QUANTITATIVE REVOLUTION IN GEOGRAPHY

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e-text

QUANTITATIVE REVOLUTION IN GEOGRAPHY

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1. Introduction

In the 1950s and 1960s, a revolutionary change described as "*quantitative revolution*" occurred in the discipline of geography. It replaced the 'idiographic' approach based on areal differentiation by 'nomothetic' one, which had its roots in the search for models of spatial structure and phenomenon. The *quantitative revolution* led the basis of geography as a spatial science that dealt with the spatial analysis of phenomena that existed on the earth surface. In simpler words, it gave geography a scientific vision through the application of methodology rooted in statistical methods. Some of the elements of positivism, which had previously been not accepted at some point in time, were now accepted open-handedly. In the words of Burton (1963) this school had set out to discover universals, to build models and to establish methods and theoretical bases on which geographical realities could be erected.

Traditionally, geography was a discipline that studied and described the surface of the Earth, but in due course of time, its definition and nature have changed. It was now related to providing accurate, systematic, rational descriptions and explanations of the variations in the geographical phenomenon that occurred over the Earth's surface. The most obvious change has occurred due to the *quantitative revolution* that brought changes in the methods and techniques used to explain the geographical phenomenon in a spatial framework.

The movement that led to the occurrence of quantitative revolution in geography was initiated by natural scientists specifically physicists and mathematicians. It expanded and led to change physical sciences followed by biological sciences. By the late 1960s, it became a feature of most of the social sciences. These include economics, psychology, and sociology; though had faint impressions in the disciplines of anthropology or political science, has not occurred in history.

The main objectives of this paradigm in geography were first, to change the narrative character of the subject (geo + graphics) and make it a scientific discipline. The second objective was to explain and interpret the spatial patterns of geographic phenomena in a logical and objective pattern way. The third objective deals with the use of mathematical and statistical

techniques; fourthly, to make accurate statements (generalization) about location order; fifthly, to prepare estimates, principles and laws for testing estimates and estimates and forecasts and lastly to provide a sound philosophical and theoretical base to geography, and to make it a scientific discipline.

These objectives lead a number of dichotomies within the discipline apart from the quality dichotomy. Now, these included measurement by instruments versus direct sense-data; rational analysis versus intuitive perception; cold scientific constructs developed in the laboratories versus rich daily sensed – experience from the real world itself; constantly changing phenomena versus discrete cases; nomothetic versus idiographic, to mention a few. If one tries to seek answers to these dichotomies he gets trapped within them and is unable to understand the movement towards quantification in geography. Thus, to avoid this we shall concentrate on how this movement became part of the discipline and slowly engulfed it in such a manner that it led to the spread and growth of scientific method in geography.

2. Quantitative Revolution in Geography

Traditionally, Geography has been a "following" discipline; the main streams of ideas had their roots in other disciplines. The doctrine of environmental determinism was represented in the writings of Semple, Huntington, G. Taylor, and Ratzel (if he can be considered a determinist). They were busy with the idea of a causal relationship and were regularly demanding and looking for "laws". A similar mechanical flavor existed in the works by "Quantifiers". It seems as if geography is re-emerging after it got soaked in ideographic approach, which created a distance between geography and environmental determinism. It seems in some way or other; the quantitative revolution took geography closer to environmental determinism especially as this revolution occurred simultaneously with the upsurge of neo – determinism. The Quantitative Revolution, but natural, was strongly opposed and the dominance of environmental determinism delayed the process of establishment of the scientific basis that the quantifiers wanted to provide. It was vehemently opposed in the United States as determinism had its strongest base there. Still, new techniques were been used and others were being developed as part of the prevailing probabilistic trend in contemporary science. In the words of Bronowski (1959) in simpler terms, statistics replace the notion of inevitable effect by probable trends. As the revolution progressed

the use and purpose of use of statistical techniques that are quantification became more and more indeterministic.

In geography, the revolution began in the late 1940's and culminated in the period from 1957 to 1960; finally, over in 1963, the year Burton wrote his paper. In between these years, it did gain momentum especially after Ackerman and Schaefer favoured in making geography more theoretical and systematic in nature. Ackerman commented, "although the simplified forms of statistical assistance have been part of geographic distribution analysis in the past; discipline is beginning to move towards more complex statistical methods-a completely logical development'. Burton further commented that both Hartshorne and Spate also agreed on the usage of these techniques in geographical thinking.

The reference of Hartshorne (1959) is being made to his statement, which says, "To raise ... thinking above the scientific knowledge level, it is important to establish generic concepts, which can be implemented with maximum objectivity and accuracy through quantitative measurements which can be subjected to comparisons through the mathematical logic".

Spate (1960) in his paper on "Quantity and Quality in Geography''; published in the Annals of the American Geographers seems somewhat skeptical about quantification in geography. The report of a National Academy of Sciences – National Research Council Committee on 'The Science of Geography' (1965) also discussed the influence of quantitative revolution in geography. They stated that geographers believe that correlation of spatial distributions, considered both statistically and dynamically, maybe the keys to understanding the development of living systems, social structures and environmental changes that occur over the earth surface. In the past progress was slow and gradual as the number of geographers was less while the problems were numerous. Moreover, the methods of analyzing these multi-variate problems were rigorous. It was only recently that systematic concepts and approaches have been adopted to analyze these multifaceted problems.

3. The Path of the Quantitative Revolution in the Discipline of Geography

The roots of the revolution were in the following publications, which had their significant influence on the incidence and growth of quantification in geography. These are – Neuman and Morgenstern's *Theory of Games and Economic Behavior* (1944); Weiner's volume on *Cybernetics* (1948); *Human Behaviour and the Principle of Least Effort* by Zipf (1949) and

Stewart's paper entitled *Empirical Mathematical rules Concerning Distribution and Equilibrium of population'* (1947). Stewart's paper needs special mention as he put forward a new way to raise the old geographic questions.

The effect of quantification began to be felt immediately in geography. Rather its rise has been startling in its suddenness. Quantification did increase in geography and one should accept it as it had a valuable role to play. For example, in 1936, John Ker Rose argued in his paper on corn cultivation and climatic conditions that "the methods of relational analysis would be particularly promising tools for geographical investigation." This call was largely ignored. Strahler initiated an excellent petition when he attacked Davis's explanatory and descriptive explanation of geomorphology and supported G. K. Gilbert's dynamic-quantitative systems.

a) Quantitative Revolution in the branches of Geomorphology and Climatology

Strahler claimed that Gilbert's paper was more apter than Davis's work; then what was the reason that it was not accepted as a sign post in geomorphology for future work; rather it has been forgotten and neglected for nearly thirty years. The answer is with Strahler himself who opines that thinks that geomorphology was a part of geography. The physical geographers did not adopt these ideas rather they followed Davis. Some of the prominent followers of Davis include *Douglas Johnson, C A. Cotton, N. M Fenneman,* and *A.K. Lobeck*. Strahler finally states these geographers made "excellent contribution to descriptive and regional geomorphology" and has provided a solid foundation for study in "human geography", but did not lay the basis for scientific study within the geographical thinking. This does not mean that prior to Strahler; geographers were not using quantitative techniques in geomorphology. Quam and Woolridge vehemently criticized his views. Quam (1950) states that mathematical formulae and statistical analysis in geomorphology may result in showing an unrealistic picture of reality that might not be accurate and objective. Similarly, Woolridge (1959) critics Strahler's views and states that although there is the prevalence of a 'new' quasi-mathematical geomorphology; it is inadvisable to use mathematics at a higher level as these are not apt in explaining the geomorphologic phenomenon. He further states that whatever the case may be they will continue to regard W. M. Davis as their founder and would criticize all those who do not agree with the methodology of Davis's interpretations of a different phenomenon occurring over the earth surface.

It is not that geomorphologists did not adopt quantification; Strahler did find his support in L. King (1962) who writes that statistical methods are useful for bulk studies and can be well appreciated if used to study complex phenomenon and processes that constitute a large number of variables or indicators. Although few studies in the branch of geomorphology can apply them, they should be used with great precision so that results are not superficial in nature. Many geomorphologists in addition to Strahler like Chorley, Dury, Mackay and Wolfman, used quantitative methods and it seemed that the practice would spread.

In the case of climatology, there is little dispute about the use of quantification. This branch of geography whole-heartedly embraced these new statistical techniques to interpret various climatic phenomena. Examples can be cited from the works of Thornthwaite, Mather and Green, Bryson who have successfully implemented quantitative techniques to seek answers for climate problems; thus silencing their critics.

b) Quantitative Revolution in the branches of Human and Economic Geography

So far, the biggest struggle for approval of quantification has been in human and economic geography. It is not surprising that in view of the possibilist tradition; it is here that the revolution runs against the ideas of independence and the uncertainty of human behavior. Here comparisons with physical sciences are useful. Physicists who work at a microscopic level, with quanta and energy, face similar problems that social scientists face with people. Such parallels when recognized are a reason for happiness and not for disappointment. In order to make a reputable place in human society, social science must get direct results in the form of a prediction science that does not need any kind of control, restriction or regiment the person. A social science that distinguishes random behaviour at the micro-level and is even able to foresee results at this level is nothing but the consequence of quantitative revolution.

Several works can be cited which used statistical techniques in a positive manner. Most interestingly large number of debates took place between scholars that appeared in the literature (Burton, 1963). Some of these are worth mentioning – Garrison's and Nelson debate on Service classification of cities; Reynolds – Garrison's deliberation on the modest use of quantification in geography. The Spate – Berry argument in *Economic Geography* that ends on the agreement that statistics are half of a filled glass, the other half is understanding and interpretations. The list is endless but some of the other debates that need to be mentioned include the contest between

Zobler and Mackay on the use of chi-square in regional geography and the dispute of Lukermann and Berry on 'geographic' economic geography.

The deliberations were done through professional magazines, which got them the much-needed attention. The result was the establishment of the Regional Science Association in 1956 that promoted quantification in geography. Moreover, it made quantifiers an essential part of the geographical thinking and giving them appreciation and approving their work part of the geographical academia.

Although most of the literature cites that, the revolution is over, it has remained active in several sub-branches of geography particularly transport, economic, and urban geography. This is evident from the fact that writings with quantitative methods have been regularly published in acclaimed journals in geography, including *Annals of the Association of American Geographers, Geographical Analysis, Environment, and Planning A, The Professional Geographer, Journal of Geographical Systems, Urban Geography,* and many others (Kwan and Schwanen, 2009). Although quantitative geography is generally "perceived as a relatively static research area," it is actually "a vibrant, intellectually exciting, area in which many new developments are taking place" {Fotheringham, Brunsdon, and Charlton (2000); Clark (2008); Golledge (2008)}.

Interestingly, quantification in geography has changed its course in due course of time. It now an ally of critical geographies - for example, the emphasis has shifted from global generalizations to local levels dealing with local relationships in a spatial framework. It has also become sensitive to variables like gender, race, ethnicity, sexuality, and age; and even pays attention to processes which shape individual's spatial behaviour (Kwan and Weber 2003; Poon 2003; Fotheringham 2006).

Quantitative research is still dominant in the fields of transport, economic, and urban geography in the writings of McLafferty and Preston (1997), Rigby and Essletzbichler (1997), Plummer and Taylor (2001), Schwanen, Kwan, and Ren (2008) and Bergmann, Sheppard, and Plummer (2009). In this regard, Kwan and Schwanen (2009) are of opinion that knowledge in statistical methods is essential for decoding and challenging regressive political agendas; often supported by numbers and quantitative analysis. Quantitative geography, when incorporated with a critical sensibility and used suitably, can be a powerful device for encouraging progressive social and political change.

4. The Criticism of Quantification in Geography

The quantitative revolution was initially propounded to make the discipline of geography a scientific discipline where the validity of the knowledge that was generated was justified according to the principles of positivism. Although many geographers like Plummer and Sheppard (2001); Kwan (2004); Fotheringham (2006) have argued that quantitative geography does not necessarily have to be based on the epistemological premises of positivism. Whatever the case may be it is to be understood that when positivist epistemology was adopted, the purpose of the geographic research was to seek universally applicable generalizations. The criticisms became more prominent as critical geographers started questioning the relevance and value of spatial science in the early 1970s. Now quantitative geography was labeled as positivist and empiricist because it was based on the principles of scientific objectivity, value neutrality, and the search for universally applicable generalizations. One of the groups that criticized quantification was the group of feminist geographers that was critical of the tendency to draw conclusions based on the principle of universal causality from inferential statistics (Kwan and Schwanen, 2009). Quantification was also criticized for other reasons. For instance, there were those who thought that this method would mislead geography towards a futile course. Some like Stamp argued that quantifiers were too busy in sharpening their instruments that they forgot the real purpose of the revolution. Few opponents also commented on the suitability of statistical techniques for all kinds of geography. They opine that these techniques were appropriate for some branches and not the entire geographic paraphernalia. Another group condemned this revolution on a note that there was a confusion of ends and means. In the words of Spate (1960), 'it is important to count what can be counted'. Another dichotomy lies in classifying and understanding; classification should never be mistaken for comprehension. Goodall's (1952) point is worth pondering where he states that quantitative methods or statistical techniques are only adjunct to elucidations or descriptions; they can neither provide explanations nor replace them. Therefore, these methods should be observed only as useful tools and not keys to universal knowledge (Spate, 1960).

These criticisms clearly point out that the quantitative methods have some severe limitations, especially when applied to the study of certain kinds of phenomena—for example when the purpose is to uncover the complex gendered, racialized or sexualized experiences of individuals or the socio-spatial construction of identities. However, this does not imply that

quantification is not in a position to make valuable contributions in the field of geography. The difference lies in the time period if we talk of the 1950s or 1960s maybe this was not possible but in contemporary geographic research, it is possible to reconnect the critical geographies with quantification. Another point of deliberation is that within the discipline of geography several subfields, like transport geography, are historically more quantitative in nature than others; this happened because of the influence of allied fields such as civil engineering and neoclassical economics (Kwan and Schwanen, 2009).

It can be said that the revolution had an early demise; it means that the purpose of the revolution was achieved or not. If seen from the point of view of Burton (1960) its basic purpose was to make geography more scientific and to develop a body of theory. Discontent with the idiographic approach in geography is the root of quantitative revolution; the development of theoretical and model-building geography with a nomothetic approach was the expected result. The basic rationale was to develop scientific method; to develop the theory and to test the theory with the prediction for which the logic of mathematics is the best tool available.

5. Conclusions

The use of statistical or quantitative techniques is one of the most suitable methods for the development of theory in geography. The revolution can never be over until it is able to seek answers and aid the theoretical development of the discipline. Moreover, theory development and its testing are the only ways of creating new knowledge and subsequently verifying it. Models have just formalized ways of descriptions that an author has visualized and represented through his arguments and justifications. In geography, quantification brought this revolution where the ideographic base was replaced by theory building in a nomothetic approach.

Geographers started developing theories and created '*new*' geography that focused on the philosophy as well as methods. These scholars were of the view that mere description, mere quantification, and mere abstraction were valid to a certain extent; but repeated use of these methods makes one an obscurantist. *Theoretical geography* got its philosophical base in Bunge's monograph published in 1962, which identified geometry as the mathematics of space and hence made spatial science the language of new geography. Harvey's *Explanation in Geography* (1969) provided a more inclusive channel for the methods and philosophy of new geography. Apart from these scholars, the Department of Geography at Lund University, Sweden became a

centre for quantitative and theoretical geography under the leadership of Hagerstrand and Morill. Hagerstrand although based in Seattle provided an academic support to the geographers working in this field at the Lund University. To conclude, whichever method one, the purpose of geography is to seek answers to questions pertaining to problems of quantity and value. Most of our experiences are qualitative in nature and when everything is, reduce to numbers; some essential attributes are lost (Huxley, 1951). Thus one needs to maintain balance as still new worlds are to be conquered and new contributions to be made.

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