unimportant as sources of seed for infestation of farmland. Many so-called weeds were attractive plants and it was important to distinguish between these and the few aggressive injurious species. In addition the plants on verges could act as 'gene banks' for weedy species in case herbicide resistant forms developed on farmland. In reference to Mr White's remarks, Dr Woodwell said that he thought that internal farm roads and tracks were just as important for conservation as the public road verges, but were perhaps often in more danger from spraying.

Mr WHITE said that there was constant pressure on farmland from town development, etc., so that farmers were forced to make fullest use of all ploughable land. There were, however, lanes and bridleways on the farms with high hedges which were protected from drift of spray, and the chemicals used were in any case generally selective sprays.

Mr STREETER added that nature reserves for weeds such as corn-cockle and cornflowers, which were considered part of the national heritage, had been considered for a long time, and, he thought, did exist already in Holland.

Mr H. N. JENNER (County Surveyor, Hampshire County Council), reporting on the experience of the Hampshire County Council in 1968, said that the decision not to cut the road verges had been forced on the Council by financial considerations. The experiment was not likely to be repeated because of the weight of opinion against it. Development of noxious weeds, effects on road safety (although in fact there had been no increase in accidents), and many other reasons outweighed any advantage.

With regard to weeds the legal advice he had had agreed with that given in the note on page 28 of the Symposium papers. He had noted a difference of opinion between Mr Cornwallis' paper and Mr White's over the rights and responsibilities of the neighbouring landowner *vis à vis* the highway authority with respect to the management and cropping of grass verges. He had previously contended that the highway verge and the growth on it were in the ownership of the neighbouring farmer or landowner. His recent legal opinion was that so far as injurious weeds were concerned it was the responsibility of the highway authority to control them. In general the authority's interests were in meeting its liabilities with respect of the highway and in ensuring that the Queen's subjects could get along it. The owner of the subsoil was entitled to any other asset provided it did not interfere with the proper functions and right of passage.

Mr Jenner did not think that the complete lack of management of verges would be acceptable to conservationists, particularly when one saw the very rapid growth of rank vegetation that had occurred in Hampshire in 1968. This growth quickly overran and suppressed many more attractive flowering plants. This was especially noticeable when new verges had been formed from improvements and this was upsetting for neighbouring owners or tenants who had surrendered land and then seen it run to seed.

With regard to co-operation between County Surveyors and Nature Conservation interests, Mr Jenner said he had had difficulty in getting information about species and sites for preservation and identifying the areas of interest and would be glad of advice. In general he thought that co-operative efforts should be directed to preserving species where they were known to exist and where they were important, and not to alienate the goodwill of road user and farm interests by attempting the impossible task of preserving everything everywhere.

Mr MARK JOHNS (Keep Britain Tidy Group) said that efforts to make verges attractive would probably be spoiled if problems of litter were not kept in mind. Was it an accident that no reference to this question was included in the papers?

Sir GEORGE TAYLOR felt that litter control was not entirely relevant to the day's proceedings, but that it was in the mind of the Landscaping Committee. It was the responsibility of the local authorities to deal with the litter problem on roads, and that they could receive help from the Ministry for this.

Dr T. LEWIS (Rothamsted Experimental Station) pointed out the value of verges as habitats and reservoirs of pollinating insects, which were essential to produce satisfactory yields in many crops. The Bee Research Association published leaflets recommending trees and shrubs suitable for amenity planting, and at the same time valuable for bees. Although there were still many orchards, particularly in the West Country, where good sets could be obtained from wild pollinators, many orchards in the eastern counties depended on the introduction of honey bees because of the lack of enough wild insects.

Agr. Ing. ZWIJNS (Netherlands) said that the verges of the smaller roads should be efficiently maintained by mowing or spraying. He considered that spraying was the only way to do this, because growing weeds spreading onto the hard surface pushed the traffic into the centre of the road, thus increasing the danger, particularly on winding roads.

Col. F. M. HILL (Council for the Preservation of Rural England) said that the morning's session had dealt almost entirely with the flora of road verges. Was there any fauna which existed mainly in the road verges?

Dr N. W. MOORE (Monks Wood Experimental Station) replied that no thorough studies had been made of the fauna of roadside verges, although a very high proportion of British butterflies, farmland birds, etc., bred and/or fed on them. One fly, so far, had its only record from a verge in Dorset, and there might be quite a lot of species whose main haunts, particularly in eastern England, were now in roadside verges, because of the disappearance of rough land from the neighbouring countryside.

Dr PERRING added that in the recent survey he had mentioned, it was noticeable that very few of the verges had been selected because of their fauna, apart from a few in Lincolnshire for butterflies. There was a potential here which the Naturalists' Trusts had not yet recognised.

Miss N. FAIRBROTHER (Landscape Architect) asked whether it was possible to obtain grants for the amenity management of roadside verges in National Parks and Areas of Outstanding Natural Beauty, where this exceeded the cost of normal routine methods.

Lord NUGENT thought that this would only be possible by the formation of a Country Park under the Countryside Act, but as previously mentioned, because of financial restrictions, the chances of doing this for a small strip of verge were not very good.

Dr M. B. USHER (Yorkshire Naturalists' Trust) asked for a definition of "Conservation" as used in the context of newly created habitats, eg the enclosed triangles of motorways.

Dr N. W. MOORE (Monks Wood Experimental Station) said that although "conservation" did not generally mean more than a prevention of waste of resources, "nature conservation" was more positive. It implied a need to maintain, and where possible enhance, the biological diversity of the environment for the benefit of our own and future generations. Conservationists should be forward-looking and not just concerned with the past. It was therefore possible to consider the creation of new areas of biological interest as being a form of nature conservation.

Mr JAMES FISHER (Countryside Commission) said that under the 1968 Act, there was a possibility of the grant-aided development of transit picnic sites, particularly for holiday traffic, and this was being investigated.

Mr Fisher suggested that the smallish areas of roadside formed during road-straightening operations, and too small to be used as picnic sites, would be useful for the provision of lavatory facilities. The cut-off laybys were in fact "weed-farms" and had research possibilities on the problems of their fauna, flora, management and future development, and could be a subject for co-operation between the highway authorities and the County Countryside Committees.

He said that the Countryside Commission welcomed the deployment of County Countryside Committees or sub-committees of the Planning Committees, and looked forward to every county having such a committee, with representation of the County Naturalists' Trusts.

AFTERNOON SESSION

Mr F. L. BROUGHTON opened the afternoon session by saying that the contributions were to be from people whose job was actually the care of roadside verges. The County Surveyor had a thankless task in pleasing all and satisfying as many as he could while performing his statutory duties. County highway personnel present constituted just under a third of all delegates and this showed that county highway authorities took the subject of roadside verges and their maintenance very seriously indeed.

He then had pleasure in introducing Mr C. R. CHADWICK, County Surveyor for Wiltshire.

Mr C. R. CHADWICK said that in his paper he had referred to common misconceptions of what the highway was and to whom the land over which it ran belonged. There were six principal categories of public highway, all of which might have verges. The right of passage subsisted over the whole width, including the verges, and was not confined to the metalled carriageway. He said that a great deal of attention was devoted to motorways and their effect on the landscape, although at present they covered only one per cent of the mileage of public highways in this country. In addition to the highways already mentioned, there were also two categories of rights of way, namely bridle-ways and footpaths, which were seldom considered but the mileage of which was considerably greater than that of repairable public roads. In Wiltshire there were something like 5,000 public footpaths across country, and in most cases the only maintenance carried out was simply to keep them open, as the right of passage had to be maintained.

Part 4 of his paper dealt with the principal requirements of a verge maintenance policy. There was sometimes a conflict of interest between road safety on the one hand and amenity on the other, but this was often greatly exaggerated. The solution was largely a matter of common sense and co-operation with local naturalists and amenity bodies. One aspect of the subject which was sometimes overlooked (and underestimated) was the positive contribution that the construction of roads could make in providing new habitats for wild plants and animals. A good example in his own county recently was a newly constructed cutting, a retaining wall of which had been back-filled last year and produced a dense carpet of snowdrops this February—presumably the corms had been imported with the in-fill. Dr Perring had complained about the dumping of soil on road verges, and whilst he agreed that this could have unfortunate effects, Mr Chadwick suggested that it could also encourage wild plants, such as poppies.

He could not accept that roads were an intrusion into the countryside: they might be so in a jungle but if by countryside one meant what man had made of the jungle, roads were an integral part of it. He said it was not an accident that in the British Isles, where there was the greatest density of minor roads, there was also the most efficient agriculture. He did not suggest that the latter sprang from the former but it was not a purely casual relationship.

Mr Chadwick said that he still had to be convinced of many of the criticisms of the geometry of road design in this country. He would not contend that mistakes did not occur, but would say that geometry and formal design were not necessarily out of place in an intensely cultivated landscape. He personally got much pleasure from looking at well designed improvement schemes with flowing lines and well-managed swards running through fertile farmland.

A point had been made about the use of indigenous plants. He wholeheartedly agreed with this in general but thought it unwise to be dogmatic. He had been intrigued in Czechoslovakia to see that trees of the edible cherry were planted as a matter of policy along their roads, to produce a "free" crop, and were very easily tended by machines. He thought that this showed interesting planning of the countryside, even if it was not very natural.

Amenity needed to be an ally to road safety, one of the most important concerns of the road engineer. This was particularly true on motorways, where the problem of monotony had to be overcome: this might not be significant on a 50-mile run, but became quite a problem on a journey of 500 miles. With regard to laybys and toilets, Mr Chadwick said that many counties were introducing toilets in laybys, to avoid the nuisance created on quite a large scale in the vicinity of laybys without them.

Mr Chadwick summed up by saying that roadside verges should be considered as part of the cultivated countryside, and should be managed in sympathy with the country scene. It must however be recognised that everything one did cost money.

Mr C. V. UNDERWOOD pointed out a correction in his paper: on P. 49 3rd line, the reference to 80s. 0d. per acre should be 100s. 0d. (Amended in the reprint version of the papers: Editor).

There were three main groups of verges to be considered in the problem of maintenance: (a) new verges, from the building of motorways and by-passes; (b) established verges, which formed the majority; and (c) maintenance of verges in residential areas. There were a number of engineering considerations for verge maintenance which included stabilisation of the soil, removal of obstruction by overhanging bushes and other vegetation, and proper drainage of the road. Drainage was a very real function of verge maintenance.

By making new embankments and cuttings the natural soil conditions were destroyed. It was necessary to establish vegetation cover quickly and in the past this had been done by applying top soil, not necessarily from the same district, and seeding it. This was very expensive. The modern technique of hydroseeding was a very quick way to establish a sward and it was also cheap: at 6d per square yard it was half the cost of traditional methods. No top soil was applied, only a spraying of water, certain additives, seed, and chopped straw, made tacky with bitumen emulsion, sufficient to establish the grass on the bank. Three weeks after application the grass would be growing. Reference had already been made to rye grass, which caused a great maintenance problem, particularly in the 50% specification of the Ministry of Transport. He thought in any case that often the correct specification of seed was not supplied to surveyors when ordered according to the Ministry specification. In Leicestershire, a different specification was used on new works, which contained low-growing grasses. They would also like to include seed of indigenous wild plants growing in the area but it was a problem to collect the seed.

In discussing the best way to manage newly established vegetation on verges, he felt that the Ministry of Transport's recommendations to keep vegetation to not more than 6 inches, for 6-7 feet from the carriageway, and in no case longer than 12 inches brought a big maintenance problem. He also felt that sometimes too much tree planting was done on the motorways. This was unnecessary from the amenity and expense points of view, whilst trees created problems such as shade, wet leaves and could be quite out of place in open countryside. In Leicestershire, for the established country verges, they had introduced a grass maintenance policy, and this was outlined in his paper. They had only one year's experience, but indications were encouraging from both the wildlife and engineering points of view. He said that although farmers liked to see frequent mowing, a short turf encouraged animals to graze on the verge and this was dangerous both to the animals and to the motorists.

Of the management techniques that were available, the tractor side-mounted flail mower was a great boon to the highway engineer. In his county they did not approve of the general application of chemicals on verges and said that use of them was restricted to dealing with injurious weeds. Although a lot had been said about weeds, the point had not been made that there were only 5 species of injurious weeds for which there was a statutory obligation to control.

Summing up, Mr Underwood said that it was necessary to keep the matter of verge maintenance in perspective, especially as it represented probably not more than 1½% of maintenance money spent by highway authorities.

Dr A.J. WILLIS in presenting his paper referred to a number of methods of chemical control of road verge vegetation, experimental work on the long-term and ecological effects of their use, and what advantages they might be expected to have over other methods. Total eradicators were of rather specialised and limited local use, as on kerbsides and at the foot of walls. The most interesting and promising techniques of general application in verge maintenance were those involving the use of growth-retarders. Over the last 20 years a good deal of work had been put into studying the effects of these compounds and especially Maleic Hydrazide (MH), the best known of them, in terms of their effects on road verge vegetation. Dr Willis then went on to describe with the help of slides the experiments at Bibury in Gloucestershire, detailed in his written paper. MH when used by itself led to a change in the composition of grass swards towards low-growing species, it prevented flowering of grasses and to some extent had a herbicidal effect on the tall-growing umbellifers. The growth-regulator 2,4-D had a herbicidal effect on the majority of broad-leaved plants but also over a period of time did lead to a shift in the composition of the grass sward. Mixtures of 2,4-D and MH led to a grass sward kept short and not flowering and lacking most broad-leaved species. If plots that had been previously sprayed with this mixture were not sprayed for a period of years there was a gradual reversion to the plant community that had been present before treatment began. However, in the comparatively short period of 4-5 years at Bibury there was no complete reversion to the original flora in terms of numbers of species present although many features of the former vegetation were by then evident. Measurements of height of vegetation had been made at intervals after treatment and he noted that some of the results did not agree with Dr Way's reported in the next paper. He hoped that they would be able to discuss this later. With regard to the effects on the botanical composition of swards of cutting compared to spraying, Dr Willis said that cutting could strongly reduce diversity.

Dr J.M. WAY introduced his paper by saying that in addition to the management of grass verges, which was mainly what had been talked about so far, there was also the question of management of woody vegetation especially in narrow country lanes. Control of this vegetation only really posed a conservation problem when there was a danger of wholesale destruction of roadside hedges and trees. There was less need for research on their management and so in his own experiments he was concentrating on the grass problem. Nevertheless roadside hedges and trees, and scrub on wide verges, contributed significantly to the conservation and amenity of the areas in which they occurred and required sympathetic treatment. In relation to grass verges, wildlife conservation interests might be summarised as the need to create DIVERSITY of habitat, to ensure CONTINUITY of management techniques in detail and to grasp the OPPORTUNITY afforded by the creation of new areas as a result of road building programmes. Sudden changes in management could have a devastating effect on plant communities that had developed under a more or less constant form of management over long periods of time. It was important to decide as soon as possible how the new techniques being evolved should be used and then as far as possible stick to them. So far as animals were concerned, if healthy and varied plant communities were encouraged animal populations would develop with them. When one talked about conservation one was often also talking about amenity but this was not always so, and good conservation for periods of time could lead to indifferent amenity: as for instance when plants went to seed or long grass was left to protect nesting birds. The Nature Conservancy had been associated with research on road verges since the early 1950s, together with other interested organisations, and hoped with the continuing co-operation of these organisations to be able to produce agreed advice for the future. Dr Way then went on to discuss in detail his research work and results to date described in his paper.

Alderman H. B. WEBBER (Devon County Council), who was not able to be present, in a written note commented that it was interesting to see that thought was being given to the introduction of indigenous wild plants onto motorway banks. In South Devon some of the amenity societies in co-operation with the County Council had scattered the seeds of wild flowers over trial areas of road verges with a view of extending this process to raw banks following roadworks, although the 1968 experiment seemed to have met with limited success. Were there other similar experiments being carried out, and if so, what were the results?

Mr STREETER replied that there was not a great deal of experience of this problem, but he thought that trials were also being made in Cornwall. One of the problems of introducing indigenous plants into established roadside verges was that the vegetation there was usually already a closed community. On the other hand, new verges, particularly those which were likely to be least disturbed, would be very valuable if properly managed, especially for the conservation of particular species which were locally becoming rare. If transfers of plants of this sort were made he emphasised that the details should be accurately recorded and sent to the Biological Records Centre at Monks Wood.

Mr UNDERWOOD said that his Council felt that the laying of turf was the best solution to the establishment of vegetation on motorway banks, although it was difficult to find sufficient suitable material. (It was suggested from the hall that railway banks would be the places to find the turf required).

A representative of the County Surveyor's Department (Gloucestershire) said that they had been sowing seed of red fescue along new highway improvements and had hoped to re-establish scabious and cranesbill, but could not find a source of seed. They would be most grateful if the Naturalists' societies could show them where seed could be obtained, so that these and other wild flowering species could be reinstated in such areas.

Mr T. A. W. DAVIS (West Wales Naturalists' Trust) said that seed of suitable flowering plants should be collected from plants grown in special nurseries or private gardens. Naturalists' Trusts should collaborate with Highway Authorities in this. The grasses included in seed mixtures should be dwarf: sweet vernal (Anthoxanthum odoratum) would be suitable in addition to others already mentioned.

Dr BRUCE CAMPBELL commented on the value of motorway "clover-leaf circles" and similar areas for conservation, especially for the re-establishment of species which could be saved from destruction during 'improvements' elsewhere. He mentioned the daffodils between the carriageways on the Ross Spur, surely the safest wild plants from the picker.

Mr R. C. STEELE (Monks Wood Experimental Station) reinforced the plea for more careful choice of trees and shrubs in roadside planting; he was disappointed to see non-native trees, such as sycamore, being so extensively used, and stressed that native species were far more valuable for wildlife conservation.

Mr CHADWICK agreed in general with Mr Steele, but emphasised that exceptions could be made to every rule and he would not like to see non-indigenous species ruled out in every case.

Mr J. D. LEEFE supported Mr Chadwick in saying that highways should be regarded as part of the countryside, and that stronger liaison was required between the highway authorities, the planning authorities and the newly formed Countryside Committees. He also strongly supported Mr Chadwick's suggestion that Parish Councils be encouraged to carry out tree planting schemes. His contact with Parish Councils showed that there was a potential fund of goodwill and knowledge and also money for tree planting. If local people participated in these types of scheme, they would have a greater interest in them.

Mr CHADWICK replied that although he had suggested that Parish Councils were the appropriate bodies to help in tree planting schemes, the response in Wiltshire had not in fact been as widespread as he would have liked. He hoped, however, that more attention would be given to this matter.

Col. F. M. HILL (Council for the Preservation of Rural England) said that the amenity interests often felt that there was a lack of co-operation between the more junior officials of the County Surveyor's offices and the planning departments, so that minor road widening and removal of hedges were carried out, which altered the whole amenity of country roads, villages, etc., without proper consultation.

He also asked whether anything was being done to produce shortgrowing grass species, in order to reduce the amount of mowing necessary.

Mr BROUGHTON replied that for certain works it was necessary for the County Surveyor to obtain statutory planning approval, and in these cases there was of course full co-operation. In his county of Cumberland, there was a good relationship between junior officials of his and the planning departments, particularly in the Lake District. In general he thought that there was a very good degree of collaboration all the way down.

Mr CHADWICK added that he and his staff in Wiltshire were very well aware of these problems and would not willingly do anything to spoil the countryside; they were always willing to take part in any desirable or necessary consultations with other departments with this in mind.

Dr WILLIS, referring to a comment made on short grasses, said that these already existed in nature, and one of the effects of maleic hydrazide was to promote the development of some of these relative to the broader-bladed, taller, tussock forms.

Referring to Dr Way's paper, Dr Willis said that he was not surprised that no change could be detected when using 2,4-D as it was several years before he became aware at Bibury that there were slow changes in the grass components of plant communities treated with this chemical; there was therefore a possibility that chemicals could be used for a period without any apparent effect, but, if used repeatedly over a number of years, might lead to fundamental changes in the vegetation. The grass was shorter after a long period of treatment with 2,4-D because the taller grasses disappeared and short forms took over. With regard to the differences between Dr Way's and his results in the heights of maleic hydrazide sprayed plants, he could not offer any obvious explanation. He had recently collected information on the effects of spray treatments with MH and 2,4-D in many different parts of Britain and also on the continent: of 15 reports, 10 specifically referred to an increase in the finer-leaved meadow grasses and fescues, but every report referred to the disappearance of coarse grasses. In no case did the height of the vegetation exceed 15 in. after treatment with MH and 2,4-D.

Mr R. C. JENNINGS (Technical Director, Chipman Chemical Co., Ltd.,) asked Dr Way if he could say how many of the 300,000 acres of roadside that had been referred to were regularly sprayed with chemical weedkillers and growth-retarders. With reference to the Ministry of Transport memorandum of 7 Feb. 1965, providing the recommendations of this were observed, did Dr Way not think that there were still ample areas in which wildlife could flourish?

Dr WAY replied that no-one seemed to have any detailed information about the amount of chemical spraying carried out for vegetation control on road verges. His impression was that it was not very great. However, it might be possible to find out from manufacturers how much material was sold for this purpose and so arrive at a figure that way. The main concern of conservationists was not so much with the main trunk roads and the 6 ft (not 10 ft) strip that was now being talked about, but with country roads. On a wide verge the treatment of a 6 ft strip would not be significant but on a surprising number of roads, particularly narrow country roads, the verges were often not more than 6 ft wide and if a substantial mileage of these were sprayed in the country with certain materials a good deal of harm could be done.

Dr B. H. GREEN (Southeast Region, The Nature Conservancy) said that the present management techniques of leaving grass cuttings along the road verges, instead of removing them as was done in the past (e.g. as hay), encouraged the growth of lush vegetation, as it acted as a fertiliser.

On railway cuttings, there was a very floristically rich sward, and that was probably due to the fact that the management regime was essentially one of burning. Recent research had shown that burning took out plant nutrients from the soil. Dr Green asked for County Councils' views on the practicability of burning as a management technique for verges.

Mr CHADWICK replied that it would be illegal to burn grass on the highway. The management methods in general use were not designed to produce the best type of sward, but the most economic. The post-war development of the flail machine, which reduced the cuttings to a fine mulch and did not require collecting, had made cutting the most economic proposition.

Miss F. M. BIRKETT (Cumberland) supported other speakers wishing to see planting of indigenous trees. The motorway verges, which were protected from the public, offered an unique opportunity to conserve some of our flowering plants. If a way could be found to establish these plants on them, and the vegetation height could be controlled by chemicals, motorway verges could form a reserve bank of plants at a time when there was so much destruction of the native flora elsewhere.

Dr PERRING emphasised that planting should not be done indiscriminately. Anybody wishing to introduce plants widely on road verges should consult with their Naturalists' Trust before doing so, so as to ensure that any species planted were native to the area concerned, and not just of the country as a whole.

Mr UNDERWOOD added that since the building of motorways caused very considerable disturbance of the natural conditions, it would be many years before soil conditions had been sufficiently ameliorated for many wild species to survive.

Mr E. P. WHITTAKER (Fisons Ltd., Chesterford Park Research Station) referred to the opposition to the large amount of rye grass in Ministry of Transport mixtures, and suggested that the addition of species such as chamomile and bird's foot trefoil would reduce the amount of cutting necessary. He was grateful to Dr Willis for bringing attention to the fact that the chemical engineer could improve the flora as well as destroy it, and this was now a developing aspect of their research. He hoped that they might be able to help the naturalist in extending the flora as well as meeting the demands of the highway engineers in reducing the height of the vegetation by maleic hydrazide and other compounds.

Mr G. G. FISHER (Fisons Ltd., Chesterford Park Research Station) asked whether the conservation of road verges on motorways was of any real value if the public could not find access to them.

Dr WAY replied that although it had already been stated that conservation and amenity interests were very similar, the creation of reservoirs for wildlife did require protection from serious public pressure, so that motorway verges, as railway embankments in the past, were of enormous value in this respect. If these reservoirs were successful they would provide sources of propagules of plants for colonisation of areas that were accessible to the public.

Mr A.P. DUNBALL (Horticultural Adviser, Ministry of Transport) took up three points raised by Mr Underwood:

1. The grass seed mixture recommended by the Ministry of Transport was constantly under review. It was formulated after advice had been sought from bodies such as the Grassland Research Institute, the Sports Turf Research Institute and the Ministry of Agriculture, in an endeavour to meet the varied requirements of the different interests. Sowing of the standard mixture usually resulted in varying herbage composition according to the soil conditions, which had a great effect on the type of community which would develop. Grass would also develop from seeds returned to the site with the top soil.

2. Referring to hydroseeding, he said that although Mr Underwood stated that this was a cheap method of establishing grasses, he had overlooked that the top soil had to be disposed of if it was not returned to the site, and that he personally preferred to grow grass on top soil rather than on subsoil.

3. Replying to Mr Underwood's criticism of overplanting of trees on motorway verges, Mr Dunball said that the width of the planting area had to be taken into account, and if there were 20 acres of land per mile, the tree planting scheme on the M1 in Leicestershire represented 70 acres planting out of 660 acres of motorway.

Finally, Mr Dunball agreed with Mr Underwood's criticism of the Ministry of Transport grass-cutting instructions, because they could not apply rigidly to all parts of England with different soil types, rainfall, etc. They must, as Mr Underwood had suggested, be regarded as a guide, and treated according to local circumstances.

Mr UNDERWOOD replied that the amount of tree planting, for instance in Leicestershire, which was predominantly an open county, seemed to conflict with the Ministry's stated policy of planting to match the surrounding landscape. He pointed out that planted trees had to be tended in the early years, which was very expensive and quite unnecessary, and referred to the booklet "Roads in the Landscape", by Mr Clough Williams Ellis of the Minister's Landscape Advisory Committee, which contained quite acceptable tree planting schemes.

With reference to rye grass in seed mixtures, he said it was necessary to mow the rye before the fescues could establish themselves, so it seemed unnecessary to plant a grass which would cause a maintenance problem. Referring to the Roads in the Landscape conference at Keele, where foreign speakers had reported on strains of short grasses, he said that it would be interesting to investigate these, import restrictions permitting. He suggested that the Ministry of Transport should find out how much of the Ministry's specified red fescue had been sown over the last ten years and compare that with the amount of S59 (red fescue) produced, ie were the Surveyors getting what they asked for?

Finally he said that if there was a general shortage of top soil, it would not of course be thrown away, but that if it was kept in dumps for over six months, its qualities were lost. Top soil was in great demand amongst builders.

Dr D.S. RANWELL (Coastal Ecology Research Station, The Nature Conservancy) said that the meeting might be interested to hear that the Nature Conservancy was also enquiring into the effect of salt on roadside verge vegetation. Evidence of this in America was reviewed at a Symposium in Connecticut and results suggested that salt accumulated under certain conditions and death of roadside vegetation, including trees, had been attributed to this. In some instances the level of salt residues found in America had risen to that found on coastal heaths in this country.

Dr J.P. GRIME (Nature Conservancy Grassland Research Unit, Sheffield) returned to the problem of the introduction of diversity into grassland of motorway margins. Natural communities with high floristic diversity were commonly found in habitats of low productivity, but it was the practice when constructing motorway margins to build up a fairly deep soil, thereby creating a fertile situation. This led to a need for cutting programmes or the use of chemical sprays to suppress the vegetation. Would it not be possible to examine the basic theory of construction and investigate means of producing initially unproductive conditions? At Sheffield, research was being carried out on the effects of inserting perforated plastics into soil profiles in order to produce rocky limestone outcrop situations, where there was naturally a high diversity of species.

Mr CHADWICK replied that it was not his experience to have a surplus of top soil, or of a particularly high grade. He thought it would be an exception to have any appreciable depth of nutrient-rich soil on a road construction.

Dr MOORE (Monks Wood Experimental Station) asked whether Dr Willis thought that in the long run maleic hydrazide would continue to increase diversity, if it prevented flowering, thus eliminating sources of seed.

Dr WILLIS agreed that there was a limit. The effect of MH on flowering was particularly pronounced on monocotyledonous species and many of the annual broad-leaved plants which invaded did in fact flower, fruit and seed. High diversity, as Dr Grime pointed out, was an indication of infertility and an open community. MH had the effect of creating open conditions by keeping some of the larger-growing plants down and therefore allowing colonisable pockets to develop. These were invaded by many of the low-growing annuals and some perennials.

Mr J.C. CADBURY (County Councillor, Worcestershire) asked whether in the use of the flail the threat to birds' nests, small mammals, insects and plants, had been safeguarded against by the introduction of the newer models mentioned by Dr Way. There had been a great deal of devastation in his county by the flail, perhaps even more than by chemical sprays.

He also asked for advice for establishing natural growth on rocky sandstone slopes and whether other plants than grass could be used on central reservations which would be less liable to damage from salt and passing traffic and require less upkeep.

Mr J.R. DEACON (Highways and Bridges Department, Worcestershire County Council) said that in Worcestershire the main use of chemicals for control of grass on verges was for safety reasons where there was poor alignment and poor visibility on Class I and II roads, and certain other spots. Rather less than 15% of grass verges in Worcestershire were treated with chemicals and if commons and bridleways were taken into account the figure would be nearer to 7% of the total acreage of grass to be controlled. He hoped that these figures would help to allay the fears of a number of people in the country who claimed that the Highway engineers were destroying the countryside with chemicals.

Dr WAY said that the newer flail machines were probably better than the old ones, but that the men who used the machines must be instructed to use them sensibly. The fitting of some form of height control facility, such as a jockey wheel or a skid was very desirable.

Mr UNDERWOOD agreed with Dr Way, but said that if flail mowing was only done the 6 ft width from the carriageway, there was still a large part of the verge in which the animals could still thrive. He felt that the reciprocating mower would cause as much damage to nests as the flail machine, and once levelled off the flail was able to give a good grass sward of 2-3 inches.

With regard to establishing grass sward on rock faces, he said that these were usually left as a feature without vegetation, but if a growth was required, the possibility of hydroseeding could be investigated.

He agreed that salt had been a problem in the last five or six years since its introduction into general use against icy conditions, but that the grass seemed to recover, although he did not know whether the concentrations mentioned by Dr Ranwell would eventually kill the vegetation.

Mrs J. K. BELLAMY (British Horse Society) said that it was gratifying to hear Mr Underwood and Dr Way refer to the importance of verges to riders. She said that although horse riders' interests might eventually be covered by the provision of Country and Regional parks, there was a short term problem that existing bridle ways, particularly near towns, were quite inadequate to meet recreational pressures. Some towns had made provisions for riders to use suitable verges to reach the open country, and riders' tracks had been marked out, but other local authorities had passed byelaws to prohibit the use of verges by horses, thus forcing them on to the road, which was undesirable for motorist and rider. She asked that when consideration was being given to highway programmes, the riders' interests should be borne in mind and consultation made with their local Sports Advisory Council or the British Horse Society.

Mr CHADWICK said that the training of racehorses and hunting were important in many counties and the councils were well aware of this.

SUMMING UP

G.R.S. PEPLER

Deputy Clerk, Lindsey County Council, Lincoln.

(Edited transcript of tape-recording)

Thank you, Mr Chairman, very much for your warm personal welcome to me. I would like to convey to you a personal apology from Mr Lane for his not being with you; I know it is a great disappointment to him, because of his indisposition, not to have the opportunity of being here. I wondered whether I ought to avoid any suspicion that I might be subject to any bias in summing up by declaring my interest as a Council member of my County Naturalists' Trust, but then I thought that I could equally well declare quite a variety of other interests as an adviser to a County Highways Committee, an adviser to a County Road Safety Committee, Education Committee, and a group of County Council agricultural committees. I mention these and, of course, as a result, a responsibility through my local authority to some 350,000 people of all ages, to illustrate the very wide diversity of interest which you find brought together in a County Council. Interests which cover all aspects of what has been concerning us all here today. And I think that this is important and significant and I would like to lead on to develop one or two points from it.

First, I think that it illustrates perhaps that the issues that we have been talking about are not issues of "we" and "they"—we are all "we" in this, and I think the way in which at the County level all these interests come together under one roof does emphasise this. It also emphasises the very great responsibilities that the local authority and the County Council have. A heavy responsibility and a tremendous opportunity, and I say this with all due deference and respect to the Ministry of Transport and other bodies with National responsibilities. You do find at County level a coming together of interests which you really do not find anywhere else to quite the same degree in a single organisation. I think one moves on from there, of course, to emphasise the great burden which County Surveyors carry in this particular matter; a burden of which they take a major share as being the member of the local authority top management team most closely concerned with roads and highways. But they need a great deal of sympathy, advice and practical help in discharging their responsibilities, and this must come both from within the authority which they serve and from without. So far as help from without goes, it is quite clear that County Naturalists' Trusts have here the very finest opportunity of taking a lead on behalf of the whole of that part of the public which is concerned about the countryside and road verges in particular; of taking a lead in establishing the right sort of contacts and the right sort of working arrangements with the County Councils, with whom they ought to be working very closely together. And of course it is not only County Naturalists' Trusts. Parish Councils were mentioned, Women's Institutes, and many other bodies. But I believe in this particular matter of road verges it must essentially be the County Naturalists' Trust which takes the major responsibility. We have had today the greatest opportunity of establishing contacts and it will be important to keep them up—and ever develop them.

In this I want to come onto a point which has been touched on once or twice, that what we have been talking about is not just a sort of top-drawer issue to be talked of in assemblies like this Symposium, or London clubs, or the lounge bar, or learned societies. It must be a down-to-earth matter which needs to be talked about much more widely and at all levels. And if I can just take up a point about a comment, a not entirely unmerited criticism, that although County Surveyors and County Planning Officers may be on the very best of terms, and work with great harmony, it doesn't follow automatically that this will happen at all levels unless conscious efforts are made to ensure that it does. I believe there is a constant responsibility on top management to provide the best opportunities and the best climate in which this kind of co-operation can tick over automatically all the way down through the different departments. With this in mind, you could well consider at the County level some sort of gathering of the same kind that we have had here today on the National level. There must be lots of people both within the official organisations and the voluntary bodies who could profit from this kind of discussion on this kind of topic at that kind of level. I hope that this is something that might be done—it may indeed have been done—but one commends it to places where it might not yet have been considered.

This again leads one to emphasise that this communication must be worked on at all levels, and this means, of course, within a highways organisation right down to the county roadman. The fact that he works now in a gang makes it even more important that he should understand the sort of thing that we have been talking about here, in the sort of language which he can easily comprehend. Because, if he does not understand what he is supposed to be doing, and why, he will neither enjoy doing it nor contribute as we would like to the objects we are after. All the more so now he is in a gang—the old typical country lengthsmen on the roads inherited the sort of built-in know-how which enabled him to produce the right sort of answers. But his modern counterpart does not always come from the same background and he needs to be helped and helped constantly, I think, to understand the part that he must play. I would look forward to the occasion when a meeting like this is next organised, and among those addressing the company is a county road foreman. This seems to me to be the sort of basis on which people ought to be participating.

This leads me on to education, a word that I would have liked to have heard mentioned more today, and from two points of view—one from the obvious one that without constant education of junior officials, county roadmen, and the general public, they cannot be expected to appreciate what is being done nor why, nor indeed to make objective suggestions how things might be done differently. That is terribly important, but there is also the very important point about schools, as very often in some parts of the country the only natural habitat for study that exists within reasonable distance of many of our schools is road verges. Speaking as one coming from a county where almost every inch is cultivated, this is something not to be overlooked. It is, I suppose, basically a matter of communication—communication up and down and all round.

Now what thoughts should one go away with? I think really I would put it this way. That I think we ought to go back home convinced that whatever we've been doing and however well we think we have been doing it, there is something more we can do, and there is something more we ought to start doing tomorrow. This sort of gathering only has its real purpose if it leads to individual responsibility being accepted by people who go away out of this room and are determined to take stock of what they are doing or not doing and then take some new step forward. The sum total of all that from a large gathering like this can be very telling. So don't keep it to yourselves. Spread the news around, and take some further action. And finally, Mr Chairman, may I be allowed, with apologies to anyone else who may have been instructed to do this, to express on behalf of all of us who haven't been taking a major part in this Symposium, our grateful thanks to the organisers and in particular to those who have written papers, who have spoken, and particularly to our two Chairmen. We all thank you very much.

Mr BROUGHTON. Thank you very much indeed, Mr Pepler, for those very wise words indeed, and for the very able way in which you have summed up our symposium today. Thank you also for doing what I thought was going to be my task in thanking all concerned. It merely falls to me now to close the symposium and to thank you all very much for attending.