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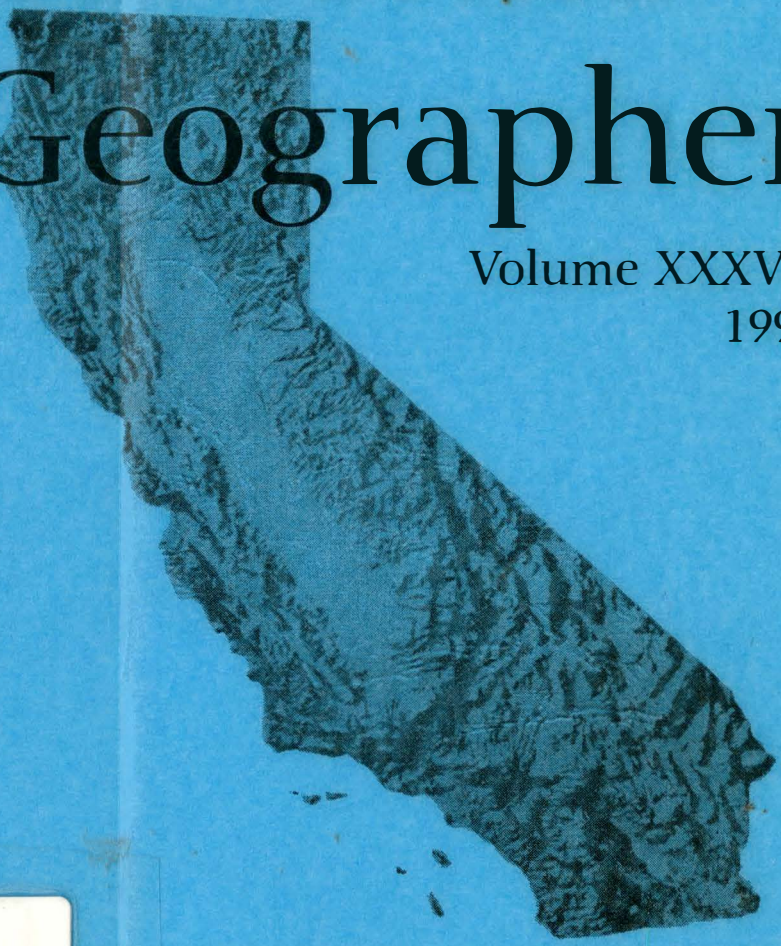

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Ultraviolet-B Radiation At Northridge

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Keywords: Ultraviolet-B radiation, UVB-1 pyranometer, Northridge, hourly and seasonal variations, statistical analyses.
Abstract: Data of ultraviolet-B radiation in 1996 at Northridge were derived from a Yankee Environmental Systems UVB-1 pyranometer. Hourly and seasonal variations of ultraviolet-B radiation were presented. Statistical analyses between ultraviolet-B radiation and other weather variables including air temperature, relative humidity, visible-infrared radiation, and precipitation were conducted.

Introduction

Since the discovery of ozone depletion in the stratosphere caused by man-made chlorofluorocarbons (CFCs) in 1974 (Molina and Rowland, 1974), the public have been warned against the possible increase in health risk associated with more penetrations of ultraviolet radiation (UVR) reaching the earth's surface. For this purpose, the US National Weather Service has since 1994 issued non-hour ultraviolet index (UVI) and minute-to-sunburn forecasts as part of their daily weather reports. In order to study the relationship between ozone depletion and ultraviolet-B (UVB) radiation in the Los Angeles area and to verify UVI forecasts, a Yankee Environmental Systems (YES) UVB-1 pyranometer was installed in July 1995 at the California State University, Northridge (CSUN) weather station to monitor UVB radiation. This article presents a preliminary study of mean hourly and seasonal variations of UVB radiation in 1996 at Northridge. Statistical analyses are given of noon-hour (11:30 a.m. to 12:30 p.m. PST) UVB radiation in relation to other weather variables such as visible-infrared radiation, air temperature, relative humidity, and precipitation.

Literature Review

UVR was first classified into three bands, UVA, UVB, UVC, by Saidman and accepted at the Second Congress of Copenhagen in 1932 (Urbach, 1986). UVC, with wavelengths less than 280 nm, is most biologically harmful. Fortunately, it is completely absorbed by ozone and other gases in the upper atmosphere (Berger and Morys, 1992). UVB, of wavelength range 280 nm to 320 nm, is of particular interest because it penetrates through the atmosphere to the earth's surface and is very effective at causing sunburn, skin cancer, eye disorder, and the suppression of immune systems in humans (Passchier and Bosnjakovic, 1987). UVB is strongly absorbed by stratospheric ozone. Small changes in ozone can lead to large changes in UVB radiation that reaches the earth's sur-

face (McKenzie and Bodeker, 1997). Worldwide UVB increases in the past decade are consistent with ozone decreases (Madronich and de Gruul, 1994; Zheng and Basher, 1993). Every one percent decrease in ozone brings an estimated two percent increase in UVB radiation and a three percent increase in nonmelanoma skin cancer per year in the United States (NIH, 1989; Sober, 1976). Increased UVB radiation may also endanger marine organisms in the upper layers of the sea by decreasing algal productivity and damaging various forms of aquatic larvae and other organisms (Smith, 1989; Bidigare, 1989). Sensitive plants often exhibit reduced growth, photosynthetic activity, and flowering when exposed to excessive UVB radiation (Tevini and Teramura, 1989).

UVA radiation, at wavelengths from 320 nm to 400 nm, can produce health damage similar to that of UVB radiation, but is much less effective. For example, UVA radiation is 1000-fold less effective than UVB radiation in producing erythema (skin redness or sunburn), but about 10 to 100-fold more UVA than UVB energy reaches the earth's surface (NIH, 1989).

Therefore, UVA radiation may contribute about 10–20% to the sunburn reaction in summer (Diffey, 1991). UVA radiation is important in the generation of photochemical smog and also degrades many materials such as plastics, paints, and fabrics (McKenzie and Bodeker, 1997).

The first global network of UVB measurements was established in 1973 as part of the Climatic Impact Assessment Program supported by the US Department of Transportation and National Oceanic and Atmospheric Administration (NOAA). Contrary to common belief and more recent findings, Robertson-Berger (RB) ultraviolet meters showed no increase in biologically effective solar radiation, UVB, at ground level from 1974 to 1985, despite decreases in upper stratospheric ozone (Scotto et al. 1988). Small increases in tropospheric absorption by polluting gases or particulates could have offset the increases of UVB radiation due to stratospheric ozone depletion, particularly in densely populated areas (Urbach, 1989). Potential adverse effects of UVB radiation on plants led the United States Department of Agriculture (USDA) to initiate a UVB radiation program in 1992 to provide information on the geographical distribution and temporal trend of UVB radiation. This information is critical to the assessment of potential impacts of increasing UVR on agricultural crops and forests. The USDA has planned to establish a climatological network consisting of 30 to 40 UVB monitoring stations using Yankee Environmental Systems UVB-1 pyranometers to measure UVB radiation (Gibson, 1996). Recently, a number of secondary schools in Los Angeles and the California State University, Northridge have participated in Project Sun to monitor both visible and UV solar radiation

using much less expensive Sun pyranometers. Project Sun is directed by the Jet Propulsion Laboratory (JPL) as part of NASA's "Mission to Planet Earth" worldwide education outreach effort (Yanow, 1996).

Method

In July 1995, the Department of Geography at CSUN established on campus an automatic weather station including a Yankee Environmental Systems UVB-1 pyranometer and a Li200X pyranometer. The former is a broadband one channel instrument measuring total UVB radiation at wavelengths from 280 nm to 320 nm (one channel with band width of 40 nm). The latter, also a broadband instrument, measures visible light and short-wave infrared radiation at wavelengths from 400 nm to 1100 nm. A broad band pyranometer measures total energy within a band wider than 10 nm [UVB, UVA, and visible radiation]. By contrast, a spectroradiometer measures a narrow band of energy with a band width 10 nm or less. UVB radiation at the CSUN weather station is obtained by the following equation:

$$\text{UVB} = 0.001 \times 2 \times 1.97 \times (\text{CR10 voltage output}) = 0.00394 \times (\text{CR10 voltage output})$$

where the factor 0.001 converts millivolts to volts; 1.97 is a calibration constant in unit of $w/m^2/volt$ (YES, 1997); and the factor 2 transfers voltage readings from UVB-1 sensor to the Campbell Scientific CR10 datalogger which outputs the UVB energy in unit of millivolts. UVB measurements are taken every 3 seconds. The other measurements of the weather station include air temperature, wind, atmospheric pressure, and precipitation. Hourly values of average, maximum, and minimum for each weather variable are stored in a module of a Campbell Scientific datalogger and can be displayed on Excel spreadsheets on an IBM computer screen via modem. The real time data can be accessed by the public through a voice phone line (818-677-5628). Macintosh software programs of Statview and Delta Graph are employed to perform statistical analyses and create graphs for the illustrations in this study.

Discussion

Figure 1 shows hourly variations of UVB radiation in January, June, July, and December 1996 at Northridge. UVB radiation was highest in July and lowest in December. In June and July, measurable amounts of UVB radiation occurred between 6 a.m and 7 p.m. PST. In the morning hours, UVB radiation in June and July were almost equal. In the afternoon, hourly UVB radiation in July slightly surpassed that in June. Mean hourly UVB radiation varied from 0.04 w/m^2 at 6 a.m. to 3.2 w/m^2 at noon in both June and July. UVB radiation from 10 a.m. to 4 p.m. in

winter was much weaker than in summer The noon-hour UVB radiation was 0.7 w/m² in December and 0.9 w/m² in January in contrast to 3.2 w/m² in both June and July. December UVB radiation slightly exceeded January UVB radiation in early morning hours, but was markedly lower from late morning through afternoon. About 86% of daily UVB radiation in summer and 95% in winter occurred between 10 a.m. and 4 p.m. The National Weather Service and the EPA have advised the public to restrict outdoor activities during those hours when the UVB radiation is most intense (EPA, 1994).

Figure 2 shows monthly variations of the noon-hour mean, maximum, minimum, standard deviation, and coefficient of variation of UVB radiation. Monthly noon-hour means of UVB radiation varied from 0.7 w/m² in December to 3.2 w/m² in both June and July as also shown in Figure 1. The noon-hour maxima of UVB radiation ranged from 3.7 w/m² in May and July, with a slight drop to 3.6 w/m² in June, to 1.1 w/m² in January and December. The noon-hour minima of UVB radiation spanned from 0.1w/m² in December to 2.1 w/m² in both June and July. The plunge of noon-hour minimum UVB radiation in August was perhaps caused by the passage of clouds over Northridge on August 15, 1996. In April and May, the range of UVB radiation was about 2.9 w/m², the highest of the year.

In terms of monthly standard deviations of UVB radiation, the period February through May was characterized by the highest value in the year. However, coefficients of variation of UVB radiation showed more clearly the influence of seasonal weather patterns on the UVB variability. The coefficient of variation is defined as the ratio of monthly standard deviation to monthly mean UVB radiation and is unitless. The advantage of expressing variability by coefficient of variation is that it is not affected by extreme mean values as is standard deviation. The coefficients of variation of UVB radiation show distinctly a higher variability in winter than in summer. Southern California weather is more variable in winter than in summer. Summer weather is more monotonous with the predominance of land and sea breezes from day to day (Keith, 1980), accounting for a very low coefficient of variation of 0.1. By contrast, winter is a rainy season and weather is more variable. Cyclonic or frontal systems and Santa Ana winds frequently interrupt the weather regime of land and sea breezes, reflected in a high coefficient of variation of UVB radiation of 0.4.

Table 1 shows monthly variations of both noon-hour visible-infrared and UVB radiation in 1996 at Northridge. Visible-infrared radiation reached a minimum of 406 w/m² in December to a maximum of 937 w/m² in June. The ratio of UVB to visible-infrared radiation in-

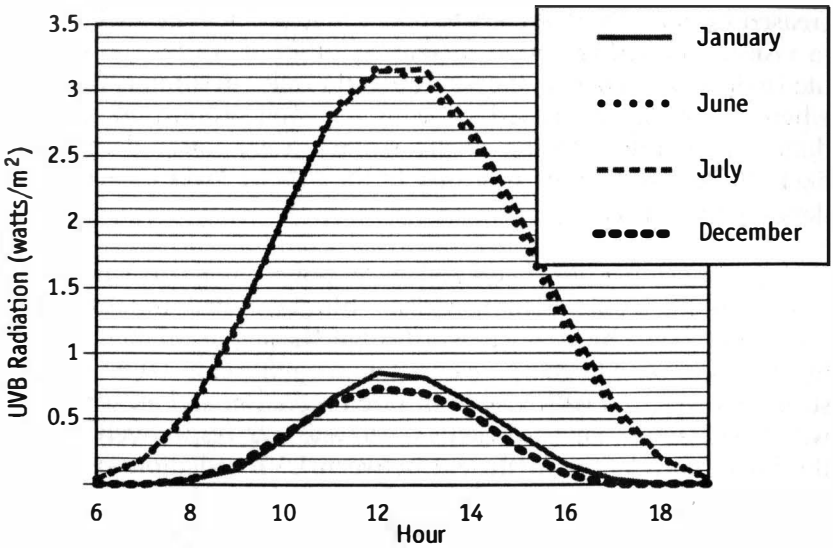

FIGURE 1. Hourly variations of mean UVB radiation in 1996 at Northridge.

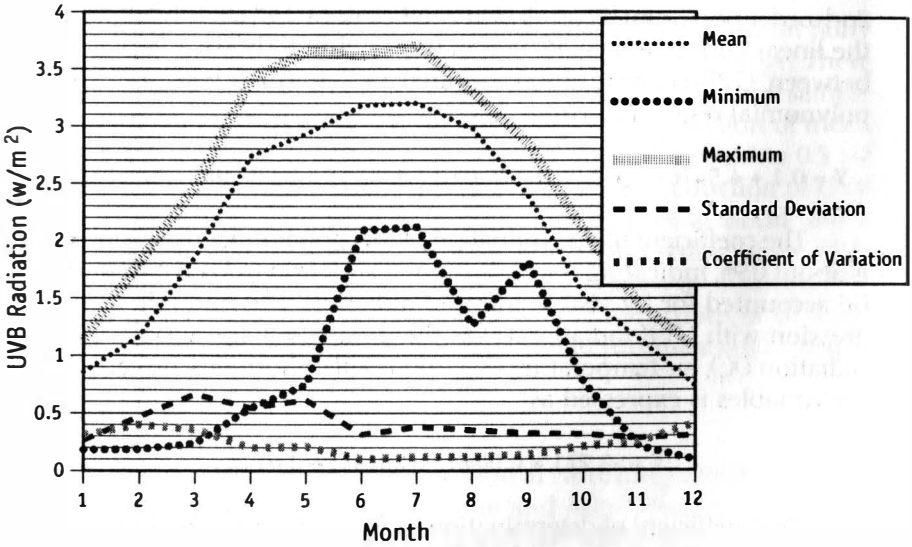

FIGURE 2. Monthly variations of mean, minimum, maximum, standard deviation, and coefficient of variation of noon-hour UVB radiation.

creased from 0.17% in January to 0.35% in July. The higher ratio of UVB to visible-infrared radiation in summer than in winter can be attributed to less cloud cover in the San Fernando Valley in summer (Keith,1980) where Northridge is located, allowing a greater proportion of UVB radiation penetrating to the earth's surface. Solar infrared radiation is likely to be absorbed by moisture in the marine layer associated with daytime sea breezes.

Table 2 shows linear and 2nd-order polynomial correlation coefficients among UVB radiation, visible-infrared radiation, air temperature, and relative humidity at Northridge. Noon-hour data on 363 days in 1996 were used to compute correlation coefficients. UVB radiation is strongly correlated with visible-infrared radiation and air temperature with linear correlation coefficients of 0.92 and 0.72, respectively. Although the linear correlation coefficient between UVB radiation and relative humidity is statistically significant, the value (-0.37) is not impressively high. Moisture does not absorb UVB radiation, but a high relative humidity may be accompanied by the presence of clouds that reduces UVB radiation reaching ground level. This is reflected by a moderate negative correlation coefficient. The 2nd-order polynomial correlation coefficient between UVB radiation and relative humidity is -0.51, a marked improvement over the linear correlation coefficient. Therefore, the relationship between UVB radiation and relative humidity is better described as polynomial than linear. The polynomial relationship also holds between UVB and visible-infrared radiation as evidenced by a 2nd-order polynomial correlation coefficient of 0.97, slightly higher than the linear correlation coefficient of 0.92. Figure 3 shows a very good fit between UVB (Y) and visible-infrared radiation (X) with a 5th-order polynomial regression curve:

$$Y = 0.1 + 4.547E\text{-}4X + 2.001E\text{-}5X^2 - 7.474E\text{-}8X^3 + 1.022E\text{-}10X^4 - 4.458E\text{-}14X^5$$

The coefficient of determination of this polynomial regression curve is about 0.94, indicating that 94% of total variation in UVB radiation can be accounted for by visible-infrared radiation. The multiple linear regression with UVB radiation (Y) as the predictand and visible-infrared radiation (X_1), air temperature (X_2), and relative humidity (X_3) as predictor variables is expressed as

$$Y = -2.271 + 0.004X_1 + 0.048X_2 + 0.014X_3.$$

The coefficient of determination of this regression equation is about 0.92, a value slightly lower than that of the 5th-order polynomial regression equation with only one predictor variable, namely, visible-infrared radiation.

Table 1. Monthly variations of mean noon-hour UVB and visible-infrared radiation and the ratio of UVB to visible-infrared radiation.

Month 1996	UVB radiation watts/m²	Visible-infrared radiation watts/m²	UVB/Visible-infrared (%)
1	0.85	491.80	0.17
2	1.17	522.00	0.22
3	1.86	707.60	0.26
4	2.74	878.00	0.31
5	2.93	883.60	0.33
6	3.18	937.00	0.34
7	3.20	904.00	0.35
8	2.98	881.50	0.34
9	2.39	807.20	0.30
10	1.53	672.00	0.23
11	1.14	557.30	0.21
12	0.74	406.00	0.18

Table 2. Correlation coefficients among temperature, relative humidity, visible-infrared, and UVB radiation. Numbers in parenthesis are 2nd-order polynomial correlation coefficients. Others are linear correlation coefficients.

	Temperature	Relative Humidity	Visible-infrared	UVB
Temperature	1			
Relative Hunidity	-0.60	1		
Visible-infrared	0.67	-0.55	1	
UVB	0.72 (0.74)	-0.37 (-0.51)	0.92 (0.97)	1

Figure 4 shows mean hourly variations of UVB radiation on rainy days and on fair-weather days in December 1996 at Northridge. There were 9 rainy days in December 1996 providing a sufficiently large sample to compute mean UVB radiation on rainy days. The reduction of mean hourly UVB radiation on rainy days reached about 0.3 w/m² to 0.5 w/m² between 11 a.m. and 2 p.m.. However, the percent reduction of UVB radiation on rainy days attained a minimum of 40% at noon and a maximum of about 80% from 2 p.m. to 4 p.m. The reduction of UVB radiation on rainy days was not significantly related to mean hourly intensity of precipitation. The hours with higher reductions of UVB radiation did not occur during the hours of higher precipitation intensity.

Conclusion

The mean noon-hour UVB radiation at Northridge varied from 0.7 w/m² in December to 3.2 w/m² in June and July 1996. The detectable UVB radiation in both early morning and late afternoon hours was 0.4 w/m². The maximum noon-hour UVB radiation was 1.1 w/m² in December and 3.7 w/m² in July. There was a much lower daily noon-hour

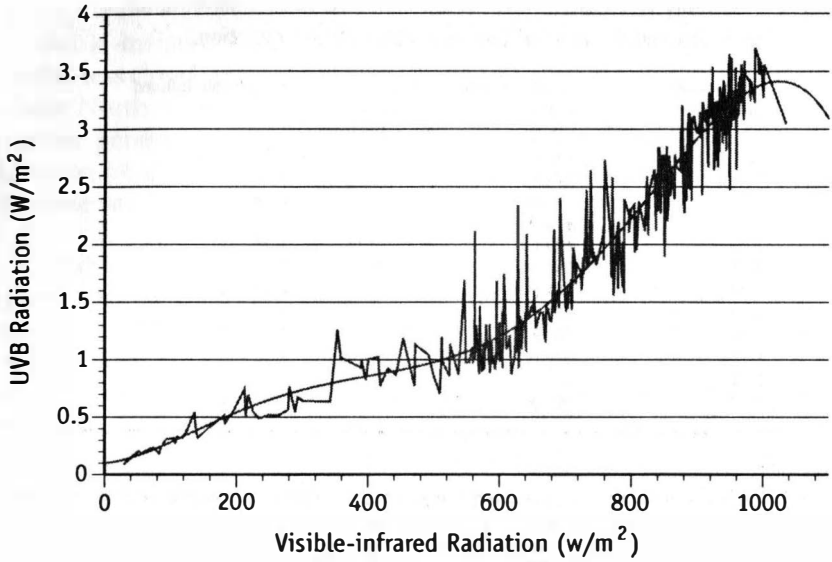

FIGURE 3. The 5th-order polynomial regression between UVB and visible-infrared radiation in 1996 at Northridge.

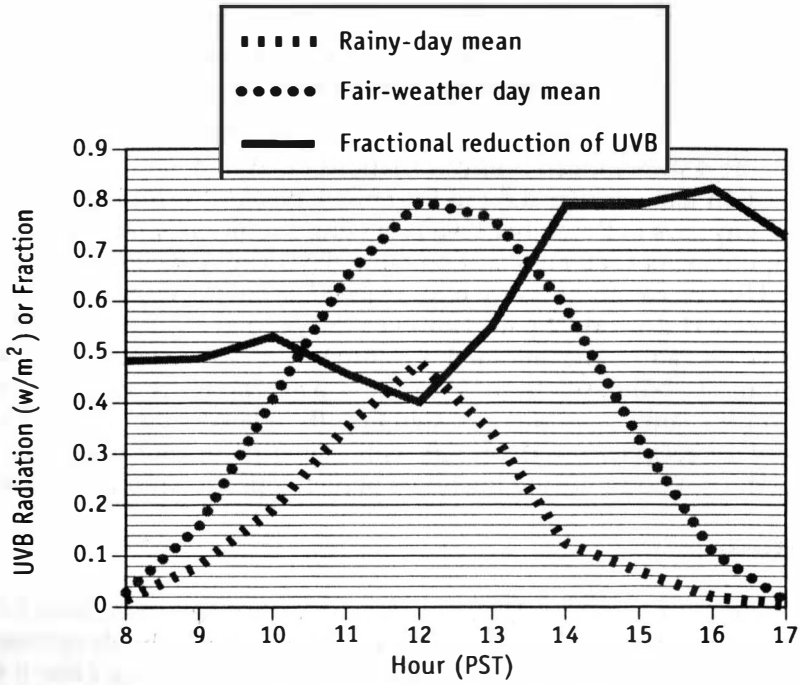

FIGURE 4. Mean hourly UVB radiation on rainy and fair-weather days and the fractional reduction of UVB radiation on rainy days in December 1996 at Northridge.

UVB variability in summer than in winter since summer weather was more monotonous, characterized by the predominance of sea breezes during the daytime.

The noon-hour UVB radiation was significantly correlated with visible-infrared radiation, air temperature, and relative humidity. The relationship between UVB radiation and visible-infrared radiation or relative humidity is polynomial. Rainy days significantly reduced UVB radiation reaching the earth's surface by about 40% to 80% depending on the time of day. However, the reduction of UVB radiation was not determined by the intensity of precipitation.

A research project is planned by the author using the regression equations developed in this study to reconstruct UVB radiation in the past when the data of predictor variables were available in order to determine whether there has been an increase in UVB radiation at Northridge due to stratospheric ozone depletion. The Northridge UVB radiation can be used to compute UVI and minute-to-burn for the purpose of verifying daily forecasts of these two variables in Los Angeles issued by the National Weather Service. Whether UVB radiation is related to surface concentrations of ozone and particulate matters will be addressed in another study. An additional Yankee Environmental Systems UVB-1 pyranometer will be installed in the summer of 1997 in order to find out the reflection of UVB radiation from the earth's surface.

Acknowledgments

I thank Dr. Bill Flores, Dean of the College of Social and Behavioral Sciences at CSUN, for providing reassigned time to me to conduct this research project. I am grateful to Tim Boyle, weather technician, for collecting data used in this study, and to Robert Provin for his cartographic assistance.

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Extreme Geography

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"If you look too deeply into the abyss, the abyss will look into you."
– Friedrich Nietzsche

Introduction:

A recent editorial in the *Annals* of the Association of American Geographers (Dixon and Jones, 1996) presented an entertaining deconstructive reading of scientific geography. This innovative essay, titled "For a *Supercalifragilisticexpialidocious* Scientific Geography" demonstrates how a popular deconstructive method adapted from the humanities might be deployed to facilitate the "self-redemption" of scientific geography from its constraining positivist closure, perhaps paving the way for its alignment with the open-ended and pluralistic world-view of an emerging critical poststructuralism. Stylistic and methodological attributes of a postmodern attitude permeate the editorial: its postmodern style is a refreshing departure from the usual flat, denotative prose of scientific reporting; the blatant refusal of the authors to marshal validity and reference authority in support of their arguments is a portent of bold, new directions for the discipline's flagship journal; finally, the topic is thought-provoking and timely, motivated in part by the authors' concern about "the absence of a considered debate over the challenges and relative merits of poststructuralism" (Dixon and Jones, 1996,767). The timing of this debate cannot be separated from events and conditions that characterize the postmodern-as-epoch (Dear and Wassmansdorf, 1993). Perhaps that time has already passed: at least one observer suggests that the impact of information technology and time-space convergence on human communication seems to render Dixon and Jones' "considered debate" less relevant in the postmodern epoch (Nemeth, 1997). Postmodern skepticism thrives on information surfeits, and ambiguous truths are bred wholesale by the speed in the span of cyberspace: this new flexibility in the accumulation of information now feeds a frenzy of popular skepticism about absolute truths that is much deeper and darker than the methodological skepticism in positivist science that continues to invest heavily in their credibilities.

I share Dixon and Jones' concern that the debate on critical poststructuralism is long overdue. Certainly their strategy of persuasion begs comment – and not only from the scientific geographers of many stripes to whom it is addressed. The debate would be enriched (if not

edified) by including the voices of relativism in the discussion. Yet, by calling for a "considered" debate, Dixon and Jones are clearly restricting their agenda to exclude relativists. How and why they do so are questions that generate some interesting insights into the alternative futures of human geography, and have implications that are the focus of my comments.

Dixon and Jones demonstrate in their editorial how the critical poststructuralist's method of destabilization-through-deconstruction facilitates freeing the center of scientific geography from its fixed ideas in order to permit "dynamism and unfixity," or what I interpret them to mean to be the play of multiple meanings in geographic discourse. However, Dixon and Jones are against relativism, and therefore intolerant of a degree of pluralism that promotes the mixing of Apollonian (orderly) and Dionysian (celebratory) world views and voices. Excluding relativists from "a considered debate over the challenges and relative merits of poststructuralism" has obvious appeal for both critical poststructuralists and scientific geographers. "Considered debate" by their agreement seems confined to an arena of "mature, deliberative thought." Both critical geographers and scientific geographers characterize themselves as mature deliberative thinkers who care about the weighty matters in which they choose to engage and deliberate. They agree to use language in socially constructive ways to solve problems. They also agree that they have achieved a balance of skepticism and criticism in the service of science that can facilitate the construction of social order and a better world. Thus, to negate methodically is viewed as a positive act within the context of the goals of scientific skepticism (Szymanski and Agnew, 1981, 1).

Yet, as Bearn has pointed out, scientific minds cannot long indulge in unrestricted skeptical and critical thinking without discovering that the way they "word the world" (that is, their social construction of it through language) is true only to the extent that they have already agreed to "share all judgements about what is relevant to what." This is why relativism persists and perseveres as an alternative to scientific thinking, because it is obvious that "all people do not share all judgements about what is relevant to what" (Bearn 1997,x).

The inevitability of making this discovery through an unfettered elaboration of skepticism results in that deeper and darker relativist thinking that has always terrorized rational and scientific thinkers by revealing to them the groundlessness of their linguistic practices. The epigraph by Nietzsche preceding my comments here suggests that the source of this terror resides in a backlash of thinking itself. Relativist thinking is a sort of intuitive echo (from the abyss) that anticipates and

negates everything shouted (hypotheses, assertions, proclamations, etc.). Paraphrasing Bearn (pp. x, xii).

Relativism shows itself in that kind of communicative failure which, when disjoined from weighty matters, incites laughter. Language (and understanding, and knowledge) rests upon very shaky foundations–a thin net over an abyss. Thus, when one considers life as a whole, one reaches the conclusion that nothing is worth saying or doing.

Dixon and Jones as critical poststructuralists define their project in part by choosing to shout anyway. However, geographers may also come to know the merits of their critical poststructuralism, and the challenges to it, by observing the futility of their tactical attempts to set restricted agendas and to otherwise exclude the contingent world of relativist thinking from contaminating their considered thoughts and debates. Since the birth of the sort of moribund scientific geography that Dixon and Jones are critiquing was attended by considered debates that excluded relativists, all that need be said about the merits of a self-redeemed scientific geography, recast in the very same foundry of considered debates and exclusion, is that it seems destined to reproduce the same dead forms.

Dixon and Jones' editorial strategy to mute the disruptive voices of relativism is clearly foreshadowed in Jones' recent *Geographical Analysis* article (coauthored with Robert Q. Hanham) titled "Contingency, Realism and the Expansion Method" (1995). Here, Jones and Hanham posit an alignment between spatial science's expansion method and scientific realism in converging traditions of analytic philosophy. Their attempt at alignment here assumes an agreement between them on the present meaning of the term "contingency": i.e. to denote–not particularity–but "an intervention in a process caused by context-dependent differences within which that process is embedded. Contingencies interrupt the operation of processes, thereby producing different empirical outcomes in different contexts" (1995,186). Jones and Hanham claim that both the expansion method and scientific realism are approaches that "reject all claims of universal determination" and "share a faith in the value of abstraction and analytical investigation" (p. 186–7). They propose their dialogue "in the hopes of enlarging the methodological terrain of human geography" (p. 187). However, their first order of business is to dismiss "contingency as indeterminacy" (relativism?) from their further consideration, because it introduces an "ontology of chance" that is "a weaker and less useful concept than most [scientific geographers] would be interested in purchasing" (p. 188). This phrasing, by the way, introduces the tactical importance of phrases like "intellectual purchase" and "temporary stabilization" into the vocabulary of critical theorists.

They seek to position their own selectively determinate and privileged contingent thinking in intellectual space, and to distance it from those indeterminate contingencies of "excessive" relativist thinking they disdain and dismiss. Unfortunately, by excluding indeterminate contingency from their analysis Jones and Hanham ignore contemplating the very type of contingent thinking most appropriate to survival in a postmodern contingent economy. I suggest that an ontology of chance is an idea appropriate to the times, and worth exploring.

Since Dixon and Jones argue forcefully and directly against excessive relativism ("hyperrelativism") in their editorial, this is where I will focus the majority of my commentary. Indeed, Dixon and Jones might as well have appended "And Against Relativism" to their title, so that readers might fully anticipate the significance and implications of their aggressive stand. In the main, they raise strong logical and moral objections to relativist thinking, but in what amounts to a lopsided discussion that ends with their dismissing relativism without ever having refuted its challenge to the project of critical poststucturalism. However, Bearn (1997, ix) emphasizes that relativism, though it has always seemed easy to refute, has always refused to retire.

As the editorial stands, Dixon and Jones' dismissal of relativism is a transparent attempt to give critical poststructuralism wider appeal among scientific geographers who are also against relativism. However, in their devotion to science, their critical poststructuralism eventually reveals itself to be more like "doing penance" than "doing tolerance." The alignment between critical poststructuralists and scientific geographers is enhanced by advantaging that inner sense of disciplinary solidarity that focuses on a common external enemy–relativism. That enemy goes by many names in the lexicon of scientific culture: "crude relativism," "cynical relativism," "excessive relativism," "hyperrelativism" and–most interesting in the context of what follows–"lazy pluralism." All of these are associated with non-instrumental-rational and lay forms of skepticism, and are glossed as "nihilism."

The editorial thus raises the issue of relativism for a limited and self-serving purpose, and without giving thought to address its potential for shaping an alternative geography that is neither scientific nor poststructural. Furthermore it is odd that Dixon and Jones think it "progressive" ("understood as a politics that promotes unlimited freedom and possibility" [p. 778]) to now indulge in the same sort of politics of exclusion that positivists have been wont to use for decades to end their own unwanted conversations with relativist thinkers. However, a rising tide of popular skepticism that in part characterizes the postmodern epoch seems to be rapidly overwhelming both old and new intellectual

levees built to preserve and privilege enlightenment morality and scientific knowledge. Dixon and Jones' efforts to order debate by excluding relativism also seems futile because (to quote an irrational credo of amoral computer hackers) "information wants to be free."

Dixon and Jones' editorial agrees with the Jones and Hanham article by suggesting that "scientific geography's greatest challenge is the construction of new methodologies appropriate to investigations of a plural and never fixed social world" (Dixon and Jones, 1996,778). To this end, they encourage scientific geographers to abandon their methodological inflexibility and to pursue a progressive alignment with critical poststructuralists. Dixon and Jones attempt to demonstrate through example in their editorial how a deconstructive critical poststructuralism might facilitate scientific geography's emancipation from its positivist closure. Their emancipatory narrative reveals that critical poststructuralists share some of the major philosophical and political enlightenment assumptions already held by scientific geographers. It is these shared values and goals that provide the common ground upon which Dixon and Jones to attempt to construct their edifice of persuasion.

Framing Mary and Forgetting Nietzsche

Dixon and Jones offer an allegorical reading of scientific geography that employs the popular Disney film "Mary Poppins" (1964). It is not necessary to view this film to appreciate how the authors deploy their allegorical narrative to critique scientific geography. The allegory interprets a nanny (Mary Poppins) as the film's poststructural character. Mary's employer (the banker George Banks) is scientific geography. Banks' children represent the geographic discipline itself. Mary's friend's Uncle Albert is a "stand-in for a celebratory poststructuralism exemplified in the later Baudrillard" (Dixon and Jones, 1996,774).

The interpretive framework that Dixon and Jones construct around Mary Poppins, George Banks, Albert and other characters in this film allows them to circumvent the extent to which the critical approach they are using to deconstruct scientific geography - though inspired by Jacques Derrida - also derives from the ideas of Nietzsche. Derrida and Baudrillard are the only intellectuals in the poststructural/ postmodern pantheon mentioned in the editorial.

Why do they forget Nietzsche? Because acknowledging him and his ideas would seriously undermine the appeal of the critical poststructural deconstructive method to scientific geographers. Nietzschean nihilism springs from his rejection of enlightenment assumptions; for example, the assumption that reasonable dialog facili-

tates progressive thought and social transformation. A progressive dialog between scientific reason and poststructural reason is made possible insofar as they both claim to share some enlightenment values; for example pluralism and democracy. Specifically, the enlightenment story that attributes the gradual emancipation of humanity from slavery and class oppression to the central role played by the progress of a goal-oriented scientific knowledge away from ignorance is mutually appealing. But, invoking Nietzschean nihilism can be embarrassing in as much as Nietzsche brought about a deconstruction of the story of science that revealed its false enlightenment assumptions and internal contradictions long before Derrida coined the term "deconstruction." Invoking Nietzsche also invokes postmodernism.

In their allegorical narrative, in a subsection titled "Posting Mary", both Mary and Albert are characterized as poststructuralists and not as postmodernists. Nor does the term "postmodern" appear anywhere but once in the editorial (yet it appears as one of six keywords appended to it). What is the difference between critical poststructuralism and postmodernism? This is a question that cannot begin to be answered here, but it helps to identify poststructuralism as "the product of French intellectuals aspiring to a post-Marxian critical approach" (Seidman, 1994,18). One of those French intellectuals is Derrida, the most prominent contemporary deconstructionist. Critical poststructuralism can thus be fairly characterized as Dixon and Jones have presented it – by the Derridian deconstructive technique. Yet nowhere do Dixon and Jones actually define critical poststructuralism in their editorial; only to imply in the negative sense that *their* critical poststructuralism is *not* postmodernism.

However, Nietzschean nihilism is also associated with postmodernism in academic discourse. This is because, as Seidman points out, poststructuralism is but one point of departure in postmodern human studies. This being so, then Baudrillard's "celebratory poststructuralism" deprecated by Dixon and Jones (p. 774) is but another postmodern point of departure. Critical poststructuralism and postmodernism may or may not be related to each other as descended from the family of ambiguous, atheoretical, relativist ideas and methods hatched from Nietzschean nihilism. For example, contemporary relativist youth thinking and the behavior it generates may arise from epochal postmodern conditions apart from any Nietzschean intellectual wellsprings (though they may also be nurtured by these wellsprings). Bearn (1997, xv), for example, suggests that Nietzsche's philosophy need not be interpreted "as exacerbating the nihilism of contemporary culture." The anti-intellectual strain of contemporary youth nihilism and relativism might then be traced to a different source–the influence of

prevailing amoral market forces. I will return to the topic of youth relativism and its implications shortly.

Dixon and Jones claim that critical poststructuralism offers scientific geographers an opportunity for self-redemption through pluralistic thinking. At the same time they offer assurances that in aligning with critical poststructuralists, the enlightenment values of scientific geographers can remain secure against immoral and amoral relativist thinking. This is an ironic proposal in the sense that irony gives with one hand while taking away with the other. Critical poststructuralists cannot give with both hands here because pluralism is a euphemism for a degree of relativism that inadvertently blazes trails to more extreme dissensus thinking. Paths of relativism that tend to lead away from consensus thinking toward dissensus thinking can also arrive at indifference to thinking. In this way scientific geography becomes more than just a pluralistic science when it aligns with critical poststructuralism (becomes *supercalifragilisticexpialidocious*). Its world view cannot but become less objective and more ethereal, less rational and more relative, less moral and more amoral.

Dixon and Jones' antiessentialist reading of scientific geography ends up revealing that critical poststructuralism shares much more common ground with scientific geography than these authors might care to admit. While their critique of the entrenched positivist philosophy in scientific geography has merit for potentially opening up the discipline to plural methodologies (in addition to the scientific method), the position of critical poststructuralism relative to scientific geography smacks more of compromise than of challenge. Dixon and Jones' proposal for facilitating the self-redemption of and alignment with scientific geography again reminds me of those amoral or morally indifferent computer hackers who claim to strengthen the corporate entities they attack, but who end up becoming part of those entities. Rather than move geography from a causal to a casual science, Dixon and Jones' proposal on behalf of a methodological and moral pluralism simply substitutes one exclusionary disciplinary regimen for another. What geographers do not need tied around their necks in a postmodern epoch where relativism and amorality proliferate is a maladaptive new scientific albatross to replace an old one.

Dixon and Jones' critical poststructuralism ends up looking a lot like the left-liberal persuasion of the American neopragmatist Richard Rorty, who argues that "thought can only be justified in the realm of action" (in Linn 1996, 42-43). Like Dixon and Jones, Rorty is skeptical of the positivist's progressive search for objective truths, but acts to preserve some enlightenment values; for example, remaining obligated to

emancipation through some kind of programmatic action. Dixon and Jones' realm of action emancipates through the progressive politics of "edifying conversations." They believe that "considered debates," for example between scientific geographers and critical poststructuralists, can nurture unlimited freedom and possibility (particularly in Western liberal democratic societies). And, they act in both subtle and overt ways to exclude relativism from their considered debates. Technically, the spirit of an edifying conversation as a way of "keeping the conversation going" is not violated in an exclusive considered debate. On the other hand, an exclusive considered debate can be an unconscionable tyranny of democracy when it trammels individualism in order to promote its program of consensus action in a social world.

Flaming Baudrillard:

To demonstrate this, I will focus more closely here on Dixon and Jones' treatment of Uncle Albert as the key point in their allegory where they try to clean up the unruly grammatical structure in critical poststructuralism that they have inherited from Nietzsche, but which embarrasses them. That point is where Albert is identified first as a "nihilistic poststructuralism that refuses any and all decisionism under the banner of hyperrelativism," and then as a "celebratory poststructuralism exemplified in the later Baudrillard ... [that] does not engage, but only cavorts in space" (Dixon and Jones, 1996,774).

Dixon and Jones feel obligated to condemn Albert as strongly as they valorize Mary because he: "refuses the prerogative of designation, and in doing so relinquishes the responsibility for evaluation, a responsibility that we see as crucial in the construction of a critical poststructuralism. Mary on the other hand, accepts the prerogative of designation, but is always cognizant of the *context* of designation" (p. 774).

Albert is condemned because he is not rational or near "normal" enough to moralize, judge and act. According to Dixon and Jones, Albert "exists in liminal analytic space, cognizant of the complete arbitrariness of the links between people and place, but refuses to take measure of both the processes that fix social space's meanings and practices and the means by which they might be reworked" (p. 774).

Albert thinks, but then he waves about "the banner of hyperrelativism" and acts irresponsibly. But why do poststructuralists want to so abruptly dismiss Albert rather than engage him?

What Dixon and Jones, as Mary, do to Albert by deprecating his

"giddy irresponsibility" then dismissing him is a good example of what critical theorists influenced by the ideas of Michel Foucault call "a monologue of reason on madness." Dixon and Jones (Mary) have no intention of engaging Albert (Baudrillard) in a dialog between their reason and his unreason. They are only interested in engaging Banks (scientific geography) in a dialog between reason and reason. But this is no dialog at all. It is just the asserting of a positivist consensus. Dixon and Jones in their righteous passion find it reasonable to exclude relativists from their considered debate as a means of ensuring that all the participants understand one another. In this sense, it resembles the more philosophical post-Marxian project of "communicative action" advanced by Jurgen Habermas.

Thus Dixon and Jones condemn Albert's narrative of madness, chance and discontinuity in their own narrative prescribing reason, order and continuity. The answer to why Albert is dismissed and not engaged exposes the ironic destiny of critical poststructuralism itself in extreme relativism, which Dixon and Jones do not want to contemplate. Albert as Baudrillard is condemned for pushing poststructuralism "to its logical, nihilistic conclusion." (Dickens and Fontana 1994,12-13). For Baudrillard, even the concept of the social is nowadays obsolete: "The disturbing consequence of Baudrillard's nihilistic diagnosis is that life in postmodern society is one of survival among the ruins" (Dickens and Fontana 1994, 9). This death of the social renders as futile any aspirations to a viable post-Marxian critical approach, as well as other intellectual projects of meaningful social inquiry. Suddenly the survival of social scientists and intellectuals among the ruins is at stake: there are no safe zones, no ivory towers. Who will choose to remain in the realm of reason? Who will choose to explore the roads leading toward madness?

Thus, Baudrilliard beckons poststructuralism to follow him far beyond the site where Dixon and Jones want to stake out their intellectual purchase; beyond where they can employ deconstruction toward social inquiry in a world that still has meaning; beyond the viewpoint of tentative relativism where they can "search for a nonrepresentational theory of judgement that still finds a place for social and political critique" (Dickens and Fontana 1994,12-13). Baudrillard as Albert represents "an interminably open-ended deconstructivist approach to reading texts, celebrating the playful, Dionysian impulse in Nietzschean thought" (Dickens and Fontana 1994,16). Dixon and Jones are sterner Apollonian moralists who are outraged by Baudrillard's Dionysian impulse (Albert's "celebratory poststructuralism"). They seek temporary stabilization in a safer relativity that permits a more rigorous way of deconstructing texts that identifies a plural, but limited number of interpretations.

Dixon and Jones' allegorical narrative is limiting and exclusionary in another way. It intentionally distorts Albert's character in order to valorize Mary's contribution to the redemption of Banks. Their reading totally ignores Albert's major contribution to the redemption of Banks. Albert is trotted out as a flawed minor character instead of a protagonist in the Dixon and Jones narrative. Yet it is Albert's Baudrillard, not Banks' scientific geography, that provides an alternative to Mary's critical poststructuralism in the excluded narrative. And, those who have seen the film surely recall that it is his unintentional retelling of Albert's silly joke, and not Mary's machinations, that ultimately saves Banks' assets.

I have suggested that deconstructive critical poststructuralism is not very far removed from positivist scientific geography in their shared antipathy for Nietzschean nihilism. However, "Once criticism enters the labyrinth of deconstruction it is committed to a sceptical epistemology that leads back to Nietzsche ..." (Norris, in Sarup 1989, 61). In their allegory, Dixon and Jones, as Mary, encounter Nietzschean nihilism in Albert: "Mary finds him bouncing off the ceiling, unable to control his infectious laughter" (p. 774). Mary deigns not to engage Albert in meaningful dialogue because he "cavorts in space" and speaks in ambiguities, absurdities and paroxysms of laughter. We recall here Bearn's (1997,x) observation that "relativism shows itself in that kind of communicative failure which, when disjoined from weighty matters, incites laughter."

It is at this point in the allegorical narrative that the ironic predicament of critical poststructuralism reveals itself. Dixon and Jones are reaching out to scientific geography for stability because their own strategic relativism (moral pluralism) is insecure. The more they think, the more they know they are slipping away toward moral relativism and moral indifference. Critical poststructuralism is exposed as a self-deluding intellectual purchase or temporary stabilization that allows its adherents to intellectualize in a chaotic world and still to sleep at night, content that their thoughts "are justified in the realm of action." Otherwise their thoughts unwinding would send them tumbling toward the extreme relativism they fear and abhor.

Moral Pluralism, Moral Relativism, and Moral Indifference

This is a convenient juncture to elaborate further on the differences between moral pluralism, moral relativism and moral indifference. Scientific geographers and critical poststructuralists might be characterized alike as functional moralists, at least to the extent they still choose to believe in the enlightenment assumption that moral issues

are open to rational deliberations (cf. Dixon and Jones' considered debates) that are useful in safeguarding the real interests of the people, and persist to pursue these deliberations under present conditions of late capitalism. While Dixon and Jones have never defined their critical poststructuralism, it appears to promote both functional moralism and a moral pluralism, and its analytical method appears part deconstructive and part rational-choice Marxism. Again, Dixon and Jones more clearly delineate what critical poststructuralism is not, *e.g.*, It is not morally relativist or morally indifferent.

Moral relativists are skeptical of functional and moral pluralism because the outcome of rational deliberations include unacceptable amounts of human (and environmental) distress and harm. They point out that scientific geographers and critical poststructuralists accept only as an act of faith that they can systematically heal and redeem a world that is rapidly becoming exhausted by the amorality of the marketplace: *e.g.*, "all the primary relationships in our society, those between employers and employees, between lawyers and clients, between doctors and patients, between universities and students are being stripped of any moral understanding other than that of market exchange" (Bellah 1997,24). In recognition of this trend, moral relativists are particularly skeptical about the continuing relevance of rational deliberations for adapting peoples around the world to the amorality of societies shaped by the contingent economy of late capitalism.

Relativist skepticism is disparaged as nihilism and cynicism, but it does not do nothing. Moral relativism and even moral indifference are not just nihilism and cynicism if they also generate insights about possible adaptations for human survival "among the ruins" of the amoral marketplace. Moral relativism and moral indifference can be characterized by their deeper, darker skepticism (Gothic as much as cynic) that spontaneously arises from within an anti-intellectual urban culture of the postmodern epoch that unintentionally redeems the world by adapting people, and particularly young people, to the amorality of the global marketplace. By dismissing the challenge of relativist thinking to critical poststructuralism and by excluding the voices of relativism from its considered debates, Dixon and Jones miss the opportunity to recognize and reflect on the active role that anti-intellectualism plays in the reconstruction of contemporary society. Critical poststructuralism as an intellectual endeavor seems out-of-touch with the advent of a relativist youth culture that entices all sorts of amoral behavior in homes, streets and classrooms, and increasingly alarms adult rational thinkers. In most private space, and increasingly in public space, reckless regard for the Truth is illegal. Geographers need to appreciate the extent to which contemporary youths, acting out their moral relativity and indifference,

are agents of social change that do make a difference whether or not they reflect on their actions, intellectualize and rationalize about them, or are rewarded or punished for them. The problem with construing "postmodernism" as "the cultural logic of late capitalism" is that it inappropriately invents a logical integrity for connecting thought with action through rational choice. However, relativist agency in the culture of late capitalism may have neither a logical integrity nor any rationality.

The relativist thinking of contemporary youth is not just a province of the poor and uneducated. Nor is it necessarily a social problem insofar as it adapts people to survival in an amoral marketplace by opening up opportunities for them that arise from its own indeterminate contingencies. Youth relativism is today a major force of social change in popular culture that is spreading rapidly throughout mainstream society. It cuts across class boundaries and manifests itself in school as the detached rudeness of the relativist ("dysrational") student who challenges received knowledge, disobeys the rules of reasoned dialog, and refuses to sit still in the shadow of a lectern (Sacks 1996). Rational thinkers often grouse that such students have learning disorders and seek to marginalize them. "Dysrationalia," for example, is a recently discovered learning disorder defined as "the inability to think rationally" (Lewin 1996). "Attention Deficit Disorder (ADD) has been pandemic among American students for over a decade, and is being increasingly diagnosed among adult learners. On the other side of the lectern are many elitist, arrogant and hypocritical professors who claim that "students are students because they don't know what they don't know," and that "bad things happen when young people lack the discipline to sit still in a room."

Geographers who address the challenge of popular youth relativism cannot avoid being drawn into some broader conversations that bear on teaching, research, service and the future of their discipline. These conversations range from the role of moral education in the schools to the rapid erosion of intellectualism in a global marketplace. Geographers who accept the challenge of moral relativism and moral indifference might even begin to learn and indulge in relativist survival stratagems.

Toward a Critical Relativism and an Extreme Geography:

Philosophers of science who are scientists themselves–Paul Feyerabend, for example–have argued that positivist science is a strong argument (explanation) supported by a weak argument (belief). The positivist cloak of unimpeachable science on closer inspection does seem rent with untenable assumptions, omissions, internal contradictions, errors, misconduct and prevarications. Public exposure of the limits of

positivism has helped revitalize relativism.

There has been a lot of talk of late about a *swing* toward a revitalized relativism in geography. Critical poststructuralism both exemplifies this movement as critique and reveals its limitations as challenge. Dixon and Jones' swing toward relativism traces a narrow arc. They promote a moral and methodological pluralism that by design fails to extend to the positions of moral relativism and moral indifference. The deconstruction of Dixon and Jones' allegorical narrative exposes the internal contradiction of their relativist/anti-relativist position. By valorizing Mary and disparaging Albert, they construe their relativism as moral pluralism in order to accommodate and appeal to those scientific geographers who still embrace the major tenets of a positivist epistemology. For example, Dixon and Jones ask scientific geographers to explore and debate the merits of moral and methodological pluralism, which might facilitate their "redemption," i.e., lead them to reconsider and reject the claim to *universality* in their positivist epistemology. Yet, Dixon and Jones do not challenge or dispute that aspect of the claim to *autonomy* in positivist epistemology that encourages scientific geographers to build and maintain discursive and institutional walls in their discipline to exclude relativist thinking. That Dixon and Jones seek to reinforce rather than remove these walls of exclusion against the free exchange of information seems inconsistent with what appears to be their sincere commitment to moral and methodological pluralism. Thus, the critical poststructuralist swing to a revitalized relativism in geography is hardly disruptive to the continuity of the hegemony of scientific thinking in the discipline. The term "swing" implies only that there is a motion (a movement within scientific geography) that is tethered and secured, and moves in an instrumental, measured, mechanical way; pendulum-like, and predictably back and forth. So how are contemporary human geographers riding this pendulum ever to break through the exclusionary wall of considered debate and explore the alternative worlds of moral relativism and indifference? A considered debate among scientific geographers is not an open forum. It accepts any critique that does not challenge or disrupt its proclivities to exclude relativism and ensure its eternal return to the same positivist closure. Its informed debate is democratic only in the sense of majority (scientific) rule. The individual, idiosyncratic, disorderly voice of relativism is ruled out. However, perhaps that exclusionary wall can be breached by sneaking a disruptive notion like "critical relativism" into that debate.

Critical Relativism as a Trojan Horse

Anyone who respects the power of language to construct knowledge can also appreciate the power of language to disrupt knowledge.

Semantic games are a Trojan horse that can break down the walls of positivist closure. The notion of critical relativism provides a way of talking about the merits of critical poststructuralism that dissolves the agenda of Dixon and Jones' considered debate. Beyond that, critical relativism encourages speculation on the advent of an "extreme geography" as more appropriate than normal (scientific) geography for exploring postmodern conditions of time-space compression. The notion of a critical relativism takes shape as we look more closely at the term "critical" used by scientific geographers and critical poststructuralists, and what it signifies.

One way that the gatekeepers of scientific knowledge have managed to safeguard its aura of transcendence for so long is that they have privileged the positivist language game of denotation (Bertens, 1995,125). Consider for example the limits set by the privileged discourse among positivists that reduces "critical thinking" to "thinking science." This discourse is restricted because in the language game of denotation "critical" signifies, according to *Webster's New Collegiate Dictionary* (1975,270), "exercising or involving careful judgement or judicious evaluation". The limitations set by the consensus denotation for "critical" also carry over to facilitate a reasonable dialog between critical poststructuralists and scientific geographers. Thus Dixon and Jones rely on "responsibility for evaluation" as a moral persuasion that complements their moral pluralism and facilitates the alignment between scientific geographers and critical poststructuralists.

However, under conditions of global time-space compression (accelerated and infinitized, in part, by the speed and span of cyberspace) there seems to be no longer adequate time nor secure space left for anyone, including geographers, to "exercise careful judgement" and to contemplate logical choices. The denotated significance of "critical" applied to critical thinking therefore seems maladaptive for human survival under urgent conditions that prevail in the postmodern epoch.

If denotation in language is used to construct knowledge by consensus leading to positivist closure, then connotation in language represents the potential for dissensus voices to construct alternative knowledges and an inclusive pluralistic society. Jones is aware of this potential, having recently discussed hegemonic narrative and dictionary definition with regard to the modifier "certain" and the residue of imprecision in one of its connotations (Natter and Jones 1997 ,153-154). This example of "critical" resonates in telling ways to his (and Natter's) example of "certain." If Dixon and Jones were to contemplate what might be a more adaptive and appropriate connotation for 'critical", given uncertain conditions of post-modernity, they might begin to appreciate

the social, political and economic implications of "critical" becoming more widely understood to signify one of its dictionary connotations: "that which is characterized by risk and uncertainty." Yet to do so would render critical poststructuralism of ambiguous value in the postmodern epoch, by revealing the futility of the responsibility for evaluation in situations of uncertainty. Werlen (1993,114) helps us understand here why Albert's irrational laughter is his judgement:

> In a situation where there is a 'decision in the face of uncertainty', the agent is not even aware of the probable consequences of the various alternatives. In that case even the evaluation cannot be indicated: perhaps one should be pessimistic, perhaps optimistic. The evaluation is neutral.

What does Albert know that Mary doesn't, that he expresses as laughter? Perhaps he knows that any considered debate whose goal is political action in a social world requires a "certain" frame of reference that outside the game of denotation dissolves in the face of everyday uncertainties. Perhaps he knows that Werlen's last sentence reads like a judgement from the cryptic *I Ching* whose images are an ontology of chance. Perhaps Albert finds it laughable that–in an age of increasing uncertainty–the neutral evaluation of indifference becomes appropriate to everything.

Grassroots philosopher Yogi Berra recently recommended "When you come to a fork in the road, take it". Some will say that Yogi has misspoke himself, yet I think his words open up a gateway to postmodern thinking by breaching the walls of positivist closure. Yogi is an apostle of critical relativism insofar as he offers pioneering and sage advice for adapting and surviving under postmodern conditions of risk and uncertainty. What is critical about critical relativism? It all depends on what "critical" is understood to signify. The ambiguity of connotation can displace the certainties of denotation by dissolving the exclusionary rules of its language game. Connotation allows more players in the language game, expanding the conversation.

Anti-relativist critical poststructuralists play by the strict rules of a denotation game that penalizes semantics–the exploitation of connotation and ambiguity–for greasing the slippery slope toward relativism. Their intellectual purchase prevents them from using old words like "critical" in new ways that might undermine the precision and agreement required for their considered debates. If Dixon and Jones can appreciate the power of neologisms and ambiguous meanings (*e.g.*, in connotations) to entice social change, which they appear to do when they invoke the word *"supercalifragilisticexpialidocious,"* then they should be able

to tolerate critical relativism as a challenge to their critical poststructuralism. If critical poststructuralists were ever to engage a critical relativist with the telling question "What does it mean to be critical?", the conversation would dissolve into semantics.

Once "critical" becomes introduced into the geographic conversation to signify "characterized by risk and uncertainty," the players can begin to advantage its complementarity to relativism. Geographers who feel constrained by the denotation game of positivist closure and enticed down the paths of critical relativism may begin to explore the possibilities of an "extreme geography."

Just Do It

Extreme geography, as a transmogrification of scientific geography, is appropriate and complementary to critical relativist thinking. Its method is madness, thus fitting for critical relativist explorations. Extreme geography offers a more radical, risky and uncertain departure from the hegemonies of scientific geography than that offered by the moral and methodological pluralism of Dixon and Jones' critical poststructuralism. Extreme geography gambles that there may be no pendulum swing back to a normal scientific geography. It finds attractive the notion of a "postmodern abyss" and a terrific exploratory descent into its depthless relativity. It invites in the place of scientific method a kind of reckless and uncontrolled plunge into uncertain territory, with no expectations of gain, and no guarantee of return.

Contrast a postmodern extreme geography, as characterized by its risk-taking and desire, to a modern normal geography that is a rational science characterized in large part as the work of agreed-upon methods of accumulating data. Critical relativism awakens the possibility of more geographers experimenting and experiencing as a freewheeling community of artists do: *e.g.*, just doing, without agreeing in their methods or moralities; for in morality, as in art, one idea seems as good as another. Whereas Dixon and Jones rationalize and moralize for a progressive scientific geography that claims to reserve judgement but is against relativism, I question the obvious limitations and internal contradictions in their project. I speak up instead for an extreme geography that can abandon judgement and accept and adapt to conditions of moral relativism that already permeate contemporary society – a geography which arises from uncertain wellsprings; that is, the wellsprings of uncertainty.

I envision extreme geographers acting on impulse to merge with contemporary youth culture's amorality and indifference, by delving

into the mysteries that incite it. To do so merges epistemology with attitude, whereupon moral pluralism becomes unmasked as moral relativism. Dixon and Jones working definition for "progressive" as "understood as a politics that promotes unlimited freedom and possibility" (p. 778) can be then be applied to "progressive music" like amoral urban funk which has been described as "an amalgam of rhythm and sex, dancing and insubordination, knowledge and fun – [and is all] about jettisoning the Puritan ethic" (quoted in Keirsey 1996b,56).

Some young geographers have already initiated a powerful discourse on the urgencies and imperatives of youth culture in the context of postmodern geographies (Norwine, et al, 1997; Ruddick, 1997). While these geographers are not critical relativists or extreme geographers, their scientific researches do begin to tease out the implications of the dynamic power in youth relativism that forces social change. One way of doing extreme geography is a risky information-retrieval technique like "dumpster diving." Youthful computer hackers have used this technique to expose and exploit security flaws in protected electronic information domains. Extreme geographers might similarly reconstitute as knowledge selections from various depositories of elided information (*e.g.*, from trashbins, audio and visual taped recordings, the Internet and the like) –discarded narratives that can tell, for example, unheard-of stories about places. The result might be crafted into a speculative spatial imaginary that takes the shape of a spectacular pastiche – like "The Watergate." Through its telling and retelling as urban myth, the story that is important is no longer important because it is true, but because it belongs to everyone. Today, in the Age of Information surfeit, anyone who "surfs" the Internet is doing dumpster diving and engaging in participatory storytelling. Dumpster diving on the Internet is also a way of doing extreme geography that can help disrupt some of scientific geography's glorified disciplinary myths about Theory, Method, Pure Research and Intellectual Property. Consider, for example, the damage that Internet-bred conspiracy theories are now doing to Theory across the disciplines as an intellectual enterprise. The death of Theory is inseparable from the death of The Intellectual in the postmodern epoch. The result of information "wanting to be free" is that, to the extent that it becomes free, everybody–whether or not they intellectualize–becomes an expert witness. The voices of relativism all have something important to say, even if it is not edifying, and even if the speakers are nobodies.

Extreme geographers can also salvage parts of old scientific methodologies to facilitate renewed explorations of familiar territory. For example, Keirsey (1996a; 1996b) has reinvented patriarchal fieldwork as a feminist field experience. Her experiments in "just doing geography" in Ireland opened up many unanticipated and enriching field experi-

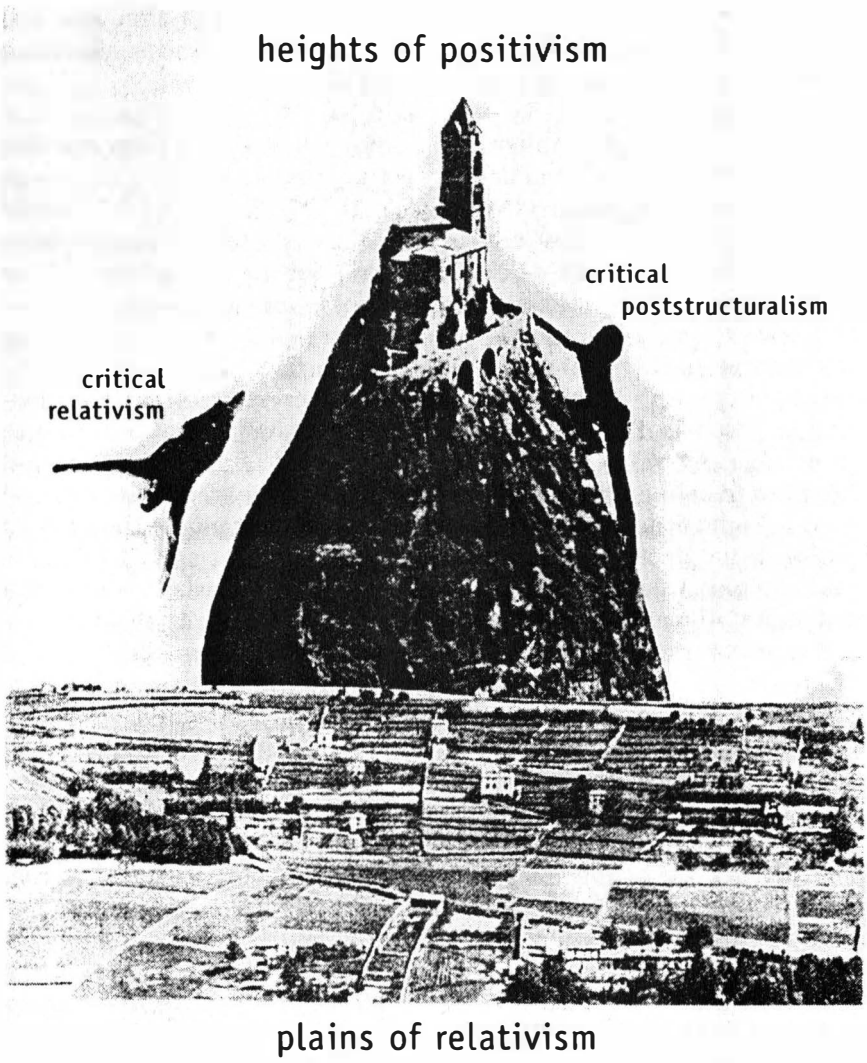

FIGURE 1. The Fortress and the Plain

ences that traditional (i.e. patriarchal) field work might have denied her. Meanwhile, she was able to identify a number of gateways to postmodern (critical relativist) thinking in the Irish landscape that appeared to have adaptive use and helped her survive and enjoy her field experience. Her guides to these gateways were postmodern platitudes appropriate to her postmodern attitudes. These included: "Put to the question all basic assumptions;" "Cross boundaries without a license;" "Present the unpresentable;" "Never complain, never explain;" and "Expect the worst, hope for the best." She also allowed her movements to be guided by an ontology of chance, and whenever she came to a fork in the road, she took it. In other words, Keirsey's geography was extreme because she had to abandon the heights of positivism to explore the plains of relativism.

I have thus far speculated on postmodern extreme geography in terms of its epochal and methodological characteristics, but these are inseparable from postmodernism as style. In matters of postmodern style, extreme geographers might mimic television's role in creating a common language style and storybook approach that appeals to diverse tastes in a global society. For example, consider the medieval chronicler's style of America's traveling television correspondent Charles Kuralt which, paraphrasing Sexton (1997), consists of a blending of pictures and words that illuminate the country in a remarkable way. There are probably no lessons in any of his reports. Kuralt puts the simplest thing under his microscope, and it becomes something beautiful, hopeful, encouraging. All he wants is stories, the wilder the better. His method is humbly inquisitive and idiosyncratically investigative. He has a nose for ignored worth. As a result, he produces big-hearted essays on topics others think tiny. He demonstrates the skill of meaningful, everyday observation. His televised chronicles are more about telling stories than they are about showing pictures.

The Fortress and the Plain

Figure 1 is a metaphorical device that conveys key ideas from this commentary. The mountain fortress of logical positivism is where scientific geography resides, claiming the high moral ground. The horizon of the entire surrounding epistemological landscape constitutes the normal curve, symbolizing the achievement of positivist science's hegemonic quest to universalize and generalize. From its privileged and lofty perspective, positivism presents itself to the world as the single source of scientific truth, the only reliable source of ultimate explanation and the best hope for human happiness. Positivism surveilles all the objects and relationships in a world it observes, names, knows as its unified domain, and attempts to describe in a lucid, straightforward

manner. But there is more to language than lucidity. Below, and overshadowed, are the ludic slopes and plains of relativism, where dwell the contextualized, the situated, the localized, and the marginalized truths. Upon these playing fields there are no rules and nothing is alien to geographical investigation from the nomadic perspective of critical relativism. There is no obligation to work, only a desire to experience. The critical poststructuralist position is depicted as exploratory, yet it clings to the same towering outcrop of enlightenment bedrock that secures the positivist position. Critical poststructuralism is a tentative intellectual purchase, or temporary stabilization, between the heights of positivism and the plains of relativism. Its tethered position is no extreme departure from positivist science. In contrast, the critical relativist departure from the positivist stronghold is a flamboyant free fall that invites risky and uncertain exploratory experiences, and perhaps grave outcomes.

Rattle and Hum:

Readers could have easily anticipated from the title of their editorial ("For a... Scientific Geography") that the persuasive gesture that Dixon and Jones would be making to scientific geography was going to be more "come-hither" than "fungu!" This in contrast to, say, the defiant critiques of realism and feminism. Dixon and Jones deploy an elaborate, playful and unthreatening deconstructionist technique that gives the iron cage of the geographic discipline's scientific tradition a little rattle while humming out a few of its favorite enlightenment tunes. They have no intent to destroy the cage or dissolve the tradition. Deconstruction is not destruction. Perhaps this is why Dixon and Jones' critical poststructuralism merits the attention of scientific geographers, but amounts to a critique shy of challenge. Let's move on to critical relativism and a more extreme geography.

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This paper is also available at http://www.utoledo.edu/colleges/ARTS-AND-SCIENCES/geography-and-planning/EXTRM.html

On the 'con's in Deconstruction

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Few commentators are neutral about deconstruction. Most critics of this method and political practice point to, first, its perceived reluctance to engage in traditional forms of social explanation, and, second, its presumed failure to posit valuative criteria that might guide political action. These are thought to stem from deconstruction's skepticism over the certainty of representation and its concomitant refusal to systematize the identification and hierarchicalization of social power relations. All have led commentators to assume that deconstructivists are agnostic with respect to the production of meaning, the presence of inequalities, and the taking of moral and ethical positions. As a result, deconstruction has been dismissed as a facile, self-nullifying commentary – one characterized by "mere" rhetoric, narcissistic reflection, and inert nihilism. In short, for these critics, deconstruction is a con.

Given this widely held view, we expected that some readers of our editorial, "For a *Supercalifragilisticexpialidocious* Scientific Geography," (Dixon and Jones, 1996), would have found fertile ground for dismissing as pointless satire our attempt at a deconstructivist reading of scientific geography. Eschewing a more traditional, paradigmatic, reading of a discipline beset by incommensurate "isms," we sketched a *field* of geographic knowledge relationally linked through a dialectic of social power and epistemological categories. Adopting a co-constitutive model of the production of knowledge, one in which all categories of thought are defined – however contingently – through their opposite, we emphasized the interconnectedness of seemingly disparate realms of geographic thought. In this view, poststructuralism and scientific geography are bound together by virtue of their relationally – and socio-historically – determined incorporation and repudiation of epistemological categories. In an effort to undermine the apparent closure of these bodies of thought, we relied upon allegory, a method that invokes an infinite translation of elements within narratives in a way that renders as arbitrary their stabilizations. Specifically, we drew an allegorical connection between poststructuralism and scientific geography through Walt Disney's film version of *Mary Poppins* (1964), with the two key protagonists, the banker-patriarch George Banks and the nanny, Mary Poppins, read against scientific geography and poststructuralism, respectively. In the film, Banks comes to reflect on the contingencies and outcomes of

his "grid epistemology," while the juxtaposition of narrative elements in *Mary Poppins* and the discipline of geography prompted us to consider the possibilities of an antiessentialist scientific geography. What, we asked, would a "progressive" scientific geography look like and do? It is this allegorical approach, and in particular our reading of a popular and playful children's film alongside important disciplinary debates, which led us to expect that some readers would find our editorial to be both irreverent and irrelevant.

In "Extreme Geography," however, David Nemeth offers a critique of our essay that differs considerably from the more dismissive line of thought sketched above. For, rather than argue that our deconstruction has gone *too far*, Nemeth charges that it has not gone *far enough*. In particular, he develops the position that our poststructuralist stance, and our method of exposition, is insufficiently removed from the very tenets of science our analysis endeavors to deconstruct. Nemeth accuses us of tethering critical poststructuralism to positivism by appealing to a third, mutually disagreeable, form of analysis, that of critical relativism. He thereby finds fault with our call for a "considered debate" over the relative merits of critical poststructuralism, for the terms of such a debate have been constructed without due consideration of the merits of the excluded party – critical relativists. Ensconced in the trappings of modernist thought, both scientific geography and critical poststructuralism look down from the common vantage point of epistemological certitude (see his Figure 1, p. 28). Unwilling to either topple the peaks or dig up the foundations of positivism, critical poststructuralists are argued to purchase only a temporary stabilization "between the heights of positivism and the plains of relativism" (p. 30). In the face of the postmodern conditions wrought by late capitalism, Nemeth advocates a form of relativism underpinned by a particular kind of nihilism, one committed to neutrality in the face of valuative judgements and decisionism. Nemeth's critical relativist – a figure whose lineage extends from Nietzsche to Baudrillard, and who is metaphorically depicted as the cavorting Uncle Albert in *Mary Poppins* – admits no rules or obligations. Instead, he engages in "a flamboyant free fall" (his Figure 1), inviting not only "risky and uncertain exploratory experiences," but also, perhaps, "grave outcomes" (p. 30).

Nemeth's essay thus points to another, quite different, "con" in deconstruction. This is not the con job that many have claimed has hoodwinked a generation (a rapidly aging cohort?) of unsuspecting social and cultural geographers, but the surplus of letters that keeps "deconstruction" from being "destruction." Nemeth claims that destruction is a more appropriate critical position for these times, and that only critical relativism is capable of extricating the "con" in deconstruction.

As a more "extreme" geography than our Derridian-inspired version of deconstruction, which Nemeth views as non-threatening (a "critique shy of challenge"), critical relativism sublimates, rather than debates, positivism. As Nemeth sums up what is at stake: "Deconstruction is not destruction" (p. 30).

For us, Nemeth's "Extreme Geography" is a welcome and thought-provoking contribution. In pointing to some aspects of youth culture as exemplary of critical relativism in practice, he initiates a concrete research agenda aimed at overcoming the seemingly ever-present divide between thought and action in critical scholarship. And, more significantly, he demonstrates that, however shopworn modernism and postmodernism might appear to some, their character is integral to an understanding of what it means to *be* "critical." It is this latter point we wish to address in our response to his essay, for on this appears to us to hinge our different approaches to epistemological analysis. Before we proceed, however, we offer a point of clarification. Nemeth is correct that we avoided the term "postmodernism" in our editorial. That we chose instead the term "poststructuralism," bespeaks the fact that postmodernism has become so much of a "free floating signifier" that it cannot provide even a temporarily stabilized meaning without being buttressed by a considerable number of authoritative character references. This was a tack that, unlike Nemeth, we chose to avoid.

In lieu of our reluctance to engage directly postmodernism, we distinguished between two forms of poststructuralism, one designated as "critical," the other as "celebratory." Both undermine the certitude of scientific geography by claiming that ontology is "always already" an outcome of epistemology. But, in asking *how* and *with what effect* ontological presuppositions become framed within bodies of thought such as scientific geography, critical poststructuralism finds a productive moment in deconstructing the social relations of power that fix objects, events, and meanings as self-evident, natural, and enduring. By contrast, celebratory poststructuralism, though equally attuned to the indeterminate character of meaning, is marked by a refusal to ask either how meaning is produced, or with what effect. Thus, though Mary Poppins and Uncle Albert are relatives at the epistemological level, the latter: "exists in a liminal analytic space, cognizant of the complete arbitrariness of the links between people and place, but refusing to take measure of the processes that fix social space's meanings and [the] practices by which they might be reworked" (Dixon and Jones 1996: 774). For these reasons, we found Mary Poppins to be a more useful vehicle for deconstructing a body of thought such as scientific geography.

This leads us, then, to assert the "con" in deconstruction, by which we mean a procedure for identifying what processes have defined centers and peripheries (e.g., objective/subjective, material/ideological, real/fantastic) as given and timeless, and who stands to gain from such stabilizations. This procedure, in turn, can lead to practices that subvert not only the hierarchies in question, but also the social powers that seal their borders. In challenging the effrontery of centers, deconstruction taps the always-existing power within marginality by disclosing the trace of the periphery within the center. In this view, deconstruction refuses an either/or understanding of epistemology, positing instead a field of binaries related through their mutually determined character. "Con," in this sense of the word, recognizes the mutually *con*stitutive (formative), *con*current (intersecting), *con*joined (overlapped), and *con*trapuntal (interwoven) relations among seemingly opposed bodies of thought.

These relations suggest that "scientific geography incorporates via exclusion even those Others its practitioners manifestly reject" (and *vice-versa*; Dixon and Jones 1996: 768). Accordingly, poststructuralists, scientific geographers, *and* critical relativists, have no recourse other than engagement (or "considered debate"), for any other position reinforces "not only the hubris of self-actualization that lurks within scientific geography, but also its essentialization by its critics" (Dixon and Jones 1996: 768). Contrast this with Nemeth's critical relativism, which *attempts* to assert a free floating, disconnected epistemology – a "post-modernism" whose prefix can, somehow, make sense after having left behind the suffix.

We emphasize "attempts" in the above sentence to signal that Nemeth is himself unable to write without invoking the very modernism he want to leave behind. In particular, his essay is replete with the trappings of structuralist thought. He invokes the postmodern economy as the *determinate* of, and the *rationale* for, the critical relativism of youth culture. He consistently draws upon metaphors that rely on the fixed placement of constitutive elements. He posits a spectrum of positivism, critical poststructuralism, and critical relativism, inviting us on a slippery slope that, through a teleology uncharacteristic of relativist uncertainty, ultimately leads to his own position. Alternatively, he offers the metaphor of the pit and the pendulum: on the one hand are essentialized (mechanical, instrumental, predictable) human geographers, on the other are those willing to "cut loose" into the postmodern abyss. And, he deploys a form of theoretical Creationism, an originary rhetoric in which it "all" dates back to Nietzsche. Even Nemeth's heroic critical relativist in Figure 1 is shown jumping *off* modernism's precipice.

We close, first, by thanking David Nemeth for his sustained and constructive critique of our essay, and second, by returning to the "text" that animated these essays. Nemeth makes the valid point that it was through the retelling of Uncle Albert's joke that George Banks finally disassociated himself from the grid epistemology of the banking world. But to valorize Albert's or even Mary's role in Banks's transformation is to unwittingly locate agency within the confines of an essential subject. In contrast, our allegory attempted to read the narrative of *Mary Poppins* as a series of epistemological engagements, and it is through these engagements that the joke – itself a potential allegorical vehicle – becomes effective.

Put differently, Banks does not have to become Mary Poppins, nor indeed, Uncle Albert. Thus, the question we posed in our essay remains: What *would* a transformed scientific geography look like and do? As the film's catalytic joke goes, Albert's nephew Bert says that he knows a "man with a wooden leg named Smith." But what, Albert replies, "is the name of his other leg?".

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A Predictive Model of Residential Land Use Change in Tijuana: 1980 to 1994

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Introduction

Residential areas in Latin American cities are in a constant state of flux. Squatter settlements gradually change from dusty wastelands of cardboard shacks to solidly built neighborhoods, fully integrated into the fabric of the city. At the same time, mansions of the elite near the city center get subdivided into apartments for the middle class as wealthy residents move outward in search of more space and modern household amenities. As in most Latin American cities, residential areas in the city of Tijuana have undergone rapid transformation in the recent past. Tijuana has played a central role in the expanding economic interaction between Mexico and the United States. Since the early part of the twentieth century, Tijuana has grown from a small town focussed on recreation for U.S. military personnel to a modern industrial city. This has allowed rapid upward mobility for local residents and attracted large numbers of migrants in search of economic opportunity. As a result, the residential landscape is constantly changing. As the middle class expands in Tijuana housing quality improves. People upgrade their homes and demand better urban infrastructure from the government. Likewise, new squatter settlements develop on the edge of the city as new migrants arrive.

While residential land use change is ubiquitous in Tijuana, it is not a random process. The presence of commercial or industrial land uses, for example, can make certain areas more or less desirable places to live. This can affect the socioeconomic character of a neighborhood and influence the amount of investment people are willing to put into homes in that location. The purpose of this study is to examine features of the built and physical landscape which affect change in residential land use. With an understanding of these features, a predictive model of residential land use change is developed. The predictive capacity of the model is then tested against observed residential land use change in Tijuana between 1980 and 1994.

Predictive urban models will facilitate our understanding of how cities grow and how they are likely to look in the future. This project attempts to model residential land use change between 1980 and 1994.

By comparing the model's predicted 1994 land use with actual 1994 land use it is possible to uncover and assess explanatory variables. Once the predictive capacity of the model is perfected, it will be possible to project change into the future. This will provide insight into future urban form and assist with the planning and management of urban growth.

Background Literature

The predictive model developed in this research is based on insights gained from the literature on Latin American urbanization. Of particular significance is the literature on urban morphology and residential land use change. This section will first present a summary of models on Latin American city structure. These models are useful in explaining the spatial patterns of land uses and the processes behind their development. Second, case studies of residential land use change will be presented. These two sections provide the theoretical building blocks for the predictive model. Finally, a brief history of growth in Tijuana will provide a backdrop for the study.

Land Use Structure and Change

The most commonly cited paper on Latin American city structure is written by Griffin and Ford (Griffin and Ford 1980). They present a simple, yet effective model which illustrates general patterns and processes behind Latin American urban morphology (fig. 1). They describe an elite residential sector radiating from the city center along a commercial spine. Along the outer edges of this spine are upper-middle and middle-class residences which act as a buffer between the elite and lower classes. In addition to an elite spine is a "zone of maturity" surrounding the central business district. This area is dominated by stable middle-class residences, some of which are professionally built and some which are significantly upgraded former squatter settlements. Subdivided mansions which have filtered down to the middle class are also located in this part of the city. In a ring around the zone of maturity is the "zone of in-situ accretion." This area shows signs of transition to a zone of maturity but is quite variable in housing quality. Many houses are poorly built while others are solidly constructed with concrete block. On the undeveloped outer edges of the city is the "zone of peripheral squatter settlements." While these communities are poverty stricken and often have the appearance of refugee camps, residents find hope in the fact that those before them have upgraded their neighborhoods over time. The relative size of each ring depends on the rate of in-migration compared with the pace of individual improvements of housing, and the ability of a city to provide urban services. Finally, there are wedges of disamenity areas emanating from the center city. These areas include

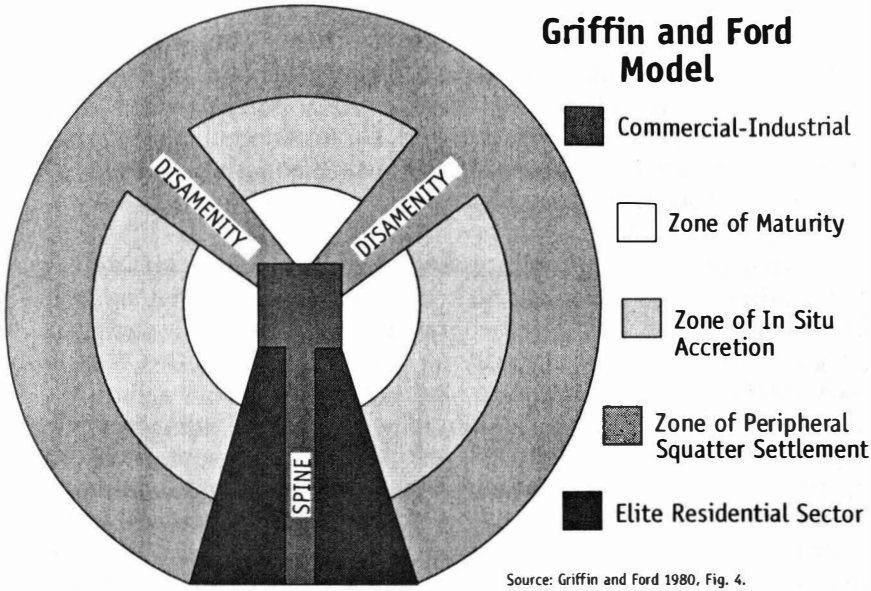

FIGURE 1. The Griffin and Ford Model of Urban Land Use in Latin American

flood zones and steep slopes where it is difficult to build and upgrade housing.

A more complex model is presented by Bahr and Mertins (Bahr and Mertins 1982). Their model emphasizes wedges and isolated islands of residential growth, as well as industrial land use. As in the Griffin and Ford model, the upper classes move away from the center city in an outwardly expanding wedge. Also, the middle and upper-middle classes act as a buffer surrounding the elite residential wedge. As the elite leave the city center low and middle class residents move into subdivided homes. At the same time low and lower-middle class communities form alongside wedges of industrial land use. Squatter settlements develop as "islands" on the edge of the city, but also on undeveloped land within the city. Inner city squatter settlements are usually temporary due to a greater risk of forcible eviction.

Other models focus specifically on Mexican border cities with the U.S. (Gildersleeve, 1978; Hoffman, 1983; Arreola and Curtis, 1993). Arreola and Curtis (Arreola and Curtis 1993) offer the most recent model and incorporate the latest changes in urban morphology. Upper, middle, and lower class housing is organized similar to previously discussed models with one significant exception. As foreign owned assembly plants, or maquiladoras, develop near the outer edges of border cities, public housing–primarily middle-class–develops nearby.

Models of Latin American city structure show that there are discernable patterns in residential land use. While land uses are not as exclusive as in the United States, there are clear patterns which help us understand how cities grow and change. For instance, upper-class housing is rarely located near low-income housing, and industry tends to be located near low or lower-middle class housing.

While models of urban morphology illustrate how cities are organized, other studies demonstrate how particular residential areas form and transform over time. Pozas-Garza (1989), for example, studied land invasions by squatters in the city of Monterrey during the 1970's and early 1980's. Numerous organized land invasions occurred during this time which resulted in the creation of several large settlements. While these invasions were initially resisted by the government, it was soon realized that rapid industrialization was shifting the population from rural to urban areas. Soon the government began to facilitate squatter settlements by providing land, construction materials, and urban services at an affordable cost. Bennett's (1989) research on urban public services and social conflict further illustrates how communities manage to improve with time. Her research documents the popular protests which led to "Agua Para Todos" in Monterrey. This program made Monterrey the first city in Mexico to have individual house connections extend into all of its poorest neighborhoods at once. These studies show how communities evolve and improve through self-help methods and, with enough pressure, eventual government provision of public services.

Other research has examined change in upper-class housing. For example, in addition to low income neighborhoods, Ward (1990) discusses changes involving elite residents in Mexico City. His research indicates that upper-class housing not only extends outward in a wedge separated from lower-class neighborhoods by natural barriers, but has also moved into existing neighborhoods through gentrification.

Growth and Change in Tijuana

Tijuana has undergone rapid growth and change during the second half of the twentieth century. During the 1940's and 1950's the city experienced rapid population growth. This was largely due to pull factors of the Bracero Program in the United States, which attracted workers from central Mexico to the border region with opportunities for agricultural work (Saghafi 1994). During this time the population of Tijuana grew from 21,977 in 1940 to 165,690 in 1960 (Zenteno Quintero and Cruz Pinero 1992). With the end of the Bracero Program population growth rates declined, however the city continued to grow significantly

in real numbers. By 1970 the population of Tijuana was 340,583. It was during this time that the city's "spine" to the southeast of the CBD grew dramatically, yet the city continued to focus on the traditional core (Griffin and Ford 1980).

During the 1970's industrial development in Tijuana accelerated and population growth continued. By 1980 there were 123 maquiladora plants in Tijuana (Comision Economica para America Latina y el Caribe 1994). This represented nearly 20% of all maquiladora plants along the U.S./ Mexico border. Initially these plants were located in commercial areas within the existing built up area of the city but soon large industrial parks on the outer edges of the city were developed (Herzog 1990). This began to pull the city outward, away from the traditional core. As Tijuana's economy expanded through the 1980's its population continued to grow. Between 1980 and 1990 the population grew 61%, from 461,257 people to 747,381 (San Diego Association of Governments 1992). Industrial expansion and population growth have continued in the 1990's. As of 1994 the population of Tijuana was 793,401 (Obee, 1997).

As can be seen, Tijuana has grown rapidly in recent decades. Compared to many Mexican cities Tijuana is young, with the majority of development occurring during the past fifty years. Even as of 1980 residential areas were concentrated around the central city and to the southwest along the spine, but this is changing. As the city grows, residential neighborhoods change. Relatively young developments have transformed from zones of in-situ accretion to zones of maturity, while new settlements have appeared on the outer edges of the city. As economic interaction continues to grow with the United States, the population of Tijuana is likely to increase. New communities will develop and old communities will change as the city and its residents adapt to changing economic and demographic conditions.

The remainder of this paper will discuss an attempt to understand and predictively model how residential areas have changed between 1980 and 1994. Insight gained from models of Latin American city structure and empirical research on housing and neighborhood transformation is used to develop a predictive model of residential land use change. With an understanding of how neighborhoods transform with time it will eventually be possible to predict where and to what degree housing quality is likely to change. This will assist urban planners and others in locating services and public facilities, hopefully resulting in a more smoothly functioning and equitable city.

Methodology

The data sources for this project are Arc/Info land use coverages for 1980 and 1994(San Diego State University et al. 1997). Each coverage contains approximately fifteen land use designations and six residential land use classifications. The residential land use classifications are discrete categories ranked from 1 to 6. Class R1 is elite residential and includes expansive luxury homes with full infrastructure and services. Class R2 is upper middle income residential and is similar to Class R1 but more modest in scale. Class R3 is middle income residential and includes fully serviced land with some paved roads. These homes are almost fully accreted and include government housing. Class R4 is lower middle income residential. These homes are rapidly accreting and are built with a wide range of materials. The presence of paved streets, electricity, water, and sewerage is evident but irregular. Class R5 is low income residential. In this class homes are being transformed into more stable structures. Dirt roads, pirated electricity, trucked water, and privies are common. Class R6 is squatter settlements. These dwellings are typically built with scrap materials such as metal, wood, cardboard, and plastic. Formal services and infrastructure are lacking in these areas. These coverages were created from air photo interpretation. The 1994 coverages were ground checked for accuracy.

Based on the literature discussed above it is evident that land uses are dynamic yet arranged in particular patterns. Independent variables were chosen which reflect the relationships between different land uses. Distances between residential classes, commercial, industrial, non-developed, and agricultural land were chosen to reflect these relationships. An additional independent variable of slope was used to determine if steep, less desirable land changed at a slower rate. The dependent variable was the degree of change in each polygon between 1980 and 1994.

Calculation of the necessary variables was done in Arc/Info. The entire residential area of Tijuana was converted to 30 meter polygons. In order to study change in residential quality, only areas that existed in 1980 were used. Residential areas developed after 1980 were blacked out of the 1994 coverage. The degree of change between 1980 and 1994 was then calculated for each 30 meter polygon (fig. 2 and 3). For example, no change gave a value of 0 while a change from R5 to R3 gave a value of 2. A decrease in quality gave a negative number. For the independent variables, the distance from each 30 meter polygon to the nearest polygon of each land use and housing class was calculated. For example, an R3 polygon would have the distance to the nearest R1, R2, R4, R5, and R6 polygon, as well as the distance to the nearest commer-

(continues on page 46)

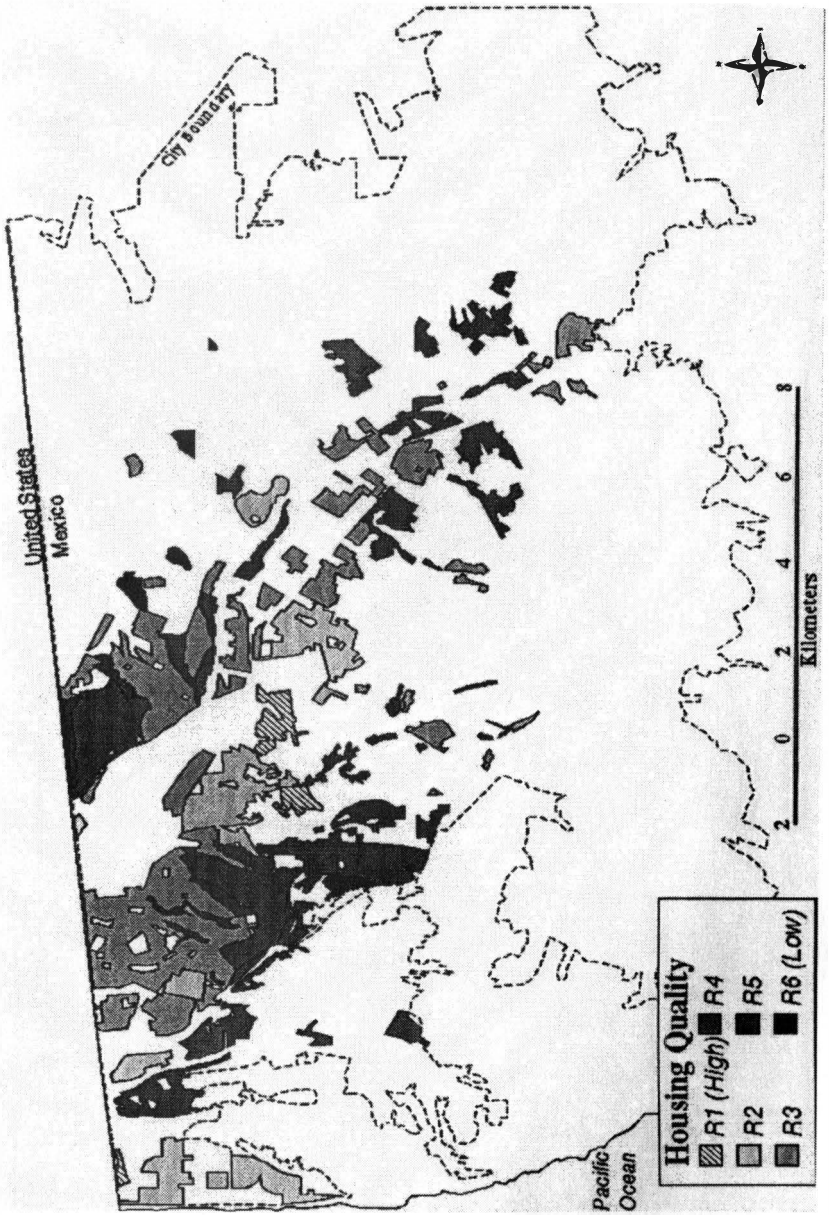

FIGURE 2. Observed Residential Landuse for Tijuana in 1980

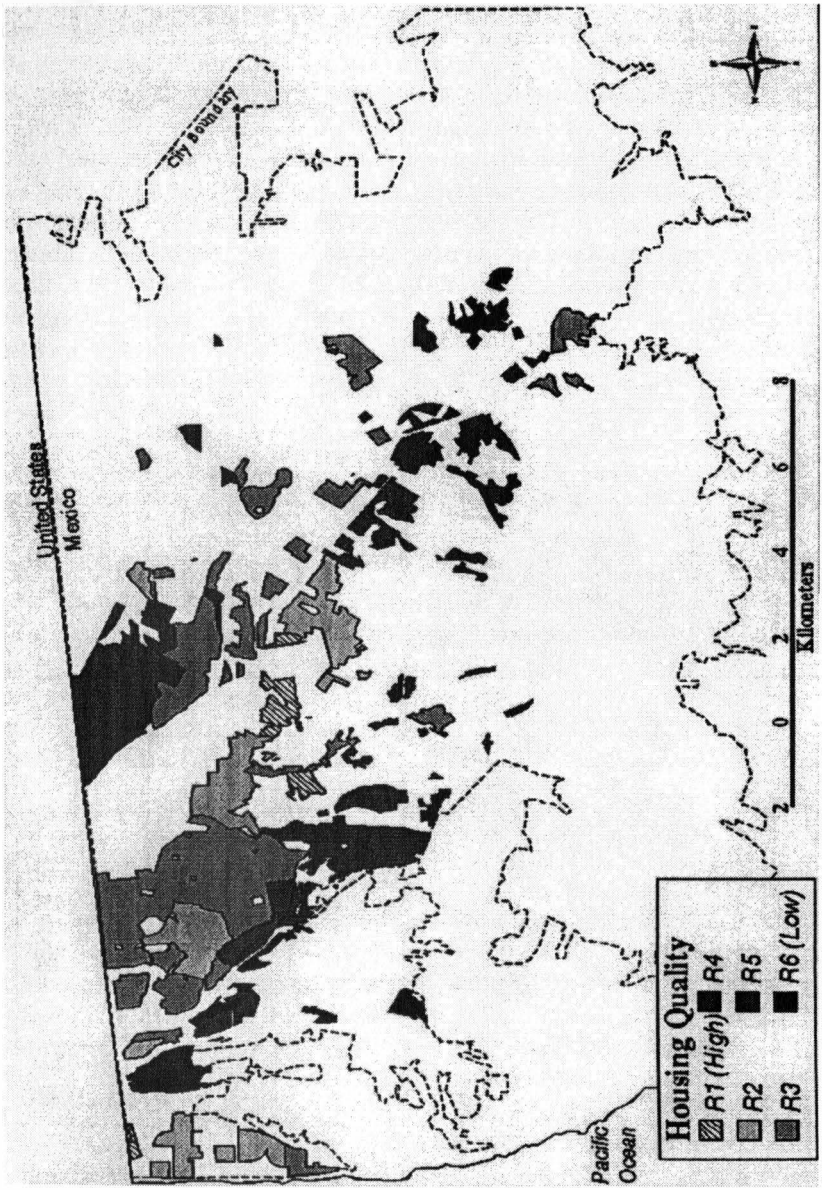

FIGURE 3. Observed Residential Landuse for Tijuana in 1994

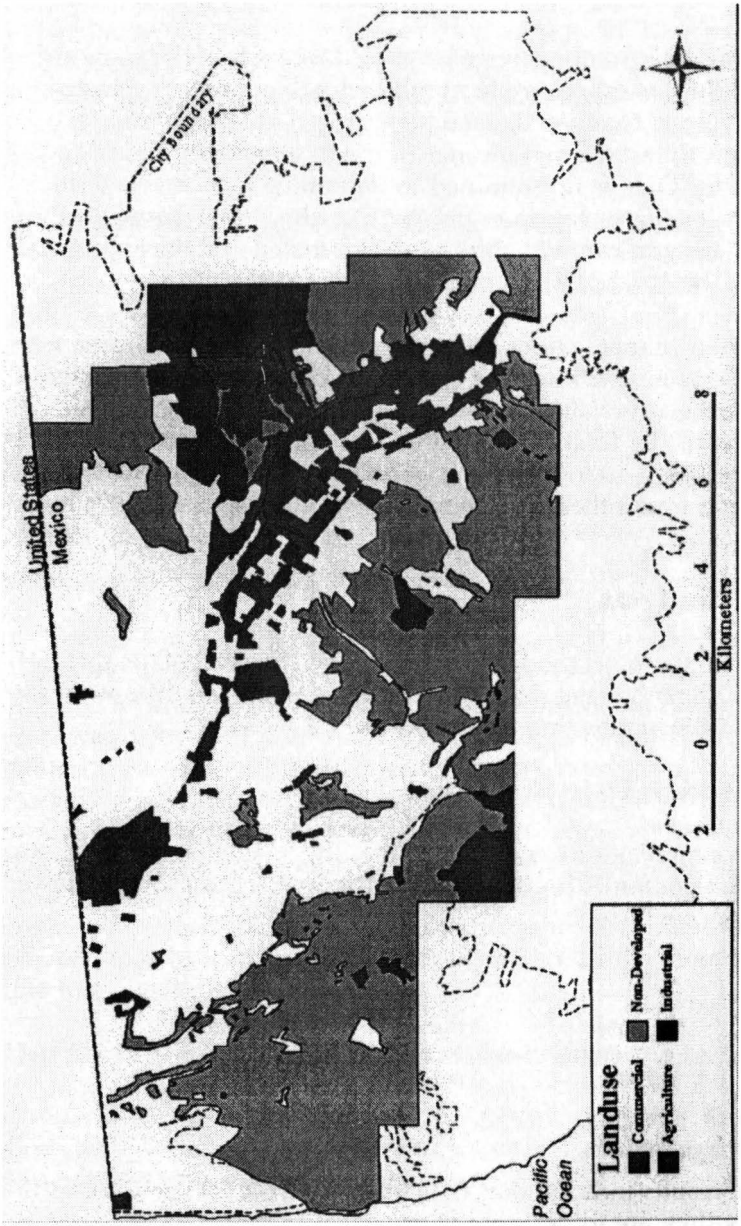

FIGURE 4. Landuse for Tijuana in 1980

cial, industrial, agricultural, and non-developed polygon (fig. 2 and 4). The 1980 land use coverages were used for these calculations. In addition, the degree of slope was added to each 30 meter polygon.

Fifty random numbers were generated for each of the six housing classes and the correspondingly numbered polygons were selected for statistical analysis. Ordinary Least Squares regressions were run for each housing class to test the significance of the independent variables. The diagnostics for OLS were examined to determine if heteroskedasticity, spatial error, or spatial lag were present (Anselin, 1992). Based on these diagnostics, insignificant variables were eliminated and the appropriate model (OLS, heteroskedastic, error, or lag) was run.

Predicted change values for each polygon in the study area were then calculated in Arc/Info. The regression coefficients for the significant independent variables were multiplied by the values in each 30 meter polygon. The final change value was usually a fraction so numbers were rounded off to the nearest whole number. The predicted 1994 housing classes were then mapped along with the observed 1994 housing classes.

Results/ Analysis

Separate statistical models were developed for each of the six housing classes. The following discussion explains what variables were significant (at 0.05) in affecting residential land use change.

The R1 Model: Elite Housing

Regression diagnostics indicated that the Spatial Error Model was the best estimator for R1 housing change. The Spatial Error Model showed the following coefficients:

VARIABLE	COEFF	S.D.	PROB.
Constant	-.271196	0.0785604	0.000556
R2dist	0.000486896	0.000136135	0.000348
Lambda	7.75488	1.00748	0.000000

AIC[1]: -37.50

These results indicate that the closer R1 areas are to R2 areas the more likely they are to decrease in quality. The positive coefficient for R2 distance shows that as the distance between R1 and R2 increases (ie. they are located further from each other), the R1 change value increases. Conversely, as distance decreases the change value decreases. Since R1

is the highest category of housing quality it is not possible for them to increase in quality. These results fit with theoretical models in that high quality housing is rarely found near low quality housing. Thus housing classes below R2 have no influence on change in R1. Also, even though R2 housing is only slightly lower in quality, if a R1 area is going to decrease in quality it is more likely to be closer to a lower quality area. Thus lower housing quality has a negative impact on higher quality housing.

The R2 Model: Upper Middle-Income Housing

The Ordinary Least Squares model proved to be the best estimator for R2 housing change. OLS showed the following coefficients:

VARIABLE	COEFF	S.D.	PROB
Constant	0.0224747	0.105634	0.832475
R4dist	0.000600642	8.30967E-05	0.000000
R5dist	-0.00018197	3.23162E-05	0.000001
R6dist	-0.000212732	3.4002E-05	0.000000
Commdist	0.000274447	0.000114428	0.020673

AIC: -14.67

These results fit less clearly with theoretical models than the R1 results. While R4 areas tend to pull R2 areas down in quality the closer they are, R5 and R6 areas have the opposite affect. No theoretical models explain why the lowest quality housing types would have a positive influence on areas of higher housing quality. Commercial distance has a negative influence on R2 change as well–the closer an R2 area is to commercial land uses the less likely it is to improve. Models of Latin American city structure indicate that higher income housing is located close to elite commercial areas. The negative relationship found with this data may indicate a threshold distance where commercial land uses are too close to upper middle class housing (R2) for them to become elite housing (R1).

The R3 Model: Middle Income Housing

In the case of R3 housing, the Heteroskedastic Error Model (Groupwise) was the best estimator of housing quality change. This model showed the following coefficients:

VARIABLE	COEFF	S.D.	PROB
Constant	-0.753497	0.144957	0.000000
R2dist	-0.000348484	6.29847E-05	0.000000
R6dist	0.000206936	4.6958E-05	0.000010
Inddist	0.00037144	8.50799E-05	0.000013

R-square(Buse)^2: 0.42

These results show that higher quality housing increases the rate of change in R3 areas while lower quality housing decreases the rate of change. As can be seen, the closer R3 areas are to R2 areas the more likely they are to upgrade and the closer R3 areas are to R6 areas the less likely they are to upgrade. The distance to industry is also a significant variable and has a negative impact on change in R3 areas. Many industrial land uses in Tijuana produce noxious emissions and are not desirable places to live for those with private transportation. Therefore middle-income areas (R3) are not likely to upgrade to upper middle (R2) or elite (R1) residential areas if they are too close to industry.

The R4 Model: Lower Middle Income

Regression diagnostics for R4 change indicate that the Spatial Lag model was the most appropriate predictor.[3] The Spatial Lag Model shows the following coefficients:

VARIABLE	COEFF	S.D.	PROB
W_Change	24.0699	4.12408	0.000000
Constant	1.21292	0.218993	0.000000
R2dist	0.000423042	0.000121804	0.000514
R3dist	-0.00069071	0.000145183	0.000002
R6dist	-0.000282885	7.55776E-05	0.000182
Commdist	-0.000985117	0.000276067	0.000359
Slope	-0.0275261	0.011568	0.017336

AIC: 44.646

The results of this regression present inconsistent theoretical patterns. Higher quality housing has both a positive and negative influence on change in R4 areas. R4 areas tend to upgrade more if they are closer to R3 areas, however they tend to upgrade less if they are closer to R2 areas. Furthermore, R6 areas nearby cause housing to upgrade more quickly. These inconsistent patterns can not be explained with traditional theoretical models. Other significant variables fit better with Latin American city structure theory. Commercial areas have a positive influence on change in R4 areas. Lower middle income (R4) residents are less likely to own private transportation so proximity to commercial land uses is desirable. This makes shopping and travel to work cheaper

and less time consuming. In addition, change occurs more rapidly on gradual slopes than on steep slopes. Steep slopes are more prone to instability and are less desirable places to live so there is less upgrading in these areas.

The R5 Model: Low Income

The Spatial Error Model was the most appropriate for R5 areas and resulted in numerous significant variables–R1, R2, R3, R4 distance; commercial, agriculture, and industry distance; and slope. The coefficients for these variables are listed below:

VARIABLE	COEFF	S.D.	PROB
Constant	1.36577	0.417095	0.001059
R1dist	-0.000347936	7.54484E-05	0.000004
R2dis	0.00123563	0.000141364	0.000000
R3dit	-0.00210654	0.000184004	0.000000
R4dist	0.00100278	0.000225516	0.000009
Commdist	-0.00151772	0.000252103	0.000000
Slope	0.0228838	0.00671277	0.000652
Agdist	0.000645821	9.73855E-05	0.000000
Inddist	-0.000755259	0.00015525	0.000001
Lambda	16.3565	2.17433	0.000000

AIC: 44.65

The results of this model are inconsistent with Latin American city structure theory as well. The coefficients show that two higher quality housing classes, R1 and R3, increase change in R5 the closer they are, while two other higher quality housing classes, R2 and R4, decrease change. Once again, this can not be explained by traditional theory. Another counter-intuitive result relates to the slope coefficient. Unlike with the R4 areas, R5 areas upgraded more on steeper slopes, despite the fact that these areas are more difficult to develop. Both commercial and industrial land uses had a positive affect on change in R5 areas. This is because low income residents are less concerned with the negative externalities of commercial and industrial land uses than they are about reducing the travel costs of work and shopping. Finally, R5 areas changed less the closer they were to agricultural land.

The R6 Model: Squatter Settlements

The Heteroskedastic Error Model (Goupwise) was the most appropriate model for R6 housing change. Listed on the following page are the coefficients for this model:

VARIABLE	COEFF	S.D.	PROB
Constant	9.09491	1.32577	0.000000
R2dist	0.00167012	0.000282022	0.000000
R3dist	-0.00133751	0.000183994	0.000000
R4dist	-0.00387374	0.000455885	0.000000
R5dist	0.000751955	0.000255526	0.003253
Commdist	0.000531753	0.000193213	0.005920
Nddist	0.0039045	0.000431427	0.000000
Agdist	0.00224627	0.000280899	0.000000
Inddist	0.002877	0.000608305	0.000002

R-square(Buse): 0.98

Again two higher quality residential classes, R3 and R4, increased change with proximity while two others, R2 and R5, decreased change. A more consistent pattern emerges with respect to the other significant variables. R6 areas are the lowest quality housing in Tijuana. Many settlements of this type form illegally on vacant land, were occupants do not have legal title to their plot. More remote settlements, in this case those further away from commercial, industrial, and agricultural land, face less threat of forced removal. This is due to the fact that remote areas have less economic value for property owners. A reduced threat of removal means that people are more willing to invest in improvements of their homes. Thus change occurs more rapidly. A problem with this explanation, however, is that R6 areas further from non-developed land also upgraded more rapidly. This leaves R6 polygons surrounded by other R6 polygons, as well as R5 and R2 polygons as the most likely to improve.

Mapping and Accuracy of 1994 Predicted Residential Land Use

Based on the regression coefficients discussed above, residential land use change was "projected" from 1980 to 1994. This resulted in a predicted 1994 residential land use map (fig. 5). Since this project only examined change in housing quality since 1980, all post-1980 development was blacked out of the map. A visual comparison of the predicted 1994 land use map with the observed 1994 land use map indicates that the models were not 100 percent accurate in predicting change in housing quality. Areas of correctly and incorrectly predicted land use can be seen in figure 6.

A quantitative summary of figure 5 was calculated through a classification error matrix (fig. 7). This matrix compares the area of observed and predicted residential land use classes. The matrix indicates that 65 percent of the residential areas were correctly predicted. These results

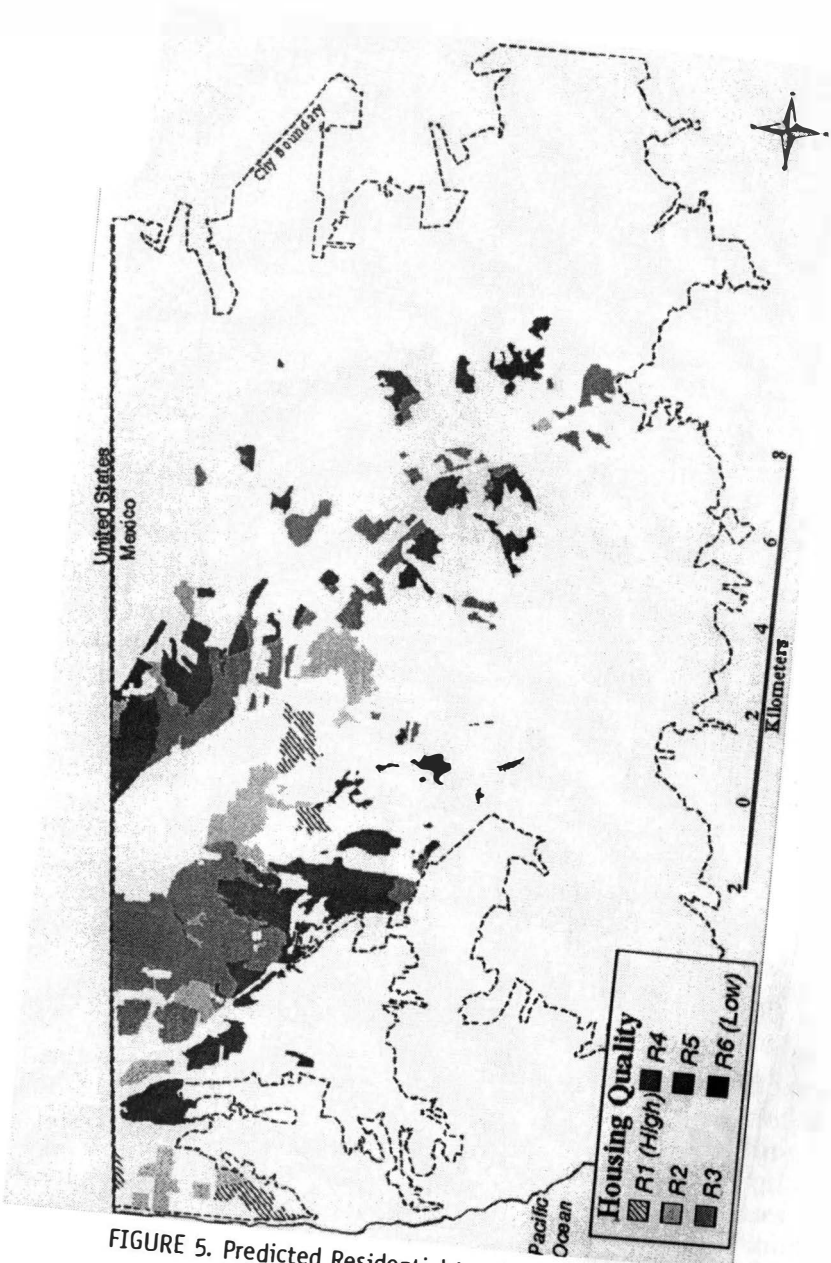

FIGURE 5. Predicted Residential Landuse for Tijuana in 1994

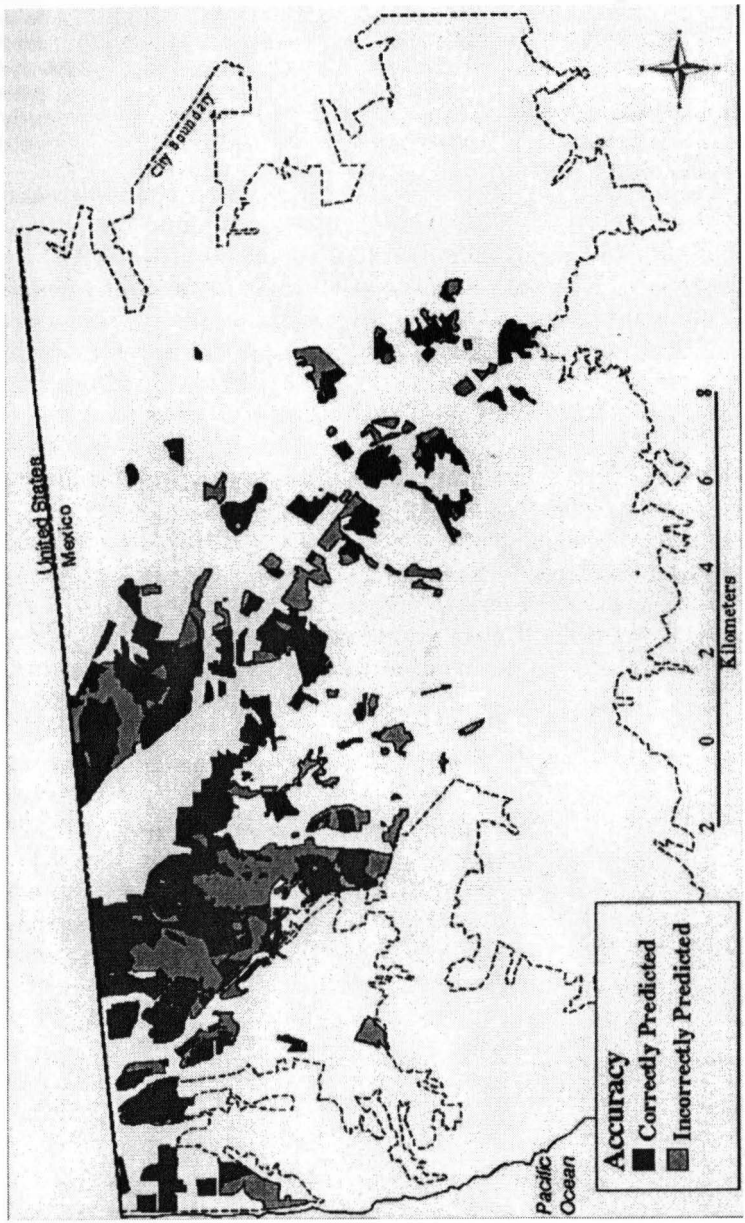

FIGURE 6. Accuracy of Predicted Residential Landuse in 1994

Observed 1994 Area

Predicted 1994 Area: Class	1	2	3	4	5	6	Row total
<1	539	0	53903	93369	38887	337684	524383
1	1111979	373434	398034	10260	0	0	1893705
2	131980	5444399	579534	445393	494	0	6601800
3	564	1828828	11339267	3327544	35366	92441	16624010
4	0	4991	3250515	6414313	1393997	294887	11358704
5	0	0	242449	484382	1675288	673057	3075176
6	0	5799	94361	226655	281866	1767875	2376556
>6	0	0	0	0	0	121816	121816
Col. Total	1245062	7657450	15958064	11001916	3425899	3287758	42576149

User's Accuracy	
1	0.59
2	0.82
3	0.68
4	0.56
5	0.54
6	0.74

Overall Accuracy
0.65

FIGURE 7. Classification Error Matrix and Model Accuracy

vary by class however. A user's accuracy, or the probability that a given classification actually represents what is on the ground, varies from 54 to 82 percent. Housing classes 2, 3, and 6 were higher than 65 percent, while classes 1, 4, and 5 were below the 65 percent overall accuracy. Figure 8 shows the breakdown of predicted housing classes by observed housing class. The models for classes 2, 3, 4, and 5 correctly predicted greater than 90 percent of the area within one value of the observed housing class. Only classes 1 and 6 had less than 90 percent of the predicted area within one housing class of the observed area.

Conclusions/Future Work

As the above results and discussion indicate, general patterns are difficult to find in the data. While higher quality housing sometimes has a positive influence on change in nearby areas, this is not always the case. Frequently the data shows that lower quality housing has a positive influence on change. Likewise steep slopes have a positive influence in some cases and a negative influence in other cases. These inconsistencies can not be explained easily with traditional models of Latin American city structure. Rather, this illuminates the limits of morphological models. While models of urban structure can show general patterns of land use, the real world is much messier. Models of Latin

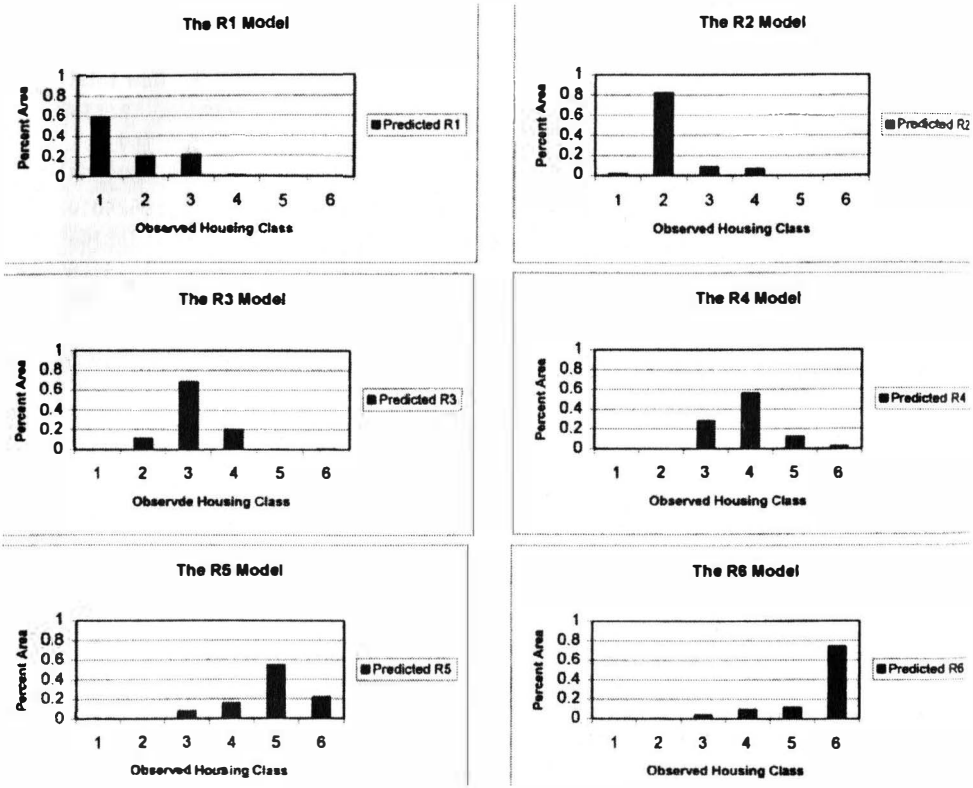

FIGURE 8. Distribution of Predicted Housing Class Area

American urban structure can assist in identifying appropriate explanatory variables, but the idiosyncratic nature of cities means that generalized forms can never be fully described or explained. Each city's unique physical setting and historical development creates a different urban form. The predictive model developed through this research correctly classified 65% of residential area change. Additional explanatory capacity may come from economic or demographic theory, which is not explicitly included in most urban morphological models. Future research will incorporate new variables and utilize spatially explicit limited dependent variable models to more accurately assess land use relationships in Tijuana. It is hoped that these models will uncover more consistent patterns and improve the model's predictive capacity.

In addition, future work will include predicting not only how existing residential areas change, but where new residential areas will develop. Both change and growth will then be projected to the year 2020 in an attempt to map how Tijuana is likely to look roughly 20

years from now. Integration with predictive demographic models will allow different scenarios to be run based on varying levels of population growth and decline.

Predictive models such as this are useful for urban planners, social service providers and others who need to efficiently allocate limited resources. Government, business, and non-profit agencies have long relied on population projections to plan for the future. Predictive land use models attempt to determine not only how *many* people there will be, but *where* they will live. With an understanding of where different people of different socioeconomic conditions are going to be, it becomes easier to plan for change. If it is known, for example, where squatter settlements are likely to develop, plans for the provision of infrastructure can be established beforehand. Likewise, placement of schools and health care facilities can be planned based on the needs of different populations. Spatial information such as this will hopefully lead to better functioning and more livable cities.

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Notes

[1] The Akaike Information Criterion (AIC) is a goodness of fit measurement which corrects for overfitting when additional variables are added. Lower values indicate better fits (Aneslin, 1992).
[2] FGLS estimation for the heteroskedastic error model does not include the AIC measure of fit. Therefore, the R-square(Buse) measure for models with non-spherical errors is included (Anselin, 1992).
[3] The Spatial Lag Model does not allow for easy calculation of predicted values in Arc/Info. Because of this, coefficients for the predictive map come from the OLS Model.

Containerization and the Changing Nature of American Railroads

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Introduction

In the past thirty years, America's railroads have seen many changes in equipment technology. The development of the 100-ton wheelset in the 1960s led to increased sizes and capacities in freight cars. At the same time, a trend was growing towards the use of unit bulk commodity trains such as coal or grain trains. Perhaps the one greatest change in railroad freight car technology has come about in the growth and development of intermodal railcars.

What is intermodal? Muller (1989) defines intermodalism as the movement of cargo using several different methods of transportation. Whenever a railroad hauls highway trailers or sea containers, it is an intermodal movement. Thus, the railcars involved in such movements became known as intermodal railcars. Intermodalism did not make a significant impact on railroads until the 1950s when advances in railcars and loading terminals made it practical to use piggyback services (DeBoer 1992). In addition, in the 1960s the sea container was growing in popularity with shipping companies as well, and more and more were showing up on America's railroads (Hannes 1996). These factors led to the development of today's modern intermodal railcars.

The Eighty-Nine-Foot Flatcar

Prior to the early 1960s, the 50-foot flatcar was the usual piece of equipment used for intermodal movements (DeBoer 1992). These cars were equipped with one trailer hitch to allow one highway trailer to be secured to it. These cars were not very efficient, though, since the weight of the flatcar itself (mostly due to the wheelsets) did not make it economical to ship one trailer per car (DeBoer 1992). The flatcars would be more efficient if two trailers were hauled. A 75-foot flatcar design was produced in the mid-1950s to solve this, but it was only capable of hauling 35-foot trailers. In 1957, 40-foot trailers were allowed on American highways thus making the 75-foot cars obsolete (DeBoer 1992). Con-

sequently, railroads began looking into 85-foot and 89-foot flatcar designs. The first cars produced could carry two trailers up to 40 feet in length each.

At the same time, more and more sea containers were showing up on railroads. Usually they were hauled piggyback-style on their wheeled chassis (Hannes 1996). However the flatcars would be lighter if the containers were carried without the chassis. In 1966, American Car & Foundry (ACF), a major railcar manufacturer, designed an 89-foot flatcar with two trailer hitches that could be folded down to accommodate containers (Hannes 1996). In addition, there were eight container pedestals on each side that could be positioned on one foot increments to secure various combinations of containers (Hannes 1996). Other manufacturers including Pullman-Standard and Bethlehem Steel built virtually-identical versions of this car (Chatfield 1992). This new "all-purpose" flatcar proved to be a popular design and was the backbone of the American intermodal railcar fleet until the 1980s. Most were owned by the Trailer-Train Corporation, a nationwide railcar pool operator (DeBoer 1992).

In the late 1970s, 45-foot trailers came into use thus forcing Trailer-Train and the railroad owners to rebuild the 89-foot flatcars with the hitches spaced further apart (Casdorph 1988). Cars rebuilt with this modification are usually stenciled "Twin-45" of "Dual-45" indicating the car's capability to handle two 45-foot trailers. Some 89-foot intermodal flatcars were rebuilt with a third collapsible hitch in the middle allowing it to carry two 45-foot or three 28-foot trailers (Casdorph 1988). Figure I shows one of Trailer-Train's (now called TTX Corp.) 89-foot all-purpose flatcars. Figure 2 is a container pedestal on modern intermodal flatcar.

Intermodal Flatcar Conversions

In the early 1980s, the growth of intermodal rail movements caused a shortage in available railcars (Casdorph 1988). At the same time, railroads found themselves with a surplus of general-service flatcars (Panza 1990). Naturally, the railroads began converting older 60, 85, and 89-foot flatcars into intermodal flatcars capable of handling 20-foot of 40-foot container combinations (Casdorph 1988). Figure 3 illustrates one of these flatcar conversions. Some railroads even cut boxcars down into intermodal flatcars to alleviate intermodal railcar shortages (Casdorph 1988). These rebuilds were equipped to handle one highway trailer up to 48 feet in length and are interestingly similar to the original 1940/50s piggyback flatcars.

FIGURE 1. A TTX Company (Formerly Trailer-Train Company) 89' All-Purpose Flatcar. Note the trailer hitch in the upright position (G. Hannes Photo).

FIGURE 2. A close-up of a container pedestal on a Denver, Rio Grande, and Western COFC Flatcar (G. Hannes Photo).

Spine Cars

In the 1970s, the Atchison, Topeka & Santa Fe Railway (ATSF) began looking into lightweight, articulated flatcar sets for use in piggyback service. This design consisted of 10 flatcar units joined together on articulated wheelsets, meaning that each adjacent unit shares one wheelset with the other. This reduces weight, maintenance, and coupler slack (Hannes 1996). In addition, the flatcar units were built with only a center sill (for linear structural support) and a small platform to support the wheels of the trailer. This design greatly reduced weight (DeBoer 1992). These cars became known as "spine" cars because of their skeletonlike design. These early cars could only carry highway trailers and were not equipped to haul containers without their chassis. The vast majority of spine car sets manufactured since the initial ATSF 10-unit cars were built in 5-unit sets (Casdorph 1988). In 1987, Trailer-Train purchased a small group of 5-unit spine cars without trailer hitches and equipped solely for containers mounted on pedestals (Casdorph 1995).

In 1989, the 5-unit articulated spine car design was updated by including container pedestals on each unit to handle containers (Panza 1991). This design, called the all-purpose spine car, has become a popular trailer-carrying flatcar and has only been revised to accommodate larger trailers (up to 53 feet on the newest ears). One is shown in Figure 4.

The First Double-Stack Container Cars

In the 1970s, the growing use of transcontinental "landbridge" container shipments caused some railroads to look into more efficient ways to handle sea containers (Muller 1989). In 1971, the Canadian National Railway tested an 85-foot flatcar design that could hold four stacked 20-foot containers in between the wheelsets and another 20-footer over each wheelset on the ends (Hannes 1996). However, the weight of even four fully-loaded 20-foot containers would exceed the capacity limit of the car. Consequently, the design was not mass-produced.

In 1976, the Southern Pacific Railroad began working with ACF on a new type of railcar that could carry two containers, one stacked upon the other, in a "well" between the wheelsets of the car (Hannes 1996). Rather than having a center sill as on conventional flatcars, the sides of the well would act as the sill, thus allowing the bottom container to sit low to the ground (only 14 inches from the railhead) to maintain a low center of gravity and to conform to height clearance requirements (Sperandeo 1983). Triangular bulkheads had devices mounted on them to help hold the upper container in place. The first single-unit ear was produced in 1977, followed by a 3-unit articulated design in 1979 (Hannes

(continues on page 64)

FIGURE 3. Two OOCL 20' containers set on a VTTX 60' Flatcar (G. Hannes Photo).

FIGURE 4. An All-Purpose Spine Car with a Sea-Land Refrigerated Container (G. Hannes Photo).

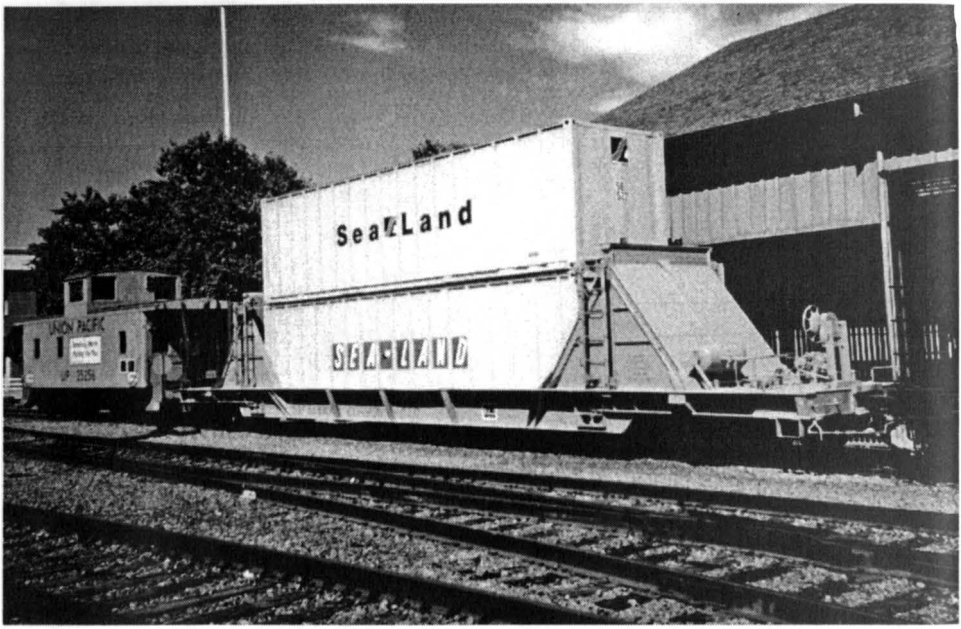

FIGURE 5. The first Southern Pacific Railroad Stack Car at the California Rail Museum (M. Hannes Photo courtesy of Model Railroad Magazine).

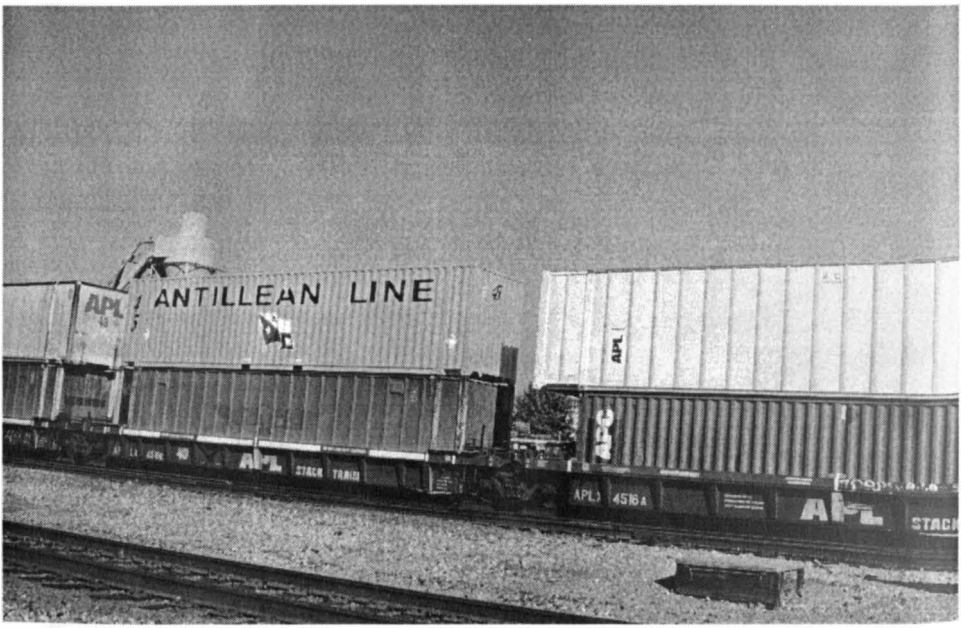

FIGURE 6. An example of a Thrall Double-Stack Car (G. Hannes Photo).

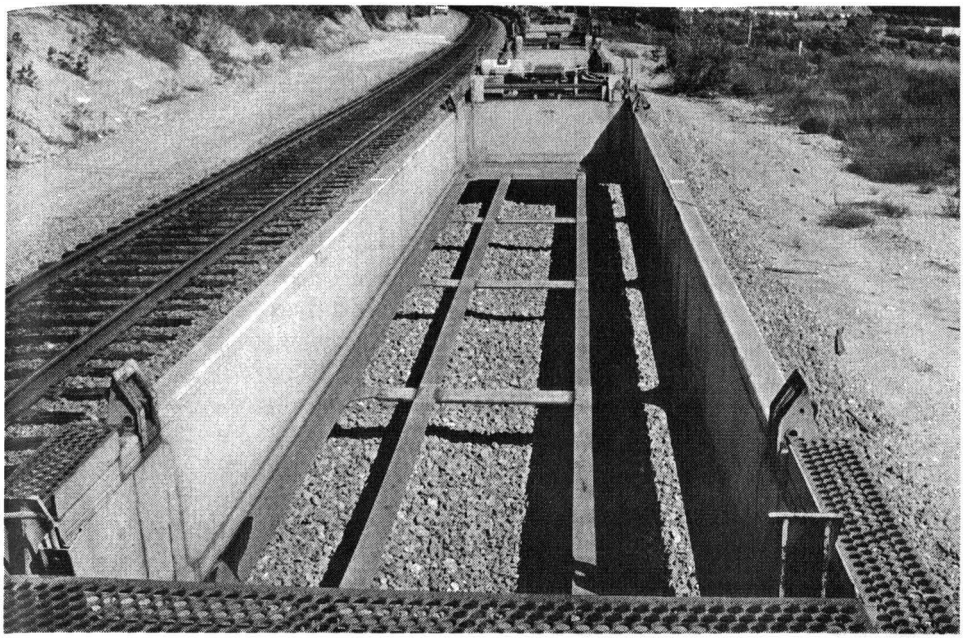

FIGURE 7. An inside view of the lacy nature of a Thrall Double-Stack Car. Notice how close the car is to the ground (G. Hannes Photo).

FIGURE 8. A Burlington Northern Twin Stack Car. Note the bulkheads for holding the containers (G. Hannes Photo).

1996). Both cars were successful, and forty-two 5-unit ears were produced in 1981 (Casdorph 1993). They became known as "double-stack" cars because of the unique way they hauled containers. Figure 5 shows one of the first ACF double-stack railcars.

The Thrall Double-Stack Car

The ACF double-stack railcar was the only design in use until 1984 when the Thrall Car Company offered another new design. The 5-unit Thrall LO-PAC 2000 design, shown in Figure 6, did not use bulkheads to hold the upper container in place. It relied only on small locking devices called inter-box connectors (IBCs) to lock the upper container in position. Until this time, IBCs were only used to secure containers together on board ships. By eliminating the bulkheads, the LO-PAC 2000 design reduced car weight (Hannes 1996). However, some railroad officials thought that the design would not be safe. As time went on, these cars proved to be just as safe as others. Figure 7 shows the interior construction of these cars.

The Twin-Stack

In 1985, Gunderson Incorporated, another railcar builder, acquired a double-stack car design from the FMC Corporation's railcar division called the Twin-Stack (Hannes 1996). It, like the earlier ACF design, used bulkheads to support the top container. The Twin-Stack also incorporated some structural component modifications that reduced car weight and allowed an increased container payload. Figure 8 illustrates a Gunderson Twin-Stack car and Figure 9 shows an articulated connection on one.

The Backpacker

Trinity Industries, a new railcar manufacturer to enter the scene at the time, began producing a 5-unit double-stack railcar called the Backpacker in 1986 (Hannes 1996). It was similar to the Thrall LO-PAC 2000 design. The main difference in structure was that the Trinity car had smooth side panels whereas the Thrall car had vertical posts on the sides. Refer to Figure 10.

The Maxi-Stack

Gunderson soon found that the Twin-Stack still could not compete with the lightweight Thrall design. In addition, safety fears were being put to rest as the Thrall cars operated for years without problems. In 1988, Gunderson introduced a design called the MAXI-STACK which

FIGURE 9. The articulated joint between two units of a Twin Stack Five Unit Set (G. Hannes Photo).

FIGURE 10. A Trinity Well Car with a Sea-Land 45' Marine Container and a Triton 40' Marine Container (G. Hannes Photo).

FIGURE 11. An example of a Gunderson Maxi-III Double Stack Five Unit Car Set (G. Hannes Photo).

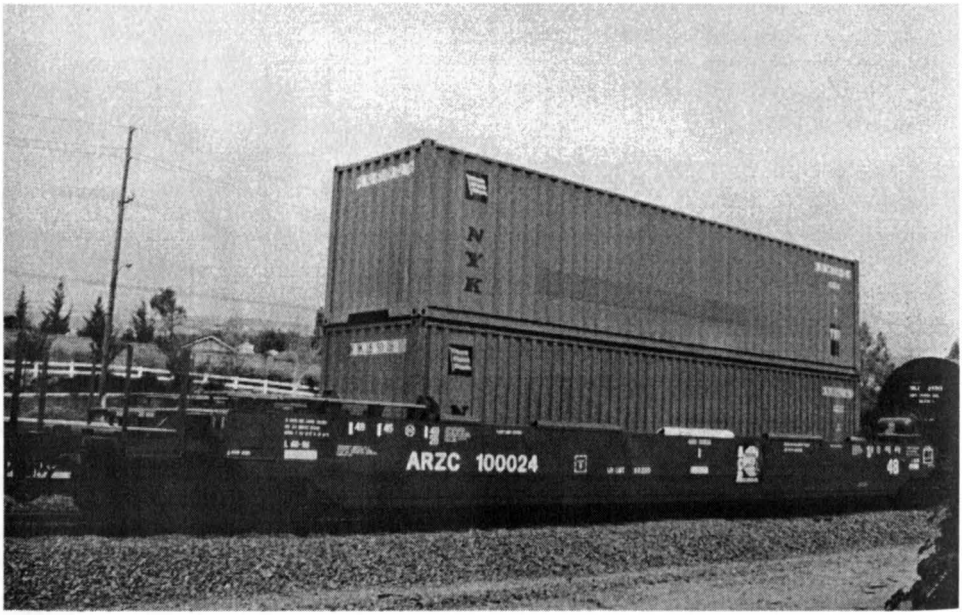

FIGURE 12. An Arizona-California Husky Stack Car with NYK Marine Containers. These containers are carrying hay through Yorba Linda, California, bound for shipment to Japan (G. Hannes Photo).

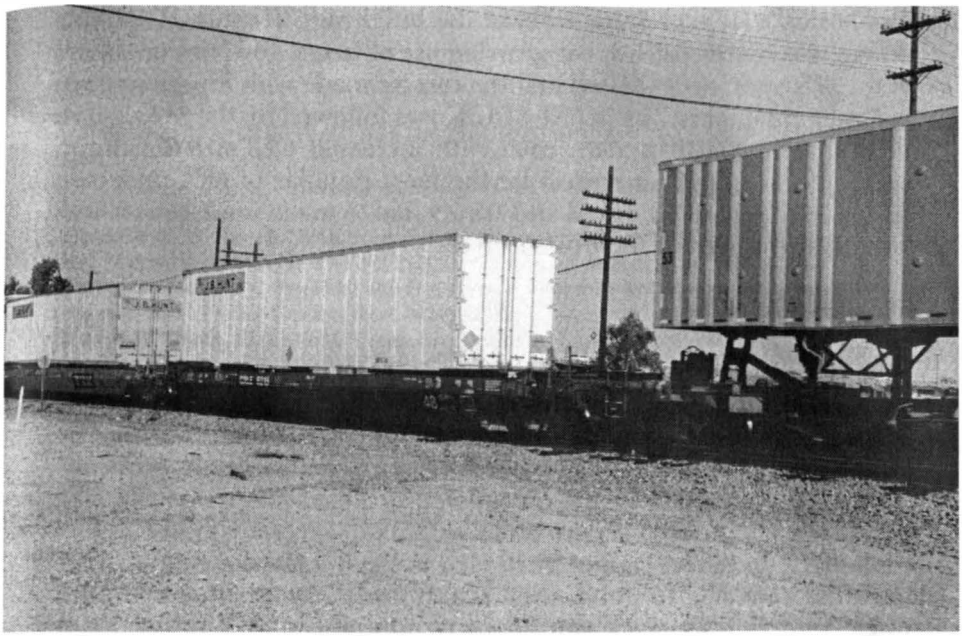

FIGURE 13. A J. B. Hunt Trailer Sets inside an All-Purpose Well Car. The 53' Trailer to the extreme right rides on a All-Purpose Spine Car Set (G. Hannes Photo).

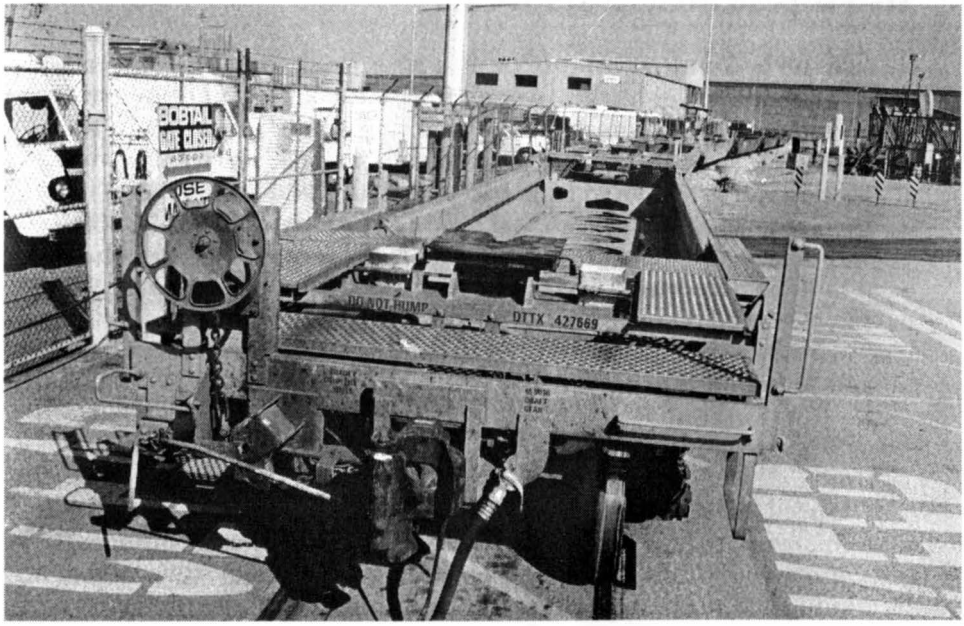

FIGURE 14. An empty All-Purpose Stack Car Unit at the Port of Long Beach, California. Note the truck trailer hitch near the front of the railroad car (G. Hannes Photo).

was basically a Twin-Stack without the bulkheads (Hannes 1996). This design was successful, but the growing use of larger, 48-foot, containers in the U.S. soon necessitated that the cars be made with longer wells to fit larger containers. The MAXI-STACK was followed by the MAXI-II in 1988 and MAXI-III in 1989, each with increased well size (Casdorph 1993). The MAXI-III proved to be the most popular of all Gunderson designs (see Figure 11). Thrall and Trinity had to make similar modifications in the design of their cars as well.

Single-Unit Cars

Twenty-foot containers are often just as heavy as 40-foot containers; thus it stands that a freight car loaded with two 20-foot containers in the bottom position and one 40-footer on top (20-footers cannot be put in the top position) would equal the weight of three 40-foot containers. This proved to be a problem on articulated railcars because the shared wheelsets decrease each unit's weight capacity. Oftentimes 20-foot containers, therefore, cannot be hauled in the intermediate units of articulated railcars. To solve this, Thrall and Gunderson have built single-unit double-stack cars to carry containers with heavy loads (Hannes 1996). One is exhibited in Figure 12.

All-Purpose Double-Stack Cars

In 1993, Gunderson introduced a new single-unit double-stack railcar that had trailer hitches over each wheelset and a floor piece thus allowing highway trailers to be set into the well (Hannes 1996). This allows the car to be used either in container or trailer service. This new all-purpose car is shown in Figure 13 and Figure 14. Thrall, Trinity, and a Canadian manufacturer, National Steel Car Company, have all subsequently designed similar all-purpose double-stack cars. So far most have been built as non-articulated cars; but in 1995. Gunderson began producing a 3-unit articulated set of all-purpose double-stack cars. At the time of this writing, no other companies have built articulated all-purpose car sets though it is expected they will.

Conclusion

Indeed, the development of intermodal railcar technology has forever changed the face of American railroading. Intermodal shipments continue to grow as more shippers switch from boxcars to truck trailers. In addition, as more and more containerships are built that are too wide to fit in the Panama Canal, the railroad systems are acquiring an increasing amount of coast-to-coast "landbridge" container shipments. These changes are helping the American freight railroads move into the

21st century.

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The International Negotiation Modules Project: Integrating International Simulation into the Geography Classroom in the Community College

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Abstract

This brief piece is designed to introduce the faculty member in geography to an innovative program which is designed to enhance the teaching of geography and other areas. The International Negotiation Modules Project relies on simulation as a means of engaging the students in learning about various aspects of geography. Furthermore, students work in groups to assist one another in the learning process, another one of the basic components of sound pedagogy. By focusing on contemporary international issues, the study of geography is built into a broader framework which makes the field especially timely and relevant.

Introduction

The International Negotiation Modules Project (INMP) was created in 1995 to adapt the ICONS networked computer simulation into the community college curriculum. Funded by a grant from the Fund for the Improvement of Postsecondary Education of the United States Department of Education,[1] the program uses networked computers to simulate negotiations on a range of international issues. Over the course of the semester-long program, students are encouraged to create and test negotiating strategies, collect and analyze information from different perspectives, and make decisions based on their research. The approach used is an ICONS-type simulation,[2] which seems to work particularly well at the community college level where the non-traditional nature of the student body is an asset. These students, many of whom are older and already have work experience, are particularly receptive to an approach which encourages them to work together and take advantage of skills that they bring to the table from their own experiences. Further, one of the most interesting modifications of the program has been the implementation of the simulation across a range of disciplines, including geography classes.

ICONS (International Communication and Negotiation Simulation) was created at the University of Maryland in the early 1980s as a response to the confluence of a number of events, primarily the rapid developments in the areas of computer and network technology along

with the increasing availability of computers, and the movement in the area of higher education to more student-centered learning. The ICONS simulation was created initially for students at the university level, and was then adapted for middle- and high school students.

The INMP, the first time ICONS was implemented at the community college level, was piloted in the 1995-1996 academic year in nine community colleges throughout the state of California where the simulation was integrated into a range of classes across disciplines from International Relations, to Psychology, to basic English Composition and Economic Geography. California seemed to be an especially appropriate area in which to pilot the program, given the articulation between the community colleges and colleges in the California university system, the demographics of the student body in the California community colleges, and the emphasis in many of the colleges on internationalizing the curriculum. In 1996-1997, the second year of the grant period, seven schools were added to expand the program to 16 community colleges across the United States. Classes in French, World Civilizations and Cultural Geography are among those participating in the program. In the third year, the program has grown to 18 colleges, including one outside the United States. The results of the evaluation of the program to date indicate that the simulation can be used successfully to internationalize a range of classes across the curriculum, and to enhance computer literacy for students who participate.

Implementation

In a typical simulation, each class represents a country or a non-governmental organization, such as Amnesty International or the World Health Organization. A scenario, which is drafted prior to each simulation, becomes the framework for the simulated world and lays out the issues for the negotiations. For the 1996-1997 program, for example, the issues included: international trade, drug trafficking and narco-terrorism, nuclear non-proliferation, human rights, and migration and immigration. The issues are selected by the faculty members based on the topics and issues that they would like to cover in their classes. Thus, although these issues do not perhaps seem to deal explicitly with Geography, all of them require that students understand geographic relationships, environment, topography, as well as the culture of the countries involved. Each of these topics is central to the understanding of the subject of "Geography."

Within each class students work in teams to become "experts" on one of the issue areas that their country will be involved in during the simulation. This requires that each team of students must learn about a

single issue in depth, including the position of the country or actor that they are representing, their likely negotiating partners, allies, and potential adversaries. As much as possible, students are encouraged to use on-line resources for their research, and to take advantage of non-US sources in order to get a truly global picture of the issue. This phase of the program culminates in the drafting of a position paper, which outlines each country's policies and negotiating strategies for the simulation.

The simulation itself lasts for four weeks during which time the students negotiate on-line using telecommunications technology. This includes a combination of asynchronous (or e-mail) and synchronous real-time communication. The e-mail is the basis for the negotiations, and the students use it to develop their position on the issues, put forward proposals, and build support for their particular ideas. The climax of the negotiations are the on-line real-time summits, which bring together 10 or 12 teams to negotiate specific details on one of the issue areas. The agenda for each summit is sent out in advance, and grows from the e-mail negotiations that have taken place to that point. Each summit lasts 90 minutes, and allows the teams to try to reach agreement on a particular item and, if agreement is reached, to determine what the logical next steps will be.

The simulation concludes with a debriefing, at which point the students and faculty assess what was and was not accomplished and why, and to draw conclusions about lessons learned. In addition, there is a rather detailed evaluation component associated with the entire program.

Application in the Geography Classroom

One of the most interesting aspects of the INMP has been the ways in which participating faculty use the simulation to internationalize a range of classes and to introduce computers as a tool for teaching and learning across the curriculum. In the four year institutions involved with the ICONS simulations[3] typically the program is implemented as part of Political Science classes, and often specialized classes such as upper division courses on international negotiation. However, as the program evolved in the community college setting, it seemed more appropriate to broaden the applications so that the simulation could be adapted successfully across the curriculum.

One of the ways in which this was done most successfully was in Geography classes in colleges in California. Three different classes in that discipline participated in the program during its first two years. Dr. Ray Sumner, initially in Los Angeles Valley College and at Pasadena City

College, then at Long Beach City College, and Professor Richard Raskoff, also of Los Angeles Valley College, both integrated the simulation into various Geography classes that they were teaching. What each of them found most effective about the program was the way in which it motivated students while enabling them to integrate culture, environmental issues and other relevant topics into the teaching of geography.

The INMP program, of course, required these faculty members to teach their classes differently than they would have otherwise, and to arrive at alternative ways of evaluating their students as well. Both faculty members required students to keep comprehensive portfolios, which included map studies as well as detailed research about the country the students were representing. (One of Sumner's classes represented Malaysia, while a joint Sumner-Raskoff class represented Japan.) This approach also reinforced to the students the fact that the study of geography is more than just memorizing places on a map, but rather, it involves understanding the ways in which the physical location of a country affect its resources, its wealth and its international relations. It also reinforced the interaction of natural and man-made events and the ways in which countries prepare for, and must respond to, each of these. In short, it made the study of geography real and relevant for the community college students, many of whom are very conscious of the need for practical application of the materials they learn in classes. Students also appreciated the fact that they were developing skills in team work, independent research, and negotiation.

The program was integrated successfully in a range of classes across the curriculum in addition to Geography. For example, one faculty member used the simulation as part of English 21, a required Basic English class. This class learned reading, writing and research skills as well as about international negotiation while representing China in the simulation. While some of the students were disconcerted by the process, which clearly did not fit the mode of a traditional Basic English class, others were stimulated by it and by what the experience taught them. During debriefing, which I attended, one woman made a point of explaining that, since her goal is to become a health care professional, she felt better prepared to confront and interact with patients from different cultures because on what she learned in this class. Further, she reminded her colleagues, since much of what we do on a daily basis is negotiate, the training in negotiation will be a valuable resource regardless of what career an individual wants to pursue. These lessons can be generalized to the lessons learned in classes across the curriculum.

Studies have shown that participating in ICONS simulations in-

creases students' critical thinking skills; they show greater sensitivity to and appreciation of other countries and cultures and they better understand the process of international negotiation.[4] The students who were involved in the pilot program in 1995-1996 give perhaps the best testimony to the impact the program had on them. For example, following the simulation one student from the Malaysian team, one of the Geography classes, wrote: "I've enjoyed spending hours in different book stores reading about Malaysia and other Pacific Rim countries. I now own an encyclopedia and have read quite a bit about other countries." Another student from that same class wrote: "...in this exercise, I have learned some economic concepts and business details. It really helped me develop my knowledge, especially [since] my major is business." And another wrote: "This activity also opened my eyes to an 'economic' perspective that I had never paid attention to before. I was also introduced to the 'Asian' way of thinking that is valuable knowledge if one is to live in a truly global community."

The INMP is an effective teaching tool because it relies upon the soundest educational principles: it requires students to take an active part in their own learning, it relies heavily upon collaboration among students, and it sets high expectations. [5] Further, the integration of telecommunications technology increases students' computer literacy by making the technology an important educational tool.

To be successful means , however, that the faculty must change the ways in which they teach. Because this is student-centered learning, the teacher must be willing to step back and act as a facilitator, guiding the students through the process but with the understanding that the primary responsibility for learning falls upon the students themselves. As noted above, those faculty who participated in the INMP pilot program had to alter significantly the ways in which they taught their course. Further, it was important at the outset that they stated clearly their own expectations of the students participating in the program who, in all likelihood, were confronting a type of learning situation that was new to them. On the other hand, the faculty also agreed that the process was so valuable that it will be difficult to return to a more traditional way of teaching. As one faulty member noted in a letter to the Project Director: "Do you have a cure for ICONS withdrawal?...I'll have to create more opportunities [in other classes] for my students to use the Internet."

Conclusion

This brief piece was designed to introduce the reader to an innovative technique applied in community college classes, including geography, designed to stimulate students interest in the subject by actively

engaging them in the learning process. The ICONS simulations has been used effectively at the high school through university level, but the INMP described here was the first application in geography classes.

The lessons of this pilot program have been that this approach is an effective way to teach the subject, and that, as a result of the experience, students are made more aware of the world around them while they are also learning the basic subject-matter of the course.

Footnotes

[1] FIPSE PR/Award P116B50043, September 1, 1995 through August 31, 1998.

[2] ICONS is the International Negotiation and Communication Simulation, which is a product of the University of Maryland. ICONS was created in the early 1980s specifically to help teach university students about the complexities of international negotiation. It was then adapted for high school students as well. The INMP was the first time that this program has been implemented in the community college classroom and, specifically, in a range of disciplines.

[3] The University of Maryland runs a number of programs specifically for four-year institutions. Each semester there is a global simulation, which typically lasts five weeks and is broad in both the scope of the issues, and the range of countries included. In addition, there is a shorter (about 3-week) case-based simulation focusing on a particular international issue. For a more complete description of the ICONS simulations, see Jonathan Wilkenfeld and Joyce Kaufman, "Political Science: Network Simulations in International Politics," in Social Science Computer Review (1993) 11, 4:464-476, and Brigid Starkey and Jonathan Wilkenfeld, "Project ICONS: Computer Assisted Negotiations for the IR Classroom," in International Studies Notes (1996) 21, 1:25-29.

[4] Judith Torney-Purta has been the evaluator of the ICONS program virtually since its creation, and she serves as the project evaluator for this program as well. For examples of the results of her evaluations see: "Cognitive Representations of the Political System in Adolescents: The Continuum from Pre-novice to Expert," in New Directions for Child Development 56 (Summer): 1992, 11-24; and the "Evaluator's Report of the International Negotiation Modules Project, 1997 (unpublished).

[5] For a discussion of some of the elements of sound pedagogy see: American Association of Higher Education, Principles for Good Practice in Undergraduate Education. Racine, WI: The Johnson Foundation, 1987.

CALIFORNIA GEOGRAPHICAL SOCIETY SCHOLARSHIP AWARDS 1997

Graduate Award: Fred Wilson, CSU-Fresno.

Undergraduate Award: Natalia Boettcher, Humboldt State and Christine Bridgeford, CSU-Chico.

GRADUATE PAPERS:

First Place : John Andrew Falkowski, San Jose State, "Small Scale Agriculture water Delivery Methods: Department of Shala, Guatemala"

Second Place (tie): William A. Harmon, San Jose State, "San Jose and the Silicon Valley: Land in Transition"

Second Place (tie): Deborah Rogers, San Francisco State, "Double Vision: Rephotographing California's Landscapes"

POSTERS:

First Place
Sophia Habl, San Diego State: "Las Menonitas: Migration and Identity in Cuauhtemoc, Mexico"

Second Place (tie): Stephen Scarpaci and Lesley Albert, Humboldt State, "Rotten Rails: The Role of the Environment on the Northwestern Pacific Railroad"

Second Place (tie): Andrew Barron and Lora Richard, CSU-Chico,"Mapping Malakoff Diggings"

UNDERGRADUATE PAPERS:

First Place : Paul Hauth, Humboldt State,"National Park and the Aggradation of Redwood Creek"

Second Place : Craig B. Clements, Diablo Valley College, "Observations on the Mountain-Valley Wind Regime of Lee Vining Canyon, Sierra Nevada."

Third Place (tie): Chinmaya Lewis, Humboldt State, "Orographies: A Case Study."

Third Place (tie): C. Weston and T. Boettcher, Humboldt State, "Colorado River Management."

OUTSTANDING EDUCATOR: Robert Christopherson

FRIEND OF GEOGRAPHY: Joe Beaton

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