MEDICAL GEOGRAPHY AND ITS CONTRIBUTION TO THE AETIOLOGY OF RARE SYSTEMIC CONNECTIVE TISSUE DISEASES

A Thesis Presented in Partial Fulfilment of the Requirements for the Degree of Master of Arts in Geography at Massey University

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ABSTRACT

This thesis is in two interrelated parts. Part One traced the historical development of medical geography since the idea of applying a geographical perspective to medical problems was first mooted in 4 B.C. The main trends in the evolving philosophy and methodology of this field were noted, and a distinction was made between the Western and Soviet interpretations of the nature and scope of medical geography. The methods available to medical geographers for cartographically portraying medical data were discussed.

Part Two represented the application of geographical principles to the study of rare systemic connective tissue diseases. The inherent problems of collection. and of verification of the medical data used in this study were detailed. Using cartographic and statistical techniques the diseases under study were spatially and temporally defined. It was found that scleroderma had a statistically significantly high incidence in the Taieri Geographic County, and it was this disease and this area which were the principal contributory factors to the statistically significantly high incidence of all connective tissue diseases at the larger scales of areal units in the Otago region.

The structures of the populations affected by these diseases were also studied, with the findings generally confirming the results obtained in overseas surveys. No association was found between the incidence of systemic lupus erythematosus, and high

sunshine hours, while the disease subsets did not exhibit a rural or urban bias in their incidence. Paucity of cases precluded a study of the possible racial predilection of the diseases or any association of incidence with a patient's occupation.

Suggested avenues for possible aetiological research accruing from this analysis were detailed.

PREFACE

Despite the long ancestry of medical geography, the field has only recently shown signs of emerging as a distinct speciality (Armstrong, 1965a). The application of geographic techniques to medical problems is frequently viewed with suspicion and scepticism not only by those in medicine, but also by many fellow geographers. This thesis attempts to demonstrate the utility of such an approach to medical research.

Although in two parts, this work should be regarded as a sequential statement on an integrated project. Part One 'The Field of Medical Geography' introduces the concepts of 'health' and 'disease', while also discussing the 'position' of medical geography on the borderline between the two parent disciplines, medicine and geography. The historical development of medical geography is examined in Chapter Two, with a differentiation being made between the respective Western and Soviet interpretations of the nature and scope of the field. While cartography has evolved to become an integral part of contemporary medical geographic research, this situation has not always prevailed. Chapter Three considers the development of medical cartography, and concludes with a discussion and evaluation of the methods available to a medical geographer for portraying health and ill-health data.

Part Two applies a medical geographic methodology to the study of rare connective tissue diseases within the New Zealand environment. The aim of this survey was to provide a perspective

on the natural history of the diseases under study, to suggest clues for further investigative research, to test whether the findings of overseas studies are confirmed by New Zealand data, and to provide an illustrative case study in medical geography. As the quality and quantity of the data available determines the extent of a medical geographic study, and the sophistication of the techniques that can be utilised, the data base is extensively discussed in Chapter Two. Cartographic and statistical techniques were employed to test a number of formulated hypotheses aimed at spatially and temporally defining the diseases. Comparison is also made with overseas studies as to the structure of the populations found to be affected by these diseases.

As medical geography is a tool for research and rarely an end in itself (McGlashan, 1972b), this study must be regarded as only a foundation stage of research into the aetiology of connective tissue diseases. Therefore, the conclusions that accrue from this study are offered as tentative hypotheses for subsequent testing.

This thesis provides evidence of the important contribution that geographers have made to medical research. Due to the multiple aetiology of most diseases, prevention or control can only be achieved through inter-disciplinary co-operation. Medical geographers, with their macroscopic perspective of the environment, and their specific geographical competences, should be considered as integral members of future medical research teams.

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PART ONE

The Field of Medical Geography

CHAPTER ONE

HEALTH AND DISEASE

The preamble to the World Health Organisation defines health as

> "a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity."(1)

To Le Riche and Milner (1971, 81) this statement is

> "euphonious, well-meaning and full of splendid idealism, but...it has very little tangible meaning. Perhaps it had better be regarded as a desirable ideal, rather than a definition of a particular condition in mankind."

Health is merely a concept and its standards will vary in different parts of the globe depending upon the availability of medical facilities, the acquisition of knowledge, and the dynamic impact of change in man's enviornment. Its real measure is the ability of the individual to function in a manner acceptable to himself and in harmony with factors likely to create stress upon his body (Le Riche and Milner, 1971). Health, as May (1958, 1961) suggests, is a complete adjustment of the organs of the body to each other and to environmental conditions. Here environment refers to those forces which act upon the living tissues, namely, both the natural (physical and biological) and socio-cultural realms of man.

Conversely, when there is a disruption of this equilibrium disease will manifest itself. Thus disease is

> "a maladjustment of the living cells to their environment" (May, 1958, 29).

Disease causation is rarely the consequence of a single, active, harmful factor but rather of a multiple aetiology. Of the numerous factors that may influence the occurrence of disease, however, two principal groups can be distinguished: endogenous factors or those which are inside the organism (e.g. the inherited constitution of the organism), and exogenous factors or those which are outside the body.[2] Therefore, if disease is viewed as the result of disruption of a state of balance between organism and environment, it may arise, according to Shoshin (1968, 9), in any of the following situations:

> "firstly, when significant endogenous changes take place within the human organism which cannot be compensated by external factors; secondly, when sharp changes of external factors take place and the defensive resources of the organism are unable to ensure the requisite balance; thirdly, when there occur changes of both endogenous and exogenous environmental factors."

In each of these situations there are three basic components which can act in various combinations:

a) the human organism with its accompanying endogenous factors;

b) the reactivity and immunity of that organism; and

c) the exogenous environmental factors.

Disease, or groups of diseases, result from the interaction of these three factors. Endogenous and exogenous factors therefore, will not only determine the patterns of occurrence of disease, or groups of diseases, but also their severity and spacio-temporal extent. Thus it may be better to think, as Banta and Fonaroff (1969, 88) suggest, of

"...degrees of health rather than of disease per se"

in which there is a continuum ranging from extreme maladjustment or death through slight illness to perfect adjustment (which would only rarely be attained in most human lives). Among populations, the degree of maladjustment is reflected crudely in morbidity and mortality indices which vary in rate through time and space.

The Role of Geography in Medical Research

By identifying the factor or group of factors, which, in combination, cause overt disease (or disrupt the balance of the organism with its environment) the first step is taken toward an understanding of the causation of disease. It then becomes possible, in the second step, to remove either that factor or one of those in a combination, and thus hopefully break the causative chain (Muir Grieve and Maytham, 1963). Geography can make an important contribution to the field of medical science, particularly in the first step, the identification of the disease causing factor or factors.

Medical geography may be defined as the study of the spatial variations and temporal changes of health and ill-health and

identifying causal relationships with the geographical environment. As a peripheral area of research, between the fields of geography and medicine, medical geography overlaps research areas of those disciplines within medical science which similarly investigate disease-environment relationships. Each field does, however, have a different emphasis.

Geographical pathology,[3] as defined by Doll (1959, 11),

> "is the comparative study of the incidence of disease and the distribution of physiological traits in peoples belonging to different communities throughout the world and the correlation of these data with features of the social and geographical environments."

Avtsyn and Javoronkov (1968) claim that the principal distinguishing feature between medical geography and geographical pathology is that the former studies the total geographical environment whereas the latter investigates the reaction of the organism to that environment.

Epidemiology[4] is a similar search for disease aetiology but with emphasis upon the kinds, and structure of the affected populations. Schwabe (1969, 160) succinctly states

> "epidemiology is the study of diseases in <u>populations</u> of organisms - often with the object of their prevention or control."

Morris (1967, 275) believes that the utility of this research field derives

> "...from the principle that in epidemiology whole 'populations' (or their samples) are studied and compared, and not particular individuals or patients."

Audy (1958, 102) questions the suitability of the term 'medical geography' as a name for the study of the distribution of diseases

over the world and their behaviour in any one community. According to him

> "clear thinking may be hindered by emphasis on geography, which is associated in our minds with large scales and exotic places..."

He, therefore, proposes the use of the term 'medical ecology' to describe

> "...the study of populations of man with special reference to environment and to populations of all other organisms as they affect his health and his numbers."

May (1952, 1967b) similarly has urged replacement of the term 'medical geography', with the 'ecology of health and disease'. This latter term he suggests (1952, 2)

> "...stresses the fact that this is primarily a study of environmental factors, and that the study of the environment of health cannot be separated from the study of the environment of disease, and that physiology cannot be separated from pathology if the latter is to be understood."

Learmonth (1970, 7) by defining medical ecology as

> "the study of the web of relationships of a disease or disease complex in its physical and social environment on ecological sites",

finds the two fields of medical geography and medical ecology complementary though distinguishable. Medical geography in this terminology becomes an extension of medical ecology dealing with larger communities at the macro-geographic scale (Audy, 1958).

In light of the foregoing comments it is apparent, in Banta and Fonaroff's words (1969, 91), that

> "disciplinary boundaries, for what they are worth, are hazy here, and hopefully will remain so."

Due to the multiple aetiology of most diseases, achieving

> "the alleviation of human suffering and the eventual elimination of disease" (Muir Grieve and Maytham, 1963, 38),

will involve inter-disciplinary co-operation. McGlashan (1972b, 14) observes that

> "collaborative effort as co-members of an inter-disciplinary team is likely to yield best results and even the disciplines represented will vary with the individual problem which requires solution."

Whereas Schwabe (1969, 64) simply states that

> "inter-disciplinary co-operation - the team approach - is the keystone of public health practice."

The initiation of any new evidence that may contribute to breaking the disease causative chain and/or prophylactic measures being formulated should be sufficient justification for conducting research whether in medical geography, geographical pathology, epidemiology, or medical ecology. Possibly the only way in which researchers in these fields can be distinguished from each other is by the discipline in which they have received their training. With a medical geographer his trained competence lies in geography and he is first of all a geographer (Learmonth, 1970, 8), whereas a geographical pathologist, according to Avtsyn and Javoronkov, (1968, 278) is first of all a doctor and a pathologist with a wide scope of interests.

The role of the medical geographer is to make the skills and techniques of geography available to medical science, but in no way to usurp the functions of workers in that field. McGlashan (1966a, 1969c, 1972b, 1973) has detailed four tasks which enable the geographer,

through his training and experience, to make a valuable contribution to medicine:

a) to prepare and collate disease data and to map them to show their spacio-temporal distributions;

b) to apply objective statistical tests to these distributions to assess whether or not the pattern is likely to have occurred by chance;

c) to measure the degree of co-extensiveness between disease and other spatially and temporally varying factors. Generally the geographer will utilise medical hypotheses concerning disease aetiology as starting points for this further investigative stage; and

d) to test whether the spatial or temporal associations that may have been shown could be causative.

Doll (1959, 1967), Hill (1965), and Hopps and Cuffey (1969) have drawn attention to the difficulties of establishing disease causality. In medical geography this problem assumes a greater complexity due to geography's inevitable generalisations about space and the interrelatedness of variables within that space. Therefore, as McGlashan (1973, 220) has noted, hypothetical relationships formulated in medical geography must also be generalisations. Despite analysing many factors the one critical factor may not be considered in a medical geographic analysis because of data insufficiency or the inherent constraints of the study. For these reasons medical geographic studies may produce inconclusive answers. Nonetheless, the establishment of one new hypothesis or a positive or negative finding for a

current hypothesis for disease aetiology will be of value to medical science.

Medical geography is a 'tool for research' (Stamp, 1964a, 1964b) and rarely an end in itself. The consequence of medical geographic studies should be the provision of pointers for further research in other specialists fields, e.g. geobotany, geology and the medical sciences. As McGlashan (1972b, 14) states regarding hypotheses postulated in medical geographic studies

> "the confirmation needed for such hypotheses will lie with a discipline which, rather than the group, studies each individual case."

With the continuing assimilation of quantitative analysis into geography, the increasing availability of the basic data (and refinement into a form applicable for utilisation in medical geographic studies), and the improvement in facilities for storing and processing that data, this tool is likely to become even more useful.