B. QUANTITATIVE METHODS AND FUTURE GEOGRAPHY

A. KELLERMAN

Haifa University

The second topic referred to quantitative methods in geography. I wish to summarize the opinions we have heard today. Prof. Conkling suggested that quantitative methods are an integral part of geography, with a current major emphasis on dynamic models. We then heard Prof. Reichman who suggested that the scientific approach using quantitative methods is insufficient for the solution of geographic questions. We also heard Prof. Karmon's suggestion that ideographic regional studies should be more open to quantitative analysis. I believe that looking at what is happening in geography in the last ten years, we note that geography has become aware of the limitation of quantitative analysis in general, and of quantitative analysis in human geography in particular. It is fascinating to see a discipline just "quantified" becoming aware of its limitations in the use of these powerful methods. I think that it has a lot to do with the fact that we have become aware of many problems that other social scientists have had to deal with. Prof. Reichman suggested that we should be aware of becoming a social science. Perhaps we should pick up at this point.

D. GROSSMAN

Bar-Ilan University

I cannot see why we should limit the social sciences to such a narrow level. Practically all the fields in the social sciences more or less deal with the same problems that we deal with in geography. Economics may be doing more quantitative work but I know from talking to anthropologists that they use more qualitative than quantitative approaches because they are fed up with that. I am sure that sociologists are faced up with the same problems we are.

E. STERN

Ben-Gurion University of the Negev

There are various examples and criticisms for the misuse of quantitative techniques by geographers. However, it is absurd to use such arguments against their continued use.

As maps have become basic and essential tools in geographic research, quantitative methods have likewise become so. Perhaps some have become discouraged by the quantitative approach, but those who are developing and using quantitative methods have long recognized that we should look upon these methods as a tool, and not as a problem.

M. SONIS

Ben-Gurion University of the Negev

The quantitative revolution in geography is over. We must remember, however, that this revolution is the second quantitative revolution in geography. The first one began with the intervention of mathematical methods into physical geography. Its sources are connected with the name of Anaximandres (VI century B.C.), to whom tradition has given credit for the composition of the first geographic map, with the name of Isaac Newton, who published in 1672 (with his own addition) the Bernhardi Verenii "Geographia Generalis"..., and with the name of Alexander von Humbolt, who introduced exact methods into Geology and Geomorphology.

The sources of the modern quantitative revolution are quite different: set theory, information theory, mathematical logic, modern statistical methods, optimal programming, combinatorical and set-theory, topology, etc... The modern quantitative revolution began to be felt at various places. Among them were: Iowa under McCarthy (1953), Seattle under Garrison (1958), Evanston under Taaffe (1958), Helsinki under Ajo (1953), Lund under Hägerstrand (1953) and Moscow under Gurevich (1962).

The bottleneck of this revolution was the use of empirical models and formal mathematical structures which were not connected

with the essence of geographical ideas. This is the reason for the present relative decrease of the influence of mathematical methods in geography. The quantitative revolution is over, but what kind of future can we predict for the quantitative methods?

It is possible to expect future developments in the direction of extension of the notion of geographical structure on the axiomatic basis. The notion of geographical structure includes "the spatial distribution, combination and interaction of dynamic natural and social complexes" (Gurevich & Sauskin). Geographical structures may apparently be best expressed by means of symbolic (logico-mathematical) expressions (formulae) containing spatial (areal) parameters. The problem of developing the notion of geographical structure is difficult. Its implementation is hindered by the simple fact that, "at present there are no mathematical methods adequate to structural representation of geographic systems" (F.K. Schaefer).

Language, and the way contemporary mathematicians think, have developed in accordance with demands of physics and technology, and are not adequate to the basic problems of geography. Moreover, the difficulty in developing the notion of geographic structure lies in the fact that the explanation of environment cannot be unique. This non-uniqueness shows expression in the form of the duality principles.

There is a duality between the quantitative and qualitative description of geographical phenomena, between the "physicalistic" and "mentalistic" viewpoints, between micro (atomic) and macro (holistic) approaches, between objectivity and subjectivity.

The main problem of geography, as distinct from economics, is the problem of analysis, but not the problem of optimization. The most interesting and important fact is the non-uniqueness of the results of analysis. This non-uniqueness ensues from the fundamental statement that analysis depends on the investigator's point of view. The geographic point of view includes (in accordance with the duality principles) the entire spectrum of objective functions, and spatial behavior of a geographic system can be only sub-optimal. The existence of other and different objective functions is the reflection of the principle of intervening opportunities (in the wide sense of the word).

In spite of this, on the whole, the geographic structure is not optimizable, nevertheless, its inner parts can correspond to some principles of one-sided optimization. The problem therefore of the calculus of geographical structures arises. This problem is followed by the problem of decomposition of the geographic structure on the substructures, corresponding to the optimization of different objective functions.

In conclusion, we once again point out that in our opinion the future of quantitative methods lies in the construction of axiomatically defined geographical structures, in the solution of the problem of their analysis, in the transferring of the optimization problems from geographical wholeness to its substructures, and in the development of the calculus of geographical structures.