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Theory in Human Geography: A Review Essay

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1. What is theory?

This volume commemorates the founding of the Royal Geographical Society in 1830. It is interesting to begin with the observation that von Thunen's *Isolated State* was first published in 1826. Theory has a long history in geography, though it has not always been practised by people who would call themselves geographers.

What is theory? It is sometimes important to explore questions of this kind with the deepest philosophical rigour. I will take the simpler view here, however, that it is easy to recognise good theory when we see it. A theory is a representation of our understanding of some entity, and its workings, which we are interested in. The philosophical problems arise because of the difficult relationship between theories and truth. Sometimes, theories are patently obviously not true, but they offer insights and perhaps a step towards something better. Theories are not 'facts', but generate predictions which can be compared with data. Above all, perhaps, in theorising, we seek ever *deeper* understanding of the elements of our discipline. Whatever has been achieved by a particular time, more difficult theoretical problems usually turn out to lie around the corner. In achieving some degree of understanding, our eyes are opened more clearly to what we do not understand.

We can also discuss what theory is not! In particular, it is important to note at the outset that theory is not the same as 'technique'. Theory is not to be identified with 'quantification' for example, important though that may be in a number of respects.

There is a wide range of forms within which theory can be expressed: as much understanding of the workings of a city may be obtained from a novel as from a mathematical model, and the kinds of understanding represented in this range will usually be complementary rather than in competition. Notwithstanding this observation, the view of this essay will, on the whole, be a more restrictive one. This arises from the way we choose to define disciplines and geographers are not usually so imperialist as to enter directly the preserves of literature, and also because a review of a field as broad as this is inevitably stamped with personal blinkers and idiosyncracies.

It is impossible to explore geographical theory without deciding what is geographical in relation to other disciplines and this preliminary topic is dealt with in the next section. This is followed by a review, in broad terms, of some of the major general features of geographical theory in section 3. Finally, a review of future prospects is presented in section 4.

2. Human geography and related disciplines

Human geography is concerned with people, their activities and their spatial distributions; and with organisations of all kinds, their activities - the production of goods and services in the broadest sense - and their spatial distributions. The discipline is subdivided in very many ways which, inevitably, overlap. The two broadest divisions are into social and economic geography, reflecting the (at times artificial) distinction between people and organisations made at the outset. Another way of slicing the subject is into urban and rural geography. Or more detailed subdivisions are sometimes used: the geographies of resources, agriculture, transport and so on. If a long time period is involved (or perhaps a particular method?), we think of historical geography. Synthesis makes us think of regional geography in the old sense - of which more later. A more modern concern with techniques produces fields like spatial analysis. Current concerns, as we will see later, relate to welfare or radical geography.

What is a discipline or a sub-discipline anyway? It is clear from the previous paragraph that whatever geography is, it will overlap with many other disciplines. The definition of a discipline in part involves substantive issues and in part social convention. At its broadest, and given its history, we might argue that geography is concerned with places and with spatial relationships. But then so are many other disciplines. This difficulty is resolved by recognising that there is substantial overlap between disciplines, and by noting that it is a matter of convention as to what the group of people who call themselves geographers actually do. This has important consequences for the discussion of theory in geography. First, such discussion cannot take place without regard to the close links with a number of other disciplines. Secondly, what is distinctively geographical theory will be part of the social convention. And thirdly, there is an important organisational corollary of the second point for the future of geography: when new and important questions arise, if geographers do not take them on, then someone else will.

At the level of general theory, it can be argued that the geographer, in his or her concern with spatial analysis, is working with the concepts of location - both of structure and of activities - and flows; with spatial networks; and with spatial dynamics. These concepts provide the building blocks for most geographical theory whatever the subdiscipline from the kind of list discussed earlier. It may also be argued, whether from the perspective of systems theory or of Marxist-structuralism, that only a unified social science is possible, and I return to this issue in the final section.

The other disciplines which are relevant, obviously include economics, sociology, politics, social administration, history and even something as far removed as civil engineering. There are also methodological disciplines like philosophy and mathematics. This list is to be borne in mind as our explorations proceed.

3. A review of some major developments and ideas

3.1 First breakthroughs

The early development of theory in human geography illustrates the point made in the previous section about the importance of recognising conventions. There were major developments from at least the time of von Thunen (1826). Perhaps the most important subsequent early locational theorists were Weber (1909), Christaller (1933) and Lösch (1940). There were important contributions from economists (for example, Haig, 1926, and Hotelling, 1929) and from sociologists (such as Burgess, 1927, and Hoyt, 1939). The study of flows and interactions, using the gravity model and the intervening opportunities model, for example, also has a long history in the work of authors like Carey (1856), Ravenstein (1885), Reilly (1931), Stouffer (1940), Stewart (1941) and Zipf (1946). But most of this work was not recognised, or worked with, in the then profession of geographers until the 1950's (cf. Gould, 1979, for a discussion of this point and for a personal history of subsequent developments). Geographers at the time were more concerned with simpler accounts of 'areal differentiation' and most of the current theoretical basis until, say, twenty five years ago, was a concern with taxonomy and elementary verbal theorising. Gould makes an exception of some work in historical geography, which is interesting in that it has a basis in another discipline.

Thus, some very important theoretical foundations were laid during the first hundred and twenty five years of the period we are considering, but they were not recognised and built on within geography until much more recently. Stoddart (1965) commented bluntly that

> "the subject has managed to isolate itself from virtually every major development in the field of scientific thought since 1859."

What was the first general breakthrough which forced this position to change? This is not the place to chart it in terms of the variety of people involved in a very difficult battle. Many others do this - see for example many of the articles in Hudson (1979), Chisholm (1975) and Johnston (1978, 1979). A good basic reference is Haggett, Cliff and Frey (1977). The essence of the change was a shift to a concern with generality and away from a belief in uniqueness. Bunge (1979) puts the matter succinctly:

> "If Hartshorne was right, not only in his insistence that locations were only unique, but humans were also only unique, then neither locations nor societies could be predicted. Then location theory, as well as scientific socialism, was impossible."

Shortly afterwards, in the same article, he makes simply the point which is perhaps all too obvious to an outsider, but was clearly not so at the time:

> "Locations and people are clearly general. But they are also unique."

It does not seem difficult to accept the idea that locations and people have some general properties and some which are unique to them. Theory is in a sense concerned with both: primarily with generality, but also with the way in which uniqueness generates exceptions.

The shift was ultimately seen as one from regional geography to systematic geography and it can be argued- as I will below - that this has had some unfortunate consequences also.

3.2 Some general considerations: problem types, scale, representation

Before charting some of the main ideas and movements which have shaped geographical theory in more recent times, it is useful to discuss some general concepts which provide a useful background.

First, we consider Weaver's (1958) categorisation of problem types (which can also be taken as a classification of system types). He noted three kinds of system. Those which could be described by a very small number of variables, such as two or three or four, which he called simple systems. They could be modelled by the methods of traditional mathematics and formed the main subjects of science up to the late nineteenth century. Then there are systems of disorganised complexity: these need many variables to describe them, thousands or millions, but their components interact together only weakly. It was the discoveries of workers like Boltzmann and Gibbs in the late nineteenth and early twentieth centuries which enabled general methods to be made available for modelling these kinds of systems. In physics, these were the methods of statistical mechanics: entropy maximising methods. More broadly, they can be seen as statistical averaging methods. They do not offer a description of system behaviour in detail, but do enable more aggregate questions to be answered, and these may be important ones in many disciplines. Finally, he recognised systems of organised complexity. These also involve large numbers of components and variables to describe them but where there is some strong interaction between the components. Because of these new complexities, no general methods have as yet been discovered for modelling such systems, and Weaver described these as characteristic of the problems of modern science.

Weaver offered his categories in the context of arguing that research funds should be increasingly devoted to the biological sciences, rather than the physical, but it is easy to see that his analysis has implications for the social sciences such as human geography. This will become evident in the discussion below. We can see the simpler methods of analysis discussed in the preceding subsection as dealing with geographical systems as simple systems and the newer methods as part of attempts to handle greater complexity.

The next preliminary point concerns scale, or level of resolution, at which a system is viewed. The finer the scale, the more detail is observed and the more complex a system is likely to seem; and vice versa. This means that Weaver's categories, and the corresponding methods of analysis, have to be applied not simply to systems per se, but to systems viewed at particular scales. There is nothing odd about this. Indeed, some disciplines are defined by scale: microbiology, biology and ecology, for example. The useful idea to absorb, and this is particularly important for geography which operates over a very wide variety of scales, is that there are usually interesting results to be obtained at each scale. While reductionism, for example, might be a useful driving force in research, it does not follow that all useful results can only be obtained at the finest scale - which in geography is the 'behaviourist' view.

The third point to bear in mind is that even when scale is appropriately chosen, there are likely to be various ways in which the system can be represented. A particularly important example of this within geography is the way in which space is represented. Most of the early theorists mentioned above treated space continuously, and this often forces restrictive assumptions - for example in urban location theory that all employment is at the centre of the city. By treating space as a set of discrete units, there is some loss of resolution, but other restrictive assumptions of that type can be avoided. Much skill in theoretical geography has to be devoted to these kinds of decisions which at first may appear relatively trivial but which are often of crucial importance.

With this backcloth, we can now proceed to review some of the main general ideas which have had an impact on theoretical geography in recent years.

3.3 Quantitative methods: statistics and model building

One of the sources of 'new geography' has been the so-called quantitative revolution (Burton, 1963). This has sometimes been misleading and has lead to the identification of theoretical geography with quantification and to some misdirected effort. Nonetheless, the impact of quantification was important, and much theoretical geography has been and is stated in statistical or mathematical terms. So a discussion of the range of techniques involved is a necessary beginning. We should also note the almost obvious point that the timing of the development of quantitative methods, on a large scale was almost certainly associated with the development of computers in the 1950's.

It is important to recognise at the outset, the distinction between the approaches of statistics and of mathematics. Broadly speaking, the former are inductive and the latter deductive; the first trying to cull generalities from data, the second trying to invent mathematical statements of theories and then testing these against data, modifying them, and so on. So almost always in the quantification of a discipline, statistical analysis comes first. This is true of geography at least in terms of the scale of the contributions of the different styles even though the examples cited of early geographical theory to some extent contradict the argument. It should also be emphasised that the dichotomy is not as sharp as stated here. A successful piece of statistical analysis may lead to a mathematical model; conversely, a model can only be effectively tested using the methods of statistics, and some of the methods of model building, such as entropy maximising, are closely related to statistical methods, such as those based on Bayes' Theorem. Further, there are plenty of circumstances when models have to represent probabilistic phenomena and then the two styles come very close since the roots of probability theory might be considered to lie jointly in statistics and mathematics (as, for example, in Curry, 1964).

The first consequence of quantification has been that many geographers have become competent in a wide range of statistical techniques, from the construction of linear models of varying degrees of complexity, through factor analysis in its various forms, through to statistical control theory. The array of literature is impressive - for typical examples, see King (1969), Berry (1972), Cliff and Ord (1973), Rees (1979) and Bennett (1979).

The second consequence was the adoption by geographers of a range of elementary mathematical models of which the most popular was undoubtedly the gravity model. When such a model was used in its most elementary form, it in effect represents a separate model for each flow in a geographical system and can be considered as an application of Newtonian, Weaver-I methods for simple systems. Similar comments could be applied to population models of the Malthusian exponential growth or the Verhultz logistic growth variety. Or to economic models of the economic base type. Location theory was firmly rooted in the authors listed in section 3.1 above and the underlying mathematics (if one neglects the geometrical complexity - in which field geographers have contributed much distinguished work - see Dacey, 1976 and Beavon, 1977, for recent reviews) was either elementary or not completely worked out - take the rank size rule and the Löschian economic landscape as representing the different ends of this spectrum.

A new range of mathematical modelling problems were arising out of theory and it is probably no exaggeration to assert that the root of the difficulties lay in the so-called aggregation problem - well-known in economics, less explicitly recognised in geography. The theory of locational or transport behaviour was based on the theory of consumers behaviour or the theory of the firm. The phenomena which were measured, and which were to be modelled, were often, indeed usually for geography, at a coarser scale. How does one aggregate the results of a micro-scale analysis to a meso (Haggett's 1965) useful recognition that the geographer's scale was often between the economist's micro and macro) or a macro scale? The recognition of this problem is, with hindsight of course, an understanding that the systems being modelled are complex - Weaver-II or Weaver-III. We can look to these general ideas to help us to interpret the forms of development through which theoretical geography, as represented by mathematical modelling, passed.

First, consider the systems which may be taken as Weaver-II. These are the major subsystems which represent the behaviour of people: residential location, job choice, use of services, transport flows, the population model itself. Weaver would lead us to expect various forms of statistical averaging procedure to be used to lift us from the micro scale to the meso, and this is indeed how we can interpret much of the work which has been done. Linear programming, entropy maximising, non-linear programming, Markov models, non-linear account-based models have all been used, often as alternative methods for modelling the same system. More recently, it has proved possible to tackle the economic aggregation question more directly using the methods of random utility theory. Probabilistic methods, involving simulation have also been used so that high dimensional arrays can be avoided, and may become more popular. Some of the work has been done in disciplines adjacent to geography, but the results have now been absorbed by geographical model builders.

The large set of complicated and important results referred to briefly above can perhaps best be charted by an introduction to some of the relevant literature. Each reference cited here can be used as the basis for building a much more extensive bibliography.

The modern foundations of location theory, building on the authors cited in section 3.1, are typified by Alonso (1964) and Muth (1969) in relation to urban residential structure and by Isard (1956) for the economic side. Their work is still in a continuous space representation and operational models have been generated by working with discrete space. Herbert and Stevens (1960) showed how to use linear programming to develop Alonso's scheme and Harris (1962) began the long task of estimating some of the utility functions involved. As Weaver might have predicted if he had examined the geographical field in 1958, there have also been extensive applications of entropy maximising methods (Wilson, 1970). This can also be seen as a form of mathematical programming and now fits into a wider framework. Nijkamp (1972) shows how non-linear programming can be applied to economic location. An alternative basis is random utility theory - as presented for example by Williams (1977) building on work by McFadden (1974) and Cochrane (1975) among others. The aggregate forms of these models can be presented in mathematical programming form, based on the idea of maximising locational surplus (Coelho and Williams, 1977). Indeed, the recognition thatmany models can be cast in mathematical programming form has produced some rich results. Evans (1973) showed that the transportation problem of linear programming was a special case of the corresponding entropy maximising formulation and this was extended in relation to dual variables and its range of applications by Wilson and Senior (1974). This work showed that entropy maximising methods, and later random utility methods could be seen as incorporating 'dispersions' to represent imperfection in economic models in contrast to the perfect market assumptions of linear programming models. It is also clear that such models can be embedded within broader planning optimisation frameworks and this further extends their usefulness (Coelho and Wilson, 1976, Coelho, Williams and Wilson, 1978). The whole class of models is usefully reviewed in two articles by Senior (1973, 1974) and in two books (Wilson, 1974; Batty, 1976) among a field of literature which is now becoming prolific.

Most of the models referred to involve large arrays of variables. These can be seen more formally as accounts, and another Weaver-II method is the application of Markov techniques (see, for example, Ginsberg, 1973). It is also possible to build account-based models on a broader foundation, seeking to make the best use of the often-imperfect data which is available (Rees and Wilson, 1977). As models and theories become more detailed, however, the arrays become very large. One escape from this problem is to use simulation methods, following the work of Orcutt et al. (1961). Wilson and Pownall (1976) showed how these methods could be applied in a geographical context and such models are now being actively developed on a larger scale (Clarke, Keys and Williams, 1979).

What of Weaver-III systems, when we face organised complexity? For the overall economic model, input-output and related mathematical programming methods offer a model which is a Weaver-II approximation, and geographers have helped to develop versions of these in which space is explicit (for example, Cripps, Macgill and Wilson, 1974). Otherwise, we have to seek new methods for handling complexity and non-linearities in this type of system. An important and well-defined subsystem with these characteristics is anywhich involves network flows and much progress has been made with models which build on and extend the shortest-path-through-a-network algorithm (see Haggett and Chorley, 1969, for a broad review and Wilson, 1979, for a review in the context of congestion and transportation). Other systems, in which non-linear dynamic behaviour is important, have to be represented directly by differential or difference equations. An important branch of work in this field, contributed from the direction of engineering, was Forrester's (1969) *Urban dynamics*. This has been an important stimulus in geography, but has also been heavily criticised and not taken up directly. Because of their slow rate of change, it is probably more difficult to model structure - the location of buildings and transport infrastructure - than to model the location of economic activity and the newer methods of dynamic modelling show signs of promise here (see Harris and Wilson, 1978, for an application to urban retail structure). Progress is often piecemeal, but recent developments in mathematics are beginning to offer general results under the heading of bifurcation theory (cf. Thom, 1975; Hirsch and Smale, 1974).

Other approaches to the study of process and hence dynamics, have a longer history in geography. Of particular importance is Hagerstrand's (1953, 1968) work on the diffusion of innovations which has developed into a wider concern with time geography (Hagerstrand, 1970, and many of the articles in the three volumes edited by Carlstein, Parkes and Thrift, 1978). In effect, much of this work is dynamical analysis at the micro scale. It offers important insights and concepts - the notion of space-time prisms for example - and many ultimately be integrated with other aspects of dynamical analysis.

The Weaver characterisation of geographical systems helps us to see why, on the whole, more progress has been made with modelling and theory in population and social geography (in the broadest sense) than in economic geography: the systems of disorganised complexity are easier to handle than systems of organised complexity.

3.4 Systems analysis

Another source of, or model for, the new geography is often said to be systems analysis (and two important recent surveys are those of Chapman, 1977 and Bennett and Chorley, 1978). I will argue here that systems analysis has five roles, and in briefly articulating these roles, an implicit definition emerges (and see Wilson, 1977, for a more detailed account).

First, straightforward help is provided in the analysis of complexity. Orderly definition of state variables at particular levels of resolution in particular representations is encouraged. Diagrams can be constructed showingthe main relationships. All this then provides a foundation for developing theory and models.

Secondly, the systems analyst focusses on the interdependence of the elements of the system. This can help in the definition of subsystems (and indeed subdisciplines). This focus on the coupling of elements is then intimately connected to the notion of whole-system behaviour: the behaviour of the whole system is likely to be very different from anything which could be predicted froma knowledge of any of the individual components. This is sometimes called systemic behaviour.

Thirdly, it provides a potential mapping of possible methods of analysis or modelling against system types. At this level, a concern with generality is developing and it builds in an obvious way on the argument of the previous subsection. If general system characteristics can be identified, perhaps as an elaboration of Weaver's scheme, and if analytical methods can also be categorised, then when a new problem turns up, it should be possible to identify the system type and then to state a list of the alternative methods for modelling. This can form the basis of analogy between systems in different disciplines. For example, the work of authors like Rescigno and Richardson (1967) in ecology can now be applied in urban dynamics.

The fourth point seeks an even higher level of generality: the development of general systems theory. At its most ambitious, this involves the building of models of a completely abstract kind to which any real situation can then be fitted. At a less ambitious level, this might involve the building of a number of geographical models, say concerned with location theory, interaction theory, network theory and dynamics which would each have a wide range of applicability.

Fifthly, when effective systems models can be built, they are usually seen as having a potential role in planning or problem solving, and this has always been one of the main motivations of systems analysts. But more of this in the next subsection.

The list, in an obvious sense, represents increasing complexity and ambition. I would argue that the conceptsof systems analysis are useful to geographers from the first stage onwards. So you do not have to believe in the possibility, at this time, in being able to represent systemic behaviour in a city, or in being able to develop general theory, for some aspects of the techniques to be useful. Perhaps the most important role is very general and not at all specific; that is, to remind us continually that systems and subsystems are very rarely isolated from each other and that this should never be forgotten in any theory building exercise.

3.5 Planning, welfare, behaviour, radicalism

It is tempting to distinguish into separate subsections the four further themes identified in the title above; but they are so closely linked that it seems better to deal with them together. Smith (1977 talks about geography's 'second revolution' as being 'radical' or 'concerned with social relevance'. Fromthe early sixties onwards, and earlier in the United States, social science has been seen as relevant to public policy, and geographers have played their part in this, though not as prominent a part as economists. This has had an impact on geographical theory through the demand for 'relevance' and has had a direct influence on what is often argued to be the best scale of analysis for this purpose - the welfare of the individual, and therefore a concern with behaviour. The radical approach is also concerned with individuals and welfare, partly in the sense of contributing new methods of analysis based on Marxian theory and partly with an argument for radical or revolutionary change. What has been the impact of these ideas on the development of geographical theory?

Planning involves the control by the state of various instruments of public policy for some kind of public good to be determined by the political process. So the first impact was to force the theorist, particularly the modeller to distinguish those variables which were potentially controllable. Various settings of these variables, now treated as exogenous to the models, could then be inserted as inputs to the models so that the impact of alternative plans could be assessed. It also forced the contruction of evaluation measures to facilitate this assessment, usually some variant of cost-benefit analysis. Perhaps the best known examples of this kind of work are represented in the transportation studies which have now been carried out in most large British towns and cities. (See Hall, 1975, for a general survey and Wilson, 1974, for a technical one; SELNEC Transportation Study, 1972, offers a specific illustration, and Scott and Roweis, 1977, a critique of the whole approach.)

The measures of welfare in these studies were based on meso-scale spatial interaction models, and were usually further aggregated to a macro-scale before being used. This, and more general arguments, lead to the criticism of these techniques as being insufficiently concerned with individual behaviour (and cf. Hagerstrand, 1970, for a plea from a different quarter). To some extent, these criticisms have been met directly with the development of so-called disaggregate models based on random utility theory with an economic foundation, or, looking in the direction of psychology, on the work of Luce (1959). But there was also criticism of the representation of individual behaviour in such models and one school of thought developed a concern with perception. This is perhaps best known in the work on mental maps (as in Gould and White, 1974) but has also been approached in a more technical way.

The radical critique is more fundamental and is best characterised by Harvey's (1973) *Spatial justice and the city*. King (1979) and Peet (1979) offer recent opinion and reviews. There are many strands to the argument. First, a warning against environmental and spatial determinism in geographical theory. The argument is that the social relations created by particular modes of production are the main determinants of change and development in society, and that spatial processes should be seen as a consequence of this. The driving force is class conflict and struggle. This leads to a concern with the study of processes driving such phenomena as urbanisation which are different from those of traditional models with their neo-classical economic foundations. It can be argued, in this sense, that this new perspective offers a new approach to dynamics through a focus on process which is more fundamental than hitherto. But there is an as yet unsolved aggregation difficulty here for geographical theory. It is also argued that the liberal approach to change through planning with the capitalist systems is always likely to be ineffective (and cf. Sayer's 1976, critique of the use of many standard models in this context) and that ultimately, the only effective *theory* will be that which is the basis of new practice. Some authors, notably Scott (1976), have attempted to combine this style of theorising with the methods of quantitative modelling in geography, but generally, this theory has not reached such a degree of articulation. It should also be emphasised that the type of theoretical work arising from this basis is more likely to be of the style of historical geography rather than leading to the modification of, and the development of new models (cf Thompson, 1978).

4. Reflections and prospects

A concluding section in an essay of this nature has to start with an apology. While I hope that I have been able to present some themes which create some useful perspectives for understanding progress in theoretical geography, I am very conscious at this stage of many omissions. In some ways, I hope that the examples I have used to illustrate the argument cover the main ground, but it is also clear that in the application of theory, I have omitted many important areas of study. I will mention two only and ask in advance for forgiveness in relation to others. First, geography is at the start of what is likely to be a rapidly expanding field in the study of resources. There is a long and distinguished history in relation to water and land and this will expand in the future to include energy. Secondly, there has been much applied work which has also contributed to theory in the study of development, particularly in relation to the third world.

There are also omissions of themes. Gould (1979) in his reflections on the last twenty years notes an increasing concern of geographers with philosophy (for example, Harvey, 1969; Olsson, 1975; and Gale and Olsson, 1979). He also notes advances in cartography, particularly singling out Tobler's work dating from the time of his doctoral dissertation (Tobler, 1961). And finally, he identifies new mathematical advances in the study of complexity which have not been incorporated in any of the themes developed above, particularly the notions of q-analysis developed by Atkin (1977).

It is nonetheless clear from the ground which has been covered that there is now a very rich basis of ideas in theoretical geography. Many of these have been contributed by practitioners in other disciplines, notably economics, but also sociology, history and methodological disciplines such as mathematics. It could be argued that if we believe in the ideas of system analysis, we should believe in a unified social science, or perhaps even more generally, a unified systems science: all things are connected. However, there will continue to be a division of labour and the problems of spatial analysis and the study of processes in space will continue to provide the geographers with some difficult and interesting problems, though there will continue to be contributions, even in these specific fields, from elsewhere. The level of development achieved, and the connections to a variety of other disciplines, will make life rather difficult for the geographer of the future in that he or she will have to acquire skills from a wide variety of sources; and these skills are continually becoming more complex. The demands of the quantitative revolution of the 1960's are nothing compared to what faces the graduate student of today - whether approaching theory from the viewpoint of the mathematical modeller or from that of Marx.

So the prospects are exciting and the tasks difficult. Ideally, it would be good to think that geography could continue to be a synthesising discipline and that a particular theoretical concern would be to put together effective theories for whole-systems of interest to geographers. It has been argued elsewhere that this could lead to a new kind of regional geography (Wilson, Rees and Leigh, 1977) but this is proving to be a very difficult task. There are also broad issues - like the long run theory of urban development - which perhaps needs contributions both from modellers and Marxists, where the bulk of the progress with a very large problem has yet to be made.

The rate of progress in the last twenty five years has been particularly remarkable. There is no sign of the pace slowing down and a corresponding review to this in ten years time should make exciting reading to those of us who are struggling with today's problems.

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