" NEW GEOGRAPHY" ACTIVITIES

FOR THE

ELEMENTARY SCHOOL

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ABSTRACT

Many new concepts and techniques have been fused together forming the ' New Geography '. Most educational efforts incorporating the new geography have been directed at secondary or post.secondary institutions. As teachers, it is our responsibility to help even the youngest pupils develop ideas characteristic of new geography thinking so that as he grows older he can transfer them to other situations.

This monograph suggests some ways in which suitable new geographical concepts could be included in the existing Quebec elementary school social studies curriculum. It begins with an identification of recent developments in academic geography, and an examination of their possible place in elementary school geography instruction. It attempts to relate the psychological research of Piaget and Bruner to current elementary school geographical education studies. Lastly, it presents some activities which were created for use in grades four and five classrooms of Quebec schools.

CHAPTER ONE

TRENDS IN ACADEMIC GEOGRAPHY AND THEIR PLACE IN THE ELEMENTARY SCHOOL GEOGRAPHY CURRICULUM

Current development in geography reveals a strong trend among researchers to make the discipline more scientific. ' The New Geography ' is the label which geography teachers use to identify recent ideas about the structure of the discipline and geography instruction. How is the new geography different from the old?

The new geography has meant a change in outlook and a broadening of horizons for geographers. Descriptive regional studies of unique qualities found in a particular region are being replaced by a search for similarities or patterns occurring in many regions. Modern geographers are using the results of their research to speculate on the explanation of the recurring patterns they have identified. Rather than just describing and classifying phenomena today's geographers want to accurately predict new locations or occurrences of a phenomenon. Gould (1973) for example states that,

> "...geographers are intrigued by the order and regularity they find in the patterns, structures, arrangements, and relationships of man's work on the face of the earth. Geographers want to find out how things hang together in geographic space, why things are where they are, how they got there and what processes and forces are shaping and molding things mappable."

In Gould's terms, it is the spatial viewpoint which has emerged as the main focus of geographical research. How has the spatial viewpoint changed our thinking about geographic space? Traditionally, the centre of study, the region, was a topographically uniform area within which human features of the landscape could be related to the physical environment. Today the vertical man-land links are being replaced by the horizontal links between regions. Thomas (1973) explains the shift in emphasis as follows,

> " the study of a particular region as a unique entity has been superseded by the search for patterns common to the many regions in which the particular case is only significant as a source of data used in the process of generalization."

He argues that geographers find it more satisfying to view the phenomena of the real world in terms of their 'set characteristics' rather than concentrate upon their individual deviations from one another. Investigation of the order and regularity found in the patterns of real world phenomena requires that geographers learn the use of precise analytical tools rather than use the descriptions and classifications that they had employed previously. The more accurate that the verification procedures are the more support can be given to an hypothesis' ability to explain future locations or occurrences of phenomena.

In order to realize some measure of success in carefully examining spatial distributions geographers are seeking scientific explanations through hypothesis testing. This is a popular route to "respectable" scientific explanation as outlined by Harvey (1969). It requires the formulating and testing of hypotheses and the building of models which will lead to the construction of a body of theory. Geographers are attempting to create models of real world geographical phenomena which will provide the basis for stating geographical laws or theories in order to predict future occurrences.

The search for scientific explanation in geography must be complimented by a full understanding of the particular field of geography involved. From this previous knowledge an hypothesis relevant to the particular problem or spatial distribution under investigation is formed. The rigors of the scientific process require that the hypothesis be stated in clear, unambiguous language and that the hypothesis be tested specifically against a carefully collected sample. On both counts mathematics provides us with the most concise terms to form an hypothesis and the most clearly defined operations for testing the hypothesis against new data. Proponents of the new geography have been quick to accept the need of geographers to be thoroughly schooled in the mathematical techniques most suited to their research. The formal sciences of geometry, topology, and probability theory investigate spatial concepts and have produced techniques and theory which geographers find useful.

The search for geographical laws or theories in order to predict future occurrences of human activity originally started with the premise that man always seeks the optimal location. Research into decision making (Wolpert,1964) led geographers to realize that everyone may have a different rationale for making a particular decision. Geographers are now trying to establish how people's perceptions influence their decisions which are reflected in the spatial patterns of human activities. Thus far it has proven very difficult for geographers to find a method of expressing human behaviour in mathematical terms.

The stress given to spatial organization has been accompanied by a concern that spatial solutions be socially relevant. Geographers are showing increasing concern for the human problems associated with present and future spatial organizations. In the last chapter of Abler, Adams, and Gould: Spatial Organization, A Geographer's View of the World (1971) topics such as trends in the location of human activities, problems of spatial imbalance (eg. encouraging people to live in presently unpopular areas which have the capacity to carry a larger population), and the creation of spatial structures to provide stability in the face of change are all discussed. Harvey (1972) has also reflected a concern that new spatial structures must improve the well being of poor urban dwellers, and Bunge has applied some of these ideas in his Detroit and Toronto "urban expeditions".

An emphasis on pattern identification, process explanation, theory development, and multi-disciplinary involvement in problem solving and planning for the future have profoundly affected the nature of geography instruction. At all levels of the education system, educators realize that the teaching of geographical facts needs to be replaced by the teaching of principles and the ability to solve problems in new situations.

At the university level, there has been a widespread acceptance that geography students must be instructed in the use of acceptable standard methods of scientific inquiry. This has led to an emphasis upon measurement in all branches of geography. Students are learning to express their data in precise mathematical terms suitable to statistical analysis. The development of this new numerical proficiency has helped students cope with the knowledge explosion and the need to organize information and ideas into what Naish (1970) calls vital cores of understanding.

In every branch of geography, there is now a strong emphasis upon the study of process. Conceptually the subject has changed from a predominantly static to a dynamic view of the world. University geography instruction has also been influenced by general systems theory (Harvey, 1969) which helps to emphasize the multi-disciplinary nature of some geographic studies. Current teaching aims to introduce the university student to the fundamental concepts and research methods of geography as a scientific discipline rather than merely attempting to pass on to him a set of geographical facts.

Elementary and secondary school geography should also do more than give a student a set of geographical facts. The elementary school teacher's concern is the total education of the child (as opposed to the university instructor's primary concern for the academic discipline) but elementary school geography can still accommodate to a limited degree the development of academic geography as a scientific discipline. After making allowance for the limited cognitive abilities of young children attention can be given to the possibility of including some aspects of the new geography in elementary school instruction. The inclusion of some topics in the elementary grades can be determined by considering several factors. Aspects of the new geography which are relevant at the elementary school level must be identified. Teachers should search out opportunities in geographical education for experimentation with new teaching techniques.

It must be remembered that the world of today's children is changing so rapidly, that the way they learn is ultimately more important than the facts they learn. The new geography offers elementary school children a new way of thinking about and handling geographical information. Blachford (1973) emphasizes the need for change as follows,

> " Sound habits of inquiry including an ability to conceptualize and a willingness to learn are of greater importance in the long run than the memorization of the results of geographic investigation at any particular time."

The ability to conceptualize is a complex skill for children to master in any subject area and its role in geographical education deserves close attention.

In order to improve childrens' ability to conceptualize, they should be led from simple conceptual experiences to the more difficult ones. This means that the teacher must be aware of the "building block" concepts which make up the subject and how the blocks are organized from the simple to progressively more difficult ones. The imparting to children of the new way of thinking about geographical data centres around the teacher's ability to identify the " building block" concepts of the discipline. The utility of an organization of concepts is expressed well by Simon (1971) when he says that concepts " are the mind's attempt to classify and categorize the buzzing confusion all around us". The development of geographic concepts is important because they guide us to collect only the facts appropriate to that core of knowledge. They tell us what meaning to assign to the data. Concepts change reflecting the dynamic nature of the new geography.

Using Simons' (1971) definitions, there are two kinds of concepts. There are the fundamental ones which are those coming from our sorting of immediate experiences. The second set of concepts are the structural ones which are developed by applying the thought processes to experiences and on this foundation erecting a structure of fact and theory with the new concepts as the building blocks.

The search for an organization of geographical concepts was no doubt prompted by the developments of Bruner, Piaget and others who were receiving wide attention at the same time. Bruner (1960) explained that,

> " the teaching and learning of structure rather than the simple mastery of facts and techniques, is at the centre of the classic problem of transfer. However, much too little is known about how to teach the fundamental structure effectively or how to provide learning conditions that foster it." (p. 12)

Using Pattison's (1964) four traditions of geography, and likely influenced by the education research of Piaget and Bruner, Warman (1968) put forth an organization of geographical concepts. He organized the discipline around the four cores of human-cultural concepts, areal concepts, operational concepts, and dynamic concepts. Within each of the cores he lists relevant concepts at the various age levels where their entry into the curriculum is most suitable. (See Fig. 1.)

Particular concern lies in the approach to instructing elementary school children in some of the areal and operational concepts outlined in Warman's structure of geography. In order to examine how young children can attain these ideas it is necessary to examine the essential skills children develop to communicate intelligence which are most applicable to new geography thinking.

According to Balchin (1970), human intelligence is expressed in four main ways. (Fig. 2) The first is written communication received (reading) or offered (writing) which he identifies as the skill of LITERACY. The second skill of spoken communication (listening and speaking) he identified as ARTICULACY. The human ability to communicate in numbers and mathematical notation is the third skill which Balchin identified as NUMERACY. The last skill used for communicating human visual-spatial intelligence he identified as GRAPHICACY. He said that no one skill of words, numbers, or maps is inferior or superior to the others. They are only more or less suitable for a particular purpose and each has various levels of complexity.

Figure 1. WARMAN'S GEOGRAPHICAL CONCEPTS

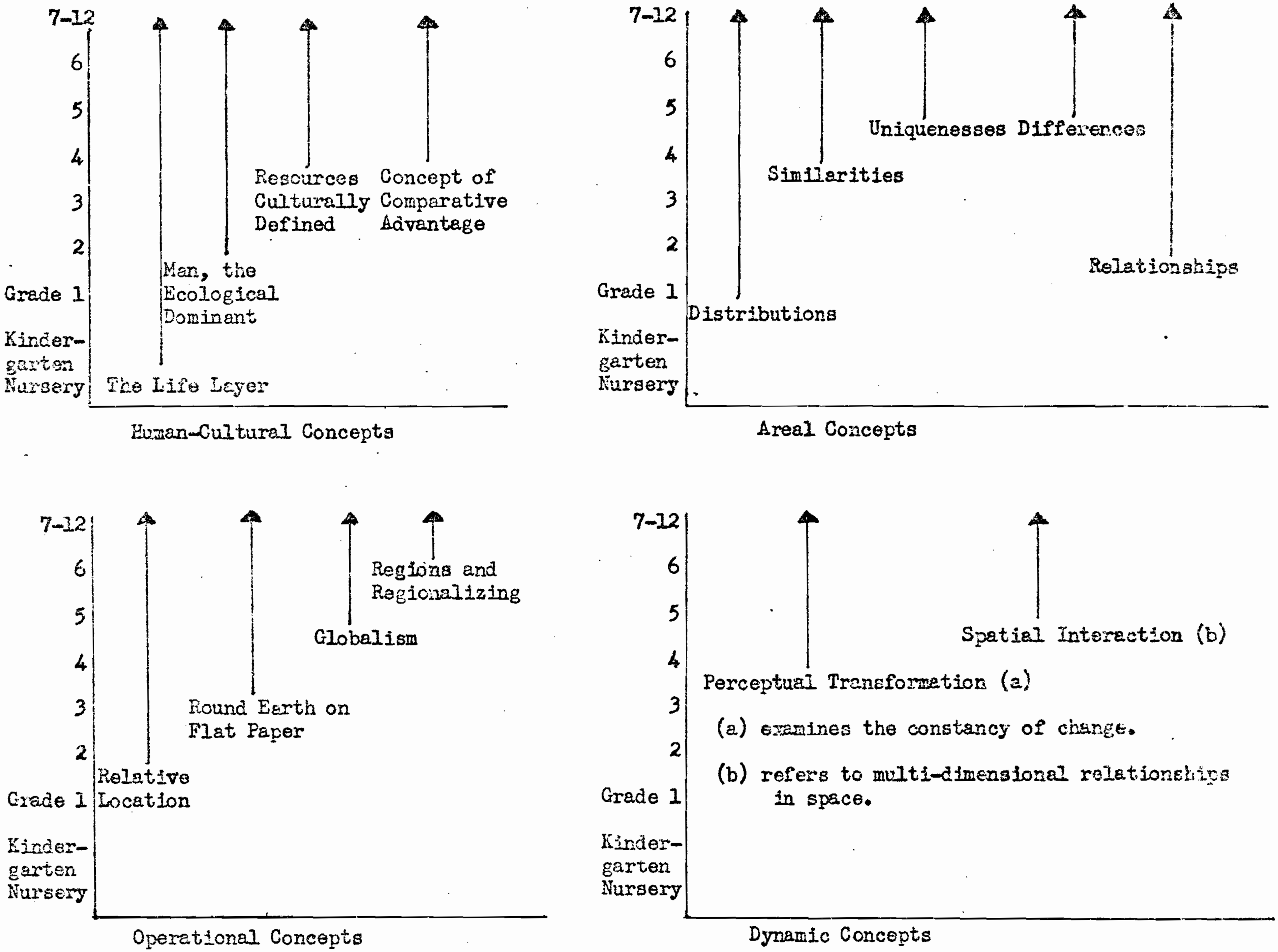
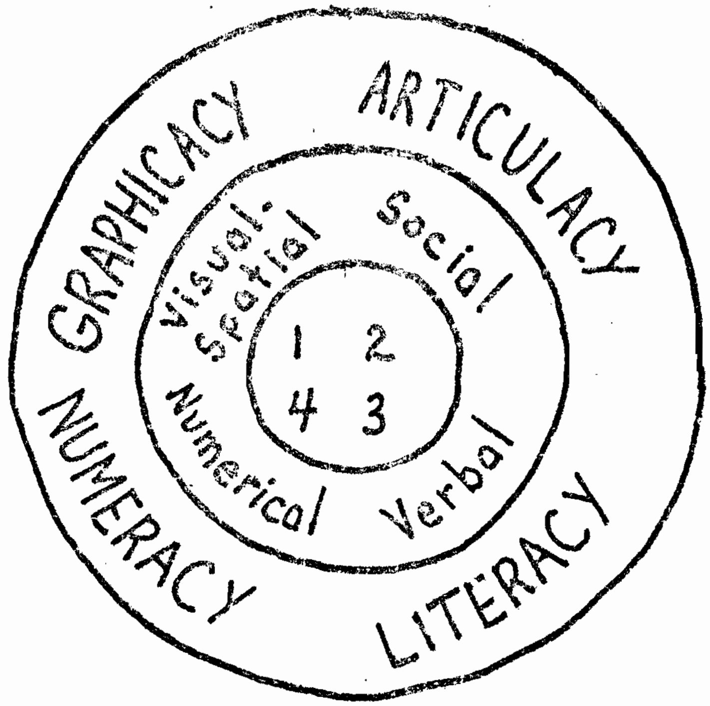
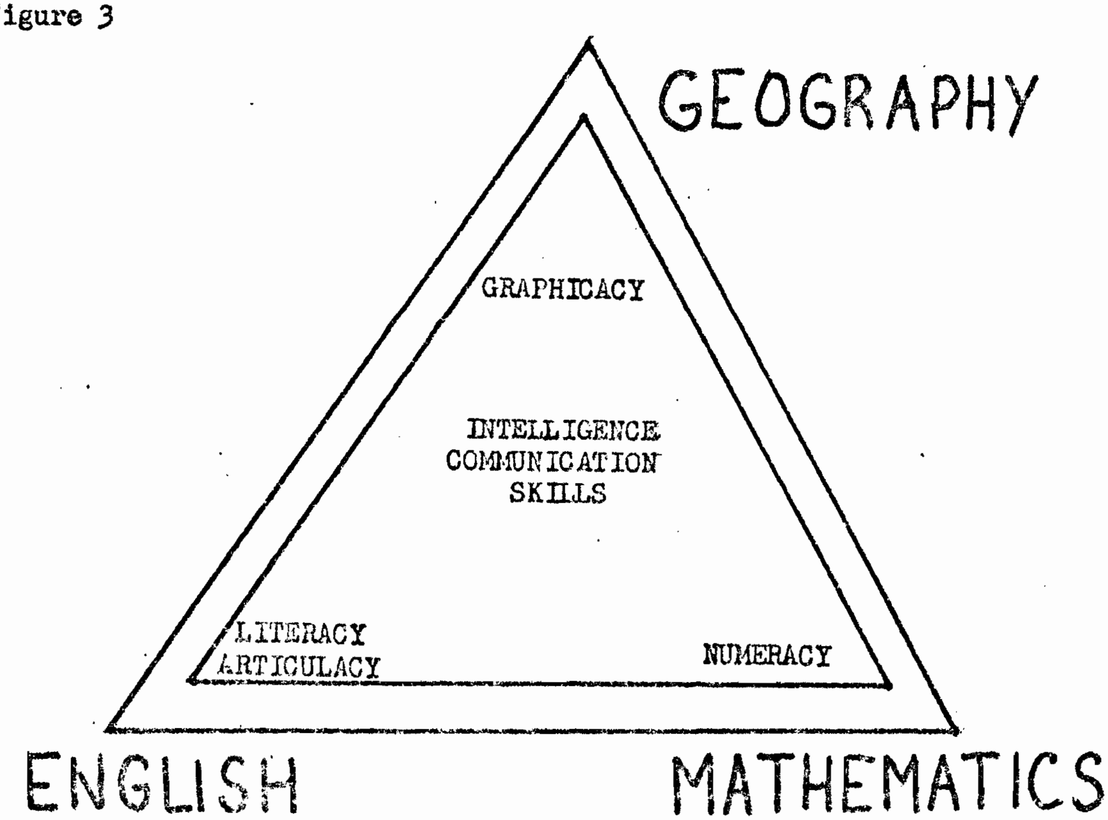


Figure 2



HUMAN INTELLIGENCE SKILLS

Figure 3



HUMAN INTELLIGENCE SKILLS
THE PLACE OF GEOGRAPHY

They are complementary, not interchangeable. Each skill has a contribution to make to the full understanding of a situation. Balchin recognized that all four skills are the goals of education but that some skills are more important than others to the different disciplines which form a child's education.

In the case of geography, Balchin (1972) argues that while literacy and articulacy are important skills, it is NUMERACY and particularly GRAPHICACY which are important to new geography. (Fig.3)

Because of its scientific orientation, the new geography is very concerned with precise measurement. Quantification is an important part of the subject. The trend for society to be more "numerate" coupled with the mathematical emphasis in geography, accentuates the need for more "numerate" geography students. Traditionally mathematical geography relied mostly on Euclidean geometry and trigonometry but now statistical theory is emphasized and some pure and applied mathematics as well. To answer scientifically the "what" and "why" questions of geography, mathematical skills must be used. Gregory (1970) argues that from simple samples, comparisons, and models appropriate to the elementary school, geography can construct a base on which more complex geographical problems can be researched later on. The growth of new mathematics in elementary schools, where children as young as six years are using set theory, presents new possibilities for the inclusion of mathematical skills in geography at a younger age than ever before thought possible.

Cole and Beynon (1970), in their series New Ways in Geography, suitable for nine to twelve year olds, have integrated many mathematical skills in the activities.

GRAPHICACY, according to Balchin (1970) the most important educational skill for geography, is the skill developed from the visual-spatial ability of intelligence as distinct from the verbal or numerical abilities. It communicates those relationships that cannot be successfully communicated by words or mathematical notation alone. Balchin (1970) recognizes GRAPHICACY as a fundamental support for the whole of geography, distinctive in kind but analagous in function to the fundamental supports of other subjects. He says that geography needs an instrument with a reducing power to scale down extensive regions to a convenient size for visual examination. Maps, photographs, and diagrams perform this function as well as aiding the examination of spatial distributions. In reference to the merits of the building block approach to a discipline's hierarchy of concepts, the educational need exists to systematize the whole concept of graphicacy.

Using the systematic approach, Balchin (1970)has tried to develop a sequence of graphical skills that students ought to acquire. Map skills begin with field sketches or landscape drawings which are bound by the horizon and laws of perspective. At the next level the horizon limitation is broken by adopting a higher viewpoint. Extensive areas are condensed into panoramas or block diagrams. At the highest level the perspective bond is broken by going to a higher viewpoint which is more distant, and imaginary viewpoints are arranged in a systematic lattice to give vertical views of all points simultaneously. A map, in the conventional sense, has been created.

The geographer can use diagrams instead of maps when it is necessary to study relationships other than the spatial distribution of phenomena over the earth's surface. Sections are used to illustrate vertical relationships. Time relationships are represented by graphs and dispersion diagrams. Vector diagrams are used for direction comparisons. Pie graphs, bar graphs, and scalar diagrams are useful for making non-directional comparisons. Flow diagrams are good for recording the movement of goods or people. Histograms and scattergrams arrange data in forms suitable for testing.

Storm (1966) has pointed out that many of these topics could be introduced earlier in a child's education sequence and so help most individuals to progress further along that sequence than at present. Balchin (1972) agrees when he states,

> " It is surely at this stage that one can gradually introduce the concept of size, shape, direction, conventional signs, linear and angular measurements, coordinates, densities, colour distinctions, and types of patterns as good foundations for later more complicated concepts in graphicacy."

Cole (1969) argues for the inclusion of mathematical skills of the new geography in the elementary school programme as follows,

> " Man builds up an awareness of the real world; he puts labels to specific places. The bridge between his mind and the world of his experience (or sometimes imagination) is provided by pictures, photographs, maps and models. Mathematical concepts and procedures, including numbers, quantities, measurements, Euclidean and topological geometry, are all a vital part of the operation. Clearly a child must be able to learn at an early stage something about distance, direction, the location of places by coordinates and by parallels

and meridians. Symbols representing various real world objects in the form of dots, lines and patches should also be appreciated.
Once the general scope of mapping has been sorted out in a child's mind, it is desirable to be able to collect, tabulate, and process information about places mapped. This is helped by some notion of statistical techniques, including the idea of a histogram and of ordering data and of finding averages."

Bailey (1974) states that geography grows from that part of the child's perception of his place in a world where spatial relationships are important. The special education contribution of the geography teacher is to begin with the child's spatial perception and to develop, systematize, and elaborate it. He argues that geography has a special part to play in the development of spatial concepts. Maps provide an economic medium for communicating spatial ideas and information. Map work demands a wide range of skills, the chief of which are the capacity to relate the ground to the map and vice versa, and to translate spatial information and ideas to and from map form. A person's spatial viewpoint of the world changes with age but it can be modified significantly by experience.

The stage at which various aspects of the new geography are introduced to elementary school children is important. The research of Piaget shows that maturation plays a significant role in concept attainment but other studies (eg. Bruner) reveal that the acquisition of some spatial concepts can be facilitated by carefully structured activities which reflect the hierarchial development of the particular concept.

CHAPTER TWO

THE NATURE OF LEARNING AND ITS RELEVANCE TO GEOGRAPHICAL EDUCATION

The acquisition of skills for the communication of spatial ideas and information is a most important part of the new geography. The special education contribution of the geography teacher is to identify the child's current level of spatial awareness skills and to systematically develop them. As Cole (1969) has stated, people gradually build up an awareness of the world. The bridge between what they experience and what they imagine is provided by pictures, photographs, maps, and models. Mathematical concepts and procedures of number, quantities, measurements, Euclidean geometry, and topology all contribute to this bridging operation.

Many geographers feel that these skills contributing to improved spatial awareness can be introduced in elementary school if the concepts are presented at a suitable level of difficulty. Geographers such as Balchin (1970), Cole (1973), have claimed that certain mathematical skills pertaining to the new geography can be introduced to children at an early stage and, recently, support for these claims has been sought in research in educational psychology. In this regard, the works of Piaget and of Bruner bear particular importance.

Piaget's theory of cognition and Bruner's idea of a spiral curriculum are reviewed before examining in detail Piaget's research about the development of spatial concepts. They provide a broad framework of the nature of learning within which the development of specific spatial concepts which are relevant to elementary school geography instruction can be examined.

PIAGET'S THEORY OF COGNITION

Piaget (1952), in his theory of cognition development, has postulated that a child's thinking develops in stages. He argues that cognitive development is a coherent process of cognitive structures or schema changes which derive logically and inevitably from previous structures. He divides intellectual growth into four stages, the order of which is more important than the approximate age limits which mark the transition from one stage to another. Piaget argues that although all children do not necessarily proceed along a continuum of intellectual growth at the same rate, all persons pass through each successive stage in a similar manner.

The Sensori-Motor Period

Piaget (1952) identifies the first period of intellectual growth as the sensori-motor period. During this time behaviour is primarily motor; that is, the child is "acting on his environment". At the completion of this stage he has developed the concepts of object permanence, causality, and has identified himself as one object among many occurring in space. At the end of the sensori-motor period the child has reached the point of conceptual development that is necessary for the introduction of language and other cognitive skills which are characteristic of the next stage.

The Preoperational Period

During the second stage, the preoperational period, the child relies less and less on sensi-motor activity and functions more at a concrete symbolic level. The development of language symbols to replace objects is the most important progression which evolves at this time. Language development begins with "egocentric speech" when children speak in the presence of others with no apparent concern for communicating with them. At the end of the second stage language has become "socialized speech" when conversations clearly involve an exchange of ideas with others. This new language ability allows conceptual activity to proceed more rapidly than sensi-motor activities did. However, the development of language does not automatically lead to logical thought.

During the preoperational period, cognitive behaviour is still overwhelmingly influenced by perceptual activities. Logical thought development, according to Piaget (1952), is hampered by the child's inability to recognize viewpoints other than his own (egocentrism). Failure to recognize viewpoints other than the egocentric one is the result of several contributing factors. The child is unable to imagine another viewpoint from a different location (transformation). In addition, the child is unable to imagine removing himself from the scene to gain a general overview (decentration). Another difficulty is the child's inability to retrace in his imagination the necessary steps in order to identify a point of origin and the subsequent events which led to the present location (reversibility).

The ability to conserve numbers (such as 7 is the same as 5+2 or 10-3) usually develops during the second stage. Although this and some other conservation structures appear in the preoperational stage, generally the ability to conserve quantities such as equivalent shapes and linear distances which are relevent to geography, are slow to develop at this stage.

Preoperational thinking is egocentric. Even in the face of contrary evidence, children unconsciously believe their way of thinking or viewpoint is the correct one and that it is shared by everyone. It is only when peer group conflicts appear that they begin to question and attempt to verify their thoughts.

Preoperational thinking is also characterized by the child's inability to focus on the process of transformation. Each event or object is treated separately for the child is unable to remember events in a certain order.

The child's attention to one perceptual centration means that he is unable to explore all the possible views of an event or object. Any cognitive activity is dominated by personal perceptual bias. The child is ready for the next stage when he is able to decentre from the perceptual aspect and coordinate it with cognitive activity.

The Concrete Operations Period

During the third stage, the concrete operations period, the child develops logical thought processes to apply to concrete problems. Logical operations dominate where perceptual ones had previously. The obstacles of egocentrism, transformation, decentration, reversibility, and conservation no longer impede the solution of concrete problems. However, the child cannot yet apply logical thought processes to purely hypothetical or verbal problems. At this stage, the child develops the ability to remember events in a certain order and will seriate the elements of a set according to some criteria. He also recognizes that an object may belong to more than one set simultaneously.

The Formal Operations Period

During this stage the child's cognitive structures reach maturity. At this level theories and several operations can be used simultaneously when attempting to solve a problem. The child now has the necessary cognitive structures to apply logical operations to all classes of problems.

Transition Through Piaget's Periods of Learning

At each new stage of cognitive development previous level structures are incorporated. The processes of assimilation and accommodation of experience permit the continuous development of qualitatively improved cognitive structures.

According to Piaget (1952), the development of these cognitive structures is the same for all children, although he admits the age of their attainment may vary according to intelligence and social environment. For young children, the time spent in school constitutes a large part of their social environment. Readiness to learn is an important part of the school's social environment. Curriculum sequences should be designed which take into account the stages of cognitive development. Piaget (1952) states that children will not attain higher level cognitive structures if they do not have the prerequisite cognitive skills.

THE WORK OF JEROME BRUNER

Bruner (1965) is also concerned with the continuity of learning. He argues that school curricula and instruction methods should be geared to the teaching of the fundamental ideas of each particular subject. In order to accentuate the underlying principles of a subject, the fundamental ideas of the subject must be identified and given a prominent role in the curriculum, and these ideas must be incorporated in materials suitable to children of different grade levels and different capabilities.

Bruner (1965) makes four general claims for teaching the fundamental structures of a subject. He says that if one understands the fundamentals then the subject is more comprehensible. Secondly, the comprehension of a subject's fundamental structure helps students remember and recall relevant details when needed in the future. Thirdly, the understanding of fundamental principles is a positive factor for adequate transfer of training to other situations that students may encounter. Lastly, by accentuating the fundamental concepts of a subject, the gap between elementary school and higher level learning may be narrowed. Bruner argues that youngsters acquire outdated material which lags too far behind academic developments.

He hypothesizes that any subject can be taught effectively in some " intellectually honest " form to any child at any stage of development. Bruner and the participants at the Woods Hole Conference viewed intellectual development in the stages which Piaget identified. While Piaget's four stages of cognitive development are all reviewed in the conference records, the most attention is paid to how the basic concepts of a subject should help the child pass progressively from Piaget's concrete thinking stage to modes of thought more characteristic of Piaget's formal operations period.

Bruner (1965) postulated that higher conceptual learning is best attained by revisiting fundamental ideas at progressively higher conceptual levels of learning. He referred to this arrangement as a SPIRAL CURRICULUM. If we recognize the stages of thought development in the growing child, and if material is adapted to an appropriate level, then Bruner says it is possible to introduce a child to mature ideas at an early age. This includes the development of good habits of scientific inquiry which are so important for organizing and giving meaning to the knowledge one has acquired.

RELATING QUEBEC'S SOCIAL STUDIES CURRICULUM CONTENT TO PIAGET'S LEVELS OF THOUGHT

Geographical education should progress in tune with the levels of cognitive abilities characteristic of elementary school children which were documented by Piaget. Children enter kindergarten usually operating at Piaget's preoperational period and will probably have completed the concrete operations period when they leave elementary school. As elementary school teachers, we must remember that we are instructing children who are operating below the formal operations level and who therefore have a restricted cognitive behaviour. Admittedly the ages which Piaget attaches to each period are approximate, but it is useful to remind ourselves of the equivalent Canadian grade levels applicable to each of Piaget's stages of cognitive development. (Fig.4) The Quebec geography curriculum content as outlined in the Baldwin-Cartier School Board Elementary Curriculum Guides for Social Studies are included for each grade level.

The choice of content for each grade level takes into account the cognitive abilities characteristic of each of Piaget's stages. The study of the immediate and local environment in grades one and two is a good one. Piaget (1960) reminds us that primary grade children can better conceptualize areas where they have lived, worked, or played. They recognize often travelled routes by familiar landmarks on the way.

Figure 4.

PIAGET'S LEVELS OF COGNITIVE DEVELOPMENT	AGE LIMITS	CANADIAN GRADES	QUEBEC GEOGRAPHY CURRICULUM CONTENT
Sensori-Motor Period	0-2 yrs.	-	-
Preoperational Thought Period	2-7 yrs.	Kindergarten	The Child- Work and Play, Holidays and Events, The World Around Us.
		Grade 1	Immediate Environment - Me and My Family, Exploring Our School, People at Work, Farms and Towns, Animals and Their Environment.
		Grade 2	Local Environment - Our Neighbourhood, Suburban Neighbourhood, City Neighbourhood, Neighbourhoods Change.
Concrete Operations Period	7-11 yrs.	Grade 3	Regional Environment - Our Municipality, Our Region, Landforms, Weather, Climate, West Island in the Past, Today, Services, Transportation, Industry, Commerce.
		Grade 4	Living in Montreal - Introducing Montreal, Situation of Montreal, History of Montreal, Growth of Montreal, Montreal Today, Things to See, Transportation, Business and Industry.
		Grade 5	Living in Canada - Regions of Canada
		Grade 6	Living in the Americas - Southern Continents
Formal Operations Period	11-15 yrs.	Grade 7	

By grade three most children are at the concrete operations stage and are able to apply logical reasoning to concrete problems. The grade three, four, five, and six geography curriculum content takes this into account. It begins with the regional environment or municipality (grade three), expands to the Montreal area (grade four), then enlargens to include all of Canada (grade five), and finally encompasses other continents (grade six). The study of other continents in the last elementary grade challenges pupils to reach higher levels of cognitive ability characterisitic of the formal operations period.

Throughout the series of social studies curriculum guides, the skills to be developed at each grade level are listed. Although the material for each level differs, it is noteworthy that the important skills of identifying, classifying, locating, directing, sequencing, and measuring are repeated as necessary acquisitions at almost every grade level. The success with which these primarily mapping skills are mastered is to a great extent dependent on the child's spatial concept development.

A child's understanding of space begins with simple topological relationships and develops into a projective and finally Euclidean space. Therefore, the construction and interpretation of maps in elementary school geography is dependent upon the level of space concept development of the child.

PIAGET AND SPATIAL DEVELOPMENT

The fullest description of how a child acquires more mature concepts of space is probably found in Piaget's The Child's Conception of Space (1956) and The Child's Conception of Geometry (1960). He explains some of the difficulties experienced by children in the drawing of maps in terms of the development of spatial concepts. Piaget (1956) concludes that the child's space is essentially active and operational in character and that it evolves from a perceptually dominated space to a conceptualized space.

He found that children progress from a topological (two dimensional) space to a projective (three dimensional) space followed by a transition to Euclidean (three dimensional measured) space. Topological space is purely internal to a particular figure or object. The child is only able to relate to one object at a time which appears on the surface (one to one correspondence). The use of projective space is attained when the child gradually changes from a one to one correspondence and includes not only the relationship between himself and the object, but can imagine all possible relationships of one object to another (many to one correspondence). Euclidean space evolves when the projective space relationships are assigned precise linear and angular measurements. The transition through topological, projective, and Euclidean space is concurrent with the child's progress along a perceptual to conceptual space continuum.

The perception of topological space involves the gradual construction of topological space relationships during early childhood. Through sensi-motor activity on their environment children develop five basic topological skills. The proximity of an object is important and this skill alters with age when finally elements of the whole situation are related to each other over greater distances. A young child also develops the ability to separate objects in the visual field. Next he is able to perceive the multi-dimensional nature of an object's position. As the child begins to consider more than one object in the visual field simultaneously, he develops the skill on enclosure (eg. in a series A,B,C, B is surrounded by A and C). Finally, as the relationships of proximity and separation improve, the preschooler recognizes the continuity of topological relationships.

During the preschool years, children make their first beginnings in conceptual space by representing their perceptual space through drawings. Initial map work essentially involves the graphic representation of a child's perceptual space. Therefore, it is important to examine how primary grade children treat the spatial relationships of their perceptual space when reconstructing them in their conceptual space.

Piaget (1956) found that the five basic topological skills appear in the drawings of five to seven year olds but the projective and Euclidean relationships are just barely emerging. Even though these children recognize some projective relationships in their perceptual space, their drawings lack coordinated points of view or a general reference system, and many different points of view all appear in the same picture. Simple geometric shapes are used to represent isolated objects not to help organize space.

At eight or nine years children are using projective and Euclidean relationships in their perceptual space, and their drawings or conceptual space attempt to incorporate perspectives, proportions, and distances simultaneously. However, Piaget (1956) found that projective and Euclidean spatial abilities are slow to develop in conceptual space. At this stage the child attempts, often unsuccessfully, to use projective and coordinate systems to indicate relative positions of individual figures in the whole.

In order to successfully use a coordinate system, the child has to pass through the stages of realizing he has a single viewpoint at any one time, that many viewpoints exist and to discriminate between them, and finally to coordinate the many viewpoints in the imagination. Children are eight to nine years old before they reach the stage of visual realism and apply the laws of perspectives systematically. At this age children try to conceptualize transformations in operational fashion by trying to understand the laws governing these transformations. Grade three and four children can orientate objects one to another, and distances between groups of objects can be compared, but they cannot coordinate true positions and relative distances in an overall way. Piaget (1956) found that only after age eleven or twelve years are true conventional reference systems developed enabling positions and distances to be compared simultaneously. These developments were documented in Piaget's (1956) "mapping" experiments about diagrammatic layouts and making a model village.

In the first experiment children were required to place a doll on a simple diagrammatic layout to represent a certain point of view. Preschool children could not even attempt the task. School children up to seven years placed the doll in relation to two or three objects but still showed no understanding of a point of view. Gradual progression in coordination by constant alterations of both projective and Euclidean relationships finally culminates in the ability to arrange an entire group of objects on the layout correctly by the time the child is nine years old.

In a second experiment, Piaget (1956) asked children to replicate a simple village from an orientation different from the original he was shown. Preschoolers crowded many objects into one corner of the paper. Not only did they fail to conceptualize the spatial correspondence between objects, but they also were unable to remember the number of objects correctly. By age seven years children matched the number of objects correctly but still did not use all the available space. Some items were sequenced correctly and placed in correct proximity to each other, but no overall reference system was evident. Between nine to twelve years of age a well coordinated system of reference is achieved, indicating that conceptual relationships have superseded perceptual ones. A child is usually twelve years old before he can draw a schematic plan as a substitute for the model.

Piaget (1956) concluded that mathematical intuition about space consists of actions performed on it which enrich and develop the physical reality eventually leading to a more mature conceptual space. Spatial perception takes place in the presence of an object, whereas the image arises only in its absence. Therefore, Piaget concluded that it is understandable when perceptual space develops far more rapidly than conceptual space.

GEOGRAPHICAL RESEARCH ON THE SPATIAL ABILITIES OF ELEMENTARY SCHOOL CHILDREN

The evidence about cognitive and spatial development put forth in the research of Piaget resulted in renewed research in geographical education. Geography teachers expressed new concern about what and how geography is taught in the schools. If one accepts the conclusions of Piaget, the direction of geography teaching in elementary schools is clear.

Geography activities in the primary grades should reflect the limited cognitive ability of young children and the perceptually dominated space they live in. Action on the environment is a big part of a child's early development of space concepts.

Towler (1971) repeated Piaget's model village experiment and he too found that primary school children were not even aware that the orientation of the model was changed. He concluded that young children see the world from their location and cannot imagine its view from another vantage point.

Blaut and Stea (1971), felt that these conclusions said very little about a child's ability to deal with map like representations of conceptual space. They wanted to find out how young children handled maps whose meanings were not dependent on a symbolic language system which they had never been taught. Aerial photographs were the most obvious example of simple maps and Blaut and Stea (1971) hypothesized that if primary grade students could interpret these photographs then it can be assumed that they can perform the basic perceptual to conceptual transformations involved in map reading. In opposition to Piaget, Blaut and Stea hypothesized that in terms of scale, distance on the photograph could at least be ordinally compared to distances on the ground. In terms of projection, they thought that direction and shape which are familiar from a roughly horizontal perspective can be recognized through a ninety degree rotation. In terms of abstraction, Blaut and Stea hypothesized that young children could understand and use iconic or pictorial symbols and signs to represent real world images. After testing several different groups of students, they concluded that preliterate children can read aerial photographs. The children could also trace a simple map from the photograph and abstract to semi-iconic map signs and were able to solve a simulated navigation problem on their map.

It seems that given the appropriate material, in this case, an aerial photograph of the homebase area, young children were able to overcome many of the barriers such as change of viewpoint which had been highlighted by Piaget. They were also able to make the transition from a primarily perceptual space to a conceptual space.

Another experiment designed by Muir (1970) aimed to teach grade one children to read and draw a 1:12,000 planimetric map. The children began with interpretation exercises based on a 1:2,700 vertical photograph at the same scale. Pre and post test analysis showed that the children learned to make maps and read certain abstract map signs.

Hart (1976), in his curriculum experiment with third grade children set out to show that geographic theory can be taught with the aid of aerial photographs to primary grade students. Beginning with large scale small area photos of the school and progressing to small scale large area photos of the Worcester, Massachusetts area, he introduced such concepts as pathways, neighbourhoods, political-administrative territories, centrality, central business district, industrial land use, interurban transportation network, and a hierarchy of local central places. He also found that by letting children play on a floor-sized aerial photograph as a substitute for the view from an airplane, they verbalized some high level geographic concepts.

It seems possible, despite Piaget's evidence to the contrary, to introduce many high level geographic concepts to young children provided that attention is paid to the level of space concept that these children have. Their primarily topological perceptual space, the strongest cognitive asset of primary grade children, can be improved through the use of aerial photographs and many difficult geographic concepts can be understood.

Children in grades four to six are usually at Piaget's concrete operations level of thought and they are able to apply logical thought processes to concrete problems. In terms of spatial concepts, upper elementary level pupils recognize projective and Euclidean relationships in their perceptual space. They try to reconstruct these relationships in their conceptual space, but they still have difficulty coordinating relative positions and distances in an overall way. During grades four to six, as thought processes mature, pupils are capable of handling more abstract ideas which they have not necessarily experienced.

Geographical education in the upper elementary grades should help bridge the gap between what the children have experienced and what they imagine. Many geographic activities can be used which encourage grades four to six children to think and reason more maturely and to develop sound habits of scientific inquiry. Activities framed as problems to be solved best enable upper elementary school children to exercise more mature investigative and reasoning powers. The making, reading, and understanding of maps is an integral part of the solution to these problem solving activities.

The successful use of maps is possible only when certain skills are developed. These include an understanding of scaled distance, an ability to differentiate directions and describe locations, and an ability to use symbols.

In very simple form, maps may indicate the space occupied by a single object but more complicated maps, because of limitations of scale, may only give the general location of an object. In their early map-like drawings, children soon learn that it is not normally possible to show graphically the space actually occupied by an object. Towler and Nelson (1968), in their Piagetian styled research, found that the concept of scale was not well developed before grade five or six. Rarely can elementary school children compare sensibly two maps of differing scale because they are unable to transfer from one situation to another. Therefore, any activities which asks children to compare maps should use maps of equal scale which adequately reflect real life proportions. The Schools Council Environmental Project (1972) suggests that accurate scale ideas are best developed through making and using large scale maps of the immediate locality before progressing to smaller scale maps. Exercises in <u>Starting With Maps</u> (1972) ask questions about scale which grades four to six children ought to be capable of answering. They involve straight line and route or curved line distances.

An ability to use directions correctly and to describe the location of a particular object are of major significance for map making and reading. Usually by grade four, children are familiar with the cardinal points and their use as a reference for locations on a map. However, the concept of a conventional grid reference system at this age is poorly developed. According to Piaget (1956), groups of objects within the whole are located at relative locations, but they are not coordinated throughout the whole. Map work with grades four to six students should take this limited orientation ability into consideration. Particular points can be described in terms of their relationships to recognizable features. When children study local area maps, they should be led to relate locations to some familiar place- quite often their homebase. Bartz (1971) favours such location reference when she says,

> " Shapes, boundaries, and fixed landmarks become a framework into which new spatial information which would otherwise have only random meaning, can be integrated and organized."

At the outset of map drawing children often use pictorial symbols to represent objects. Olson (1968) found that the strategies employed by children to solve problems change drastically when they can use more powerful tools of symbolic representation. Upper elementary school pupils should progress from using the pictorial symbols of the primary grades to the abstract ones such as dots and lines. Bartz (1971) suggests that spatial concept development might be more effectual if children had to map things themselves, If given the opportunity, she argues that children are capable of categorizing data which they may possibly have collected on their own. Creativity in encouraged by letting them translate their observations or numerical data into spatial forms. After providing a simple base map, the child may solve the problem of representing data on it, and is faced with the real problems of how to organize and categorize data and worrying about what symbols and colours will be most effectual. Bartz (1971) concludes that if a child can solve the problems of making a map, it nearly guarantees the ability to read them.

An exposure to investigating and accounting for distributions which are an important part of new geography should be included in upper elementary grade geographic activities. The study of distributions or patterns of phenomena which are stressed in the new geography are clearest when they are expressed mathematically. If grades four to six pupils are going to study distributions, then the mathematical skills involved in probability and simple statistics must be adequetely developed. Bruner (1965) states that games in which lots are drawn, games of roulette, and games involving a gaussian distribution of outcomes (particularly relevant to geography) are all ideal for giving the child a basic grasp of probabilistic reasoning. In such activities children acquire a notion of chance defined as an uncertain event contrasted with deductive certainty.

Romberg and Romberg (1976) suggest that upper elementary grade students should begin to develop distributions, compare two or more distributions, and begin to examine probabilistic concepts utilizing problem situations already familiar to most students. The Cambridge Conference on the Correlation of Science and Mathematics in the Schools (Romberg and Romberg, 1976) recommended that simple descriptive statistics be introduced in levels kindergarten to grade two, that intuitive and elementary probability be introduced in grade three and four, and that the properties and applications of probability be introduced in grade five and six. As argued by the conference participants, probability and statistical instruction is vital because they supply a natural link between mathematics and the social sciences.

SUMMARY

The grade by grade development of elementary school geography should respect Piaget's periods of cognitive development. It should emphasize the fundamental concepts of geography in a manner outlined by Bruner as the fundamental structure of a discipline set in a spiral curriculum.

As children progress through Piaget's levels of knowing, they are able to handle ideas which they may not have experienced. Quebec's elementary school geography curriculum reflects this progression from what a child has experienced to what he imagines when it starts with the immediate surrounding in kindergarten and grade one and expands to include other continents in grade six.

Primary grade children are normally in Piaget's preoperational thought period and are operating primarily in a topological perceptual space. Contrary to Piaget, however, it seems possible for grades one to three children to reach a more mature conceptual space if they are given suitable materials. Piaget's experiments, with which grades one to three children had great difficulty, relied on general materials (model toys were used to make the village). Blaut and Stea, however, appealed to the childrens' knowledge of a familiar area when they used large scale aerial photographs of the school and surrounding area. Many of the obstacles outlined by Piaget as barring young children from progressing to a conceptual space, were overcome. Suitable material, in this case, aerial photographs, helped the young children reach more mature spatial concepts.

Action in the immediate environment continues to be important in grades four to six. Using the homebase as a source of material, grades four to six students can develop mature mapping skills and appreciate simple probabilities and statistics as a means of solving close to home geographical problems. The use of the homebase area as a source of raw data fosters sound habits of scientific inquiry.

The acquisition of fundamental concepts of the new geography are comprehensible and interesting for elementary school students if carefully sequenced teaching practices are employed which reflect the nature of how children learn.

CHAPTER THREE

ACTIVITIES FOR THE NEW GEOGRAPHY TEACHING IN ELEMENTARY SCHOOLS

Most educational efforts emphasising aspects of the new geography thinking have been directed at secondary or post secondary schools. However, one noteworthy exception is the series New Ways in Geography by Cole and Beynon (1970). They thought that some of the new geography concepts, if suitably presented, could easily be taught to nine and ten year old children and would indeed appeal to their interests and experiences.

Cole and Beynon point out that geography taught as the acquisition of an encyclopedic knowledge of places and products of places has left many children bored and uninterested in geography. As an antidote, they suggest that studies should focus on such topics as "measurement", "map reading- symbols, coordinates", "distance- land, air, and time as measures of distance", "network analysis", "optimum locations- busiest places, routes", "diffusion processes", and "perception of places". (See Appendix 1) Situations familiar to British nine and ten year olds are used to illustrate these ideas. Cole and Beynon, most often start with situations in a small geographic area such as a school district, and proceed to successively larger regions. This is a development which is in keeping with the progression of widening experiences which young children have. The aspects of the new geography developed by Cole and Beynon (1970), should also be an integral part of elementary school geography in Quebec. Taking into consideration the many ideas included in New Ways in Geography, the six topics of spatializing the perception of neighbourhood and urban area, mastering the skill of classification, new dimensions in mapping (histograms, Venn diagrams), investigation of different patterns of spatial distribution, the concept of probability, and network analysis are developed. The activities which follow are suitable for geography instruction in grades four and five, and are meant to supplement the existing programme. While they are specifically directed at the City of Laval and environs, the exercises are generally applicable to any urban area.

SPATIALIZING THE PERCEPTION OF THE NEIGHBOURHOOD AND THE URBAN AREA

As a child grows, he builds up an awareness of the world. We all carry with us "mental maps" (Gould, 1974) of areas familiar to us. Perceptual and behavioural geographers feel that an understanding of the way in which men perceive their environment may at least help explain many of the spatial patterns of human activity which have been observed. Geographical studies relating people's perceptions to locational decisions of industries, agriculture, and new home areas are numerous. (eg. Saarinen 1966, Kates 1962, Burton 1964, Gould 1966)

Interesting field work can be done in the local area by having the children explore the concept of a neighbourhood. Just as Lynch (1960) was able to study the different images which people have of a city, so can children identify the areal extent of their "action" or "social" space.

In the first activity, similar to that of Friedman (1968), by keeping a record and mapping their daily travels for a week, children are able to establish the extent of the neighbourhood in which they live, work, and play. The neighbourhood compiled on the class map is defined as the area frequented by more than ten class members during the week. The number ten is arbitrary and students may decide to use another number.

A comparison of each student's neighbourhood map to the neighbourhood identified on the class map can give the child the opportunity to participate in a simple perception exercise. (Activity 2) Children quickly see that no two students have mapped the same neighbourhood. They might then be led to consider why the responses are so different. Is the neighbourhood delineated by a new classmate different from that of a student who has lived in the area for several years? Why?

By asking parents to map their social space (Activity 3), children see that perceptions of the neighbourhood are different again. Do all the parents mark larger neighbourhoods than the children ? Why?

In the last exercise (Activity 4), the same technique of recording and mapping is used for the parents' journeys to work. Using this information and an aerial photograph of Laval and Montreal, the child can spatially represent the urban area in which his family lives.

ACTIVITY 1 IDENTIFYING THE LOCAL AREA

On a street map of Laval, your teacher will help you identify your home location. You will also receive eight outline maps of Laval.

Your job is to record on the map where you travel each day. You will use one map for each day of the week. At the end of the week try to shade in YOUR NEIGHBOURHOOD based on your journeys of the last seven days. Use the map that is left over.

The daily travels that you and your classmates record will be put together with your teacher's help on the class map of Laval on the following day.

At the end of the week the class can identify the outer limits of the neighbourhood by joining those places where fewer than ten students visited.

The area inside the boundary that you made (where more than ten students visited) identifies the NEIGHBOURHOOD used by your CLASS.

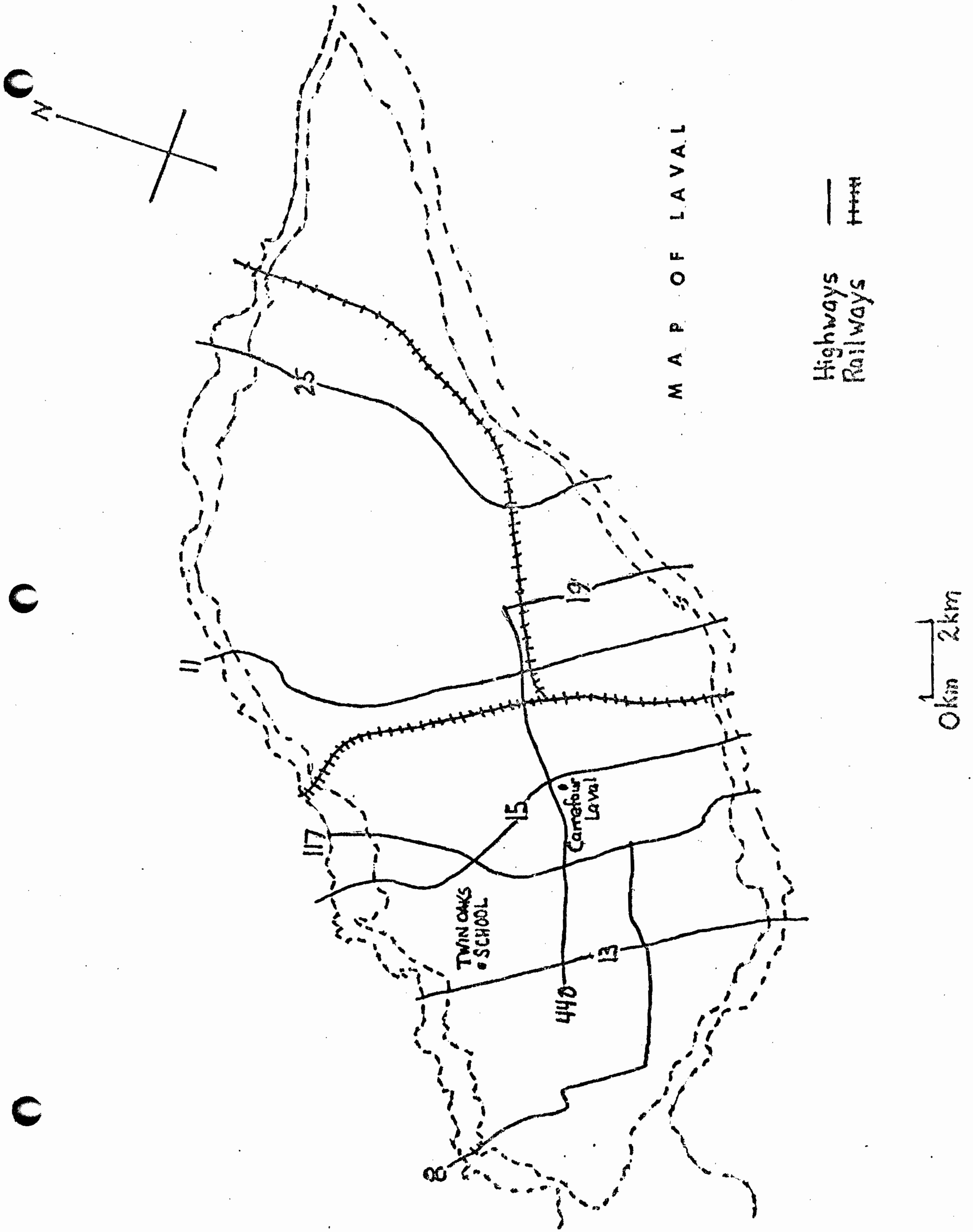
ACTIVITY 2 COMPARING NEIGHBOURHOODS

Compare YOUR NEIGHBOURHOOD map to the CLASS map. Is your neighbourhood larger or smaller than the one recorded on the class map?

Compare your map with those of your friends. Are they the same? Why?

ACTIVITY 3 COMPARING NEIGHBOURHOODS WITH YOUR PARENTS

On an outline map of Laval, ask your parents to sketch what they consider to be the neighbourhood in which they live. Is your parents' map the same as the one you made? Why? Were there areas outside of Laval that your parents wanted to include in their neighbourhood but couldn't?


MAP OF LAVAL
Highways
Railways
0km 2km
N
25
19
11
117
15
13
440
8
Carrefour Laval
TWIN OAKS SCHOOL

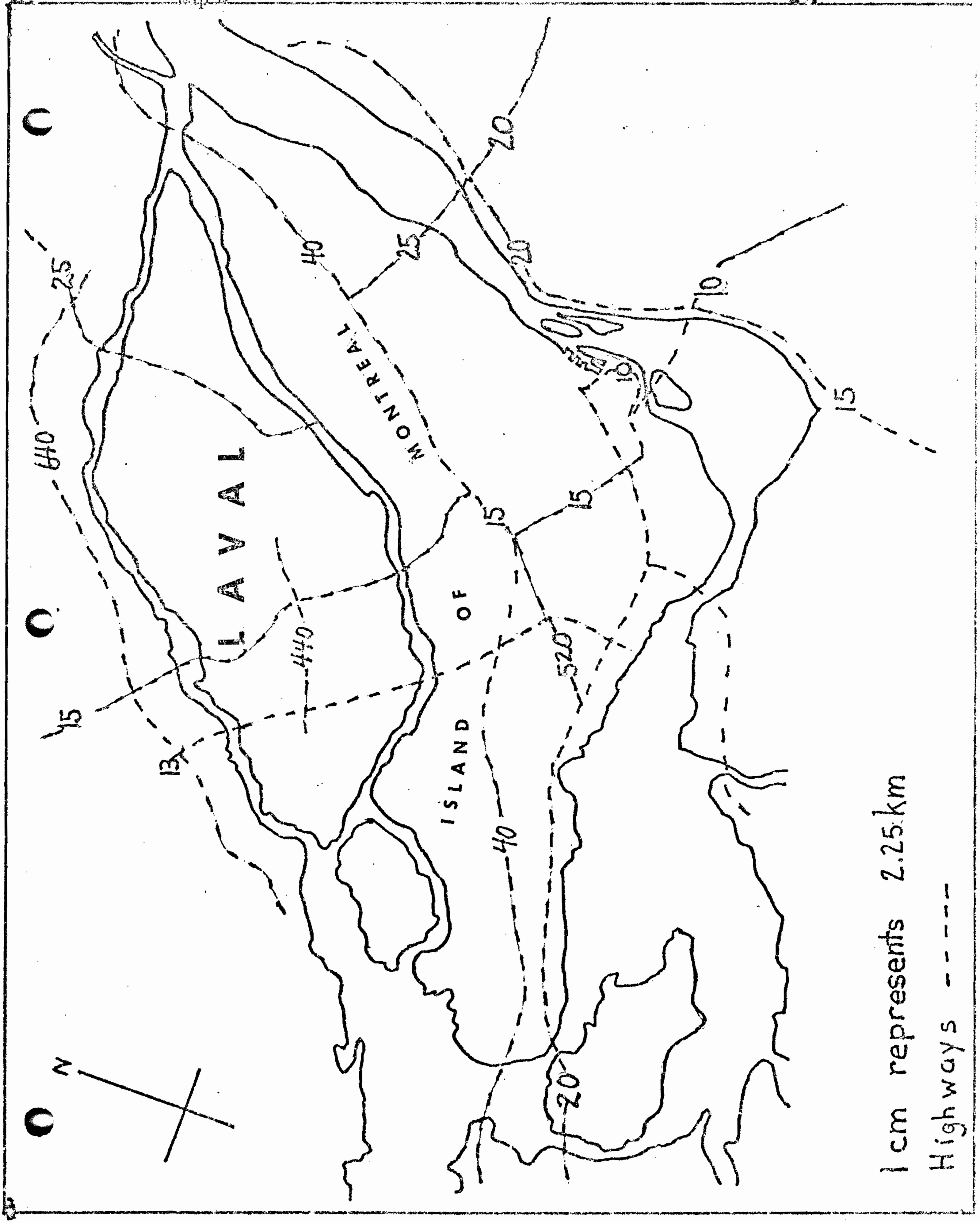
ACTIVITY 4 IDENTIFYING THE URBAN AREA

In this exercise, your job is to ask your parents where they work and what route they follow to get there. On the outline map of Laval and Montreal given to you, help your parents mark the approximate location of their work place. On the back of the map write the address of the company or factory.

The work places which you and your classmates record individually will be compiled on the class map of Laval and Montreal.

Using an aerial photograph of Laval and Montreal mark on the class map any other built up areas where no class parents work or live. You have now identified the URBAN AREA of which your family is a part.

Compare the urban area on the class map with a map showing the boundaries of Montreal and Laval. Are the areas of the two maps the same? Which map best describes the urban area in which your family lives?


LAVAL
ISLAND OF MONTREAL
N
1 cm represents 2.25 km
Highways - - - -
440
15
25
40
20
10
13
520

MASTERING THE SKILL OF CLASSIFICATION

The ability to classify is an important skill which once acquired helps geographers make good scientific use of their observations. Once a geographer has collected his information, classification aids him in rearranging his data to suit the purpose of his investigation. Quantitative geography studies of the distributions of various phenomena (eg. population, tree species) are only possible after the raw data has been classified. Classification allows us to see patterns that are much more difficult to discern from the raw data alone. Gould (1974) explains the importance of classification as follows,

> " A fundamental aspect of most scientific work is the attempt to order and explain a set of experiences that may initially appear unique by extracting from them their common characteristics. This is why the act of classification is one of the most basic and scientific human procedures: it involves putting unique objects together, into conveniently similar groups." (p. 51- 52)

Teachers are probably familiar with the primary grade reading exercises which require children to rearrange new vocabulary under given headings.

eg. beach, rush, much, trash, branch, brush, reach, and crash can be rearranged as follows,

Words ending with: <u>CH</u> <u>SH</u>

Such exercises are really asking pupils to order the unique objects (in this case words) according to a particular classification scheme. Field work in geography at the grade four or five level can also involve students in more mature classification exercises.

Asking children to classify words (Activity 5), emphasizes that there are many different ways of classifying information. Fenton (1966) uses this exercise to introduce the idea of classification to history students. It reinforces the fact that the classification scheme you decide to use must suit your particular purpose. In activity 6, a geographical situation is used. After observing many different land uses on the way to school, the children are asked to form no more than five classes of land use. Then using their own classification system, they can be sent into the field to map the land uses of a selected area.

ACTIVITY 5 PUTTING WORDS INTO GROUPS

Often we find it easier to arrange things in groups. For example, in gym class the students are divided into groups or teams in order to run relay races. The following words have been grouped according to the number of syllables they have.

One Syllable	Two Syllables	Three Syllables
shark	tuna	elephant
cat	turkey	
grouse	eagle	
bass	rabbit	
pike	condor	
	ostrich	
	lion	
	squirrel	

Think of another way to arrange these words in groups by making up your own classification system.

ACTIVITY 6 INVESTIGATING THE LAND USES IN THE NEIGHBOURHOOD

When you travel to and from school, you probably see land being used in many different ways. In your notebook, record all the different land uses that you see.

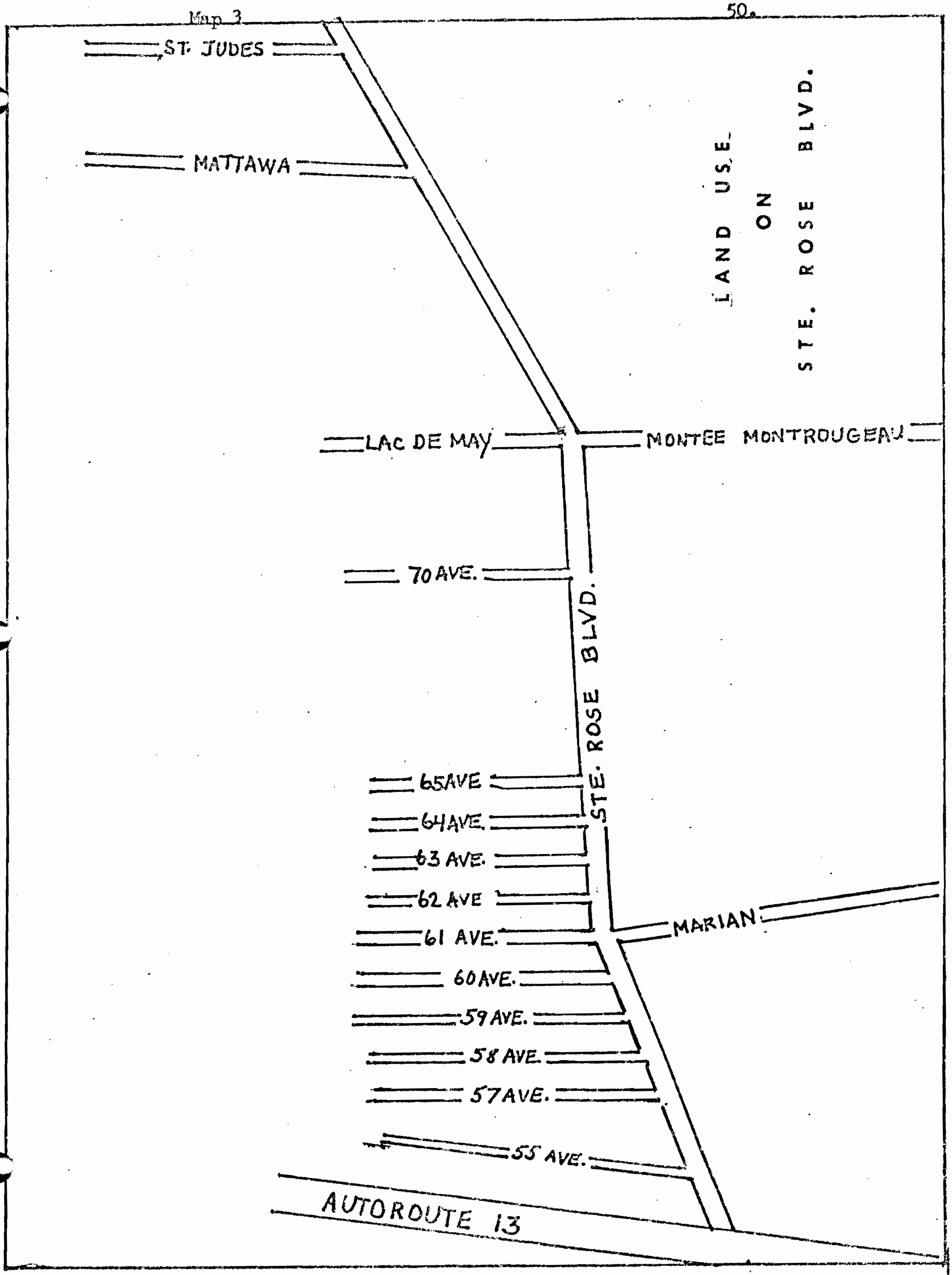
Can you sort these land uses into groups or CLASSES? For example, you may group all of the different gasoline companies into one CLASS called GAS STATIONS.

Try to group the land uses you record into NO MORE THAN FIVE CLASSES.

CLASSES OF LAND USE

1.______	2.______	3.______	4.______	5.______
a)	a)	a)	a)	a)
b)	b)		b)	b)
c)	c)			c)
				d)

Following the land classification you made, map the land uses on Ste. Rose Blvd. beginning at Autoroute 13 and finishing at rue St. Judes. Choose different colours to represent each CLASS of land use.


LAND USE
ON
STE. ROSE BLVD.
ST. JUDES
MATTAWA
LAC DE MAY
MONTEE MONTROUGEAU
70 AVE.
STE. ROSE BLVD.
65 AVE
64 AVE.
63 AVE.
62 AVE
61 AVE.
MARIAN
60 AVE.
59 AVE.
58 AVE.
57 AVE.
55 AVE.
AUTOROUTE 13

NEW DIMENSIONS IN MAPPING

Mapping in geography is most often associated with putting a symbol on a map to represent some object or event from the real world. However, mapping in geography has taken on new dimensions with the recent emphasis on quantification. Many of the "new mapping forms" being used in geography today really have their roots in mathematics. Tables, matrices, diagrams, graphs (especially histograms and scattergrams), and set notation are all acceptable mathematical techniques for recording information but it is only recently that geographers have begun to use them. When geographers became interested in analyzing spatial patterns of objects they were faced with the problem of handling their information in an efficient and precise way. They realized that the various mathematical forms offered the most economical medium for storing geographical data.

The widespread use of "new mathematics" has meant that children as young as six years are learning about set theory and using Venn diagrams. Because of the new emphasis on ways of handling and thinking about geographical data, coupled with the entry of new mathematics in elementary school curriculums, it is important that young geographers be made aware of the interesting and useful connection which exists between the two subjects.

Field work given to children often requires them to collect data. Collecting population information (Activity 7), gives children the opportunity to record geographical data in a table. Using the same information, children can easily transform their data into a histogram. (Activity 8) They are already familiar with forming classes (Activities 5 and 6) and probably have made many bar graphs in mathematics. The histogram they create is really just a combination of these two skills. The utility of the histogram in geography is great. Abler, Adams, and Gould (1971) point out that explaining why spatial distributions are structured the way they are is the foundation of geographic study. A distribution is simply the frequency with which a phenomenon occurs in space and we can use histograms to describe these distributions. Scattergrams are useful for graphically showing the relationship between two different phenomena. They have been ommitted here because their use really requires an understanding of regression lines which is beyond the capabilities of elementary school students.

Activity 9 allows the children to observe that the shape of histograms can change. It is important for children to realize that the nature of all distributions depends on the scale at which we observe. If we use small divisions (or classes) we produce a different histogram than if we use larger ones.

Working with sets is a part of most mathematics programmes today, but it can be useful and fun in geographical situations too. Using a presence/absence table and a Venn diagram the children are encouraged to make locational decisions based on the information given. (Activity 10) This exercise is modelled on one created by Cole and Beynon (1970) for a British situation. Teachers might find it profitable to discuss the merits of using a Venn diagram compared to a table for answering certain types of questions.

ACTIVITY 7 INVESTIGATING THE POPULATION OF THE NEIGHBOURHOOD

You are to visit each house on the street which you are assigned. Politely ask how many people live in the house. Record the information in table form

ADDRESS	NUMBER OF PERSONS LIVING IN THE HOUSE							
	1	2	3	4	5	6	7	8 or more
3642 Edgar Street				x				
3644 Edgar Street					x			

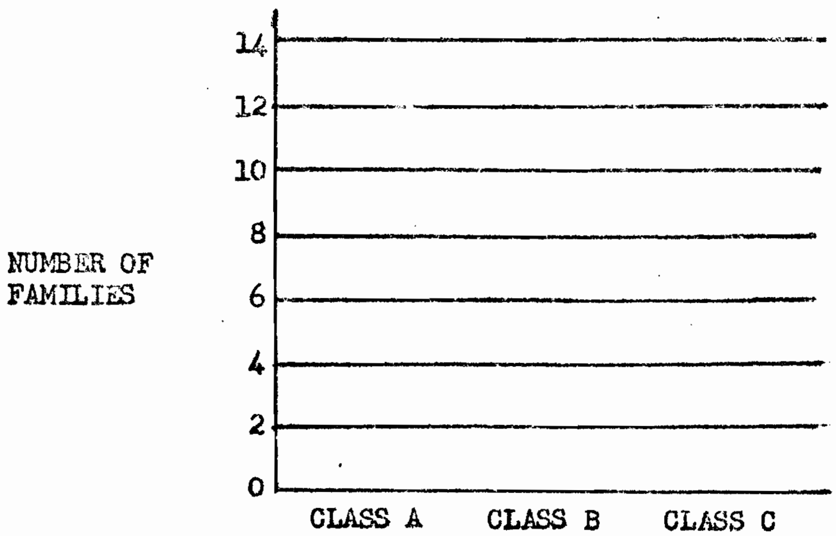
Find the average family size for your sample street. You can do this by adding up the number of persons living on your sample street. Divide this total by the number of homes you visited. What is the average family size for your sample? How many families did you visit which are larger than the average? How many families did you visit which are smaller than the average?

ACTIVITY 8 CONTINUING OUR INVESTIGATION OF THE NEIGHBOURHOOD POPULATION

Often we want to know how many houses have 1 or 2 people, 3 or 4 or 5 people, and so on. We can do this very easily by setting up classes of family size. From your sample count the number of families which could join each of the following classes.

CLASS A 1 or 2 people	CLASS B 3,4, or 5 people	CLASS C 6 or more people
Total=	Total=	Total=

Make a graph of your results. This graph is known as a HISTOGRAM.



Which class has the most members? the least?

ACTIVITY 9 PUTTING NUMBERS INTO GROUPS

Our government likes to keep a record of how many people (population) live in different areas of Canada. Each province is divided into different areas called COUNTIES. Here is a map of some of the counties around Laval and Montreal. The population of each county as reported in 1971 is in brackets.

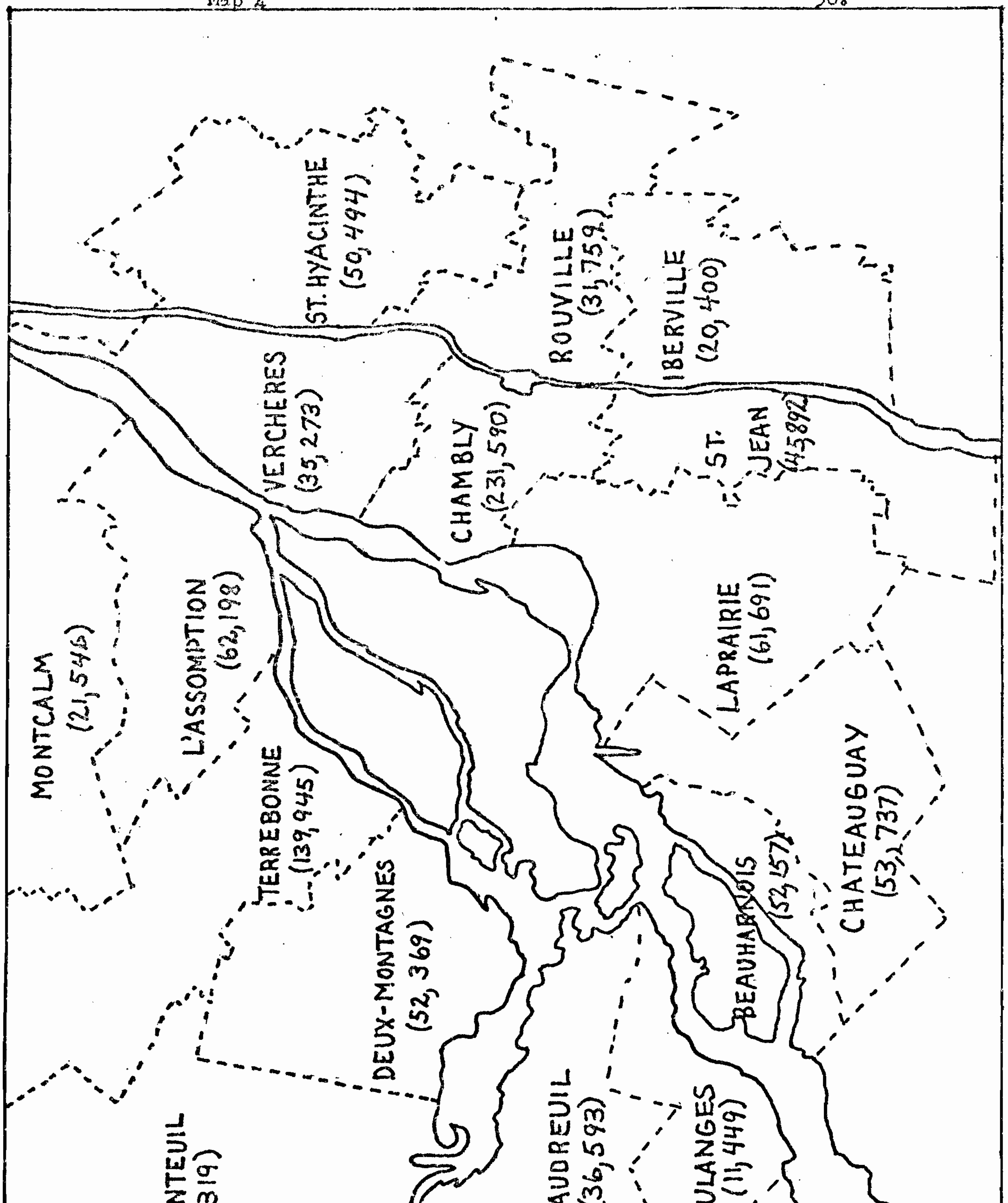
It is often more useful to know how many counties have a population of less than 20,000, between 20,000 and 40,000, and more than 40,000. We can show this very easily by setting up CLASSES or groups of different population sizes. Put each county into the correct class according to its population and then make a HISTOGRAM of your results.

CLASS 1 $<$ 20,000 people	CLASS 2 20,000 to 40,000 people	CLASS 3 $>$ 40,000 people

How many counties are there in each class?

Which class has the most counties? the least?

Make a new classification system with FOUR CLASSES this time, and make a HISTOGRAM of your results. What happens to the shape of the HISTOGRAM when the number of classes is increased?


ST. HYACINTHE
(50,494)
ROUVILLE
(31,759)
IBERVILLE
(20,400)
VERCHERES
(35,273)
CHAMBLY
(231,590)
ST. JEAN
(45,892)
MONTCALM
(21,546)
L'ASSOMPTION
(62,198)
LAPRAIRIE
(61,691)
TERREBONNE
(139,945)
CHATEAUGUAY
(53,737)
BEAUHARNOIS
(52,157)
DEUX-MONTAGNES
(52,369)
VAUDREUIL
(36,593)
SOULANGES
(11,449)
ARGENTEUIL
(31,319)

ACTIVITY 10 INVESTIGATING A SET OF FIVE LAURENTIAN VILLAGES

Here are five villages which can be found in the Laurentians, northwest of Montreal. Each village offers some services. In the table below, a 1 means the village has the service at the top of the column, 0 means it does not.

VILLAGE	CHURCH	GROCERY STORE	POST OFFICE	GARAGE	THEATRE
Arundel	1	1	1	1	0
Brownsburg	1	1	1	1	0
Lakeview	1	1	0	1	0
Lost River	0	1	C	0	0
Pine Hill	0	1	0	0	0

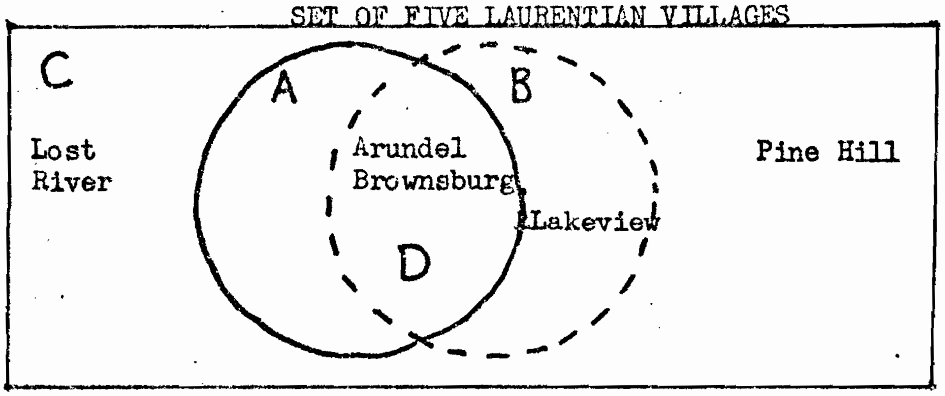
Which two villages have exactly the same services?

Which service do all the villages offer?

Which service do none of the villages offer?

The information about which villages have post offices and garages can be put in diagram form.

SET OF FIVE LAURENTIAN VILLAGES



Subset A includes the villages having a post office.
Subset B includes the villages having a garage.
Subset C includes the villages which DO NOT HAVE a post office OR a garage.
How would you describe the members of Subset D?

Mr. Boyd wants to live in a village which has a post office and a garage. Which villages have both?

Mr. Seale wants to live in a village which has a post office OR a garage OR both. Which villages could he choose?

Mr. Adams wants to live in a village which has NO post office or garage. In which villages can he live?

IDENTIFYING DIFFERENT PATTERNS OF SPATIAL DISTRIBUTION

A map is valuable for recording the observed occurrences of a phenomenon. When a geographer says that he is studying the spatial pattern of a particular phenomenon he is in fact trying to find out if there is any order to the spacing of the locations of the activity in question. At a descriptive level, spatial patterns can be identified as clustered (each occurrence of a phenomenon is located around a point), random (each occurrence of a phenomenon is located haphazardly), or regular (each occurrence of a phenomenon is located equidistant from the others). Quantitative methods are used (eg. nearest neighbour analysis) which assigns numerical values to clustered, random, and regular patterns.

Complete Regularity	2.1491
Complete Random	1.0
Linear Clustering	0.23
Absolute Clustering	0

(Source: Quantitative Methods
An Approach to Socio-Economic Geography
Tidswell and Barker, p. 34)

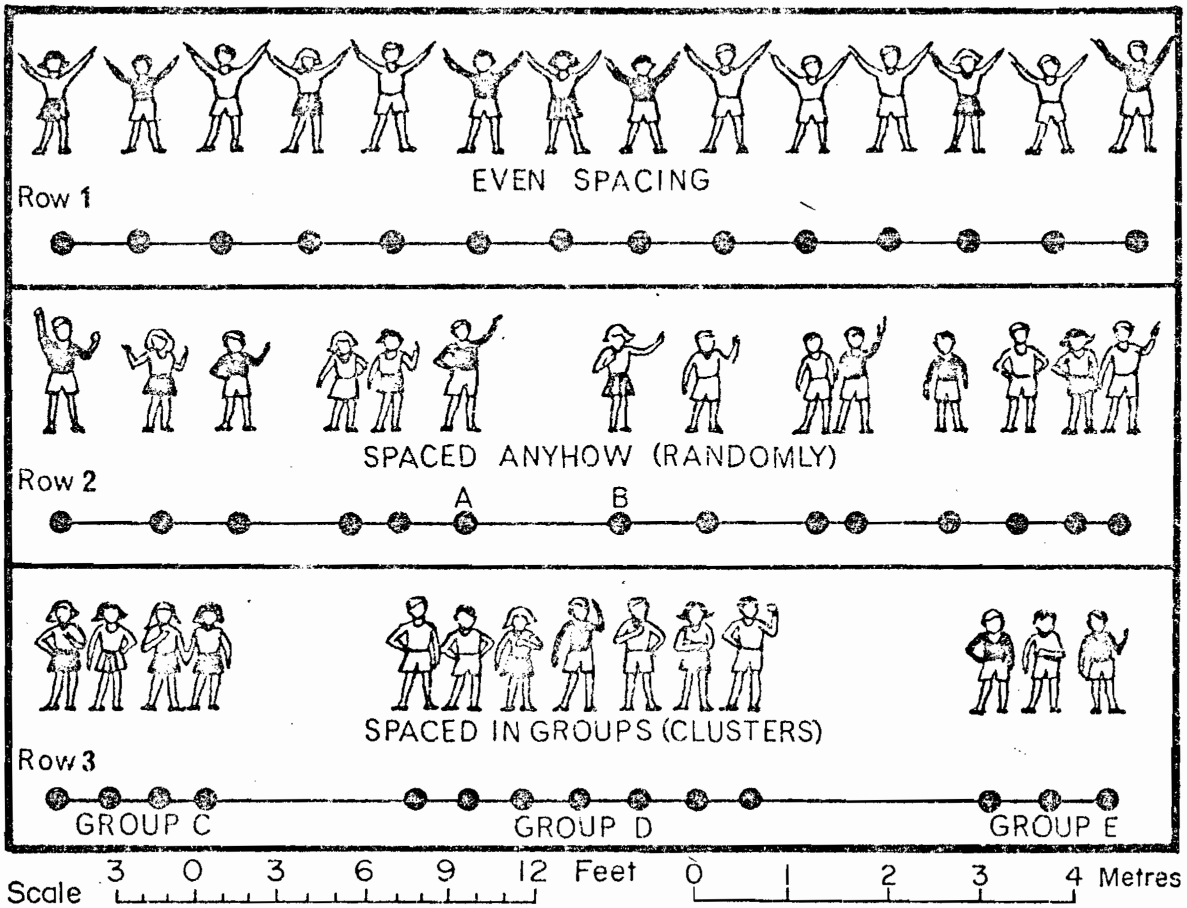
Central Place Theory allows geographers to investigate the spacing and size of settlements.

While geographers are concerned with describing spatial patterns, they realize that any one pattern at any particular time is merely a static representation of a dynamic situation. Their second concern is to identify the processes at work which created the pattern they are seeing. Abler, Adams, and Gould (1971) make the distinction as follows,

> " It is not the distributions themselves which excite geographers, but rather the fact that distributions vary in pattern and intensity from place to place. When we observe something at one location but not at another, or when we note that densities of occurrence vary, we immediately begin to ask why this variation occurs." (p.56 and 58)

There are many patterns of spatial distributions found in an urban area which children can investigate. Initially, exercises should instruct the students in the use of the terms clustered, random, and regular. The exercise involving the spacing of children on a line (Cole and Beynon, 1970) is especially good for this purpose. (Fig.5) Activities 11 through 14 ask the children to plot the locations of various phenomena (community services, commercial establishments, industries) and to describe the patterns which they create. Each child is intended to help complete only one of the distributions. When they are finished, valuable class discussion can centre upon comparing the different patterns which they see. In reference to the fire and police station patterns, children can be asked why they think these services are located where they are. Are all areas being served equally well? A new home building project has been approved by the city and 1000 new homes will be built in a certain location (eg. Joliburg in Laval). The city wants to build a new police station. Can you suggest a good location for it? Answers to questions such as these can direct discussion to the fact that patterns change. Talking about why the shopping centres and industries are located where they are, can lead children to consider the connection between locations and transportation networks. If interest is high, the students may suggest other phenomena to be studied.

Figure 5



Arranging Things on Lines

(Source: <u>New Ways in Geography</u> Book 2, Cole and Beynon, p.5)

ACTIVITY 11 INVESTIGATING THE LOCATIONS OF FIRE STATIONS IN LAVAL

If a fire broke out at your home you would expect the fire trucks to come quickly, wouldn't you? Do you know where the nearest fire station is located?

Here is a list of all the fire stations in Laval. Plot the location of each fire station on the map you have been given.

Administration Centre and Station	Fabreville	725 Montee Montrougeau
Station No.1	Pont Viau	55A Boul. des Laurentides
Station No.2	Chomedey	2 Place Souvenir at Chomedey Blvd.
Station No.3	St. Vincent de Paul	1111 St. Etienne
Station No.4	Ste. Dorothee	950 Boul. Hotel-de-Ville
Station No.5	St. Francois	6645 Boul. d'Argenson
Station No.6	Laval Ouest	2392 35 Avenue at St. Rose Blvd.
Station No.7	Auteuil	6200 Boul. des Laurentides
Station No.8	Ste. Rose	216 Boul. St. Rose
Station No.9	Vimont	1661 Boul. des Laurentides
Station No.12	Iles Laval	342 Chemin de Tour

Measure the distances between the stations on your map. Are all the distances approximately the same?

If you had to describe the pattern of these locations on the map, which of the following words would you choose?

evenly spaced   scattered   clustered

ACTIVITY 12 INVESTIGATING THE LOCATIONS OF POLICE STATIONS IN LAVAL

Often you see the police patrolling on your street making sure that your street is safe. Do you know where your local police station is located?

Here is a list of the police stations in Laval. Plot the location of each police station on the map you have been given.

Ste. Dorothee	965 Boul. Hotel-de-Ville
Chomedey	560 2 Street
Pont Viau	55 Boul. des Laurentides
St. Francois	6645 Boul. d'Argenson

Measure the distances between the stations on your map. Are the distances all approximately the same?

If you had to describe the pattern of these locations on the map, which of the following words would you choose?

evenly spaced   scattered   clustered

ACTIVITY 13 INVESTIGATING THE LOCATIONS OF LARGE SHOPPING CENTRES IN LAVAL

Many of your families visit Carrefour Laval to shop.

Here is a list of the locations of large shopping centres in Laval. Plot the locations of these centres on the map you have been given.

Carrefour Laval (Steinberg Beaucoup)	3003 Le Carrefour (at the intersection of Hwy. 440 and Autoroute des Laurentides)
Centre 2000 Laval (Hypermarche)	3195 St. Martin Blvd. West (at the intersection of St. Martin Blvd. and Marois Blvd.)
Centre Laval (The Bay)	1600 Le Corbusier (at the intersection of St. Martin Blvd. and Le Corbusier)
Centre Duvernay (Bonimart)	3100 de la Concorde (at the intersection of de la Concorde and De Callieres)
Galeries Papineau (K Mart)	1950 de la Concorde (at the intersection of de la Concorde and rue J.J.Joubert)

If you had to describe the pattern of these locations on the map, which of the following words would you choose?

evenly spaced   scattered   clustered

Can you think of any reasons why these shopping centres are located where they are?

ACTIVITY 14 INVESTIGATING THE LOCATIONS OF SOME INDUSTRIES IN LAVAL

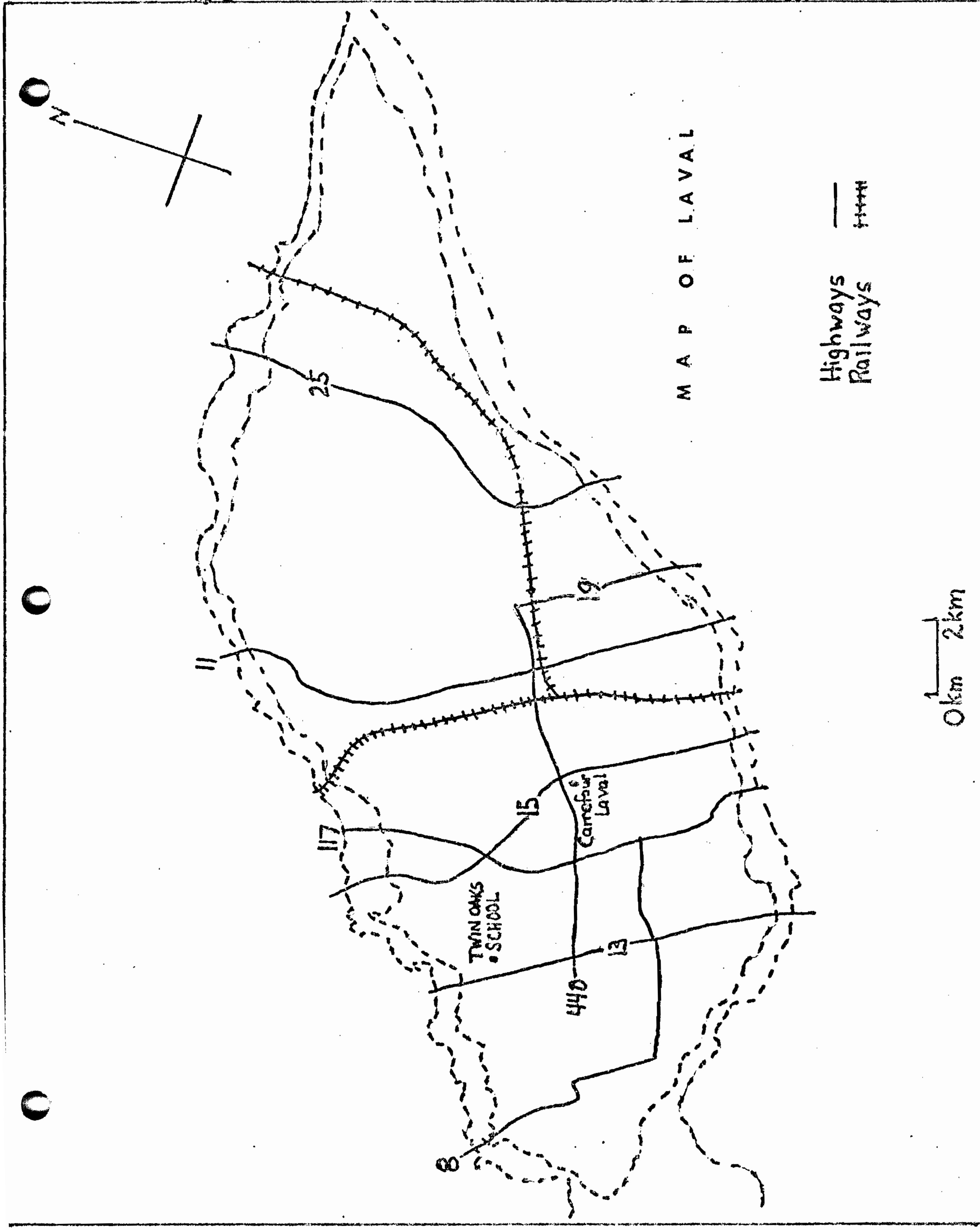
Here is a list of some industries which decided to "set up shop" in Laval. Plot the location of each on the map you have been given.

Pacific Steel Inc.	845 Munck Blvd.
Hunter Douglas Construction Materials Division	2300 Francis-Hodge Avenue at the corner of Cunard St.
Provigo Warehouse	2700 Francis-Hodge Avenue (next to Hunter Douglas)
North American Food Equipment	2300 Industrial Blvd. at the corner of Cunard St.
Pierrette Dairy	St. Martin Blvd. at the corner of Industriel Blvd.
Marshall Steel	Marshall St. at the corner of Fortin St.
Alcan Aluminum	2000 Fortin St. at the corner of Lippmann St.
Primo Italian Food Products	2345 Francis-Hodge Avenue near Hwy. 440
Zenith Corporation	St. Martin Blvd. at the corner of Industriel Blvd.
Uni-Chem Paints	Fortin St. at the corner of Place Sauve

If you had to describe the pattern of these locations on the map, which of the following words would you choose?

evenly spaced   scattered   clustered

Can you think of any reason which helps explain the pattern you found?


MAP OF LAVAL
N
Highways
Railways
0km 2km
TWIN OAKS
• SCHOOL
Carrefour Laval
25
19
11
15
117
13
440
8

THE CONCEPT OF PROBABILITY - AN INTRODUCTION

A statistician thinks of probability as the proportion of times an event will occur if the experiment or situation related to the event is repeated indefinitely.(Holland, 1976) Based on a priori grounds, out of one hundred experiments, it would be expected that the event would occur approximately sixty six times. In geography, we usually deal with a sample distribution of a phenomenon because it is often impossible to collect data for every occurrence of that particular phenomenon. Many probability tests (eg. Poisson and Binomial distribution tests, F test, and Chi square test) can be used to identify the nature of the geographical sample distribution in question. These procedures allow us to determine if the sample distribution is a random one (ie. unbiased) or not. The establishment of the validity of the collected data is an important prerequisite to hypothesis testing in geographical research.

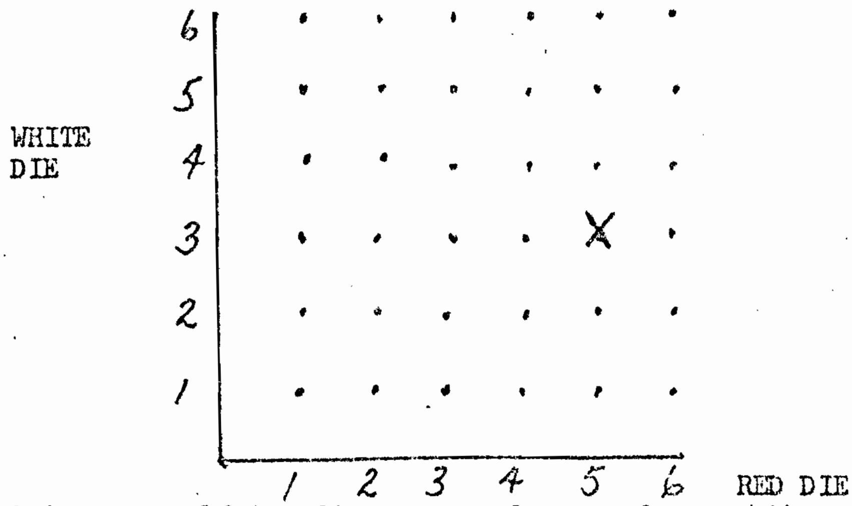
On a more practical level, the hazards of flooding are an environmental event which geographers are studying. Despite millions of dollars spent in the United States on flood control, damage done by floods has not diminished. Why is this so? Abler, Adams, and Gould (1971), point out that flood control projects are usually built to deal with average conditions and cannot handle the horrible flood which probability distribution tells us will occur, once in say every fifty years. Snowstorms are a weather situation familiar to Montrealers. Snow removal budgets are based on the probability that we will experience a winter of average snowfall. We all know what happens when a larger than average winter snowfall occurs. Snow removal budgets are exhausted several snowstorms before the end of winter.

Many of our daily decisions are based on the concept of probability. If it will most likely rain today, I shall take my umbrella to school. If the air controllers are not likely to go on strike, I shall fly to Vancouver next Wednesday. What are the chances of winning in Loto Canada? These are all expressions of probability in different forms. It is important that children have some understanding of the concept of probability which is a part of their daily lives.

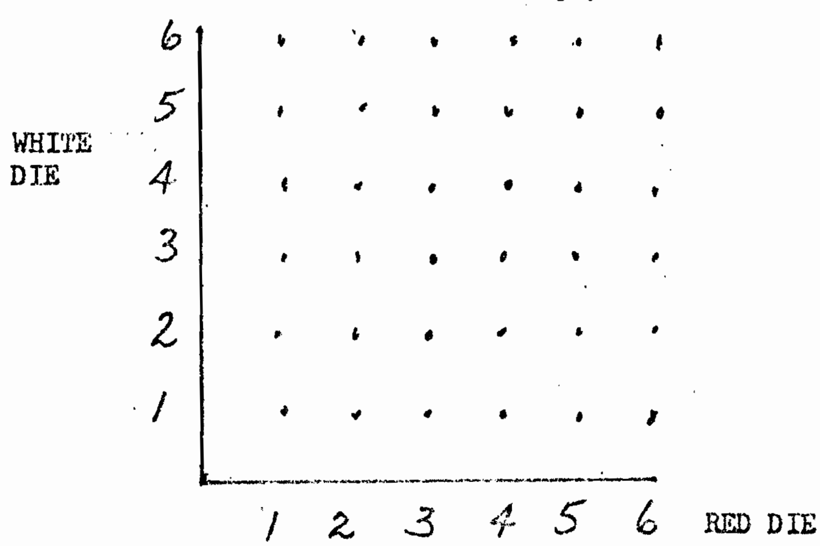
Unhappily, for some Laval families, spring flooding forces them to vacate their homes, but this turn of events provides an excellent geographical situation for teaching the concept of probability.

Before doing this, however, the basic notation for expressing probabilities must be taught. In recording a probability, two numbers are used. One number indicates all the possible outcomes, and the other indicates the probability that a particular event (or events) will occur. (eg. When rolling a die, the probability of rolling a four is 1 out of 6 or 1/6 of all possible outcomes) Activities 15 and 16 aim to introduce the idea of probability to the students. Using coins and dice, May (1971) created these and other exercises for introducing probability to elementary grade pupils. Several lessons may be required to reinforce the concept before investigating the flood situation in Laval.(Activity 17)

ACTIVITY 15 WHAT ARE THE ODDS?



Find for yourself two dice, one red one and one white one. Roll the dice and cross out the dot on the lattice that shows the numbers on the two dice. For example, if the red die shows 5 and the white die shows 3 you would cross out the point (5,3) on the lattice. Roll the dice five more times and cross out your results on the lattice. How many different results can you have when you roll the two dice? How many different ways can you roll a 7 with the two dice? (The number on the red die plus the number on the white die must equal 7.) Use the lattice below to help you.



What is your chance (probability) of rolling a 7 with the two dice? (Hint: compare your chances of rolling a 7 to all the results possible when you roll two dice.)

Record your answers for the other numbers in the chart below.

The PROBABILITY of rolling a 2 when you roll two dice is ____.

" " " " " 3 " " " " " " ____.

4 ____.

5 ____.

6 ____.

7 ____.

8 ____.

9 ____.

10 ____.

11 ____.

12 ____.

ACTIVITY 16 FLIPPING A COIN

Using a coin and a die, answer the following questions.

How many different results can you have when you flip a coin and roll a die? (Draw a lattice showing all possible outcomes.)

What is the probability of rolling an even number and getting heads when you throw a die and a coin?

What is the probability of rolling a 3 and getting tails?

Using two coins, answer the following questions.

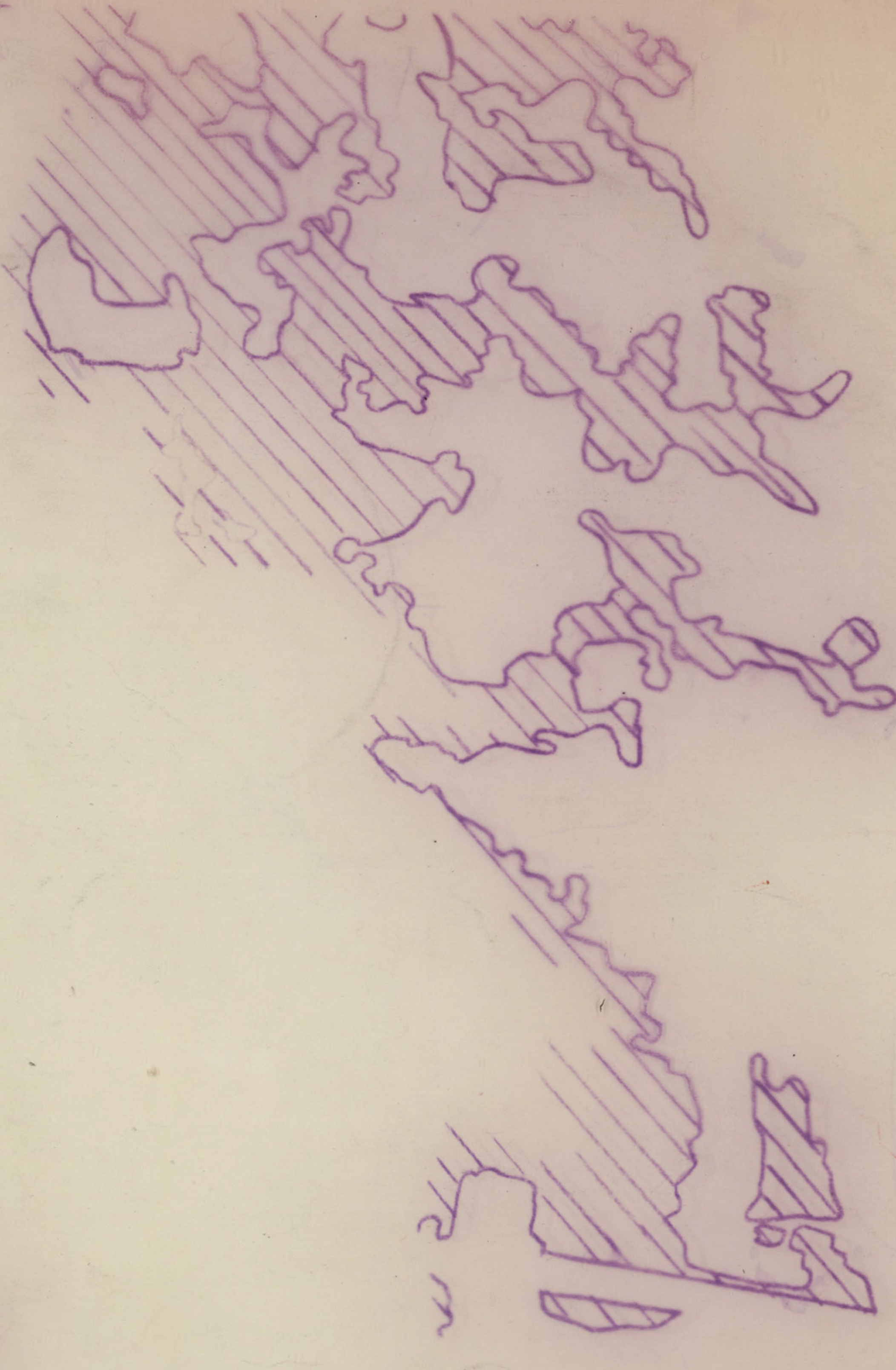
What is the probability of tossing a head and a tail?

What is the probability of tossing 2 heads?

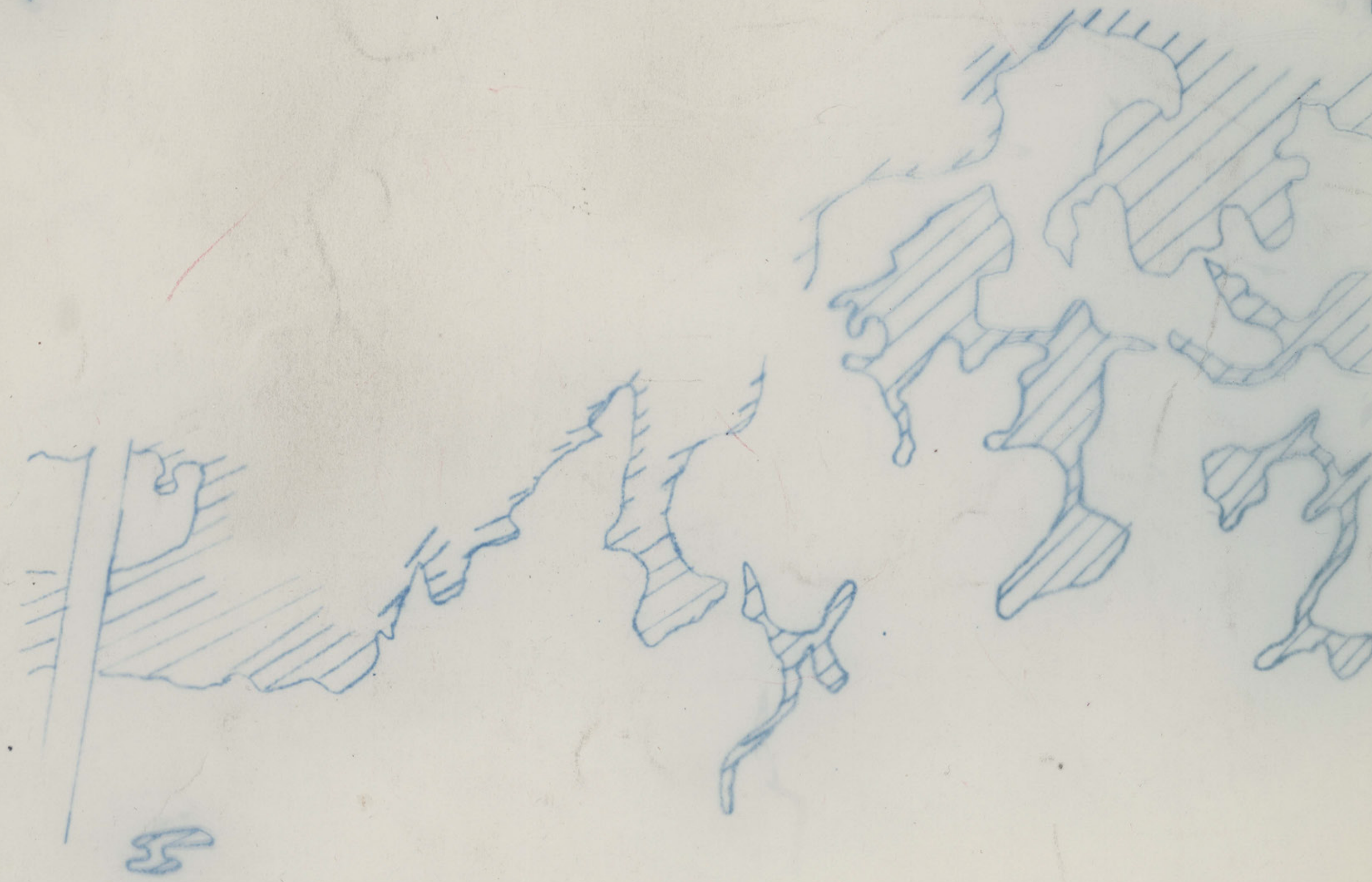
What is the probability of tossing two tails?

Is your chance of tossing 2 heads (or 2 tails) greater or less than tossing a head and a tail?

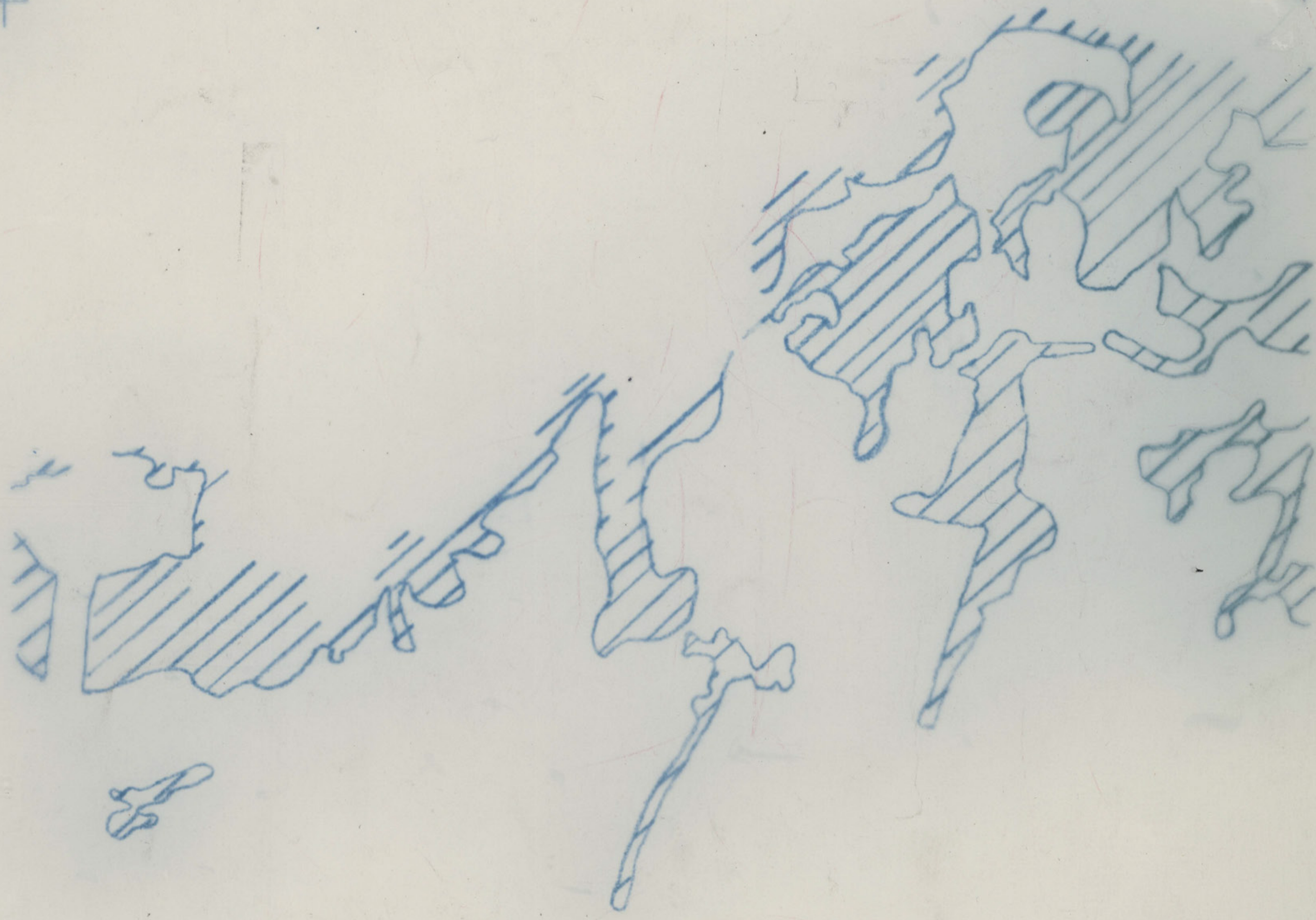
Ag 128
522



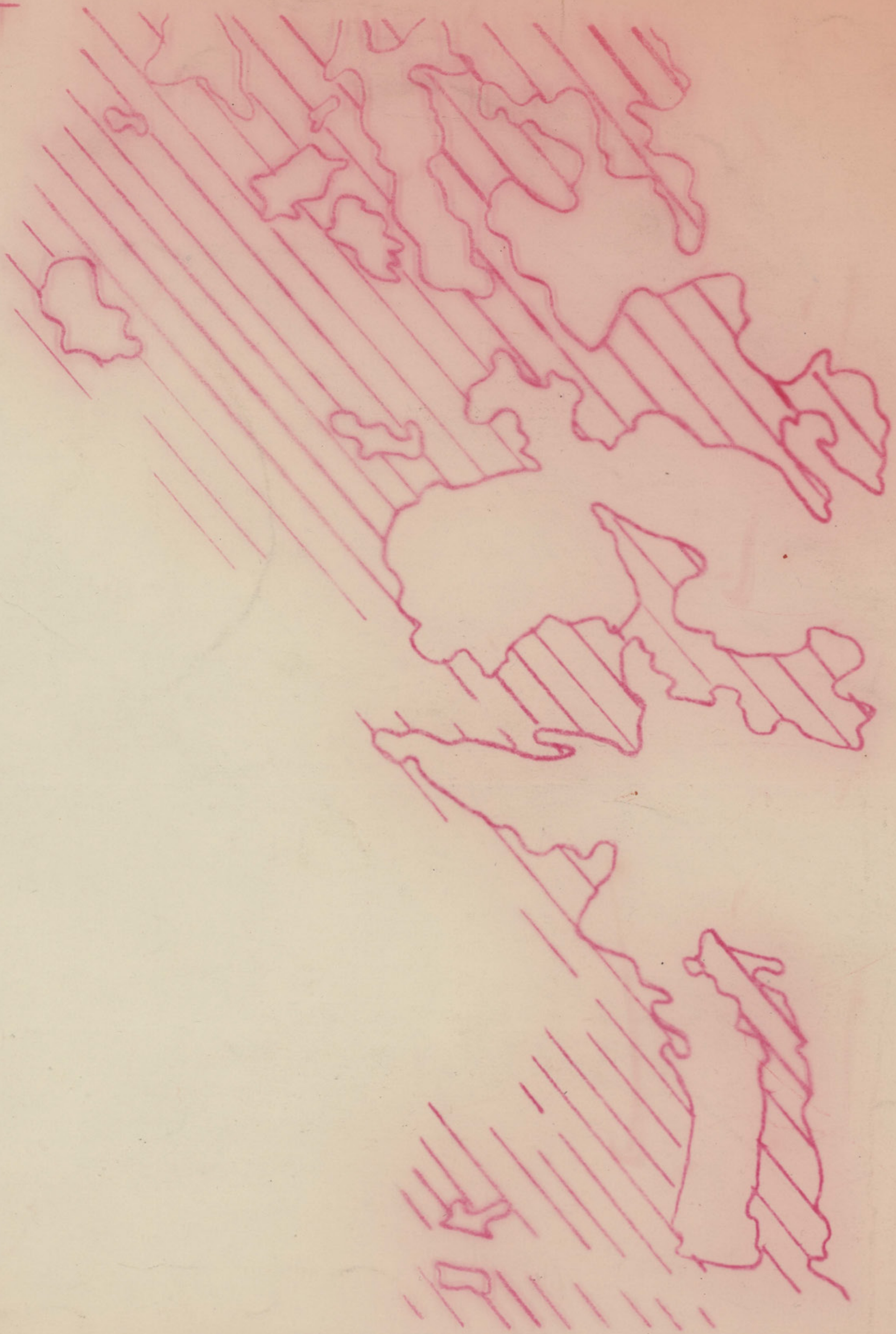
1971



1972

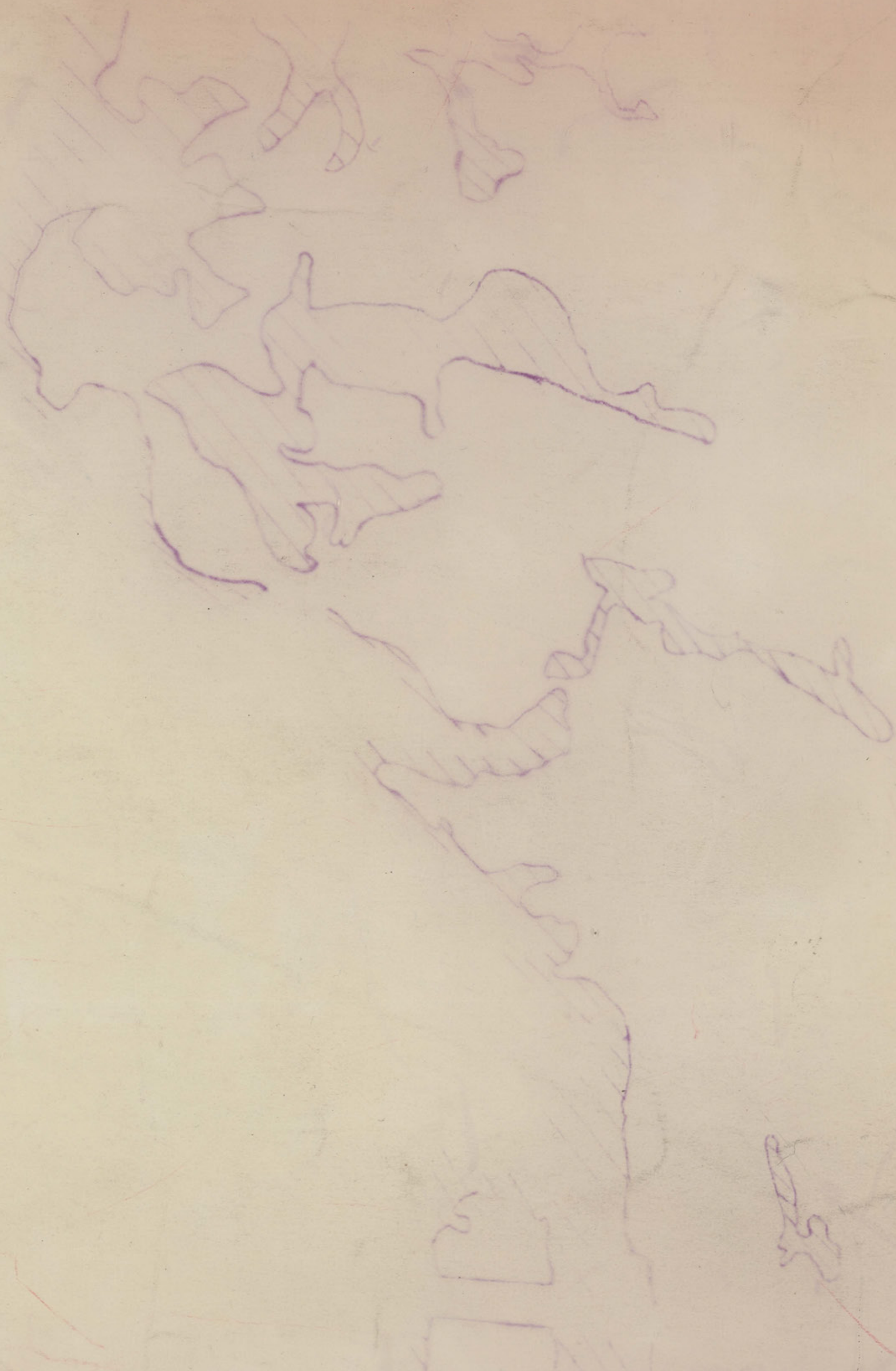


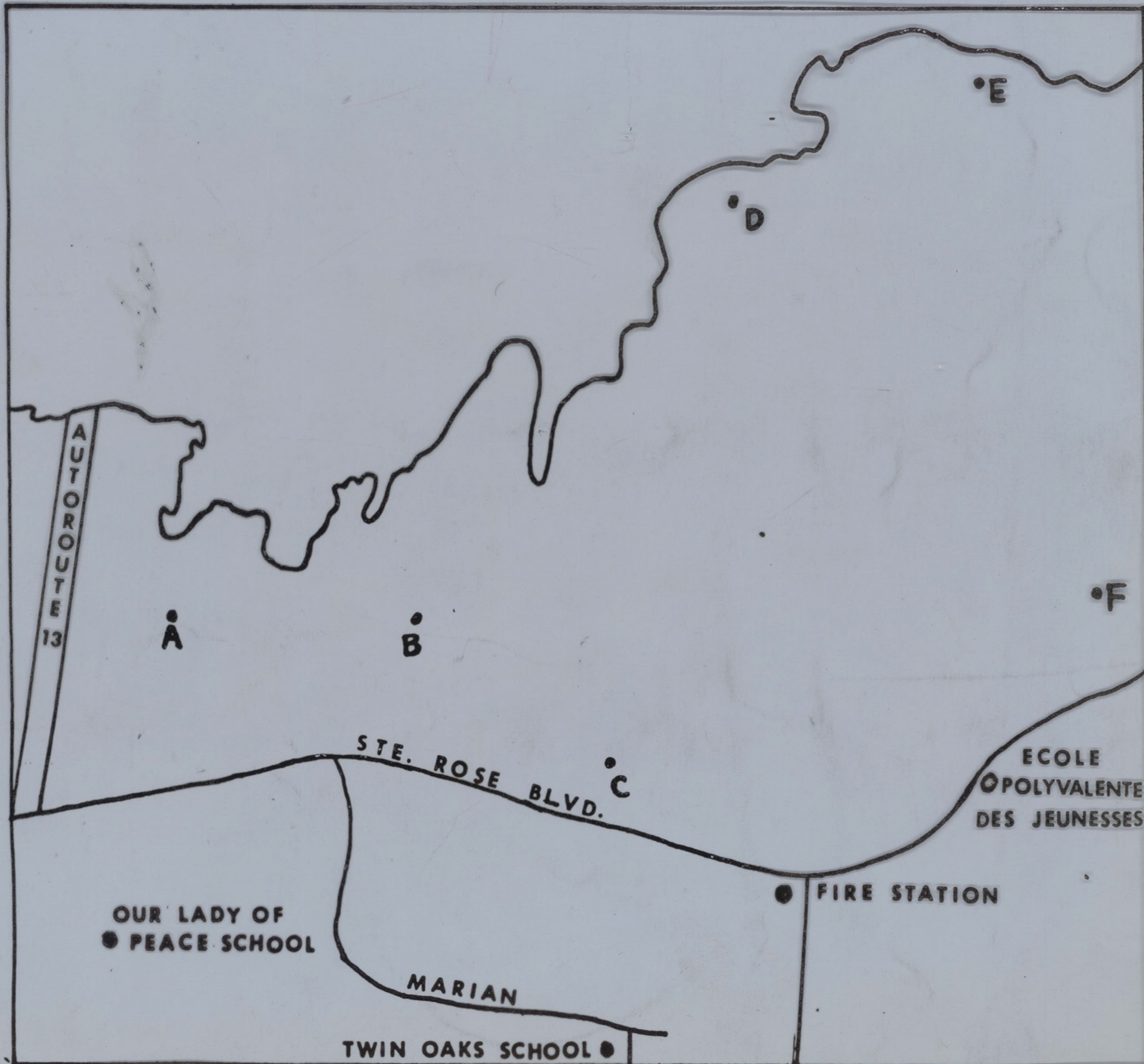
1974



1976

1977




AUTOROUTE 13
A
B
C
D
E
F
STE. ROSE BLVD.
ECOLE POLYVALENTE DES JEUNESSES
FIRE STATION
OUR LADY OF PEACE SCHOOL
MARIAN
TWIN OAKS SCHOOL

ACTIVITY 17 INVESTIGATING FLOOD CONDITIONS IN THE FABREVILLE SECTOR OF LAVAL

Every spring, some Laval families are forced to leave their homes because they are flooded with water. The following maps show the flood conditions in the Fabreville sector of Laval for the past seven years. The shaded areas show the land which was flooded. Using the maps, fill in the following table. Put 0 if the point is not flooded. Put 1 if the point is flooded.

Points on the Map

Flood Year	A	B	C	D	E	F
1971						
1972						
1973						
1974						
1975						
1976						
1977						
TOTAL						

Based on the information you collected in the table, answer the following questions.

Which points have the greatest probability of being flooded?

Which point has the least probability of being flooded?

Recently a new house was built beside Point D. The man who bought it asks you if he is safe from floods. What would you tell him?

Land next to Point A is for sale. The person who owns it complains to you that no one is interested in buying it. Can you think of a reason why?

Suppose you were moving into this area, at what location would you choose to live now that you know about the flood situation?

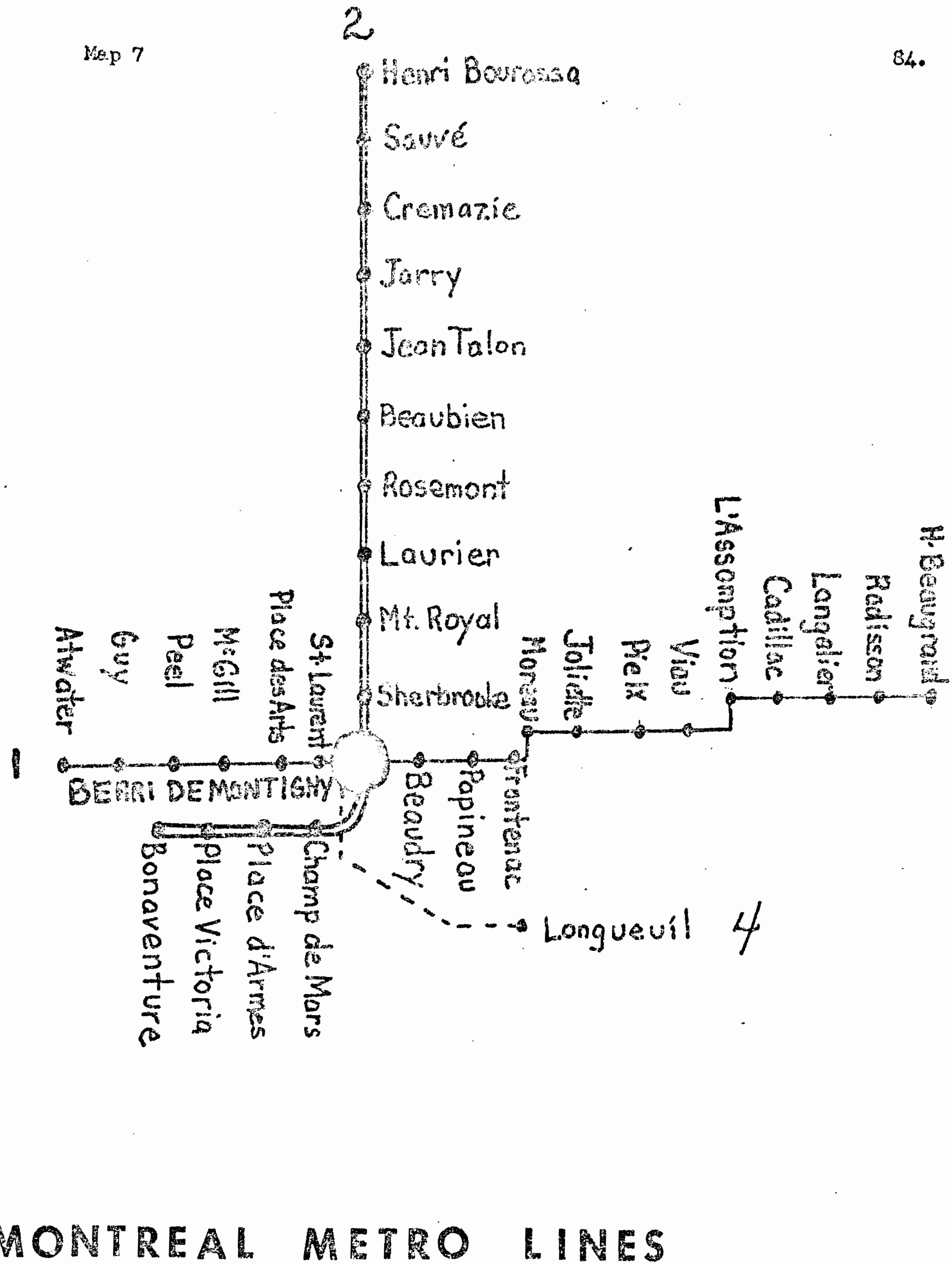
THE USE OF MAPS WITHOUT SCALES

Kansky (1963) defines a network as a set of geographic locations interconnected in a system by a number of routes. Networks are used by physical geographers to study drainage basins (Horton,1945), and by human geographers to study transportation networks (Garrison, 1960). It is valuable to spend some time in geography studying networks because they focus on how a spatial structure functions as a system. The study of networks helps develop an appreciation and understanding of order in the landscape. Ambrose (1969), argues for the inclusion of network study at an early stage of geographical education when he says,

> " If the concept of a network is introduced at an early stage of training, using very simple examples, the task of understanding progressively more difficult techniques of network analysis becomes that much easier." (p.286)

The study of a network using a topographical map, may be tedious because it includes information which is not needed and may in fact confuse the student. Topological transformations, or graphs using lines for routes and vertices for the intersection of routes, are easier to manipulate. Probably the topological map most familiar to Montrealers is the one posted in each subway car of the Metro which shows the different subway lines and transfer points. Activity 18 uses the Montreal subway system as a simple introduction to networks for children. Using local bus routes of western Laval, activity 19 considers a more detailed network and introduces the idea of a numerically assigned most accessible location. In topological terms, the most central place is the place with the lowest associated number.

Map 7



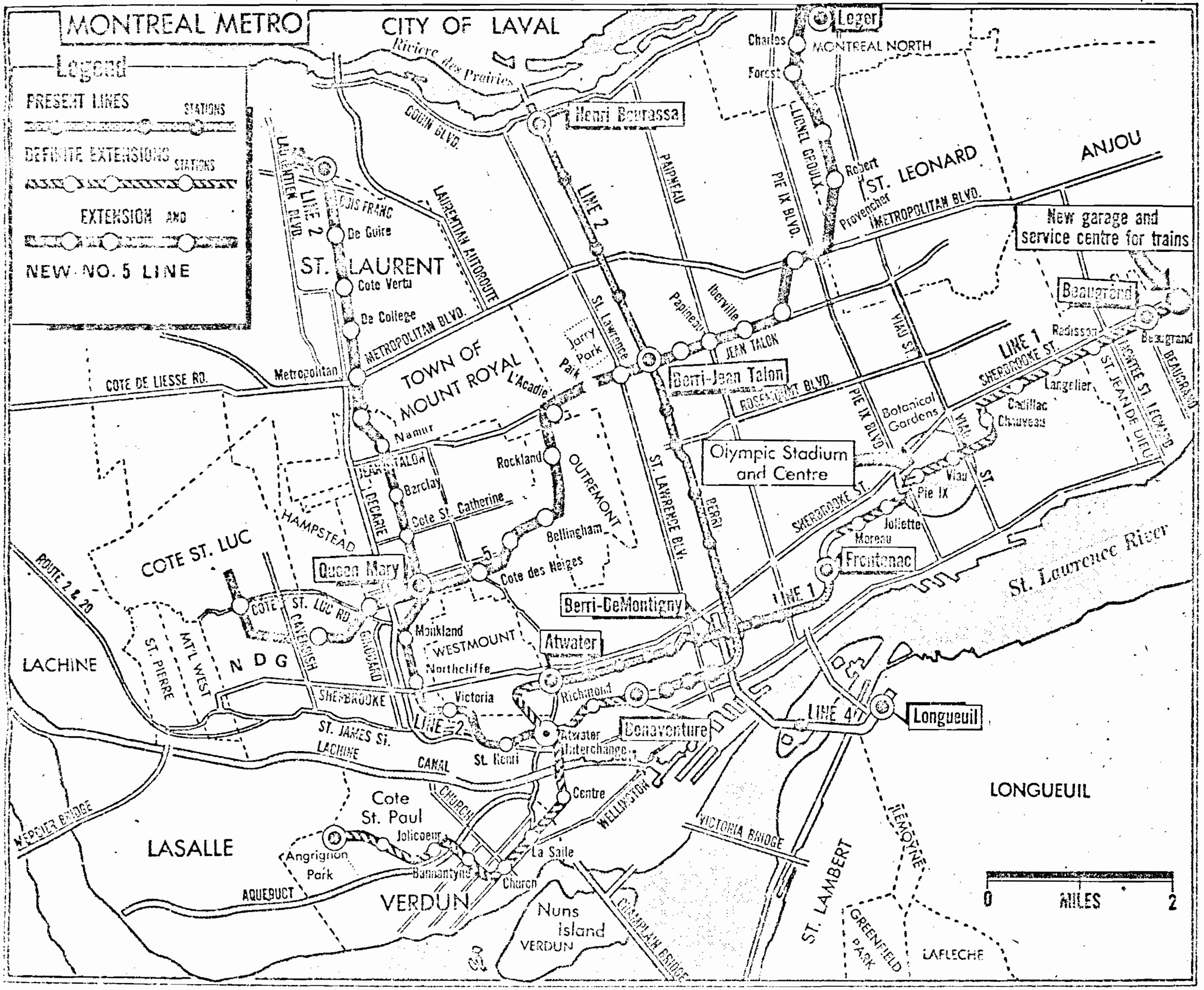
MONTREAL METRO LINES

ACTIVITY 18 LOOKING AT THE SUBWAY LINES IN MONTREAL

Answer the following questions using the diagram of Montreal's subway lines which you were given.

1. How many different subway lines make up Montreal's subway system?
2. In order to travel from Henri Bourassa to Cremazie station, is it necessary to change subway lines? From Sauve to Bonaventure? From Frontenac to Peel?
3. In order to travel from Beaubien to Atwater station, is it necessary to change subway lines? From Jean Talon to Viau? From Longueuil to Atwater?
4. Which station can be reached without any transfers (changes) no matter which subway line you travel? We call this station the MOST ACCESSIBLE one because it is the easiest one to reach.
5. The City of Montreal is planning to extend subway lines 1 and 2 and to add a new line called line 5. Look at the map taken from The Montreal Star to see where these new lines will go. Try to draw your own diagram which will include these new additions. You may add to the diagram you were given or make a completely different one.

Map 8



Map shows Line 2 and Line 5 extensions in solid black. Proposed station locations and line routes have drawn criticism from citizen groups

ACTIVITY 19 ANALYZING THE BUS ROUTES IN THE WESTERN PART OF LAVAL

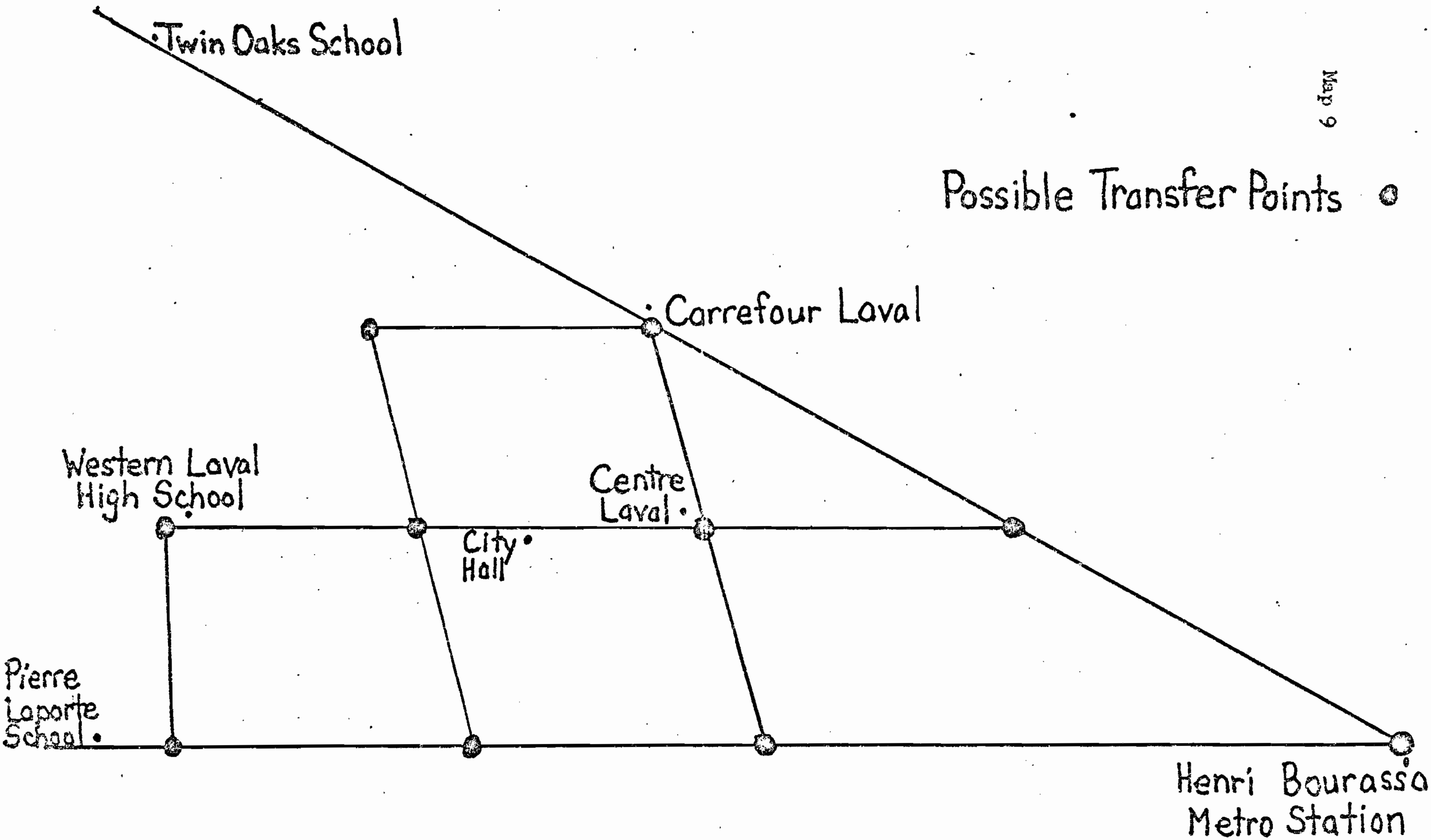
The map on the next page shows the bus routes in the western part of Laval. A scale is not used on this map because we are really interested in how the routes join to make a transportation network, not how long the routes are.

In the chart below, record the number of bus transfers you have to make in order to arrive at your destination. (A transfer point is counted ONLY IF YOU CHANGE DIRECTION.)

FROM ↓ \ TO →	Metro	Twin Oaks School	City Hall	Western Laval H. School	Centre Laval	Pierre Laporte School	Carrefour
Metro							
Twin Oaks School							
City Hall							
Western Laval High School							
Centre Laval							
Pierre Laporte School							
Carrefour							
TOTAL NUMBER OF TRANSFERS							

Which location requires the largest total number of transfers?
Which location can be reached from the other six places with the least number of transfers? We call this place which can be reached the easiest the MOST ACCESSIBLE PLACE IN THE NETWORK.
Is it sensible to you that this place should be the most accessible? Why?

Map 9



BUS ROUTES IN WESTERN LAVAL

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APPENDIX 1

CONTENTS OF

NEW WAYS IN GEOGRAPHY

BOOKS 1 AND 2

BY

J. COLE AND N. BEYNON

SITUATION	LOCAL	DISTANT
1. Measuring - 2 dimensions	School ground	Holiday Destinations
2. Co-ordinates - on a Cartesian Plane *3rd dimension of height is introduced	Classroom Town	Maps
3. Symbols and Map Reading *final exercise is cumulative	Windpumps Tractors, Roads, Railways, Woods, Parks,	Settlements
4. Journeys - straight vs. crooked - detours - air distance vs. land distance * Skill of recording and reading journey distances or obstacles in table form is introduced.	School building School ground Shopping mall	Inter-continental journeys. Physical land barriers vs. use of Suez Canal or Panama C.
5. Networks (Routes over which journeys are made.) - interrupting networks - finding routes in a network - identifying road networks as "web" like "tree" like (many-to-one correspondence vs. one-to-one correspondence.) - Network development in time *Skill of recording absence or presence of links between towns (nodes) in table form is introduced.	Landslides washed out Bridges etc. which interrupt road networks British towns Northern Ireland Building up a railway network using historical dates. Russian example.	San Francisco, U.S.A. Isle of Elba, Italy
6. Scale - On a map, the larger the scale, the more detail, but a smaller area is covered.	Bramcote village	Part of Iowa, U.S.A.
7. Game	Build Your Own Railway System	

SITUATION	LOCAL ——— DISTANT
1. <u>Distributions</u> - Arrangements on lines - In patches - Things on patches - Throughout time to stress - even spacing - random spacing - clustered pattern	Children lining up in school · Trees lining sides of streets · Village buildings Bus stops along a street Cows in a field · Children in a school at various times of the day
2. <u>Best Location</u> Finding the best location - using Law of Least Effort - using Reilly's Law of Retail Location	In a school cafeteria, 24 children are eating lunch. Out of 32 chairs, which 8 will probably be left empty? On a beach, (diagram given) where will Mr. Park, the ice cream man locate? Students choose position for capital city on ficticious island and comparing to some capital cities in the world.
- identifying the "breaking point" between two locations and competition and future	Pupils choose the university one would expect various English students to attend. Locating a store. Locating a gasoline station.
3. <u>Journeys</u> - Identifying busiest places. (junctions or nodes) - Identifying busiest routes. (main road links)	School building · Supermarket
- Choosing location for new routes	British countryside examples. Many possible new routes are given. The factor of personal preference influencing a decision is introduced.
- journey patterns (leads to linkage between towns of the same size and order.)	Journeys of British football teams. Journeys of British students for their holidays.

SITUATION	LOCAL	DISTANT
4. <u>Sets, Organization and Relationships</u> Attempts to deal with sets of geographical things and relationships between the sets by: - classifying information - using Venn Diagrams (emphasizes that more than one variable can be used for making a decision.)	Students are to choose one of six British villages to locate in which has the functions they most want	
- correlating information	Relationship between crops and land. *Skill of using a Contingency Table is introduced. Relationship between time and distance using journey to school. *Skill of constructing a graph is introduced. Relationship between Height and Rainfall. *Skill of using Random Numbers Table is introduced. Visual correlation on a "Scattergram" is introduced which will later lead to Person Product Correlation test. Relationship between Slope and Potato Yield *Skill of ranking is introduced. Relationship between the distance of the field from the farm and the value in $ of what the field produces. *Skill of identifying difference in rank is introduced which will later lead to Spearman Rank Correlation. Relationship between time and distance. *Skill of reading time schedules is introduced.	
- spreading information (Diffusion process)	spread of bad apples in a tray	spread of a new way to grow corn.

SITUATION	LOCAL		DISTANT
5. <u>Contours</u> - reading contours	Construction of a simple contour model.		
6. <u>Boundaries</u>	Recognizing field boundaries		Recognizing state boundaries
7. <u>Games</u>	* Colonising An Island	Gaining Control of the Island	Finding a Job

*Introduces study of good and bad positions in areas, control of territory, element of chance.

INDEX DES NOMS DE RUES