THE UNIVERSITY OF MANITOBA

METRIC CONVERSION IN SCHOOLS: A STUDY OF GENERAL IMPLEMENTATION PROCEDURES, TEACHER IN-SERVICE, TEXTBOOK PUBLISHING AND INSTRUCTIONAL APPROACHES FOR EDUCATORS, WITH IMPLICATIONS IN THE FIELD OF GEOGRAPHY

by

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Master of Education

ABSTRACT

The Federal Government of Canada began the process of going metric by passing the White Paper on Metric Conversion in Canada, January, 1970. Following this action, the Curriculum Branch of the Department of Education in Manitoba established the Committee to Study and Introduce the Metric System in Manitoba Schools.

This thesis is a result of the writer's involvement on this Committee, in which he represented the Social Science teachers of Manitoba. It was largely because of the writer's realization of the lack of literature and research available about the implications of going metric specifically for the Social Sciences that the study was undertaken. It soon became evident that geography, within the Social Sciences, would be especially affected by metric conversion.

The Study reviews Canadian, American, and British literature available at the time of the writing and outlines a brief history of the metric system. It summarizes the present world status of the metric system as well broad metric developments in Canada, the United States and Britain.

The writer spent two weeks in Bitain studying the British conversion to the metric system in the field of

education. During this time, November 8 - 20, 1973, several educators were interviewed and their opinions recorded. The information obtained from the educators in Britain as well as the information from the writer's own involvement and experiences on the Committee to Study and Introduce the Metric System in Manitoba Schools during the past two and one-half years will be of value to educators in general and to geography teachers in particular. The Study will be helpful in assisting curriculum developers and planners, textbook authors and publishers, teacher training institutes, teacher in-service groups, school administrators and teachers in planning for the overall change to the metric system in a more systematic and efficient manner.

Conclusions are drawn and guidelines are recommended in the following four areas:

A. Implementation of the metric system in schools.

B. Teacher in-service for preparation in teaching the metric system.

C. Publishing and selecting textbooks during the changeover period.

D. Instructional approaches for teaching the metric system.

An outline of specific implications for going metric in the field of geography as well as specific conclusions and recommended guidelines in that field of study are included.

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TABLE OF CONTENTS

CHAPTER ONE

BACKGROUND TO THE PROBLEM

I. PURPOSE

With the introduction of the White Paper on Metric Conversion in Canada, January 1970, the Federal Government began the process of eventual adoption of the metric system in Canada. The White Paper says adoption of metrication is "ultimately inevitable and desirable for Canada."[1]

A person may well ask why should Canada become involved in the confusion of changing over to the metric system of measurement when on the surface the present system appears quite adequate. . . after all has Canada not reached the present standard of living through the use of the imperial measurements? Persons involved in the promotion of the process of conversion to the metric system are often faced with questions such as:

"Why is the change necessary?"

"Is our present system of measurement not adequate?"

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[1]Government of Canada, White Paper on Metric Conversion in Canada, (Ottawa: Department of Industry, Trade and Commerce, January 1970), p. 5.

"Is the metric system that much of an improvement over the present system to warrant the costly change?"

"What are the advantages of the metric system?"

"Isn't the metric system very difficult to learn?"

The above questions are asked by people who have little or no familiarity with the metric system. The persons who are familiar with the metric system are not nearly as apprehensive about the conversion and make comments such as:

"It's about time Canada changed over."

"The metric system is so simple and easy to use."

"Science has always used the metric system."

The changeover from the imperial system to the metric system of measurement will affect everyone living in Canada. Naturally, the affect will be greater for some people than for others.

One group of people who will be especially affected will be the teachers of geography.

The primary purpose of this study is to identify specific areas of concern for the geography teacher when the changeover from the imperial to the metric system of measurement occurs, however, consideration will be given to areas of general concern for other teaching areas as well. The secondary purpose of the study is to provide specific guidelines in preparation for going metric for the geography teacher as well as general guidelines for other teachers.

II. SETTING

The provincial government of Manitoba followed the footsteps of the Federal Government in issuing a White Paper[1] on Metric Conversion which basically supported the changeover. It announced a program to facilitate the introduction of the metric system as part of a coordinated, phased system for the nation. The Manitoba policy stated, "It is the intention of the Manitoba government to accomplish this transition in such a way that they (Manitobans) are more ready than the rest of Canadians to make the change to the metric system."[2]

The provincial government supported the following principles laid down in the Federal White Paper:[3]

> The use of the metric system for all measurement purposes required under legislation;
>
> Encouragement of the planning in the public and private sectors at the lowest possible cost;
>
> Dissemination of metric information to the general public particularly where it will have maximum educational impact at the lowest possible cost; and

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[1]Government of Manitoba, White Paper on Metric Conversion, (Winnipeg: Department of Industry and Commerce, November 1971).

[2]Government of Manitoba, News Service, (Winnipeg: Services Branch, March 2, 1973), p. 2.

[3]Ibid, p. 2.

> Close consultation between provincial officials and the business community on the timing of changes which are most appropriate to each individual sector of the provincial economy.

As a result of the Manitoba government policy, the Curriculum Branch of the Department of Education established the Committee for the Study and Introduction of the Metric System in Manitoba Schools.[1] The Committee consisted of representatives from industry and commerce, universities, community colleges, business and vocational education, faculties of education, mathematics and science education, the social sciences, physical education, and home economics.

The Committee met for the first time in September 1971 with the responsibility of developing guidelines and programs to assist students and adults to "think metric" in preparation for the changeover to the metric system.

The general frame of reference for the Committee was contained in the following criteria:[2]

> to study the current developments in Canada and other countries respecting the introduction of metrication in school education;
>
> to set up guidelines for instructional input necessary for introducing the metric system in Manitoba schools;

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[1] In the summer of 1971.

[2] Department of Education memo mailed to members of the Committee for the Study and Introduction of the Metric System in Manitoba, June 22, 1971.

to prepare a brochure outlining to administrators and teachers suggestions for the introduction, development, and application of the metric system in conjunction with all existing school programs K-12 inclusive;

to identify, annotate, and list in the brochure various print and non-print materials suitable for teaching the metric system; and

to set up guidelines for the development and implementation of an adult program in the metric system.

The Committee developed these criteria in broad terms rather than identifying them only with a specific subject or subject areas.

The writer has represented the interests of social science teachers of Manitoba on this Committee since its first meeting in September 1971.

III. SIGNIFICANCE OF PROBLEM

A. Statement of the Problem

This study materialized as a result of the writer's involvement on the Department of Education Committee for the Study and Introduction of the Metric System in Manitoba Schools. As a Committee member, representing the interests of social science teachers, the writer realized early in the history of this Committee that there was very little research of any kind about the implication for the social science teachers with the introduction of the metric system. Indeed, initially the Committee's feeling may well have been that the social science teachers would not really be much affected by the changeover. However, as a

geography teacher, the writer realized that the implications for geography teachers would be substantial once the changeover became reality. The implications for other social science teachers would not be nearly as pronounced.

It was the lack of research and literature in this field that prompted this study to:

i. Identify specific implication for geography teachers, as well as general implications for other teachers when the changeover occurs; and

ii. Recommend guidelines for educators in general, as well as guidelines for geography teachers specifically, in the areas of:

a. implementing the metric system in schools;

b. preparing teacher in-service programs;

c. publishing and selecting textbooks; and

d. outlining classroom instructional approaches.

B. General Implications of Going Metric

For many people the change to the metric system will require learning and adopting a new language of measurement. The whole idea of eradicating a system of measurement used until now and replacing it with a new system will be a major undertaking in itself. The sense of judgement of what a metre length, litre capacity, or a kilogram mass really is requires an effort on the part of the individual just being introduced to these units. A total new sense of judgement must be acquired - it is not adequate to simply convert from the imperial system to the metric equivalent. What one needs to learn is the new system itself - the

ability to think in terms of the metre length, litre capacity, and kilogram mass as measurements themselves and not in relationship to imperial units. This process of "thinking metric" will be the most difficult aspect of adopting a new system of measurement. To eliminate the tendency to think in terms of the imperial system and then convert to the metric will require a major effort on the part of those people who want to become proficient in the metric system.

The degree to which one can think metric may be determined by the ease with which one can answer questions such as the following:

How tall are you in centimetres?

How long is that room in metres?

How far is it from your home to the University in kilometres?

What is the average annual rainfall of Winnipeg in millimetres?

How many millilitres are there in this glass?

What is the outside temperature in degrees Celsius?

These questions may be thought to be rather unfair because of the use of degrees Celsius, precipitation in millimetres and distance in kilometres, etc. but that is just the point; until a person is ready to accept metric measures and has a reasonably accurate sense of judgment about them in day to day life, one has not begun to think metric.

The disappearance of terms such as inch, foot, yard,

rod, mile, ounce, pint, quart, gallon, bushel, barrel, pound, acre, horsepower, square mile, miles per hour, pounds per square inch, Fahrenheit and the introduction of terms such as millimetre, centimetre, metre, kilometre, litre, millilitre, gram, kilogram, square kilometre, degree Celsius etc. will require a new orientation to measurement.

The effect of metrication in schools will vary considerably from subject to subject. Language teaching will be largely unaffected and the history instructor will not be much affected either. In Science, metric measures have long been used and the change will be one of adopting the SI units and will not constitute a major change. The mathematics teacher, concerned primarily with technique and method, will be able to adopt the metric system without serious difficulty once the textbooks have been issued in the new system of measurement; indeed calculations may be simplified. The teacher of primary children will be confronted with a whole new system of measurement and will have to have a thorough understanding of the metric system. It is here that the system of measurement is introduced to the child.

The geography instructor will be affected perhaps as much as any other when the changeover occurs. Changes in expressing temperature, precipitation amounts, snowfall recordings, wind velocities, distances, land areas, map scales, statistics, etc. are some examples which will directly concern the teacher of geography.

C. Specific Implications for Geography Teachers During Metric Conversion

The adoption of the new measurement language will significantly affect measurement units and statistical information facing the teacher in the field of geography. Not only will the geography teacher have to be familiar with the new units in the sense that he can use them but he will have to be able to think in the metric language of measurement. This can be illustrated with several examples:

i. With reference to maps, atlases and globes the change will occur in the expression of:

- scales
- distances
- elevations
- contour intervals
- size of countries
- population densities
- statistics involving measurement
- isotherms
- isohyets
- isobars
- acerage

ii. The following are examples of weather and climatic information which will be expressed in metric units.

- common daily, monthly, yearly temperatures
- relationship of temperature to climatic regions
- relationship of temperature to latitude and elevation
- isotherms, isohyets, isobars
- relationship of climatic region with temperature, precipitation, and elevation
- daily, monthly, yearly recorded precipitation
- snowfall recordings
- relationship of amount of precipitation with bushels per acre
- wind velocity

- pressure readings
- information recorded on climatic graphs

iii. The change to the metric system will change those definitions and statistics where some form of measurement is used. The following are some examples.

- troposphere
- stratosphere
- ionosphere
- normal lapse rate
- adiabatic lapse rate
- major cloud types (defined in part by altitude)
- climatic regions (defined largely by temperature and precipitation)
- mountains, hills
- relief
- land area (from acre to hectare)
- crop yield (from acre to hectare and bushel to kilograms)
- "gallons" per capita
- horsepower
- farm size
- continental shelf
- densities of population
- soil horizons
- nutrition
- river flows

iv. A new orientation will be required in the extremes often used for comparison purposes. The following are such examples:

- highest mountain
- deepest part of the ocean
- greatest amount of rainfall
- coldest temperature
- highest temperature
- size of largest continent, country, province, etc.
- longest river
- greatest density of population

The kind of change facing the geography teacher can be illustrated by selecting a section from a present Grade XI geography textbook, Elements of Geography.[1]

> "Yields of 40 bushels per acre are average for China and Japan; . . . the average yield in India; . . . is only 14 bushels per acre, . . . average yield of wheat in the United States, which is 15 bushels per acre.
>
> . . . rice must be grown in areas where the average temperature is above 70°F. . . . for rice must be flooded to a depth of 6 inches . . . an annual total of at least 60 inches is required."

Each of the underlined measurements will be expressed in metric units, which is just an example of the kind of change which will occur throughout this textbook as well as any other geography book.

Because of the change in the language of measurement, the geography teacher will undoubtedly face initial difficulties when textbooks using the metric system are introduced. Also, well known reference books will become outdated wherever reference to some form of measurement is made. The store of basic information which has been gathered slowly over many years will have to be replaced with metric equivalents when the new system of measurement is introduced.

To investigate the problem in greater depth, as well as to clarify and consolidate the writer's own thoughts and views, a fact-finding visit to Britain was carried out

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[1]J.M. Smythe, C.G. Brown, E.H. Fors, Elements of Geography, (Toronto: MacMillan of Canada, 1964), pp. 357-358.

from November 8-20, 1973, during which time several educators were interviewed on the problem outlined. This aspect of the research is developed in Chapter III.

The information obtained from the writer's own involvement and experiences on the Committee to Study and Introduce the Metric System in Manitoba Schools during the past two and one-half years, which is developed in Chapter IV, as well as the visit to Britain should prove of value to geography teachers. It should be helpful in assisting curriculum developers and planners, textbook publishers, teacher training institutes, teacher in-service groups and geography teachers in planning for the overall change to the metric system[1] in a more systematic and efficient manner.

IV. DELIMITATIONS

This study included only the research literature from Canada, the United States, and Britain. No attempt was made to study the developments in countries such as Australia or New Zealand because in these countries the development of metrication was at about the same stage as in Canada.[2] The writer selected these three countries

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[1] SI system.

[2] S.M. Gossage, Target Dates for Metric Conversion in Canada, (Presented to Minister's Advisory Council, September 19, 1973), p. 2-3.

as references because they were all in a somewhat different position with regard to going metric and also because of their influence on Canada.

Britain officially began the process of going metric in 1965 and was scheduled to be completed by 1975. However, the process will take somewhat longer.[1] Canada officially began the process in 1970 and is scheduled to be completed by 1980, while the United States has not yet made an official statement about going metric but unofficially the process is progressing at about the same rate as in Canada.

Reference to the American metric experience was made only to the extent that literature was available and no attempt was made to study in depth what was happening in specific schools in the field of geography with regard to metrication.

The British metric experience in education, however, was emphasized because the process has been developing there for several years. The implications, implementation procedures, and guidelines were re-inforced from the experience in Britain or were initiated from the investigation there.

The findings of this study must be evaluated in terms of the following context:

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[1]Ibid , p. 2.

i. The almost total lack of available research literature in this field at the time of writing.

ii. A visit to Britain between 8 - 20 November 1973 during which time the writer interviewed the following people and recorded their statements.

- A Science Education Officer of British Council
- The Executive Secretary Assistant of the Association for Science Education in Britain
- The Headmistress of Saint Philip Roman Catholic School in Hatfield
- The Director of Education and Industrial Training of the Metrication Board
- A Senior Inspector of the Department of Education and Science
- A Geography teacher, presently employed with Schools Council on a geography project, also author of several recent geography books
- The Geography Department Head of Eltham Green Composite High School
- The Managing Director of Heinemann Educational Books, a publisher directly involved with school textbooks
- A senior representative from John Murray Publishing Company Limited who had previously been on a Metrication Board Committee
- Several teachers as well as a few people from the general public who were interested in metrication

iii. The writer's own involvement and experience on the Committee to Study and Introduce the Metric System in Manitoba Schools between September 1971 and January 1974.

- This involvement included 21 full day Committee meeting, 14 one-half day experimental metric workshops for adults during the development of an adult program to introduce the metric system, as

well as 5 two-day metric workshops for preparing resource teachers from various School Divisions in Manitoba. The writer's involvment also included writing the article "Think Metric Now" in the June 1972, Curriculum Bulletin,[1] and compiling and writing the original manuscript for the Department of Education publication, Introduction to the Metric System.[2]

Even though this study is directed to geography teachers, it is also directed to educators in general who are associated with the school system. The process and preparation for metrication is similar for most teachers - the difference being only in the degree of preparedness. To that extent this study is relevant to them as well.

V. LIMITATIONS

A limitation of this study may be that the number of interviews in England had to be restricted because of lack of time. Because the educational system in England is the responsibility of Local Education Authorities the difference between a school in one Authority may be quite different from a school in another Authority. It was not possible for the writer to visit the various Local Education Authorities. However, the writer feels that the general picture throughout England would be very much as presented in this paper.

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[1]John R. Lohrenz, "Think Metric Now", Curriculum Bulletin, (Manitoba: Department of Education, June 1972), vol. 6, no. 4, pp. 10-14.

[2]Committee for the Study and Introduction of the Metric System in Manitoba Schools, Introduction to the Metric System, (Manitoba: Department of Education, 1973), p. 87.

VI. DEFINITION OF TERMS

The following terms, when used in this study have the meanings indicated.

1. Metrication - the process of going metric, a word recently coined in Britain.
2. "Think Metric" - the ability to think directly in metric units of measurement without first converting to the imperial system of units, and then seeing or feeling the measurement in terms of the imperial measurement.
3. SI - Système International d'Unités[1] (International System of Units) was adopted by the Eleventh Conference of General Weights and Measures in 1960. The coherent units are designated "SI" units. The International System of Units is based on the following seven independent units and the two supplementary units:

metre	(m)	for length measurement
kilogram	(kg)	for mass measurement
second	(s)	for time measurement
ampere	(A)	for electrical current measurement
kelvin	(K)	for temperature measurement

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[1]Canadian Standards Association, Metric Practice Guide, (Rexdale, Ontario: Canadian Standards Association, 1973), p. 9.

candela	(cd)	for luminous intensity measurement
mole	(mol)	for amount of substance measurement

Supplementary Units:

radian	(rad)	for plane angle measurement
steradian	(sr)	for solid angle measurement

The International System of Units is the first complete, internationally harmonized system of compatible scientific measurement units.[1]

4. Imperial Units - the present units of measurement used in Canada.

5. Metric Commission - a commission consisting of commissioners from all across Canada established to promote an overall plan for conversion to the International System of Units. The Metric Commission advises the Minister of Industry, Trade and Commerce on plans for conversion. It initiates, coordinates, and undertakes investigations, surveys and studies to metric conversion.

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[1]Note: for the measure of angles, the traditional 90 degree angle was called a grade. It was divided into decigrades, centigrades, and milligrades. (It is for this reason that the term Centigrade as applied to temperature, is incorrect. It is more properly called Celsius, after the Swedish scientist Anders Celsius who created that particular temperature scale). The renaming of angles never caught on, however, due to the cumbersome fractions involved.

6. General Conference of Weights and Measures[1] - this Conference is an international treaty organization, established by the Treaty of the Metre in 1875. Canada and the governments of over forty nations are members of this Conference.

VII. SUMMARY

This chapter stated the purpose of the study, namely, to identify specific implications for geography teachers with the introduction of the metric system and to recommend guidelines in preparation for metric conversion. It outlines governmental action with regard to passing White Papers on metric conversion and described the establishment of the Manitoba Committee for the Study and Introduction of the Metric System in Manitoba Schools. It stated the problem to be studied and described general implications of going metric as well as specific implications for geography teachers. The chapter indicated the delimitations of the study and also defined the meaning of several terms used in the study.

The following chapter reviews Canadian, American and British literature related to the study. It also reviews the history, advantages, and present world status of the metric system as well as indicating broad metric developments in Canada, the United States and Britain.

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[1]Meets every four years. Last meeting held in 1971.

CHAPTER TWO

REVIEW OF LITERATURE AND RELATED INFORMATION

I. RELATED RESEARCH

In reviewing the literature related to the study outlined in Chapter I, Canadian, American, and British articles from journals, magazines, and government publications, were researched.[1] Even though these articles were related in some degree to this study, only one, "Metrication in Geography,"[2] deals more specifically with the topic being researched in this paper. The article was limited to outlining a number of problems facing the British geography teacher with the change from imperial to metric measurement. The article also briefly reviewed the history of measurement in England to the development of the International System of Units. The article, however, did not include teacher in-service, teaching techniques, or guidelines for the teacher in preparation for the metric changeover.

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[1] See Bibliography, p. 130.

[2] J.A. Morris, "Metrication in Geography," Geography, (January 1970): pp. 1-15.

There was, to the writer's knowledge, no Canadian, American, or British literature, which dealt directly with the study attempted in this paper.

The few books on metrication that were available were quite general and did not really concern themselves with the educational aspect of going metric, except in a short chapter or so.

Going Metric: Implications for Secondary Schools,[1] a curriculum paper prepared by a consultative committee of the Scottish Education Department, contains a small section on the implications for geography. This article makes reference to the changes which will occur in mapping, distances, area, river flows, temperature, rainfall, nutrition, and crop yields but makes no references to teacher preparation for metrication.

A useful publication for studying problems of education in general was the U.S. Metric Study Interim Report: Education.[2] This publication presented: (a) the educational advantages and disadvantages of both the metric and the customary systems of units; (b) the current usage of metric measurements in American schools, and trends in

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[1]Scottish Education Department, Going Metric: Implications for Secondary Schools, (Edinburgh: Her Majesty's Stationery Office, 1968), reprinted 1969, pp. 6-8.

[2]United States Department of Commerce, U.S. Metric Study Interim Report: Education, (Washington: United States Government Printing Office, 1971), pp. vii and 203.

that usage; (c) the ways in which education would have to change as the United States accomodates to increased world-wide use of the metric system, under a planned national program or without such a program; (d) recommendations for ways in which to take best advantage of the changes. Even though this publication did not deal specifically with the study of this paper it nevertheless did help in formulating some procedures for implementation, implications of that procedure, and guidelines for teacher preparation.

. Another book, Metrication,[1] did include one chapter entitled "Metrication and the Teacher" in which the author rationalized the change from the archaic imperial units to the universal metric units. The chapter, however, did not enlighten one to any great extent on the study attempted in this paper, even though it was an excellent book on the various topics dealing with metrication.

In February 1969, M.O. Murphy and M.A. Polzin published "A Review of the Research Studies on the Teaching of the Metric System"[2] in which the authors reviewed the research studies on the teaching of the metric system and measurement. One of the conclusions the authors drew from

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[1]F.W. Kellaway, ed., Metrication, (London: Penguin Books Limited, 1968), p. 124.

[2]M.O. Murphy and M.A. Polzin, "A Review of the Research Studies on the Teaching of the Metric System," Journal of Educational Research, (February 1969), vol. 62, no. 6, pp. 267-270.

their study was that relatively few research studies in the area of measurement and the metric system have been conducted.

The writer reviewed recent educational journal articles related to instruction and in-service to help in formulating the think metric[1] concept. As will be seen later, the articles are re-enforced by the comments made by the educators who were interviewed in England. In the article entitled, "Teaching Children to Think Metric"[2] we read:

> "Unfortunately, the approach often used to teach the metric system - conversion from the metric system to the English system and vice versa - promotes confusion and dislike for the only common measurement system whose components are meaningfully related to each other."[3]

In this article a student activity approach to teaching the metric system is described by a grade four classroom teacher. A significant quotation of the description follows:

> ". . . They first estimated the measurement . . . and then performed the measurement. . . . Estimation acted as a motivation for accuracy in that the boys and girls wanted to check their guesses. . . . They also seemed to enjoy the chance to guess the answer before verifying their estimates.

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[1]See definition p. 16. Also pp. 6-8.

[2]G.W. Bright and C. Jones, "Teaching Children to Think Metric," Today's Education, (April 1973), pp. 16-19.

[3]Ibid., p. 16.

> . . . Estimation practice seems to have several consequences. It helps develop the concepts of multiples of numbers, especially multiples of powers of 10. Further, it may aid the growth of mental concepts of spatial visualizations. It certainly does force children to make visual comparisons among dimensions of objects."[1]

The article concludes with:

> "Experience with the units will breed familiarity with the actual sizes of the respective units, and it is this familiarity that allows people to make a smooth transition to the metric system. This familiarity, in turn will free people to THINK METRIC."[2]

In another article, "The Meter Stick", a teacher writes:

> "I remember how I dreaded the metric system all through high school and college. But then, as I recall, I never once <u>experienced</u> the metric system. It was always rote memory of conversion and solving meaningless problems. . . . We were never given any reason for having to learn the metric system. It was in the curriculum and it had to be covered."[3]

The teacher has changed this approach and in its place describes an alternative method of learning:

> " . . . We labeled doors, walls, windows. Things we couldn't label like the playground, school bus, and sidewalks we put on a chart. We had an olympic event and measured results of running and jumping by the metric system. We marked a path of a kilometer on the playground and let those who were athletic run it."[4]

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[1]Ibid., p. 18-19. [2]Ibid., p. 19.

[3]S.G. Sheffield, "The Meter Stick," <u>Science and Child</u>, (March 1973), p. 22.

[4]Ibid., p. 23-24.

In the article "Going Metric in Hawaii"[1] the authors write:

> ". . . As we teach the program, two facts are becoming increasingly apparent. First the children thoroughly enjoy measurement activities and are gradually discovering the properties of the metric system. Having had extensive experience with the treatment of measurement in conventional programs, we are very pleased and excited about an activity approach to teaching measurement. Our experiences have convinced us that measurement should not, and in fact cannot, be 'taught'. Learning to measure is a gradual process related to the personal experiences of each learner."[2]

Fred J. Helgren in an article, "Schools are Going Metric"[3] writes that in the past "schools approached the use of the metric system in a way that gave it little encouragement." He indicates that the following are some of the poorly conceived practices:[4]

1. Metric measure was not studied as a system by itself.
2. People were not taught to THINK METRIC.
3. Textbooks often contained only a single unit on the system, and problems were merely conversion from one system to the other.
4. The unit on the metric system was frequently at the end of the textbook. As a result, it was seldom taught. Teachers had little knowledge of the system, and it was omitted because of lack of time.

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[1]Irv. King and Nancy Whitman, "Going Metric in Hawaii," The Arithmetic Teacher, (April 1973), pp. 258-260.

[2]Ibid., p. 259.

[3]Fred J. Helgren, "Schools are Going Metric," The Arithmetic Teacher, (April 1973), pp. 265-267.

[4]Ibid., p. 265.

Even though the above comments are directed to the educators in the United States, the situation in Canada is probably very similar. The author also indicates what should be done in the field of education to go metric.[1]

1. Teach the metric system by itself so that teachers and pupils learn to think in this language of measure. Do not try to learn or teach the metric system through conversion problems, and do not try to learn conversion factors. Learn the metric system by itself. THINK METRIC.

2. Change mathematics and science textbooks so that only metric units of measure are used.

3. Select one member of the faculty to be the metric authority for the school. He can get the information and materials necessary to enable the school to go metric.

4. Teach the metric system to all prospective teachers, for the change to the new system is not just a mathematics or science project.

In the article, "Experiences for Metric Missionaries"[2] the author points out that:

> "The initial emphasis in instruction should be placed on teaching the fundamental units - metre, gram, and litre - and the prefixes that indicate the multiple and submultiple of ten."[3]

The author also continues with:

> ". . . assignments could include making measurements of parts of buildings, or items in and around the house, and finding perimeters, areas, and volumes in metric measurement."[4]

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[1]Ibid., p. 266.

[2]Lottie Viets, "Experiences for Metric Missionaries," The Arithmetic Teacher, (April 1973), p. 269-273.

[3]Ibid., p. 269 [4]Ibid., p. 272.

In the author's review of the "U.S. Metric Study Interim Report on Education", Lewis M. Branscomb reports:[1]

> "Students in U.S. schools are not taught to 'think metric'. If they encounter the metric system of measurement at all, it is in connection with science and math classes. Even there, experience with the metric system is cursory and fades soon after the course is completed. Education today simply does not give students a sense of metric measure to take into the world and use. . . . There is no attempt to make the understanding and use of the system instinctive."[2]

The U.S. Metric Study[3] makes the following comment about teaching measurement:

> ". . . measurement should not and really cannot be 'taught' through a series of planned lessons. Learning to measure (especially in a relatively unfamiliar system) is a gradual process related to each child's experiences. Until a child has had the opportunity to experience in concrete, comparative terms what a gram and a kilogram, or a centimeter and a meter are, the term 'five centimeters plus seven centimeters' is meaningless to him. Again it is much like learning a new language. We have discovered that we cannot teach a new language (which the metric system really is) by teaching the vocabulary and grammar of this language. The most effective way to learn the new language is to use it in meaningful, everyday oral expressions. So too with the metric language, children will learn it best if it is not 'taught' but experienced and used in some activity in the context of situations in which a child is actively involved."[4]

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[1]Lewis M. Branscomb, "The U.S. Metric Study," The Science Teacher, (November 1971), pp. 58-62.

[2]Ibid., p. 58.

[3]United States Department of Commerce, U.S. Metric Study Interim Report: Education, (Washington: United States Government Printing Office, 1971).

[4]Ibid., p. 51.

It is in the context of the above information that in-service programs should be planned and developed. The U.S. Metric Study on Education emphasizes that in-service training should be strongly activity based because "teachers generally teach as they are taught."[1] The article "Going Metric in Hawaii"[2] states that in addition to teaching the metric system of measurement, the in-service should also "stress the teaching strategies of an activity approach to learning."[3] It also states that:

> "We believe that a . . . workshop, which actively involves teachers in estimation and measurement activities, can adequately prepare teachers for the task of teaching the metric system."[4]

The article, "Are You Measuring Up to Metric"[5] points out:

> "One major concern is the in-service training of elementary school teachers, and it is pointed out that the emphasis should be in the demonstration of teaching strategies and tactics."[6]

The conclusions and guidelines from the literature that has been reviewed are developed in Chapter V.

The writer is not aware of any studies made in Manitoba, other parts of Canada, the United States or Britain, of the problem under investigation in this study.

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[1]Ibid., p. 51.

[2]Irv. King and Nancy Whitman, "Going Metric in Hawaii," The Arithmetic Teacher, (April 1973), pp. 257-260.

[3]Ibid., p. 258. [4]Ibid., p. 259.

[5]Michael T. Irving, "Are You Measuring Up to Metric?" School Progress, (December 1972), pp. 22-23.

[6]Ibid., p. 23.

II. A BRIEF HISTORICAL REVIEW OF THE DEVELOPMENT OF THE METRIC SYSTEM TO THE PRESENT INTERNATIONAL SYSTEM OF UNITS (SI)

The metric system dates back to the sixteenth century when the Flemish mathematician Simon Stevin published an arithmetical theory concerning decimal fractions, and this event, together with his proposal for a decimal system of measurement, virtually laid the foundations for the metric system. However, it was not until 1791, when twelve members of the French Academy of Sciences were appointed to establish a decimal system based on the real world, that the metric system was actually created. Because the decimal system of numeration had proven to be easily taught, a measuring system was selected with a decimal basis. This new system used the base unit ten. All other units were to be a multiple of ten of the base unit. This system greatly simplified conversion from one unit to another by either multiplying or dividing by a power of ten.

As a result of the committee's proposals, and the increasing need for more accurate measurements to investigate and substantiate scientific theories, as well as the need for international standards of measurement in communicating the results of research and study, the metre and kilogram were enacted into law in France a few years later. It took until 1840 though, before these units were in general use in France and other parts of Europe. It was not until 1875, however, that the Treaty of the Metre

was signed in Paris. The treaty established a General Conference on Weights and Measures, which now is an International Treaty Organization to which over forty nations formally adhere, and which meets periodically[1] to adopt new definitions. Over the years the General Conference has steadily extended and refined the metric system. In 1960 the Conference adopted its International System Units - (Système International d'Unités) or SI which is the universally recognized metric system in all languages. The international system of measurement is the first complete, internationally harmonized system of compatible scientific measurement units. It is based not only on the metre, kilogram and second but also includes thermal, electrical, mechanical and radiation units. For convenience it is called the "international metric system." All modern industrial nations assure the compatability of their scientific measurement systems, at the highest levels of precision, through international metric measurement standards. At present SI rests on seven independent units for measurement, and two supplementary units. SI derives the units for all the quantities needed in science, technology, and everyday life from these seven independent units.[2]

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[1]Every four years with the last meeting in 1971.

[2]See p. 16.

III. THE ADVANTAGES OF THE METRIC SYSTEM OVER THE IMPERIAL SYSTEM

The most obvious virtue of the metric system is its decimal nature. To convert from a smaller unit of measure to a larger unit, it is necessary only to multiply by 10, 100, 1000, etc., and to convert from a larger unit of measure to a smaller unit it is necessary only to divide by 10, 100, 1000, etc. This means that once a person understands the basic unit of length measurement, the metre for example, all other units of length measurement are related to it by a multiple of 10. Similarly, if you understand the basic unit of capacity measurement, the litre, all other capacity measurements are related to the litre by a multiple of 10. This greatly simplifies the whole system of measurement because it eliminates memorizing a great number of conversion figures which are so very necessary in the imperial system. The following quotation, taken from the Twentieth Yearbook of the National Council of Teachers of Mathematics, sums up the apparent reason for world-wide acceptance of the metric system of measurement.

> "From the point of view of teaching and learning it would not be easy to design a more difficult system than the present English system; in contrast, it would seem almost impossible to design a system more easily learned than the metric system."[1]

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[1]Beloit Tool Corporation, Discover Why Metrics, (Roscoe, Illinois: Swani Publishing Company, 1972), p. 17.

A second advantage the metric system has over the imperial system is that for everyday usage a person will have to learn only three basic units of measurement and their prefixes instead of the dozens of units that are required in the imperial system. The three basic units are:

metre - for measuring length

gram - for measuring mass

litre - for measuring capacity

Once a person has a feeling and understanding of each of these basic units all that is necessary then is to learn the prefixes and their meaning to understand and use the metric system.

In the metric system then, the value of the basic unit is changed simply by placing a prefix in front of it. With the three basic units: metre, litre, and gram, the prefixes: "kilo," "hecto," "deca," "deci," "centi," "milli," etc., will change the quantity of the basic unit by a multiple of ten. Some prefixes are used more commonly than others. Usually multiples of 1000 of the basic unit are preferred. To illustrate:[1]

Greek prefixes	-	kilo	(thousands 10^3)
	-	hecto	(hundreds 10^2)
	-	deca	(tens 10^1)
Basic Unit	-	no prefix	(one 1)
Latin prefixes	-	deci	(tenths 10^{-1})
	-	centi	(hundredths 10^{-2})
	-	milli	(thousandths 10^{-3})

[1]All prefixes have not been shown here. See Appendix A for complete list, p. 138.

If length measurement is expressed in relationship to the basic unit - the metre,[1] then:

1000 metres	-	1 kilometre
100 metres	-	1 hectometre
10 metres	-	1 decametre
1 metre	-	10 decimetres
1 metre	-	100 centimetres
1 metre	-	1000 millimetres

Similarly, if capacity measurement is expressed in relationship to the basic unit - the litre,[2] then:

1000 litres	-	1 kilolitre
100 litres	-	1 hectolitre
10 litres	-	1 decalitre
1 litre	-	10 decilitres
1 litre	-	100 centilitres
1 litre	-	1000 millilitres

Similarly, if mass measurement is expressed in relationship to the basic unit - the gram,[3] then:

1000 grams	-	1 kilogram
100 grams	-	1 hectogram
10 grams	-	1 decagram
1 gram	-	10 decigrams
1 gram	-	100 centigrams
1 gram	-	1000 milligrams

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[1]The common units for length measurement are kilometre, metre, centimetre, and millimetre.

[2]The common units for capacity measurement are litre and millilitre. The kilolitre is used for large tank containers.

[3]In the SI, the gram unit of mass proved to be too small for practical application, therefore, the kilogram has been officially designated as the standard unit for mass.

The common units for mass measurement are kilogram,

A third major advantage of the metric system is that the three basic units, metre, litre, and gram, are all related. The litre as well as the kilogram are defined in relation to the metre. By definition a litre is simply a container which holds 1000 cm^3, (a cube 10 cm by 10 cm by 10 cm which is one tenth of a metre on each side). A kilogram is simply the mass of 1000 cm^3 (a litre) of distilled water at its greatest density, 4°C. Similarly, a millilitre is simply a container which holds 1 cm^3 (a cube 1 cm by 1 cm by 1 cm) and a gram is the mass of 1 cm^3 of water at 4°C.

A fourth advantage of the metric system is that the whole system is coherent. That is, the product or quotient of any two or more base units is the derived unit of the resultant quantity. It eliminates many of the numerical factors that enter into present calculations and greatly simplifies conversion from one technology to another.

Whereas SI derives the units for all the quantities needed in science, technology, and everyday life from the seven base units, the imperial system has over eighty denominate units of measure which are haphazard and illogical in their relations one to another.

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gram, milligram, also ton (1000 kilograms).

The metric system distinguishes between mass and weight by using different units. Mass is measured in kilograms, but weight is measured in newtons. Weight is defined as the pull of gravity between two objects and can be 0, (in space for example) while mass remains the same throughout the universe.

Another advantage with the adoption of the metric system is that many awkward proper and improper fractions, numerators, least common denominators, greatest common divisors, and mixed numbers will receive much less emphasis with the greater stress on the decimal system.[1] This no doubt will simplify calculations greatly and make the whole system more compatible with the computer.

IV. THE GROWTH AND PRESENT STATUS OF THE ADOPTION OF THE METRIC SYSTEM IN THE COUNTRIES OF THE WORLD WITH SPECIAL EMPHASIS ON THE DEVELOPMENTS IN CANADA, THE UNITED STATES AND BRITAIN

A. A Summary of World Developments

A major reason for the growth of the metric system[2] is the advantage that it has over all other systems of measurement in simplicity, efficiency, universality, precision, coherence and logic.

Over 125 countries, colonies and protectorates of the world have officially adopted or are presently in the process of adopting the metric system as their system of measurement. This leaves only a few countries uncommitted to a system of measurement that is rapidly becoming the

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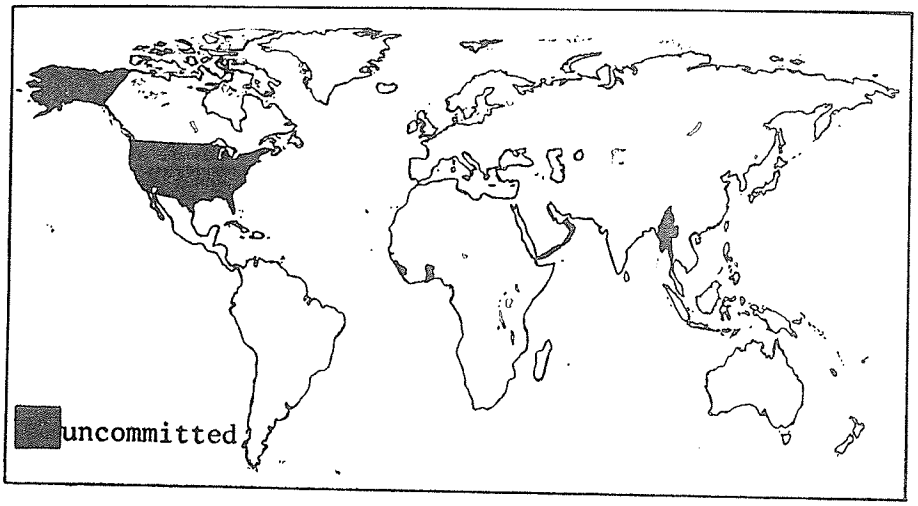
[1] All measurements in the metric system are recorded in whole numbers or decimal fractions.

[2] See chart, p. 36.

universal language of measurement throughout the world. The following map illustrates how close the world is to a single measurement system, namely, the metric system.[1]



The present situation in the world is that over 90 percent of the population is using or converting to the metric system and most of the remaining 10 percent is seriously considering its usage.[2] Countries have continuously been adopting the metric system of measurement since it was first devised. The chart on the following page

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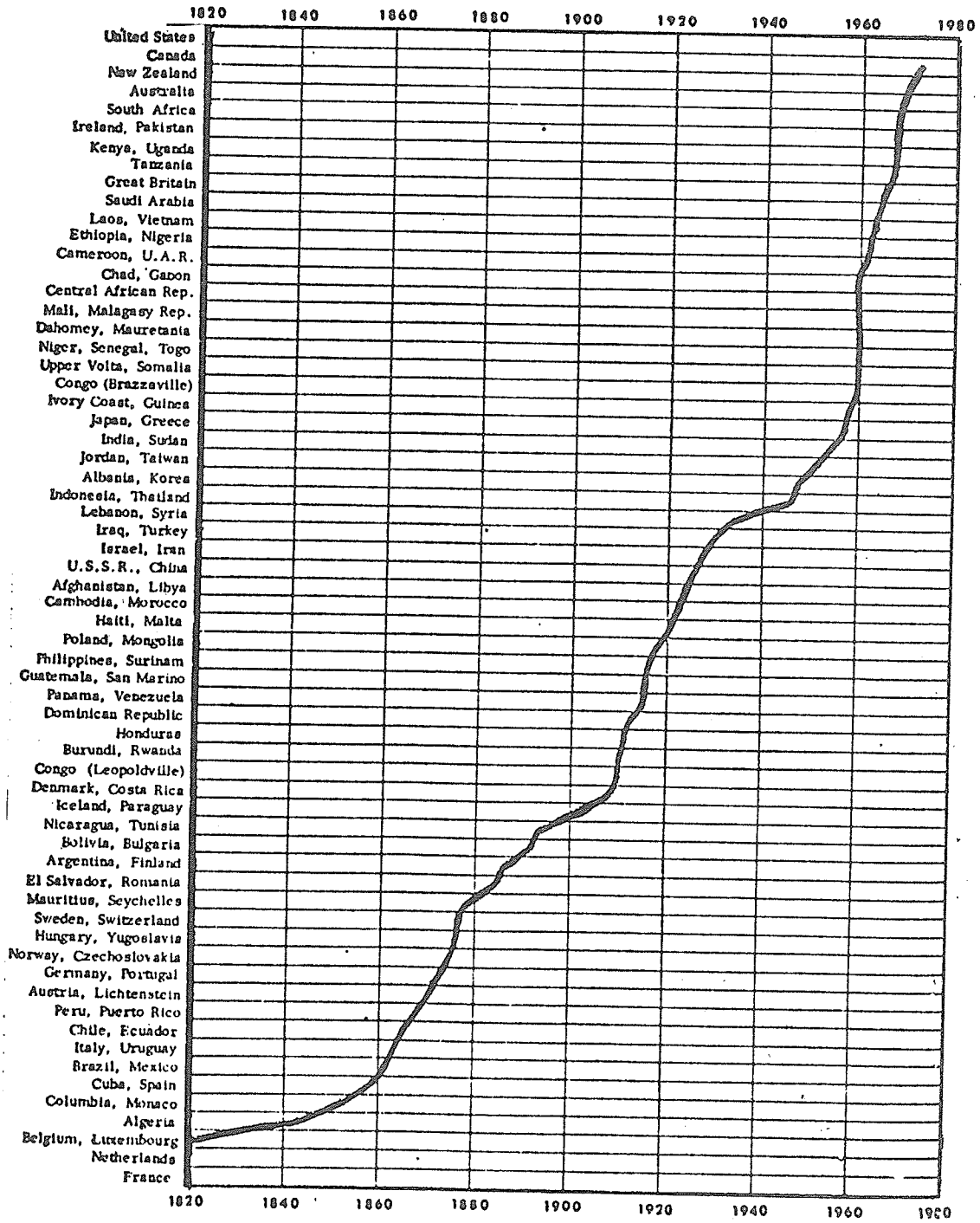
[1]Outside of the United States, the only countries that have not yet formally adopted the metric system are: Barbados, Gambia, Jamaica, Liberia, Nauru, Sierra Leone, Tonga, Yemen People's Democratic Republic. A total population of under 10 million. Source: Metric Commission First Report, (Ottawa: Information Canada, 1973), p. 4.

[2]Almost 94 percent of the world's population (99.8 not counting the U.S.A.) is now on the metric system or is converting to it.

ADVANCE OF METRIC USAGE IN THE WORLD[1]



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[1]John T. Milek and Valerie Antoine, Bibliography of the Metric System, (Waukegan, Illinois: The Metric Association, 1968), p. 84.

illustrates the continuous adoption of the metric system.

With 80 per cent of the world's trade being conducted in the metric system, the need for Canada to adopt a universal system of measurement has become urgent if Canada is to maintain its position as one of the major trading nations of the world. Canada cannot afford to remain in isolation from the world scene in commerce, industry and science. Industry will benefit from improved trading abilities and opportunities in improved world markets. Canada must be prepared to supply its goods in the manner that importing countries desire, which is more and more in the metric system.

B. A Summary of Developments in Canada

As previously indicated Canada began the process of adopting the metric system in 1970, the year in which the Federal Government introduced the White Paper on Metric Conversion. Included in the White Paper are the following broad principles:[1]

1. The eventual adoption in Canadian usage of a single coherent measurement system based on metric units should be acknowledged as inevitable and in the national interest.

2. This single system should come to be used for all measurement purposes.

3. Planning and preparation in the public and private sectors should be encouraged in such a manner as to

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[1]Government of Canada, White Paper on Metric Conversion in Canada, (Ottawa: Department of Industry, Trade and Commerce, January 1970), p. 8.

achieve the maximum benefits at minimum cost to the public, to industry, and to government at all levels.

Although the metric system has been legal in Canada since 1873 it was only in 1970 that the metric units began to be used alongside the imperial system of measurement.

Also, in 1970, the Federal Government appointed a Metric Commission[1] to promote an overall plan for metric conversion. Under the Chairmanship of Stevenson M. Gossage, the Metric Commission consisting of sixteen commissioners from all across Canada reports to the Minister of Industry, Trade, and Commerce. The Commission had its first meeting in January 1972. The Commission may call upon officers and employees of any department or agency of the Government of Canada as necessary, or engage organizations or persons having specialized or technical knowledge, for advice and assistance.

The Commission is established to advise the Minister of Industry, Trade, and Commerce on plans for conversion to the (SI) metric system. It has initiated and will coordinate and undertake investigations relating to metric conversion.

It will prepare, in consultation and cooperation with concerned parties, an overall program for conversion so that the benefits to the Canadian economy may be effected

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[1]A Metric Commission Organization Chart is contained in the Metric Commission First Report, (Ottawa: Information Canada, 1973), p. 10.

to the best advantage and achieved at minimal cost. The Commission will furnish, publish and disseminate information concerning conversion to the metric system and advise the Minister on the need for legislation or any other action required to facilitate conversion.

In order to carry out the conversion to the best advantage, the Commission will require the cooperation of all elements of the Canadian economy to develop an overall plan that will cause the least difficulty and dislocation to the different sectors. . . and produce the greatest net benefit.

Eleven steering committees of the Metric Commission have been formed and over two hundred national, industrial, consumer, service, labour trade, agricultural, professional, and educational associations have been asked to establish planning committees to study the impact of metric conversion and to suggest a timetable most suitable to their sector. From such tentative plans, the Commission intends to develop, in further cooperation with all areas of Canadian society, an overall program for planned conversion that will ensure the benefits while minimizing costs by adequate phasing.

Each steering committee will receive reports from all of the organizations comprised in its sectors on all matters concerning metric conversion. It shall review these reports and prepare an overall plan, for each of its sectors, to be presented to the Metric Commission. It shall coordinate and oversee the implementation of such sector plans that have

been adopted by the Metric Commission.

The chart on the following page attempts to show the structural organization of the process of metrication in Canada. The sector committees are shown as being representative of the individual industrial sectors that are represented in the eleven steering committees. To date, there are sixty sector committees whose representation comes largely from the more than two hundred national organizations.

The Metric Commission Steering Committees are shown below:[1]

No. 1 Transportation, communications, electric power

No. 2 Iron and steel mills, metal fabricating, machinery, shipbuilding, boatbuilding, motor vehicle, truck, trailer and motor vehicle parts industry

No. 3 Electrical, electronics, aircraft and aircraft parts manufacturers

No. 4 Mining and metallurgy, non-ferrous metals, non-metallic minerals, oil, natural gas, chemicals, rubber and plastics products industries

No. 5 Construction, engineers, architects, surveyors, real estate

No. 6 Food, beverages, tobacco, packaging, agriculture, grain handling, fishing, grocery trade

No. 7 Textiles, clothing, leather industries, trade (hard and soft goods) and miscellaneous manufacuring industries

No. 8 Forestry, wood, furniture, paper and allied manufacturing, printing and publishing

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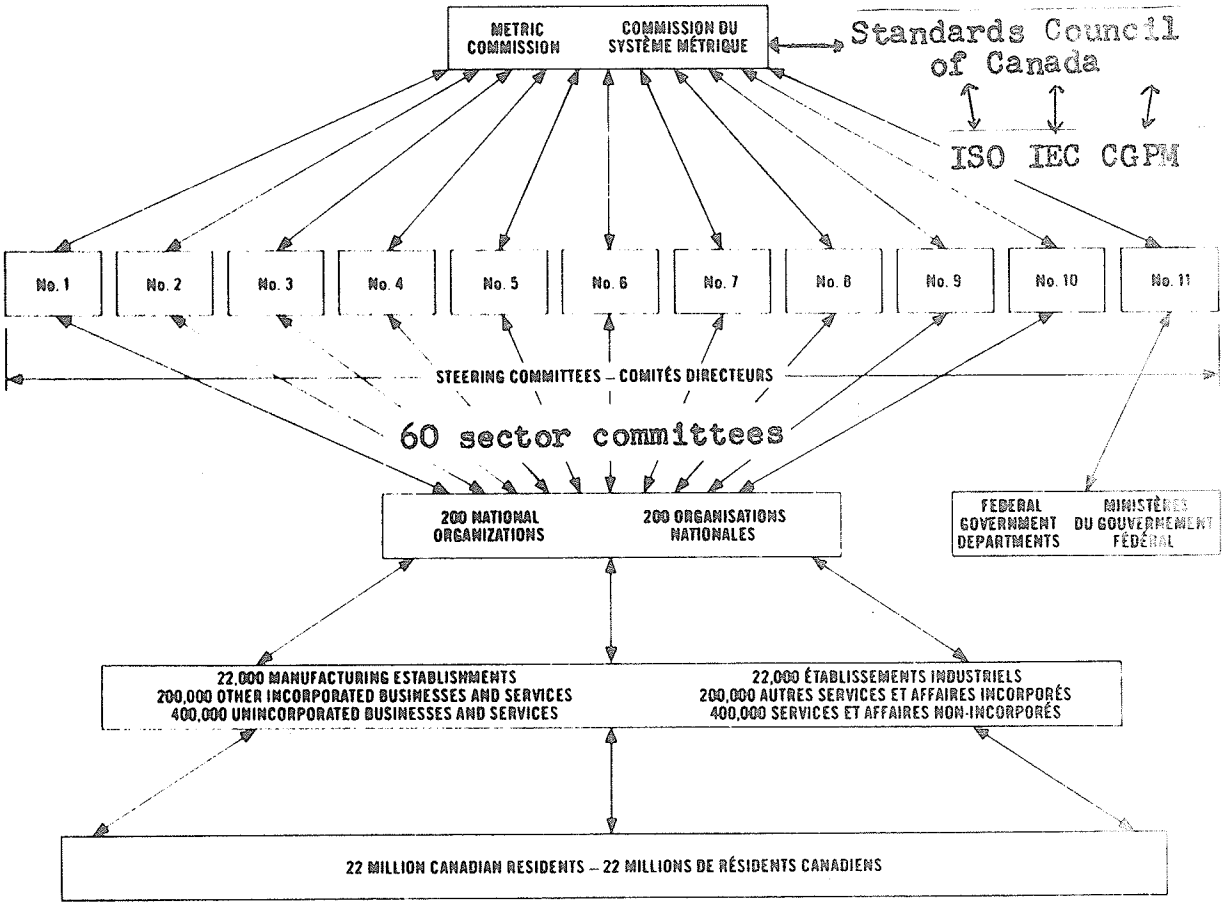
[1]Metric Commission, Metric Commission First Report, (Ottawa: Information Canada, 1973), pp. 12-13.

No. 9 Consumers, services, labour organizations

No. 10 Information, education, training

No. 11 Federal Government departments

Metric Conversion Information Flow Chart[1]



[1]Metric Commission, Bibliography, (Ottawa: Metric Commission, n.d.), p. 4.

An alternative chart is shown in the Metric Commission, Metric Commission First Report, (Ottawa: Information Canada, 1973), p. 12.

Each Sector Committee is expected to come up with a plan which suits its particular condition and needs. In some cases four or five national organizations might be involved in one individual Sector Committee. In other cases a single association's metric conversion committee might form the nucleus of the Sector Committee. Each Sector Committee is assigned to a specific Steering Committee which coordinates the plans of the Sector Committee working under it. For example, Steering Committee No. 10 has been assigned the area of education and training.[1] This Committee is under the chairmanship of Mr. Willis M. Hall, Assistant Director of Youth Education, Department of Education, Halifax, Nova Scotia. Other members of the committee represent the various bodies interested in the problem of education and training. The committee is responsible for coordinating plans in its field and advising the Metric Commission how they fit into the overall program.

Education is, of course, a provincial responsibility. It is up to the provincial Departments of Education to say what will be taught. The Metric Commission can only suggest and see that information on decisions is made as widely available as possible.

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[1]Elementary and secondary schools, vocational centres, trade schools and business colleges, post-secondary non-university educational institutions, universities and colleges.

Varying degrees of provincial involvement are expected at the sector level. It is in this forum that individual interests must be integrated into a sector plan. It can be done through the national organizations or through the provincial representative. It is also at this level that most of the problems and issues will be identified and that the solutions to these problems will be found.

The chart also shows the interrelations, by means of lines, between individual organizations, national associations, Sector Committees, Steering Committees, the Metric Commission, the Standard Council of Canada and the international organizations to which Canada belongs. Each line shows a two way communication channel and each of Canada's twenty-two million citizens has more than one channel by which problems and issues may be brought to the attention of those who will be making the final decisions.

The basic philosophy of metric conversion has to a great extent been accepted by the provinces of Canada.

The process of metric conversion falls into four phases. First comes investigation, then planning, then scheduling and finally implementation.[1] Canada is at present actively engaged in investigation and is organizing for

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[1]These four phases are developed in more detail in the Metric Commission, Metric Commission First Report, (Ottawa: Information Canada, 1973), p. 11.

planning through the structure of Sector Committees. Scheduling will specify for each industry the approximate spread of dates between which the elements of the plan should be realized. This will again be the function of the Sector Committees. Implementation is the responsibility of the individual firm or organization with the knowledge, however, of the recommended industry schedule.

The investigation phase is now very active and should reach its peak early in 1974. It will be succeeded by the planning and scheduling phases which should extend through 1974 and 1975 and should be substantially completed by 1976. Implementation should hopefully start in volume by 1975 and increase rapidly in 1976 to reach a peak in 1977-1978. By the end of 1980, the normal day-to-day transactions in the economy should be entirely in the metric units, although within industries there may be areas where for good economic reasons the use of imperial units may continue.[1]

With reference to education, the main interest of this paper, the suggested timetable of conversion means that by 1975 teachers should be well prepared to teach the metric system. In fact, the introduction of the metric system into schools could begin in the fall of 1974.

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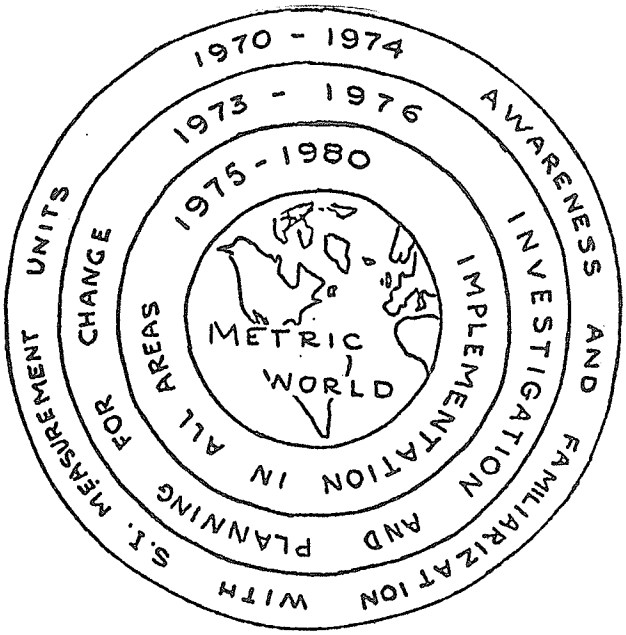
[1]S.M. Gossage, Target Dates for Metric Conversion in Canada, (Presented to Minister's Advisory Council, September 19, 1973).

"The challenge of going metric," according to S.M. Gossage[1] chairman of Canada's Metric Commission, "is to education. Conversion to the use of the metric measurements is not only, or even primarily, a mechanistic changing of machines. Most importantly it means forming and changing men's minds, the task of education."

The following chart illustrates the projections as proposed by S.M. Gossage.



Metrication will not occur all at once but will occur sector by sector as illustrated by the following diagram.

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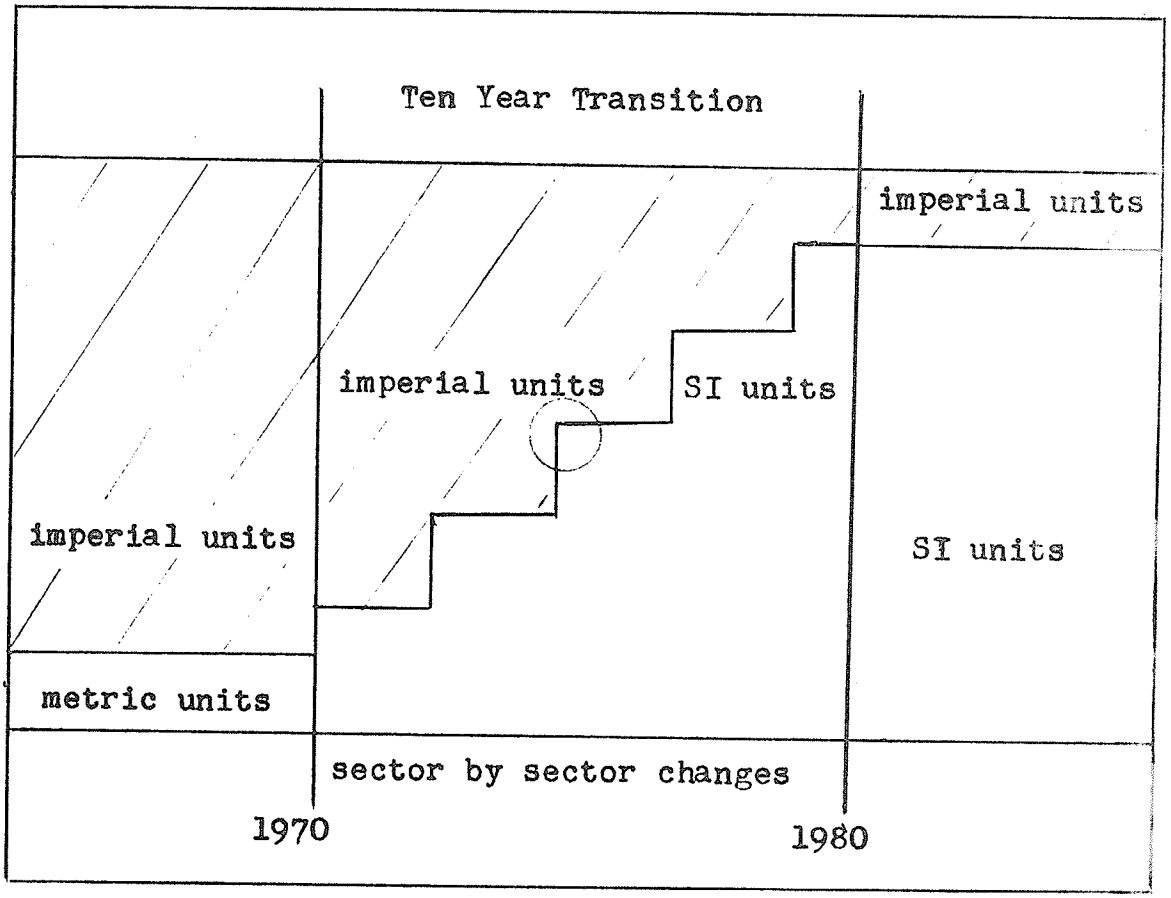
[1]S.M. Gossage, "The Metric Challenge," Journal of Education, vol. 3 (Nova Scotia: Winter 1972-1973), p. 10.



By 1980, Canada will basically be a metric country. The major part of the transition, however, will occur well before that date.

C. A Summary of the Developments in the United States

Because Canada is greatly influenced by the United States it is perhaps desirable to look briefly at the status of the metric system in that country.

A look into the past shows that as early as 1790 Thomas Jefferson, as Secretary of State, prepared a plan for a unified system of weights and measures. Jefferson's plan

was discussed by Congress over a period of six years, but no laws were passed as a result of his work. Undoubtedly, a reason for the hesitation on the part of Congress was a discussion of a new measurement system that was concurrently taking place in France. Even though Jefferson's plan was not the metric system, it was decimally related. Jefferson was following the same principle previously advanced by scientists and mathematicians elsewhere in the world.

Another attempt in 1821 by John Quincy Adams who had been requested by the Senate to prepare a new statement concerning the regulations and standards of weights and measures also failed to convince Congress to take any action.

However, the search for a simpler and more uniform system of weights and measures continued. In 1843 Alexander Dallas Bache became responsible for the Office of Weights and Measures. In various reports to Congress, he noted that the current arrangement of weights and measures was "deficient in simplicity and in system" and argued for the universal uniformity of weights and measures. The intervention of the problems of the Civil War period, however, gave low priority to these and other plans for the adoption of the decimal system. But in 1864 a House of Representative Committee on Weights and Measures initiated legislation that, in 1866, made it lawful throughout the United States "to employ the weights and measures of the metric system." However, a date by which the use of the system should become

mandatory was not included. Action for full adoption was again delayed but in 1875 both the yard and the pound were defined by carefully specifying what fraction of a metre would constitute a yard and what fraction of a kilogram would constitute a pound.

The metric controversy continued in the United States and finally in 1968 the United States Congress directed the Secretary of Commerce to undertake the U.S. Metric Study. The purpose of the study was to evaluate the impact on America of the metric trend and to consider alternatives for national policy. Events which probably led up to this report were:

1. 1957 the launching of the Soviet Union's Sputnik which created a new interest in scientific education and research.
2. 1959 the customary standards were officially defined in terms of metric units.
3. 1960 the Système International d'Unités (SI) was established.
4. 1965 Great Britain announced its intention to convert to the metric system within ten years.

In 1971, the report of the U.S. Metric Study was transmitted to the Congress of the United States. The study recommended that the United States change to the International Metric System deliberately and carefully, and that "the Congress, after deciding on a plan for the nation, establish a target date ten years ahead, by which time the United States will have become predominately. . . metric."[1]

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[1]Arthur E. Hallerberg, "The Metric System: Past, Present, Future?" The Arithmetic Teacher, (April 1973), p. 253.

On August 18, 1972, the United States Senate passed on a voice vote the "Metric Conversion Act of 1972" - S 2483. However, action was not taken by the House of Representatives in the ninety-second Congress and so Congress will need to begin again on a new metric conversion act in 1973-1974.

The following paragraph summarizes the U.S. Metric Study Report:

> "The cost and convenience of a change to metric will be substantial even if it is carefully done by plan. But the analysis of benefits and costs made in (this report) confirms the intuitive judgment of U.S. business and industry that increasing use of the metric system is in the best interests of the country and this should be done through a coordinated national program. There will be less cost and more reward than if the change is unplanned and occurs over a much longer period of time . . . ."[1]

One of the most important recent developments to give urgency to metrication is the increase in internationalized engineering standards. Engineering standards are "norms" regulating size, weight, and standardization of practices. The International Organization for Standardization is a non-governmental body "to promote the development of standards in the world with a view to facilitating international exchange of goods and services and developing cooperation in the sphere of intellectual, scientific, technological, and economic activity."[2]

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[1]Ibid., p. 254.

[2]American National Standards Institute, Measuring Systems and Standards Organizations, (New York: American National Standards Institute, 1970), p. 36.

Even though Congress has not yet officially committed the United States to adopt the metric system there are many indicators toward a strong movement of metrication in the country.

American industry, for example, has apparently come to the conclusion that metric conversion is coming and is therefore taking matters into its own hands. Some eighty major industrial firms have embarked on metric conversion or have declared a policy of doing so. In the absence of Congressional action the American National Standards Institute (ANSI) has established an American National Metric Council. ANSI is a privately financed body and the American National Metric Council will be financed through members' subscription and will have no official standing. Membership, however, will be open to governmental bodies and some departments of the Federal Government have already indicated interest. When a National Metric Conversion Board is established by legislation the Council hopes to establish constructive and cooperative relations. From this it appears clear that the United States is now in fact committed to metric conversion and that progress in the industrial field may be quite rapid.

D. A Summary of the Developments in Britain

A Historical review, similar to the one given for the United States could also be given for Britain, where numerous attempts in the past have been made for adopting the metric system. However, for the purpose of this study

attention will be given only to the more recent developments.

In the printed proceedings of the British Parliament for May 24, 1965, the president of the Board of Trade is quoted as follows in reply to a question by a member of the House of Commons about the adoption of the metric system:

> "The Government are impressed with the case which has been put to them by the representatives of industry for the wider use in British industry of the metric system of weights and measures. Countries using that system now take more than one-half of our exports; and the total proportion of world trade conducted in terms of metric units will no doubt continue to increase. Against that background the Government consider it desirable that British industries on a broadening front should adopt metric units, sector by sector, until that system can become in time the primary system of weights and measures for the country as a whole. . . . Practical difficulties attending the changeover will, of course, mean that this process must be gradual; but the Government hope that within ten years the greater part of the country's industry will have effected the change."[1]

That is how Britain - the nation that developed the imperial system of weights and measures - announced its decision to go metric. The government aimed at 1975 as the year in which Britain should for all practical purposes become a metric country. The Minister of Technology set up a Standing Joint Committee on Metrication, whose function was to encourage all sectors of the economy to start planning for the changeover. The committee also considered the machinery for making the changeover and recommended the

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[1]Lord Ritchie-Calder, "Conversions to the Metric System," Scientific American, (July 1970), p. 17.

creation of a Metrication Board to facilitate the process. The board consisted of representatives from journalism, the arts, social research, civil engineering, the central government, local governments, agriculture, mechanical engineering, the universities, the trade unions and women's interests. The Board held its first meeting in May 1969.

The process of metrication has continued in Britain to the point where the majority of industries are now metric but where a major part of the population, namely the consumer, is still faced with the process of metrication. The general public of Britain is still largely functioning in an imperial world when it comes to purchasing consumer products. Most products are labelled in the imperial system with the metric unit in brackets beside it. A store may well purchase cloth by the metre and sell it by the yard. A few products, however, are totally metric but this is just beginning.

Temperature is reported in both centigrade (which is called Celsius in SI) and Fahrenheit, which causes most people to listen only for the Fahrenheit temperature and pay little or no attention to the Celsius. The newspapers also report temperature in both units. This dual reporting has allowed the general public to remain in "Fahrenheit thinking" and not caused them to think degree Celsius.

Another aspect of some importance , which means that Britain may well go metric in all measurements except where miles are concerned, is the deliberate action by the

government to delay indefinitely the changes of miles to kilometres.[1]

Through visiting England and interviewing a number of educators the writer came to the conclusion that the government is hesitating, or at least not forcing the final major metric change - that of consumer products. This final change appears to be going rather slowly and perhaps somewhat haphazardly.

V. SUMMARY

This chapter reviewed the literature presently available in Canada, the United States and Britain. This was followed by a brief history of the metric system. It summarized the present world status of the metric system and reviewed broad metric developments in Canada, the United States and Britain.

The following chapter of this study outlines the information gained from the interviews held with educators in England.

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[1]From information obtained from the interviews in Britain. Since there has now been a change in government, a new policy may be issued.

CHAPTER THREE

A SUMMARY OF THE DEVELOPMENTS OF METRICATION IN THE FIELD OF EDUCATION IN ENGLAND AND THE RESULTS OF THE INTERVIEWS HELD WITH EDUCATORS THERE

I. THE BACKGROUND OF THE EDUCATIONAL SYSTEM IN ENGLAND

In England the National Department of Education and Science is not directly concerned in providing education at any level. Provision of primary, secondary and most further education is in the hands of Local Education Authorities whose duty it is to provide an effective education service to meet the needs of the local population. The institutions of higher education that are not under the single or collective control of the Local Education Authorities (mainly, the universities) are autonomous and formulate their own educational policies, although they derive most of their funds from Central Government.

The content of the curriculum of schools rests in a formal sense with the Local Education Authorities, although it is normally a matter for head teachers. Her Majesty's Inspectors form the link between the Central Department and the Local Education Authorities, schools and colleges, and are available to give help to teachers and college authorities as they need it.

The curriculum at secondary schools in England is influenced to a considerable extent by a system of external public examinations. These examinations are set by examining bodies with broad regional responsibilities and containing a large representation of serving teachers. There are two main sets of secondary school examinations: The General Certificate of Education (GCE) and the Certificate of Secondary Education (CSE). The GCE is granted by eight separate examining bodies most of which are sponsored by universities. Certificates are awarded at two grades, Ordinary and Advanced level, for examinations taken respectively in about seventeenth and ninteenth year of age. Control of the examinations for the Certificate of Secondary Education is in the hands of representative serving teachers on fourteen Regional Boards.

Guidance on the curriculum in schools (but not directives) are given at the national level by the Schools Council for the Curriculum and Examinations (commonly referred to as the Schools Council). The Schools Council is designed to be representative of the whole education service and has the object of promoting curriculum study and development and of sponsoring research and enquiry where this is needed. In addition the Schools Council has responsibilities for coordinating secondary school examinations.

Other autonomous bodies such as the Royal Society may play a significant part in drawing the attention of the education service to trends and developments which may

influence the curriculum.

In-service courses for teachers are run at a number of places - at colleges of education, at teacher centres[1] and on some occasions at technical colleges or at schools. Generally these are short courses lasting from one to several days.

II. ENGLAND'S INITIAL STAGES OF GOING METRIC IN THE FIELD OF EDUCATION

The statement in Parliament in May 1965, referring to the educational changes involved in metrication said:

> "We are also considering how we can best encourage educational work to familiarize future school generations and students in technological establishments with working in terms of metric units."[2]

It is from this beginning that the changeover from imperial to metric units in the British education service has taken place.

The Standing Joint Committee on Metrication consulted the Department of Education and Science, the Schools Council, the Royal Society, Examining Bodies, Local Education Authorities and other organizations with an interest in education. These discussions stimulated the

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[1]The purpose of Teacher Centres is for teachers to get together to set new objectives, plan procedure and appraise methods in the light of experience. Teacher Centres are relatively new in England.

[2]Commonwealth Secretariat, Commonwealth Conference on Metrication, (London: Metrication Board, April 24-27, 1973), p. 3.

establishment of metrication advisory committees by Local Education Authorities. The Department of Education and Science kept in touch with developments and identified what steps needed to be taken in the schools to bring about the change. The publication, Metrication in Schools,[1] contained broad suggestions to that end.

In June 1969 the Metrication Board set up a Steering Committee for Educational and Industrial Training.[2] One of the first tasks it undertook was to cooperate with the Schools Council in the preparation of a pamphlet[3] for teachers about the metric units to be used in teaching, and this was followed by the publication in 1971 of the Schools Council booklet, Metres, Litres and Grams,[4] a guidance booklet for teachers in primary schools.

The Commonwealth Secretariat report[5] concludes with the statement:

> "The move towards metrication has consequently received a general welcome. No fundamental

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[1]Education Information, Metrication in Schools, (London: Department of Education and Science, September 1969).

[2]For Terms of Reference see Appendix B, p. 139.

[3]Schools Council, Change for a Pound: A Teaching Guide for the Introduction of Decimal Currency and the Adoption of Metric Measures, (London: Her Majesty's Stationery Office, 1969).

[4]Schools Council, Metres, Litres and Grams: Introducing Metrication in the Primary School, (London: Evans Metheun Educational, 1971).

[5]Commonwealth Secretariat, Commonwealth Conference on Metrication, (London: Metrication Board, April 24-27, 1973, p. 6.

> difficulties have impeded the change to metric units in curriculum subjects, although there are undoubtedly difficulties of timing because the changes taking place in day-to-day business and activities outside the schools are necessarily gradual. The schools have to equip children to live in the world as it actually is."

The information gathered from the interviews should be considered in the context with the organizational structure of the educational system as well as the official position of the Metrication Board.

III. PROCEDURE FOLLOWED FOR ARRANGING INTERVIEWS IN ENGLAND

The British Council was requested and agreed to make the arrangements for interviewing educators in England on the process of going metric. The request was for assistance in arranging interviews with educators in the following fields:

1. A member of the Metric Commission concerned with education.
2. A member of the Department of Education and Science concerned with introducing the metric system to social science teachers.
3. A teacher in the social science area directly involved in carrying out the changeover at the curriculum level.
4. A high school geography teacher.
5. A professor at a Teacher Training Institute in the field of the social sciences.
6. A representative from a textbook publishing company involved in the metric changeover.
7. A headmaster or teacher in a primary school.

The British Council was informed that the writer was writing a research paper (thesis) for the Faculty of Education, University of Manitoba on the topic:

> "A study of implementation problems and implications confronting a geography teacher with the change to the metric system of measurement as well as guidelines for the preparation to metrication."[1]

The British Council was also informed about the writer's involvement on the Department of Education Committee to Study and Introduce the Metric System in Manitoba Schools which included:

a. learning in part the metric system;

b. studying developments in other parts of the world with regard to metrication;

c. studying metrication developments in Canada;

d. writing an adult education program for the introduction of the metric system to Manitoba; and

e. preparing guidelines for teachers to introduce the metric system to children.

The stated purpose for interviewing educators in England was to investigate the following (with special emphasis for social science teachers):

a. the procedure of implementing the metric system in schools;

b. the implications for education in "going metric"; and

- teacher in-service (type, length)
- teaching techniques
- textbook changes, equipment, etc.

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[1]Personal letter to British Government Office, Trade Commission and Information Services, 402-333 Broadway Avenue, Winnipeg, Manitoba. Dated September 5, 1973.

c. guidelines and recommendations for Manitoba.

- what appeared to be successful
- what didn't go as well

It was also indicated that the information gathered from the interviews would be used for three purposes:

1. Research paper (thesis) for University of Manitoba,
2. Report to the Manitoba Committee for the Study and Introduction of the Metric System in Manitoba Schools; and
3. Report to the Metric Commission of Canada.

The interviews were arranged by the British Council in the context of the above information. The outline of the program for interviews was received by the writer only after his arrival in England. This is normal practice and worked very satisfactorily because an opportunity to discuss the appointments with the Program Organizer was given before the itinery was begun.

IV. BRIEF AUTOBIOGRAPHY OF THE PEOPLE INTERVIEWED

Because the number[1] of people interviewed had to be limited, it is important to realize the context in which their comments were made. For this reason a brief auto-biography of each person interviewed is outlined (in order of interview).

1. Miss J. Gayton, officer of the Science Education Section of British Council, had been in her present position for only a few months but had been a teacher of geography

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[1]Because of lack of time and financial resources.

and mathematics previous to her present position. She had also taught in Africa for several years.

2. Mr. H. MacGibbon is Deputy Managing Director of Heinemann Educational Books Limited, one of the large suppliers of textbooks in England as well as to countries in Africa which once were colonies of Britain. He was very much involved in the decision-making process relating to metrication in publication within his own company and therefore was very knowledgeable about the problems associated with publishing textbooks during the changeover period. He was also familiar with Nigeria's metrication process because of the large number of textbooks that his company sells there. Heinemann Educational Books Limited appeared to have taken the lead among publishing companies in England with respect to metrication.

3. Mr. Kenneth Pinnock is Management Director of John Murray Limited, a publishing company in England. He is a leading member of the Educational Publisher's Council and served as chairman of its Metrication Committee which had association with the Metrication Board during the initial stages of the changeover. He was well informed about the problems confronting the publishing industry during the changeover to the metric system of measurement.

4. Mrs. Wilson is Assistant Executive Secretary of the Association for Science Education, a national association in Britain. She had been a science teacher during the first years of metrication and was familiar with the problems associated with science teachers. She commented on

implementation procedures, teacher in-service, textbooks, examinations, etc. In connection with this interview the writer was also able to talk to three teachers at the Hatfield Polytechnic College about metrication. However, the information obtained from these three people was not recorded on tape.

5. Sister Marie Agnes is headmistress of the Saint Philip Howard Roman Catholic School in Hatfield. The metric system had been taught in this school for five years and she had been fully involved in the metric developments since the beginning. The imperial system was only being taught for historical reasons. The writer was able to visit several classrooms and talk to other teachers as well as see the equipment and books that were being used. The writer was able to get an excellent review of developments of metrication as they affected an elementary school.

6. Mrs. P.M. Jolley is Director of Education and Industrial Training of the Metrication Board. She held the position of Assistant Director before her appointment as Director. She has been involved with the Metrication Board for several years and was therefore very able to outline fully the developments from the Metrication Board's point of view, which involved the whole education system.

7. Mr. J.L. Kay is Her Majesty's Senior Inspector in the Department of Education and Science. He has been involved directly and indirectly with metrication in elementary schools since the introduction of the metric system.

8. Mr. R. Beddis is associated with Avery Hill College of Education as well as working on a Geography Project with the Schools Council. He is author of several recent geography textbooks; among the titles are:

"Europe and the Soviet Union"

"Asia and North America"

"The Land and People of Britain"

"Africa, Latin America and Lands of the South-West Pacific"

He had previously taught geography at the secondary level. He was indeed knowledgeable about the implications for geography teachers both as a teacher and as an author.

9. Mr. J. Parsons is the Geography Head at the Eltham Green Composite School. His duties include teaching geography as well as administration. He had been in this position for several years and was qualified to speak about the implications of metrication from the geography teacher's point of view. Included with this interview are responses from Mrs. Allen, a geography teacher at this school. At this school the writer talked to two science teachers about the metrication process as well.

V. PROCEDURE FOR RECORDING AND ANALYSING THE INTERVIEWS

Just prior to the actual interview each participant was given a brief written summary of the writer's involvement with the metric system, the purpose of the interviews and how the information was going to be used. After the person interviewed had read the summary and purpose, no

questions were asked until a substantial statement had been made by the person being interviewed. After this the person interviewed was asked to respond to certain questions which were asked by the writer. Each interview was recorded on cassette tape. The interviews ranged in time from one to three hours.

The information from the interviews was transcribed on paper and then organized into the following four categories with sub-headings. The information was organized into these categories and sub-headings for clarification only. There is no doubt some overlapping but an attempt has been made to keep this to a minimal.

The categories and sub-headings are as follows:

A. Implementing the metric system in British Schools.

   i. Description of implementation procedures.

   ii. An evaluation by British educators of implementation procedures.

   iii. Suggested guidelines and recommendations for implementation procedures.

B. In-service programs preparing British teachers for teaching the metric system.

   i. Description of in-service programs.

   ii. An evaluation by British educators of the in-service programs.

   iii. Suggested guidelines and recommendations for teacher in-service programs.

C. Textbook publishing procedure during the changeover period.

   i. Description and evaluation by British educators of textbook publishing during the conversion period.

ii. Suggested guidelines and recommendations for publishing textbooks during the conversion.

D. Teaching approaches used in Britain to introduce and teach the metric system in the classroom.

i. Description and evaluation by educators of teaching approaches used in Britain.

ii. Suggested guidelines and recommendations to introduce and teach the metric system in the classroom.

The cassette tapes[1] containing the interviews are available from the writer. No attempt has been made in the following pages to associate a specific quote with a certain person. The writer felt that the overall picture obtained from the interviews was much more important than the individual statements. All the information obtained has been taken into consideration wherever applicable.

VI. A DESCRIPTION OF THE INFORMATION OBTAINED FROM INTERVIEWS OF EDUCATORS IN ENGLAND

The following is a description of the combined information obtained from interviewing educators in England on the process of going metric.

A. Implementing the Metric System in British Schools

i. Description of implementation procedures.

Historically, the impetus for the metric changeover in England came from industry and not from government. Perhaps as a result of this the government never took the

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[1]For list of tapes available see Appendix C, p. 140.

leadership it could have. It appeared that the general policy of the government was not to impede the changeover but not necessarily to promote it either. The whole metrication process appeared to lose government momentum after 1970.[1] There was a great deal of doubt in the minds of educators even as late as 1970-1971 if in fact Britain was going to adopt the metric system generally, even though industry was going ahead with the change. The decision to go metric wasn't very clear for some time. However, some schools just went ahead with metrication without the full confidence that the government would actually implement it. Implementation therefore appeared haphazard and teachers were waiting for some definite direction from the government. This direction wasn't forthcoming until 1972 when the present government issued a White Paper which supported much of the previous government's metrication policy.

The function of the Metrication Board[2] was to coordinate and encourage metrication but it had no power to order anyone to go metric. It reported to the government in annual reports about what had happened as well as giving an indication of future developments. The Metrication Board did not produce a program for the educational system to go metric. However, in June 1969, the Metrication Board

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[1]The people interviewed indicated a change in direction of the metrication policy with the change of government in 1970. A period of uncertainty about the whole changeover occured with the change of government.

[2]For terms of reference of the Metrication Board see Appendix D, p. 141.

set up a Steering Committee for Education and Industrial Training whose terms of references are in Appendix B.[1] This committee cooperated with the Schools Council in the preparation of a pamphlet for teachers about metric units to be used in teaching as well as conducting surveys to find out the extent to which metric units were used regularly in primary and secondary schools.

At a conference held on March 20, 1968 at the Royal Society, attended by persons representative of a wide range of primary and secondary educational interests, the following resolution was passed:

> "In primary schools there should be a change of emphasis in favour of the metric system of weights and measures from September 1969."[2]

Even though this resolution was passed, the Royal Society, nor any other organization can enforce it. The decision of whether the resolution is implemented into a school rests in the hands of a Local Education Authority and the Headmaster of a school.

As a result of this resolution and no doubt other developments, the metric system was introduced into the Primary Level of many schools in 1968 and 1969. The emphasis was not on a sudden change but rather a gradual phased changeover beginning with the primary school which

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[1]For the terms of reference of the Steering Committee for Education and Industrial Training see Appendix B, p. 139.

[2]Commonwealth Secretariat, Commonwealth Conference on Metrication, (London: Metrication Board, April 24-27, 1973), p. 4.

gradually forced the movement up to high school. In the primary schools the metrication process is well underway now. The three publications: (a) Metrication in Schools,[1] (b) Metric Units in Primary Schools,[2] and (c) Metres, Litres and Grams[3] as well as the abundant metric mathematics books have no doubt contributed a great deal to this. Also, Local Education Authorities have allowed a metrication allowance on top of the basic allowance per teacher to purchase metric equipment and books.

In high school, however, the situation is somewhat different. Some of the people interviewed felt that it was by no means a sort of systematic introduction. The feeling was that there was little compulsion to go metric unless the Headmaster gave specific direction for the changeover to occur or unless the examination boards decided to make the exam metric wherever measurement occured. The following are comments made by high school teachers not teaching science:

> "We seem to have drifted into it in the typical sort of English way of compromising and gradually introducing. No specific direction was given but the process appeared to drift and meander inefficiently and haltingly rather than take place as a systematic and rational effort. A committment to go metric appeared to be lacking."

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[1]Education Information, Metrication in Schools, (London: Department of Education and Science, September 1969).

[2]The Royal Society, Metric Units in Primary Schools, (Cambridge: University Printing House, April 1970).

[3]Schools Council, Metres, Litres and Grams: Introducing Metrication in the Primary School, (London: Evans Metheun Educational, 1971).

"Until there is definite direction there will be no incentive to adopt the system."

"My guess is that many secondary teachers are relatively unaware of metrication."

"Geography teachers in secondary schools in this country think and talk imperial."

"But while its going on piecemeal and in an ad hoc way it will drift on for years and years."

"Half hearted switch makes it confusing for students, teachers, and publishers."

In fact, many teachers in the high school who aren't teaching science or mathematics are only now beginning to face the implications of going metric because they are receiving students into their schools who have had their instruction as far as measurement is concerned in the metric system.

In high school, the science teachers were the first to be affected because the examining boards decided to set all exams in SI units as early as 1970. The incentive and motivation for going metric has come from national exams. The teachers of high school mathematics fully adopted the SI units only when the national examinations began using the SI units in 1972.

In geography exams, the student may answer questions using the imperial or metric system and therefore many teachers have not yet adopted the metric system. Examinations play an important part as motivation. It appears that teachers will only make the step of adopting and teaching the metric system once national examination boards state that the exams will be metric. The national geography

exams are scheduled to adopt the metric system during the 1974-1975 school year. At the present time most geography teachers rely heavily on imperial units of measurement and where textbooks use metric units there is a tendency to convert. With more and more textbooks going metric, however, converting from metric units to imperial will be inadequate. The geography teacher will have to be prepared to adopt the metric system as part of his measurement language.

It is interesting to note that all of the educators interviewed admitted that they were still thinking in degrees Fahrenheit even though the B.B.C. and the newspapers have reported the temperatures in both degrees Fahrenheit as well as degrees Celsius for over five years.

As a result of the comments made by the people interviewed, the writer concluded that the lack of government leadership and direction caused, to a large extent, an uncertainty about the whole process of adoption. This resulted in implementation in Grade I and letting the process work its way into high school which has resulted in high school teachers[1] postponing the adoption of the metric system far too long. It appears to the writer that more definite direction could have improved the implementation procedure greatly.

The procedure of reporting temperatures in both Fahrenheit and Celsius scales over many years appears to

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[1]With the exception of science and mathematics.

have been quite ineffective. People just wait for the temperature scale that they are familiar with and do not bother to listen much to the other.

ii. An evaluation by British educators of implementation procedures.

The people who were interviewed indicated a distinct dissatisfaction with the uncertainty that existed about going metric. They felt that the government should have made a decision one way or the other to clarify its position. Some of the people who were interviewed felt that the whole issue of metrication had become too much of a political issue; such as being associated with entry into the European Common Market. There was also a feeling among some of the educators that metrication had become associated with a political party. Hence, with the change in government in 1970, there was good reason for a period of uncertainty. A period of waiting for new legislation occurred after 1970 until the new government declared the policy again. This took until 1972[1] and so in the period between 1970-1972 the metrication process lost its momentum. This uncertainty occurred at a very awkward time for most schools. During this time the government didn't block any movement to go metric but they didn't promote it either. The lack of information about timing caused metrication to occur piecemeal. Another aspect which affected metrication was the

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[1]White Paper on metrication passed by the present government.

decimalization of money which was completed in February 1971. The reaction of the public to decimalization may well have been a factor for the lack of committment about metrication on the part of the government. Many people saw decimalization as an opportunity for business to greatly inflate prices and this backlash may well have caused the government to move slowly on metrication because people saw metrication as another opportunity for business to raise prices.

Several of the educators interviewed felt there was a lack of information about the metric developments and the metric system. Some relevant comments were as follows:

> "I taught one year ago and had received no real introduction to the metric system."
>
> "Because of the lack of precise information some people didn't really understand the difference between decimalization and metrication."
>
> "More definite information should have been given to teachers."

The lack of direction and guidelines from the government, and the uncertainty about whether or not the metric system would be adopted was evident in the implementation within the schools. It was in the context of this uncertainty that Local Education Authorities and Headmasters had to make decisions regarding metrication. As a result of this, metrication did not advance at the same rate throughout the country. Some elementary schools just went ahead with implementation while others waited for more direction. The schools which took the initiative are now well advanced in the process of going metric. These schools, however, faced

numerous difficulties initially in obtaining materials, and textbooks, as well as teachers to teach the metric system. The lack of initial teacher preparation will be dealt with later in this paper.

The method of implementation, where it was introduced into the primary level and then allowed to work through the school system, has allowed secondary teachers to postpone metrication.

The teachers of secondary schools with the exception of science and mathematics are in a position now where they are not really conversant in the metric system, but the students entering their classrooms are. This is creating difficulty especially for geography teachers. Teachers in secondary schools can no longer reject the change and will now have to face the inevitable. In many ways this is analagous to the consumer who is not prepared to face the changeover until he is more or less forced to. One educator said,

> "Implementation in secondary schools is going to take a long time."

Further comments were:

> "We will muddle along as long as we don't really have to change."
>
> "Geography in schools did not really get off the ground as far as metrication is concerned."
>
> "I taught geography one year ago and I had no real introduction to the metric system."

The piecemeal implementation of the metric system subject by subject puts the student into the position where

he "measures temperatures in degrees Celsius in the science room and degrees Fahrenheit in the geography room, even today."[1] With more planning and direction this diversity could have been eliminated.

From the interviews the writer got the distinct impression that the educators were generally dissatisfied with certain aspects of the implementation procedures and therefore could indicate suggestions for improvement. This aspect will be dealt with later in this paper.

The writer gathered no negative feeling about the metric system itself from the interviews. The people interviewed, all saw it as a necessary step for Britain to take. None of them objected to the metric system itself and none had very strong negative feelings about the method of implementation, however all were prepared to offer suggestions on how this could be improved.[2]

iii. Suggested guidelines and recommendations for implementation procedures.

Each person interviewed was asked to suggest guidelines and recommendations for implementation procedures. The educators responded in the following way:

1. "The question of timing is the most important of all. Advance warning stating what will happen should be given to: schools, metric suppliers,

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[1]Quote from one of the people interviewed.

[2]It is perhaps important to note that all the people interviewed looked positively at the work done by the Metrication Board. Most felt that the Metrication Board didn't have enough authority to implement and give direction.

publishers, educational organizations, etc. Included should be as precise dates as possible of the developments that have been planned."

"Encourage the government to produce and announce a comprehensive program of what is going to be done in advance of the changeover, including when the changes are planned."

"Real need for a well published timetable about metric developments as they are planned."

"Make clear cut guidelines - a timetable to let people know what is planned."

"Direct leadership from the government would be desirable."

2. "Make implementation 'as small a meal as possible' - don't make a big issue of it - just go ahead and do it."

"Encourage better planning so that the whole process of change is more systematic and rational and not as piecemeal and haphazard as it was here. Be definite about the developments because it is too difficult to prepare unwilling teachers if you stress the <u>trend</u> rather than the <u>specifics</u>."

3. ". . . recommend that the changeover be more rapid than it was here."

"I would prefer a more sudden change than in England."

"I would encourage implementation across the board in schools instead of starting in Grade I and waiting for it to work its way through the school system."

"If possible have the direction of metrication for education emanate from one central body. One from where teachers could get help and support . . . . We left too much to the individual teacher."

4. "Attempt to create a positive attitude for switching over - make the change desirable . . . a positive public relations program is a necessity for a smooth changeover . . . producing relevant video tapes and films which are readily available."

5. "Encourage the use of 'think metric' - converting from imperial is not the answer. Publication of a handbook for all teachers with relevant information

and guidelines probably would be very helpful."

6. "Get teachers involved in the changeover as much as possible."

7. "Encourage planning within a school so that the same measurement language is used in all the courses - not imperial in one and metric in another."

   "Mathematics and science should go SI at the same time."

8. "I would recommend a metrication allowance for each elementary classroom during the initial years of implementation - to buy equipment and materials."

9. "Strongly recommend that you do not make the same mistake in reporting temperature that we did. After four or five years of reporting both temperatures I still 'think Fahrenheit'. You must eliminate the Fahrenheit temperature within a short time of implementation."

10. " . . . keep the metric changeover from becoming a political issue."

The implementation procedures for geography teachers will be summarized later in this paper.

B. In-Service Programs Preparing British Teachers for Teaching the Metric System

i. Description of in-service programs.

Teacher in-service programs are available at teacher's centres, colleges of education and technical colleges, and at schools. The courses are offered by various groups such as: college of education staff, technical college staff, Local Education Authority (L.E.A.) advisors, Department of Education and Science officials or teachers' groups. Most of these are short courses. It is also important to recall that the decisions about what is taught in schools rests in

the hands of Local Education Authorities and the Headmasters of each school. Even though the initiative for teacher in-service programs may come from several areas, the decision as to whether a teacher may take the course rests with the Local Education Authorities and the Headmaster. Local Education Authorities are perhaps responsible for initiating most of the teacher in-services. From the interviews, the writer gathered that attendance at in-service is largely voluntary on the part of teachers.

When the people interviewed were asked what was done about teacher in-service they commented as follows:

> " . . . very little guidance was given to teachers . . . all I received as a teacher was a conversion table."
>
> "Not much advice was given to teachers."
>
> "I found out how to use it by teaching it."
>
> "As a science teacher I received no training or re-training for the changeover . . . I was not aware of any general in-service for teachers."
>
> "Lectures were given at Teaching Centres around the country but these were completely voluntary."
>
> "I was aware of several day courses by education authorities but have no knowledge what was taught."
>
> "I know that several Colleges of Education put on courses, but I am not aware of what was taught."
>
> "Advisory teachers from L.E.A. gave advice to particular schools about the metric system."
>
> "Teachers just out of Colleges of Education have received instruction about the metric system especially in the field of science . . . these teachers were of great help in my school."
>
> "Teachers just learned the new system themselves by having to teach it . . . in some cases teachers had a great deal of difficulty."

"It was my own responsibility to learn the metric system . . . I would say that on the whole it has been the responsibility of the schools to do as much as possible themselves . . . we learned it by teaching."

"I attended one short course which was not really worthwhile."

"Most of it I learned myself, sitting down and learning it from mathematics books because I had to teach it . . . I think most teachers have done this."

"One of our teachers went on a course and brought back a list of basic equipment which helped us . . . we learned a great deal from one another within our school."

"In-service was held for teachers in L.E.A. but I don't know any details about these courses."

"The Department of Education and Science ran a series of national in-service courses for elementary school teachers. These included practical workshop approaches."

"I have a feeling that there isn't a national systematic attempt to introduce the metric system in geography."

"I was aware of one course to introduce the metric system in geography, but it was theoretical instead of practical . . . I did not attend."

"Most teachers have deferred the change as long as possible."

"Some teachers who should have taken courses on the teaching of the metric system didn't."

"As a geography teacher I have not attended any in-service and I don't know what has been offered."

"On numerous occassions the Metrication Board has indicated they are prepared to send out speakers, but the response from the teachers, I believe, has been disappointing."

The conclusion drawn from these comments is that partly because of the structure of the British education system it is difficult to get a national systematic in-service program instituted. The onus of teacher preparation

appeared to be largely an individual decision. Those teachers who wanted in-service could obtain it, those who felt they wanted to delay it could, and those who chose not to take any in-service could do so. The lack of a specific timetable and the uncertainty of what action the government would take appeared to be evident in the lack of action in teacher in-service.

ii. An evaluation by British educators of the in-service programs.

The people who were interviewed were asked to comment on how well they felt the in-service programs worked. They responded with the following comments:

> " . . . not at all good for me, because I received none."
>
> "In-service was weak, however, in science I saw no major problem."
>
> "Because of the structure of our education system, some schools metricated quickly, others slowly, and some really slow."
>
> "I don't think learning it completely on your own is the best way . . . because many of us didn't really know what to do initially."
>
> "I felt in-service was weak."
>
> "Frankly, I'm not very happy with the way it went . . . there was too much uncertainty at a very awkward time which made teachers feel they could wait, and therefore didn't attend in-service."

From these comments as well as other impressions from the people interviewed the writer concluded that metric in-service programs were not a very strong element in "going metric". However, the number[1] of teachers interviewed

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[1]Approximately 18.

perhaps was not sufficient to get an overall picture of the in-service programs. The Commonwealth Secretariat's report[1] indicates that in November 1970 the Committee[2] conducted a survey which indicated that eighty-four percent of Local Education Authorities were providing or had provided in-service courses for teachers. However, the report does not say what type of in-service, nor does it say how many teachers attended or what kind of response the in-service received.

Also, primary teachers had been involved to a greater degree with in-service than secondary. The writer met no secondary teacher who had actually attended a metric in-service. However, secondary teachers were now having to face metrication and were therefore looking for in-service help.

iii. Suggested guidelines and recommendations for teacher in-service programs.

The people interviewed suggested the following guidelines and recommendations for teacher in-service programs. The responses are not all recorded verbatim but an attempt has been made to record the meaning or idea as closely as possible.

1. "In-services should be more directed than they were in England . . . and should be far more centrally organized. Ample opportunity should be given for each teacher to attend an in-service.

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[1]Commonwealth Secretariat, Commonwealth Conference on Metrication, (London: Metrication Board, April 24-27, 1973).

[2]Steering Committee for Education and Industrial Training.

In England this would have speeded up the process considerably. Completely voluntary teacher in-service is not adequate . . . there should be strong encouragement to attend at least one well planned in-service."

2. "Ample publicity should be given about the in-service programs offered, as well as what the in-services are intended to do."

3. "The primary teachers must be prepared to teach the metric system and therefore all primary teachers should definitely receive preliminary in-service help."

4. "A basic overall in-service program of metrication should be developed for all teachers. The emphasis should be on appreciating the strength of the metric system."

5. "In-service programs should prepare the teachers to think metric as well as helping them to introduce and teach the metric system in the classroom. Programs should include practical activities involving measuring in the metric system."

6. "Discourage converting from the metric system of measurement to the imperial system at all levels. Each system must be taught as a separate system."

C. Textbook Publishing Procedures During the Conversion Period

1. Description and evaluation by British educators of textbook publishing during the conversion period.

The writer relied heavily on the comments made by the two representatives from the publishing establishments for the description here.

The publishing companies were also faced with the lack of government direction and uncertainty that existed about metrication in England. This meant that the companies had to anticipate the trends of metrication. This created difficulties in terms of making decisions about what to publish as

well as when to make the change. Because the dates of the changeover in the educational field were not clearly specified in advance, an over supply of non-metric texts occurred in several instances. The market for textbooks dropped to zero for those non-metric books when the decision was made to go metric. For example, when Examination Boards suddenly made the decision to go fully into SI units the bottom fell out of the sales of non-SI books. Because of the lack of advance guidelines, the problem of large amounts of old stock became inevitable. If dates are established well in advance then the publishers can prepare for this change without being caught with an excessive number of non-saleable textbooks. Often the publishing companies found that a great deal of guess work had to be taken into consideration when making decisions about re-publication, revision, or producing new publications. Heinemann Educational Books Limited assumed quite early in the changeover that Britain would go metric and made its publishing decisions based on this assumption.

Another area of concern for publishing companies initially was to try to decide what it meant when a certain program or subject was to go metric. There was some question of whether this meant following SI units completely or whether certain deviations could be made. An example was given where a publishing company decided to publish an Engineering and Science book. In this book a compromise was made between the existing metric system and the SI units. The publisher indicated that they learned a major lesson from

this experience because of the feedback from educators and inspectors which was a "terrific negative response."[1] They had never experienced anything like this before because the book did not satisfy either the existing metric advocates nor the SI advocates. The publisher indicated that this book never sold and that it really was a total write-off as far as sales were concerned. The conclusion and decision that this company made, largely based on this experience, was that <u>all</u> books which were to be written, re-written or revised would follow as closely as possible the SI units. Also, in elementary mathematics the question of which units of length to use became an issue. Should the decimetre and centimetre be introduced even though they are not preferred SI units? The decision[2] in England was to use the centimetre and the 10-centimetre length and not the decimetre.

A third area of concern for publishing companies existed in deciding whether to publish a book which was totally metric or a compromise with the imperial system. The compromise would include the imperial unit in brackets after each metric measurement. The experience gained from compromising a metric textbook with the imperial units was two-fold.

1. Economically it meant that the textbook would require revision shortly to eliminate the imperial unit and therefore increase the cost of production.

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[1]Quote from publisher.

[2]At least in some schools.

2. It was found that the readers were not relating to the metric units but were simply ignoring them and relating to the familiar imperial units which followed the metric units. The book was not accomplishing the objective of causing the reader to "think metric." In fact, the reader was not paying much attention to the metric units at all.

As a result, at least two publishing companies decided early in the changeover to publish totally metric SI books, and not use the dual system. A conversion table at the end of the book was included as reference material. The above policy, however, has created difficulty in publishing geography textbooks because the government has delayed indefinitely the change of miles to kilometres. It is difficult to justify using the kilometre in geography books if the teacher and student will not be concerned with kilometres outside the school. It is presently easy to find within a secondary geography textbook numerous inconsistencies such as; temperature recorded in degree Celsius, precipitation recorded in inches, mass recorded in kilograms, distance recorded in miles, and elevation recorded in metres. This has not been a satisfactory policy.

There is another difficulty facing the publishers of geography textbooks. Minor revision of textbooks in which the only change is the translation of imperial units to metric units is not satisfactory. This creates difficulties in terms of getting odd numbers which are too complicated for student instruction. An example is translating a Fahrenheit isotherm of 0°F into -17.8°C, a number which is not nearly as easy to remember. What is necessary is not

just a direct translation but an actual re-drawing of the isotherm so that the isotherm would read -20°C or -15°C. Similar examples can be given with isoyhets, contour lines, elevations, climatic graphs, etc. What this in effect means is that geography texts will have to undergo a major revision or perhaps even be re-written.

ii. Suggested guidelines and recommendations for publishing textbooks during the conversion period.

The publishers interviewed were asked to suggest guidelines and recommendations for publishers in Canada. Teachers were also asked to comment critically on metric textbooks they had used or were using and to suggest improvements. Their responses follow, and even though they are not direct quotations they are very close to verbatim.

1. "Without a doubt the right policy in publishing textbooks is a complete change to SI units . . . no reference to imperial units should be made except perhaps in tables. From a publishing point of view no dual reference should be made at all - I'm convinced! Change to SI units completely. Using two different systems creates more problems than it solves. . . . the metric system will not be advanced in a textbook which converts metric units of measurement to imperial units . . . my feeling is that we are intellectually lazy and if we are presented with the new and the old, side by side, we will stick with the old."

2. "From a commercial point of view, compromising other measurement units for SI units is the worst possible solution in publication. Compromise does not impress the people who are in favour of metrication nor does it satisfy the others. . . . in terms of expense you might as well go 'whole hog' instead of doing it twice within a short period of time. Standard publishing procedure should be 'all metric' and 'all SI units'."

3. "Give precise details of what is to be done in books . . . what does metrication mean in each subject. For example, the publisher should know

what the policy will be for primary grades in terms of the use of the millimetre, centimetre, and decimetre. . . . carefully spell out for the publisher what the implications are for going metric within each subject."

4. "Directives must be given to publishing companies as early as possible to turn out books using metric measurements. . . . they require a lead time, which also helps to eliminate an over stock of non-metric books."

5. "General books on metrication must be written early; well before the actual change because the sales go down to zero after the change occurs."

6. "In courses like geography, translation is not satisfactory. The isotherm cannot just be literally translated from °F to °C but must actually be re-drawn and a round number used. Also, in geography a textbook which is partly metric and partly imperial is not satisfactory."

7. "I would encourage the use of a standard metric symbol to be used on each metric textbook or on each textbook that has been revised."

D. Teaching Techniques Used in Britain to Introduce and Teach the Metric System in the Classroom

i. Description and evaluation by educators of teaching approaches used in Britain.

In 1972 the Metrication Board's Steering Committee for Education and Industrial Training produced a leaflet "A Guide for Schools"[1] and commissioned a video tape entitled "Learning Metric"[2] from the Audio-Visual Centre of the University of Hull. The video tape, of which there is a 16 mm black/white film version, shows teachers of primary

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[1]Metrication Board, A Guide for Schools, leaflet MG4, (London: Metrication Board, n.d.)

[2]Film: Learning Metric, (Central Film Library, Government Building, Bromyard Avenue, London W3 7JB).

school children how they might introduce the concept of measurement using standard metric units. The video tape shows a student oriented activity approach to teaching the metric system. Children are shown actually measuring lengths, masses, and volumes using various types of metric measuring devices.

No teaching material as such has been produced by the Metrication Board, although its leaflets on SI units, produced primarily for industry, have been drawn upon by educational establishments as valuable aids to classwork.

In the area of teaching techniques in the infant and junior schools, the writer is relying heavily on the information received from the Headmistress and several staff members of an infant and junior school, as well as the information received from interviewing an Inspector of schools from the Department of Education and Science.

The initiative of implementing the metric system in the infant and junior schools has been the responsibility of the mathematics teacher within the mathematics program. The teachers interviewed in the infant and junior school felt very confident teaching the metric system <u>now</u> because they had done it for several years and they now had sufficient textbooks and equipment. However, they all expressed the concerns they had encountered when it was first introduced and the initial textbooks were vague and not too well organized. Also there was a shortage of equipment, as well as some that was not very satisfactory. For example,

they had a graduated commercial litre container which in fact held only slightly over 900 millilitres. Government legislation has since been passed to set specific standards for metric equipment suppliers.[1]

The teachers in each classroom emphasized the student activity oriented approach to teaching the metric system. The classrooms all had numerous metre sticks, tapes, metric mass weights, scales, balances, and metric graduated containers. The teachers all felt that the actual measurement involving the children was the most effective method of teaching the metric system. They also all discouraged the use of conversion from metric units to imperial units or vice-versa. They strongly encouraged teaching the metric system only, even if the world outside the school was still using imperial units. Imperial units in this school received very little emphasis and were mentioned simply for historical reasons. The teachers reported no obvious difficulty with the fact that children were learning the metric system in the school and then living in a largely imperial world after school. The textbooks and work cards in mathematics were all totally metric with little or no reference to imperial units.

In this school it was decided to emphasize the

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[1]Under the guidance of the British Standards Institution, recommendations were drawn up regarding safety, accuracy, and mathematical soundness of desirable forms of equipment. This was followed by legislation.

centimetre and 10-centimetre lengths in the earlier grades because the millimetre was found to be too small a unit and the metre too large a unit for children to work with. Similarily, the 100-gram mass weight and the 500-gram mass weight received emphasis over the gram and the kilogram in early grades. In volume measurement the litre, 500-millilitre and 100-millilitre units received the emphasis. The other units were used as the children became older. The above decisions, however, were made within this school and were not necessarily followed in other schools. The teaching process in this school with regard to the metric system emphasized the "think metric" concept. The children and teachers were now having very little difficulty with the metric system.

In the high school, with the exception of the science and mathematics programs, which are now metric because the national exams have been metric since 1970 and 1972 respectively, the majority of teachers[1] have not really faced the issue of how to teach the metric system. The teachers are in the position of having to learn the system themselves because they are now getting students who have been instructed in the metric units for several years and hence know the system. Therefore, the teachers are not faced with the issue of having to teach it as much as

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[1]Excludes home economics teachers, industrial arts teachers, physical education teachers, and business teachers.

having to learn it. The writer was not, therefore, able to get much information on teaching the metric system in the non-mathematics area, because in England the mathematics teacher has the responsibility of teaching the metric system.

In Manitoba, however, the majority of high school teachers will be involved in teaching certain aspects of the metric system initially, because the plan of implementation is different. This aspect will be dealt with in Chapter IV.

A number of publications have helped teachers of science and mathematics to teach the SI units. In science, for example, the following pamphlets were published:[1]

1. SI Units, Signs, Symbols, and Abbreviations: For Use in School Science.
2. Metrication and Domestic Science.
3. An Introduction to SI Units for Scientists and Technologists.

There is also one publication in mathematics:

1. Introduction of SI Units in School.

However, no similar publications are available in the field of geography.

In geography the teachers were changing to the metric units only when they came across these units in the textbook. At the time of writing, the geography teachers had not really worked out any clear cut guidelines for teaching the metric system. As has been indicated earlier, they were not satisfied with the approach taken in England with regard to

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[1]See Bibliography p. 130.

metrication. However, they were prepared to suggest guidelines for teaching the metric system which are developed in the next section.

From the interviews, the writer concluded that the teaching techniques for introducing the metric system in the infant and junior classroom developed after a year or two of introduction. The dominant elements which prevailed were:

1. The emphasis on student oriented activities for teaching the metric system.
2. The "think metric" concept.
3. The absence of teaching any conversion from the metric to the imperial or vice-versa.

In the high school, this whole area is rather weak except where science and mathematics are concerned. Teaching techniques have not really been developed here.

ii. Suggested guidelines and recommendations to introduce and teach the metric system in the classroom.

The educators interviewed were asked to suggest guidelines and recommendations for introducing and teaching the metric system in the classroom. These are indicated below and are not necessarily word for word as recorded. However, an attempt was made to portray the idea as closely as possible.

1. "In primary grades I would strongly recommend the student oriented activity approach for introducing and teaching the metric system. I think this is by far the best method. Get the children involved in actual measurement."
2. "The policy of not converting from metric to imperial and vice-versa should be strongly encouraged."

3. "Select only those textbooks which strongly encourage the 'think metric' concept and which are student activity oriented. I would recommend that you do not use textbooks which encourage conversion."

4. "When you introduce the metric system of units be sure you have adequate and sufficient equipment available for the children to use. Initially we improvised some measuring devices."

5. "Check carefully that the equipment purchased meets the standards you anticipate. (Government legislation may be necessary here)- In England the equipment which meets a certain standard has a symbol[1] on it. . . . this has helped a great deal."

6. "In the primary grades we have found that emphasizing the centimetre length, 10-centimetre length, 100-gram mass weight, 500-gram mass weight, 100-millilitre volume, 500-millilitre volume has been an advantage."

7. "In high school geography select those textbooks which have been newly written or re-written as opposed to those that have just had the imperial units translated to metric. Also select those books which are completely metric as opposed to those which are partly metric and partly imperial."

8. "In geography I would encourage many practical activities relating to temperature, precipitation, elevation, land area (hectare), mass, etc., in order to give students and teachers a sense of feeling and judgement for the metric units."

9. "Be sure that your teachers, both in the primary and in the high school, understand the SI units in terms of rules and symbols so that these are taught correctly from the beginning and re-teaching will not be necessary."

10. "Introduce the metric system into a school systematically so that each teacher knows the general implications for the other teachers as well as the specific implications for himself."

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[1] A key picturing a Union Jack.

VII. CONCLUSIONS

The writer's conclusions and recommendations of the experience in England will be developed in Chapter V.

VIII. SUMMARY

This chapter briefly outlined the educational system in England and described the initial stages in the change to the metric system there. The procedure for arranging interviews was outlined and a brief autobiography of the educators interviewed was given. This was followed by a description of the procedure for recording and analysing the interviews. The final and major part of this chapter outlined the information obtained from the interviews in England under the following four broad categories: implementation procedures; teacher in-service; textbook publishing; and teaching techniques.

Chapter IV outlines the writer's involvement on the Department of Education Committee to Study and Introduce the Metric System in Manitoba Schools.

CHAPTER FOUR

A SUMMARY OF METRIC DEVELOPMENTS IN MANITOBA EDUCATION

I. ORGANIZATION OF THE COMMITTEE TO STUDY AND INTRODUCE THE METRIC SYSTEM IN MANITOBA SCHOOLS

With the passage of the White Paper on metric conversion in Canada in January 1970, the movement was begun to implement the metric system in Canada. Because the field of education would be very directly involved in the whole metrication process, the Curriculum Branch of the Department of Education initiated and organized a Committee to Study and Introduce the Metric System in Manitoba Schools in the summer of 1971. Membership[1] and the frame of reference for the Committee were developed in Chapter I of this paper.[2]

II. ACTIVITIES OF THE COMMITTEE TO STUDY AND INTRODUCE THE METRIC SYSTEM IN MANITOBA SCHOOLS

Since the first meeting of the Committee in September 1971, the Committee has met for a total of twenty-one full

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[1]For list of membership on the Committee see Appendix E, p. 143.

[2]See Chapter I, p. 4.

day meetings.[1] Also, various members of the Committee have offered fourteen half day[2] experimental workshops during the development of an adult education program as well as numerous half day workshops once the program had been developed. Various members of the Committee have completed eight two day regional in-services[3] for training resource teachers within the province.

One of the initial tasks undertaken by the Committee was to review and report on articles written about metrication; these are listed in Appendix F.[4] From the reports given by Committee members the following points were noted:[5]

> "The degree of teacher in-service should be quite extensive. This in-service should stress pragmatic involvement and activity on the part of teachers in order to develop the ability to think metrically."
>
> "In presenting the metric system to children the methods should be activity oriented so that the students are actively engaged with manipulative materials."
>
> "The notion of conversion from one system to another should be discouraged as far as teaching is concerned. This tends to confuse rather than elucidate."

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[1]The writer has attended all of these meetings.

[2]The writer has been involved in ten half day experimental workshops as well as numerous workshops after the program was completed.

[3]The writer has been involved in five regional in-services.

[4]See Appendix F, p. 145.

[5]Minutes of the Committee to Study and Introduce the Metric System in Manitoba Schools, October 20, 1971, p. 1.

The Committee also reviewed video tapes on measurement produced by Schools Broadcasts of the Department of Education[1] and several films[2] from various organizations to give members an insight into the problems encountered during the metric transition.

In one of its early meetings the Committee also set up as its intermediate goal the study and recording of information required for the development of an adult education program. This goal incorporated the first and last of the criteria[3] outlined earlier and provided an opportunity for acquiring relevant information for the development and implementation of such a program. Several presentations helped the Committee in formulating guidelines for an adult education program. These presentations are indicated below:

1. Two leading members involved in giving direction for the changeover to the metric system of the Manitoba hospitals.
2. The Chairman of the Metric Task Force for the Department of Education of Ontario.
3. The Chairman of the Metric Commission of Canada.

As well as hearing the above presentations the Committee was in correspondence with the Metrication Board in Britain and the British Information Services. It was from the background

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[1]For list of video tapes reviewed see Appendix G, p. 147.

[2]For list of films viewed see Appendix H, p. 148.

[3]For list of criteria see Chapter I, p. 4.

of reviewing literature, hearing presentations, reading correspondence, and viewing video tapes and films that the Committee began developing an adult education program entitled, Introduction to the Metric System.[1] In conjunction with the above, the Committee also began developing a videotape "Why Go Metric?"[2] which has since been completed. As well as the above, the Committee published an article in the Curriculum Bulletin[3] entitled "Think Metric Now" to introduce educators to the forthcoming change.

In developing the adult education program, several important decisions were made which acted as guidelines:

1. The program should be developed for adults in general and not specifically for teachers.

2. The approach incorporated in the program would be a workshop which would be mainly participant oriented.[4]

3. The content of the workshop would be limited to introductory material and would emphasize four areas:

   a. length measurement
   b. mass measurement
   c. capacity (volume) measurement
   d. temperature measurement; and

   with a supplementary section concerning itself with:

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[1]Committee for the Study and Introduction of the Metric System in Manitoba Schools, Introduction to the Metric System, (Manitoba: Department of Education, 1973).

[2]Video Tape, Why Go Metric? (Manitoba: School Broadcasts Branch, 1973).

[3]John R. Lohrenz, "Think Metric Now", Curriculum Bulletin, vol. 6, no. 4, (June 1972), pp. 10-14.

[4]Workshop participants limited to approximately 30.

a. area and volume measurement
b. interrelationship of length, mass, and capacity units.

4. The time required to complete the introductory workshop would be a session of not more than three hours.[1]

5. The program would be written in its final form only after sufficient experimental workshops would be held to refine, re-write, and evaluate the program.[2]

6. The description of the workshop would be in a booklet which would also include relevant material[3] about the metric system. The booklet would be given to each participant doing the workshop.

The introductory activities for the metric workshop have been included in Appendix I.[4] The booklet[5][6] is available from the Department of Education, Winnipeg, Manitoba.

With the completion of writing the adult education program, the Committee began investigating the problem of

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[1]The Committee decided that it would be practical to limit the workshop session to under three hours so that it could be used either in a morning session, afternoon session or as evening session.

[2]Experimental workshops were held at Thompson, University of Manitoba, University of Winnipeg, and at approximately ten schools in Winnipeg. Included were teachers, other professional people and parents. Their comments were considered in developing the program.

[3]Reasons for going metric, prefixes, rules, definitions, history, list of available video tapes and films, references, etc.

[4]See Appendix I, p. 149.

[5]Committee for the Study and Introduction of the Metric System in Manitoba Schools, Introduction to the Metric System, (Manitoba: Department of Education, 1973).

[6]The writer compiled and wrote the original manuscript as well as each revised one after review and modification.

implementation of the metric system in Manitoba Schools. This aspect involved two things:

1. Teacher in-service; and
2. Recommendations regarding implementation.[1]

With regard to teacher in-service the Committee made the following recommendation[2] to the Department of Education:

> "That in-service sessions be held in the fall of 1973 in the five inspectorial regions.[3] These sessions would be of at least two day duration. The trained resource people would be responsible for carrying on metric workshops for the teachers in their respective divisions."

The above recommendation was accepted by the Department of Education and the Committee then informed the Superintendents of Schools of the initial implementation procedures. Included in the correspondence to the Superintendents of Schools[4] was the following information:

Stage One of Implementation

> "During stage one, workshops will be conducted to train teams of teachers from each School Division to act as resource personnel in their division." (This initial stage could be completed by the end of 1973 or early 1974).

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[1]The Federal and Provincial governments have not yet allocated any funds to implement planned metrication programs nor have they officially set any dates for implementation in the field of education. (January 1974).

[2]Minutes of the Committee to Study and Introduce the Metric System in Manitoba Schools, April 24, 1973, p. 2.

[3]An inspectorial region includes about ten school divisions.

[4]Letter to Superintendents of Schools dated June 21, 1973, from the Chairman of the Committee. See Appendix J, p. 184.

Stage Two of Implementation

> "The teams trained during the initial stage would act as resource personnel for the training of teachers within their School Division. Completion of this phase is tentatively suggested for June of 1975."

Included in the communique was the following statement:

> "A two day in-service for a team of three teachers from each School Division would be held in each inspectorial region in the fall and winter of 1973. Representatives from each of the areas of Grades one to six, seven to nine, and ten to twelve would likely be an advantage. This approach would serve to distribute the load in terms of introducing the system to teachers in the Division. Dependent upon their needs, School Divisions may wish to send a single representative."

The training of resource teachers in each School Division has been completed by the Committee. Two day regional in-services have been held at the following centres: Dauphin, Brandon, Carman, Transcona, Winnipeg (3 sessions), and Cranberry Portage. A total of almost two hundred teachers have attended the two day in-services with representatives from all but one of Manitoba's School Divisions.[1] A detailed outline for the two day in-service is included in Appendix K.[2]

Each of the agenda items in the two day in-service was evaluated by each participant on the basis of a numerical value of 1 2 3 4 5 with 5 being the highest rating.[3] Each participant was also given an opportunity

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[1]No explanation why one School Division did not send representatives.

[2]See Appendix K, p. 188.

[3]See Appendix L, p. 194.

to comment critically on each agenda presentation. This evaluation was used as a guide by the Committee for modifying and revising further in-services. The agenda items were planned around the workshop activities as found in the program, Introduction to the Metric System and included in Appendix I.[1] Because the main purpose for evaluating each agenda presentation was to help the Committee in analysing its own work for future in-service programs, the writer will not comment on this aspect of the in-service any more except to say that the workshop activities scored between 4 and 5 at each regional in-service. The workshop was the highlight of each in-service and numerous comments both verbally and written were made about this aspect of the in-service. The following are comments which were recorded on the evaluation sheets by participants at the regional in-services on the metric workshop activities:[2]

> "... very good, enjoyed working with metric units, hands on approach very good, very valuable in helping a person get an exact idea of the nature and size of metric units, enjoyed this part most, excellent, right approach, very valuable way to get acquainted with the system, exceptionally good, the only way to get into the metric system, useful and informative, hands on method is excellent, practical, interesting, a good type of workshop, very useful, manipulations at the tables were very helpful, very enlightening, informative and a good way to get going. . . ."

The Committee has also been active in preparing recommendations for continuing the implementation of the metric

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[1] See Appendix I, p. 149.

[2] The evaluation sheets are available from the writer.

system in the schools. A difficulty exists here because neither the Federal nor the Provincial governments have allocated any funds to implement metrication programs nor has the Federal government established specific target dates for the implementation of the metric system into the educational field. Federal and Provincial governments are negotiating[1] the financial arrangements and thereby defining responsibilities. As a result, statements of recommendation have a limited value until the above issues have been clarified. However, the following recommendations have been made by the Committee:

1. To Curriculum Committees of Department of Education.[2]

> "That the various curriculum committees be informed now about the state of metrication developments and that their work has to begin now in preparing suitable teaching materials for the students."

This recommendation has been acted upon by at least one committee,[3] the Mathematics Curriculum Committee, which has begun to revise the curriculum from K-6, introducing the metric units wherever applicable. This revised curriculum is to be available to schools by the fall of 1974.

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[1]From interview held with the Chairman of the Curriculum Committee of the Council of Ministers of Education, February 11, 1974.

[2]Minutes of the Committee to Study and Introduce the Metric System in Manitoba Schools, April 24, 1973, p. 4.

[3]The Home Economics Consultant, the Physical Education Consultant, and the Industrial Arts and Vocational Consultant are also active in introducing the metric units in their respective programs.

2. To the Curriculum Branch.[1]

"That key personnel from groups such as:

a. Superintendents Association;
b. Manitoba Teachers' Society;
c. Manitoba Association of School Trustees;
d. Vocational Industrial Training Association;
e. Business Educational Training Association;
f. Manitoba Industrial Arts Association; and
g. Other similar associations,

be called together for a briefing about the operational plan. Their suggestions and support would be welcome."

This recommendation has not been acted upon, largely because the Federal government has not yet officially established target dates for implementation within the educational system.

The Committee also drew up a proposal concerning phases for and costs of implementation of the metric system into Manitoba Schools. This proposal[2] was presented to the Council of Ministers of Education[3] in January 1974 for consideration. Proposals from several other provinces were also presented.

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[1]Minutes of the Committee for the Study and Introduction of the Metric System in Manitoba Schools, April 24, 1973, p. 4.

[2]Proposal is included in Appendix M, p. 196.

[3]Council of Ministers - A charter organization of the Ministers of Education of the provinces of Canada who meet periodically to discuss mutual problems facing the educational systems of the provinces. The Council is presently establishing a Metric Task Force to give direction for uniformity in pertinent areas relating to metrication as it affects the education system. Terms of reference have not been fully spelled out as yet. (January 1974).

As can be seen from the proposal,[1] three implementation phases have been indicated, beginning with 1974 and concluding with 1979, by which time the educational system should be more or less completely metric.

The above proposal, or a revised version of it, can be acted upon only when the Federal and Provincial governments have indicated target dates for implementation; until then, everything remains tentative. The Committee is waiting for a decision from the Council of Ministers with regard to the proposal as well as specific dates[2] for implementation from the Federal government. Before much further action can be taken, a climate for the change to the metric system must be established. This responsibility rests with the Federal government.

III. CONCLUDING OBSERVATIONS, ASSUMPTIONS AND DECISIONS OF THE COMMITTEE FOR THE STUDY AND INTRODUCTION OF THE METRIC SYSTEM IN MANITOBA SCHOOLS

A. The Federal Scene

There appears to be minimal indication from the Metric Commission in the field of education[3] that Canada is involved in metric conversion. Both the Federal and Provincial governments appear to be withholding the

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[1] See Appendix M, p. 196.

[2] Specific dates should be forthcoming shortly.

[3] Probably because education is a provincial responsibility.

initiative to act because of the fear that the first one to make a move will be responsible for the costs. Provinces are reluctant to make the first move because they will then be legitimate targets for School Boards in terms of finances.

There are presently perhaps three categories into which the provinces can be placed in terms of metric activity in the field of education:

i. Extensive activity - Ontario, Manitoba, Nova Scotia.

ii. Some activity - British Columbia, Alberta, Quebec.

iii. Minimal activity - others.

There is quite a range of metric activity in the field of education among the provinces of Canada; from those which have been active for over two years, to those who have done nothing at all or very little.

The concern of the Committee in this area is for the establishment of target dates by the Federal government. The Metric Commission, which is more of a coordinating body than a policy making body, has published some general target dates for implementation, but the Federal government has not yet publicly sanctioned them. Until the Federal government makes a definite decision, the Departments of Education in the different provinces, with some exceptions, are not likely to initiate a metric changeover very rapidly. To this point in time it does not appear to be a priority item for many Ministers of Education. Even though the Metric Commission has published target dates which have gone to the

Steering Committees, and from there to national organizations and committees, it appears to the Committee that the organizational network which has been set up by the Metric Commission to provide information is not serving that function adequately at the present.

The provinces are still in the process of negotiating the cost-sharing procedure to be used for implementing the metric system in the educational field. There appears to be little breakthrough from the position "to let costs fall where they occur." Currently, the Metric Commission is attempting to get a timetable of conversion accepted by the Council of Ministers of Education.[1] However, there appears to be an attitude of reluctance on the part of several provinces.[2] This attitude could change, though, with the present developments occuring in the United States.[3] The Metric Task Force of the Councils of Ministers is involved in:

i. Preparing a "Style Guide" which is an extension from the Metric Practice Guide,[4] of that

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[1]Perhaps an attempt to get those provinces with minimal metric activity in the field of education to begin initiating a plan for metric conversion.

[2]An attitude which appears to have changed insignificantly during the last six months.

[3]Part of the reluctance of the Ministers of Education perhaps stems from the uncertainty of metric conversion in the United States. However, this is changing rapidly with over eighty large firms, including IBM, General Motors, and Ford committed to go metric.

[4]Canadian Standards Association, Metric Practice Guide, (Rexdale, Ontario: Canadian Standards Association, 1973).

information which is appropriate to schools. This will also form a standard guide for publishers throughout Canada.

ii. Establishing a timetable with reference to metric conversion for the Canadian School System.

In summarizing the Federal scene in terms of education and metric conversion there may well be some truth in a statement made by a member of the Committee, "Somebody is waiting for somebody to tell somebody something."

B. The Provincial Scene

Until there are fixed committments on the part of the Federal government it appears that the position of the Department of Education within Manitoba is to make it possible for schools to do those things in the field of metric conversion which do not involve heavy finances. It is a policy of doing things "cautiously" without pushing metrication and without a great amount of financial committment.

The Committee for the Study and Introduction of the Metric System in Manitoba Schools met on February 26, 1974 to review its involvement during the past two and one-half years as well as to try to anticipate future developments. The Committee is now in a position where it has more or less fulfilled the function[1] for which it was established in 1971. For it to continue to function under its present

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[1]With the exception of general adult education. The Metric Commission has accepted this responsibility.

format, further direction from the Department of Education was required.

Before a discussion on new direction was begun several assumptions were made about some of the future developments:

i. That beginning in September 1974, some schools will be teaching the metric system, especially in the primary levels. Implications for elementary levels, junior high schools, and secondary schools need to be studied and appropriate action taken.

ii. That events will likely occur much faster during the next two years than they did in the preceeding two years. This would include a rapid acceleration of problems, such as an innundation of American metric materials on the Canadian market. These may not correspond to the standards set in Canada with regard to symbols, spelling, rules, etc.

iii. That a great amount of work in planning, in-service, and implementation will be required during the next two years in specialized areas, such as technical, vocational, industrial and business training, home economics as well as mathematics, science, and the social sciences. There is a need to identify specific groups and their specific problems and take appropriate action.

From these assumptions arose several important decisions:

1. Planning for implementation within the educational system must continue. This planning could probably be best done by small representative specialist groups,[1] from which a Steering Committee should evolve.[2] This means that the Committee for the Study and Introduction of the Metric System in Manitoba Schools will no longer exist under its present structure.[3]

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[1]These specialist groups need to be identified.

[2]Representatives on these specialist groups should include personnel from rural areas as well as from the cities.

[3]As of next meeting.

2. Three members of the Committee were elected to rework the Proposal Concerning Phases for and Costs of Implementation of the Metric System in Manitoba Schools[1] in such a way that the basic policy direction be shifted from a position of "tentative," "should," and "will occur," to one of "specific action" which includes target dates. The revised proposal is then to be presented for approval to the Minister of Education. The "specific action" implies "pushing" metric conversion in a planned and organized manner, which includes a financial committment. A suggestion was made that activities in 1974 be on a voluntary basis and that in 1975 activities become compulsory.[2]

3. That the principle established in industry where "committment from top management must be obtained first" should be adopted in the field of education also. This would include committments for metric conversion from; the Minister of Education, the Manitoba Association of School Trustees, the Superintendents Association, and the Principals Association.

4. To send a communique[3] to the Superintendent of Schools in each School Division requesting:

   a. What has been done within the School Division with regard to teacher metric in-service since the Regional In-Service meetings.

   b. An indication of how well the principle of the Resource Team is working within the Division.

5. That the policy of having all teachers in the province attend a metric in-service equivalent to at least the Workshop experience be continued. That this in-service be completed no later than June 1975.

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[1]See Appendix M, p. 196.

[2]By 1975 the Metric Task Force will likely have established a timetable which will probably be quite similar to the one drawn up by the Committee.

[3]For information to the Committee for further action if necessary.

6. That a serious attempt be made to coordinate the in-service of secondary industrial arts teachers with the in-service of instructors at the Community Colleges wherever feasible.

7. That some form of communication be established with the resource teachers in each School Division and the newly formed Steering Committee.

In summary, the provincial scene is one in which a more active policy is being sought and one in which the Committee for the Study and Introduction of the Metric System in Manitoba Schools has completed its assignment and a new structure will continue the process of metric conversion in Manitoba schools.

IV. SUMMARY

Chapter IV summarized the metric developments within the educational field in Manitoba. It outlined the organization, activities, concluding observations, assumptions, and decisions of the Committee for the Study and Introduction of the Metric System in Manitoba Schools from September 1971 to February 1974.

The next chapter draws conclusions and outlines recommendations evolving from the study.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDED GUIDELINES DRAWN FROM THE STUDY FOR IMPLEMENTATION, TEACHER IN-SERVICE, PUBLISHING AND SELECTING TEXTBOOKS, AND INSTRUCTIONAL APPROACHES DURING METRIC CONVERSION IN SCHOOLS

I. DESCRIPTION OF THE PROCEDURE FOR DRAWING CONCLUSIONS AND RECOMMENDATIONS

This chapter draws conclusions and outlines recommendations <u>for educators involved with schools in general</u>[1] and <u>for geography teachers in particular</u> from the study outlined in the previous chapters. For clarification purposes, this chapter has been organized into the following four broad sections:

A. Implementation of the metric system in schools.

B. Teacher in-service for preparation in teaching the metric system.

C. Publishing and selecting textbooks during the changeover period.

D. Instructional approaches for teaching the metric system.

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[1] Steering Committee on Education, Provincial Departments of Education, School Superintendents, School Trustees, School Administrators, Teachers' Organizations, Teacher Training Institutes, Textbook Publishers, etc.

Within each section the writer will draw conclusions from the study described in Chapters II to IV and recommend guidelines to be followed by educators in general as well as guidelines to be followed by geography teachers in particular.

II. IMPLEMENTATION OF THE METRIC SYSTEM IN SCHOOLS

A. Conclusions on Implementation

The British experience described in Chapter III gives evidence that to bring about a change as major as that of completely changing one system of measurement for another throughout the educational system; a change which will involve everyone, a well defined policy and committment by senior governments is a necessity. The direction must come from government; in Canada first from the Federal Government and secondly from the Provincial Governments. The policy on the part of senior governments must be well planned, well directed, specific, and well publicized. It is not sufficient to have the Metric Commission set up guidelines and target dates if the Federal Government fails to openly and publicly declare its support to those guidelines and target dates. After the Federal Government has publicly announced its policy, including the target dates, the Department of Education in each province can and should establish a metric conversion policy in context with the Federal policy. This policy should then also be made public. There should be as little confusion as possible

in the minds of educators what in fact the policies of the Federal and Provincial Governments are. It is only after the policies of senior governments are established and publicized that support and committment on the part of School Superintendents, School Trustees, School Administrators, Parent Teacher Associations, and Teachers can be counted on. Without this direction the process of metric conversion will likely occur haphazardly, half-heartedly, and in a piecemeal and uncertain way.[1]

In Canada there appears to be minimal indication from the Federal Government in the field of education that metric conversion is almost upon the scene. A timetable of metric conversion within the field of education, has not yet been openly publicized by the Federal Government.[2] Hence, the Departments of Education in several provinces have not yet considered metric conversion a priority and have, therefore, not initiated a policy to promote the changeover. In Canada an awkward situation has occured where several provincial Departments of Education have been reluctant to make a committment until a clearly stated policy has been issued by the Federal Government. The incentive on the

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[1] England experienced a lack of direction and government leadership and as a result an uncertainty about the whole process of metric adoption was evident throughout the field of education.

[2] The Metric Commission has published target dates but these have not been openly reacted to by the Federal Government. It has not been made public if these dates are or are not Federal Government policy.

part of Provincial Departments of Education to initiate an active policy of metric conversion has been lacking.

Another conclusion to be drawn from the study in Chapters II to IV is that there is a need to identify as early as possible the implications of metric conversion in each subject area so that necessary plans can be established by publishers, curriculum committees, in-service personnel, teacher training institutes, administrators, and teachers. Together with the identification of such implications there is a need to establish early in the process of conversion, a metric guide, for all educators, including publishers, of accepted practices with reference to metric symbols, rules, spellings, terms, etc., to be used in the field of education. This guide could include directives such as the "think metric" concept which should be encouraged throughout the field of education. The guide could also include instructional approaches [1] to introduce the metric system in the schools.

The field of geography need not be separated from the other subject areas at this stage of implementation. Teachers of geography, however, should be made aware of the implications resulting from metric conversion. These implications have been outlined in Chapter I in the section[2] "Specific Implications for Geography Teachers During Metric

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[1] Guidelines

[2] See Chapter I, p. 9.

Conversion." It is very necessary that geography teachers be fully aware and understand the metric system itself and also realize the importance of the change that will take place in the field of geography when the conversion to the metric system occurs.

B. Recommended Guidelines on Implementation

The following recommended guidelines, for implementing the metric system in schools, have been developed from the study described in Chapters Two to Four.

1. That the Federal Government be requested to produce and announce a comprehensive program (including target dates) of metric conversion in the field of education[1] immediately. Basically, this would be a timetable to let the public know what is planned and thereby also establish a "climate for metric conversion."[2]

2. That the Federal Government be requested to establish a national organization (or use an existing one) whose responsibility it is to publish a guide which outlines acceptable symbols, spellings, rules, practices, within the field of education as well as the implications that the metric conversion will have in specific subject fields. This publication should include directives to publishing

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[1]This could be done through a general statement which includes education.

[2]Expenses will increase greatly if the change to the metric system is made suddenly. Several years will be required to change textbooks if the cost is to be kept to a minimal.

companies (think metric concept) as well as guidelines for teaching the metric system.

3. That the Provincial Departments of Education be requested to establish a policy for metric conversion and set up machinery to implement it. Teachers should be included in the deliberations.

4. That precise details be given to publishers of what is to be done in textbooks. Identify what metric conversion means in each subject area. For example, the publisher should know what the policy will be for the primary grades in terms of the use of the millimetre, centimetre, and decimetre. These directives must be given to publishing companies as early as possible so that suitable materials will be on the market when the changeover is made in the classroom. Issue guidelines to authors and editors concerning the accepted SI usage and establish a clearing-house for advice to authors, editors, and others, to answer questions immediately or to secure authoritative opinion on short notice. Urge authors, editors, and publishers to make <u>suitable</u> metric materials available as soon as possible.

5. That School Boards and other textbook purchasers be requested to rearrange their schedules of new book purchases in order to be able to place metric books in the hands of students as soon as possible; and in particular not to supplant currently held textbooks other than with metric ones.

6. That curriculum planners be requested to take the

opportunity to revise current approaches to teaching measurement, especially in the elementary mathematics area, by making curriculum reforms at the same time that the implementation of the metric system occurs.

7. That professional organizations related to education be requested to:

a. introduce an active publicity campaign by encouraging papers and discussions on metrication at conventions, regional, and local meetings;

b. issue pamphlets and other short pieces of literature for teachers concerning the educational implications of the introduction of the metric system; and

c. promote the publication in periodicals teachers read, of articles on the proper usage of the SI system, on strategies and tactics for education in a world going metric, on criteria for judging instructional materials and equipment, and on ways teachers may improvise metric measuring devices and materials.

III. TEACHER IN-SERVICE FOR PREPARATION IN TEACHING THE METRIC SYSTEM

A. Conclusions on In-Service Programs

There is a need, evidenced from the study carried out in England,[1] for a well planned, well organized, systematic, informative, and enthusiastic in-service program for teachers if implementation of the metric system is to proceed smoothly and positively. The major reason for in-services is to overcome the stumbling blocks that exist because of a lack of understanding on the part of many teachers about

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[1]See Chapter III.

"why the metric system?" and "what is the metric system?" To "let teachers go it on their own" is too inefficient a method. An in-service that is well planned and informative can greatly facilitate learning a large amount of information[1] which may otherwise take a much longer time to learn if teachers are required to do it on their own.

Secondly, from the interviews carried out in England, and from the various reports from other educators, as well as from the experience gained in Manitoba, the writer concluded that the initial in-service should include at least a portion of the time for a participant activity oriented approach in which the actual metric measuring devices are used and actual measurements are made.[2] The participants should appreciate a sense of judgement of at least the three basic units - metre, litre, and gram, as well as an understanding of the prefixes - "kilo," "milli," and "centi" at the initial in-service.

A third conclusion stemming from the study is that <u>all teachers</u> should attend a basic in-service in which the important aspects of the metric system are presented. Because the metric conversion will affect everyone, the writer feels strongly that all teachers should be able to speak to the public about the conversion in an informed

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[1] SI units, accepted rules, spellings, symbols, etc.

[2] Example included in Appendix K, p. 188.

way. It is not just a "mathematics thing" or a "science thing" but something which includes everyone. Once all teachers have attended an initial in-service, then further consideration can be given to teachers in specialized areas who should be involved in further in-services. However, it is essential that all teachers are involved in at least a basic informative in-service on metric conversion, preferrably one which includes participant activity with actual metric measuring devices and actual measuring experiences. This would be in keeping with the "think metric" concept[1] described earlier.

Finally, from the interviews with geography teachers in England, the writer's conclusion is that geography teachers, as teachers in all other subject areas, should attend a basic in-service to get an understanding and a sense of judgement and appreciation of the metric system itself. Following this in-service, the geography teacher should be required to attend further in-services which identify specific implications for the geography teacher[2] as well as prepare him for the changes when they occur in the instructional materials.[3]

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[1]The aspect of converting from metric units to imperial units should be strongly discouraged.

[2]As described in Chapter I of this study.

[3]These in-services should be planned, organized and carried out during the next two years so that geography teachers will be fully prepared to adopt the change when instructional materials are fully metric.

B. Recommended Guidelines for In-Service Programs

The following recommended guidelines, for in-service to prepare teachers in teaching the metric system, have been developed from the study described in Chapters II to IV.

1. That in-service groups be encouraged to prepare a basic in-service[1] for all teachers which is well planned, well organized, informative, and at least in part participant activity oriented. Answers to questions such as the following should be given at the in-service.

a. Why should the metric system be adopted?

b. What is the metric system?

c. How will we go metric?

d. What are the general implications of going metric?

Guidelines in the following areas should be developed.

a. "Think metric" concept.

b. Criteria for evaluating metric instuctional materials.

2. That all teachers in specialized areas such as geography[2] be encouraged to attend more than just a basic in-service. That further in-services identify specific implications and methods to help deal with concerns specifically applicable to the specialized area. These would be designed to help the teacher cope with the changes

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[1]In a planned and orderly metric conversion the cost could be largely absorbed in existing programs of in-service.

[2]Industrial arts teachers, home economics teachers, physical education teachers, science teachers, mathematics teachers, business teachers.

when instructional materials are in fact metric.

3. In the field of teacher in-service, a central body (provincial) should be encouraged to develop programs, including the identification of problems to be faced in training elementary, secondary, and occupational teachers, the production of whatever materials may be needed, and the scheduling of workshops. A clearinghouse should be established to evaluate instructional materials, particularly films and videotapes, and to coordinate their use in schools.

4. Encourage each school to select one staff member to be the metric authority for the school. This person would be encouraged to attend metric conferences, do extra reading in this field, and generally keep the staff informed on metric developments.

IV. PUBLISHING AND SELECTING TEXTBOOKS DURING THE CONVERSION PERIOD

A. Conclusions on Publishing and Selecting Textbooks

A conclusion drawn from interviewing British textbook publishers and teachers is that if textbooks or text materials are to be used as tools for promoting metric conversion there should be no dual references.[1] A textbook using imperial units of measurement in such a way that no reference is made to imperial units.[2] For teachers, this

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[1] Both imperial units and metric units side by side.

[2] Except perhaps in a table at the back of the book.

means that they select only those metric textbooks which do not include imperial units side by side with the metric units.[1][2]

A second conclusion, arrived at from interviewing teachers using geography books not fully metric, is that when textbooks in courses such as geography are revised; translation from imperial units to metric units within the textbook is not satisfactory.[3] Isotherms, isohyets, contour lines, etc., must be re-drawn on maps. It is not sufficient simply to replace the imperial measurement with a metric equivalent. For teachers this would mean that a close check should be made when selecting a textbook to see if it is actually rewritten or merely translated.

B. Recommended Guidelines on Publishing and Selecting Textbooks

The following recommended guidelines, for publishing and selecting textbooks during the changeover period, have been developed from the study described in Chapters II to IV.

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[1]From a commercial point of view, compromising other measurement units for SI units is the worst possible solution in publication in terms of expense. It means that the book will have to be revised again in a very short time and therefore the expenses are greatly increased.

[2]It was found that the readers were not relating to the metric units but were simply ignoring them and relating to the familiar imperial units which followed the metric units.

[3]Example: 0°F to -17.8°C. This is much too unwieldy and much too difficult to learn. The line must be either drawn slightly north or south and numbered -20°C or -15°C.

1. That publishers be advised to publish textbooks without any reference[1] to imperial units and that all textbooks follow the SI units of measurement. No dual reference[2] should be published in textbooks.

2. That educators, especially teachers, be advised to select textbooks that follow the accepted SI units of measurement and that use no dual reference within the textual materials.

3. Advise publishers that textbooks in fields such as geography require a major revision or perhaps even rewriting. Direct translation from imperial units to metric units is not satisfactory in most instances. (e.g. 0°F to -17.8°C)

4. Teachers should be advised not to purchase textbooks or workbooks which emphasize conversion from imperial units to metric units or vice versa. The experience has been that these books cause more confusion than clarification.

5. Teachers be advised to select those textbooks or text materials which emphasize the "think metric" concept.

6. Teachers be advised to select those textbooks and text materials, especially in the primary and lower elementary levels, which emphasize the student activity approach to learning. During the initial years of metric conversion this could be a guideline for all levels, including adults.

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[1]Perhaps a conversion table at the back of the book.

[2]Metric and imperial units side by side.

7. School Boards be advised that if the replacement of textbooks for going metric is spread over a period of a few years then the cost could easily be absorbed in the usual replacement process.[1]

V. INSTRUCTIONAL APPROACHES FOR TEACHING THE METRIC SYSTEM

A. Conclusions and Instructional Approaches

Several conclusions can be made from the study about instructional approaches for teaching the metric system.

One conclusion is that teachers who felt successful in teaching the metric system were involved in the student activity oriented approach to teaching the metric system of measurement. There was a general feeling among teachers that involving the children in actual measurement was a very effective method of learning the metric system. Placing the emphasis on activities which caused children to "think metric" was strongly recommended. Also, teachers reported that children thoroughly enjoyed measurement activities and learned the properties of the metric system through these activities. There was a general feeling that measurement in fact could not be "taught" but that learning to measure was a gradual process related to the personal experiences of each learner. Until a learner has had the opportunity to experience in concrete, comparative terms what a gram,

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[1]Textbooks generally have a life span of four to five years. If a lead time is given then textbooks can be replaced without extra cost.

kilogram, metre, and litre are, they remain meaningless to him.

Secondly, teaching the metric system through conversion from the imperial system or vice versa promoted confusion and even dislike for the metric system.[1] Teaching the metric system by relating it to the imperial system appeared to be a very unsatisfactory method of teaching the metric system and did not cause learners to "think metric." It was strongly suggested that teachers do not try to teach the metric system through conversion problems or to teach conversion factors. The metric system must be taught as a system by itself.

A third conclusion, which in part comes from the first two, is that a careful selection of instructional materials has to be made before adoption in a classroom. Teachers should not purchase materials which encourage conversion to or from the imperial system. The materials which should be purchased are those which encourage the "think metric" concept and present the metric system as a system in itself.

In the field of geography, instructors and learners will have to go through a similar process as described for other teachers and students to become proficient with the metric system. The major change for the geography teacher will occur when geography textbooks are published in metric units. Before a geography textbook using the metric units

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[1]From interviews with teachers in England.

can be used effectively, however, both teacher and learner will have to have a sense of judgement, appreciation, and understanding of the metric units as they are used in the field of geography.[1]

B. Recommended Guidelines on Instructional Approaches

The following recommended guidelines, on instructional approaches for teaching the metric system, have been developed from the study described in Chapters II to IV.

1. That instructors be encouraged in their teaching to emphasize the learner participant activities involving the use of metric measuring devices and actual measurements using metric units. The emphasis should be on the "think metric" concept. Activity-based instruction should be the foundation for instruction of metric measurement at all levels.

2. That instructors be strongly discouraged in teaching the metric system through the use of imperial conversion or conversion problems.

3. Educators be advised to select those metric textbooks or metric instructional materials which encourage the "think metric" concept and which teach the metric system as a system in itself. Educators should be discouraged from purchasing textbooks or other instructional materials which are just translated from imperial units.

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[1]Appropriate in-services should be planned to accomplish this for the geography teachers.

4. Departments of Education be requested to institute a system of cataloguing and critically evaluating commercially produced instructional materials as part of the educational program. Materials and particularly audio-visual materials judged to be especially valuable should be made readily available through a provincial department of education library.

5. That purchasers be advised to make a careful selection of metric measuring devices in order to check the accuracy of commercial equipment.[1]

VI. AREAS FOR FURTHER STUDY

This study has not developed the type of in-service necessary for teachers in specialized areas[2] who have gone through the basic in-service. Even in geography this has not been attempted in this paper and is therefore open to further study and development.[3] Perhaps another area of

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[1]In England examples of commercial litre containers were on the market which actually held only 900 millilitres. In other instances it was found that the graduations on volume (capacity) containers was very approximate. Legislation has since been passed regarding accuracy, safety, and mathematical soundness.

[2]Industrial arts, home economics, science, mathematic- social sciences, and business courses.

[3]Especially the development of in-service programs teachers just prior to the introduction of metric textboo This would be the development of an in-service program after the teachers had already participated in the basic in-service.

further study is the whole subject of measurement in geography as it is presented at the present time. To what extent do learners in fact understand the concepts of measurement as they are presently being presented in most geography courses? Geography teachers use a great many measurement comparisons within their courses - to what extent are these real for students now, and to what extent will they be real after metrication? There appears to be a need for further study in the whole area of how measurement is being taught in schools.[1] Perhaps the opportunity should be taken at the time of metric conversion to investigate this area and make recommendations to curriculum planners and developers.

VII. SUMMARY

Chapter V has outlined conclusions and recommended guidelines from the study for implementation, teacher in-service, publishing and selecting textbooks, and instructional approaches, during the changeover period from the imperial units of measurement to the metric units. These conclusions and recommended guidelines have been directed to educators in general and wherever applicable specific guidelines have been directed to geography teachers. This

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[1] M.O. Murphy and M.A. Polzin, "A Review of the Research Studies on the Teaching of the Metric System," Journal of Educational Research, (February 1969), pp. 267-270. This article concludes that there are "relatively few research studies in the area of measurement."

study has emphasized only the early stages of metric conversion with regard to teacher in-service and has not attempted to develop the kind of in-service necessary for teachers in specialized areas. The study has suggested that further study needs to be carried out in the area of preparing in-service for specialized teachers and also in the teaching of measurement itself.

The fundamental concept underlying all implications is that of making a direct transfer to metric measurement without the use of conversion, dual listings, or any similar "halfway house solution." In short the basic concept is to think metric.

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APPENDIX A

LIST OF METRIC PREFIXES AND THEIR SYMBOLS[1]

Prefix	Factor by which the unit is multiplied	Symbols
tera	10^{12}	T
giga	10^{9}	G
mega	10^{6}	M
kilo	10^{3}	k
hecto	10^{2}	h
deca	10^{1}	da
deci	10^{-1}	d
centi	10^{-2}	c
milli	10^{-3}	m
micro	10^{-6}	μ
nano	10^{-9}	n
pico	10^{-12}	p
femto	10^{-15}	f
atto	10^{-18}	a

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[1] The prefixes, detailed rules, symbols and spellings are found in:

Canadian Standards Association, Metric Practice Guide, (Rexdale, Ontario: Canadian Standards Association, 1973).

APPENDIX B

METRICATION BOARD STEERING COMMITTEE FOR EDUCATION AND INDUSTRIAL TRAINING: TERMS OF REFERENCE[1]

a. to commission such enquiries as are necessary to establish the state of preparation for the change to metric in this sector;

b. to determine which bodies are best equipped to undertake a general oversight of these preparations and to decide whether it is necessary to charge any other bodies to work out more detailed programmes for the particular industries and educational bodies in this sector;

c. to report to the Board on its preliminary findings by 1st December 1969; and

d. to report on programme developments in the Educational and Industrial Training Sector with recommendations for such legislative, regulatory, or other action required of public departments and for such publicity or other action required of the Board as is necessary to secure a smooth transition to the metric system.

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[1] Commonwealth Secretariat, Commonwealth Conference on Metrication, (London: Metrication Board, April 24-27, 1973), p. B-1.

APPENDIX C

LIST OF CASSETTE TAPES OF THE INTERVIEWS HELD IN ENGLAND[1]

Sister Marie Agnes	-	Headmistress of the Saint Philip Howard Roman Catholic Elementary School in Hatfield
Mr. R. Beddis	-	Teacher and author of several Geography textbooks and member of Schools Council Geography Project
Miss J. Gayton	-	Officer of the Science Education Section of The British Council
Mrs. P.M. Jolley	-	Director of Education and Industrial Training of the Metrication Board
Mr. J.L. Kay	-	Her Majesty's Senior Inspector in the Department of Education and Science
Mr. H. MacGibbon	-	Deputy Managing Director of Heinemann Educational Books Limited
Mr. J. Parsons	-	Geography Department Head at the Eltham Green Composite High School
Mr. K. Pinnock	-	Management Director of John Murray Limited, a publishing company in London
Mrs. Wilson	-	Assistant Executive Secretary of the Association for Science Education

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[1] These tapes are available from the writer on request.

APPENDIX D

METRICATION BOARD:

TERMS OF REFERENCE[1]

1. The Board shall facilitate the transition from the use of existing systems of weights and measures in the United Kingdom to the metric system on the assumption that the end of 1975 should be the target operative date for all provisional programmes, with the qualification that, if this date proves to be unreasonable for any particular sector, the programme for that sector may aim at an earlier or later date.

2. In particular the Board required:

a. to examine in consultation with such organisations and persons as the Board consider appropriate the problems involved in the transition;

b. to advise the responsible Minister on the implications of the change to the metric system in each sector of the economy and, so far as practicable, the costs and other considerations involved, including any legislative changes which may be judged necessary;

c. to make generally available information and advice on the co-ordination of timetables and programmes for the change in the various sectors of the economy;

d. to furnish to any enquirer information and to publish, whether by advertisement or otherwise, such information as the Board may think useful for familiarising the public with the metric system;

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[1]Metrication Board Report, Going Metric: Progress in 1970, (London: Her Majesty's Stationery Office, 1971), p. 133.

e. to ensure that the relevant educational interests are kept fully and continually informed of plans and progress for metrication;

f. to make investigations and surveys for obtaining information relevant to the performance of any of the duties of the Board;

g. to give such assistance to the Government as Departments may request in connection with the preparation or amendment of any legislation needed to permit the wider use of the metric system; and

h. to give such other assistance as the Government may require in the implementation of Government policy on the adoption of the metric system.

3. The Board shall report annually to the Secretary of the State for Trade and Industry on the performance of their duties in a form suitable for publication.

APPENDIX E

MEMBERSHIP AND REPRESENTATION ON THE COMMITTEE TO STUDY AND INTRODUCE THE METRIC SYSTEM IN MANITOBA SCHOOLS

Peter Luba	-	Mathematics Curriculum Consultant and Chairman until February 1973
Bill Soprovich	-	Science Curriculum Consultant and Chairman from February 1973
Ken Armstrong	-	Representative from the Universities
Don Elliot	-	Chairman of the Manitoba government Standards and Metrication Committee until 1973
Harold Grunau	-	Representative from the Faculty of Education from September 1973
Bryant Hasker	-	Representative of school administrators
John Lohrenz	-	Representative of social science teachers
A. Roy Low	-	Representative of Community Colleges and Universities from September 1973
Harold May	-	Representative from Faculty of Education until September 1973
George Nick	-	Physical Education Curriculum Consultant
John Pankiw	-	Representative from technical and vocational training
Dan Roberts	-	Representative from technical and vocational training from September 1973
Bob Rodgers	-	Representative from the Community Colleges until September 1973
Georgina Samuel	-	Representative of elementary mathematics teachers
Bill Solypa	-	Secretary and mathematics representative

Earl Warnica	-	Mathematics Curriculum Consultant from September 1973
Isabel Wettlaufer	-	Home Economics Curriculum Consultant
Victor Wieler	-	Representative of secondary mathematics teachers

APPENDIX F

LIST OF ARTICLES REVIEWED BY THE COMMITTEE TO STUDY AND INTRODUCE THE METRIC SYSTEM IN MANITOBA SCHOOLS DURING THE FALL 1971

Binyon, M. "L.E.A.'S Are Reluctant to go Metric." Times Educational Supplement. July 10, 1970. p. 16.

Clarke, F.J. "Preparing for D Day at Local Authority Level." Times Educational Supplement. September 5, 1969. p. 25.

Crane, Beverly. "The Metrics are Coming." Grade Teacher. (February 1971): 88-89.

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Hyck, J.L. "Metric System and Business Teacher." Business Education World. (June 1966): 16-17.

Kellaway, F.W. "Just a Few Words of Warning." Times Educational Supplement. September 5, 1969. p. 24.

Leigton, D.R. "Well-trodden Path to Metrication, Cuisenaire Rods." Times Educational Supplement. August 22, 1969. p. 18.

Mayer, J. "Metric System Developments." School Science Mathematics. (March 1964): 221-228.

McFee, Evan E. "Education in Decimal Currency and the Metric System: A Report on Great Britain's Progress in the Elementary Schools." School Science and Mathematics. (October 1969): 644-666.

Mills, N. "The Metric Revolution." Forecast Home Economics. (December 1969): 28.

Murphy, M.O. and Polzin, M.A. "A Review of the Research Studies on the Teaching of the Metric System." Journal of Educational Research. (February 1969): 267-270.

Oberlin, L.C. "Let's Teach the Metric System Through Its Use." The Arithmetic Teacher. (May 1967): 36.

Schlessinger, Phyllis E. and Kennedy, Barbara M. "Metric Measurements in Food Preparation." Journal Home Economics. (February 1967): 120-123.

Streng, Evelyn. "Meaningful Metric." School Science and Mathematics. (May 1964): 421-422.

Swan, M.D. "Experience, Key to Metric Unit Conversion." The Science Teacher. (November 1970): 69-70.

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Times Educational Supplement. Metrication and Decimalization. (September 5, 1969): 23-26.

Times Educational Supplement. Those Dammed Dots. (September 4, 1970): 27-30.

Times Educational Supplement. We Must Think Metric. (January 10, 1969): 69.

Trauttmansdorff, A. "Craftsman and Scavanger With Metrication on His Mind." Times Educational Supplement. (July 18, 1969): 19.

Vickers, J.S. "The Challenge of Going Metric." Times Educational Supplement. (September 5, 1969): 26.

Westmeyer, Paul and McAda, H. "Awkwards and Other Units." The Science Teacher. (March 1966): 62-65.

Zafforoni, J. "Developing Concepts of Measurement." The Instructor. (April 1962): 32-34.

APPENDIX G

LIST OF VIDEOTAPES VIEWED

The videotapes listed are available from:

School Broadcasts Branch,
Department of Education,
214-1181 Portage Avenue,
Winnipeg, Manitoba.
R3C 0V8

1. Linear Measurement
2. Capacity and Volume
3. Weights
4. Think Metric
5. The Big Change

APPENDIX H

LIST OF FILMS VIEWED

The films are available as follows:

I. Visual Education Branch,
Department of Education,
214A-1181 Portage Avenue,
Winnipeg, Manitoba.
R3C OV8

1. Metric System
2. Industry Goes Metric

II. British Government Office,
402-333 Broadway Avenue,
Winnipeg, Manitoba.
R3C OS9

1. Keys to Metrication Series
   a. Planning Metrication
   b. Phasing in Metric Design
   c. Metric Production and Inspection
2. Dimensional Co-Ordination
3. Industry Goes Metric

APPENDIX I

ACTIVITIES FOR THE METRIC WORKSHOP

Included are the activities for length measurement, mass measurement, capacity measurement and temperature measurement from the program Introduction to the Metric System developed by the Committee to Study and Introduce the Metric System in Manitoba Schools.

Approximately 25 minutes are required to complete each of the activities for:

a. Length measurement

b. Mass measurement

c. Capacity measurement

Approximately 20 minutes are required to complete the pre-test, temperature activity and the post-test. Normally a 15 to 20 minute introduction is given before the Workshop Activities are begun. The pre-test is usually given before the Workshop is introduced and is used basically as an "interest getter". The Workshop is limited to approximately 30 participants with 10 working at each table for 25 minutes and then moving on to the next table. Participants work in groups of two with a resource person at each table to answer questions and explain difficulties.

The section "Guidelines for Conducting a Metric Workshop" follows the Activities.

activities for the metric workshop

CAN YOU THINK METRIC?

In each of the following questions, choose the answer you think is correct and place a check mark in the space provided.

1. *A gram is about the weight of:*

   ___ *an apple*
   ___ *a dime*
   ___ *a pineapple*
   ___ *not sure*

2. *A metre is about the height of:*

   ___ *a door*
   ___ *a table*
   ___ *a chair seat*
   ___ *not sure*

3. *Water freezes and boils at:*

   ___ *32°C and 212°C*
   ___ *100°C and 200°C*
   ___ *0°C and 100°C*
   ___ *not sure*

4. *A measuring cup would hold about:*

   ___ *2 millilitres*
   ___ *20 millilitres*
   ___ *200 millilitres*
   ___ *not sure*

5. *A new born baby weighs about:*

___ *3 kilograms*

___ *30 kilograms*

___ *300 kilograms*

___ *not sure*

6. *A tall man is about:*

___ *20 centimetres high*

___ *200 centimetres high*

___ *2000 centimetres high*

___ *not sure*

7. *Normal body temperature is about:*

___ *25°C*

___ *37°C*

___ *45°C*

___ *not sure*

8. *A regular size soft drink tin holds about:*

___ *1.5 litres*

___ *1 litre*

___ *0.3 litres*

___ *not sure*

9. *A litre of water weighs about:*

___ *100 grams*

___ *10 grams*

___ *1000 grams*

___ *not sure*

10. A new lead pencil is about:

___ 50 millimetres long

___ 100 millimetres long

___ 200 millimetres long

___ not sure

11. One teaspoonful of cough syrup would be about:

___ 0.5 millilitres

___ 1 millilitre

___ 5 millilitres

___ not sure

12. A professional football player weighs about:

___ 45 kilograms

___ 90 kilograms

___ 180 kilograms

___ not sure

13. A dollar bill is about:

___ 15 centimetres x 7 centimetres

___ 20 centimetres x 10 centimetres

___ 100 centimetres x 70 centimetres

___ not sure

14. The thickness of a dime would be about:

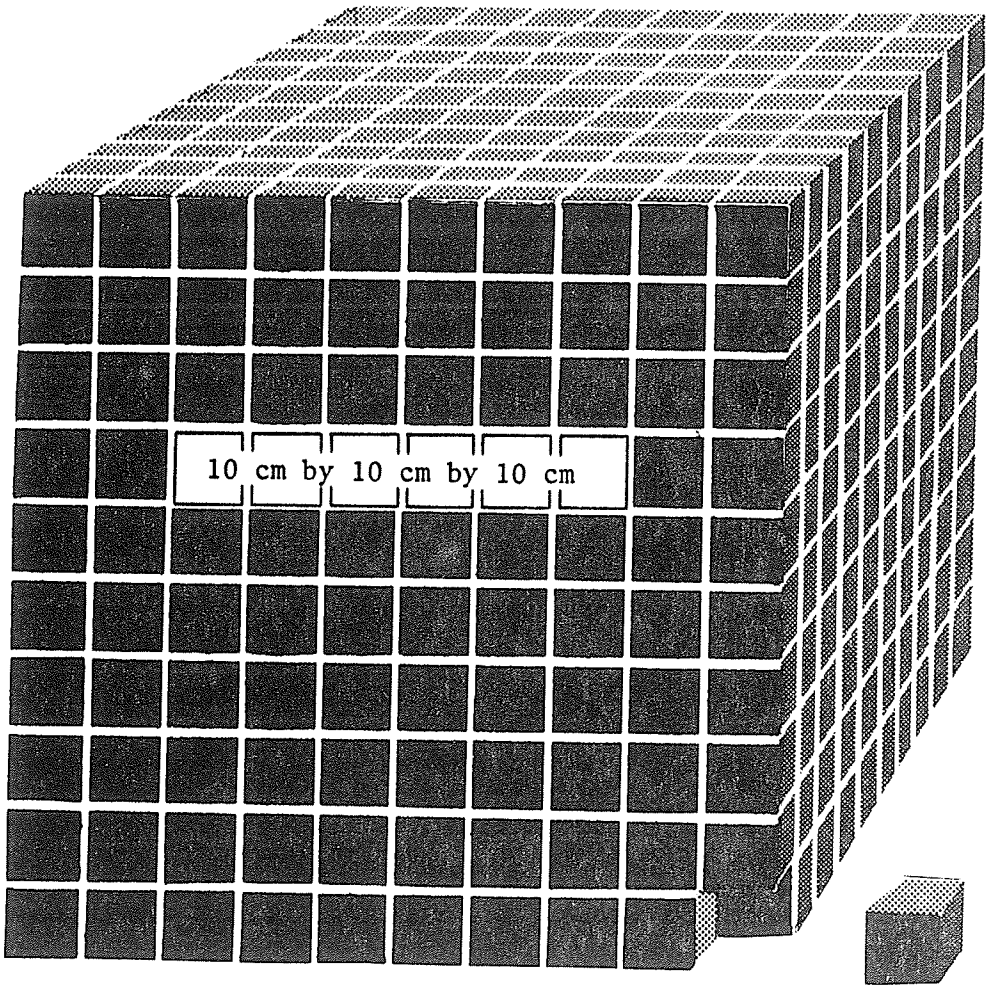
___ 0.1 millimetres

___ 1 millimetre

___ 5 millimetres

___ not sure

length measurement



LENGTH MEASUREMENT

This section includes the measurement for length, width, height, thickness, and distance.

A. COMMON METRIC UNITS USED FOR LENGTH MEASUREMENT:

millimetre (mm)	Used in measuring very small lengths. example - postage stamp.
centimetre (cm)	Used in measuring very common lengths. example - body measurements.
metre (m)	Used in measuring intermediate lengths. examples - room size, track and field events.
kilometre (km)	Used in measuring long distances. example - from one town to another.

B. RELATIONSHIP OF THE METRIC UNITS USED FOR LENGTH MEASUREMENT:

10 millimetres = 1 centimetre

100 centimetres = 1 metre

1000 metres = 1 kilometre

C. WORKSHOP MATERIALS:

The materials listed are for ten people (five groups of two) working at length measurement.

- 10 - 30 centimetre rulers showing millimetre divisions
- 10 - 1 metre cloth tapes
- 2 - 10 metre tapes (or longer) or 2 trundle wheels
- 5 - 1 metre sticks

D. WORKSHOP ACTIVITIES TO THINK METRIC:

Read sections A and B of Length Measurement.

1. *Draw lines of the following lengths by Estimation first, then using a ruler draw the actual length.*

   10 millimetres

   100 millimetres

   1 centimetre

   10 centimetres

   0.01 metres

   0.1 metres

2. *Measure this line* ⊢——⊣ *and express its length in:*

   millimetres _____ *mm*

   centimetres _____ *cm*

   metres _____ *m*

3. *Measure the length of this line and express in:*

   ⊢——————————————————————⊣

   millimetres _____ *mm*

   centimetres _____ *cm*

   metres _____ *m*

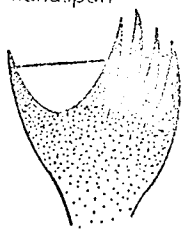
4. *ESTIMATE each of the following before doing the actual measurement.*

Express the answers as indicated in each activity.

Estimate _____ *cm*

Actual _____ *cm* _____ *mm*

your handspan



Estimate _____ *cm*

Actual _____ *cm* _____ *mm*

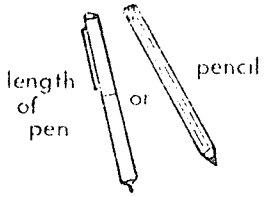
length of your shoe

Estimate _____ *cm* _____ *cm*

Actual _____ *cm* _____ *mm* _____ *cm* _____ *mm*

length

width



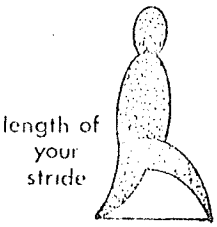
Estimate

_____ *cm*

Actual

_____ *cm*

_____ *mm*



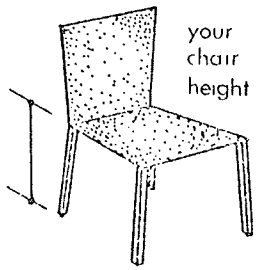
Estimate

_____ *m*

Actual

_____ *m*

_____ *cm*



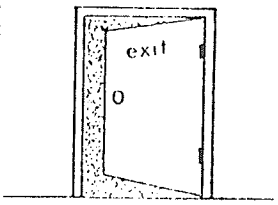
Estimate

_____ *cm*

Actual

_____ *cm*

_____ *m*



Estimate

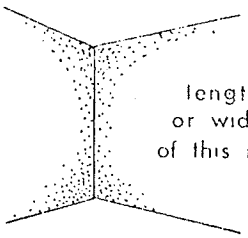
_____ *m*

Actual

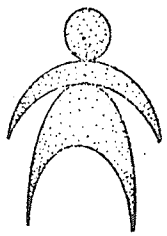
_____ *m*

_____ *cm*

Estimate	*Actual*	
_____ *m*	_____ *m*	length or width of this room



Estimate	*Actual*	
_____ *cm*	_____ *cm*	height
_____ *cm*	_____ *cm*	neck
_____ *cm*	_____ *cm*	wrist
_____ *cm*	_____ *cm*	waist

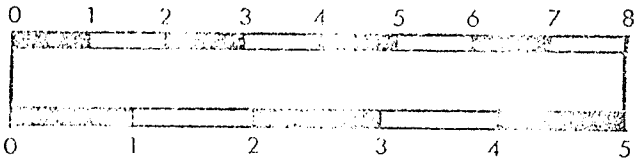


Estimate	*Actual*	
_____ *mm*	_____ *mm*	thickness of 25 cents

Estimate	*Actual*	
_____ *mm*	_____ *mm*	thickness of 10 cents

5. *Select two localities separated by a distance known to you. Using the following scale, give the approximate number of kilometres between the two centres.*

Scale in Kilometres



Scale in Miles

(a) *The distance from* _____ *to* _____ *is* _____ *kilometres.*

(b) *The distance from* _____ *to* _____ *is* _____ *kilometres.*

6. *By using the above scale, what speed limit in kilometres per hour would you suggest for:*

(a) *a quiet residential area?* _____ *km/h*

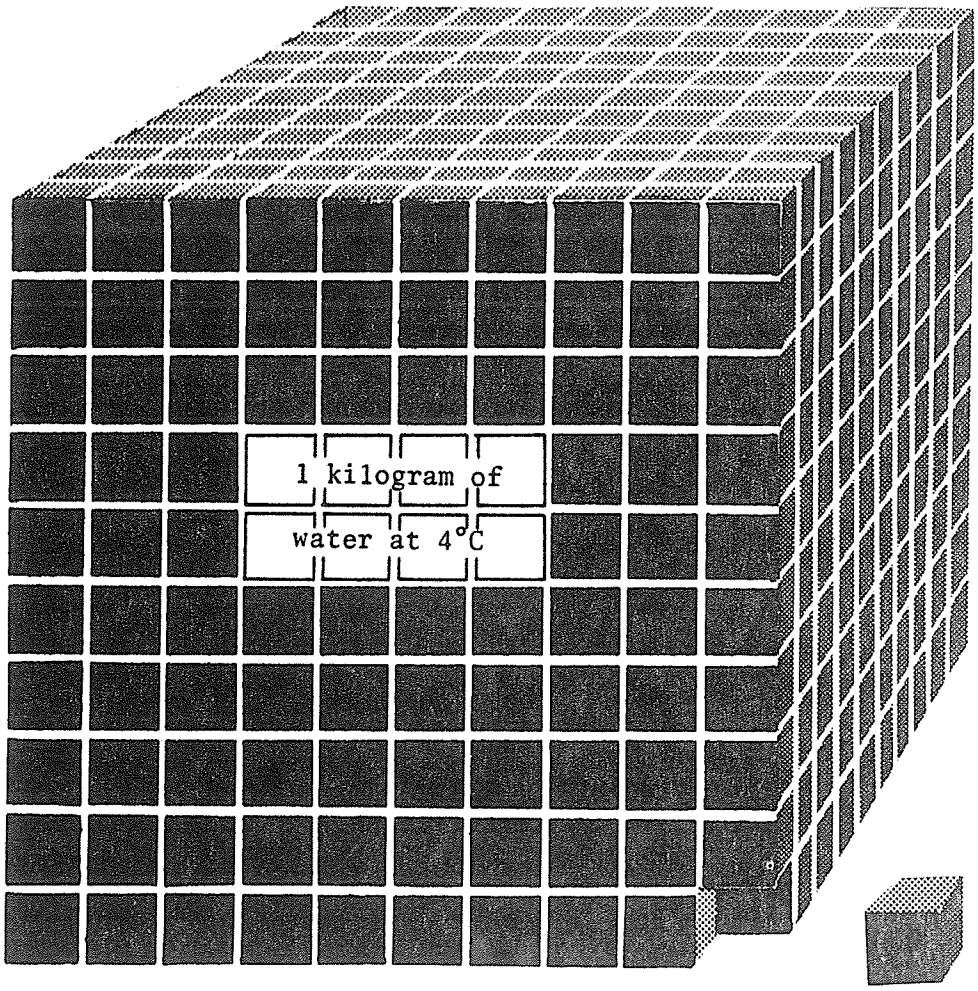
(b) *a paved two lane highway?* _____ *km/h*

7. *Which is the better buy? (Check ✓)*

(a) *150 centimetres of cloth at $6.00 OR* _____

1 metre of the same cloth at $4.50 _____

mass measurement



MASS MEASUREMENT

This section includes the measurement of quantity of material or the measurement of mass. Mass, which remains the same anywhere in the universe, is measured in units of milligrams, grams, kilograms, and metric tons.

In everyday life, mass, and weight are often used interchangeably.

> Weight is the measurement of the gravitational force on an object and varies with location in the universe. Weight is measured in Newtons.
>
> To illustrate the above, a one kilogram mass on the earth's surface is acted upon by a gravitational force of approximately 9.8 Newtons. The same kilogram mass on the moon's surface is acted upon by a gravitational force of approximately 1.6 Newtons.
>
> The following example distinguishes between mass and weight. One kilogram of potatoes measured by mass (balance scale) would be exactly the same quantity of potatoes either on the earth's surface or on the moon's surface. Similarly, 9.8 Newtons of potatoes measured by weight (spring scale) would be one kilogram mass on the earth's surface, however, it would be approximately six kilograms on the moon's surface.

In summary, because almost all of our measuring occurs on the earth's surface, it is common practice to use the unit kilogram weight.

A. COMMON METRIC UNITS USED FOR MASS MEASUREMENT:

milligram (mg)	Used in measuring extremely small amounts of mass. examples - pharmaceuticals, vitamins.
gram (g)	Used in measuring small amounts of mass. examples - breakfast cereals, butter.
kilogram (kg)	Used in measuring larger amounts of mass. examples - potatoes, apples.
metric ton (t)	Used in measuring very large amounts of mass. examples - coal, iron ore.

B. RELATIONSHIP OF THE METRIC UNITS USED FOR MASS MEASUREMENT:

1000 milligrams = 1 gram

1000 grams = 1 kilogram

1000 kilograms = 1 metric ton

C. WORKSHOP MATERIALS:

The materials listed are for ten people (five groups of two) working in mass measurement.

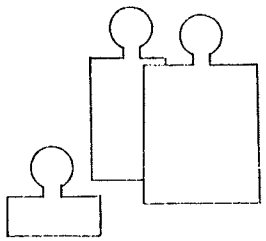
1 - Metric bathroom scale
5 - Compression scales or balance scales
5 - Sets of metric weights
10 - Plastic square litre containers (graduated in millilitres)

5 - Plastic measuring cups
- Wheat or rice (minimum of three litres)
- Dried beans (minimum of three litres)
- Potatoes (minimum of two kilograms)
- Salt (minimum of one kilogram)
- Oranges or apples (minimum of twelve)
- Large dictionary or large book

D. WORKSHOP ACTIVITIES TO THINK METRIC:

Read sections A and B of Mass Measurement.

1. *Pick up various metric weights and estimate the number of grams of each. What is the actual weight?*



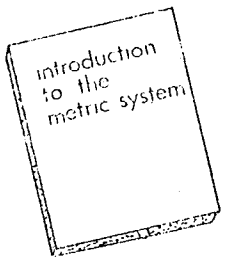
2. *In each of the following activities, ESTIMATE first and then find the actual mass measurement.*

Express the answers as indicated in each activity.

Estimate _____ *g*

Actual _____ *g*

_____ *mg*

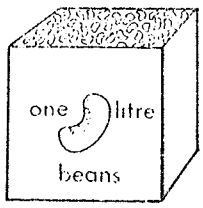


this booklet

Estimate _____ *kg*

Actual _____ *kg*

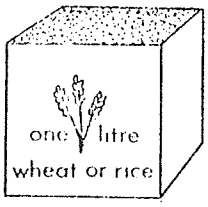
_____ *g*

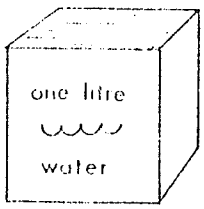


Estimate _____ *kg*

Actual _____ *kg*

_____ *g*

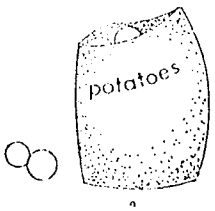




Estimate _____ *kg*

Actual _____ *kg*

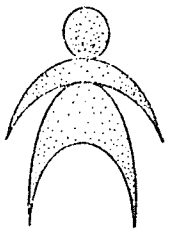
_____ *g*



Estimate _____ *kg*

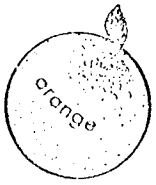
Actual _____ *kg*

_____ *g*



Estimate _____ *kg*

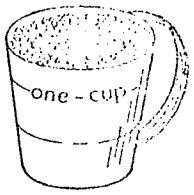
Actual _____ *kg*

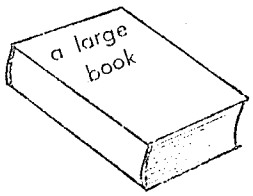


Estimate _____ *g*

Actual _____ *g*

_____ *mg*

Estimate	Actual	salt
_____ g	_____ g	

Estimate	Actual	
_____ kg	_____ kg	

3. *By estimation measure out the following portions. Check your accuracy.*

   (a) One kilogram of oranges (approximately)

   (b) One kilogram of wheat or rice

   (c) 500 grams of dried beans

   (d) 250 grams of salt

4. *Which is the better buy? (Check ✓)*

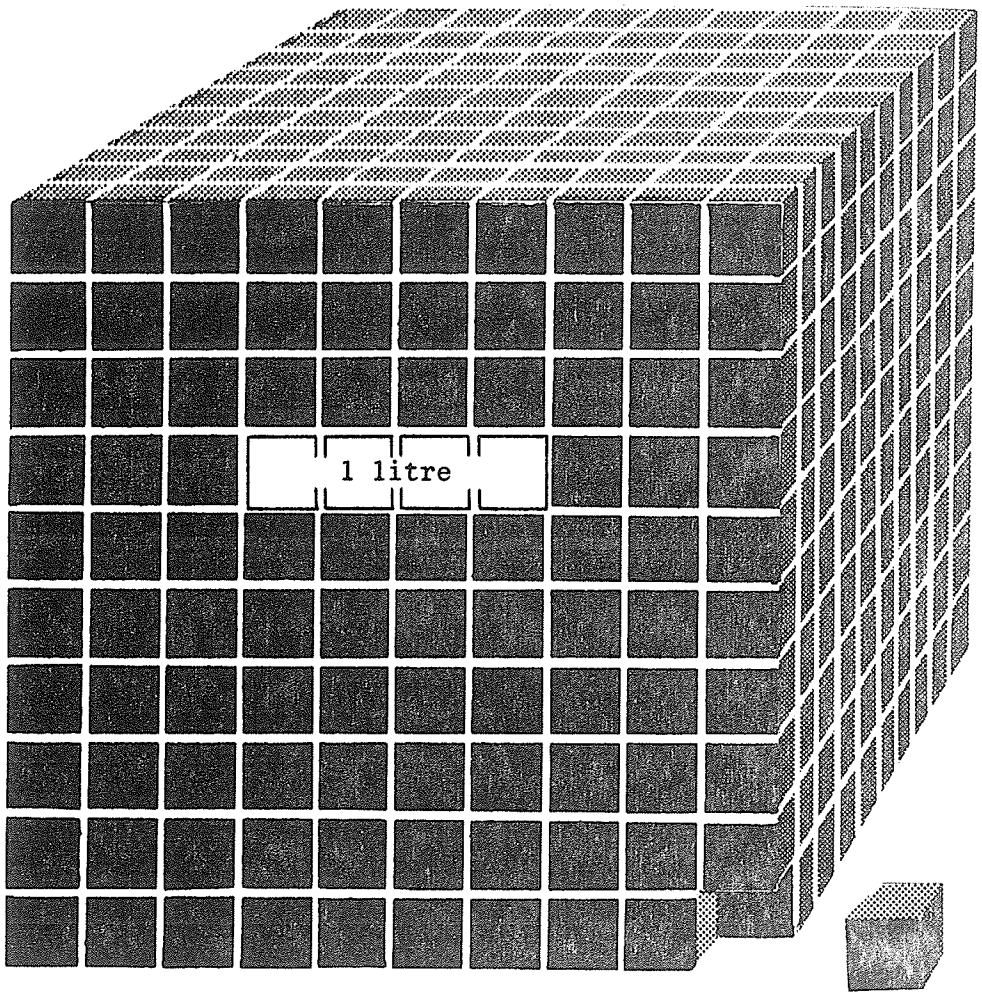
   (a) 300 grams of jam at 60 cents OR _____

   1 kilogram of jam at $1.50. _____

   (b) 1 kilogram of sugar at 40 cents OR _____

   2.5 kilograms at $1.10. _____

capacity measurement



CAPACITY MEASUREMENT

This section includes the measurement of liquid content in a container or capacity measurement.

A. COMMON METRIC UNITS OF CAPACITY MEASUREMENT:

millilitre (ml)	Used in measuring small amounts of liquids. examples - medications, soft drinks. (1 ml = 1 cm^3)
litre (l)	Used in measuring common amounts of liquids. examples - milk, gasoline, paint. (1 litre = 1000 cm^3)

B. RELATIONSHIP OF METRIC UNITS IN CAPACITY MEASUREMENT:

1000 millilitres = 1 litre

C. WORKSHOP MATERIALS:

The materials listed are for ten people (five groups of two) working in capacity measurement.

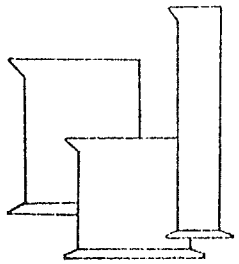
5 - Sets of plastic metric graduated containers - 1000 ml, 500 ml, 100 ml, 50 ml
5 - Plastic funnels
5 - Plastic measuring tablespoons
5 - Plastic measuring cups
5 - Non-graduated containers
5 - Plastic table juice containers
5 - Ordinary water glasses (plastic)
5 - Soft drink tins (ounce label covered or removed)

5 - Family-sized soft drink bottles
(ounce label covered)
5 - Metric graduated syringes

D. WORKSHOP ACTIVITIES TO THINK METRIC:

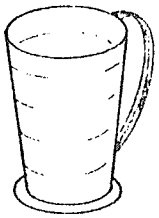
Read sections A and B of Capacity Measurement.

1. *Pour various amounts of water into a non-graduated container. Estimate the number of millilitres, then find the actual amount with a graduated container.*



2. *In each of the following activities, first ESTIMATE and then find the actual capacity.*

Express the answers as indicated in each activity.



juice container

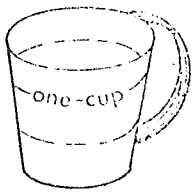
Estimate _____ *l*

Actual _____ *l* _____ *ml*

Estimate *Actual*

_____ *ml* _____ *ml*

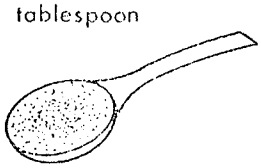
_____ *l*



Estimate *Actual*

_____ *ml* _____ *ml*

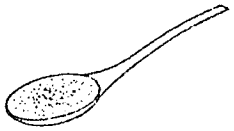
tablespoon



Estimate *Actual*

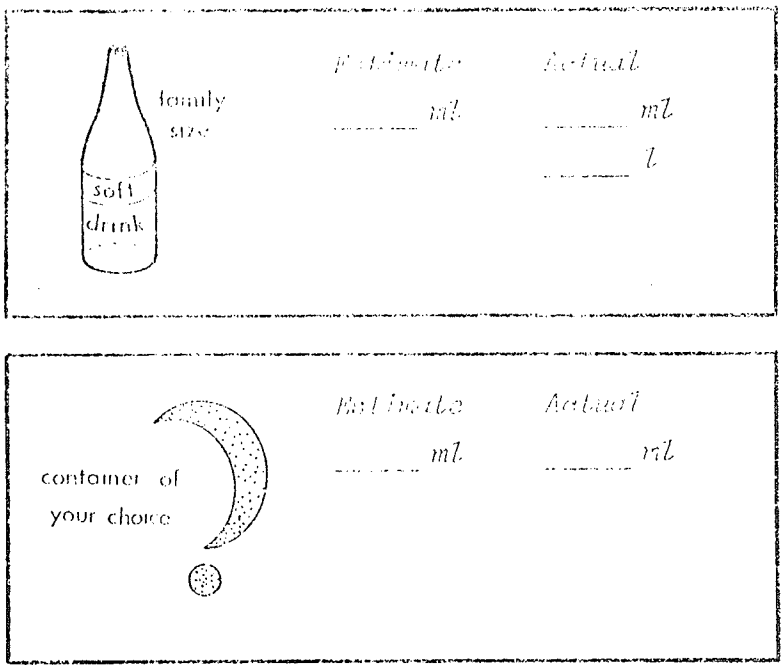
_____ *ml* _____ *ml*

teaspoon



Estimate *Actual*

_____ *ml* _____ *ml*



3. *Estimate each of the following portions first and then check by actual measurement.*

   (a) 25 millilitres

   (b) 100 millilitres

   (c) 500 millilitres

   (d) 1000 millilitres

4. *Which is the better buy? (Check ✓)*

   (a) 3 litres of milk at 90 cents OR _____

   500 millilitres of milk at 20 cents _____

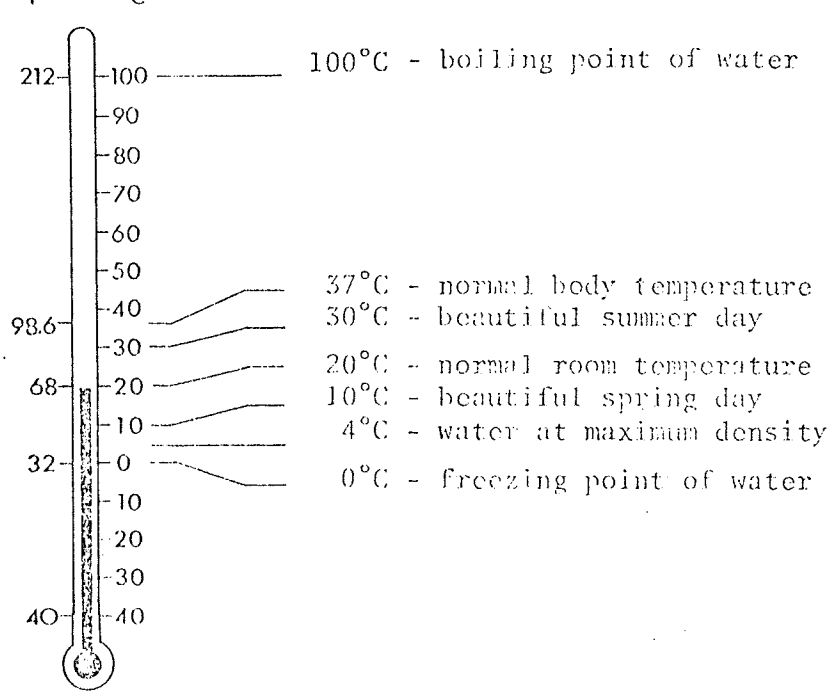
METRIC TEMPERATURE MEASUREMENT

This section includes the measurement of temperature in the metric system by using the Celsius thermometer scale. The Celsius thermometer was named after Anders Celsius (1701-1744) a Swedish astronomer and scientist from Uppsala, Sweden. He presented the first idea of separating the freezing point and boiling point of water with 100 equal parts. Hence,

the freezing point of water 0°C

the boiling point of water 100°C

A. RELATIONSHIP OF CELSIUS AND FAHRENHEIT SCALES:



B. WORKSHOP ACTIVITIES TO THINK METRIC:

Read section A of Metric Temperature Measurement.

1. *Indicate the Celsius temperature for each of the following:*

(a)	*water freezing*	_____ °C
(b)	*water boiling*	_____ °C
(c)	*present room temperature*	_____ °C
(d)	*normal body temperature*	_____ °C
(e)	*approximate outside temperature*	_____ °C
(f)	*comfortable outdoor swimming temperature*	_____ °C
(g)	*warmest outdoor temperature you have experienced*	_____ °C

Note: The Celsius scale is derived from the Kelvin scale. The term 'Kelvin' derived from Baron Kelvin of Largs. He lived between 1824 and 1907 and began work in thermodynamics very early in life. He attended Glasgow University at the age of eleven where he discovered the the second law of thermodynamics. The Kelvin temperature scale has the same size of degree as the Celsius scale, but starts at a different reference point.

THINK METRIC TEST

In each of the following questions, choose the answer you think is correct and place a check mark in the space provided.

1. *A gram is about the weight of:*
   - (a) ___ *an apple*
   - (b) ___ *a dime*
   - (c) ___ *a pineapple*
   - (d) ___ *not sure*

2. *A metre is about the height of:*
   - (a) ___ *a door*
   - (b) ___ *a table*
   - (c) ___ *a chair seat*
   - (d) ___ *not sure*

3. *Water freezes and boils at:*
   - (a) ___ *32°C and 212°C*
   - (b) ___ *100°C and 200°C*
   - (c) ___ *0°C and 100°C*
   - (d) ___ *not sure*

4. *A measuring cup would hold about:*
   - (a) ___ *2 millilitres*
   - (b) ___ *20 millilitres*
   - (c) ___ *200 millilitres*
   - (d) ___ *not sure*

5. *A new born baby weighs about:*

   (a) ___ *3 kilograms*

   (b) ___ *30 kilograms*

   (c) ___ *300 kilograms*

   (d) ___ *not sure*

6. *A tall man is about:*

   (a) ___ *20 centimetres high*

   (b) ___ *200 centimetres high*

   (c) ___ *2000 centimetres high*

   (d) ___ *not sure*

7. *Normal body temperature is about:*

   (a) ___ *25°C*

   (b) ___ *37°C*

   (c) ___ *45°C*

   (d) ___ *not sure*

8. *A regular size soft drink tin holds about:*

   (a) ___ *1.5 litres*

   (b) ___ *1 litre*

   (c) ___ *0.3 litres*

   (d) ___ *not sure*

9. *A litre of water weighs about:*

   (a) ___ *100 grams*

   (b) ___ *10 grams*

   (c) ___ *1000 grams*

   (d) ___ *not sure*

10. *A new lead pencil is about:*

(a) ___ *50 millimetres long*

(b) ___ *100 millimetres long*

(c) ___ *200 millimetres long*

(d) ___ *not sure*

11. *One teaspoonful of cough syrup would be about:*

(a) ___ *0.5 millilitres*

(b) ___ *1 millilitre*

(c) ___ *5 millilitres*

(d) ___ *not sure*

12. *A professional football player weighs about:*

(a) ___ *45 kilograms*

(b) ___ *90 kilograms*

(c) ___ *180 kilograms*

(d) ___ *not sure*

13. *A dollar bill is about:*

(a) ___ *15 centimetres x 7 centimetres*

(b) ___ *20 centimetres x 10 centimetres*

(c) ___ *100 centimetres x 70 centimetres*

(d) ___ *not sure*

14. *The thickness of a dime would be about:*

(a) ___ *0.1 millimetres*

(b) ___ *1 millimetre*

(c) ___ *5 millimetres*

(d) ___ *not sure*

15. *The standard of length in the metric system is the:*

(a) ___ *millimetre*

(b) ___ *centimetre*

(c) ___ *decimetre*

(d) ___ *kilometre*

(e) ___ *metre*

16. *The liquid capacity of a jar is 0.75 litres. This is equivalent to:*

(a) ___ *75 millilitres*

(b) ___ *75 cubic centimetres*

(c) ___ *7.5 cubic centimetres*

(d) ___ *750 millilitres*

(e) ___ *7500 millilitres*

17. *A desk top is 65 centimetres across. This is equivalent to:*

(a) ___ *650 millimetres*

(b) ___ *0.65 metres*

(c) ___ *6.5 metres*

(d) ___ *0.065 kilometres*

(e) ___ *6500 millimetres*

18. *The appropriate numerical factors for milli, centi, and kilo are:*

(a) ___ *x 1000; x 100; x 10*

(b) ___ *x 0.001; x 0.01; x 1000*

(c) ___ *x 10; x 1000; x 1000*

(d) ___ x 100; x 10; x 0.1

(e) ___ don't know

19. The basic temperature scale used in the metric system (SI) from which the derived units originate is the:

(a) ___ Celsius scale

(b) ___ Kelvin scale

(c) ___ Fahrenheit scale

(d) ___ Centigrade scale

20. A certain container holds 1500 cubic centimetres of a substance. How many millilitres and litres respectively would it hold?

(a) ___ 150 millilitres and 15 litres

(b) ___ 1500 millilitres and 1.5 litres

(c) ___ 15 millilitres and 150 litres

(d) ___ cubic centimetres and litres are not related

(e) ___ don't know

Answers

1. b	6. b	11. c	16. d
2. b	7. b	12. b	17. a and b
3. c	8. c	13. a	18. b
4. c	9. c	14. b	19. b
5. a	10. c	15. c	20. b

GUIDELINES FOR CONDUCTING A METRIC WORKSHOP

This section has been included as a guide for those instructors planning to use a similar workshop approach in teaching the metric system. It basically attempts to answer the question, "What is required to plan and develop a meaningful metric workshop?".

The Committee believes that the approach used in this program can also be used, with modifications, for students.

The guidelines will be outlines under the headings:

A. Pre-planning

B. Organization

C. Procedure

D. Follow-up

A. PRE-PLANNING

Pre-planning includes both the preparation of the instructor as well as the preparation of the participants prior to the workshop. Before the actual workshop the instructor should become familiar with:

(a) A Brief History of the Metric System - why it began, where it began, where it is being used, its development to the present International System of Units (SI), its historical development in Canada and Manitoba.

(b) Why Go Metric? - a justification for going metric, advantages.

(c) The Metric System - the units of measurement, decimal nature, prefixes and their meaning, the relationship within each unit of measurement, the interrelationship of the various measurement units, simplicity of the system.

(d) The THINK METRIC Concept - new language of measurement, no conversion between the Imperial System and the metric system, how to think metric by using perhaps body measurements.

From this background knowledge the instructor should be able to prepare the participants for the actual workshop. Part of this preparation could also be done through some of the videotapes that are listed in this program.

B. ORGANIZATION

The organization includes the involvement of the instructor prior to the actual workshop. The following should be considered:

(a) What is the purpose of the workshop? - which unit(s) of measurement is going to be dealt with in the workshop?

(b) Time and available room should be decided - atmosphere suitable for this kind of activity, tables are preferable to desks, ease of movement for participants, limit the number of participants per workshop to perhaps thirty or fewer and also limit the number of participants per table to ten or fewer.

(c) Sufficient equipment - preferable to have participants work in groups of two, supply enough equipment so that each group of two can work easily, equipment will depend on the activities.

(d) Workshop activities - select the workshop activities that would interest your participants, require them to estimate first - it causes them to think metric, instructor should do activities before the participants do them to make necessary modifications, etc.

(e) Resource personnel - have available at each table personnel to direct and help with actual activities. These people should have experienced the "workshop approach" previously.

C. PROCEDURE

This involves the workshop activities themselves and assumes that the pre-planning and the organization have been completed. The following should be considered:

(a) Statement of purpose - actual measurement in the metric system, estimate first, think metric, no conversion from Imperial System.

(b) Explanation of procedure - work in groups of two, amount of time, perhaps use a questionnaire as an "interest getter", etc.

(c) Time element - approximately 30 minutes have been found satisfactory for each of the activities outlined in this program under Length Measurement, Capacity Measurement, and Mass Measurement.

D. FOLLOW-UP

Follow-up includes a discussion of how well the objectives of the workshop have been accomplished. The following suggestions could be considered in a discussion:

(a) The metric units of measurement used.

(b) The advantages of the metric system.

(c) The decimal nature of the metric system.

(d) The relationship within the unit of measurement used.

(e) The use of the prefixes and their meaning.

(f) The interrelationship if more than one unit of measurement was used.

(g) The simplicity of the metric system.

(h) The accuracy of the estimations.

(i) How can you think metric?

The follow-up might well include a videotape to reinforce the experiences that the participants had with the workshop. It also offers an excellent opportunity to review significant aspects about the metric system.

APPENDIX J

LETTER TO SUPERINTENDENTS OF SCHOOLS

The letter informs the Superintendent about metric developments in education and is also a request for resource teachers to attend regional metric in-services.

Province of Manitoba
Department of Education
Curriculum Branch

Robert Fletcher Building
411 – 1181 Portage Avenue
Winnipeg, Manitoba
R3C 0V8

June 21, 1973

TO: SUPERINTENDENTS OF SCHOOLS

I am certain that you are aware of the increasing pressure developing in Canada for the replacement of the Imperial System with the Metric System. Associated with the conversion to the Metric System in industry, is a parallel movement to standardize the number and variety of materials in a particular field. Because of these two factors, it is extremely difficult to determine a date for the final conversion to the Metric System of industry, consumer goods, and other areas which are concerned with measurement. However, we can predict firstly, that students will be operating for the next few years in a world which uses a dual system of measurement; and secondly, that students presently in the intermediate school will be entering a metric world after graduation.

A Department of Education committee has been active in attempting to provide for the introduction of the Metric System into Manitobs schools. Research concerning the introduction of the Metric System into other countries indicated the following:

1. The major difficulty occurs in the unlearning of the old system rather than the learning of the Metric System.

2. Teaching conversion from one system to another should be eliminated.

3. Young students generally have little difficulty if they are introduced to the Metric System by means of a "hands-on approach" which helps the student to become familiar with or think in metric units. Adults tend to have more difficulty in changing from the use of one system to another.

During the past year, the Metrication Committee has developed and tested a metric booklet, videotape, and workshop. The materials and workshop are intended to be a part of an in-service package in the training of teams of resource personnel from each school division.

On the basis of their research, the Metrication Committee has proposed a method of introducing the Metric System into Manitoba schools.

STAGE ONE:
During stage one, workshops will be conducted to train teams of teachers from each school division to act as resource personnel in their division. (This initial stage could be completed by the end of 1973.)

STAGE TWO:
The teams trained during the initial stage would act as resource personnel for the training of teachers within their school division. Completion of this phase is tentatively suggested for June of 1975.

As indicated earlier, the dates are of necessity flexible. However, present indications are that the rate of introducing the Metric System into Canada may increase. More specific information relative to the initial stage follows:

1. A two day in-service for a team of three teachers from each school division would be held in each inspectorial region in the fall and winter of 1973. Representatives from each of the areas of Grades 1-6, 7-9, and 10-12 would likely be an advantage. This approach would serve to distribute the load in terms of introducing the system to teachers in the division. Dependent upon their needs, school divisions may wish to send a single representative.

2. Suggested times and places are as follows:

Region	Tentative Date	Tentative Place
Northern	October 11-12	Dauphin
(This may be held at two places because of travel difficulties.)		
Western	October 25-26	Brandon
Southern	November 8- 9	Carman
Eastern	November 22-23	Winnipeg
Winnipeg	December 6- 7	Winnipeg

The areas and place for the in-service are tentative only. In addition, some representatives may find it easier to travel to another region.

3. The Curriculum Branch would assume the costs of the workshop leaders, accommodation for representative personnel from school divisions, and the printed materials for school division representatives to conduct training sessions with the elementary teachers of their divisions.

4. Costs to a school division for stage one would be the cost of substitutes if required, and travel costs of representatives.

In addition, when divisions proceed to stage two, or the training of teachers within their schools, a metric kit similar to that used in the workshops will very likely be needed. Such a kit will cost approximately $200.00.

Since the number of inquiries concerning the introduction of the Metric System into schools has been increasing within the last few months, this letter is intended to provide you with some basic information concerning the present position and recommendations of the Metrication Committee and the Curriculum Branch. I would appreciate any reactions that you have concerning the implementation of the Metric System into Manitoba schools generally, and concerning the dates, willingness to participate, and any problems that you foresee. I realize this is a very busy time for you; however, any immediate reactions would allow us to formulate our plans more effectively. I would hope to have your comments by August 1st, 1973. May I take this opportunity to thank you for the consideration you are able to give to the proposal.

Yours truly,

W. Soprovich

W. Soprovich
Curriculum Consultant

WS:sz

APPENDIX K

DETAILED OUTLINE FOR TWO DAY REGIONAL IN-SERVICE TO TRAIN RESOURCE TEACHERS TO TEACH THE METRIC SYSTEM[1]

I. Introduction to the in-service. (30 minutes)[2]

1. The following points were briefly developed:

a. Official Government position

i. Federal Government - White Paper
ii. Provincial Government - White Paper

- Standards and Metrication Committee
- Committee to Study and Introduce the Metric System in Manitoba Schools

b. The Metric System

i. Briefly several reasons for going metric
ii. Explanation of SI units

2. Statement of the purpose of the in- service:

a. Awareness and familiarity with the metric system through practical experience
b. Promote the THINK METRIC concept
c. Provide sufficient background for teachers as resource people so that they are confident in giving in-service to teachers within their own School Division

3. Review the agenda for the two day in-service

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[1] This outline was used by the Committee. Three Committee members were present at each in-service.

[2] Times are close approximations.

II. Workshop Activities as outlined in the program Introduction to the Metric System.[1]

1. The following procedure was followed:

a. The program, Introduction to the Metric System, was handed to each participant and the purpose of the program was briefly explained. (7 minutes)

b. The THINK METRIC concept was explained and the participants were asked to do the questions Can You Think Metric? on pages 25-27. (8 minutes)

c. The videotape Why Go Metric? was shown. (25 minutes)

d. An introduction to the Workshop Activities was given which briefly developed: (15 minutes)

i. Identifying and showing the three metric units: the metre, the litre, and the gram

ii. The decimal nature of the metric system

iii. The use of prefixes in the metric system

iv. The interrelationship of the metre, litre and kilogram

v. Hints to THINK METRIC

e. The procedure to be followed during the Workshop Activities was explained. (5 minutes)

i. 10 participants at each table working in groups of two

ii. Estimate before measuring

iii. About 25 minutes will be spent at each table

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[1] The Committee for the Study and Introduction of the Metric System in Manitoba Schools, Introduction to the Metric System, (Manitoba: Department of Education, 1973).

COFFEE

f. Each of the participants worked through two of the following activities: (50 minutes)

i. Length measurement

ii. Mass measurement

iii. Capacity measurement

LUNCH BREAK

g. Each of the participants worked through the following activity not yet done: (40 minutes)

i. Length measurement

ii. Mass measurement

iii. Capacity measurement

After the completion of the Activities participants were asked to complete the activity related to temperature and then complete the questionaire on pages 49-53.

III. History and background of the development of the Metric System to the present SI System. (30 minutes)

COFFEE

IV. Standardization and its effects on consumer and industry.

a. Resource used: (60 minutes)

i. Metrication A Guide for Consumers[1]

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[1]Information Canada, Metrication A Guide for Consumers, (Ottawa: Department of Consumer and Corporate Affairs, 1972). Consumer Research Report No. 2.

ii. What is Standardization?[1]

iii. Film - Industry Goes Metric.[2]

DAY TWO

V. Detailed summary of the rules of the SI System.[3] (30 minutes)

VI. Supplementary Workshop Activities as outlined in the program Introduction to the Metric System. (30 minutes)

a. Each of the participants worked through the supplementary Workshop Activities:

i. Area and volume measurement.

ii. Interrelationship of length, mass and capacity.

VII. Methods of running an in-service.

a. An explanation was given of the organization and structure of in-service within Manitoba as well as outlining the function of the Committee to Study and Introduce the Metric System in Manitoba Schools. Also the main function of the Resource Teachers was developed. The section "Guidelines for conducting a Metric Workshop" was drawn to the attention of the participants. Comments on type and costs of equipment were made.

COFFEE

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[1]Standards Council of Canada, What is Standardization? (Ottawa: Standards Council of Canada).

[2]Appendix H, p. 148.

[3]Canadian Standards Association, Metric Practice Guide, (Rexdale, Ontario: Canadian Standards Association, 1973).

b. A demonstration was given on improvising metric measuring devices. (15 minutes)

VIII. Examination and evaluation of available resources. (60 minutes)

a. The Committee had sent a letter to a number of publishing companies requesting available metric books to be examined by teachers at Regional In-services. The participants were asked to examine several books and evaluate them using the following criteria:

i. Does the book emphasize the student activity approach? (THINK METRIC concept, no conversion)

ii. Is the book simply translated from imperial measurement to metric measurement?

iii. Does the book follow acceptable SI rules?

iv. Would you recommend this book for school use?

b. A portion of the time was given over to viewing various videotapes and films which were running simultaneously. Participants could choose which ones to watch and for how long. This gave an opportunity for participants to select materials for their own in-services. Numerous posters were also displayed.

LUNCH BREAK

IX. Implementation and implication for curriculum and instruction.

a. The following areas were briefly developed: (45 minutes)

i. External changes and how they may affect the introduction of the system.

ii. General implications in the various subject fields.

iii. For K-6, possible methods of instruction in 1974-1975.

iv. For 7-12 possible methods of introduction by subject area.

v. Work of Curriculum committees in planning for and implementing the change.

vi. Guidelines re: implementation, textbook publishing, instructional techniques.

b. The participants were asked to group themselves into one of the following areas: (45 minutes)

i. Primary and elementary

ii. Junior High

iii. Senior High

The grouping was to be used for discussing: teacher in-service, implementation within the school, or ask any questions. A member of the Committee was with each group.

APPENDIX L

DAY ONE EVALUATION SHEET

The Committee for the Study and Introduction of the Metric System in Manitoba Schools would like each participant to evaluate and comment on each AGENDA ITEM as the day progresses. The evaluation will be used to modify, revise etc. future in-services. 5 is the high rating.

1. Introduction to the In-Service. 1 2 3 4 5
   Comment:

2. The videotape "Why Go Metric?" 1 2 3 4 5
   Comment:

3. Introduction to the Workshop Activities. 1 2 3 4 5
   Comment:

4. Workshop Activities. 1 2 3 4 5
   Comment:

5. History and Background. 1 2 3 4 5
   Comment:

6. Standardization and its Effects. 1 2 3 4 5
   Comment:

7. Film "Industry Goes Metric" 1 2 3 4 5
Comment:

8. Overall rating of the In-Service. 1 2 3 4 5
Comment:

DAY TWO EVALUATION SHEET

1. Rules of SI System. 1 2 3 4 5
Comment:

2. Supplementary Workshop Activities. 1 2 3 4 5
Comment:

3. Methods of Running an In-Service. 1 2 3 4 5
Comment:

4. Examination of Resource Materials. 1 2 3 4 5
Comment:

5. Implementation and Implications. 1 2 3 4 5
Comment:

6. Overall Rating. 1 2 3 4 5
Comment:

APPENDIX M

PROPOSAL CONCERNING PHASES FOR AND COSTS OF IMPLEMENTATION OF THE METRIC SYSTEM INTO MANITOBA SCHOOLS

This proposal has been prepared by the Committee to Study and Introduce the Metric System in Manitoba Schools. It was presented to the Council of Ministers in January 1974.

PROPOSAL CONCERNING PHASES FOR AND COSTS OF IMPLEMENTATION OF THE METRIC SYSTEM* INTO MANITOBA SCHOOLS

I INITIAL ASSUMPTIONS AND PRINCIPLES CONSIDERED IN THE IMPLEMENTATION PROCESS

A. The Metric System and the General Public - A Date

It is assumed that only metric units will be used in specifying standards for most consumer goods and many other areas of concern to the general public by the time range of 1978-80. Indicators which led to this choice of a time range are as follows:

1. Federal Government and Manitoba Government White Papers suggest 1980 as a target date.

2. Presentation to Minister's Advisory Council - September 19th, 1973 (S.M. Gossage)

   "Implementation should hopefully start in some volume in 1975 and increase rapidly in 1976 to reach a peak in 1977-78. By the end of 1980, the normal day-to-day transactions in the economy should be entirely in metric units..."

3. Canada's Approach to Metric Conversion presented to the American National Metric Council, October 17th, 1973 (P.C. Boire Executive Director, Metric Commission).

   Highway signs from coast to coast will be converted over a one month period by September 30th, 1977...The meteorology sector has made tentative plans to give weather forecasts in SI units starting in April, 1975.

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*Although differences exist between SI and some aspects of the metric system the terms will be used as if they are equivalent within this proposal.

Correlation between the changes occurring external to the school system in terms of consumer goods and industry, and the introduction of the SI units into the schools, is important if we wish to maintain a positive climate for this change. Some general implications of the target time range suggested are:

1. Young children will be in an essentially metric world by the time they have completed their elementary education; thus, conversion to the metric system can begin immediately.

2. Since vocational and business education is closely related to changes occurring within industry and business, educational changes developing within these fields will occur as the change becomes obvious within a specific vocational or business area. The need for coordination between secondary and post-secondary areas is assumed.[1]

3. As the metric system is introduced within the elementary school, a need will exist to provide parents with information about the introduction of the metric system through the curriculum.

4. The Federal and Provincial Governments should become involved in a promotional program early in 1974 in order to make the public aware of impending change.

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[1] It should be noted that some areas of the curriculum are already partially metric e.g. dental assistants.

B. Some General Principles

1. Initially, we are concerned with developing an awareness and familiarity with basic metric units through the use of concrete materials and practical applications.

2. Young children can adapt readily to the metric system. General stages of understanding for young children are the establishment of basic concepts of number, an appreciation of the need for a standard unit of measurement, and the use of metric units to develop "thinking in metric."

3. Conversion between the metric and imperial systems of measurement should not occur at the elementary level and should be limited at any level beyond elementary. When conversion is necessary (e.g. drafting), a conversion table could be used as a temporary measure.

4. Since new textbooks can be expected to have a life of 4-5 years, new textual materials in the primary-elementary area should use the metric system only rather than a combination of both systems.

5. In buying new equipment in the vocational and technical area, schools should consider the ease with which new equipment can be converted to the metric system. Whenever possible, new equipment bought in other fields should be metric only.

II IMPLEMENTATION PHASES

Phase I 1973-74

The basic emphasis within Phase I will be upon familiarizing teachers with the reasons for conversion to and familiarization with the SI units. It is expected that changes in the emphasis upon metrication will occur within school systems in the fall of 1974, beginning essentially but not exclusively in mathematics. Commitment by the Department of Education toward a time range and a plan for metrication should occur.

Teacher Training

1. Preparation of resource personnel with school divisions will be completed by February of 1974. In-service for all teachers will begin in 1974 and will be essentially completed by the end of the 1974-75 school year.

2. Training for elementary teachers begins at the Universities of Manitoba and Brandon. Student teachers will be made familiar with basic SI units of length, mass, volume, and temperature. Training of secondary teachers will provide them with a similar level of competency.

Curriculum

1. Mathematics guides in K-6 will be modified to introduce the metric system and de-emphasize or remove the imperial

system of measurement. "Metric" texts will be authorized.

2. Modification of the approach to teaching the metric system in Grades 7-12 mathematics will be suggested. "Metric" books will be introduced as they become available.

3. The curriculum guide in Industrial Science 103-303 will include the development of the metric system. Modification of the industrial arts program will begin.

Phase II 1974-75

The training of teachers begun in Phase I should be completed by June of 1975. Teacher training programs for particular course changes will occur as course guidelines are modified.

Curriculum

1. Modification of the curriculum guides in science and mathematics (7-12) will occur. Recommendations of materials which include SI units will be included within the modifications.

2. Criteria for metric materials are to be developed within specific fields. Materials in other fields could be recommended and phased into curriculum

guidelines according to availability.

3. Reference texts in the metric system should be made available to all teachers who are concerned with the course changes.

Phase III 1975-79

Teacher in-service sessions will be related to the specific changes as modifications of guides and new authorizations occur. For example, a specific in-service session may be required in geography. The concern of the schools in the area of adult education will vary from rural to urban areas and will also be dependent upon the input by Community Colleges, and various governmental departments. The primary concern of the school in this area will be that of relating what has occurred within the school to the parents. It is also possible that teachers in some areas may be requested to offer a short evening course as adults become concerned about the changes. Support for this area of adult education would appear to be an interdepartmental one.

For example, the Department of Consumer, Corporate, and Internal Affairs should be involved.

Curriculum

1. Modification of guides and authorization of new materials will occur.

2. All students should have texts with SI units within a period of 3-4 years of the modification of curriculum guides.

III ESTIMATED COSTS OF IMPLEMENTATION

A. General Principles Considered

1. Teacher training will generally occur as part of the regular in-service program and thus the costs will be absorbed as part of normal costs.

2. Texts and audio-visual materials will be replaced by school divisions within the normal framework of present grants.

3. Replacement of measuring devices and the addition of kits of concrete materials will be needed.

4. The introduction of changes in curriculum guides related to the metric system will generally be a part of the work of curriculum committees which have broader concerns (e.g. K-6 mathematics committee); thus, limited additional costs will occur within this situation.

5. Adult education costs may be covered by fees or subsidized by other departments of the government.

B. Suggested Costs of Implementation

1. In-service for resource personnel:	
Resource team from the Department of Education	700.00
Costs of meals and lodging for resource personnel from school divisions.	1,000.00
Printed materials for resource personnel and future in-services.	4,000.000
Metric Kit	200.00
TOTAL	5,900.00
2. Kits for teacher training and for use in elementary schools.*	150,000.00
3. Vocational equipment **	
4. Other fields. Minimal costs for new equipment are expected. These costs could be absorbed over a period of time as part of the normal replacement process.	

*Minimum suggested and method of obtaining this value is illustrated in Appendix A.

**Within the item for vocational equipment, minimal costs are expected for the replacement of expendable tools and equipment. Expensive fixed equipment with built-in measuring devices would normally use conversion tables.

APPENDIX A

Minimum amount of equipment is based upon use by 10 classrooms within an elementary school.

Quantity	Item	Estimated Costs
10	Metre sticks	20.00
30	Metric tapes	15.00
1	10-metre tape	8.00
150	Metric rulers	30.00
10 sets	Metric weights	50.00
10	Balance or spring scales	100.00
1	Bathroom scale	10.00
10 sets	Litre containers	70.00
	COST OF KIT	303.00

WS:sz
14/12/73