

Design

Council of Industrial Design

152

August 1961

Price 3s

LEGIBILITY

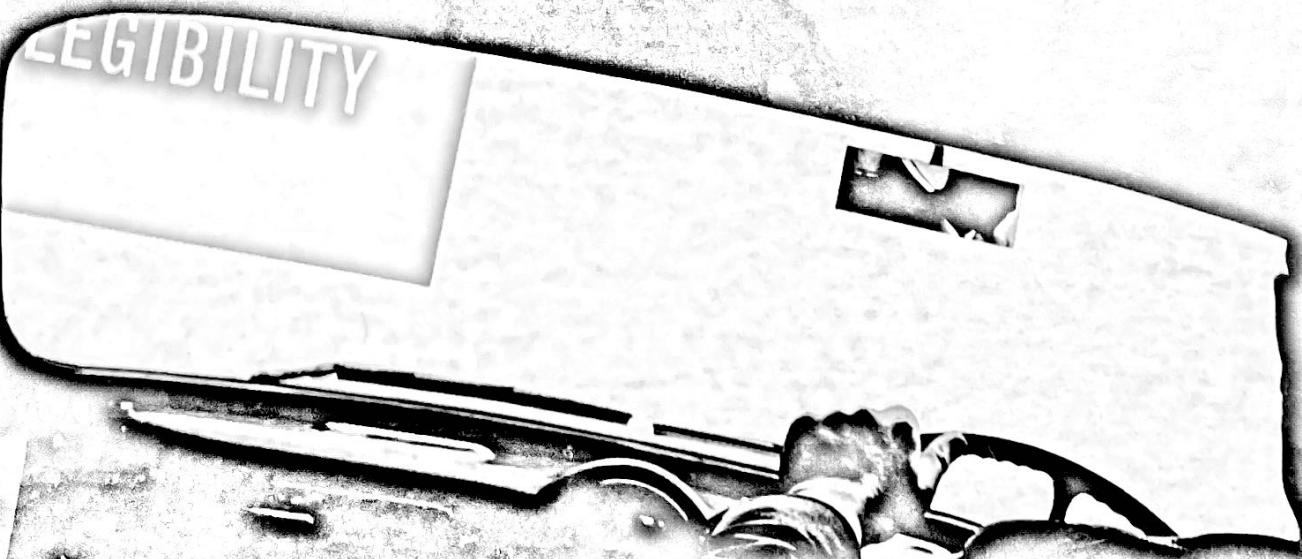
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LETTERING & LEGIBILITY

Direction signs for motorways represent a radical departure from previous highway signs put up by the Ministry of Transport in that place names are in lower case letters. When the first experimental signs were erected on the Preston motorway in 1959 this change from the traditional practice of using capital letters aroused considerable controversy, and arguments for and against the new signs were reported in the article Which Signs for Motorways? (DESIGN 129/28-32). One problem was that conflicting conclusions could be drawn from the available data on the comparative legibility of lower case and capital letters, and the article recommended that further research should be carried out to see if the arguments could be settled on a factual basis. Subsequently, both London Transport Executive and the Road Research Laboratory have conducted experiments, reports of which are published here in summarised form together with comments from three graphic designers.

RESEARCH ON BUS BLINDS . . .

HAROLD F. HUTCHISON,
publicity officer, London Transport Executive

At London Transport we have approached the controversy on whether lower case or capital lettering is preferable for signs with reference to three of our types of publicity – the lists of station names on our ticket machines, the station names on our diagrammatic maps and the names of destinations and places served on our bus blinds.

On ticket machines we have unhesitatingly introduced the lower case system, and on our new diagrammatic map, 1, we have used capitals for our more important stations and lower case for the less important – a practice which has always applied to geographical maps.

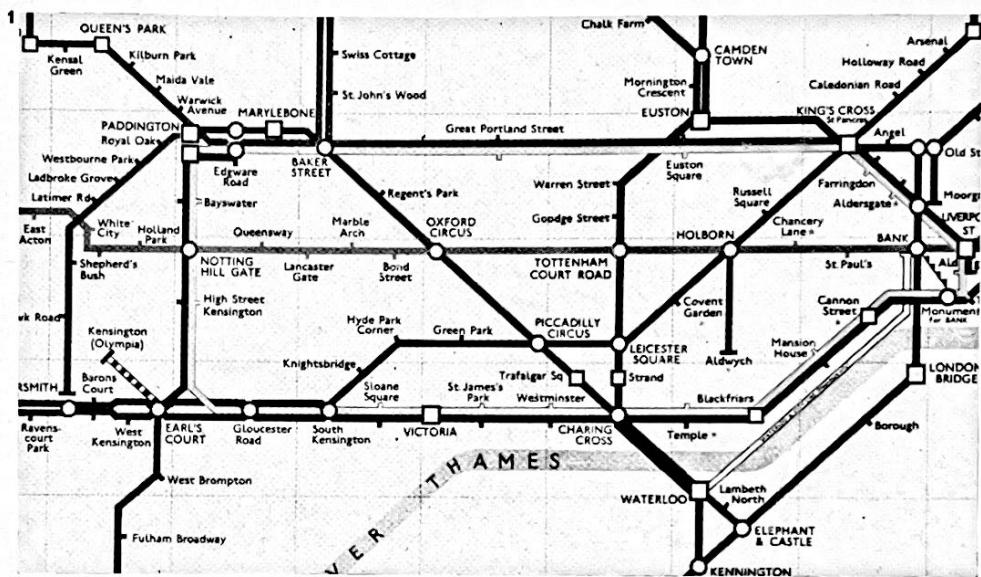
On our bus blinds we came to more controversial ground, and it was decided that our director of research should carry out some scientifically controlled tests related to our own special needs. It does not follow that the results of this research apply universally, and it should be noted that all tests were made with the condensed sans serif lettering designed for London Transport by the late Edward Johnston.

It was essential for operational reasons that we should have as many names of intermediate roads and places as was possible in the given space, and it was decided that we could reasonably afford four lines of three inch capitals as the maximum.

There will be some readers of DESIGN who will be interested in the detailed report*. But here is a brief outline of the tests made and their results:

Tests were designed to assess first the 'distance legibility', and second the 'glance legibility', of two front bus blinds, one arranged in capitals and the other in lower case. Distance legibility was comparatively simple, but glance legibility, or the capacity to take in a message quickly from a brief glance, necessitated more complicated tests, 2.

All the tests were carried out with a group of observers made up of a representative cross-section of new entrants to London Transport and of our laboratory staff – both male and female. For distance legibility each observer wrote down the complete message as soon as he could read every word (this of



2



course was checked), and his distance from the blinds at this point was noted. Various checks were devised for avoiding bias, but the broad conclusion was clearly that there was no appreciable difference between the results for the two different types of blind.

Glance legibility testing required a screen with a shutter placed at about 30 ft from the front of the buses. The observer was placed behind the screen and the shutter opened. The time taken for the observer to find a particular place name on display was recorded. This was repeated for a further three times with either display. The wording of the blinds was elaborately mixed so that memory played no part in the exercise. Again, the overall result was that there appeared to be no significant difference in the time taken to read lower case as against capitals. Exactly the same results were obtained at night as in daylight – which shows that there is nothing wrong with the London Transport method of making and illuminating the blinds.

A further test we called the 'treasure hunt' test. Two blinds were erected. The observer was given, for ex-

ample, Ringwood as a starting point and the shutter opened. Ringwood gave him Gargrave, Gargrave gave him Hamilton, and so on. The time was measured from the opening of the shutter to the finding of the final 'treasure'. Again, there was no significant difference between the two systems, but of course unfamiliar names took longer to read than the familiar names of the previous list. All results were statistically checked.

London Transport was therefore told by its research department that so far as its bus blinds were concerned there was no scientific proof that lower case was superior to capitals.

Before making our choice we prepared a final test to help us. Two mock-ups, 3 and 4, were erected, one representing a bus front top for a typical London route in capitals, and the other giving the same information in lower case, but in both instances we retained capitals for the name of the final destination of the bus – this seemed to us a sensible compromise suited to our own needs. I think readers of DESIGN will agree with us that the upper photograph, 3, is

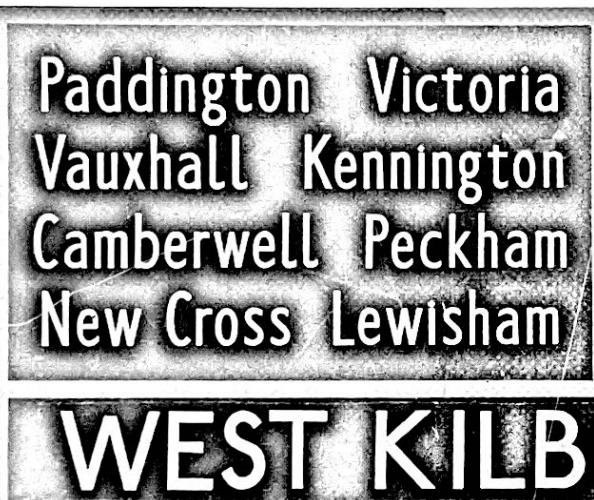
superior as a typographical design, and when tested over a cross-section of the public it also met with popular approval.

The London Transport Executive has, on the strength of these various tests, and on the advice of those responsible for design matters within the organisation, decided to go ahead with new bus blinds on the lines of the upper illustration, 3, but it will of course be some time before we begin to see the results on the London streets.

My own belief is that for ourselves our compromise is sensible and right, and that even on road signs there is a great deal to be said for retaining capitals for major destinations and lower case for minor. The dispute which is now brewing as to serif versus sans serif type founts is so old (and so futile) that we are happy to continue to use the masterly sans of the great Edward Johnston.

* Research Report Summary 118: Final Report on the Comparison of Upper and Lower case Lettering on Bus Blinds, London Transport Research Department (a few copies are available on application to T. Wilford, director of research, 55 Broadway, London SW1).

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4



... AND ON ROAD SIGNS

A. W. CHRISTIE and K. S. RUTLEY

Road Research Laboratory, Department of Scientific and Industrial Research

The types of lettering compared in these tests* are shown in 5 and, reading from the top, are as follows:

- (a) the sans serif upper case script used on signs on ordinary roads (based on lettering designed by Edward Johnston);
- (b) a serifed upper case script designed by David Kindersley; and
- (c) and (d) the sans serif lower case script used on the motorway signs, and designed by Jock Kinneir; (c) in close spacing, and with an x height of 2·4 inches and (d) in wide spacing with an x height of 2 inches.

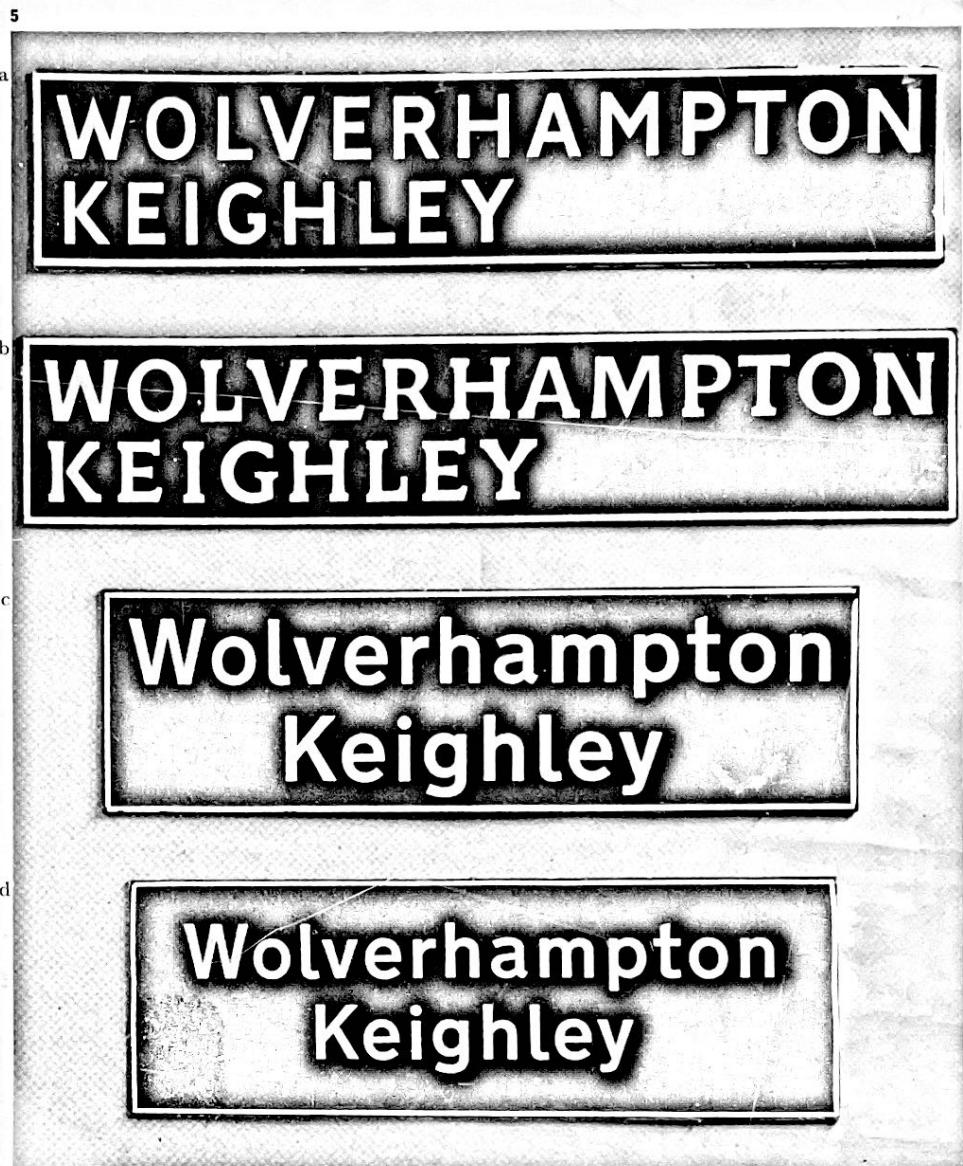
The aim of the experiment was to determine which of these types of lettering would enable drivers to read a sign of fixed area from the greatest range. The reason for making the comparison on the basis of equal area is that the cost of a sign is roughly proportional to its area. The reason for using reading distance as the criterion of effectiveness needs a little more explanation. Since road signs should be readable with the minimum possible distraction from driving, they should be readable, first from the greatest possible range (to keep the angle between the driver's line of sight and the road ahead as small as possible), and second in the smallest possible time. The best single criterion on which to compare two signs, therefore, seems to be the distance at which a driver approaching a sign finishes reading it, for this depends on both the static legibility distance and the time taken to read it.

The reading distance for a sign of given area under a given set of conditions depends on the type of lettering, and also on the extent to which the lettering fills up the available space. The reading distance is small, if small lettering is used, but increases as the letter size is increased, until the legend nearly fills the whole of the available space. Any further increase in letter size leads to a reduction in reading distance. From a preliminary experiment reported in DESIGN's earlier article, it is known that in the case of white lettering on a black ground the maximum legibility distance is obtained with marginal and interlinear spaces of the order of two stroke widths. The signs used in the experiment to compare the different letter types were designed approximately in accordance with this finding. While it is not certain that precisely the optimum condition was achieved with any of the scripts, since the variation in spacing near the optimum condition results in little variation of legibility distance, all the indications are that possible improvements would not amount to more than a few per cent. However, as a check on the effect of spacing, a second set of signs using the motorway script, 5, was added with wider marginal and interlinear spaces of the order of four or five stroke widths. Further details of the spacing conventions adopted are given in the Appendix (page 60).

Legends on the experimental signs

Since one of the advantages claimed for lower case lettering is that it gives to place names characteristic

* A. W. Christie and K. S. Rutley, *The Relative Effectiveness of some Letter Types designed for use on Road Traffic signs*, published in *Roads and Road Construction*, August 1961, Carriers Publishing Co Ltd, 3s.



shapes which enable familiar and expected ones to be recognised from their general outline, care was taken to obtain a representative sample of familiar English place names. The choice was restricted to the names of places with a population of over 50,000. The average number of letters in such place names is 8·23, the average number of ascenders 2·13 and the average number of descenders 0·44. A random sample of 18 such place names was chosen which had the correct average numbers of letters, ascenders and descenders, and which also had the right proportion of long and short names and the most frequently occurring combinations of ascenders and descenders.

Six of the names were then selected for six single-name signs and the remaining 12 used on six two-name signs. The same 18 names were used again on six three-name signs. All these selections were made using tables of random numbers. For simplicity it was decided to have merely the place names on

these experimental signs and to omit any directional symbols.

A further six legends were selected which consisted of written messages, either instructions such as 'Keep Left' or warnings such as 'Ice'.

A total of 96 signs was used, four versions of each of 24 sign legends. Examples are shown in 5. These were produced by photographic enlargement, so that the areas within the white borders of corresponding signs were equal within an accuracy of better than 2 per cent. The average height of the upper case letters was approximately 3 inches, while the height of the lower case letters was 2·4 inches (the close spacing) and 2 inches (the wide spacing).

Experimental procedure

The tests were greatly speeded up by fixing the signs to a khaki coloured panel mounted on top of a car. The car was then driven at 30 mph towards groups of from 10-15 stationary observers seated on a tiered

platform. Though this is the reverse of what happens in practice, it is unlikely that it would affect the order of merit in which the signs were placed. An average of 37 observers (all volunteers from the RAF) saw each sign and, since they were asked to read individual names on separate occasions, more than 6,000 reading distances were recorded, all in fine weather conditions.

Before the experiment, the observers were shown a list of the legends (place names and warnings) which would appear on the signs. The names and messages were therefore 'expected'. No information was given about the types of lettering or the purpose of the experiment.

Each observer was instructed to press a button immediately he could read the required information on the sign. The button operated a pen of a moving chart recorder. An additional pen was used to record the receipt of radio signals transmitted from the car after every 10·8 ft of travel and another to record the passage of the car over a pneumatic detector opposite the observers' platform. The chart therefore enabled the reading distances for each observer to be obtained.

The experimental signs were presented in a balanced random order. The order was varied for different groups of subjects so as to eliminate any bias due to practice, learning or fatigue.

Results

The mean reading distances are given in 6.

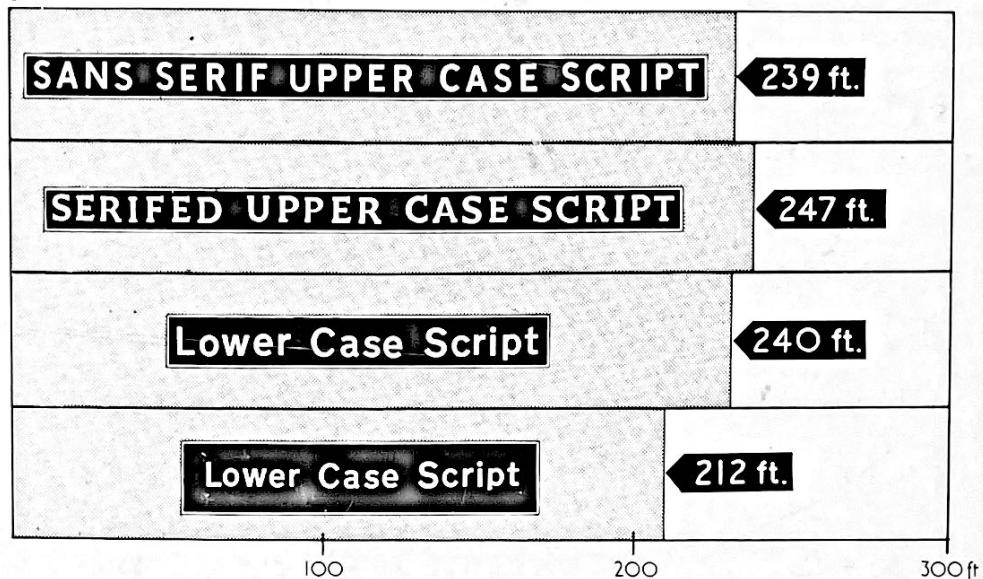
The largest observed effect on reading distance was that due to the change in the spacing convention. The mean distance for the closely spaced version of the lower case script was about 12 per cent greater than that for the widely spaced version (this difference being statistically significant). This finding supports the conclusion from the preliminary experiment on spacing, and the view that the reading distances obtained with the three closely spaced scripts are near to the maximum values which could have been obtained with the sign areas used.

The observed difference between the distances for the closely spaced version of the lower case script and the sans serif upper case script is not statistically significant (ie, it could have arisen by chance). The difference between the distances for the serifed upper case script and the other two scripts is about 3 per cent and this is statistically significant (ie the difference is unlikely to be due to chance.) However, as it is not certain that precisely the optimum spacings were used, it is possible that minor modifications in layout might slightly change the estimate of this difference or even reverse it. It is perhaps worth pointing out that it is not at all certain that the difference is due to the serifs, since the scripts differ in other ways which affect legibility (eg, the width to height ratio).

Conclusions

What the results do clearly indicate is that none of the three scripts tested has any appreciable advantage over the others with regard to legibility. Consequently, it is unlikely that large differences can exist between the maximum reading distances obtainable with good upper and lower case scripts, whether serifed or sans serif.

6



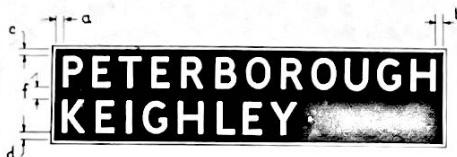
Since there is little difference in legibility between the different types of lettering, it seems reasonable to make the choice on aesthetic grounds. Aesthetic considerations may enter also into the choice of the convention to be adopted for the marginal and interlinear spaces. As has been shown, the most economical solution (smallest sign) is obtained with quite narrow spaces. If it is thought that a better appear-

ance is obtained with wider spaces and that this is desirable, then the signs to give the required reading distance will be larger and more expensive. For example, the area and cost of the widely spaced version of the lower case script used in this experiment would have to be increased by 25 per cent to give the same reading distance as the closely spaced version of the same script.

APPENDIX

Upper case scripts

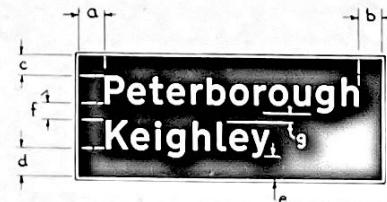
The interlinear and marginal spacings were a fairly constant multiple of the stroke width for the two upper case scripts, and average values are given in the table below. For the sans serif script the stroke width was constant, but for the serifed script the stroke width was different at different parts of the letters, and the value used was that obtained by measuring across the middle of vertical strokes (such as the leading stroke of D). In all cases the clearances mentioned in the table are based on minimum clearances, eg, the clearance between an initial capital C and the left hand border was measured half-way up the letter.



	a	b	c	d	f
Sans serif upper case	1½	1½	1½	1½	2¼
Serifed upper case	1½	1½	1½	1½	2¼

Lower case scripts

The spacings for the widely spaced version of the lower case script were much more variable (probably because each sign had been designed separately). The values given in the table below are average values. The convention adopted for the closely spaced version varied slightly according to whether or not there was a letter with a descender in the bottom line.



Average spacings (number of stroke widths) in inches

	a	b	c	d	e	f	g
Widely spaced version	5½	4½	4	5½	4½	3½	1½
Closely spaced version with no descenders in bottom line;	2	2	2	2	-	3½	1½
with descenders in bottom line	2	2	2	-	1	3½	1½

COMMENTS

DESIGN invited three British graphic designers to read the two reports, and submit their comments

Herbert Spencer: It is the designer's function to evolve solutions which are satisfactory on both practical and aesthetic grounds. Neither the one consideration nor the other is of greater value so far as the designer is concerned, and only a design which fully satisfies both requirements ought to be regarded as 'good' or 'successful'.

What is aesthetically acceptable is a matter of taste, tradition, relevance, and fashion. But the practical element can generally be measured and assessed, although the methods and techniques for carrying out such tests are sometimes difficult to devise. In the case of lettering and typography such tests are especially difficult to arrange since legibility and readability are determined by both physical and psychological factors.

These two reports on carefully arranged tests conclude that there is no significant difference between the legibility of upper and lower case on the one hand and between the sans serif used by Jock Kinneir on M1 road signs and the partially serifed letter proposed by David Kindersley on the other. Mr Kinneir's M1 lettering closely corresponds with that used by most European countries, and I personally believe that this should be adopted for all British road signs. (The fact that as a nation we seem to prefer flights of prose on our road signs rather than simple, internationally understood symbols ought not, I think, to lead us to use book types for road signs). If the Road Research Laboratory tests had proved that Mr Kindersley's lettering was overwhelmingly more legible than Mr Kinneir's, then I would accept the case for abandoning the latter; but, as a designer, I would be quite unable to accept the former, which I find clumsy and which, I think, ignores both taste and tradition alike. If, then, the result of these tests had been strongly in favour of Mr Kindersley's lettering, as a designer I would have needed to know (and this is where scientific tests have so far proved of little help) what were the particular characteristics that made this style more legible than the other under conditions of movement. For only with this information would I be in a position to try to arrive at a form of lettering that would be efficient in use and that I would find aesthetically acceptable.

Such tests of lettering as these are therefore useful in disposing of pseudo-scientific arguments, but in cases where the results strongly favour a particular design they must, to be of practical use to designers, be elaborated upon so that we can clearly understand why one design functions more effectively than another.

Reynolds Stone: As far as they went, the experiments described in these reports proved surprisingly that there was barely a pennyworth of difference between the legibility of capitals and lower case letters. There was, however, one rather glaring omission which left the issue still in doubt. Except for a set of unusually serifed capitals designed by David Kindersley, all the experiments were made with sans serif letter forms. One might have supposed that a fairly condensed bold serifed Roman lower case would have been ideal (lower case cries out for serifs more than capitals). Or even an Italic, which, of all forms of the alphabet, uses less lateral space for a given size and can be beautifully clear.

The Road Research report goes out of its way to emphasize that "aesthetics as opposed to economics" were hardly considered (does the latter just mean the cost of the making of the signs?). Yet in a matter so purely visual, aesthetics will keep breaking in. The authorities rightly employed a good designer, Jock Kinneir, to make new signs, which were an enormous improvement on the old Ministry of Transport ones. Did he or they suggest sans serif forms? There was the example of Edward Johnston's London Transport sans; and the forms used on Continental highways perhaps encouraged the feeling that the sans serif letter would look up to date. Of course such types were in use more than 100 years ago, yet it appears at intervals as the latest thing, notably in the 'twenties with the New Typography inspired by the Bauhaus. Fashionable or not, the use of sans meant ignoring experts like the psychologist Sir Cyril Burt, who "has recently recalled and reaffirmed scientific findings that 'for word recognition a sans serif type face was the worst of all.'" (see *Letters without serifs* by P. M. Handover in *Motif 6*). Presumably motorists, as well as *Motif* readers, are concerned with 'word recognition'. A test with a good serifed lower case might have been interesting.

Mr Kinneir's white lower case letters are well drawn and look clear on their coloured ground. His numerals could be more legible, and possibly his lower case G (a difficult letter).

The report on the legibility of bus blinds was entirely concerned with comparing the legibility of the capitals and lower case of the condensed version of Edward Johnston's sans serif letter. What an excellent alphabet it is! The narrowness of the forms makes up to a certain extent for the absence of serifs. It might have shown up well on the motorway.

An afterthought: the restriction of lower case for town names and the use of capitals for injunctions like 'No Entry', when they have more force, might make for overall clarity. Will this be done?

Colin Forbes: All designers should welcome independent scientific evidence in their field of design. The two reports summarized here at least clarify some simple points. It would appear that there is so little difference between alphabets based on a classical Roman form with or without serifs as to make argument useless.

The problem in research, however, is that the level is so elementary – and yet permutations of letter design in relation to spacing and the variations of capitals and lower case are endless. The whole problem is very pertinent to me at the moment, as I am involved with a new signposting system. This is an extension and variation of a project that I worked on a few years ago. The discussion in the Road Research report points out that the very slight advantage of capitals may well be reversed by reduction of the interlinear spacing in the tested signs. The most significant alteration is in the spacing of the signs, and I have already decided to reduce the margin areas and interlinear spacing to the minimum. This is by no means an innovation, only an extension of the trend in magazine and book design. This trend has, however, been mainly intuitive, and it is reassuring to have it confirmed by research.

The full version of the Road Research report claims that there was a tendency for imperative messages to be more effective in capitals. The full version of the London Transport report states that public opinion would be equally divided between capitals and lower case. A thought struck me that the real division among designers is one of two generations, allowing for the fact that many belong to a different generation from the one their age would suggest.