SETTING THE SCENE: DISCOVERING CONCEPTS BASIC TO MAPPING

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Introduction

In this welcoming talk, I want to try and explain the perhaps provocative and certainly long winded title of this Working Group Seminar: *"Exploring the ways children in elementary schools can discover concepts which are basic to the understanding of maps and their usage for inventory, analysis and discussion".* There are a number of words there which carry special meanings which we hope will help place our discussions in a useful context and give direction to the future work of the Working Group. My comments are meant not as a directive, for we have in our program a fascinating variety of reports and demonstrations from the general to the specific, from the theoretical to the pragmatic. Without anything from me, there are already rich topics for discussion and consideration that will give substance to our future plans and actions.

To start, let me note a few assumptions behind some of the words in the Conference title. I've already alluded to **"exploring"** by noting the richness of our program together. The reference to **"Elementary schools"** suggests that they deserve more of our attention because it is there that we introduce maps and mapping to children. Given that different countries with different conditions will invariably develop programs in different ways, it may be at the elementary level that we have the most in common and thus the most to talk about in our meetings. One could also argue that we should be building our curricula on the firmest of foundations. **"Concepts"** suggests that there are ideas underlying maps and their use, that they are universal to all maps and mapping activities, and they are another area of common interest. **"Discover"** suggests that there are ways in which children can come to understand these concepts through classroom activities rather than by being asked to take our word for their meaning and significance. **"Maps and their usage"** have to be reunited. Too many teaching materials that I have seen and too many lessons that I have witnessed talk about the map in isolation of the task which it is to perform. Our seminar title mentions three map use tasks: **"inventory, analysis, and discussion."** To these I would add **"navigation, measurement, and argument."**

So where did all these ideas come from? For me, they are derived from two activities:

1) an attempt to develop a taxonomy of map use tasks [Castner, 1995a, 1999], and

2) an examination of creativity in cartography [Castner, 2000].

Let me say a little about these two activities.

Taxonomy Of Map Use Tasks and Creativity in Cartography

Several years ago, I began to muse about how many distinctly different types of maps there are and how many of these do we introduce to students? The best way to consider this was to develop a taxonomy which, by its very nature, would establish the differences and similarities between the various kinds of maps that we acknowledge. It would also highlight the kinds of questions or problems one could address with maps. This, in turn, would raise questions about the different ways we generalize data and design maps so that they reveal in their structures the relationships we wish to study. The result of this work is a taxonomy in Figure 1. It identifies four major map tasks: inventory, navigation, measurement, and analysis with this latter one divided between those using quantitative information and those using qualitative information. Associated with these general tasks, there are over fifty different types of models, drawings, and maps, not all of which have names that are recognizable or agreed upon names. We seem willing to have a relatively small number of general map names to cover the great variety that we can actually differentiate.

In another study, I examined the nature of creativity because in discussions about the Barbara Petchenik International Children's Map Competition one finds words like "creativity" or "creative representation." But what is meant by these references? Is it the spontaneous expression of one's feelings or a more deliberate attempt to present, in cartographic

ways, certain ideas about the world, no matter how simple? If it is the former, how do we begin to measure success? If it is the latter, how do we call attention to basic concepts about design and communication, encourage their use in the Competition, and make use of them in acknowledging achievement, i.e., in judging or adjudicating the map entries? To explore these questions I looked at what both cartographers and artists said.

In responding to the question of what role artistic talent plays in the making of a map, Arthur Robinson [1953, 12-13] noted that every map is a different problem [my emphasis] requiring a new solution. "Good judgment, based on principles, is the major requirement of design in cartography; and such judgment may be easily acquired in training." Thus, for him, creativity has an intellectual component, based on principles and focused on a problem. Some sixteen years later [1969,178] he suggests that more of the principles of cartography are being based on an understanding of communication and less on individual aesthetic intuition. An artist, Betty Edwards [1986,7], claimed that artistic talent "...is simply a matter of learning basic perceptual skills -- the special way of seeing required for drawing." Later she [Edwards,1986,43] notes that "The rules and heuristics of drawing are broad enough to allow infinite variation -- a necessary characteristic because the visual information "out there" is infinitely variable and complex."

This infinite variation echoes a point made by Barbara Petchenik herself in talking about cartographic research in map design. She notes that "...it is not easy and often not even possible to say which graphic characteristics of a map are 'better', let alone 'best. In isolation, 'better' and 'best' are not meaningful concepts; they take on meaning only in the form, 'better for what?' Anyone who has designed a map will be well aware of the issue here; almost no design choice can be made that does not require a trade-off among goals" [Petchenik, 1985, 25-6]. Only by designing maps that address specific problems will children come to experience these conflicting goals and understand the compromises that are required. The specific communication goals of cartography, I believe, place cartography in a very competitive position within the curriculum for providing both useful rules for graphic presentation and skills for problem solving.

Implications

What then can we draw from these two studies? It is clear from examining the taxonomy (Figure 1) that map users ask a variety of questions for which many different map tools have been developed. These specialized maps have been tailored in their designs to expose attributes of data or objects mapped so that particular relationships can be illuminated. The complexity of the diagram alone attests to the diversity of geographic inquiry, and it identifies some important educational problems. First, can we possibly talk about all of these maps in already crowded and competitive curricula, both within geography and without? Are any of these map tasks more important pedagogically than others? How can we go about determining priorities and in what order might these tasks be covered? At present, evidence would suggest that at the elementary level inventory tasks dominate our teaching. Perhaps we should be asking what the most important distinctions are that we want to make about maps and map use? One way to address this question is to consider the concepts and attributes that are shared by all maps.

We have, of course, enshrined a few of them in a variety of acronyms. TODALS, for example, stands for **title**, **orientation**, **date**, **author**, **legend** and **scale**. But as you well know, not all maps require these elements. For example, the repetitive plates of a thematic atlas of a state or country do not have to repeat the name of the jurisdiction, its orientation, or scale once they have been established at the outset. Indeed, placing a scale bar on a small scale thematic map of a large portion of the earth may invite the viewer to use it to measure some long distances. When the particular map projection is inappropriate, this can lead to a gross error of measurement. In contrast, the need for and form of the title, scale and orientation indications relate to the question we are attempting to address. Only with a specific question in mind can we make the correct decisions about these elements and select appropriate symbols to illuminate the problem. Only at this point can we begin to determine what the legend might look like. I say "might" because the specific grouping of objects, or the choices of class boundaries for numerical data, can only be made after determining the true character of the information to be mapped. Without such analysis, map skills will be taught in isolation from the problems which they should be designed to probe.

ELEMENTS OF THE MAPPING PROCESS:

1) **THINKING** about the world and some aspect of it or of a phenomenon in it;
2) **DETERMINING** the essential characteristics of that aspect or phenomenon;
3) **ESTABLISHING** a communication goal, i.e., the use(s) to which a representation will be put;
4) **CONSIDERING** the various forms and modes of representation that can speak to that goal; and only then
5) **EXECUTING** some representation that best addresses that communication goal.

Figure 2: Elements of the Map Making Process

This is one reason that I have, in my work, tried to make the distinction between mapping and map making -- the

latter being only the fifth step in mapping (Figure 2) after much consideration has been given first to the problem being addressed, determining the nature or essential characteristics of the data available, establishing a communication goal, considering the options for presenting that data, and only then executing a map [Castner, 1990]. The intellectual heart of answering geographic questions with maps involves all of these steps in which ideas and data are manipulated, classified, and symbolized in ways that will allow an analysis to take place, a relationship to be discovered, or an argument to be made. But how should we go about this? We hope that our experiences with children and our formal research will provide some direction. Certainly the Games Room, which we will be opening this afternoon, is an attempt to share our perspectives on these questions. But perhaps there are some other strategies that may be useful. Let me suggest five:

Strategy #1

Earlier in this paper I spoke of the use, in "Map Skills" studies, of acronyms like TODALS. My complaint with them is that they emphasize maps as conventional objects. If we are to encourage teachers to place map making in the context of specific spatial problems, we should have a more useful acronym that considers all of the steps involved in mapping. I suggest to you an acronym which I call PICLTON (say "pickle-ton" for ease of memory). It is an obvious expansion of the concepts involved in mapping and calls attention to the necessary steps of:

1. Defining geographic **Position**, i.e., where is the place(s) to be mapped and with what system will information there be located?
2. Discovering the **Internal structure** of the data, i.e., what is the essential character of that which is being mapped, whether it is objects or numerical data?
3. **Classifying** the data for mapping, i.e., how should we arrange or group the information to answer a particular inquiry?
4. Establishing the **Logic** of the relevant symbols, i.e., what attributes of the symbols (e.g., their color or size) convey the essential characteristic(s) of the data?
5. **Transforming** images and geographic space, i.e. what is the appropriate map projection (and aspect) for the tasks to be performed on the map?
6. **Orienting** the map appropriately for the communication task at hand. Certain landmarks are necessary for positioning the data, for oneself in navigation, or for users to interpret the map. In other words, what are the appropriate landmarks?
7. Using appropriate geographic **Names** and labels, i.e., what names and labels are needed to help users correctly interpret the map?

Strategy #2

In a more formal way, these same concepts can be carried further by tying them to classroom curriculum topics or classroom activities that will allow them to be discovered. Let me suggest a sequence of activities for two of them.

Understanding the logic of symbols (#4), probably begins with making pictures of objects and later landscapes. In them, children must sort out the essential nature and invariant dimensions of what they see, a point made above by Betty Edwards. This is the basis, of course, for the simplest of pictorial symbols. Along the way, we can point out the existence of four physical types of symbols (**point**, **line**, **area**, and **label**) and, more important, three intellectual types of symbols (**image related**, **concept related**, and **abstract**). With these concepts in mind, most conventional symbols should then be easily deciphered without our having to teach them because our students will have had lessons in the logic of symbols. Color, which may be part of all of these symbol types, requires some special handling but nothing that cannot be done in elementary grades, especially if the school art teacher is at all sympathetic to the idea of improving the perceptual skills of her students. Also it is fortunate that the color solid neatly meshes with ideas about latitude and longitude as in Figure 3.

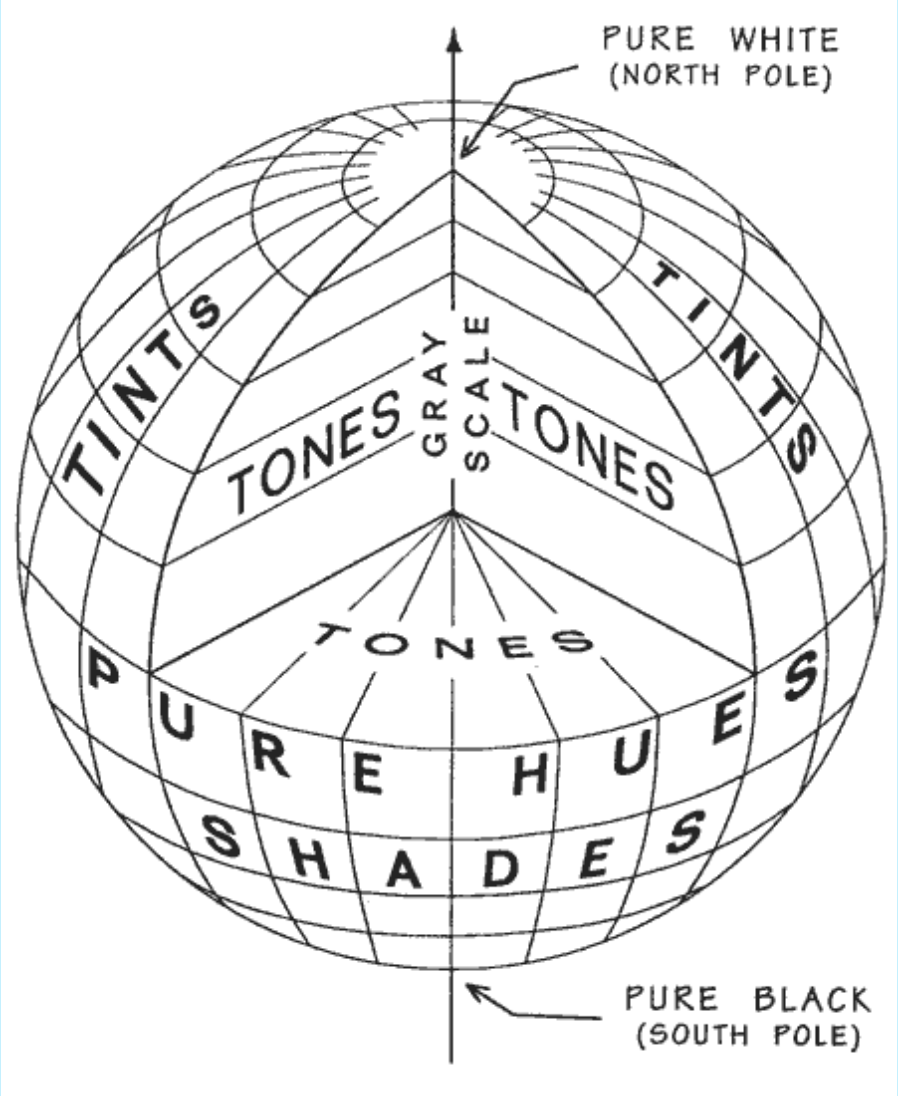

Figure 3: The Color Solid expressed in terms of the Earth's Graticule from Castner (1995b, 112)

Second, our experience with using landmarks (#6), probably begins in infancy where the body is the landmark and everything is seen in Ego Space -- a point I will return to in Strategy #5. As we learn our language, we begin to use prepositions to describe our positional relationship to other objects around us. Further refinements of language allow us to specify directions and positions in relative space and to learn such formal systems as polar coordinates and the use of the clock face. Various kinds of folk dancing give children active lessons in navigating in relative space. Perceptual orienteering with landmarks and directional clues in natural environments provides more sophisticated lessons. Working with a gnomen introduces us to the cardinal directions and orienting ourselves in absolute space. Formal orienteering provides experiences in all these things.

Strategy #3

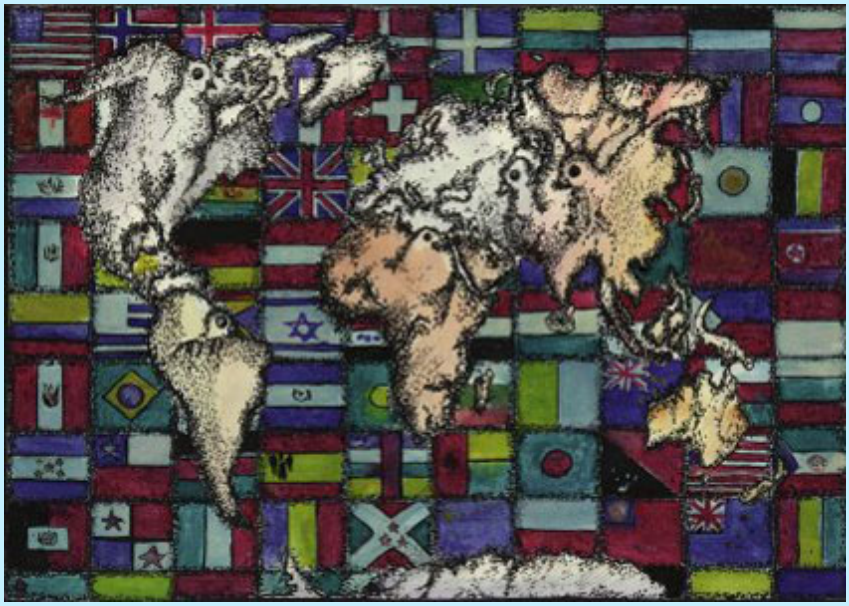

Figure 4: "Peace in the World" by 11 year old Alfonsas Lekavicius, Lithuania, a winner in the 1993 Barbara Petchenik Children's Map Design Competition

A third strategy suggests giving children design problems whose solutions require them to create what I call graphic metaphors. By thinking systematically of cultural images or associations, they can suggest such abstract ideas as peace (Figure 4) or a clean environment (Figure 5).

Figure 5: "Untitled" map by 13 year old Yui Seito, Japan, a winner in the 1993 Barbara Petchenik Children's Map Design Competition

As we see here in previous Petchenik Competitions, white doves and healthy plants have provided graphic connections to these less tangible messages. Borden Dent [1985,24] describes a list of activities that are shared by people considered to be great thinkers, scientists, or artists -- activities that are common to their creative work. These (Figure 6) include such mental attitudes as challenging assumptions, recognizing patterns, seeing in new ways, making connections, taking risks, using chance, and constructing networks. If you will, these can be considered heuristics of creative design.

ACTIVITIES SHARED BY CREATIVE PEOPLE

The Heuristics of Creative Thought

1) **Challenging Assumptions** – daring to question what most people take for truth.
2) **Recognizing Patterns** – seeing similarities or differences in ideas or things.
3) **Seeing in New Ways** – looking at the commonplace with new perceptions.
4) **Making Connections** - bringing together seemingly unrelated ideas or objects .
5) **Taking Risks**- daring to try new ways with no control over the outcome.
6) **Using Chance**- taking advantage of the unexpected.
7) **Constructing Networks**- forming associations for the exchange of ideas, perceptions, questions, and encouragement.

Figure 6: "Activities Shared by Creative People" abbreviated from Borden Dent (1985, 24)

A component of this strategy, but common to all five, is to use the Barbara Petchenik Map Design Competition as a vehicle for helping both teachers and children to work with their experiences of the world (even if they relate to such popular topics as the World Cup, Figure 7) and concepts about graphic expression, and to express them in some cartographic manner. Along the way it might also help us to decide what we want children to know about the nature and role of creativity in mapping. Given the breadth and ambiguity of the Competition theme in 1999 ("A World Map") it is difficult to understand what we regard as the conceptual basis of the competition. Perhaps we will want to make future Competition themes more specific and tied to identifiable geographic questions or propositions. These are questions we may want to consider on Thursday in our session on the Competition.

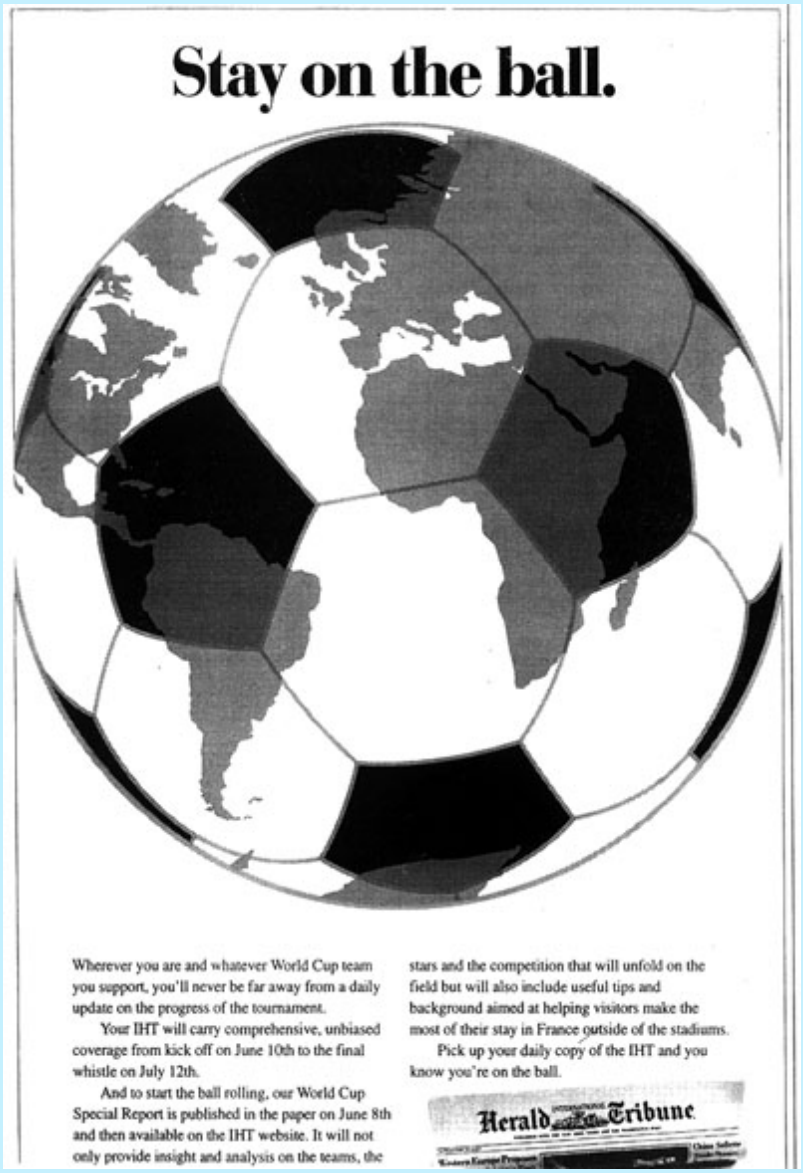

Figure 7: "Stay on the ball", an advertisement for the International Herald Tribune and its coverage of the World Cup

Strategy #4

Implicit in this is a fourth strategy: the obvious need for us to reach out to teachers -- a constituency that has rarely been considered or contacted at the international level. Our Terms of Reference as a Working Group declare our intention "to improve general cartographic literacy" as it relates to children. Assuredly, this means doing the same for their teachers! Obviously, on our return home, each of us will be in a position to help in this through appropriate national organizations. However, few of us can do so alone. It seems to me that our periodic regional meetings provide a venue in which we can help each other or others not represented here. One mechanism for this would be that one day of our meetings would be devoted to going out to separate schools for some hands-on activities that can be left with the teachers there. In other words, each program speaker would also be a workshop presenter to a small group of local teachers. Preparation for this is another role that the Games Room can play -- a place to adjudicate and share activities that we feel can be of help to teachers and exciting to students.

Strategy #5

Finally, the word "technology" seems to have a very special and narrow electronic meaning in today's schools. I retain a certain technological skepticism that we may be developing electronic map making systems for children that hide the very critical design decisions that make for effective map design, and thus problem solving with maps. But for educational purposes, do we want these critical mapping steps to be hidden? Do we want our children to walk before they have crawled? Must we not be sure that children come to understand the meaningful questions, manipulations and trade-offs that are involved in mapping? Andrew Tatham [1998] makes a useful point here in noting our great dependency on electricity, and that we can hardly comprehend the possibility of cartography without it. But, he adds, we have a responsibility to ensure that our technical advance is not at the expense of our fellow workers in other parts of the world. "This is, perhaps, the biggest challenge of all -- and one in which -- as individuals we may feel very ineffectual." Another view comes from a neurological perspective on The Hand by Frank Wilson [1998] which forces us to consider the balance of technologies which we provide to young children.

In his book, Wilson examines what he calls the "hand-thought-language nexus"-- the connection between object manipulation, the mediation of the brain, and the development of symbolic ways of communication. And while he doesn't name maps, I would certainly include cartographic communication here. Wilson considers that creativity is a critical element at the core of all learning *"when it involves the gathering of information, the exploration and testing of ideas, and decisions made toward some goal"* – an improvisational model of mapping if I have ever heard one! He asserts that it is the hand, both in anthropologic time and in the span of a single human life, which interacts with the brain to expand, not only the things that the hand can do, but also the ways in which the brain can think. But while we do and must learn a variety of manipulating skills, Wilson asserts that the historic role of the hands in the acquisition of knowledge and skill during one's apprentice-ship, continues in the dynamic processes of the imagination. He tells of a senior geographical-research designer who still works regularly with a pencil and paper -- tools that, ironically, the designer considers more interactive than the computer, because they force him to think through the implications.

Wilson reviews research that suggests a strong parallel between the ways the brain organizes the child's interactions with objects and the ways it organizes the production of speech. From the beginning "...the hand is involved...in the baby's construction of visuomotor, kinesthetic, and haptic representations of the world and the objects in it." Here the brain must develop and integrate a multi-sensory reference system and establish a coordinate system for external objects located in three dimensional space." In other words, this perspective regards the body as an extension of the mind.

Obviously all this supports the general notion of geography as an experiential science and geographic education as a process of personal discovery, rather than the mastery of a bounded set of facts and figures. In particular, it suggests that some manual activities can bridge the gap between what young children see and the abstract concepts involved in the various steps in mapping. This would seem especially relevant for such topics as orientation and position in geographic curricula where we often insist on starting with the abstractions of cardinal directions and latitude and longitude rather than with some of the steps outlined above.

According to Wilson, *"The clear message from biology to educators is this: The most effective techniques for cultivating intelligence aim at uniting (not divorcing) mind and body."* And he reminds us that *"Intelligence, the capacity for innovative response to the world, is also an aspect of the entire organism." "The brain does not live inside the head, even though that is its formal habitat. It reaches out to the body, and with the body it reaches out to the world."* The basic inquisitiveness of the human mind serves the fundamental desire of the person to establish meaningful relations between himself or herself and the world. This seems a most useful basis for any educational pedagogy, including ours!

Conclusion

With those thoughts, I want to again welcome all of you to Montreal and express the hope that all your expectations

for these meetings will be fulfilled. We have some exciting activities ahead of us so let us begin.

References

Castner, H.W. (1990). Seeking New Horizons: A Perceptual Approach to Geographic Education. McGill-Queen's University Press,.Montreal & Kingston.

Castner, H.W. (1995a). "An educational taxonomy for maps in a child's world," Annual Meeting, NACIS, Wilmington, NC, 27 October.

Castner, H.W. (1995b). Discerning New Horizons: A Perceptual Approach to Geographic Education. Indiana, PA: National Council for Geographic Education.

Castner, H.W. (1999). "A Functional Taxonomy for Mapping in Geographic Education," Research in Geographic Education. I (#1), 38-65.

Castner, H.W. (2000). "The nature of creativity in cartographic design: with special reference to the Barbara Petchenik Map Design Competition," Cartographic Perspectives, (#36, Spring), 12-23.

Dent, B. (1985). Principles of Thematic Map Design. Addison-Wesley, Reading, MA.

Edwards, B. (1986). Drawing on the Artist Within. Simon and Schuster, New York.

Petchenik, B.B. (1985). "Facts or values: basic methodological issues in research for educational mapping," Cartographica, 22(3), 20-42.

Robinson, A.H. (1953). Elements of Cartography. John Wiley, New York.

Robinson, A.H. and R.Sale. (1969). Elements of Cartography. 3d Edition. John Wiley, New York.

Tatham, A. (1998). "A Message from the President: Cartography on the Threshold of the Millennium," Maplines, 4(3), December, pp. 3-4.

Wilson, F.R. (1998). The hand: how its use shapes the brain, language, and human culture. Pantheon Books, New York.