SOME NOTES ON GEOGRAPHY AND SOCIAL ENGINEERING*

by

Gunnar Olsson

Department of Geography

University of Michigan

"A main source of our failure to understand is that we do not command a clear view of the use of our words." Ludwig Wittgenstein in Philosophical Investigations.

"Instead of posing as prophets we must become the makers of our fate. We must learn to do things as well as we can and to look out for our mistakes." Karl Popper in The Open Society and Its Enemies.

A. Introduction

In this essay, I will report on some recent explorations into the border territories of geography, philosophy, and planning. Interim reports with extensive references to relevant literature have already appeared, (1) but more detailed discussions have been saved for a forthcoming monograph. (2) The following exposition will borrow freely and without detailed quotations from these writings.

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The raison d'etre of this particular research lies in my view that the goal of social science theory and model formulation should be to provide tools for societal action and control. (3) More specifically, my endeavors have been prompted by the belief that scientific models ideally could perform such steering functions first by indicating which alternative actions can be accommodated within the bounds of currently accepted scientific knowledge, and second, by specifying the foreseeable side effects of these actions. It follows that evaluation of social science models should be in terms of their ability to furnish guidelines for visionary but nevertheless responsible change. In this regard, my conception of social engineering has closer affinity with the notion of piecemeal social engineering favored by Popper than with his notion of utopian social engineering. (4) I nevertheless prefer the term social engineering to the term social planning, primarily because the former provokes greater awareness of the possibility of creating unacceptable side effects.

In the remainder of this essay I will draw attention to three interrelated issues involved in my programmatic statement. These issues concern: (1), the relations between observational and theoretical statements; (2), the relations between the concepts of explanation and prediction; (3), the relations between statements from different levels in the hierarchy of reasoning. In the first section, these issues will be discussed in relation to epistemological problems. In the second section, I will proceed into the realm of spatial analysis and ask whether a well-known family of spatial models actually possesses the ideal characteristics outlined in the first section. Finally, in the third section, the preceeding philosophical and geographical evaluations will be merged and used as a basis for remarks on the appropriateness of employing existing spatial theories and models as tools in social engineering.

B. Epistemological Principles

B.1. Observational and theoretical statements

Standard positivistic accounts assume that there is a basic difference between the language of a theory and the language of the empirical observations which the theory is designed to explain. It has in fact sometimes been argued that the prime concern of the scientific enterprise is to bridge the gap between these two languages. In the textbook case, this connection is normally established by providing the

theory with a model, which in turn is connected with observables; through this translation procedure, the formal syntax of the theory will have been given semantical meaning.

The quoted procedure provides a dangerously oversimplified approach. Problems arise for many reasons, but primarily because the results will be highly dependent both on our particular definition of what a theory is and on our views of the relationships between a theory and its various models. This means that when statements written in the theoretical and observational languages are deemed not to conform with one another, there is no a priori reason for adhering to the empiricists' contention that it is always the theory which is wrong. Instead, our increased awareness of the problems of subjectivity in the social sciences suggests that it may not be only our theoretical statements which need to be revised but our observational statements as well.

The tenor of this proposal is of course shared by many,(5) even though it goes counter to much in our methodological heritage. As a consequence, it does not fit too well into any of the standard definitions of what a theory is.(6) This is certainly the case with Russell's atomistic views, according to which theories are disguised observation statements such that every theoretical term is defined as observables; the implications of Craig's theorem provide sufficient evidence for suggesting that if such formal similarity were the only required relationship between theory, model, and observation, then it would be impossible to distinguish the three concepts from one another.(7) For this reason, it seems desirable to recognize explicitly both that theories and models have very different epistemological characteristics and that a theory can be provided with more than one model.(8) It follows that comparative work with alternative models is likely to suggest theoretical improvements. In addition, such work should help to isolate situations where a priori theories could influence the actual physical construction of new realities. In the latter case, social engineering would furnish a mechanism whereby the "is" of the empirical could be brought in closer agreement with the "ought" of visionary politics and prescriptive theory. The implementation of this approach, however, requires rejection of the view that theories are disguised observation statements.

The need for assessing social engineering theories as much in terms of their normative content as in terms of current empirical

truth conflicts also with the so called realist view of Quine and Braithwaite;(9) since normative theories by definition speak about alternative possible worlds of the future, they consist not only of true or false statements about real alternatives.

The social engineer's use of subject matter theories necessitates revision of Nagel's instrumentalist view as well. (10) Thus, it is usually not sufficient for the responsible and action-oriented social scientist to think of theories only asintellectual instruments whereby empirical observations of past events can be represented and interpreted. More specifically, if we limited our conception of a theory to that of an "inference ticket in accordance with which conclusions about observable facts may be drawn from factual premises, not as premises from which such conclusions are obtained"(10) then we may be tempted not to give sufficient attention to the formulation of much needed perscriptive theories, i.e. to the formulation of constructs whose double purpose is to mirror current empirical observations and to aid our evaluation of the many possible future worlds. In addition, the instrumentalist view comes close to the conception of a theory as a black box into which selected input data are entered and out of which, somehow, a set of insights emerge.

It is willingly admitted that the inference strategy of the instrumentalists eventually can lead to valuable ampliative generalizations. Likewise, it should be admitted that this black box approach can be very powerful for short term predictions. For the responsible planner concerned with long term investments, however, it is not a particularly desirable approach. The reason is, of course, that such black box predictions tend to be based more on observed covariance relations established via correlation analysis than on causal relations established via regression analysis. It follows that if predictions derived from the former type of models were to be implemented through social engineering action, then the risk of creating long range unforeseen side effects would increase.

In conclusion, none of the conventional definitions of a theory seems to meet the needs of those social engineers who wish to rely on theories and models for guidelines and tools in the achievement of action and change. The limitations inherent in the discussed views of the theory concept are likely to become increasingly acute, especially if social scientists become more concerned with fitting reality to a priori preference premises and less engaged in formulating theories which mirror empirical occurences as these are currently observed. In

this context, it is interesting to note that already Neurath, in one of the classical manifestos from the Vienna school, suggested something rather similar. Thus, he seems to have proposed that when statements from the empirical and theoretical languages are found not to agree with one another, then it may sometimes be more appropriate to rebuild reality, or at least our statements about reality, than to obtain morphism between the two languages by replacing the theoretical statements. (11) It may be important to realize that Neurath was the only member of the original Vienna group who had a strong interest in politics and the social sciences.

It should be evident by now that scientifically-anchored social engineering requires far reaching changes in conventional ways of thinking and therefore in the definition of some of our most fundamental epistemological concepts. Thus, it is not sufficient for the social scientist cum social engineer to be concerned only with altering his theories so they conform with empirical observations, but he must also be concerned with rebuilding reality so it conforms with the normative, ideological, and moral premises of his theories. Such an approach seems necessary particularly for the utopian social engineer, who frequently must decide on the appeal of a given theory not so much on the basis of whether the model prediction P agrees with past observations, as on whether the future realization of P is deemed so desirable that the other parts of the system should be altered in such a way that they come to agree with those axioms and intermediate theorems without which the model could not have produced P. Identical approaches should satisfy the needs of the more cautious piecemeal social engineer whose main interest is in whether a particular plan agrees sufficiently well with empirical observations to produce the intended results.

In conclusion, it can not be overstressed that our degree of belief in a given theory with social engineering implications depends not only on its logical coherence and associated empirical observations, but also on our estimates of pragmatic utilities. (12) Rephrased, this means that the appeal of a particular theory depends not only on its current truth status but also on our anticipations of the positive and negative effects that would be created if its predictions actually were to be implemented Anticipating the need for this kind of intellectual construct, we may be wise in following Achinstein's suggestion and put more emphasis on the development of imaginary as opposed to representational or observational models. (13)

B. 2. Explanation and prediction

It is well known how Hempel and Oppenheim in their classical treatise argued that there is a structural identity of symmetry relationship between the notions of explanation and prediction. The only distinction between the two concepts was said to be pragmatic. (14) Thus, it was held that in explanation the phenomenon under investigation, E, is known to have happened, which leaves the initial conditions, $\{C_k\}$, and the general laws, $\{L_i\}$, to be determined. In prediction, on the other hand, the initial conditions and general laws are known and the final event is left to be determined.

The most common position today is, of course, that the original symmetry thesis is only partly true in the sense that every adequate explanation is said to provide a potential prediction, while successful prediction is not the same as successful explanation. On the operational level this important distinction suggests several positive analogs with the distinction between least-squares regression and correlation. More specifically, such changes in the general law statements that lead to reversal of the hypothesized functional relationship -- i. e. to a reversal of the x- and y- axes -- will affect the magnitude of the regression coefficients but not the value of the correlation coefficients. (15)

Since the side effects of social engineering seem easier to anticipate if the planning operations are executed through manipulation of cause rather than effect variables, action prompted by interpretations of observed correlations may well create more problems than it solves; even though models which yield high correlations can provide powerful short term predictions, they are by definition not explanatory models. It follows that correlation analyses can not help us anticipate the long term effects of a given action. Conversely, explanatory analyses can not only delineate the bounds of the physically possible, but also indicate some of the side effects of an action. In practice, however, this ideal property of explanatory analysis can rarely be realized, simply because we do not yet possess any good procedures for substituting the initial set of laws, $\{L_i\}$, as components into another set of laws, $\{L_j\}$, with less restrictive boundary conditions. The role of explanatory models in social engineering is further complicated by the unresolved problems connected with Arrow's impossibility theorem. (16) As a consequence, available tools require that the target population and aspiration levels be explicitly defined.

In conclusion, it is unfortunate that social scientists have not yet

developed a host of good analytic models which can be used as aids in the determination of the direction and strength of causal relationships and thereby in the selection of proper target variables. The fact remains, however, that prediction and explanation are asymmetrical concepts much in the same manner as correlation and regression. It follows that if we wish to keep the side effects under control, then our proposals for action are likely to be more responsible if they are anchored in explanatory as opposed to predictive analyses. Models which yield high correlation but fluctuating regression coefficients are not sufficient for this task. Rather we need detailed knowledge of law-like statements as specified in terms of non-erratic causal parameters.

B. 3. The hierarchy of statements

The discussion thus far suggests that responsible social engineering requires a free but nevertheless disciplined interplay between the various levels in the hierarchy of reasoning. Thus, it is through such an interplay that we may hope to combine the openmindedness that characterized my comments about observational and theoretical languages, with the stringency and fear for creating long term negative side effects that caused me to prefer explanatory regression type models to predictive correlation analyses. By anchoring our research in such an analytic framework, it may in fact be possible to produce models which are useful both for the visionary utopian and for the cautious piecemeal social engineer.

On the highest level of abstraction, such a framework requires that close connections be established between moral preferences, conceptualization, and alternative logical calculi. It is challenging, for instance, to speculate on the usefulness of subject matter theories written in the language of deontic logic, i.e. in a language which through its explicit focus on action and norm systems bears directly on the problems of social engineering. (17) The reason for this suggestion is that the ambiguities of subsequent social engineering applications may be minimized by having the initial conceptualization of the subject matter problem occur within the bounds of a logical system which initially has been chosen so as to avoid later conflicts between the syntax, semantics, and pragmatics of the resulting theories. (18) The important point in this argument is that the descriptive theory, whose purpose is to mirror past empirical events, must be written in the same logical calculus as the prescriptive theories, whose purpose is to help the social engineer choose among the many possible worlds of the future. While the main issues tackled by descriptive theories would remain those of explanation and empirical validity, the

issues addressed by prescriptive theories would concern both what is scientifically possible and not possible, and what is ethically permitted and not permitted. Since the social engineer's evaluation of what is possible and not possible at least partly depends on what the descriptive theories distinguish as being empirically valid, he should require that the two types of theory be phrased in identical logical calculi.

Despite the well known difficulties of interpretation, (19) various modal logics may provide the formal syntax by which descriptive theories can be corrected. Thus, it seems intuitively clear that several theorems from non-standard logics can throw light on both moral and operational problems in social engineering. To substantiate this intuitive assertion we need only recall the discussion of von Wright's deontic expression(20):

$$O(p|q) \;\&\; O(\sim p|q) \qquad \text{(I)}$$

Given the usual notation that O stands for obligation, expression (I) of course says that, given that it is the case that q, then it ought to be the case that p but also not be the case that p. Since one can argue that it is possible to have logically acceptable normative systems which imply inconsistent conditional obligations, we automatically create the situation of predicament specified by (I). Rephrased, this means that expression (I) states that whatever the change agent does, he does something he ought to omit, and whatever he omits, he neglects something that he ought to do. It is important to note, however, that this type of predicament can arise only if he already has done something which is deontically impossible. Thus, it can be demonstrated that if the act of an agent gives rise to conflicting duties of the type specified in (I), then this act is itself something from which he has a duty to abstain; as an example, promising the forbidden is itself forbidden.

For the social engineer it seems particularly interesting to note that situations analogous to the situation of predicament tend to occur when two or more deontic life-trees are amalgamated, i.e. when the change agent is forced to act under the influence of more than one norm system. The cases of the western planner working in non-western cultures and the middle class politician dealing with the ghetto immediately come to mind.

Exactly how a particular non-standard logic can influence the formulation of subsequent theories and models is less evident. However,

recent attempts to write decision models in the languages of fuzzy sets and many-valued logics offer interesting indications of what eventually may be achieved. (21) In those particular instances it is thus clear how the choice of model language has influenced the low-level reasoning that occurs when descriptive theories and empirical observations are confronted with each other. But social engineering action furthermore requires that the model predictions derived from descriptive theories be compared with the pragmatic utilities and moral consequences which would arise if these predictions actually were allowed to be implemented in the real world. As a consequence, it seems useful to distinguish representational theories and models from prescriptive or imaginary theories and models. This distinction is especially prompted by the fact that predictions derived from conventional models can be confronted with observations of what has already occurred, while predictions derived from imaginary models are strictly speaking non-testable in the sense that they relate to events that have not yet occurred.

In summary, I have attempted to isolate the relationships between the various levels of reasoning which I deem particularly important for those who share my view that the goal of the social sciences is to provide tools for responsible societal action. The fact remains, however, that one of the most crucial steps in any scientific discourse concerns the translation between statements from the various levels in the hierarchy of reasoning. To keep the noise down, we must therefore be extremely careful in our specification of correspondence rules. It seems in fact that the notion of correspondence rules itself must be defined more broadly than usual, perhaps along the lines discussed by Schaffner. (22) Thus, given my previous remarks, it is not sufficient to equate correspondence rules with operational definitions; such a conception would be too closely akin to the unacceptable dichotomous view of theoretical and observational languages.

The need for redefining the concept of correspondence rules is especially pressing for constructs with social engineering applicability. This is so because the social engineer frequently conveys meaning on theoretical terms not only by relating them to observables and to imagined future realizations but also by relating them to antecedent theories which typically contain references to both observables and unobservables. The definition of correspondence rules should consequently be wide enough to allow reference both to imagined possible and permitted future realizations, and to previously existing descriptive theories. With this definition,

correspondence rules could be used as linkages in collapsed causal sequences through which theoretical terms with antecedent meaning can be allowed to account for currently observed realities as well as for imagined future realizations. Within such a framework, correspondence rules and reduction functions would take on pivotal roles in the perpetual game of scientific progress; each theoretical term would have a primary sense specified by the initial theory, and a secondary sense ascribed to it through the couplings provided by reduction functions and correspondence rules. In the context of the present essay, this is an important argument, since it leads to some extremely pertinent questions about reductionism and about the subsequent use of social science models as a basis for social engineering. I will return to this issue below, but it has to do with those extensions of Arrow's impossibility theorem that concern the problem of how to connect models from different aspiration and aggregation levels.

C. Spatial Models

C.1. Observational and theoretical statements

This is not the occasion for a detailed and well referenced discussion of the relations between observational and theoretical statements in geography. Suffice it to say that even a cursory examination of the history of the discipline provides overwhelming evidence for the conclusion that the majority of statements are either statements of empirical regularities or statements of empirical regularities which then have been given theoretical interpretations. Using the same terminology as earlier, one has started off with a set of observational statements which then at best have been rephrased in a theoretical language. The intent has thus been to mirror empirical observations as closely as possible. When statements from the two languages have been found not to coincide, the majority of spatial analysts have consequently proceeded as if the observations were correct and the theories were wrong; in the terminology of the present essay, they have attempted to formulate descriptive theories, usually of Nagel's instrumentalist type.

This characterization certainly holds for Hägerstrand's important development of spatial diffusion theory. (23) Primarily because of its clarity, this work provides an excellent example of an investigation which began with a set of detailed descriptions of the spatial properties of innovation diffusion and then proceeded to the formulation and

subsequent reformulations of a set of simulation models. More specifically, the main characteristic of Hägerstrand's approach was that the observed spatial patterns were conceived as being the result of an interplay between deterministic and random factors. On the model level this conception then took the form that the general development was determined by various distance functions which in turn were translated via the frequentist probability interpretation into the operational form of mean information fields, while the exact development was conceived as being influenced by a large number of chance factors, operationally represented by the drawing of random numbers. Finally, the results from these simulations were visually compared with the empirically observed patterns after which the exact rules of the game were successively changed until the generated patterns agreed sufficiently well with the observed ones. It follows that the primary purpose of Hägerstrand's simulation models was to describe empirically observed spatial patterns, i. e. to arrive at descriptive rather than prescriptive theory.

The development of Christaller's central place theory, (24) of the various distance models of the gravity type, (25) and of the intracity population density models(26) can be described in much the same manner as the development of Hägerstrand"s diffusion theory. As an example, it is fascinating reading to trail the mathematical formulations of how population densities taper off with increasing distance from the city center; Clark initially started off with a set of straightforward regression analyses, which then were used as the observational backdrop both for Alonso's extensions via economic equilibrium interpretations and for Newling's curve fittings. The former have then been extended into Casetti's and Papageorgiou's alternate explanations on the one hand and into Scott's maximum likelihood derivations on the other.

In conclusion -- and without having gone into any detail -- I would assert that with the exception of Lösch's normative location theory, (27) practically all so-called theories and models in geography are positivistic constructs in which the instrumentalist attitude has prevailed and in which theoretical statements successively have been reformulated to agree better and better with empirical observations.

C. 2. Explanation and prediction

I have already noted that although adequate explanation may lead to

successful prediction, successful prediction is not the same as successful explanation. Likewise it has been stressed that even though correlation coefficients may well indicate the strength of the statistical covariance between a set of variables, it is mathematical parameters like regression coefficients that provide summary statements of the general laws which constitute a required part of the explanans. It follows that detailed analysis of the stability of empirically estimated causal parameters can indicate the explanatory power of a given model. In more operational terms, it is by carefully analyzing the behavior of its mathematical parameters that we conclude whether a causal model contains large specification errors. Thus, if the estimated parameters are found to vary erratically over time, space, and aggregation levels, then we should take this as an indication that the model has not been properly specified or calibrated.

For this reason, it is regrettable that most spatial research has not focused on the accumulation of knowledge in terms of systematic collection of parameter estimates. There are nevertheless a small number of models for which comparable estimates do exist. The most relevant of these data relate to the distance exponent of the gravity regression model. (28) Less comparable results have been obtained with the Clark and Newling type models of intracity population densities. (26) In addition, some cell counting models, especially the negative binomial and the Thomas' Double Poisson models, have been applied frequently enough to yield useful data on the behavior of empirical parameter estimates. (29)

In neither of the mentioned cases have I found the parameters to be stationary. Instead, it seems that whatever short term predictive power the models may have is due either to circular reasoning or to high spatial and temporal autocorrelation effects; detailed scrutiny of the erratically behaving parameters indicate that several relevant variables not included in the models are highly, but perhaps spuriously, correlated with the explanatory distance variable. This suspicion that distance may be an inappropriately used proxy variable is particularly supported by the fact that the estimated parameters behave erratically with changes in the temporal and aggregational settings.

At least in the case of stochastic point models of the cell counting variant it is well verified that the problems of parameter stability are closely related to the classical geographic inference problem of form and process. (30) Thus, performed experiments with these

models provide clear evidence that several different behavioral processes may generate the same spatial form. As a consequence, it is not safe to use the approach of the mentioned models, i.e. to take observed spatial patterns as given and then proceed to inferences about generating processes. Following Popper's dictum that society is best understood as the result of norms and decisions exerted by individual human beings, (31) it would therefore be dubious to advocate that these same constructs be used as a basis for responsible social engineering. It is clearly impossible to say anything about the long term effects that implementation of such aggregate and form oriented constructs would have on the individuals involved.

C. 3. The hierarchy of statements

Geographers have yet to develop a set of constructs which have been based on antecedently understood theories ordered into causal sequences. Within the previously discussed context of correspondence rules and social engineering, it is nevertheless illuminating to stress that the spatial postulates of location theory frequently can be shown to be special cases of behavioral theorems. It follows that the explanatory power and potential planning applicability of geographic theory does not depend on the employed and usually specified spatial axioms but rather on the unspecified axioms about individual and group behavior. (30) For the social engineer who looks to the spatial analysts for theoretical guidance, this observation has important and somewhat disconcerting consequences; this concern is obviously related to my earlier remark that most existing studies have taken observed spatial patterns as given and then proceeded to statements about generating processes and underlying human behavior.

In conclusion, the nature of the causal sequences inherent in traditional spatial theories makes existing constructs less attractive from the social engineering viewpoint. There are, of course, signs that this situation may change, particularly as the earlier stress on the geometric outcome of the spatial model game has lessened in favor of analysis of the rules which govern the moves of the actors who populate the gaming table. Those researchers who now are pursuing this course seem to aim at a better understanding of those cause and effect relationships which are relevant to the decision makers themselves, i.e. to those who actions eventually will determine the success of various social engineering endeavors. Essentially, these writers argue that geography should

be part of the study of human behavior and that theoretical statements which contain behavioral statements should be possible to falsify or confirm independently of their particular spatial context. This is clearly a reductionist argument, through which it is suggested that the releveance of any social science theory ultimately depends on its propositions about the micro units. It is only if those propositions are made explicit that we will be able to formulate social science-social engineering theories which are internally consistent in terms of moral preferences and long range side effects.

D. Spatial Models as Social Engineering Tools: Concluding Remarks

D. 1. Observational and theoretical statements

By ascribing to the proposal that there is a need for planning and guided societal change, we seem to imply that there is something in the projection of today's empirical world that we may wish not to occur. If this is correct, then I submit that the use of spatial theories and models as social engineering tools may have contradictory consequences. The reason for this warning is, of course, that practically all existing theories are positivistic and instrumentalist constructs in which the theoretical statements successively have been refined to agree better and better with current observation statements. To argue for extensive implementation of projections derived from these spatial constructs would therefore be conservative in the true sense of the word; planning based on descriptive subject matter models would only help to perpetuate the existing state of the world. In short, it strikes me as a contradiction in terms to argue for social engineering based on theories and models which originally were designed with the intent of describing past and current observations as perfectly as possible.

This conclusion suggests that the main problems in social engineering concern some very fundamental methodological issues. It is true that continued empirical investigations may serve the indispensable purposes of indicating first what actions are feasible, and second, what side effects these actions may generate. But the most serious thinking must nevertheless be geared towards the formulation of alternative normative theories. The goal of these prescriptive theories should perhaps be to arrive at normative solutions which are maximally just to those who would be affected by their implementation. (32) It follows that the present emphasis on theoretical and

representational models should be supplemented by increased experimentation with prescriptive or imaginary models whose moral premises have been made explicit. (13)

As detailed earlier, this recommendation is based on my belief that it is sometimes more appropriate to attempt to rebuild reality so that it conforms with the moral premises of our prescriptive theories than to restructure scientific statements so that they conform with current empirical observations. In this sense, the yet-to-be-formulated prescriptive theories could -- by focusing on the deontic issues of permitted and not permitted -- suggest alternative solutions to societal problems. Existing positivistic constructs with their intent of mirroring current observations could then -- by focusing on the modal issues os possible and not possible -- indicate whether a particular normative plan is feasible, i.e. whether the prescriptive theory agrees sufficiently well with the decision makers' observed behavior to actually work and produce intended results.

Judging from the current state of the art, it would be premature to argue for extensive social engineering action based on existing spatial theories and models. To alter this situation requires analyses not only of what the current state of the world is but also of what the future states of the world ought to be. Although deontic logic may well offer a suitable formal framework for such analyses, the first requirement is to redefine what is meant by a theory;(33) such redefinitions will have to be found that descriptive and prescriptive theories can be allowed to bear more directly on one another.

D. 2. Explanation and prediction

A main theme of the essay has been that the best insurance against creating side effects is to have the social engineering action firmly anchored in explanatory as opposed to predictive analysis. Since the estimated parameters of an important family of spatial models tend to behave erratically over time. space, and aggregation levels, this was taken to indicate that we have not yet arrived at a reliable and non-trival set of general law statements in geography. It follows that extensive action based on the prediction of these models could be irresponsible.

But the issues are not as simple as this categorical statement may suggest. The reason for the complexity is that despite the

non-stationarity of observed causal parameters, the correlation coefficients of the various distance models remain fairly high. One solution to this paradox is to recognize explicitly that the specification errors can well be masked and statistically counteracted by autocorrelations for which distance serves as a good proxy variable. It is this characteristic that makes the distance models into rather accurate short term predictors despite the fact that their explanatory power is low. Action based on these constructs are therefore liable not only to preserve current spatial patterns but also perhaps to create long term undesirable side effects. The decision on whether to base social engineering on spatial models is consequently contingent on our particular time perspective; it may occasionally be defensible to use them as a basis for piecemeal social engineering with short term effects but never as a basis for more vigorous utopian social engineering.

D. 3. The hierarchy of statements

It should be clear by now that the descriptive and non-explanatory character of existing spatial models leaves me rather ambivalent about their use as social engineering tools. Even though I have argued that existing theories and models sometimes can serve the limited purposes of the piecemeal social engineer, I have repeatedly stressed that these constructs do not possess the epistemological characteristics that would warrant their use in extensive piecemeal social engineering let alone in more vigorous utopian social engineering. This judgment seems worthwhile regardless of whether we accept or reject Popper's view that any utopian action must be termed irresponsible.

Considering at last the nature of aggregation levels and causal sequences in geographic theories, my earlier ambivalence remains. Thus, even if the issues connected with the moral foundations of these descriptive theories are sidestepped, I am left very concerned. The reason is, of course, that with the traditional focus on the spatial properties of the models, it is virtually impossible to say anything meaningful about the implied behavioral axioms. It follows that if we were to implement extensive social engineering endeavors based on existing theories, then we may well be able to draw valuable conclusions about efficiency and large scale spatial consequences, but we would know little about the long range consequences for the individuals. This strikes me as regrettable, since it means that

until subject matter theories with different epistemological characteristics have been formulated, the focus of our spatial planning must continue to be on supermarkets, roads, and airports, and not on the needs and desires of those individual human beings that the facilities allegedly are constructed to serve. (34) To argue otherwise would be to extend a limited body of knowledge far beyond its boundaries.

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