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NATURE AND FUNCTION OF LETTERING:

A STUDY IN CARTOGRAPHIC DESIGN

BASED ON CULTURAL FACTORS

BY

A. E. ALKHOTANY

A thesis submitted to the Faculty of
Graduate Studies in partial fulfillment
of the requirements for the degree of
Master of Arts

Geography Department
Carleton University
Ottawa, Ontario
1985

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"NATURE AND FUNCTION OF LETTERING: A STUDY IN CARTOGRAPHIC
DESIGN BASED ON CULTURAL FACTORS"

submitted by A.E. ALKHOTANY

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in partial fulfilment of the requirements for
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ABSTRACT

This thesis highlights the influence of cultural factors on both the traditional and automated systems of cartography and provides a new insight into the field of cartography by focussing on the application of lettering design.

The Arabic alphabet is compared with the English alphabet to create an analogy between the contrasting natures of the two alphabets.

The following new findings are proposed:

1. A scale of measurement to identify type of straight lines alignment, applicable to both systems of writing: left to right and right to left.
2. A new scale of curvature alignment on maps based on geometrical and trigonometrical measurements applicable for automated lettering in both systems of writing.
3. A new figure "Letter Style Route" modelled by grouping all letter characteristics and elements to help in decision-making in the planning of lettering design.
4. A new comprehensive figure "Letter Style and Data Classification" modelled to simplify the procedures of categorization and ranking of map information.
5. A new tabulation methodology to solve part of the conventional names problem.

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It is just as important to study the proper and effective use of various forms of graphic presentation, as it is to study the values of different methods, treatment, grades, and forms of verbal presentation.

William Morris Davis.

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CHAPTER 1

INTRODUCTION

1.1 Statement of Purpose and Major Elements

Lettering on maps is a task which consists of selecting letter styles, sizes, forms, shapes, alignment and positioning of names and/or text on the map. Although it is generally acknowledged that lettering provides the verbal presentation used to identify, classify and explain the symbolization systems (points, lines, areas) of the map, the cultural implications of lettering have long been neglected and the influence of cultural factors has been dominated by the technical aspects in most cartographic literature.

This thesis introduces a new concept of lettering design by examining how cultural factors monitor and influence both the traditional and automated cartographic systems of lettering design on maps, and shows how cultural factors can be integrated with the technical aspects of cartography. The study initially investigates the cultural perspective (see Figure 1.1:2, box 2) of the alphabet by selecting and defining nine indispensable variables. This is achieved by an intensive review of literature from cartography and related disciplines, as well as by two

FIGURE 1.1

CHART OF THE PROCESSES OF THOUGHT FOR THE STUDY

Source: The writer

types of survey: a local survey of lettering and number usage on houses and shops, and a survey of lettering on book spines. The study then selects and defines five dependent cartographic variables (see Figure 1.1:2, box 4) which are used in the field of cartography to manipulate the lettering task in data classification and ranking. It amalgamates the cultural variables with traditional cartographic lettering criteria and examines their impact on the automated mapping system of lettering.

It defines three major functions of lettering on maps as follows:

1. Labelling, e.g. Canada, Ottawa, Hudson Bay, etc.
2. Explanation, e.g. The key or the legend.
3. Identification of real and imaginary locational information, e.g. oil fields, international date line, etc.

The study concludes by emphasizing lettering design as communication by design, rather than "cartographic communication and map design". The former is deemed to convey better than the latter the purpose of the lettering function on maps, that is, to provide visual knowledge of the hierarchy of the classified data on the map.

With the above statements in mind, the goals of this thesis can be stated as being three-fold:

- A) To examine and compare two culturally different alphabets to reveal:
 - (i) cultural foundations of lettering per se; and,
 - (ii) list of independent lettering variables.
- B) To examine lettering on maps (traditional and automated) to reveal:
 - (i) dependent cartographic lettering variables; and,
 - (ii) influence of independent on dependent.

- C) Taking into consideration the cultural basis of lettering established in A and B to offer, by means of original diagrams and tables, principles and simplification of design decisions required when planning map lettering. These include using the geometrical scale of degrees to suggest rules for automated line curvature of lettering alignment and positioning, and also, using the scale to define the type of straight lines rotation. The use of tabulation and figures to suggest solutions to problems of application of lettering.

1.2 Methods

In approaching the central purpose and the related goals, several research methods have been used. These methods can be summarized as follows:

- A) A review was undertaken of the literature on lettering in cartography and related disciplines, with particular emphasis being placed on the aspect of lettering in map design. This literature is cited throughout the study when pertinent.
- B) Two types of survey were conducted: a local survey of how people position their house numbers, shop numbers and name signs, and a survey of lettering on book spines, to support the stated influence of the defined fundamental cultural factors.
- C) A comparison analogy study was developed of the contrasting natures of two alphabets, the English system of writing and the Arabic system of writing.
- D) Geometrical and trigonometrical rules were utilized to measure the method of writing, type of alignment and the application of the suggested curvature alignment by mathematical formulae.

E) Statistical tabulations were made to test some of the conventional names problems and to suggest possible solutions.

1.3 Organization of the Study

The study consists of six chapters, and the conclusion. Using a method of analogy and comparison between two culturally different languages, English and Arabic, Chapter 2, "Cultural Factors in Lettering", investigates and defines nine selected cultural variables (see Figure 1.1:2, box 2) within the alphabet nature which exert cultural influence on the cartographic design of lettering on maps. Therefore the nine variables are considered in the study as dominant factors in traditional cartography and are relevant to automated cartography. A scale of measurement for straight lines alignment on maps is formulated which is applicable to both the English and Arabic systems of writing.

Chapter 3, "Cultural Factors and Automation in Lettering", amalgamates cultural factors with the technical criteria of traditional cartography for lettering and examines their influence on the automated system of lettering. A rotation rule of curvature alignment based on geometrical (circular) measurements is formulated for use in automated cartography.

Chapter 4, "Variables in Lettering", emphasizes the cartographic perspective. It is divided into two groups: basic cartographic variables: (1) case, (2) size, (3) style, and assisted variables (1) colour (2) cut-window. The five variables are examined and defined to show how each is used to manipulate the lettering task in map design and how each assists in implementing the lettering function on maps. Two planning guides for lettering are formulated to simplify the task of lettering design on maps.

Chapter 5, "Lettering Functions", investigates the direct and indirect symbolization usage of lettering on maps. It defines and clarifies the three major functions of lettering as being labelling or naming, explanation, and identification of real and imaginary locational information. It analyzes conventional names problems and suggests tabulated methodology to solve some of the problems.

Chapter 6, "Communication by Design", focusses on the essence of lettering design by revealing the influence of the fundamental cultural factors on the cartographic criteria for both the traditional and automated systems to achieve a pleasing and functional appearance of lettering on maps. The work then moves to a conclusion that summarizes the findings and observations made in the main body of the text and then evaluates the findings against the objectives as laid out in Chapter 1.

CHAPTER 2

CULTURAL FACTORS IN LETTERING

2.0 Introduction

This chapter introduces and examines the cultural factors of the alphabet by looking at how the alphabet and numerals are used in various situations, such as name signs, house numbers and shop numbers, as well as lettering on book spines and assesses their influence on the cartographic lettering system. Nine variables which influence and monitor the task of lettering design on maps are examined. The different natures of two alphabets, English and Arabic, are analyzed, and a new instrument for measurement applicable to both systems of writing is introduced.

An alphabet is a form of human communication which has its foundation in the culture of origin and use, so any usage of constructing the letters, individually or collectively, has to be according to a particular cultural dogma, although, of course, there can be commonality of both an alphabet and its usage amongst peoples of contrasting cultures (e.g. English in England or Canada or New Zealand or, for many people therein, India, and elsewhere). It should be noted, however, that to understand such an areal spread in shared and different usage, one has

to appreciate the processes of origin and diffusion. This study is not about the vagaries of local usages, or dialects, but is, rather, an examination of certain common key elements in formal usage as they pertain to cartographic issues.

The English language is used for comparison with Arabic (which is this writer's first language) because it is the most widely spoken language in the world, followed by French, Spanish and Arabic respectively (see Table 2.1:9). The English, French and Spanish alphabets differ from Arabic in form, shape, and the directional system of writing, as well as other aspects.

Nine variables have been selected and defined as basic factors of the English and Arabic alphabets (see Table 2.2:10) because of their influence in lettering design on maps and are examined in numbered sections as follows:

- 2.1 Number of letters, e.g. English 26 and Arabic 28.
- 2.2 Kinds of letters, e.g. upper and lower cases.
- 2.3 Hierarchy and Ordering, e.g. A.B.C., a.b.c., I.II.III, i,ii,iii.
- 2.4 Method of Writing, e.g. single, joined, or both.
- 2.5 Direction of Writing, e.g. left to right and right to left.
- 2.6 Symbolization, e.g. H for Highway or Hospital.
- 2.7 Number of Styles, e.g. Gill, Times, Univers, etc.
- 2.8 Spacing, e.g. ABC, A B C, etc.
- 2.9 Position, e.g. straight or curved.

The flexibilities and limitations of the alphabet and map nature are defined and clarified through comparison between the two languages, English and Arabic.

TABLE 2.1

LANGUAGE DOMINATION*

This table shows the impact of a single language used as a first language by nearly one third of the United Nations countries.

Language	Number of Letters	**Number of States that Use Language
English	26	49
French	26	28
Greek	24	02
German	26	06
Spanish	25	21
Russian	33	01
Chinese	4000	03
Japanese	2000	01
Arabic	28	20

* Harry Bruce, in "Spread of English language has become world-wide epidemic," (1985:C3) stated that: No one knows how many people regularly use English. UNESCO estimates the world's population at 4.7 billion, with 325 million speaking English as their first language, and another 300 million using it as an additional tongue!

** According to Longman Dictionary of Contemporary English, London, Longman Group Ltd., (1978:1303).

Source: The writer

TABLE 2.2

SOME BASIC FACTORS OF ALPHABET NATURE

TITLE	No OP		DIRECTION OF WRITING		METHOD OF WRITING		ORIGINAL FORM		SHAPE				WEIGHT				PUNCTUATION		ABBREVIATION		TRANSLITERATION		HIERARCHY	
LANGUAGE	LETTERS	KINDS	STYLES	Right to left Top to bottom	Left to right Bottom to top	SINGLE	JOINED	U	I	S	D	C	E	L	M	B	NO	YES	NO	YES	NO	YES	NO	YES
ENGLISH	26	2	Many																					
ARABIC	28	1	A few																					

U - Upright
I - Italic
S - Serif/San Serif
D - Decorative
C - Condensed
E - Extended
L - Light
M - Medium
B - Bold

See Figure 4.3:64.

Source: The writer

2.1 Number of Letters

The English language has an alphabet means of communication. Its letters are 26 in number although the total different shapes or forms which have to be recognized are 40 (upper and lower cases); this figure could rise to 43 with the extra three shapes of 'a', 'g' and 'q' (see Table 2.3:12). Recognizing 40 or 43 shapes of letters is much easier than trying to know over two thousand or even one thousand ideograms of the type used in some East Asian languages. The Arabic language has 28 letters in its alphabet, yet the total shapes or forms is only 17 (see Table 2.4:13), this being due to there being only one case. In this respect the Arabic alphabet is more economical than English but it loses the variation and combination that the English alphabet has of the two cases (upper and lower) in hierarchy usage on maps.

Maps communicate by graphics, symbols and lettering. Kindersley (1968:70) stated that "It is acknowledged that progress in the human race is closely connected and facilitated by alphabetic communications". It is unfortunate if a language has no alphabet or does not have an economic media for identifying and explaining objects on the map: It is hard to cope with the practicality of the map if it has to have symbols to explain the symbols and graphics representation in a very limited space, as is always the case with maps. Withycombe (1928:429) indicated that "...the practical value of a map largely depends upon the writing used". This value has been recognized by various countries which has led them to use English lettering on their maps to solve the problem and to gain wider communication outside their own zone and domination while retaining, through the map's key or legend, the presence of their own language.

TABLE 2.3
VARIABLES WITHIN LETTERS
FOR ENGLISH ALPHABET

Upper Case	Lower Case	No Change	Slight Change	Cross Change	Total Change	Extra Shape
A	a				-	a
B	b		-			
C	c	-				
D	d			-		
E	e				-	
F	f	-				
G	g			-		g
H	h				-	
I	i		-			
J	j		-			
K	k	-				
L	l		-			
M	m		-			
N	n				-	
O	o	-				
P	p	-				
Q	q				-	q
R	r				-	
S	s	-				
T	t				-	
U	u	-				
V	v	-				
W	w	-				
X	x	-				
Y	y	-				
Z	z	-				
26		12	5	2	7	3

Source: The writer

TABLE 2.4

AN ECONOMIC SHAPE:THE ARABIC ALPHABET*

Total Shape		Total Letters
ا	←→	ا
ب	←	ب
ت	←	ت
ث	←	ث
ج	←	ج
د	←	د
ذ	←	ذ
ر	←	ر
ز	←	ز
س	←	س
ش	←	ش
ص	←	ص
ض	←	ض
ط	←	ط
ق	←	ق
ك	←	ك
خ	←	خ
د	←	د
ن	←	ن
ي	←	ي
17	17	13

* An economic alphabet because the total original shapes are seventeen from the original twenty-eight letters.

Source: The writer

2.2 Kinds of Lettering

The alphabet in English can be written in two ways, capital or small (upper and lower case). Urdike (1922:57) in his study Printing Types declared that,

... to trace three forms of writing: the formal, to which in type our capital letter answers, the less formal, to which our lower case type is equivalent; and the epistolary or cursive, which is now rendered into type called 'italic'.

One can disagree with Urdike inasmuch as his third category (that is italic -- see under 4.3:60) really refers only to a matter of style. Fundamentally then, there are only two forms of writing: these two forms or kinds of letters give lettering design on maps a flexible element especially in categorization.

Upper and lower cases produce between them three alternatives, which are three classes available to the designer to use and these are:

- (i) Using all letters in capital e.g. OTTAWA;
- (ii) Using the first letter in capital
and the rest in lower case e.g. Ottawa.
- (iii) Using all letters in lower case e.g. ottawa.

Utilizing both the vertical (upright) and oblique (italic), we have six possible variations, and that is without introducing sizes, serif, and colour. These variations could be increased to eight if the following case is considered:

- (iv) Using all letters in capital with
a larger size for the first letter e.g. OTTAWA.

This case is widely used in books, magazines and newspapers but does not seem to have been used on maps. Phillips et al. (1978:76) suggested that:

Names set in lower case with an initial capital are easier to search for than names set entirely in capitals of the same point size. As lower case names also occupy less space on a map, they are strongly recommended.

But this recommendation would not have pleased Kindersley (1968:70) who believed that "lower case letters, strictly speaking, are deteriorated capitals". Deriding the lower case does not detract from its useful function on maps. Lower case is a positive product of any language which has it, for its ease of categorization and ranking data, as well as for alleviating the space problem on maps. The survey by this writer of 250 random name signs on shops in Ottawa showed a 37.4 per cent use of all capital letters, a 15.2 per cent usage of lower case only, while the combination of upper and lower case showed 47.4 per cent. The survey clearly indicated that culturally the usage of lower case, or a combination of upper (numerically minor) and lower (dominant) case, are favoured.

In Arabic, the strong economic factor (see Table 2.4:13) of having one case does not introduce the above three or four alternatives available to the English alphabet, it therefore makes categorization, classification and ranking totally dependent upon sizes and styles which places a heavy burden on the designer. The task is made easier, to some extent, for the designer who has access to upper and lower cases, such as is the case in English.

2.3 Hierarchy and Ordering

The hierarchy order of the English alphabet runs from 'A' to 'Z'. Capital 'A' has a higher priority than the lower case 'a'. A name written in capitals is more important than a name written with its first

letter in capital and the rest in lower case, and this is more important than if the whole name is written in lower case.

On road maps some countries rank or classify their roads as: Motorway (Highway), A-Road, and B-Road; the order shows the class and quality of each one. The Highway or Motorway is a full functioning name which reflects its superiority over 'A' and 'B' roads, in road classification.

Lettering on maps is for labelling an object and to show its class and quality by using all the possibilities of the cartographic techniques of case, size, weight, etc. The variation in the alphabet (upper and lower cases) is of considerable help in the process of classifying map information.

Classification and ranking are indeed a hierarchy order for the object within its group on the map. Imhof (1975:129) declared that "Type arrangement should reflect the classification and hierarchy of objects on the map; variation of style and size help do this".

The Arabic alphabet has a different hierarchy ordering system from its original order (see Table 2.5:17) but the system of Arabic hierarchy ordering cannot be used in data classification and ranking on maps in the same manner as the English hierarchy order, therefore the task of classification and categorization has to rely on other alternatives such as style, size, etc.

2.4 Method of Writing

The map with its juxtapositional data and information requires a freedom to manipulate the individual letters in lettering a name by squeezing or spreading the arrangement of the name's letters according to the given or available space.

In Arabic, the manipulation of individual letters in a collective name cannot be done because the system of writing requires that the letters be joined. This factor might not be critical in a tiny space such as lettering a city or a village, but it would not be practical for a spread out name, such as a country's name, because the joined name would obscure a lot of information and data. If this problem could be overcome, then the alphabet of a joined system of writing would be advantageous in showing the continuity of the identified object. The problem of map data being subdued cannot be totally overcome, even given the flexibility of the system of writing the alphabet individually or singly.

For ideographical languages, it would be more advantageous if each object on the map could be represented by one ideogram without suppressing the symbol representing the object.

2.5 Direction of Writing

Direction of writing can be:

Left to Right as in English;

Right to Left as in Arabic; or,

Top to Bottom as in Japanese.

The direction of writing is a fundamental cultural factor. It monitors the alignment of letters and numbers in any space. Clarity in readability is the ultimate aim of alignment within its familiarity and normality.

Biggs (1961:14) stated that:

And as we recognize most quickly those things with which we are most familiar, it follows that letters with which we are familiar are, to that extent, more legible than unfamiliar forms. There is much more to legibility than familiarity, but familiarity,

which might be called normality, is certainly one of the most important factors in legibility. In order that a type may be legible, in the sense that it may be easily read with the least fatigue on the part of the reader, it must be familiar in general shape and proportion.

The layman in Canada, for instance, aligns his house number in various ways, normality is the first choice; if a house has three digits, the 'hundreds' are on the far left side first, followed by the 'tens' and then the 'ones'; all are positioned in a straight line. Other arrangements, apart from the straight line, have to be in a way familiar to one's culture (see section 2.9:24) below).

The calligrapher's aesthetical skill and the map designer who succeeds brilliantly in lettering his map effectively, are both reflecting cultural factors.

The map designer's task in lettering is a hard one, if not the hardest task, because he has to work within a very confined space juxtapositioned with ranking data. Also the direction and alignment of lettering has to be easily and comprehensively perceived by the user.

In Figure 2.1:20, the alignment direction of lettering on book spines takes various directions (see section 2.9:24). There is obviously a space problem, although on a blank background. On a map there is no unoccupied space and some types of alignment direction shown in Figure 2.1 cannot be applied to maps.

2.6 Symbolization

Symbolization by alphabet (letters) and numerals has been used on maps for a very long time. Symbolization is concerned solely with the representation of alphabet by individual letter(s) to indicate the full

FIGURE 2.1

DIRECTION OF LETTERING ON BOOK SPINES*

A	B	C	D	E
180°-0°	270°-90°	90°-270°	90°-270°	90°-270°
		180°-0°	180°-0°

* Direction of writing and alignment has been measured according to angles, see section 2.9:24.

Source: The writer

meaning of the information on the map. Symbolization is categorized here by dividing it into two categories, as follows:

- I: Direct symbolization which uses one letter from the whole name - usually the first letter - such as 'H' for Hotel or Hospital and 'i' for information or inquiry.
- II: Indirect symbolization which uses letter(s) or digit(s) or both to represent an object or group of objects, or for long explanations such as [N] and [MM] for country trunk highways (as used in Rand McNally Road Atlas: United States/Canada/Mexico, 1985), and [M1] for motorway in road maps and atlases.

Smith (1979:661) believed that "The most common displayed symbols are, of course, letters," and Fawcett (1940:19) indicated that "The writing on a map is usually regarded as a map symbol in itself".

Letters and numbers have been used for symbolization and therefore have meaning, direction and orientation. A grid reference is achieved by letters and numbers to locate an object and to find out the direction to it.

Symbolization by letters and/or numbers can be used in Arabic in the same way as in English.

2.7 Number of Styles

In English, in addition to classification by the fundamental factors of upper and lower cases and their combinations, there is a rich choice of letter styles which offer many additional alternatives for classification and ranking of data, irrespective of the oblique shape and the use of size and weight. By contrast, the Arabian letter style is limited in this respect.

Selecting the appropriate style from the vast choice is an important task for the map designer because the selection has to suit the map's content and purpose and reproduction durability, as well as the user capability of reading all the styles selected without fatigue.

Biggs (1961:14) asked "What is type for?" and he gave the following answer:

Obviously to read, and to read with as little discomfort on the part of the reader as possible. But reading at different times is carried out under different circumstances, and the qualities desired on one occasion might be irrelevant on another.

Thus, different criteria apply for different circumstances in selecting and using type.

On maps, some circumstances or factors which assert their influence on style are:

- I: Map's requirements from style.
- II: User's requirements from style.
- III: Type or style flexibility.
- IV: Cartographer's skill and ability in filtering these various requirements on a map. (These factors will be elaborated on in Chapter 4, see section 4.3:60).

2.8 Spacing

Keates (1973:201) suggested that "...proper arrangement of the names in the total map image, could only be achieved by purely manual methods by very skilled cartographers". The arrangement and positioning of names on maps has to be done letter by letter, often balancing them visually against mixed and contrasting areas as well as keeping the continuity and the constancy of the name, therefore, patience and a high

degree of skill are needed by the cartographer. Withycombe (1928:432) suggested that:

Distinction and contrast - certain names should be clearly distinguished and different types of alphabets used and their gauge and spacing should achieve this.

Therefore, it is a task with great responsibility. Dent (1985:278) stated that "Entire map projects can be weakened by poor spacing of letters and words; no other feature is so obviously incorrect at first glance". Corrections can be made, but it is not easy to go through placing or arranging names again because they were spread more or less than they should have been, or for any other reason.

Small, or medium, size letters which do not need rearrangement, letter by letter, for the appropriate given space reduce the problem. Bridgman and Wade (1956:378) felt that "...better visibility might be achieved by using smaller letters than the maximum size possible in a given space".

Lettering of an object name does not depend on having a proper comfortable space nor does the available space influence the size and in-between spacing of the letters. The main criteria is legibility within the framework of the map's scale, type of user, and amount and type of information on the map. Therefore, the cartographer has to take into consideration various factors which dominate the flexibility and limitation of using the available space.

Fullard (1965:190) outlined two factors (scale of the map and size of the letters) when he stated that:

A user ... will not take account of the crowding which would result from showing all such obscure places on that scale of map, or he may not appreciate that to show very small place names would

require a size of lettering below the minimum for easy legibility.

Spacing the letters has to be according to the society's normality and familiarity in their alignment of writing, and according to the figurative form of the letters individually and/or collectively (see Figures 2.2, 2.3 and 2.4:25). The cartographer should have a critical eye and the experience to achieve an appropriate balance in spacing. Dent (1985:278) stated that "Practice and a critical eye are essential in providing correct spacing".

2.9 Positioning

Names and text on maps are for identification and explanation of objects which vary in their nature (physical features, cultural features, etc.). The alignment's direction of letters - lettering - is not an arbitrary task. It is achieved according to various factors, such as:

- (i) The natural direction of writing the alphabet.
- (ii) The natural direction of the object mapped.
- (iii) Latitude and longitude system of the map (straight or curved).
- (iv) Purpose and content of the map.
- (v) Object's spatial size.
- (vi) Object's position and location (inland or coastal).

Legibility is the central focus of the above determining factors in orienting and monitoring the lettering task of the map. Imhof (1975:128) stated that:

Good name position aids reading considerably and enhances the esthetics of the map. Poor, sloppy, amateurish type placement is irresponsible, it spoils even the best image and impedes reading.

The pioneer Imhof gave some excellent examples for direction and orientation of lettering in map design based on two level scales: Good and

LETTER SPACING VARIATIONS

Figure 2.2 Geometrical Spacing

B C D E

F G H K

M N P Q

R S X Z

The figurative form of these letters could achieve good visual perception mostly by fixed geometrical spacing between these letters.

Figure 2.3 Slight Spacing Adjustment

O

U

A slight space adjustment to the two adjacent letters to 'O' is needed to achieve effective spacing balance, while 'U' needs less adjustment.

Figure 2.4 Critical Spacing Adjustment

A I

J L

T V

W Y

Always require space adjustment to achieve effectiveness and harmony with letter spacing.

Source: The writer

Poor, but he did not theorize his enlightened work. As Keates (1982:112) observed:

The Swiss cartographer Imhof has not published any theories about visual perception even though he has produced many stimulating accounts of the principle and practice of map design.

Lettering in map design has various directions and orientations, based on the positioning alignment. It can be straight or curved alignment. The aim of alignment is to achieve an easy visibility with readable legibility within the framework of the six above-mentioned factors, at the same time, the alignment of any name on the map ought to reflect the fluency of the feature or object to enhance the overall map appearance.

To examine the issue of alignment, and to test an instrument (Figures 2.5-12:29-32) developed by this writer, two surveys were undertaken in Ottawa in the winter and spring of 1985. The surveys conducted showed that the alphabet and numbers were aligned in different straight line directions other than the usual horizontal direction. These were analyzed according to the direction of angles which produced two distinctive alignments: (1) straight line alignment (rotation); and, (2) vertical alignment where the letters of a collective name were aligned in the form of top to bottom.

The results of 500 samples in this writer's two surveys of Ottawa house numbers and shop name signs (see Table 2.6:27) showed the following:

Names

- 1). 88.4% use straight line positioning alignment (see fig.2.5:29).
- 2). 6.5% use slanted alignment below 180° (see fig. 2.6:29).
- 3). 2.0% use slanted alignment above 180° (see fig. 2.7:29).

TABLE 2.6

ALIGNMENT SURVEY RESULTS

ANGLE	TYPE	NAMES		NUMBERS	
		Sample	Percentage	Sample	Percentage
180° - 0°	Straight	221	88.4	127	50.8
Above 180°	Straight	5	2.0	55	22.0
Below 180°	Straight	16	6.4	52	20.8
90° - 270°	Straight	7	2.8	16	6.4
90° - 270°	Top to Bottom)				
270° - 90°	Straight	1	0.4	-	-
TOTAL		250	100.0	250	100.0

Source: The writer's surveys; undertaken in Ottawa during the winter and spring of 1985.

- 4) 2.8% use top to bottom alignment (see fig. 2.8:30).
- 5) 0.4% use bottom to top alignment (see fig. 2.10:30).

Numbers

- 1) 50.8% use straight line alignment similar to fig. 2.5:29 of writing (see table 2.6:27).
- 2) 20.8% use alignment below 180° similar to fig. 2.6:29 of writing (see table 2.6:27).
- 3) 22% use alignment above 180° similar to fig. 2.7:29 of writing (see table 2.6:27).
- 4) 6.4% use alignment of 90° to 270° similar to fig. 2.8:30 of writing (see table 2.6:27).

However, the survey of lettering on book spines showed the following alignments:

- 1) The use of 90° - 270° rotation is applied in two ways:
 - (i) Not having any change in the alignment of the letters, as if the original axis of 180° - 0° takes the position of 90° - 270° (see fig. 2.9:30 and fig. 2.1:20).
 - (ii) Changing the alignment of the letters direction in descendant vertical adjustment (see fig. 2.8:30 and fig. 2.1:20).
- 2) The use of 270° - 90° rotation as if the original axis of 180° - 0° takes the position of 270° - 90° (see fig. 2.10:30 and fig. 2.1:20).

From the two types of surveys conducted the following has been concluded:

- 1) The common usage of positioning name alignment can be classified into the following categories:

STRAIGHT LINES ROTATION

STRAIGHT FORM

Figure 2.5

 $180^{\circ} - 0^{\circ}$

Usual positioning alignment. The names survey shows 88.4% usage while the numbers survey shows 50.8% usage.

Figure 2.6

 $180^{\circ} - 225^{\circ}$

A range of 45° below the original axis gives legibility. This legibility can be increased by decreasing the rotated angle towards the original line ($180^{\circ} - 0^{\circ}$).^{*} This range of angle can be artistic in appearance depending on the way used. The names survey shows 6.4% usage while the numbers survey shows 20.8% usage.

Figure 2.7

 $180^{\circ} - 135^{\circ}$

A range of 45° above the original, the legibility can be increased by increasing the rotated angle towards the original.^{*} The artistic appearance depends on the way used. The names survey shows 2.0% usage while the numbers survey shows 22% usage.

^{*} See figure 2.11:31

VERTICAL FORM

Figure 2.8

90° - 270°

This alignment is virtually "top to bottom" in absolute vertical form because the letters are aligned to show the normal appearance while read collectively from top to bottom. This type of alignment and positioning does not apply in the rotation rule as with the preceding three figures and the following two.

The names survey shows 2.8% usage and the numbers survey shows 6.4%.

Figure 2.9

90° - 270°

No change occurs in the positioning alignment of the letters as the base axis (180° - 0°) is moved up to terminate on 90° - 270°. Neither the house numbers survey nor the names survey showed any usage of this alignment, although it is widely used on lettering on book spines.

Figure 2.10

270° - 90°

No change occurs in the positioning of the letters as the base axis (180° - 0°) is moved down to terminate on 270° - 90° axis.

The names survey shows 0.4% usage while the numbers survey showed no usage.

STRAIGHT LINES ROTATION ALIGNMENT

APPLICABLE TO ARABIC

Figure 2.12

<u>Ideal Positioning</u>		<u>Within Range of:</u>	
East to West	$= 0^{\circ}-180^{\circ}$	0°	Horizontal
<u>Acceptable Positioning</u>			
(a)	N.E. to S.W. $22.5^{\circ}-202.5^{\circ}$ and S.E. to N.W. $337.5^{\circ}-157.0^{\circ}$	45°	Slope
(b)	N.E. to S.W. $45^{\circ}-225^{\circ}$ and S.E. to N.W. $135^{\circ}-135^{\circ}$	90°	Sharp Slope
<u>Critical Positioning</u>			
(a)	North to South and South to North	$90^{\circ}-270^{\circ}$	0° Vertical
(b)	South to North	$270^{\circ}-90^{\circ}$	

Source: The writer

(i) Straight alignment within a range of 180° , 90° above the original axis of $180^\circ - 0^\circ$ and 90° below the original axis which is the base line for the usual way of English alphabet alignment. This measurement can be applied to the same level or degree to the Arabic alphabet except the starting point is on the right-hand side.

(ii) Both systems of writing, left to right and right to left, can have a circular rotation as they bisect the circle. The left side to the English rotation while the Arabic takes the right side of the circle (see figs. 2.11:31 and 2.12:32).

2) The vertical alignment can take two ways:

(i) Absolute form of vertical adjustment as in fig. 2.8:30.

(ii) Vertical, but the letters alignment taking place as if on a straight line of $180^\circ - 0^\circ$, as in figures 2.9/10:30.

Arabic lettering cannot practice the flexibility of two English lettering factors:

1) Lower case in kinds of letters.

2) Singular (unjoined) practice in method of writing.

Apart from that, the two alphabets have more similarities than dissimilarities within the nine cultural factors, irrespective of their strong contrasting scripts. They share the same angles in a circular measurement in their lettering alignment irrespective of bisecting the circle into west for English and east for Arabic (see figs. 2.11:31 and 2.12:32).

CHAPTER 3

CULTURAL FACTORS AND AUTOMATED LETTERING

3.0 Introduction

The recent application of lettering (text) by automation has proved effective and time-saving in the printing of running text in books, journals, theses, etc., compared with the manual or semi-manual method.

In contrast, automation has not yet achieved the same desirable impact of effectiveness on map lettering. This seems due to two reasons:

- (i) The varied and juxtapositioned data of the map does not allow the same flexibility of manipulation as straightforward running text has on blank paper.
- (ii) Automated lettering has not developed curvature alignment to suit the map's requirements.

Traditional cartography uses automatic devices and equipment throughout the process of map-making, combined with the experience and skill of the cartographer. These two elements have contributed to the traditional map's accuracy, reliability and pleasant appearance. Lettering a map has just that approach, where the letter styles and sizes for the required map are produced by automatic devices while the

task of positioning the alignment of the object's name is left to the experience of the skillful cartographer to adjust the alignment by eye.

If the alignment of lettering is to be executed by automation, then the text system should be developed to suit map lettering. The traditional criteria of lettering alignment has progressed to achieve the desirable familiarity of pleasant map appearance. The artistic touch of the well-established system should be considered in automation, even though this is difficult to apply due to the logical nature of automation...

3.1 Traditional Cartography and Automated Lettering

The object, in its location, is represented on the map graphically by means of symbols (points, lines, areas) which refer to the nature and the spatiality of the object.

Lettering is used to identify the object's nature and its order of importance (rank), e.g. settlement ranks, road ranks, etc. Therefore, all types of maps require lettering for labelling, identification of real and imaginary objects, and explanation of various usages on the map. Keates (1973:66) stated that "Names are applied to both physical and cultural features, and to any other aspects of human society which have spatial direction", while Robinson et al. (1978:781) concluded that:

Anything that is anywhere, either tangible such as a road, or intangible, such as religious adherence, is a spatial phenomenon having location and is capable of being mapped.

Any object on the earth's surface, land and water, which is observed by human beings can be mapped. It has a name, nature, spatial location and function. Lettering should identify these elements as much as possible in an effective manner.

Guidelines of lettering alignment and adjustment have been developed over the years by traditional cartographers to achieve satisfactory standards to cope with the needs of various situations facing the task of lettering on maps. These guidelines should also be adopted by the automated system of lettering, as long as the purpose is to achieve the familiar map.

The satisfactory standard has a set of rules for varied presentation of the cartographic system which consists of points, lines and areas, taking into consideration two basic factors which are:

- (i) Lettering (names) should be unambiguous in their designated places and should be readable and visible even in their smallest sizes.
- (ii) Lettering (names) should be aesthetically pleasing to achieve a high quality of the map appearance as a whole.

These two factors have created general technical guidelines to achieve the basic requirements in positioning or alignment of names on maps. They (the technical guidelines) apply to the whole task to lettering on maps, by traditional or automated systems because they are the measurement criteria or rules to achieve an objective function and aesthetic appearance of a map. These technical guidelines are:

- (i) Names should be designated to the best position available in terms of priority of positioning order (see figs. 3.1/2/3:37/38).
- (ii) The space between the object's symbol and its name should not exceed more than the breadth of one of its letters (it is hard to specify the exact space which is an artistic element or measurement determined by the designer's experience, skill and the nature of the specific surrounding objects).

FIGURE 3.1

PRIORITY OF ALIGNMENTPoints

Shows fourteen possible locations of positioning alignment divided into two sections, any of 'A' taking preference over all of 'B'.

Source: The writer

PRIORITY OF ALIGNMENTFigure 3.2 Lines

(1) is preferred to (2) because the space between the base line of letters alignment and the line representing a linear feature could be evenly balanced especially when using lower case after an initial capital letter.

Figure 3.3 Areas

(1) is preferred to (2) because it matches the area's orientation.

Figure 3.4 Interference

(B) takes preference over (A)

Source: The writer

- (iii) Names should enhance and cohere with the shape of the projected map (straight or curved longitudes and latitudes).
- (iv) Names should not conflict with or be distressed by each other.
- (v) Names should not hide, or subdue, or cause ambiguity to other features, especially major ones (foreground data).
- (vi) Names should not be allowed to interfere with other name symbols (see fig. 3.4:38). This ambiguity should be eliminated or resolved by the designated position of alignment.
- (vii) Names should be positioned within their political areas or zones to clarify to which country or province they belong.
- (viii) Coastal places should have their names aligned on water and should never have part of their names on land.
- (ix) Names should flow smoothly with the physical body of the object's direction with respect to other surrounding names.
- (x) Names should be adjusted to avoid the folds, if the map is to be folded.
- (xi) Names of the mapped areas should be gracefully formed and complement each other.

The above considerations produce good pleasant lettering appearance if they are applied to justify any object's position before positioning the alignment of its name. The automated lettering system should consider the above traditional criteria to achieve effectiveness and a functional system. Freeman (1985:273) acknowledged that when he stated that:

Any automatic system for name placement should obey the same conventions and approach the same standards of quality that one has come to expect from a map produced in the traditional manner...It must not look like an engineering drawing!

The advances made in the automated lettering system in straight lines rotation applicability (see figs. 3.5/6:41/2) are indisputable. Productivity has been increased while time and costs have been cut dramatically. However, the challenge of the map's nature at present defies the application of lettering by automation. If this challenge is successfully met then traditional cartographers would welcome an end to the most tedious and time-consuming task in map-making procedures.

3.2 Straight Lines Rotation

The efficient progress of automated lettering system has been made in all types of positioning alignment of straight lines rotation from 0° to 360° . This application is based upon geometrical manner by simple computer program.

In the case of map lettering by GIMMS and MIGS systems, two basic factors which are required to execute the type of direction alignment on the map are:

- (i) X and y values (coordinates) of the starting position of the required name.
- (ii) Angle of direction of alignment of the whole name.

A series of straight lines can be produced from 0° to 360° by the above factors (see figs. 3.5/6:41/42). Other factors are included in both the GIMMS and MIGS systems to manipulate the form or shape; upright or oblique, etc., but do not go beyond the straight alignment.

Two major problems confront the application of automation in map lettering:

1. Space adjustment: The problem occurs for automation because the spacing adjustment is based throughout the task mostly on the skill of the cartographer's critical eye adjustment and not on logical

STRAIGHT LINES BASED ON CIRCULAR ROTATION RULES

GIMMS and MIGS systems produce the above alignment by giving x and y positions of the name and the angle required for the direction of the alignment.

Source: The writer

FIGURE 3.6Vertical Base

A
U
T
O
M
A
T
I
O
N

GIMMS and MIGS systems produce vertical alignment by adding "vertical" to the type of alignment of the name.

Source: The writer

geometrical adjustment, which is an essential factor in automation. The problem of spacing adjustment may not occur on some types of maps where the nature and purpose of the map do not cause any strain on the identified objects. At present, single letter spacing adjustment to the whole name takes a longer time than the traditional way and automation defeats its objective by being slower.

2. Curvature alignment is the second obstacle to automation applicability on maps and is examined in the following section 3.3.

3.3 Curved Lines Rotation

The earth's surface is not flat as it is drawn on the map's piece of paper but the projected map can be either in straight lines transformation or in curved lines transformation which is indicated by the longitudes and latitudes. In either case, the alignment of curved line lettering occurs frequently because the mapped object is transformed into graphic forms according to its natural spatial pattern and direction.

Traditional cartographers use curvature alignment when necessary, such as for labelling a river, or when forced by the curvature of the longitudes and latitudes which influence most feature names, or by the shape of the mapped area. Phillips, et al. (1977:672) stated that "Cartographers frequently arrange letters of a name along a curve for example, when naming a bay or river", while Cooper (1978:24) believed that "River names should be curved to approximately follow their courses". (See Chapter 5, Section 5.2:93).

The nature of curvature alignment of lettering on maps depends upon the artistic experience and skill of the cartographer to achieve effectiveness in the following judgements:

- (i) The visual adjustment and balance of name alignment is judged and measured by the eye and not by the logical adjustment of geometrical measurements.
- (ii) The curvature of a name could be in sine and cosine shape (see fig. 3.7:45), smoothly joined by visual manipulation of positioning alignment and spacing.
- (iii) The arc of alignment curvature should not be acute.

Because of the nature of these adjustments, it is hard to envisage the feasibility of applying the traditional measurement criteria of curvature to the automated system which is based on systematic and logical order.

The possibility of creating an automated curvature applicability alignment is a mathematical one (see figs. 3.7/8:45/46) and could be achieved by programming the following requirements or rules:

- (i) Programming of the circumference(s) of the circle(s) and its (their) radius (radii), because there will be a need for different lengths of radii for different centres.
- (ii) Programming of the length of the arc(s) to space the letters of a name with a specific length of alignment.
- (iii) All alignment should be based on the arc as a base line, therefore the arc can be 'IN' or 'OUT':

'IN' refers to the shape of the arc, its bending direction is southerly (see fig. 3.8:46). It always takes cosine graph shape.

'OUT' refers to the shape of the arc, its bending direction is northerly (see fig. 3.8:46). It always takes sine graph shape.

NATURE OF LETTERING CURVATURE ON MAPS

Sine and Cosine Shape

Base line of "Mediterranean Sea" alignment

The graph shape of sine and cosine is not measured according to mathematical procedure; it is an eye measurement procedure according to the object's direction and surroundings.

Source: The writer

FIGURE 3.8

MATHEMATICAL CURVATURE RULES

Northerly Bending:

It is always "OUT" (sine shape, see fig. 3.7:45) because it adjusts the letters of a name (or part of a name) outside the circle and it should be considered as a base line for alignment.

continued...

Source: The writer

Southerly Bending:

It is always "IN" (cosine shape, see fig. 3.7:45) because the alignment of a name is inside the circle and it should also be considered as a base line.

The Degree θ :

It is always between the two radii which define the length of the arc required for the alignment.

The Limit:

It is for rotating the two sectors to maximum and minimum bending (225° to 45°) which enables good readability (see figs. 2.11:31 and 3.5:41 for comparison), beyond that limit the aligned letters (names) will read upside-down.

- (iv) Apply the rules of straight lines rotation (x and y values and angles) as well as the other manipulating parameters which are already incorporated into the GIMMS and MIGS automated lettering systems.
- (v) Careful thought should be given to programming the circumference, the arc and the radius, because the centre of the required curvature of the circle would not necessarily be found on the actual map. Or, if a name is situated at the edge of the map with two types of bending (see fig. 3.7:45), the centre of one of the bendings (if not both) will be outside the map. The arc of the alignment should not be acute, as it could be part of a large circle, therefore sine and cosine may be appropriate for calculation.

The suggested basic technical aspects for curvature alignment are:

- (i) Type of base line = Curved
- (ii) Nature of base line = IN or OUT (see fig. 3.8:46)
- (iii) Beginning of the alignment name = X and Y
- (iv) Length of the alignment = Arc length in cm. or mm.
- (v) Radius = r
- (vi) Angle in radians.

The mathematical formulae for curvature application are:

- (i) Finding the radius = r
- (ii) Finding or determining the starting position = x and y
- (iii) Finding the arc length = $r \theta$
- (iv) Finding the angle = $\frac{\text{Length of the arc}}{\text{Radius of the circle}}$

(v) The angle in radians $= \frac{\text{Angle in degrees} \times \pi}{180^\circ}$

(vi) "OUT" and "IN"
Should be programmed to describe the type or nature of the arc bending (see fig. 3.8:46), by doing so, the required shape of curvature alignment can be specified).

Working example based on figure 3.8:46

- (i) Beginning of alignment $x = 3.1$ and $y = 4.3$
- (ii) The radius of the circle $= 4.5$ cm.
- (iii) The angle in degrees $= 35^\circ$
- (iv) Change angle from degrees to radians $= \frac{\text{Angle in degrees} \times \pi}{180^\circ}$
 $= \frac{35 \times 3.1415}{180}$
 $= 0.610$
- (v) The required arc length $= 4.5 \times 0.610 = 2.745$ cm.
- (vi) The required shape of curvature $= \text{OUT}$

The same procedure applies to "IN" alignments.

CHAPTER 4

VARIABLES IN LETTERING

4.0 Introduction

"Lettering Variables" consist of five major elements, case, size, style, colour and cut-window; the first three are natural factors in lettering, the fourth is an assisted element introduced to map design in general, while the fifth variable is an assisted technical element recently introduced to the field. Each variable or element exerts its own influence on lettering functions on maps (see table 4.1:51). The function of lettering would be enhanced if these potentials in the variables were manipulated in the initial stages of map design by map-makers. Table 4.1:51 shows the relationship between the cartographic variables and their implemented purpose or function on maps. For example, letters as a variable has 100 per cent implementation in all classified functions, while size as a variable has 33 per cent because it serves only two functions; ranking and emphasis, and so on. Comparing each individual function in terms of utilizing the variables, the 'emphasis' function can utilize up to four variables (80 per cent) more than any other function, while the 'naming' function utilizes only two variables (40 per cent).

TABLE 4.1
CARTOGRAPHIC VARIABLES AND THEIR FUNCTIONS.

V F	CARTOGRAPHIC VARIABLES				ASSISTED VARIABLES		% of Function
	Letters (Cases)	Size	Style	Colour	Cut- Window		
Naming or Identification	X			X			40%
Classification	X		X	X			60%
Ranking	X	X					40%
Emphasis	X	X		X	X		80%
Simplification	X		X		X		60%
Symbolization	X		X	X			60%
% of Variables	100%	33%	50%	66%	33%		

V = Variables of Lettering

F = Function

Source: The writer

Planning guides, figures 4.3:64 and 4.4:71, have been formulated to simplify the task of lettering design on maps. Both figures are based on utilizing letter styles, form, weight, etc., as effectively as possible to achieve optimum visual contrast and harmonious rhythm between the varied data and its sub-divisions.

4.1 Case

Case gives flexibility within the alphabet nature; the upper and lower cases allow a number of alternatives in the process of data classification and categorization, which assist cartographers in their task of lettering. The following examples clearly illustrate the advantages of upper and lower cases:

I: Vertical Alternatives:

- a. All capitals.
- b. First letter capital and the rest lower case.
- c. All lower case.

II: Oblique Alternatives:

- a. All capitals.
- b. First letter capital and the rest lower case.
- c. All lower case.

III: Serif Vertical Alternatives:

- a. All capitals.
- b. First letter capital and the rest lower case.
- c. All lower case.

IV: Serif Oblique Alternatives:

- a. All capitals.
- b. First letter capital and the rest lower case.
- c. All lower case.

Within these four basic groups, twelve classifications can be used within the one same lettering size for all of them.

Introducing size variations to implement priority and order for various objects and features or for sub-divisions or more classification within the family of the object or feature gives even more flexibility. Size will be dealt with later; the interesting point is that there are twelve variations within the upper and lower cases before introducing any assisted elements.

Any alphabet which has not got this flexibility is limited in data classification and ranking in map design, which makes the task of lettering harder in this respect.

Lower case has a positive role in lettering design on maps as it helps in data sub-classification as well as alleviating the space problem on maps. Phillips, et al. (1978:76) declared that, "As lower case names also occupy less space on a map, they are strongly recommended", and they recommended the use of lower case with an initial capital letter because of time-saving in name-searching on maps.

The survey conducted by this writer of Ottawa name signs on shops showed a positive acceptance of lower case with an initial capital letter (see table 4.2:54).

Dent (1985:285) reinforces the advantage of lower case readability by quoting Tschichold, J. who stated that "Lower case words impress the mind with total silhouette while capitals are mentally spelled out letter by letter". The advantage of lower case with an initial capital letter would hopefully convince Kindersley (1968) who did not think highly of lower case status (see page 15).

TABLE 4.2

THE USE OF CASES

KINDS OF LETTERS	USAGE	PERCENTAGE
CAPITAL	124	49.6
ALL LOWER CASE	38	15.2
COMBINATION	88	32.2
TOTAL	250	100.0

Clear evidence of the positive acceptance of lower case usage by shop owners in Ottawa.

Source: The writer's surveys, undertaken in Ottawa during the Winter and Spring of 1985.

4.2 Size

Fawcett (1940:19) declared that "...by the size and character of writing it can also convey some other information about the feature", which is really what should be reflected by all lettering used on maps. Size by its form and weight variations (see figs. 4.1/2:56/57) reflects visual identification and classification of the object or the feature, thus the identified object or feature should reveal part of its meaning by utilizing these two basic principles of form and weight.

The association between the lettering size, weight, form or shape, and the phenomenon or the object depends upon human feelings and perception of the two, feature and lettering. This association could lead to wide discussions and arguments, but is generally recognized that in lettering maps the capital of a country is more important than any town and a city is more important than a village. The term 'important' is used here as an order (rank). And for many reasons, the appearance of the country's name usually has to have the largest size and heaviest or boldest weight than the rest of the names on the map.

Size selection according to the principles of form and weight is influenced by the following factors:

- (i) Purpose of the map which determines the type of information on the map.
- (ii) Scale of the map and sheet size.
- (iii) Type of user.
- (iv) Amount of information on the map.
- (v) Kind or type of information (foreground and background).
- (vi) Condition(s) under which map will be used, e.g. outdoors, indoors.
- (vii) Colour attributes (hue, saturation and brightness).
- (viii) Legibility of small size within the executed map.

FIGURE 4.1PRINCIPLES OF FORM

The three Principles of Form are:-

1. Height:
From top to bottom of the letter's stem
2. Width:
From left to right of the letter's stroke
3. Weight:
The scale of the letter's boldness

These principles vary in measurement. If carefully selected, any set of them would enhance the general appearance of data classification and ranking.

Source: The writer

FIGURE 4.2

PRINCIPLES OF WEIGHT

Weight is one of the three form principles, but because of its variations it could be used successfully in data ranking and therefore consideration is given to it separately.

The three Principles of Weight are:-

1. Light
2. Medium
3. Bold

These three scales apply for one size and can be varied as the point size of the letter changes, i.e. if a point size of a letter is 0.1, then this letter point can be light, medium or bold in appearance.

The weight principles have a strong and an effective role in data ranking.

Source: The writer

The above factors and principles of size selection have to be considered to suit the needs of the approved classified data and its ranking. Even then, letter sizes still cause the cartographer problems, for two main reasons:

- (i) There is a strong demand on small letter sizes, especially on a small scale map, because most maps are superimposed with various types of data on the map sheet.
- (ii) Once letter sizes are designated according to data classification, sub-classification and order of importance, the cartographer cannot at a later stage alter or change a size for any reason.

Therefore, the letter size selection is critical. It needs considerable attention in the planning procedure of ranking the data, and patience to choose the appropriate position to align the object's name, because the map is usually clustered with overlapped information.

Readable visuality should be the main concern in lettering a map and it plays a strong influence in the choice of small size lettering.

Hodgkiss (1966:28) stated that:

- (a) Legibility, bearing in mind that the smallest size of lettering regarded as being legible is '4' point which is roughly 1mm high,
- (b) Perceptibility and harmony, the weight of the letter should be balanced against the background. It should be solid enough to be legible against varied backgrounds but not so heavy as to distract attention away from other features.

Robinson et al. (1978:327) specified the point size, and they agreed with Hodgkiss when they stated that "It is safer to generalize that probably 4-point or 5-point type comes closer to the lower limit of visibility for the average person". Yoeli (1972:99) gave more

attention, seemingly, to the "normal conditions" than to the user and did not specify point size when he declared that "The minimal basic letter size is that size of lettering which can still be easily read under normal conditions without magnification".

Flexibility in small letter sizes is produced by various weights: light, medium and bold. These weight variations are preferable for maps providing their application is not at the expense of clarity. Use of large letter point size could then be reduced to the minimum thereby reducing the problem of the data being subduced by large lettering.

Flexibility in size variations also applies to style, as the style can be extended or condensed, which reflects differently in the same given point size. An experienced and skillful map designer could ease - to some extent - the problem he faces in data classification on the map by taking into consideration all the possibilities of size flexibility.

Recommendations have been made by experts for manipulating size selection to distinguish between various categories and classifications of the information on the map. Keates (1978:206) advised the use of weight, when he suggested that "In many cases, the emphasis on a certain name, or a certain class of names, is more effectively attained by additional emphasis in weight than by an increase in size". In contrast, Lawrence (1979:38) favoured sizes and styles when he stated that:

~~In order to distinguish between places of different size or different status (i.e. in terms of administrative function, capital cities, towns, parishes, etc.) a different size and style of lettering can be employed.~~

4.3 Style

Riddiford (1952:9) stated that:

The successful map will have unity and rhythm, which results from harmony between the various type styles chosen, and the best use of these in emphasis and contrast to win for the map a high degree of liveliness.

A successful map has a few selected styles to achieve balanced harmony with all the components of the map.

Styles have various appearances and variations in point sizes, these differences have to come together with the named objects to suit the type of information presented on the map, as well as consideration for reproduction, and some other conditions, such as folding, which also have to be taken into account. Fawcett (1940:19) suggested that:

The writing on a map ... think of it as it will appear on a map which has been folded, creased, and more or less soiled by use. We need writing which will still be legible after such treatment, and it is by its legibility under such conditions in the field that map writing is to be judged.

Style selection for a map should consider the following requirements:

I: Map's Requirements:

The map has its own contents which are mainly the immediate purpose and the supporting information, at the same time, the map represents bodies of the earth's surface organizations, such as: land and water, as well as human creations; each one has its own classification and divisions. Therefore, the map needs careful selection of letter styles with certain criteria to be met. As Keates (1973:206) stated, typeface should be:

- (i) Legible at very small sizes.
- (ii) Available in a variety of forms and weights.
- (iii) Should not contain any unusual or ambiguous letter forms.

The above three points mentioned by Keates are very important because they are based on the map's nature and requirements, as well as the user's conditions.

II: User's Requirements:

A person's visual capability influences his perception and consequently his judgement of all types of maps. Tuan (1974:6) declared that "Of the traditional five senses man is more consciously dependent on sight to make his way in the world than on the other senses". Because sight is a personal sense - but influenced to some degree by cultural learning - it may thus be impossible to produce a map that will fully satisfy every individual, and, of course, user needs vary. With respect to user needs, there are indoor users, outdoor users, office users, school users, special users, and so on, and each individual user has varying familiarity, taste and visual capability. Perhaps it is impossible to satisfy every individual! Nevertheless, great care and attention has to be given to selecting the most appropriate styles and overall visual balance when creating maps. Biggs (1977:43) declared that "We are concerned with appearance. Forms must appear right; indeed, it is only right if it appears right". But the question is, how could it be right for everybody and where are the criteria to fulfill self-complacency for each user? Biggs went on to state:

The designer must be forever on the alert to detect when a form does not look right because of the illusions that are due to the physical nature of the eye and how the phenomena are interpreted by the mind.

III: Style Flexibility:

Variations in style such as serif and sans-serif, vertical and oblique, provide a very clear visual distinction. The human planet has two bodies: water and land. Could that not be used as a basic division in using lettering on maps? (see pp. 70/72)

Flexibilities in style include the following:

- (i) Wide selection of letter styles.
- (ii) Capital and lower cases in each style.
- (iii) Serif and sans-serif.
- (iv) Vertical and italic.
- (v) Extended and condensed.
- (vi) Light face, medium face and bold face.
- (vii) There is some independence in sizes, as a point size in one style is not necessarily the same as others.
- (viii) Punctuation is not necessary.

All these are positive factors which assist map designers and facilitate choices in their task.

IV: Cartographer's Skill and Ability:

Irrespective of the above-mentioned flexibilities, the cartographer or designer in map-making has to have the skill and knowledge in filtering the proper styles with their proper sizes according to the capacity and the purpose of the map and the importance of the objectives accordingly, as well as bearing in mind the user's conditions and ability where possible. Keates (1973:206) felt that "The visual appearance of lettering on the map reflects the importance of the object named". Therefore, the task in hand is not just to select the right styles but also to achieve harmony with the final appearance of the map.

Taking lettering for granted and not giving appropriate attention to its design and style could jeopardize the rest of the good efforts put into the map. Irrespective of the function of lettering (identification, classification and explanation), the natural figuration of letters contributes considerable support to and enforcement of the named object. Bartz (1969:129) declared that "...both the physical characteristics of letter shapes (type style) and the arrangement of the shapes on the map may encode considerable information".

The physical characteristics and the arrangement of letters are part of many considerations in planning or selecting styles. The writer has listed below the basic factors which should be carefully considered to enable selection of the most appropriate style for the map:

- (i) Purpose of the map.
- (ii) Type of information, its amount, and the scale of the map.
- (iii) Type of user and the conditions under which the map will be used.
- (iv) The General Physical Characteristics of Style:^{*}
 - A: Basic Form:
 - (a) Upright (or Vertical)
 - (b) Italic (or Oblique)
 - B: Shape:
 - (a) Serif (including Sans-Serif)
 - (b) Decoratif
 - (c) Extended
 - (d) Condensed
 - C: Weight:
 - (a) Light
 - (b) Medium
 - (c) Bold

^{*} See Fig. 4.3:64.

FIGURE 4.3

LETTER STYLE ROUTE

Source: The writer

D: Size:

- (a) Between Upper and Lower Cases
- (b) Between One Style and Another.

- (v) Technical possibilities and limitations.
- (vi) The influence of reproduction on lettering.
- (vii) Map users reasonable cost.
- (viii) Map makers acceptable cost, and so on.

Styles selection is an important and critical task because it is part of the general design appearance of the map. Fawcett (1940:8) stated that "To select the proper type for a map calls for almost as much judgement as it does ability to design the type itself".

The selection and arrangement of lettering in map design are related problems, although each one has its own requirements; some of the selection requirements have already been mentioned, while the following points are some of the arrangement requirements:

- (i) The space available on the map and its permitted manipulative flexibility.
- (ii) The importance of the class (ranking of the object named).
- (iii) The natural direction of writing the alphabet and the natural direction of the feature or the object which has to be named.
- (iv) The natural method of writing the alphabet (single/joined).
- (v) Longitude and latitude.

The requirements of style selection and arrangement of lettering are for achieving a sensible sort of conversation, which is communication between the mute map and the user, and to ensure that the function of identification does not misrepresent that which is to be interpreted.

Because style and its arrangement have a strong effect on the final appearance of the map, pioneers have given considerable attention to overcoming problems in lettering and have put forward recommendations and guidelines. Withycombe (1928:435) recommended that:

Clear readable type, harmonizing with the map itself, should always be used and the marginal information should be grouped in such a way as to make reference easy, and enhance the balance and general artistic effect of the sheet.

Withycombe's statement was a call for filtering the most suitable styles to be used on maps.

Styles are cultural developments and so they have different functions in various situations. Keates (1956:76;1973:201-211) recommended that it was advisable to associate some features with some specific style or type. In 1956 he wrote that:

For an ideal face I would list the following points:

- (i) Large in the body, fairly narrow set, short ascenders and descenders, good open counters.
- (ii) Rounded shading (in serif style) with not too much contrast between thick and thin strokes.
- (iii) Plain italics, without any fancy letters.
- (iv) All capitals to range on the same base line.
- (v) A semibold version for use where emphasis is required.
- (vi) A related sans-serif face to match.
- (vii) A condensed version in all sizes about 10 points.
- (viii) A decorative style of caps to match.

These recommendations are mostly technical ones and take into consideration the need to fulfill a high degree of contrast between letters. Keates (1973:207) emphasized visual association for selecting the styles which have clear visual differentiation as in the case between serif and sans-serif, Roman and Italic, and capital and lower case forms. He

believed that "These three characteristics are sufficiently distinctive to be used to distinguish between different categories of information" and he gave the following examples:

- (i) The names of physical features on a map may all appear in old style serif face, such as Times.
- (ii) The land features may be shown in the Roman form.
- (iii) The water features in the Italic form.
- (iv) Similarly, all the cultural features may be shown in a sans-serif face, such as Univers: towns and settlements may be presented in the Roman form; names of other features, such as buildings, monuments, etc., in the Italic form.

Phillips, et al. (1978:76) also gave some advice, including the following:

- (i) Legibility of type must be considered in relation to the legibility of the map as a whole.
- (ii) Bold type is no more legible than normal weight type and should be avoided as it has a cluttering effect on maps.

Keates' recommendations are more effective because they are more specific, indicating distinctive styles, than the general advice given by Phillips, et al.

The map is pictured land, water, populations, human creations (and/or a combination of these). These criteria generally are subdivided and classified so that using or selecting more than one style is a positive dimension, irrespective of all difficulties. Fawcett (1940:19) stated that:

There is a need for several different styles of writing the letters and figures, 26 + 9 symbols of our alphabet, which we may speak of as so many 'alphabets' for use on maps.

Objects on the map have different natural characters/classes within their importance and styles have various forms and weights, so it is vital to employ style characters and size variations according to the object's classification and ranking to enhance the appearance of the map's varied information. Keates (1973:206) concluded that "...the visual appearance of lettering on the map reflects the importance of the objects named".

Cartographers and others have been trying to find out the right style(s) to be used on maps. Some made generalizations, such as Withycombe (1928), and Fawcett (1940) about what they thought was a good style (type) or good lettering. And some, such as Keates (1956, 1973), went further as they offered recommendations and advice, while others, such as Kindersley (1968), rejected any attempts leading to that type of standardization or associating maps with certain types of style. Withycombe (1928:432) felt that:

...the style of lettering on a map should be as good as that exhibited by the best founts of type in use by book printers. As legibility is one of the characteristics of every really good alphabet, the first aim will be attained if really good style is achieved.

And Bartz (1969:137) suggested that "It seems likely that increased type legibility would contribute to increased overall map legibility", while Robinson et al. (1978:321) stated that "The utility of a general map depends to a great extent on the characteristics of the type and its positioning". Keates (1973:206) believed that:

The typeface should be legible at very small sizes, it should be available in a variety of forms and weights, and it should not contain any unusual or ambiguous letter forms,

but Kindersley (1968) rejected standardization and had little faith in "Legibility Research". He believed that it would somehow affect the evolution of letter style (calligraphy); his point of view was focussed on the freedom of movement of calligraphy which he felt enhanced the penman's freedom of imagination. Kindersley (1968:69) declared that "We don't want standards because they prevent evolution", and he also believed that:

The results of psychological research into the legibility and comprehensibility of types could slow down the imaginative and creative work of the artists who contribute so much to the printed book.

Bartz (1969:127) considered that "...problems in the selection and arrangement of lettering are among the most complex of those confronting the cartographer as he designs the map", and she made the following useful observations: "Type is considered to be (i) Symbolic (ii) Analogic; (a) Locative Analogy, (b) Quality Analogy and (c) Quantity Analogy".

All recommendations and descriptions of good or suitable style(s) for maps have led to style classification. Withycombe (1928) called for grouping them together under certain conditions, while others, later, tried to do so. Keates (1973:204) stated that "There are hundreds of different typeface designs,...the principal division is between designs with serifs and those without", while Cooper (1978:19-21) classified type faces into five "races" - as he called them - and each "race" into "families", as follows: (i) Text, (ii) Roman faces, (iii) Gothic faces, (iv) Script and Cursive faces, and (v) Decorative or Novelty faces; and each one of these was sub-divided. These classifications may be useful, but Keates' classification is more feasible than those of Cooper.

The implication of classification and recommendation in style(s) is to achieve various objectives and feasible application on the map; letter forms, weight and their association with the object named, lettering size and its manipulated flexibility to overcome the space problem, etc.

The writer has amalgamated the more important aspects of letter style selection and data categorization (by style and size) and formulated them into a logical diagrammatic structure (see fig. 4.4.:71) based on the following facts: The map is a miniature of our "real" world presented in graphic forms. The "real" world includes land, water, human beings and their creations, flora and fauna, therefore:

- (i). Land and water can be considered the two main divisions of the "real" world and the diagram adapts these two divisions as a main classification by style; sans-serif for land and serif for water, while not implying any priority between the two physical bodies. The variation in the two different shapes is for a visual distinction, because any serif shape on land still indicates a water feature, e.g. a river, and any sans-serif shape on water still indicates a land feature, e.g. an island. By this means, the identification function is achieved by showing the object's nature, without interfering with its importance or imposing any priority.
- (ii). Human presence and activities, artificial features, as well as others are either on land or water, therefore, the sub-division should distinguish between the nature of the objects; the natural features such as mountains and oceans, the human features such as

FIGURE 4.4

LETTER STYLE AND DATA CLASSIFICATION

human presence and settlements, and the artificial features such as Rideau Canal, Suez Canal, and polders, where land has been reclaimed from the water.

- (iii) After the process of categorization and ranking order in each group of the selected data, size of letter should be introduced to achieve the ranking function by form (height and width) and weight (light, medium and bold). Point sizes of letters have to be carefully selected for clear visibility and to maintain the categorization within each ranking group of data.
- (iv) Colour introduction in lettering enhances classification, emphasis and symbolization, e.g. blue for water (even if on land) is a good association for the common usage of blue for symbolizing water features while black symbolizes all land features.

4.4 Colour

Colour is introduced as a part of lettering variables because it facilitates greater enhancement within the natural factors of lettering and it increases the number of alternatives which can be used within one letter size, thereby assisting in the categorization of data classification.

Irrespective of the technical frustrations of colour applicability and its high cost, colour usage on maps is worth attention for its reinforcement and clarification as well as its flexibility in greater classification. Robinson, et al. (1978:300) declared that:

Color on a map allows greater detail; it adds visual interest; it increases the design potentialities; and it adds greatly to the possibilities for hierarchic graphic structures.

Geological maps are good examples of using colour as main symbols for classification and hierarchy of different groups of geological classifications. Keates (1982:41) stated that:

The use of colour on maps is important, because it introduces a large number of variables which can enhance contrast, and therefore extend the number of perceptual differences which can be employed in discrimination. The effect is to aid legibility, and therefore to increase the total range of information which the map can present.

This paper applies what the pioneers have stated for colour generally in map design to lettering in map design. Map-makers have been applying colour for lettering as well as for the graphic variables for many years; lettering water features in blue, lettering land features in black, and lettering some important features in red for reinforcement and so on. The limitation on the number of colours used in lettering is an objective factor. Association between a colour and a feature could achieve effectiveness and legibility; the association of blue with water features - in lettering - has been a successful representation. Phillips *et.al.* (1977:671) noted that Foster and Kirkland (1977) had used:

A map where land names were in black, and water names in blue. When subjects knew the colour of the name, search times were faster than a map where all the names were printed in black but when they did not know the colour, the single colour map was faster.

Therefore, association between colour and the feature named is not enough in itself, even though the association is a perfect one. Time is needed to establish colour association and to acquaint the user with the associated colour(s). A good example of associating colour with an object or labelling names is the London (England) Underground Map:

Blue for Victoria Line
 Green for District Line
 Red for Central Line
 Yellow for Circle Line, etc.

The Underground map uses colour in all its transport lines, and it has the benefit of effectiveness because the line colours have not been changed since being introduced.

Apart from the long period of time needed to establish colour association with an object, colour has meaning and is rooted in most cultures. Robinson (1967:52) declared that "...most cultures have developed and perpetuated symbolic associations with colour", and Fickeler (1971:99) stated that "...most religions favor a particular colour that is especially distinctive and characteristic...".

It would be effective to have minimum colour (preferably solid) association with lettering on maps - such as blue for all water features and black for all land features (see fig. 4.4:71) for technical and visual reasons. And using solid colours for all lettering while relying on letter sizes to illustrate the importance and ranking of the objects named. Red colour lettering should be minimized and used only if it is very necessary, for technical and cost reasons.

Size of lettering (black or blue) should be applied:

- (1) To achieve the optimum visual legibility of a name.
- (2) To show the ranking importance of the object.
- (3) To minimize the discontinuity of the (linear) features which could be subdued and/or overlapped by the size of the name (length and breadth).

Robinson (1967:52) stated that:

When the objective of a map is to communicate geographical data and concepts then the use of

color, like the use of line, must be based upon precepts and understanding of how color affects communication.

The same principle should be applied to letter colouring as both should achieve their function of identification through legibility.

4.5 Cut-Window

Cut-window is a technical methodology to overcome some of the lettering problems to achieve legibility. It is for this reason that this method is considered in this paper; as a variable which assists lettering design on maps to achieve legibility by visualization.

Recently, some cartographers or map-makers have been using "a window" or what Shortridge (1979:19) referred to as "patterns with windows". It is a technical operation, done mostly by photographic procedures to solve the problem of making lettering legible. Shortridge explained the term by saying:

A design alternative to superimposing a gray screen pattern directly over, or under, lettering is to cut out a rectangular box immediately around each lettering area, leaving block lettering on a white background.

Cut-Window is termed "shield" in the GIMMS Manual 4.5 (1983:6.29) which states that:

Giving this option will cause the text area to be 'shielded' after the text is drawn. A margin around the text may be specified. (see fig. 4.5:76)

This method of "cut-window" or "shield" by traditional and automated cartographic systems does not really solve the lettering problems for the following reasons:

- (i) Both systems cut the continuity and consistency of the features.

FIGURE 4.5
CUT-WINDOW
(SHIELD)

GULF OF OMAN

ARABIAN SEA

GULF

ARABIAN

ADDAMMAM

HABAD

SCALE

125

25000

ARRIYAD

BURAYDA

NAJRAN

SEA

ARAR

SAKAKA

HAIL

ALMADINA

MAKKAH

BAHA

ABHA

JIZAN

N

RED

- (ii) All primacies in lettering being given to designated place names at the expense of the foreground and background information in those areas.
- (iii) Some improvement is gained in lettering legibility but not in feature visuality.

Shortridge (1979:20) referred to the positive results of using this method, which indicate that it is at the expense of other elements on the map. She declared that:

Cutting a window around a word grouping improves map readers scores and makes the judgements comparable with those for maps containing no super-imposed patterns.

Bridgman and Wade (1956:378) compromised when they stated that:

Esthetic and artistic consideration have always demanded a margin between inscribed letters and the limits of their background, on the other hand, printing particularly lower case letters can still be used when a considerable portion of the detail is masked.

It may be that the technique of Cut-Window is suitable for ideographic lettering such as Chinese or Japanese to separate the symbols of the map from the symbols or the strokes of the ideogram for clarity and legibility.

CHAPTER 5

LETTERING FUNCTIONS

5.0 Introduction

— Lettering functions on maps, using letters both individually and collectively, directly and indirectly, are to establish verbal communication within all elements of a map. The use of cultural variables and the cartographic variables of letters (see table 5.1:79) are to achieve the ultimate lettering functions on maps, which are:

1. Place and object names, 'Labelling', e.g. Ottawa, Hudson Bay, Atlantic Ocean, etc.
2. Explanatory function, e.g. i for information; the legend and marginal areas of maps are rich with various examples.
3. Positioning for identification; this can be for real locational objects, e.g. Oil fields, wheat fields, or it can be for imaginary locational objects, such as International Date Line, Arctic Circle, etc.

To achieve effective communication between the mute map and the user, the cartographer should (i) employ lettering variables (cultural and cartographic) as effectively as possible (see table 5.1:79) and (ii) maintain a coherent appearance of the map's contents, which include

TABLE 5.1

CULTURAL AND CARTOGRAPHIC VARIABLES AND THEIR FUNCTIONS

V F	LETTERS (CASES)	STYLE	SIZE	FORM	WEIGHT	SPACING	COLOUR	CUT- WINDOW	% OF FUNCTION
NAMING OR IDENTIFICATION	X						X		25
CLASSIFICATION	X	X					X		37.5
RANKING	X		X	X	X				50
EMPHASIS	X		X	X	X	X	X	X	87.5
SIMPLIFICATION	X	X				X		X	50
SYMBOLIZATION	X	X					X		37.5
% OF VARIABLES	100	50	33	33	33	33	66	33	

Table 5.1 is an extension to Table 4.1:51.
It illustrates the implemented functions
of the cultural and cartographic variables
see Introduction to Chapter 4:50).

V = Variables
F = Function

Source: The writer

foreground and background information, so that it is visually predictive and explanatory.

Lettering a map is a sensitive aspect in terms of having the correct spelling and correct form of a name because users react towards what they believe the name should or should not be. Although cartographers apply conventional and internationally recognized and officially accepted forms of names on maps, the problem of having unacceptable forms of names from part of the world's societies is still unresolved.

The writer categorizes the problem and suggests a tabulated methodology to resolve the disagreements, although the writer himself believes that original forms of conventional names should not be changed when an object has a long-established world-wide identity.

Through the analytical procedures, three aspects have been taken into consideration as follows:

- (i) Type of information which needs to be lettered.
- (ii) Cultural influences which monitor the functions of lettering.
- (iii) Support for wide cooperation nationally and internationally to resolve the ambiguity of certain geographical names to achieve standardization.

The focus on cartographic and cultural criteria is to stress the aesthetical traditional principles of lettering design on maps which enhance the process of data classification and results in a harmonious rhythm with the rest of the elements of the map.

5.1 Place and Object Names

Labelling (lettering) on a map is identifying an object which has been named by human beings, usually according to their cultures. The

object can be land, water or human creations, etc.; each object has its own natural character and value by human criteria, which determines the distinction and classification between most objects - these in turn are sub-divided into 'families'.

Identification by lettering on maps is a limited function, for example, a road name on a town map does not show the nature of that road - is it a Roman road? (which is paved by stones) or is it a one-way system? (which is its traffic function). The limitations here are that the nature of the road and the function of the road could not be deduced by the identified name on the map. Another type of limitation is that a city name on a map does not show the spatial distribution of the city or the direction of its spatial expansion or distribution (aspects which concern geographers and planners, etc.), although the point size of its name may show its importance within the settlements (cities, towns, villages, etc.). It would not be possible to identify the three aspects (nature of the object, function of the object and its spatial distribution) mentioned in the examples by lettering forms or weight. Keates (1973:66) stated that:

The use of names as a reference system ... is a convenient means of communication over a limited range, not a system of absolute identification, as is the use of geographical co-ordinates on maps.

By lettering (names), it is possible to record some historical information of the geographical names of the place on the map. This is one aspect of the lettering function (identification) which illustrates that a map is a record of the history and the knowledge of human beings, but this function is a specialized area (toponymy) with which this paper is not concerned.

The discrimination between land, water and human creation names on maps by letter style and colour association is to identify the nature of the identified object (see fig. 4.4.:71), therefore when the lettering classification has been established between all map-makers and professionals in the cartographic field, it will, in the long-run, enhance the indispensable function of names on maps.

Communication by lettering (names) varies according to the map's purpose (geological map, tourist map, etc.) and the user's requirements and knowledge of the place, and of using and reading maps. The scale of the map is the dominant factor to present names in various sizes and to show their importance in various weights. Keates (1973:66) stated that "...the use of names as a reference system is the normal means of describing location in verbal communication", while Ostrowski, J. and Ostrowski, W. (1975:124) believed that "...an object can be found only according to its address, therefore this information should be taken into account when determining the range of contents of a map". These two statements illustrate that names on maps are the link between the user and the actual object in creating a sort of communication. Style choice, point of letter size and the arrangement of names influence that communication by speeding it up or slowing it down. Research has been conducted to measure the time taken to find a name on a map as a way of evaluating maps. The speed of finding a name quickly is affected by the amount of information on the map, the importance of the named object to the user, and the natural method of writing the letters. In Arabic lettering, the score could be positively high, because the natural method of writing is always joined, while the advantage of writing 'single' (as in English) could slow down the speed if the spaces between

the letters were wide and crossed with other names. Therefore, contrast and discrimination by visuality in letter style (serif and sans-serif) would enhance the discrimination between water feature names and land feature names without implementing any priority, while human creations could take a third style, visually contrasting from the chosen two. This form of visuality could enhance object names identification and speed up time-searching for a name.

Names on maps have to be written correctly as they are well known nationally and internationally and geographical names have their own rules and regulations. The application efficiency varies from one country to another for various reasons. Keates (1973:67) stated that "In a country with a homogenous culture and adequate written and historical records, it is possible to establish correct names for virtually all places". But even a country with these advantages could only partially solve the names problem, because geographical features could be shared with more than one country; although the object is the same, this situation could reflect different spelling for the same object, with, in turn, different pronunciation.

The United Nations is trying to standardize geographical names, which would eliminate confusion and ambiguity and would ultimately enhance the function of lettering identification. Although as Keates (1973:66) observed "...the changing of names is nearly always resisted because names form part of the culture of any social group".

5.1.1 Transliterations

Communication between people has different forms, and the map is one of these forms. Various cultures have recently integrated in different ways, although this integration is limited. Transliteration -

a form of integration - is a method based upon certain criteria to monitor the change in names from one language to another by experts who have specialized knowledge of the languages involved. Boards have been set up in many countries to deal with this aspect, therefore Americanizing, Anglicizing, Arabinizing, etc., are references to those boards. Map-makers and cartographers employ only officially and universally approved and recognized names, but transliteration does not always provide clarity within well known feature names, even though it has been used accurately between the languages concerned.

The White Sea, Red Sea and Black Sea are generic and specific, correctly translated by their meanings (not pronunciation) into Arabic as follows:

البحر الأبيض Each name consists of two words. The first (from the البحر الأحمر right) means Sea, and the second in each one is the البحر الأسود descriptive name - White, Red and Black respectively.

A different example of transliteration is 'Ar Rub al Khali'. Although this name takes into consideration the Arabian sound (pronunciation), it causes some difficulty to an Arabian person in recognizing the sound from a non-Arabian speaker, and consequently, difficulty in recognizing the feature meant. This problem occurs by there not being equivalent sounds in English of two Arabian letters which are (ع) and

(خ) ; the first is dismissed, while the second is replaced by 'kh' which has the same sound as the last two letters in 'loch' (lake in English) as pronounced by a Scottish person. The proper meaning of 'Ar Rub al Khali' is the Empty Quarter.

Transliteration is necessary and is a sign of integration between cultures irrespective of its limitations, although the degree of integration is dependent upon the willingness of the experts or authorities in charge.

Some examples of Arabian transliteration are given in table-5.2:86.

5.1.2 Names Within One Country

Lettering on maps is a means of verbal communication, nationally and internationally, therefore it is a written language presented by means of an alphabet, such as English, or ideographic, such as Chinese. Every country should have respectable support for conventional names in its own territory for wider communication, and any changes should not abolish the conventional ones totally, even if culture, ideology, etc., are the grounds for the changes. Keates (1973:70) stated that:

...Several countries which do not use the Roman alphabet, such as Russia, Turkey, China and Japan, have officially adopted the use of a Roman alphabet for international use, which of course is intelligible to English-speaking people.

Chinese or Japanese script is not easily combined with graphic presentation of the information on the map especially for those who have no knowledge of these languages.

Names within each country - generally speaking - could be split into three categories or classes. The stability of names - not having been changed from time-to-time - is of major importance within the following three categories:

5.1.2.1 Names under the Jurisdiction of the Country

Names under the jurisdiction of the country are names of places or objects which have no overlap whatsoever, physically, politically or culturally. The homogeneity of the social groups of a country, if

TABLE 5.2ARABIAN transliteration and form

ENGLISH FORM	ARABIAN SOUND FOR ARABIAN FORM	ARABIAN FORM
Britain	Britania	بريطانيا
Canada	Canada	كندا
France	Fransa	فرنسا
Germany	Almania	ألمانيا
Italy	Etalia	إيطاليا
Russia	Rosia	روسيا
Spain	Aspania	أسبانيا

Source: The writer

2 OF/DE 2

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

united and efficient, could establish the stability and the correct written names for all places within the country's authoritative zone, or territory. Keates (1973:67), stated that:

Provided that the area of a map falls within the sphere of a single language group, it is possible at least in theory to establish the correct forms of names and make rules about their application. It is also possible to control the application of new names to some extent.

Keates' theory though does not apply when map making is done by an outside body. A clear example of this is Saudi Arabia. It is an homogenous country with a single language - Arabic - and names of places and objects all over the country do not cause any problems within the Arabic lettering (in terms of having correct names for all places) but because the English equivalents of the Arabic place names have not all been officially agreed and approved by the Saudi authorities this has caused the present discrepancies in place names between English, American and Canadian map producers, etc. (see table 5.3:88).

5.1.2.2 Conventional Names in the Country

For many countries, conventional names supersede the native form name, therefore the identification of the place is widely known by the form of the conventional one and this could reflect the importance given to it on maps. Conventional names are dealt with in the thesis in two groups: the first group, where the whole physical body of the conventional object or feature's name is under one authority, such as names in table 5.4:89, and the second group, where conventional names are shared with other countries, see 5.1.3:91 and the discussion which follows.

The degree of difference between the conventional names which are not shared with another country could be classified into the following categories:

TABLE 5.3

THE NEED FOR STANDARDIZATION OF
ROMANIZED FORMS OF ARABIAN NAMES

ENGLISH VERSION			ARABIAN FORM
*Canadian Atlas	**English Atlas	***U.S.A. Atlas	
Ar Riyad (Riyadh)	Riyadh (Ar' Riyad)	Ar Riyad (Rīyadh)	الرياض
Makkah (Mecca)	Mecca (Makkah)	(Mecca) Makkah	مكة
Al Madinah	Medina (Al Madinah)	Al Madinah (Medina)	المدينة
Jiddah	(Jedda) Jiddah	Jiddah	جده
Az Zahran	Dhahran (Az Zahran)	Dhahran (Az Zahran)	الظهران

* The Concise Atlas of Canada and the World,
Methuen Publications, Toronto, Canada, 1983.

** The Times Atlas of the World, Sixth Edition,
John Bartholomew & Son Ltd., Edinburgh, 1980.

*** National Geographic Atlas of the World,
Fifth Edition, National Geographic Society,
Washington, D.C., 1981.

Source: The writer

TABLE 5.4ANALYSIS OF THE CONVENTIONAL NAMES PROBLEM

	CONVENTIONAL NAME	NATIVE NAME	FORM OF WRITING
i	Rome	Roma	No Need
ii	*Mecca	Makkah	Makkah (Mecca)
iii	Cairo	Elqahira	Elqahira (Cairo)

* In the New Reference Atlas of the World,
(New York: C.S. Hammond & Company, 1924),
Plate: Asia, p.13, Mecca was written in
the form of 'Mekka'.

Source: The writer

(i) The conventional name and the native one have established their identity because there is no great change between the two forms, such as Rome and Roma. The change is small as the last letter in each one changes only the end sound of the name (see table 5.4:89).

(ii) The conventional name is accepted as a native one, therefore any changes would still have a connection with the conventional form as is the case of 'Mecca' which was accepted as native but has recently been changed for two reasons. Firstly to avoid the association between the form of Mecca as a religious place name, and Mecca as a dancing and/or a betting place. Secondly to have a form which gives the correct pronunciation by the natives. Therefore the new form is 'Makkah'. This romanized form was requested by the Saudian delegation at the Fourth United Nations Conference on the Standardization of Geographic Names in Geneva, 1982. (Canada Geographic Names and the United Nations, 1982, para 67:12). Comparing the two forms it would not appear a great change, because the actual change took place in one letter, which changes 'e' to 'a' in the new form, while double 'c' produced the same sound as the double 'k' in the new version, therefore the new pronunciation is not totally different from the conventional one (see table 5.4:89).

(iii) This is a total change in pronunciation and form of names between the conventional and the native names. This category takes a longer time than the second to establish the native name without having the conventional name written beside the native one, as in the case of Cairo to Elqahira.

It seems (i) has easier integration because of the similarity between the two languages and because the change is small, while (iii) is the most ambiguous because there is no similarity in the letter forms nor in the pronunciation, therefore (ii) is less ambiguous (see table 5.4:89).

5.1.2.3 Conventional Names Shared with Another Country

This is the second group of conventional names, where the physical body of the feature of the object runs into a wide area which is occupied by different states or countries. If these countries differ culturally - languages - then the name of the feature varies from one country to another. Keates (1973:67) declared that:

...larger problems occur when the area of a map extends over the territories of several languages cultures. In this case some means must be found of dealing with the place names which exist in other languages even where they are incomprehensible except to scholars.

A very clear example is the River Danube. It is an object shared between seven countries and is written in five different ways as follows:

1. Germany	- Donau	5. Yugoslavia	- Dunaw
2. Austria	- Donau	6. Bulgaria	- Dunaw
3. Czechoslovakia	- Donaj	7. Romania	- Dunarea
4. Hungary	- Duna		

The 'Danube' form and pronunciation is a conventional version and none of the countries concerned use it. The change in the river's name has various forms because the river flows through different countries which have different administrations and languages, therefore the problem of using the conventional version or of having one version of spelling is difficult. (see table 5.5:92).

TABLE 5.5

DANUBE LETTERS COMBINATION

Letters Countries	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z																										Total
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	
Germany	X			X										X	X						X						5
Austria	X			X										X	X						X						5
Czechoslovakia	X			X						X				X							X						5
Hungary	X			X										X							X						4
Yugoslavia	X			X										X							X		X				5
Bulgaria	X			X										X							X		X				5
Rumania	X	X		X	X									X				X			X						6
	8			6	1									7	2			1			7		2				35
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	

According to the Table, the only letters shared by all countries are: A, D, H, and U. These four letters are the only components of the River Danube in Hungarian and they are in the conventional. Therefore, could it be possible to have the Hungarian name officially adopted by all the countries concerned?

Source: The writer

5.2 Positioning for Identification

Objects are presented on maps by the cartographic transformational language system which consists of points, lines and areas, and which are formulated according to the nature of the object. The system is also applied to imaginary objects which are established to benefit human beings.

Names provide direct explanation because they identify objects and spatial information which are presented indirectly by symbols. This identification answers such questions as "What is it?" and "What is there?"

To achieve the optimum identification function, the positioning alignment of a name has to fulfill the following considerations:

- (i) Normal visual readability in the designated position or place.
- (ii) Aesthetical and coherent appearance with the surroundings.
- (iii) The name should indicate as closely as possible the correct location of the identified object on the map (see the general guidelines for positioning alignment, i-xi:36/39).

5.2.1 Point Identification

Names identifying point features should be adjacent to and not spread out from the point symbols. The point size of names (letters) should be consistent for all groups of the same nature and value. The hierarchy order of importance to a group of point features should be consistent, according to the process of data classification and ranking (see fig. 4.4:71), and to the official status given, for example, the national capital should have the highest or boldest letter size - within cities and towns - then the provincial capitals should all have the same point size and style of lettering - lower than the national capital -

and then followed by cities, - irrespective of their sizes, and then towns and villages, thus achieving clear visual identification of the hierarchy order within a group of objects.

Point identification has fourteen possible positioning alignments, far more than line and area identification, which allows better and clearer visual identification to be achieved.

5.2.2 Line Identification

Minimal curvature and repetition are preferable for long nature (linear) features. Features with two-part names (e.g. Rideau Canal and National Transcontinental) should not be too widely spread apart. They should (if possible) be aligned as in the normal way of writing them and should not be split above and below or east and west of the object named. The space between the object and the base line of the letters (name) should be even (see fig. 3.2:38). The direction and orientation of the linear features can be indicated by using various types of straight or curvature lines alignment (see figs. 5.1/2/3:95 and figs. 2.5/12:29/32).

5.2.3 Area Identification

The name of an area should cover two-thirds of the area's length (see fig. 3.3:38) and should be centred visually. The positioning alignment of the name should indicate the direction or the orientation of the area's shape with respect to the neighbouring areas.

Choosing the name's letter size (width, height) should not subdue the information nor dominate the general visuality of the map as a whole.

LINEAR ALIGNMENT AND FEATURE DIRECTION

Figure 5.1

North to South:

It would be visually effective if the base line of the river's name was aligned on the east bank of the river parallel to the river symbol (line) because the space between them could be evenly balanced, and by doing so, indicate the direction of the river (Rhône, France), from north to south by the direction of the lettering of 90° to 270° alignment.

Figure 5.2

South to North:

Because the river's direction is south to north (Yenisey, Central Asia) the alignment of its name would take the west bank, from 270° to 90°, for the same reason as mentioned above.

Figure 5.3

West to East:

Choosing the north bank of the river (Lucar in Spain) to balance the space between the base line of the name and the river's line for visual effectiveness. East to west alignment does not apply because the system of writing is left to right.

Source: The writer

Areas with the same value, such as Canada's provinces, should all have the same size and style, unless they are varied for a special-purpose map.

5.3 Explanation

5.3.1 Lettering in General

The explanatory role played by lettering is indispensable so long as there is no universal agreement on all the various symbols used on different types of maps.

The use of abbreviations and symbolization by individual letters on the main area of the map have to be explained to the user somewhere else on the map (key and marginal area) to give the full meaning of the names or objects for which it is not possible to use their full identification. Taylor (1975:167) stated that "Maps contain a vast array of complex symbols and the map user is unlikely to detect every symbol let alone appreciate their meaning", while Wooldridge and East (1970:64) believed that "Younger students and many 'Laymen' are under the impression they can read a map when all they are doing is laboring to spell it out".

The map is generally a medium between the real earth's surface, which has spatial distribution, and the user. Therefore, the method of transforming the information to the map has to be made known to the user by a lettering explanation, because the shape of the distributed spatial information is influenced by the projection and the scale used. Sorrell (1981:89) stated that "...major graphic adjustments are affected by scale and projection", while Keates (1982:106) declared that "...to a large extent the map content may be predetermined by the subject and scale". Therefore the title of a map indicates its purpose and the dominant content information, while the marginal area should include, as Keates (1973:161) stated:

...the date of any revision if this is involved, the publishing authority or authors, the definition of the measurement system, including the vertical interval for a contoured map, and graphic or supplementary scales.

Marginal explanation thus is also part of the map and so it is essential to refer to it for effective use.

Positioning lettering on the marginal has to be straight as in a text book, while the size of letters and their weight (light, medium and bold) per se are an explanatory function to show the rank and importance of the feature or object.

5.3.2 Legend and Marginal Area

The discussion is concerned with legend function as an explanatory rôle and not legend design. DeLucia and Hiller (1982:48) stated that "A map legend is an integral part of the cartographic communication process because it provides an explanation of existing map symbology".

Legend provides the following functions:

(i) Aids the reading of the map:

Board (1981:68) suggested that "Success in map reading depends on much more than correctly using the legend for decoding individual symbols". The legend is for understanding what has been coded on the main area of the map and to enable the mute map to be useful and functional to an active user. Monkhouse and Wilkinson (1973:23/24) declared that "A map, with its key and legend should be complete in itself and self-explanatory, ... to maintain the strict essential liaison between text and maps".

(ii) More than one language can be shown:

Lettering the legend and/or the marginal areas in more than one language - if it is necessary - eases the task of lettering the

main area which then need only be lettered in one language. At the same time, the map could be used equally in all the languages in the key or marginal area.

(iii) Explains indigenous usage of symbols: —

Variation of symbols, abbreviations and using individual letters for a particular function on a map between one language and another makes, according to Robinson, et al. (1978:295) "Legends or keys ... naturally indispensable to most maps, since they provide the explanation of the various symbols", while Lawrence (1979:39) stated that "The full legend to the map will include a comprehensive list of all ... abbreviations".

(iv) Refreshes memory:

Robinson, et al. (1978:112) believed that:

An experienced interpreter may find keys helpful to refresh his or her memory or to introduce image characteristics in a new geographical area.

Generally speaking, lettering on the legend and/or the marginal area is easier to design, because it is straight and parallel as in a text book, than the lettering on the main area of the map. Therefore, the legend and the marginal area enforce the function of lettering and clarify the graphic elements.

CHAPTER 6

COMMUNICATION BY DESIGN

6.1 Lettering and Map Design

Lettering is a visual form which has to identify the content of the map. The form, size, and weight of letters provide clear visual discrimination and contrast without introducing colour. Board (1977:48) believed that "Discrimination involves the user in being able to tell that there are differences between what is printed (or not printed) in various parts of the map".

Discrimination has to be made by design within the framework of balance between all the map's components. Map's content is the major part of those components; it can be divided into two major levels: (i) the primary information or data, which is the immediate purpose of the map and which has to be shown - by lettering also - in the foreground because it is the subject matter, and, (ii) the secondary information, which is assisted data to the primary and which has to be in the background because it is supplementary to the subject matter. Within each level, there are sub-divisions; the cartographer who marries the two levels and their sub-divisions successfully creates a harmonious

balance. Thrower (1966:13) declared that "Maps of superior design are those which convey their ideas in a direct and simple fashion".

Balance between the three principles of map design, content, visibility and contrast (see fig. 6.1:101) should be applied to each element of the map's components and compositions, such as colouring, symbols and lettering, etc., to produce a coherent order appearance, smooth integration and unity in aesthetical fashion within all elements of the map.

The cartographer applies his experience, artistic skill, and the factor and principles of his field design, to gain user satisfaction. It may not be fair to evaluate a map upon user satisfaction, because users vary in their ability and experience of understanding maps. Conveying the purpose and the idea of the map by "superior design" cannot be appreciated by all kinds of users, therefore considering users as the criteria of measurement of judgement for the whole map involvement is not fair to them. The relationship between all kinds of users and cartographers should be established by various channels of cooperative communication to develop the product and to develop the user's ability and knowledge of maps. Sorrell (1981:86) indicated that:

It is of great interest to any engineer to know that his product is or is not satisfactory and to identify both good and bad attributes. It can only add to the development of successful cartographics to know the degree of relationship between the product and the user.

Board (1981:71) believed that geographers can help to enhance the map's quality when he declared that:

If the principles of cartographic communication are to have any real significance for geographers they should throw light on the nature of map use in geography and lead ultimately to improving map

FIGURE 6.1PRINCIPLES OF MAP DESIGN APPLIED TO LETTERING

~~Balance between foreground and background of map's content~~

Balance between foreground and background visually

Balance between foreground and background importance

Balance between the three principles collectively

Source: The writer

design in order to increase the flow of information on and appreciation of the nature of geographic space.

Board's statement magnifies the core matter of map quality to cartographers. Two significant points can be deduced from his statement:

- (i) High quality design leads to good map communication.
- (ii) Experienced users such as geographers are capable of improving map design because of their natural connection with the map's contents.

Wooldrige and East (1970:58) believed that "He (the geographer) would need maps to crystallize and modify his knowledge". Geographers knowledge is summed up by Knight's (1985:3) statement that:

Geographers focus on spatial patterns, processes, and relationships between human society and their physical environments and the resulting regional structures.

Guelke (1976:111) stated that "Maps show spatial patterns and spatial relationships". Therefore cartographers, when compiling maps, should seek - first - those users whose specialized knowledge of the subject of the map can enhance their map since, after all, cartographers cannot be experts in all mapped subjects. Board (1977:55) believed that "We cannot expect cartographers (acting simply as draftsmen) to be experts in map reading as well as map making". When the latter is the case then, as Knight (1970:281) warned, the draftsman in executing the final product, must be aware of the map compiler's intentions so as to reflect "geographic fact accurately". It should be stressed, however, that this writer firmly believes that the cartographer must be both "compiler" and "draftsman".

Map design per se is a field of its own, which has its own requirements, and the cartographer has to be very aware of map design involvements. A critical element in map design clearly is lettering. Robinson (1966:47) stated that "Letters are very complicated visual forms and their design is an exacting process". Communication can be hindered by poor lettering design, irrespective of good efforts put into the map. The cartographer's experience and skill are reflected in lettering by design; the beauty, simplicity and legibility of lettering on the map and communication by design can be established.

6.2 The Final Appearance of the Map

Board (1975:6) declared that:

By recognizing meaningful groupings of symbols the map reader first identifies and then describes (either graphically or verbally) what he sees. At the same time comparison enables the map reader to identify types of elements or features and in a complementary fashion contrast helps him to discriminate between symbols and features composed of symbols.

The process outlined by Board's statement depends largely on the map's design in which the map's information, under certain technical applications, has been presented. Keates (1982:111) stated that:

...It is impossible to separate content, design, and the technical factors of production, the whole map will result from a dialogue between all parties concerned and its production.

This dialogue is conducted to achieve an overall satisfactory product by its content and appearance which enables the user to proceed as described by Board. Guelke (1976:115) believed that:

A map is invaluable in many situations because it enables a user to see inter-relationships among phenomena and to comprehend the meaning or significance of particular elements in relation to the whole; that is their geographical context.

Lettering influences both the content and the map's appearance. Lettering should identify the content according to its nature; is it foreground or background information? Is it a sub-division? If so, to which nature of content does it belong? etc. The object's class and rank should be identical effectively by the shape, form, style and size of lettering. Bertin (1978:123) believed that "One only sees a difference when one should see an order". Lloyd and Yehl (1979:155) suggested that "The visual hierarchy formed by lettering size should be of the same order as the importance of the map elements". The properties of form (see fig. 4.1:56), weight (see fig. 4.2:57), size variations (see pp.55-59) and style flexibility (see p. 62) can enhance the classification of the various information contained on the map. Balance (see fig. 6.1:116) between all the above lettering factors would undoubtedly lead to very distinctive lettering design. Board (1981:63) thought that "Lettering ... has a special quality that conveys a distinctive character to a map".

Lettering, especially its size (as well as size of symbols) is a clear visual aid to distinguishing between various scales of the map.

Robinson, et al. (1978:322) were referring to those aspects when they stated that "We can often tell 'by looking' that one map is a larger or smaller scale than another". The scale chosen for a map exerts a strong influence on the appearance of the information in which lettering size varies in ranking the data between large and small scale maps, but it would not be easy for all map users to differentiate between the various scales - by letter size - as they differ in their knowledge of maps.

The quality acknowledged by Board and Robinson et al. in fact refers to

good design which is the essence of the traditional product and promotes the map as a reliable piece of knowledge. Thrower (1966:13) believed that:

The map ... is a fundamental research tool enabling one to discover relationships not otherwise understood or, at least, a necessary form of scientific illustration.

Traditional cartographers combine science and art in their product to serve a human need; as Bertin (1979:23) declared, "One doesn't 'make' a map, a map is a response to a need". Ignoring the artistic element will hinder the familiar quality of traditional maps. Keates (1984:38) declared that:

The end product (the map) will be not only informationally effective, but aesthetically pleasing... If cartography should ever be reduced to some collection of scientific 'rules' I for one would have no further interest in it.

Map's information, quantity and quality have to be addressed clearly through various aspects in map design. The quantity of information which could be defined by Guelke's (1979:66) statement that "The basic map content will be determined by the purpose of the map and its intended use"; and by Keates (1982:102) definition that "The content of the map (its information) is normally their (map users) primary concern". The actual data required according to the purpose may need much field and office work and modification by the cartographer to assemble and classify the required information (content) for the particular map. Keates (1982:107) stated that "Information does not 'flow' from something called reality to the cartographer. It has to be sought." Putting together all selected and modified information coherently in an effective and attractive appearance reflects the quality side of the map.

The quality of the map would be at least in the right direction if all the map's components have been taken into consideration as a whole before making the final decision to produce a map. Keates (1982:172) declared that:

Maps are produced by taking a large number of specific decisions about content, form and design. The quality of those decisions as a whole reflects the cartographer's skill and knowledge.

The map quality is reflected by different schools of style in the field of map-making. It seems to the writer that the German and Swiss represent one school of map style, while the Americans and Canadians represent the North American school of style, and the British have another distinctive school of style of map-making. Board (1981:63) stated that:

The different appearance of the maps at the same scale is imparted by specification and house style and most convey quantitatively if not qualitatively different information.

It seems the high quality of various schools or 'houses' of map-making relies on 'good' representation on maps by attractive and functional design. Therefore, it would be appropriate for the theme of, ~~'cartographic communication and map design'~~ to consider the term or the theme as communication by design. The problem of separating the terms (cartographic communication and map design) was noticed by Olson (1983: 262) when she stated that:

These definitional problems with the terms 'cartographic communication' and 'design' perhaps appear to be primarily internal matters for researchers in the field.

The whole purpose of designing a map is to create effective representations of symbols, colour, lettering, etc., which make the design of the required map functional in terms of generating communication between the map as a whole and the user. Poor representation or design, especially lettering, will spoil the good work in the rest of the map elements, because the map would appear as one collective piece of poor work.

Attempting to create an active design (communicating) appearance on the map has a dual purpose: (i) to evaluate the map highly, and, (ii) to aid the user to anticipate actively. Sorrell (1981:85) stated that "The cartographer is essentially an engineer attempting to construct a visual device which will effectively communicate geographical information to a percipient"

Users have to take the initiative to understand the map (whatever its scale) because the map by its nature is a passive device (on a piece of paper) and cannot be programmed to act by itself. It can only interact when the user is an active agent. Bertin (1978:123) believed that "...One should move into action in order to get all information held in a diagram or a map and not remain a passive receiver", while Keates (1982:99) stated that "The map itself is passive. Communication only takes place when a map user actively directs attention to it".

CONCLUSION

The comparative cultural approach adopted by this thesis with respect to lettering presentation in map design provides a new insight into the field of cartography through one's own culture without foreknowledge of the technical aspects. It illustrates how the fundamental cultural factors monitor the techniques and designs of both the traditional and automated systems of cartography and furthermore, establishes a positive perception of a totally different culture. It is hoped that this new approach will be helpful to geography students in particular when designing their project maps.

The sequence structure of the main body of the thesis presented a coherent and comprehensive picture of the whole task of lettering in map design, and the objectives were examined and evaluated accordingly. The overall purpose and findings of the thesis can be summarized as follows:

- (1) Lettering is part of cultural identity, its construction in any form or shape by any means is based upon cultural dogma. Any form of utilizing letters can never go beyond what has been established by the particular cultural system. The new instrument formulated to measure type of straight lines alignment in Chapter Two, and the proposed scale of curvature alignment in Chapter Three are based

upon mathematical measurements, and illustrate the cultural influence of lettering design on maps, and are applicable to both the left to right and right to left systems of writing.

- (2) The speed, accuracy and convenience of automation should not overshadow human experience, skill and ability. Keates (1984:43) declared that:

... the fact that there are realms of human experience which are not - and never will be - products of science; and although few of us can aspire to create them, we can - and should - enjoy them.

The attempt at automating the alignment of lettering is like trying to replace the traditional European way of eating (using knife, fork and spoon) with an automatic feeding machine. The present application of automated lettering on maps does not go beyond the layman's usage as shown by the surveys conducted by the writer in Ottawa in 1985. The proposed new system of automated lettering curvature alignment adapts the automated nature to suit the map's nature.

- (3) A group of new figures and tables were proposed to simplify and clarify the cartographic design elements of lettering utilizing the natural characteristics of letters.
- (4) Lettering functions were classified into three categories to achieve a concrete and coherent analysis of the lettering purpose on maps.
- (5) Lettering design in terms of communication by design was shown to deal with the subject collectively rather than separately as cartographic communication and map design does, and it was

suggested that the design should be qualified by how well it achieves its purpose in conveying the ideas on the map to the user.

It is hoped that some - if not all - of the ideas in this thesis are worthy of further research within the cultural and comparative framework to aid lettering design on maps. It is also hoped that the curvature of lettering alignment can be implemented by the automation experts in the field of cartography.

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