Report on the influence of school-books upon eyesight / British Association for the Advancement of Science.

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BIRMINGHAM MEETING, 1913

REPORT

ON THE

INFLUENCE OF SCHOOL-BOOKS

UPON

EYESIGHT

(Second Edition Revised.)

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Report[1] *of the Committee, consisting of*—

Dr. G. A. Auden (*Chairman*), Mr. G. F. Daniell (*Secretary*), Mr. C. H. Bothamley, Mr. W. D. Eggar, Professor R. A. Gregory, Mr. N. Bishop Harman, Mr. J. L. Holland, Professor Priestley Smith, *and* Mr. W. T. H. Walsh, *appointed to inquire into the influence of School-books upon Eyesight.*

The Committee was appointed at Portsmouth in 1911, and from the beginning of its investigations has had the advantage of the assistance of Dr. H. Eason, Professor H. R. Kenwood, Mr. R. B. Lattimer, Miss Brown Smith, and Dr. Louisa Woodcock.

In view of the fact that Local Education Authorities are able greatly to influence the selection of school-books, the Committee made an inquiry, on which is based the section of this report headed 'Present Practice of Local Education Authorities.' At the request of the Committee Dr. H. Eason, Mr. Bishop Harman, and Professor Priestley Smith drew up the 'Oculist Sub-Committee's Report.' The typographical section of the report has been revised since its original presentation at Dundee, and to this portion oculists, school medical officers, directors of education, teachers, publishers, printers, and type-founders have contributed. The Committee desires to record its sense of obligation to the pioneer work of Javal.

[1] This report is a revision (involving substantial alterations) of that presented by the Committee in 1912, and is printed from the type in which the report of 1912 was set up, at the request of the Committee, subsequently to its issue in the ordinary type used for the Annual Report of the Association.

The Present Practice of Local Education Authorities in England and Wales.

In a circular (No. 596) issued by the Board of Education in 1908 the functions of the School Medical Officer are defined. Under the heading of 'Arrangements for attending to the health and physical condition of school children' it is stated that he will advise the Local Education Authority with reference to improvements of the school arrangements. It is further stated in the Circular that 'As regards cases of defective eyesight he will indicate such measures as can be taken to remedy or mitigate the defects by altering the position of the children in the class, or improving the lighting of the school in amount or direction; and he will call attention to the strain imposed on eyesight by the use of too small type in text-books, the teaching of very fine sewing, &c.' There can be no doubt that this suggested advice has in many cases led to an improvement where certain school arrangements have been prejudicial to vision; but hitherto it has not been possible to deal effectively with the provision of satisfactory school text-books.

A circular letter was sent to the Education Authority of each county and county borough stating the objects of the Committee, and asking for information on the following points:—

(1) Whether the eyesight of the children in the schools of the Authority is tested at regular intervals;

(2) Whether advice on the care of the children's eyesight is given to school teachers;

(3) Whether the teachers instruct the children in the general care of eyesight;

(4) What regulations (if any) have been adopted for the selection of school-books and

atlases (including limits of price, size of type, character of illustrations, weight, &c.), wall maps, charts, and diagrams;

(5) Whether any definite principles or rules have been laid down by or for those who select school-books for the Authority.

Replies were received from sixty Authorities, to whom and their officers the Committee is much indebted for the information supplied.

Under the system of medical inspection now general in public elementary schools, in accordance with the day-school code, the eyesight of children of school age is tested at least twice during their school life, the test being made, with few exceptions, by means of the well known test-cards. A few Authorities in both counties and county boroughs go further, and employ a competent oculist, either part or full time, his duty being to examine special cases and prescribe spectacles or recommend that medical or operative treatment be obtained. Some Authorities have arrangements under which spectacles according to the prescription of their oculist are supplied to the children at cost price, which is comparatively low by reason of special contracts. Arrangements are also made for free provision of spectacles in case of need, frequently with the aid of voluntary associations.

The school medical officers and ophthalmic surgeons on the occasion of their visits give advice to the teachers concerning the treatment of children with defective sight. With one or two important exceptions, however, it would seem that instruction concerning proper and improper use of the eyes in school-work has not been given to teachers. The Committee is pleased to report that, under the new regulations for the training of teachers, hygiene, including testing of eyesight, is now a

compulsory subject for the Board of Education examination of training-college students.

We learn that it is not customary for teachers to give the children special instruction concerning the care of their eyes. It is stated in several instances that teaching of this kind is given incidentally in the course of the lessons on hygiene which form part of the school curriculum; but nothing more is done, and what is done amounts to very little.

Speaking generally, no definite principles or rules as to printing and other conditions of legibility have been adopted in the selection of school-books, atlases, diagrams, &c. Two or three Authorities, when drawing up their book-lists, have given considerable attention to their possible effects on eye-sight, but without formulating any definite rules. Several state that the Committee or officers responsible for the supervision of the book-supply pay attention to the type, paper, &c.; several, on the other hand, inform us that the selection of books, &c., is left to the teachers.

Summarising the evidence generally, it may be said that whilst effective arrangements for the detection of existing defects in the eyesight of elementary school children are general and arrangements for the supply of proper spectacles at cheap rates are not uncommon, practically no systematic attention is given to the influence of school-books upon eyesight.

The replies lead us to believe that the report of the Committee will have attention from Local Education Authorities.

Report of the Oculist Sub-Committee.

The eye of the child is a growing eye. It is immature both in structure and in function. At

birth the eye has a volume equal to about half that of the full-grown eye; the materials of which it is built are comparatively soft and yielding; the functional power of the visual apparatus is merely a perception of light. By growth and development, rapid at first, slower later on, the eye tends progressively to acquire the dimensions and the powers of the normal completed organ.

Nutrition by healthy blood, and the natural stimulus of voluntary use, are essential to this process. We know by experience that in early infancy disease may arrest the growth of the eye, and that suspension of use, as when a serious ophthalmia prevents an infant for many weeks from attempting to use its eyes, may check functional development to an extent which cannot afterwards be made good. On the other hand, excessive efforts, due to unnatural demands on the eyesight, are apt to be injurious in the opposite direction. Unfortunately there is evidence to show that the demand made on the eyesight of school children is not infrequently excessive.

At the age when school life begins the visual apparatus is still immature. The orbits, the eyes themselves, and the muscles and nerves which move them, have still to increase considerably in size. The various brain-structures concerned in vision have not only to grow but to become more complex. The intricate co-ordinating mechanism which later will enable the eyes, brain, and hand to work together with minute precision is awaiting development by training. The refraction of the eyes is not yet fixed. It is usually more or less hypermetropic, with a tendency to change in the direction of normal sight; in other words, it has not reached the ideal condition in which the eyes see distant objects without accommodative effort, but is tend-

ing towards it. In short, the whole visual apparatus is still unfinished, and is therefore more liable than at a later age to injury by over-use.

Over-use of the eyes is chiefly to be feared in such occupations as reading, writing, and sewing, not in viewing distant objects. During near work the head is usually bent forward, and the blood-vessels of the eyes tend to become fuller; the focus of the eyes is shortened by a muscular effort which alters the form of the crystalline lens; the visual axes, which in distant vision are nearly parallel, are held in a position of convergence, and if the work be reading, they are also moved continuously from side to side. It is near work, therefore, that makes the greatest demand upon the eyes, and the nearer the work the greater the strain. Moreover it is chiefly in near work that continuous mental effort is required.

Children who do too much close eye-work suffer in various ways. Some simply from fatigue, showing itself by inattention, mental weariness, temporary dimness of sight, or aching of the eyes and head. Some from congestion of the eyes, as shown by redness, watering, and frequent blinking. A certain number, in circumstances which predispose them to the disorder, develop strabismus, or squint. Some others—and these cases are perhaps the most important of all—develop progressive myopia.

Myopia, or short sight, commonly depends on undue elongation of the eyeball. It is never, or hardly ever, present at birth. It is rare at five years of age. It usually begins during school life, and increases more or less from year to year during the period of growth. It sometimes continues to increase after growth is completed. It is not necessarily, or always, associated with over-use of

the eyes, either in school or elsewhere, for we see it arise after illness, we meet with it in illiterates, and we know that the predisposition to it is strongly hereditary. But it is everywhere most frequent among the most studious, and there is a mass of evidence to show that it depends very largely, both in its origin and in its progress, on over-use of the eyes in near work.

A moderate myopia which does not increase may be regarded as an innocent, though somewhat inconvenient, over-development of the eye. A high myopia usually involves serious stretching and thinning of the coats of the eye, and a liability to further trouble. A high myopia in a child is a very grave condition, for further deterioration always follows. In connection with myopia alone, to say nothing of other eye defects, the question of school-work in relation to eyesight deserves more attention than it has hitherto received.

The subject has many sides : the lighting of school-rooms, the arrangement of the desks, the design and proportion of individual desks, the attitudes of the scholars, the amount of work required, are all factors of importance ; but they cannot be considered here. Our present effort is directed to the standardising of school-books, a very important step in the desired direction.

Small print leads the young scholar to look too closely at his book. He is not yet familiar with the forms of the words, and his attention is not easily secured unless he has retinal images larger than those which satisfy the trained reader. To obtain these larger images he brings the book too near to his eyes, or his eyes too near the book, and this, for the reasons already given, is apt to be injurious. Hence the importance of establishing certain standards of legibility for school-books,

having regard to the ages of the scholars who are required to use them, and of employing only such books as reach these standards.

The importance of the matter becomes still more evident when we remember that, according to recent medical inspection, at least 10 per cent. of the children in our elementary schools have serious defects of vision, and about 20 per cent. errors of refraction, and see less easily and clearly, even when provided with proper glasses, than do normal-sighted children.

At what age should children begin to read from books? From the hygienic point of view the later the better, and there is reason to believe that little, if anything, is lost educationally by postponing the use of books in school until the age of seven at earliest. Beginners may learn to read from wall-charts; and in the general instruction of young children, teaching by word of mouth, with the help of black-boards, large-printed wall-sheets, pictures, and other objects which are easily seen at a distance, is preferable from the medical standpoint, for it has the great advantage of involving no strain on the eyes.

Hygienic Requirements with which School-books should conform.

The Committee desires to acknowledge the helpful advice received from Mr. J. H. Mason, Mr. R. J. Davies, Mr. F. J. Hall, Mr. H. Fitzhenry, and Mr. F. Killick in connection with the technical and trade aspects of this section of its report; also to thank Messrs. Caslon & Co., the Chiswick Press, John Haddon & Co., the Imprint Publishing Co., Miller & Richard, Shanks & Sons, Stephenson, Blake & Co., R. H. Stevens & Co., for the loan of specimen books, types and printing papers.

The factors which have been taken into consideration are : (1) The nature of the psychological process involved in reading; (2) the quality of the workmanship employed in book-production ; (3) the quality of the paper on which text and illustrations are printed; (3a) the mode of binding books; (4) the character of the illustrations and the process employed for their reproduction ; (5) the colour and quality of the ink used in printing the text ; (6) the mode of printing ; (7) the character of the type ; (8) the size of the type faces and their vertical and horizontal separation ; (9) the length of the lines; (10 to 18) particular requirements of special subjects.

1. *The psychology of the reading process.*—The special consideration to be here noted is that the printing should be such as will facilitate the main aim of reading—viz. the getting of the meaning of what is read. The trained reader generally recognises whole words and phrases at a glance. It is therefore important that the process of beginners should be made as easy as possible towards the recognition of word-wholes and phrase-wholes by the use of type suitable in character and judiciously spaced. The best type for isolated letters is not necessarily the best for word-wholes, and attention must be given to the comparative legibility of letters as seen in context.

2. *Workmanship.*—It frequently happens that much of the good effect of well-selected type, paper, &c., is neutralised by inefficient workmanship. In all the recommendations which follow, good workmanship will be assumed.

3. *Paper.*—The paper should be without gloss. Glazed paper is trying to the eyes by reason of reflections which are apt to interfere with binocular

vision. Pure white paper gives the greatest contrast with the ink, and therefore a paper which is white or slightly toned towards cream-colour is to be preferred under average conditions of class-room illumination. A hard-wearing paper of suitable quality should be used, as a soft paper has two defects—(1) it is readily soiled, (2) the surface is easily rubbed off and the detritus is injurious. The surface should be fairly smooth, because a rough-surfaced paper necessitates a heavy impression in order that the unbroken surface of each letter may appear, which impression is liable to cause a still rougher surface on the other side of the sheet. The print of one side must not show through from the other, and the printing must not affect the evenness of the surface of the other side. These rules also apply to illustrations, which afford a good test of the opacity of the paper. Books are occasionally bound and pressed before the ink is dried, and a faint impression of the opposite sheets causes a haze. Copies with this defect should be rejected.

3a. *Mode of binding books.*—Books should be stitched with thread. Books should open flat and should not require the restraint of the hand to keep them so; stabbing or clipping should therefore be avoided. If not flat, the convex surface of the page gives rise to eye-strain. On recent tests of a large number of school-books Mr. Bishop Harman reports that certain small books with very good paper and type could not be passed as satisfactory because they were clipped from side to side with wire staples. The books could not be opened flat; the back margin was lost and sometimes even the print near the back. The excessive handling needed to keep such books open would soon cause the pages to be soiled. Even in the

better samples of wire-stabbed and thread-stabbed work the margin was reduced.

4. *Illustrations* include (1) pictures for young readers, (2) diagrams and sketches, and (3) photographic reproductions involving considerable elaboration of detail. For (1) it is important to recollect that children are only confused by elaborate or complex pictures. Bold, firm treatment of a few objects is appropriate alike to their visual powers and to their understanding. From this point of view line blocks from pen-and-ink drawings are preferable to half-tone blocks from photographs or from wash-drawings. The pictures should be of a good size, and the printed text should not extend in narrow lines at the side. In the case of (2) diagrams, it is important that the lettering should not be too small to be easily read. (3) For the older scholars it is sometimes necessary to provide illustrations exhibiting details with the precision most readily obtainable by photography. For the sake of obtaining effective illustrations by the half-tone method, use is frequently made of highly glazed paper. Whenever this is done it is important that such paper should be used for illustrations only, and not for the text. By the use of recent methods it is possible to secure half-tone prints with good rendering of detail on matt paper. Blurred photographs not only fail to instruct; they tend to injure eyesight.

5. *Ink.*—The ink should be a good black, and it is important to secure a proper, sufficient, and even distribution of it over the whole page. The use of coloured inks for reading matter is strongly to be deprecated, especially the use of more than one colour on a page.

6. *Mode of printing.*—It is important that types should be in true alignment along the base line.

The practice of printing from stereos produces quite satisfactory results, provided that the stereo is carefully made from new or little-worn type. A slight thickening of all the lines results from stereotyping, but this in no way detracts from legibility. Stereos should not be used when they begin to show signs of wear. The ordinary text of school-books which are intended for continuous reading should not be printed in double columns.

7. *Character of type.*[1]—The type should be clean-cut and well-defined. Condensed or compressed type should not be used, as breadth is even more important than height. The contrast between the finer and the heavier strokes should not be great, for hair-strokes are difficult to see. On the other hand, a very heavy-faced type suffers in legibility through diminution of the white inter-spaces, as, for example, when the space in the upper half of the *e* is reduced to a white dot. In an ideal type the whites and blacks are well balanced in each letter, and it is easy to discriminate between *e, c,* and *o,* between *í* and *l,* and between *h* and *k*; and to recognise *m, nn, nu, nv, w, ín.* The general form of the letters should be broad and square rather than elongated vertically; thus the letter *o* should approach the circular shape. Legibility is not increased by adding to the height of a letter without adding to its width. There should be a lateral shoulder on every type so that each letter is distinct. Long serifs should be avoided, and any extension sideways which forms or suggests a continuous line along the top or bottom is detrimental.

The upper half of a word or letter is usually more important for perception than is the lower half, because the upper half of most letters has a more distinctive shape than the lower. In some

[1] For explanation of technical terms, see Appendix.

recent type-faces the designers have accordingly shortened the letters below the line, and lengthened those above—thus the *p* is shortened and the *h* lengthened, at the same time the upper parts of the *r* have been raised. It is too early to pass judgment on the results, and more experiment is desirable.

With reference to the question of 'modern-face' *versus* 'old-face' design for type, the Committee is not prepared to advise the use of either to the exclusion of the other, good and bad varieties of both styles being at present in use. Great contrast between the thick and thin strokes is a serious defect which often appears in 'modern face.' It is claimed for the 'modern face' that the letters are more legible, and it may be conceded that failure to provide the minimum height of the short letters is more frequent in 'old face.' Hence the letters of the 'modern face' are sometimes more legible in the case of sizes below twelve-point. The advocates of the 'old face' contend that the 'modern face' letters remain isolated, whereas the letters of the 'old face' flow more naturally into words; thus the form of the word and its meaning are apprehended smoothly. It is also claimed that the basic design of the 'old face' is of higher æsthetic merit. The Committee insists on the importance of the minimum height and breadth for the small letters (*vide* columns 2 and 3 of the table), and if this be secured leaves the decision between the 'modern face' and 'old face' to individual judgment helped by the criteria provided in various paragraphs of this report.

Italics, being less easy to read than ordinary type of the same size, should be used sparingly.

8. *The size of type-faces and their vertical and horizontal separation.*—The size of the type-face is

the most important factor in the influence of books upon vision. Legibility depends mainly on the height and breadth of the short letters, for the larger the type the further from the eyes can it be read with ease, and it is of the first importance to induce the young reader to keep a sufficient distance between eyes and book. Children under seven years old should be able to lean back in their seats and read from the book propped up on the far side of the desk. (As a rule books should not be too large or heavy to be held in the hand.) The appended typographical table shows the minimum requirements, in the opinion of the Committee, for the various ages given; the dimensions are given in a form which can be understood and utilised by readers unacquainted with the technical terms used by printers.

The sizes and spacing of the type suggested for age eight to nine years may be adopted for older readers.

The column giving the minimum length of the alphabet of the small letters (*i.e.*, not capitals)

Standard Typographical Table.

Age of Reader	Minimum Height of Face of Short Letters.	Minimum Length of Alphabet of Small Letters	Minimum Interlinear Space	Maximum No. of Lines per Vertical 100 mm. or 4 inches	Maximum Length or Measure of Line
Under 7 yrs.	3·5 mm.	96 mm.	6·5 mm.	10	——
7 to 8 yrs. .	2·5 mm.	72 mm.	4·0 mm.	15	100 mm. or 4 in.
8 to 9 yrs. .	2·0 mm.	55 mm.	2·9 mm.	20	93 mm. or $3\frac{2}{3}$ in.
9 to 12 yrs. .	1·8 mm.	50 mm.	2·4 mm.	22	93 mm. or $3\frac{2}{3}$ in.
Over 12 yrs.	1·58 mm. or $\frac{1}{16}$ inch.	47 mm.	2·2 mm.	24	93 mm. or $3\frac{2}{3}$ in.

1 inch = 25.4 mm.

Specimens of printed matter conforming with the above table will be found in a Supplement.

affords a measure of the breadth of the types. Strictly speaking, this cannot be measured by the reader of a book. A sufficiently good estimate can be made when it is recollected that there are twenty-six letters in the alphabet, and accordingly a word of thirteen letters should not fall short, to a material extent, of half the lengths stated in the third column. A rough rule may be given thus: The number of letters per running inch or 25 mm. should not on the average exceed—

6 or 7	letters for readers	under	7 years.
8 or 9	,, ,,	from 7 to 8	,,
11 or 12	,, ,,	,, 8 to 9	,,
13	,, ,,	,, 9 to 12	,,
13 or 14	,, ,,	over 12	,,

By 'interlinear space' is meant the vertical distance between the bottom of a short letter and the top of a short letter in the next line below. This space between the lines should vary in proportion to the size of the type. Too little space is a source of fatigue in reading, for it involves difficulty in passing from the end of a line to the beginning of the line below. Very wide space, on the other hand, has no advantage as regards legibility, and involves waste of paper and undesirable increase in the size of the book. Columns 4 and 5 of the table indicate a suitable proportion.

9. *The length of the line* is important in a school-book intended for continuous reading. Other things being equal, the longer the line the greater the excursions of the eyes and the greater the difficulty in passing from one line to the next. Very short lines, on the other hand, demand too frequent a change of direction in the movement of the eyes. The use of lines longer than the maxima given in the last column of the table is sure to cause fatigue to a considerable proportion of readers.

Approximate uniformity in length is desirable; but not absolute uniformity. It is doubtful whether the power of fairly rapid intelligent reading can be attained without the *unconscious* performance of the swing from near the end of each line to near the beginning of the next. This swing may be compared with the motion of an oarsman's body between the strokes. An occasional slight indentation in the lines helps the reader; but large ones, if frequent, hinder the acquisition of a good habit of swing. Children of eight years old should not have their reading confined to very short paragraphs, as the habit of swing has been found well established in good readers of between nine and eleven years of age. In other words, these readers made the necessary eye-movements without conscious effort and with great regularity.

Unusual separation of letters should be avoided. For beginners, lines should not end in the middle of a word; the whole word should be carried to the next line and not be hyphened. The admission in the table of a four-inch line for the large type is a concession intended to meet the difficulty of securing an even set of the letters in a line of shorter measure.

Good margins are restful to the eye, and are well worth their slight cost. As a rule the margin at the top or 'head' of a page should be less than that at the bottom or 'tail'; less on the inner side or 'back' than on the outer or 'fore-edge.' So many influences, including optical illusions, have to be considered in determining the proportion of margin that it is not thought desirable to propose formulæ for the purpose. It should be considered a defect in a school-book if the width of fore-edge is less than half an inch, or of back-edge less than three-eighths of an inch, at any page of the book.

Particular Requirements of special Subjects :

10. *Bibles, Prayer-books, and Hymn-books.*—It is to be regretted that these books are so frequently printed in type which is injurious on account of its small size. It is desirable that the standard given in the table should not be lowered with respect to these important books, which are frequently used under poor conditions as regards illumination. The fact must be faced that the Bible contains more matter than can be squeezed into a volume of a size which can be handled by children. It is desirable that one or more volumes should be issued, containing those parts of the Bible which are used in schools. When it is considered desirable to place the complete Bible in the hands of older pupils, this should be in parts or fascicules. The public demand for handy Prayer-books has led to the use of compressed type and of thin paper which is liable to show the print through. Children should not read bijou editions of Bible, Prayer-book or Hymn-book.

10a. *Poetry.*—As it is occasionally impossible to set poetry satisfactorily in type of the size given for under seven years, except on a large page, a height of face not less than 3 mm., with length of alphabet not less than 84 mm. may be allowed in these cases.

11. *Books for Evening Work.*—The unfavourable conditions resulting from artificial illumination and fatigue of the learners make it highly desirable that the rules 'from age twelve' should be maintained for books to be used for home-work or for evening continuation classes.

12. *Exercises, Sets of Examples, and Questions.*—These are important parts of a school-book, and the rules for the printing of them should on no account be less stringent than those applied to

the rest of the book. The same rules should be applied to test-cards. The use of hektographing or other multiplying processes is increasing in schools. Care should be taken to secure clear and legible copies.

13. *The Types for Mathematical Symbols, including those used for Algebra*, should correspond with, or be larger than, the sizes of type recommended for the various ages. It is important that the smaller symbols should not be too fine. For children under twelve years no fractions should be employed less than 4 mm. in height of face; thus in $\frac{3}{4}$ the distance from the top of the 3 to the bottom of the 4 should not be less than 4 mm. For pupils over twelve the minimum face height for fractions should be 3·5 mm. There should be a clear interval between the figures and the separating line. It should be easy to discriminate between the numerals 3, 6, 8 and 9.

14. *Squared Paper.*—Use of squared paper should be restricted to work for which it is really required. If this be done, and paper with rulings not less than one-tenth inch apart be used, there will be little danger to vision. The use of millimetre paper should be restricted to students over fourteen, and it should only be used by them in a good light—on exceptional occasions.

15. *Atlases.*—It does not appear possible to avoid some use in atlases of type which is below the desirable standard of size, and the care which should be exercised by teachers in regard to the children's eyesight needs to be specially emphasised in this connection. Their use should be avoided when the illumination is below normal—the less they are used for home-work the better. Location by reference lines should be taught from the begin-

ning, and children should not be allowed to hunt for a name in an undirected fashion, as they may thus have to read fifty names in finding the one sought. Atlases intended for use by children under nine should have no type smaller than ten-point, with minimum height of 1·6 mm. or one sixteenth inch for the short letters. No school atlas should be printed with type smaller than eight-point, with minimum height of 1·2 mm. for the short letters. The type should be extended; italics should not be used more than is necessary, and should not have fine hair-lines.

It is not necessary that every map should be coloured. (It has already been pointed out that colour decreases legibility.) In the case of beginners, the colour helps the appreciation of area; but for this purpose the colouring should be pale, and few names inserted. For the pourtrayal of relief, the practice of block-shading the contours is better than heavy black hill-shading by hachures. Maps should be duplicated where it is necessary (*e.g.*, Switzerland) to exhibit great variation of contour together with several place-names. In general it is better to multiply maps than to put much detail into one.

If a system of inserting the names of every town of a certain population be adopted, the result is certain to be overcrowding of those portions of the maps which represent highly-populated countries. It would be better to avoid this overcrowding, even at some sacrifice of systematic uniformity. Modern methods in the teaching of geography are reducing the hunting for place-names, and thereby diminishing eye-strain. This advantage will be more general when the supply of orographical maps to public elementary schools

is increased. The reading of Ordnance Survey sheets by the older pupils is not objected to, provided they are used in good daylight.

16. *Music.*—For the tonic sol-fa notation the minimum height of the short letters should be (*a*) for music, 2 mm.; (*b*) for words, 1·5 mm. Staff music is often produced by lithography, in which all gradations of size and shape are possible. Care in printing is needed, so as to secure well-defined stave-lines and tails. Advantage should be taken of the elasticity in the length assigned to different bars in the lithographed music, so as to avoid compression of complicated passages. For beginners music of the size of the 'Giant Note' is recommended. For others, the stave-lines should not be less than 1·75 mm. apart, or the four spaces should measure not less than 7 mm. The ruled paper for music-writing should have lines not less than 2 mm. apart.

17. *Greek.*—Greek type is troublesome to beginners by reason of its unfamiliarity and of the difficulty of synthetising accents and letters into word-wholes. Type which has a line of uniform thickness affords easy discrimination of individual letters, and is legible in mathematical formulæ, even when small sizes are used. The variety of Greek type which employs fine hair-lines should be entirely abandoned. For reading, it is recommended that no type smaller than twelve-point be used for beginners, or eleven-point for experienced readers.

18. *German.*—The older styles of German type are not easily legible, partly on account of the ill-placed hair-lines at the top of the letters. Recent forms of the black letter used in German books are improved in this respect; but since Roman

type is being used largely even for literary works in Germany, the use of the less legible German types may be reduced in our schools with some gain to the security of eyesight.

Conclusion.

The Committee observes in conclusion that:—

(1) The existence of a very serious amount of visual defect among children of school age is established as a result of official inspection. Some portion of this defect is preventable by greater care in the selection of books.

(2) It is desirable that a standard of book-production should be established, and that the publication of books below standard should cease.

(3) It appears possible that the adoption by local education authorities of a common standard would render unprofitable the publication of books which failed to reach such standard.

(4) It is hoped that this report may assist the responsible authorities in the work of determining the standard of book-production requisite for the protection of the eyesight of children so far as it is influenced by the books which the children are compelled to read in school.

APPENDIX.

Notes on Technical Terms used in this Report.

Type-body, type-face, lateral shoulder, large-face.—The letters are cast on a 'type-body'; the part of the type which actually leaves its impress is the 'face.' When the face is nearly as large as the body will carry, the type is 'large face.' The space on the upper surface of the body on each side of the face is the lateral 'shoulder.' All one reads is the impress of the faces of the type.

Serif.—A type in which each letter had only its bare necessary features would be 'without serif,' the serifs being the terminals of the letters. If of proper design, the serifs guide the eye from letter to letter and give a balanced effect. In some styles the serifs take the form of purposeless ornament, which is undesirable in books which are intended for continuous reading.

In *condensed* or *compressed* type the bodies are narrow, so that the letters are narrow and close together. Column 3 of the typographical table excludes such type.

Old face and *modern face* refer to styles of type. In the specimens in the Supplement the faults of the more extreme varieties of each have been avoided.

Heavy type, heavy fractions refer to type of which the lines are thick.

Point is a unit of measurement. Unfortunately manufacturers do not agree precisely as to the size of 'point' which they use. Approximately one point = 1/72 of an inch. Thus an eighteen-point type has a body one-quarter inch high. The face may be of any size smaller than the body.

Solid and leaded.—If the types of consecutive lines are set with no vertical interval between the bodies, the type is 'solid.' When there is a vertical interval, say of a thirty-sixth of an inch, the type is 'two-point leaded.' A large face type of ten-point body with two-point leading will produce about the same vertical space between the short letters as a small-face type of twelve-point body printed solid.

An *indentation* occurs in a line where the print does not extend to the same length as in neighbouring lines, *e.g.*, the first line of this paragraph.

SUPPLEMENT.

SPECIMENS OF TYPE.

The Committee draws attention to the fact that there is considerable variation in the size of the faces of the various types coming under the same rating in point body, or bearing the same trade description. The following specimens are inserted for the purpose of illustrating the dimensional rules proposed by the Committee in the Standard Table (p. 14). The Committee does not undertake to recommend these or other individual designs of type.

For the purpose of testing books reference should be made to the Standard Table, as in several instances the specimens exceed the *minimum* requirements.

No. 1.

UNDER SEVEN.

This type may be used for books to be read by children under seven years. The letters are larger than the minimum in the typographical table. Printed from type known as Thirty Point Old Face.

No. 2.

UNDER SEVEN.

This type may be used for books to be read by children under seven. The letters are larger than the minimum given in the typographical table. Printed from 24 Point Old Style.

No. 3.

UNDER SEVEN.

This type may be used for books to be read by children under seven. The letters are larger than the minimum given in the typographical table. Printed from 24 Point Old Style Antique.

No. 4. AGE SEVEN TO EIGHT

This type may be used for books to be read by children from seven to eight years old. The letters are larger than the minimum given in the typographical table. Printed from Eighteen Point Old Style Antique.

No. 5.* AGE SEVEN TO EIGHT

This type may be used for books to be read by children from seven to eight years old. The letters are larger than the minimum given in a typographical table. Printed from Eighteen Point Old Style, with 2 point Leading.

No. 6.* AGE SEVEN TO EIGHT

This type may be used for books to be read by children from seven to eight years old. The letters are slightly larger than the minimum given in the typographical table. Printed from Old Style Great Primer with 3 point Leading.

No. 7.* AGE EIGHT TO NINE

This type is suitable in size for books to be read by children from eight to nine years old. The size of the letters is slightly larger than the smallest given in the typographical table. Printed from Fourteen Point Old Style with 2 point Leading.

No. 8. AGE EIGHT TO NINE.

This type is suitable in size for books to be read by children from eight to nine years old. The size of the letters is slightly larger than the smallest given in the typographical table. Printed from Twelve Point Modern, with 2 point Leading.

No. 8.* AGE EIGHT TO NINE.

This type is suitable in size for books to be read by children from eight to nine years old. The size of the letters is slightly larger than the smallest given in the typographical table. Printed from Twelve Point Antique Old Style with 3 point Leading.

No. 9.* AGE EIGHT TO NINE.

This type is suitable in size for books to be read by children from eight to nine years old. The size of the letters is slightly larger than the smallest given in the typographical table. Printed from Twelve Point Old Style Antique, No. 7 with 2 point Leading.

No. 10. AGE NINE TO TWELVE.

This type is suitable in size for books intended for readers over nine years old. The size of the letters is slightly larger than the smallest given in the typographical table. Printed from Eleven Point Modern, with 2 point Leading.

No. 11. AGE NINE TO TWELVE.

This type is suitable in size for books intended for readers over nine years old. The size of the letters is equal to the minimum given in the typographical table. Printed from 12 Point Old Style, with 1 Point leading.

No. 12. AGE NINE TO TWELVE.

This type is suitable in size for books intended for readers over nine years old. The size of the letters is equal to the minimum given in the typographica table. Printed from 12 Point Old, with 1 Point leading.

No. 13. OVER TWELVE.

This type is suitable in size for books intended for practised readers over twelve years old. The size of the letters is in conformity with the smallest dimensions given in the typographical table. Printed from Ten Point Modern, with 2 point Leading.

No. 14. OVER TWELVE

This type is suitable in size for books intended for practised readers over twelve years old. The size of the letters is in conformity with the dimensions given in the typographical table. Printed from 11 Point Old Style, with 1 Point leading.

No. 15.* OVER TWELVE.

This type is suitable in size for books intended for practised readers over twelve years old. The size of the letters is in conformity with the smallest dimensions given in the typographical table. Printed from Ten point Antique Old Style, with 2 point Leading.

No. 16.* OVER TWELVE.

This type is suitable in size for books intended for practised readers over twelve years old. The size of the letters is in agreement with the requirements specified in the typographical table. Printed from Ten Point Old Style Antique, No. 7, with 2 Point Leading.

12 POINT GREEK.

ΔΙΟΔΕΥΣΑΝΤΕΣ δὲ τὴν Ἀμφίπολιν καὶ Ἀπολλωνίαν, ἦλθον εἰς Θεσσαλονίκην, ὅπου ἦν ἡ συναγωγὴ τῶν Ἰουδαίων, κατὰ δὲ τὸ εἰωθὸς τῷ Παύλῳ εἰσῆλθε πρὸς,

TONIC SOL-FA MUSIC.

(The smallest size suitable for school use.)

d	: -	: -	d	: -	: d	d	: -	: s_1	f	: -	: m	r	: -	: m	r	: -	: -
Sleep,			gen	-	tle	babe,		your	pret	-	ty	eye	-	lids	clos	-	
l_1	: -	: -	la_1	: -	: la_1	s_1	: -	: m_1	l_1	: -	: s_1	f_1	: -	: s_1	f_1	: -	: -
ma	: -	: -	ma	: -	: ma	m	: -	: d	d	: -	: d	d	: -	: d	t_1	: l_1	: t_1
Sleep,			gen	-	tle	babe,		your	pret	-	ty	eye	-	lids	clos	-	
f_1	: -	: -	fe_1	: -	: fe_1	s_1	: -	: s_1	s_1	: -	: s_1	s_1	: -	: s_1	s_1	: -	: -

p

d	: -	: -	-	:	:	s	: -	: -	m	: -	: d	l_1	: -	: -	t_1	: -	: -
ing,						Soft			sleeps		the	moon	-		beam		
m_1	: -	: -	-	:	:	d	: -	: -	s_1	: -	: m_1	f_1	: -	: -	f_1	: -	: -
d	: -	: -	-	:	:	m	: -	: -	d	: -	: s_1	r	: -	: -	s_1	: -	: -
ing,					*p*	Soft			sleeps		the	moon	-		beam		
d_1	: -	: l_1	s_1	:	: r^1	d_1	: -	: -	-	: -	: -	-	: -	: -	-	: -	:
	Sleep	on			till	day,											

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