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Typographic measurement: a critique and a proposal

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In this paper, by Séamus Ó Brógáin MIOP, the author examines the 'point systems' for typographic measurement, some of which have been in use for over a century, and assesses their pertinence in relation to today's modern technology and printing practices.

He suggests a proposal for a new system which is logical as well as appearance-orientated, applicable to all methods of letter assembly, and suited to the needs of the printing industry.

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Introduction

For over one hundred years, the *point system*—or one of a number of point systems—has been used in every country in which printing has been carried on.

For most of that time, it could be said to have met the requirements of the printing industry for a measurement system which was sufficiently accurate and sufficiently easy to use, and appropriate to the technology of the time. Even then, however, it had a number of drawbacks.

The typographic point has had different measurements in different countries and at different times; and it still has. The Anglo-American point, measuring 0·3514598mm,[1] is not an exact division of any measurement system; nor is the continental European (*Didot*) point, of 0·376065mm[2] or 0·3759mm[1] (according to whom one believes). And there have been, and are, other 'points': the 'metric point' (0·4mm[3]), the Imprimerie Nationale point (0·39877mm[3]), the Monotype point (0·3513582mm[4]), the Lumitype point (0·25mm[3]), and the IBM point (0·3527mm[5]), among others.

But the inherent fault in the point system—that is, in all the point systems—is that the distance measured, in whatever units, is not necessarily visible on the printed sheet, although it is visible, and measurable, where metal type is concerned.

The co-existence of these incoherent systems with modern systems of measurement makes for strange and wonderful combinations: 'Type sizes can be reproduced in graduations of 0·01mm between five and 36 point.'[6]

Three developments at the end of the twentieth century make necessary, and at the same time make possible, a complete departure from this inherently faulty method:

- the internationalization of trade and communications, which requires that the standards, and especially the measurements, used in a particular technology should not vary between different countries (much less between different manufacturers);
- the development and widespread adoption of phototypesetting, in which the object measured by the point system no longer exists;
- the universal adoption of the International System of Units (SI).

A number of proposals have already been made for the adoption of a 'metric system of typography', but, for various reasons, all have failed to win support. In the absence of an agreed standard, it seems that we are going to be subjected to *ad hoc* and go-it-alone measurement systems and notations, some at least of which give us no real information about dimensions. This situation has produced, for example, the term 'key' (very modern-sounding, and no doubt computer-inspired) used in place of *point*, and such combinations as '10 key on 12 point'.[7] This is further exacerbated by the abbreviation of *key* to k (which also has the meaning 'thousand', and also has the meaning 'ascender height'): and there is surely nothing to be said for the piebald '10k/4·25mm'.[8]

To sum up the critique of the point system:

- the dimension expressed is at best unclear, at worst non-existent;
- the point has had different definitions in different places, and at different times, and even among different manufacturers;
- none is related systematically to the metric (or any other) measurement system.

Previous attempts to arrive at a generally acceptable standard system of typographic measurement have failed. The time may now be right to have a fresh look at the problem.

What is to be measured?

Two fundamental questions must be tackled:

- what is to be measured?
- in what units is this measurement to be expressed?

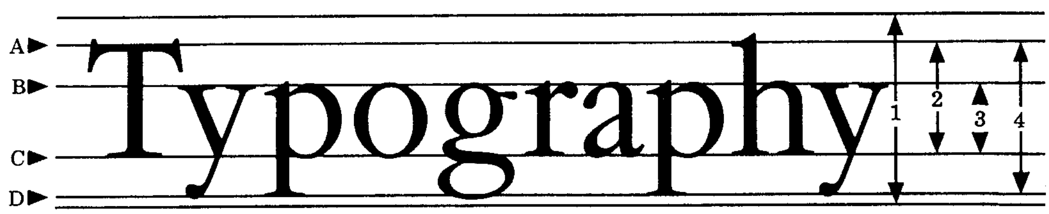
The first question is the one on which there has been most disagreement, and on which the attempt at an international solution within the framework of the International Organization for Standardization (ISO) foundered. To the uninitiated, this might seem strange, but a familiarity with traditional (that is, letterpress) printing discloses a firmly rooted thought process among printers and manufacturers who have spent their working lives using the point system.

For hundreds of years, typesetting was carried on by means of small metal blocks, one for each character. Each piece of type was a solid object with a measurable depth—called the *body size*. This body size served as the 'type size'. Although the size of the letter form on each piece of type was not deducible from the body size, or *vice versa*, there was a certain relationship, albeit a variable and unpredictable one.

The different pieces of type for a given size, regardless of typeface or manufacturer, must align exactly. This was crucial to the success of the whole process, and indeed provided the impetus for the development of the point system. (See Illustration 1).

From the size of the metal type, printers and their customers referred to the printed image as '10-point type' or 12-point type' or whatever it might be, even though the image cannot be measured and said to be 10 points, 12 points, or whatever. The measurement from one base line to the next will produce this figure, but only if the type

Illustration 1



A: cap line
B: mean line
C: base line
D: descender line

1: body size
2: capital height
3: lower-case height
4: overall height

is known to be *set solid,* without any *leading* or additional line spacing: and this is something which cannot be assumed.

When the first attempts to 'metricate' typographic measurement were made, the proposers did just that: they converted the dimensions of lead type from points to millimetres. The most notable such proposal was by Stork,[9] whose scheme was implemented in a number of printing houses in the Federal Republic of Germany and elsewhere.[9,10]

What might not have been foreseen by Stork, however, was that printing technology itself was changing: changing so rapidly that in one generation the industry has been transformed, with the equipment to which Stork applied his innovation in 1954 already regarded in many countries as museum pieces.

From early experimental models in the 1940s and 1950s, phototypesetting of one kind or another is now the everyday typesetting method throughout the industry. The object measured in Stork's proposals simply does not exist with present-day processes.

The same approach was adopted in the drawing-up of the British standard, BS 4786.[11]

This standard, issued in 1972, has largely been ignored. Type sizes in Britain are never (so far as can be ascertained) specified in terms of its provisions: and there is evidence that British equipment manufacturers intend to continue ignoring it until there is an international standard, and international agreement on the method and units of measurement.[12]

Before it was published, the draft British standard was submitted to the ISO for consideration.[13] ISO Technical Committee 130 (Graphic Technology) established Working Group 4 (Typographic Measurement) in 1975. This working group became the battle ground between those who wished to adopt a standard based on measurement of the printed image (the majority) and those who wished to continue specifying type size in terms of body size, even for phototypesetting. Draft proposals for international standards were drawn up, reflecting the majority viewpoint,[14,15] but agreement could not be reached, and the working group was disbanded in 1982.

The ISO draft proposals—the most serious attempt at an international solution—recognized the logic of phototypesetting in rejecting the notion of measuring the type body: but chose instead the height of the capital letters as the definitive measurement. ('For the purpose of short reference, H-height shall be used as the nominal character size designator.'[14])

It is remarkable that the ISO draft proposals, having made the necessary break with tradition, failed to carry through the logic of this change and recognize the dimension which decides the visual size of the type: the lower-case height. The argument has frequently been put forward that the body size (whether there is a body or not) gives no definite indication of visual size: but it is equally true that capital height does not either. (See Illustration 2).

The ISO draft proposals were inconsistent and unscientific, in proposing that type size no longer be specified in terms of a dimension which does not indicate the real size of the type, but in terms of another dimension which does not indicate it either.

The proposal fell, however, not because it was not a *complete* break with the thinking of the past, but because it *was* a break with the past. Certain circles in the printing industry just would not part with the type body, even for phototypesetting, insisting that the latest methods and units of measurement be used to measure something that does not exist.

There is now no immediate or foreseeable prospect of an international standard. How long such a totally unsatisfactory situation will be allowed to continue must be a matter of concern to all with the interests of the printing industry at heart.

The fundamental purpose of a measurement system must be to indicate the size of the thing measured: this is a truism. In the absence of a type body (at least with most technologies, and with those most widely and increasingly used), the visual size seems the obvious candidate.

Looking at a page of printed text, one sees that a definite pattern is formed by the alternating horizontal stripes of white space and the grey rows of predominantly lower-case characters. It seems clear that if a system is to be adopted which specifies the visual size of a typeface, then it is the lower-case height which must be the definitive measurement.

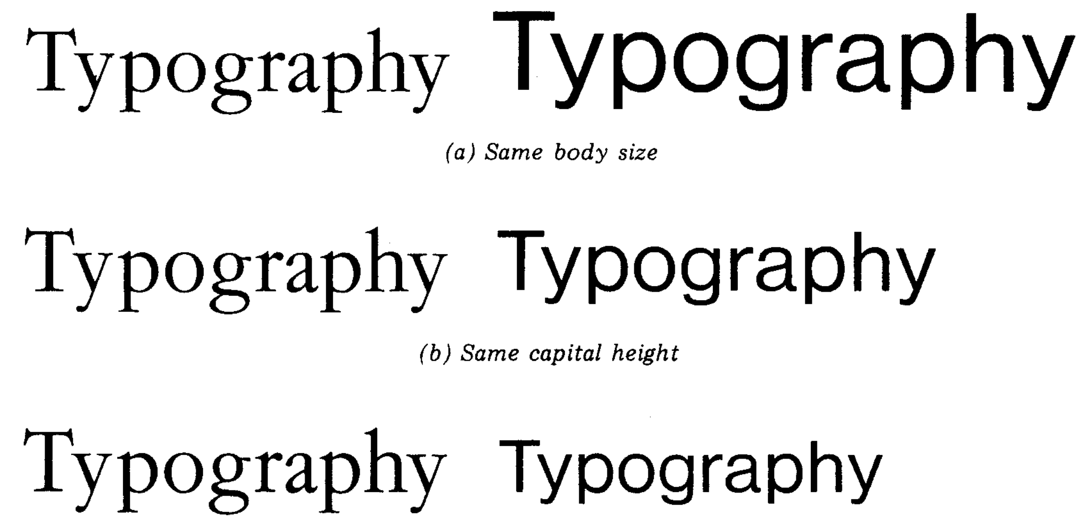
Continuous-text setting in the roman alphabet is made up overwhelmingly of lower-case characters; and 'typesize' and lower-case height are therefore, almost by definition, identical. Ascenders and descenders clearly ascend or descend *from* something, that something being the mean lower-case height (often called the x-height); and capital letters, from the measurement point of view (although not of course from the historical or any other point of view) are merely one kind of ascender.

The lower-case height decides the visual size of the letters, both absolutely and relatively: relative to other typefaces, and relative to other sizes of the same typeface. It is with the lower-case height that other characters should be visually aligned when it is necessary to introduce another typeface into a text; and it is the lower-case height that is most significant in the measurement of legibility.[16]

Indeed, the fact that lower-case size is the real (visual) size is widely recognized, although perhaps not explicitly acknowledged. The literature abounds in references to the necessity of regarding 'x-height' as the deciding factor in judging the size of type. Almost every reference to type size, especially in text-books and manuals, pronounces the body size to be the definitive type size, and then, with no apparent realization of the irony, immediately contradicts itself by explaining that the decisive factor in choosing type size is the 'x-height'.[17]

This permanent double standard—for that is what it is—is an objective necessity, for the reasons already shown, *and would continue to be necessary if capital height were chosen as the primary means of identifying type size.*

With the growth of consumer protection laws and the plain-language movement, *Illustration 2*



(a) Same body size

(b) Same capital height

(c) Same lower-case height

type size for certain documents (for example, contracts and insurance policies) may be specified by law. But if this is specified in points, as it is in recent American statutes, how can these laws be enforced, as the visual size of the printed characters (which is, manifestly, what the law is aiming to control) is not in reality specified? As a *reductio ad absurdum,* consider the possibility of casting 1mm letters on 10-point type body, which is entirely possible, and which would satisfy the legal requirement of 'type larger than 8 point'.[18]

Because of the prominence given to capital height in recent proposals, some manufacturers anxious to 'go metric' are already giving capital height (in millimetres) alongside point sizes. This information is not usually of much use, as it gives no indication of the visual size for text setting. All-capital setting is of course common, frequently unaccompanied by the lower case: and for this reason a rational system of measurement and notation must provide for this factor also.

One other dimension which might usefully be expressed in a standardized notation is the overall height or 'kp height': the height from the top of the ascenders to the bottom of the descenders (which also approximates to the body size in many instances). Given this measurement, as well as the lower-case and capital height, it is possible to calculate (*a*) descender height, and (*b*) ascender height (when this is not the same as capital height).

As to the unit of measurement to be employed, this part of the debate has been resolved by life itself, with the universal adoption by all branches of technology and industry of the SI. The question of the adoption of a special unit, with or without a special name, has been definitively dealt with by Hoch.[10]

It is suggested therefore that type size should be defined by the height of the lower-case letters without ascenders or descenders, in millimetres. Increments of one tenth of a millimetre are visually discernible, and technically feasible, and there is international consensus on the use of basic increments of 0·1mm:[13] therefore notation should express sizes in millimetres and tenths of a millimetre, to the nearest tenth.

Notation

The proposal made here is that the size of printing type, produced by whatever process, be expressed primarily in terms of the lower-case character height, and secondly, by other measurable characteristics. These, as well as the line spacing (base line to base line), are expressed in millimetres, in increments of 0·1mm.

To operate successfully a system of typographic measurement, it is necessary to have an agreed notation, so that type sizes can be referred to, and specified for production purposes, with a minimum of time and inconvenience and without ambiguity. If such a notation is also language-neutral, not requiring the use of words or abbreviations from any one language, so much the better.

Two complementary versions of the notation are proposed, each more appropriate for particular uses: one for *description* (defining the characteristics of a typeface), and the other for *specification* (working instructions for a particular typesetting job).

The basic notation, especially where the context requires explicit reference to the elements measured, consists of a letter which symbolizes the height measured, followed by a number. The symbol mm for millimetre is superflous.

The draft proposal for an international standard, which died with the dissolution of the ISO working group, proposed that in size notations the decimal point be omitted to eliminate the extra key stroke.[14] The ambiguity of referring to a height of 1·0mm as 'H10' seems a very high price to pay for eliminating one key stroke.

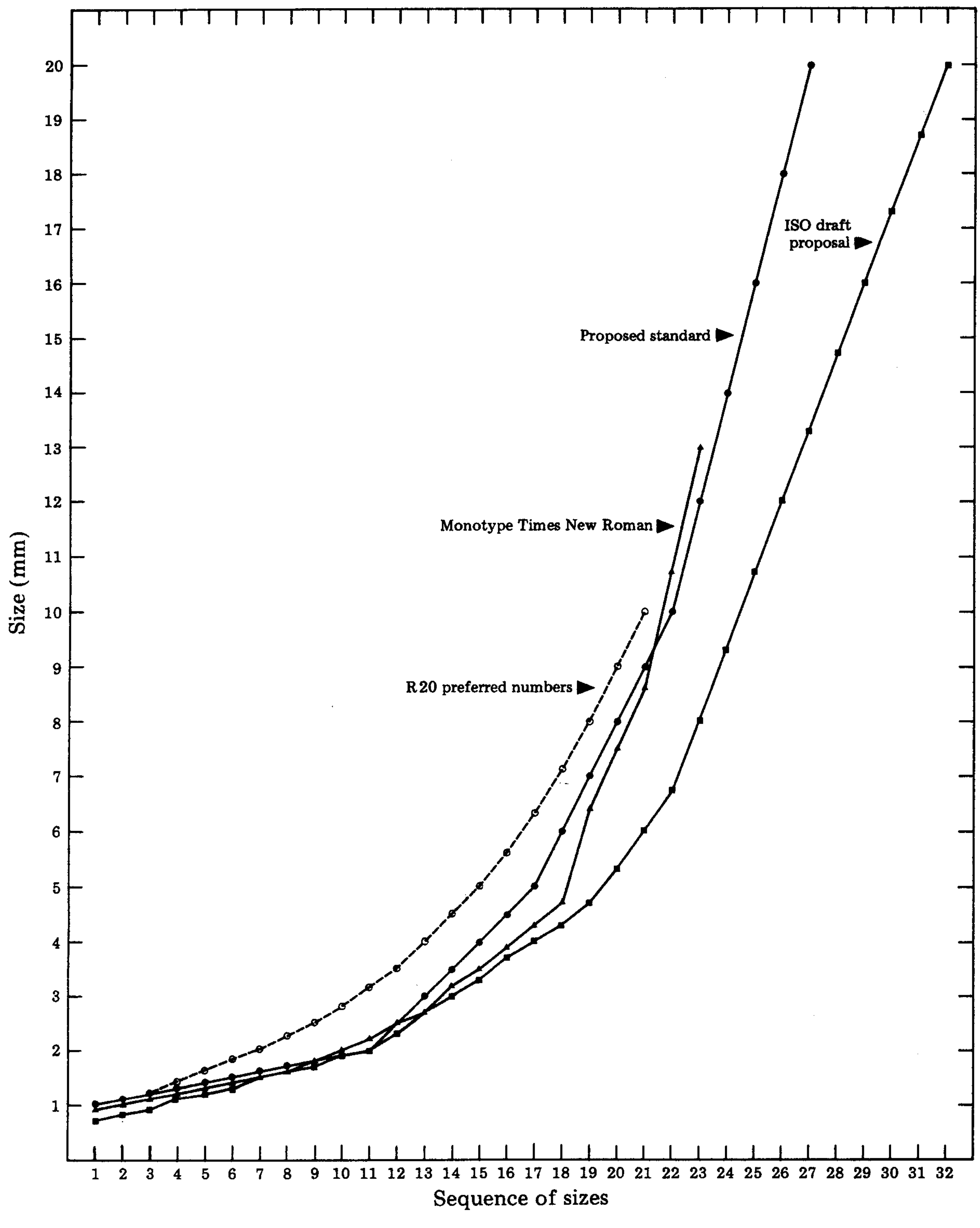
The letter symbols proposed are: z (lower-case height); E (capital height); k (ascender height, used only when this is not the same as capital height); Ep, or kp, as the case may be (overall height).

The reasons for the choice of these letter symbols are distinctiveness, and ease of measurement from the printed sheet. The lower-case z presents two substantial parallel surfaces defining the height of the letter; the same applies to the capital E. For this reason, these letters are preferred to the more customary x, and the proposed use of H. The use of x also introduces confusion with the multiplication sign.

By analogy, other dimensions can be expressed by suitable characters whenever this is necessary: for example, É (capital with diacritical mark); 1 (numeral, if different from capital height).

The reference to the height of the lower-case letters, and therefore the definitive reference to type size, would be in the form: z1·5. A typical reference to capital height would be in the form: E2·2; and so on. These and other size indications can be conbined: thus, z1·5 E2·2.

Illustration 3



A notation for working specifications must also include information on line length and line spacing, and would take the following form:

- name or reference number of typeface;
- type size (lower-case height), *preceded by dash;*
- capital height, *in parentheses;*
- overall height, *in brackets;*
- line spacing (base line to base line), *preceded by diagonal stroke;*
- line length (in whole millimetres), *preceded by multiplication sign*

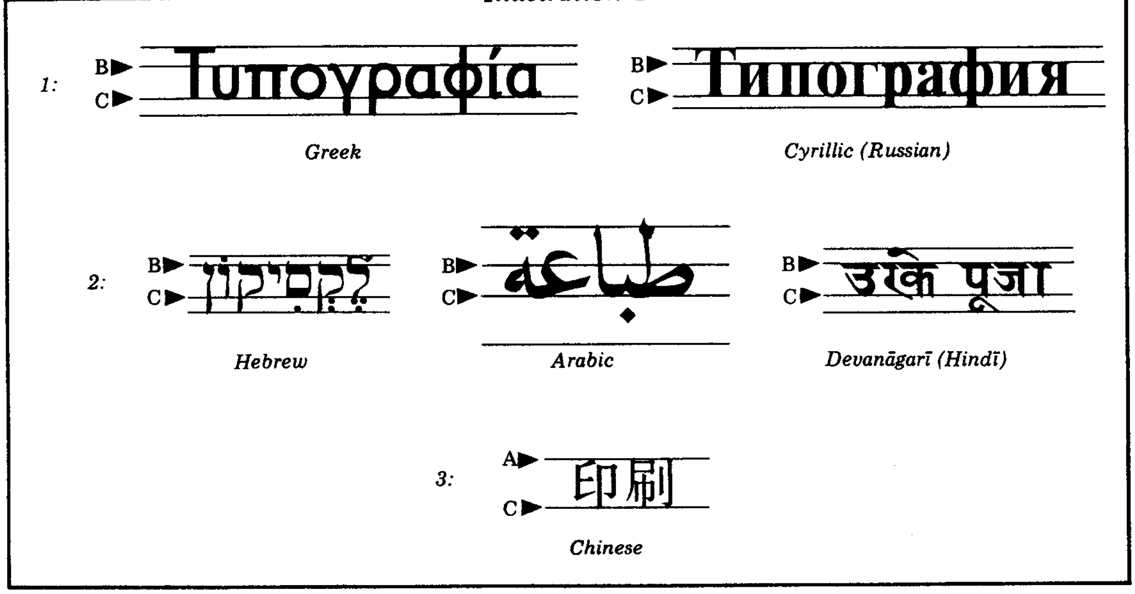
A maximum notation by this method would take the form:
327–1·5(2·2)[2·7]/4·2×105

This is, obviously, a rather ungainly string of numbers and signs: but the notation fulfils the important requirement of being able to accommodate all the information that is required for specification purposes, without any ambiguity. In practice, of course, much shorter specifications would suffice: thus, for text setting, the usual form would be:
1·5/4·2×105

A number of elements of this notation are already customary (the dash, stroke, and multiplication sign). What is novel is the use of parentheses and brackets to allow the inclusion of additional or alternative size criteria in a single notation, and without recourse to letter symbols.

The *sequence* of elements in this notation corresponds to the order of importance. The use of different typographical signs to differentiate the elements means that any *combination* of elements in a notation is possible: for example, in all-capital setting,

Illustration 4



a size specification could be given as (2·2)/4·2, which eliminates the information about lower-case height, at the same time making impossible any confusion as to what is represented by the 2·2.

Manufacturers could recommend a minimum line spacing for each size of a given typeface. This would be the counterpart of type set solid in metal type, and would be such that the ascenders (or upper-case diacritical marks) and descenders of consecutive lines do not clash.

The particular advantage of this notation in the context of the controversy surrounding the element to be measured is that those who wished to specify type size by capital height or even by overall height could continue to do so (assuming all the relevant measurements are supplied by the type manufacturer), provided they agree to retain the parentheses or brackets.

If such a system were accepted as a standard, software for computerized typesetting could be designed without any difficulty in such a way that this notation could be used with little or no modification in the *formatting codes* with which the operator instructs the machine to set in a particular combination of typeface, size, and spacing.

It is understood that variations can occur between manufacturers' nominal dimensions, and dimensions on the printed sheet (after machine inaccuracies, platemaking distortions, ink spread, and so on), but these are unavoidable. Such variations will rarely if ever exceed the 0·1mm increment which would cause a type to be included in another size category.

Preferred sizes

A preferred range of type sizes seems to be desirable, even though with much modern typesetting equipment it is possible to set almost any size desired. A preferred range can be applied to equipment which cannot produce infinitely variable sizes (particularly hot-metal typesetting; typewriter setting; adhesive transfer lettering; display phototypesetting), and in any case provides a suitably shortened range (of considerable importance to manufacturers), and a simplified choice for a graded hierarchy of sizes in specific applications.

It is to some degree desirable that any such range be a geometric series, as this provides the greatest choice where most needed—among the smaller sizes—with progressively greater intervals among the larger sizes.

However, practical convenience must be the first concern; and if this requirement clashes with the possibility of having a geometric series of preferred sizes, then some other approach must be adopted.

The graph (Illustration 3) shows (1) the sizes of one of the most widely available typefaces with traditional technology, Monotype Times New Roman (measured from the Monotype specimen book, to the nearest 0·1mm; note that different 'sizes' with the same lower-case height have not been included twice); (2) the sizes from the ISO draft proposal (an arithmetical series), the recommended capital height converted to lower-case height by multiplying by the average figure of 0·67; and (3) a proposed standard (arithmetical) series in which the size increment increases towards the upper end of the scale (as in the ISO draft): increments of 0·1mm from 1·0 to 2·0mm; of 0·5mm up to 5·0mm; of 1mm up to 10·0mm; and of 2mm up to 20·0mm.

The graph demonstrates (*a*) that there is a close correspondence between the different ranges, and (*b*) that all approximate to a geometric curve. A geometric series producing an approximately similar curve would be one with a factor of 1·12, or R20 in the Renard series of preferred numbers recommended by the ISO.[19] (The R20 curve is shown on the graph as a broken line.) Such a series would leave unacceptable gaps in the critical smaller sizes, such as 1·2, 1·5, 1·7, and 1·9. The R20 series of preferred numbers also has the disadvantage of containing numbers with two decimal places, and this applies also to the adjoining R10 and R40 series.

There are other reasons for not adopting a geometric series: for example, variation of size by fixed increments corresponds to the technological requirements of most typesetting equipment. But perhaps most important of all, there is a definite advantage in easily remembered numbers for the size designations; and this also favours the fixed increments of the kind suggested here.

These considerations combine to suggest the suitability of the arithemetical series illustrated in the graph, namely:

1·0	2·5	6·0	12·0
1·1	3·0	7·0	14·0
1·2	3·5	8·0	16·0
1·3	4·0	9·0	18·0
1·4	4·5	10·0	20·0
1·5	5·0		
1·6			
1·7			
1·8			
1·9			
2·0			

No preferred size range would be imposed on the capital height, or on any other variable dimension; and therefore no restriction of any kind is placed on type design, as the ratio between lower-case height and all the other dimensions may be whatever the type designer considers desirable.

Application to other writing systems

The proposal put forward in this thesis for a new standardized system of typographic measurement is aimed specifically at the roman alphabet. However, it is possible, with a minimum of modification, to apply it to other writing systems.

Typesetting in other alphabets and scripts is mainly carried out on similar machines to those used for setting in the roman alphabet; and two or more writing systems are often required in the same piece of setting work.

In order to apply this measurement system, it is necessary to place other scripts in one of the following categories:
(1) those identical in structure to the roman alphabet, and therefore requiring no modification (for example, Greek, Cyrillic);
(2) writing systems, other than those in category 1 above, which have variations in depth comparable to ascenders and/or descenders, and whose mean height can be aligned with the lower-case height of the roman alphabet (for example, Hebrew, Arabic, the scripts of Indian origin, and many others). It should be noted that the four-line alignment for Arabic shown here is customary for that script, and is not an innovation;
(3) characters with no significant differentiation in height (for example, Chinese, Korean), and which can most conveniently be aligned with capital height. (See Illustration 4).

The standardization bodies in other countries or script areas, in co-operation with equipment manufacturers, could adapt this sytem to their specific requirements.

Conclusion

This thesis proposes a new method of specifying type sizes, one which—unlike the present method, and unlike the proposals for its replacement—indicates clearly the visual size of the type.

The most authoritative and most nearly successful attempt to bring about a change at international level failed, because a minority of the interests involved refused to accept the realities—the technological realities—of the problem facing them.

The proposal put forward here could be characterized as an even further move from traditional thinking than the ISO draft proposals, and it is reasonable to suppose that those who would oppose the latter would even more vigorously oppose the former. By the same token, the interruption in the work of standardization at international level provides an opportunity for reflection: an opportunity for those who opposed the ISO draft proposals to re-consider, and for those who supported them to consider that, if we are to have a *more* scientific system, we may as well have a *thoroughly* scientific one.

The requirements of the printing industry, and of the broader communications industry (in which a standing will be conceded to the printing industry according to the degree to which it is seen to adapt itself to the realities of the present time), are not decided by votes at committees, but by technological and economic realities. Sooner or later, this problem will be solved, and it will be solved when the interests concerned arrive at a consensus which meets the real needs of the industry.

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16: Bror Zachrisson. *Studies in the legibility of printed text.* Stockholm: Almqvist och Wiksell, 1965.

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There is also the following very revealing reference in a recently published work: "The typefaces of the various systems are different in their image size for the same type size. . . . In order to provide an *objective comparison*, the lower-case letters have been brought to a unfied dimension." (Roland Zimmermann and Heinrich Fleischhacker.
Balancing type widths, and the different effects of metal, photo, CRT and laser setting systems [in German and English; supplement to *Typografische monatsblätter,* number 5/1982], page 16 (emphasis added).

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He has made an extensive study of writing systems, and the different schemes for their transliteration into the roman alphabet. He is working on a book of typographical style which, he says, will contain the most authoritative collection of romanization schemes ever published together.

His other interests include typographic design, colour measurement and colour order systems, standardization and nomenclature (especially as applied to the printing industry), English literature and classical music.

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