I N F L U E N C E S   O N   T H E   L I F E - S P A N   O F   U R B A N   B U I L D I N G S :

An examination of some locational,
economic and social factors affecting
the existing stock.

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ABSTRACT OF THESIS

This thesis undertakes an examination of the factors which influence the life-span of the existing stock of urban buildings. It is divided into three major parts: a theoretical examination of the principal factors, a further investigation of some of the most critical principal factors, and an empirical survey of the relationship between the critical factors and some of the existing stock in Edinburgh.

In Part One, a brief introduction to existing research in this field is first described and a distinction drawn between prolonging the usefulness of the existing stock and intensifying its utilisation is made. The principal factors are then described and categorised and the effects of change of the factors is examined.

Part Two examines more closely the social and economic factors which influence the life-span of the existing stock, as well as examining the rôle of the building industry in adapting the stock to meet changing demands.

The Third Part of the thesis consists of two related empirical investigations into the changing relationship between the critical factors and some of the existing stock in Edinburgh, as well as examining the validity of a number of theories about urban growth and change in the light of empirical data.

Finally, the thesis develops a few major lines for further investigation, not only of interest to this particular undertaking, but also to peripheral ventures as well.

I declare that this thesis has been composed by myself based upon my own research.

20 OCT: 1975

A C K N O W L E D G E M E N T S

At the beginning of this thesis, I would like to express my gratitude to everyone who has helped me in this undertaking; without whom this volume would never have been produced. However, all errors must, of course, remain my full responsibility. In particular, I would like to thank Prof. G.B. Oddie of the Department of Architecture, who persevered through three years as my principal supervisor, and D. Wright of the Department of Economics, who manfully joined in discussions between two architects and brought economic coherence to this work.

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T A B L E   O F   C O N T E N T S

Page No.

Page No.

Page No.

PART THREE

CHAPTER SEVEN - A CROSS SECTION OF AN URBAN ENVIRONMENT: A SURVEY OF CHANGE

CHAPTER EIGHT - AN AREA OF AN URBAN ENVIRONMENT: A SURVEY OF CHANGE

PART FOUR

CHAPTER NINE - IMPLICATIONS OF THE RESEARCH

Page No.

APPENDICES

LIST OF TABLES

Page No.

TABLE

Page No.

TABLE

LIST OF FIGURES

Page No.

FIGURE

Page No.

FIGURE

Page No.

FIGURE

Page No.

FIGURE

PART ONE

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTORY SUMMARY

1.01 It is probably a truism to say that a great deal of post-graduate research is undertaken in an attempt to clarify ideas or answer questions generated during previous academic study. If it were possible to distil the numerous reasons for this present undertaking, it would be to answer the question: What factors influence the life-span of the existing stock of urban buildings? In order to answer this question, as well as the numerous subsequent questions generated by it, definitions of important concepts must be undertaken. For example: What constitutes the 'existing stock'? What is meant by 'life-span'? What are the factors which influence the life-span of the stock, and how do they influence the 'usefulness' or 'uselessness' of the stock? Further, what is the difference between prolonging the usefulness of an item of stock and intensifying its usefulness? Finally, what previous research, both theoretical and empirical, is presently available which lends support and/or direction to this present undertaking?

1.2 REASONS FOR RESEARCH

1.02 In a great number of post-graduate theses, the initial interest in undertaking research begins with a number of rather unconnected ideas, questions and 'feelings'. This thesis is no exception. During the last two or three years of my academic training as an architect, questions arose concerning the utilisation of the existing stock[1] of buildings, which were compounded through discussions with other architects, clients and friends. The basic issue perceived then, may be

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1. For discussion of the term 'existing stock' see Section 1.3.

stated thus: why do people dislike new buildings and, by contrast, seem to like the older stock of buildings? Rather than investigate this question per se (even though it is a valid area of inquiry), I decided to investigate some of its underlying implications. For example, it can probably be accepted as a truism that people, in general, dislike modern architecture and like the older stock of buildings. This leads to the question: Why is the stock which people like replaced by stock which they dislike? That is, what are the factors which influence the life-span of the existing stock and what forces do these factors exert on the stock[2]?

1.03 It became obvious rather early that some items of the stock were affected more strongly by the factors than others. That is, some items of stock have an almost unlimited life-span mainly due to the fact that they are protected by law from some of the factors by other factors[3]. These may be called the 'precious' items of stock: the Tower of London, Edinburgh Castle, Moray Place and Royal Circus. The bulk of the existing stock, the 'non-precious' items of stock, are not so protected. These are the ones of interest in this thesis.

1.04 In order to undertake this inquiry, a set of more concrete questions were formulated. These served to limit the scope of the inquiry as well as give it direction. Among these questions were: What are the factors and their forces? How can they be described and catalogued in a useful manner? What is the relationship, not only between the factors and the life-span of the stock, but between the factors themselves?

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2. For discussion of the terms 'factors' and 'forces' see Chap. 2.
3. See Chap. 2.

How are these relationships affected by the passage of time? Are some of the factors more important than others and, if so, how is the relative importance of the factors affected by time? What empirical and theoretical evidence exists that may be used to analyse the relationship between the factors and the existing stock? How should the evidence be structured and does it yield any patterns?

1.05 In an attempt to answer these questions, to determine the factors and their relationship to the existing stock, this thesis will first examine the factors and their forces in a theoretical manner. It will also examine the effect of the passage of time on these factors in both a theoretical and an empirical manner. An examination, with the use of sociological, psychological and economic evidence, will be undertaken to study the impact of change of the factors and the stock on society. Finally, it will undertake a pilot investigation of the relationship between some of the more important factors and the life-span of the stock in order not only to demonstrate that relationship, but how it has changed over time. In a sense, therefore, this thesis is partially theoretical and partially empirical; it is a descriptive rather than a predictive thesis.

1.3 SOME CONCEPTS CONCERNING THE UTILISATION OF THE EXISTING STOCK

1.06 Before continuing with the investigation, it is first important to define some of the terms used in this thesis. This is necessitated by the conflicting use of some of these terms in the relevant literature and by the emphasis placed on certain terms in this thesis which may differ slightly from common or personal understanding.[4]

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4. Here, only a few basic terms are examined. Other terms will be defined in the appropriate sections of the thesis as they are introduced.

1.07 The 'existing stock' of urban buildings is defined as all structures in an urban environment that exist at any one point in time which are generally considered to be buildings. That is, roads, bridges and other works of civil engineering are not considered in the thesis to any large extent, even though they influence the life-span of the stock[5]. It is obvious that the constituent parts of the stock differ not only from century to century, but also, in a large urban area, from day to day. That is, as items of the stock are replaced, the 'existing stock' is altered in its composition. The stock may be seen to be composed or parts or items which are in different stages of evolution: under construction, in use, undergoing alteration, vacant, being demolished, etc. In this thesis, the existing stock is defined, admittedly somewhat arbitrarily, as excluding stock under initial construction, and final demolition. That is, the concern is for stock from its first utilisation to the beginning of its final dismantling.

1.08 Every item of the existing stock differs from every other item not only in its style, size, shape, material components, structural system, age and state of repair, but also in its use or the pattern of activities contained within the stock, as well as its user. As will be shown later in the thesis, the state of repair of the stock is also critical to its life-span. The state of repair (which may be related to the 'level of maintenance') differs not only due to the age of the stock, but between buildings of the same age. Stone[6] has estimated that 2% of the total stock is 'new' each year, and somewhat less than 1% is removed[7].

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5. See Chap. 2.
6. Stone, P.A.: Building Economy, Oxford, Pergammon Press, 1966.
7. From the figures recorded in the survey part of this thesis (see Chap. 7), these figures seem too high. Of the 11,000 buildings existing in the survey area in 1970, approximately 3,500 were/...

Thus, if every item of stock were replaced on a systematic basis, it would take at least one hundred years to complete the operation.

1.09 The 'utilisation' of the stock, or, indeed, of anything, is to have it serve a 'useful' purpose. Thus, the utilisation of the existing stock is to have each of its component parts (or each item of stock) serve some useful purpose. The concept of 'usefulness' (or its opposite, 'uselessness') will, of course, vary from person to person, culture to culture, and age to age. The perception of usefulness is very dependent on the context in which it is employed. In the context of this thesis, usefulness is discussed in terms of differing perception and changing time[8]. The perception of the usefulness of an item of stock implies a knowledge on the part of the perceiver of the use to which the stock is to be put and the physical manifestations or description of the use and of the item of stock. More importantly, it implies a need to perceive the factors and their forces which render a certain item of stock useful or useless. (That is, the factors which are external to the stock - its use and user - which influences them[9].) These factors may be categorised as:

1) the <u>location</u> of the stock - the point at which an item is physically placed in relation to other items of the stock[10];
2) the <u>economic</u> factors - taxes, interest rates, valuation rates, maintenance and capital costs, etc.;

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7. (contd.) added and 500 demolished over 100 years. Therefore, on average 35 buildings (.004%) were added and 5 buildings (.0007%) were demolished per year.
8. See Chap. 2.
9. For example, a user may perceive the use of an item of stock as a house, but certain external factors, such as the location of the stock, the laws affecting the stock, etc., may preclude its use as such. (See Chap. 2 for further discussion).
10. This definition of location is later expanded; see Chap. 2.

3) the social factors - inarticulated or uncodified desires, symbolic meaning, and images common to the society in general or to particular segments of it;

4) the legal factors - social factors which have become codified;

5) the natural factors - such as wind, rain, etc., which cause physical deterioration of the stock; and

6) the technological factors - which serve to make one item of stock more desirable than another, due to improved standards, convenience in use, etc.[11]

1.10 The utilisation of an item of stock may be described in terms of the length of time over which it remains useful (its useful life-span[12]) or in terms of the intensity of its use. That is, the factors and their forces at the same time direct and to some extent control not only the life-span of the stock, but the intensity of its use. Both of these types of utilisation are well worth investigating and are complex enough to warrant a number of explorations. This thesis, however, concentrates on the former only, the useful life-span of the stock.

1.11 Before developing this objective, however, it is instructive to examine briefly some of the recent research work and literature in the latter area. This work is generally related to the issue of the intensification of the use of the existing stock, as it holds implications for

11. For discussion of these factors, see Chaps. 2 & 3.
12. As well as describing the life-span of the stock in terms of its usefulness, the stock may also be described in terms of 'economic' life and 'physical' life. All three of these are determined by the factors outlined above, but will significantly differ one from the other. See Chap. 5.

the study of the life-span of the stock, and increasing the efficiency of the utilisation of the stock, so that it may be more intensely used without being detrimental to production, human comfort or other measures of effective utilisation. Most of the recent work in this area has tended to concentrate on items of stock where the use of the stock already has a relatively rigid timetable (such as factories, offices, schools and universities) thus affecting the pattern of use by the users. By altering the time-structure, the item of stock may be used more intensely, thus increasing its efficiency, whether measured in terms of output of units of production per unit of time, or the number of people accommodated over a certain period of time. Intensification of utilisation thus implies that some standards, which increased efficiency may be measured against, have or can be established. These standards may be stated in terms of 'space-norms' such as the University Grants Committe norms or University Space Standards in the United States[13]. Extensive work in describing the intensification of utilisation of existing University buildings has been undertaken in this country at University College, London[14], and the Land Use and Built Forms Study Group (LUBFS) at Cambridge[15]. Examples of work from abroad are mainly North American[16] such as the work at California, Illinois, New York and Toronto. In all

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13. For example, see: University Grants Committee: Survey, London, UGC, 1972. Bareither, H. and Schillinger, J.L.: University Space Planning, Urbana (Ill.), University of Illinois Press, 1968.
14. Doidge, C.: 'University Space Utilisation', Ph.D. Dissertation, University College, London, 1972. Musgrove, J. and Doidge, C.: 'The Use of Space and Facilities in Universities', London, UCERG, 1969 to 1971 (various papers and reports).
15. Bullock, N.: Surveys of Space and Activities: Reading University, Cambridge, LUBFS, Working Paper 40, August, 1970. Bullock, N. et al: A Theoretical Basis for University Planning, Cambridge, LUBFS, Report No. 1, April, 1968.
16. Bareither, H. and Schillinger, J.L.: op.cit. Doidge, C.: 'The Use of Space and Facilities in Universities: North American Visit', London, UCERG, February, 1971.

of these studies, the usual impetus to intensify the utilisation of the existing stock was due to the ever-expanding number of students who need to be housed inexpensively as well as the need to rationalise the building construction allocations of large university systems. At the same time, great importance was attached to retaining sufficient freedom of movement that the traditional 'air of intellectual freedom' associated with institutions of higher education was not compromised.

1.12 As well developed as this facet of the utilisation of the existing stock is, there is still great scope for more original and complimentary work. The other facet, however, the examination of the life-span of the stock and the factors which affect it, is still a rather unexplored and certainly unco-ordinated field. While this thesis does attempt an examination and co-ordination of the many parameters of this field, it by no means claims to exhaust, even partially, the thinking and data which should be applied. Indeed, this would require an immense amount of work by a very diverse group of experts. However, this thesis does purport to help in this investigation by describing the basic factors involved, examining some of the relationships between the factors and the life-span of the existing stock, and by providing indications for further research in the field.

1.4 PREVIOUS RESEARCH INTO THE FACTORS AFFECTING THE LIFE-SPAN OF THE EXISTING STOCK

1.13 Research into the factors affecting the life-span of the existing stock and their effects on that life-span has not been hitherto undertaken in any single, co-ordinated attempt. This is not to say, however, that the ground work for this investigation has not been laid in some form. Research into the areas of the adaptability and flexibility of buildings[17], indeterminancy in architecture[18], the conservation and preservation of buildings[19] have all influenced and are referred to in this thesis. More importantly, basic ground work and conceptual understanding of the factors has been laid mainly by the work of the Joint Unit for Planning Research[20] in studies on the process of growth, change, and ageing of buildings. It is, therefore, appropriate to devote some space to reviewing this latter work here so that an understanding of the present 'state-of-the-art' may be obtained.

1.14 One side of the reciprocal relationship between the life of the stock and the factors which affect and are affected by the stock, is the forces that the factors exert to render an item of stock useless. Uselessness, or usefulness, as explained above, is a relative concept; what is useless to one person may be useful to another. One item of stock may also be more useful to one person than to another, neither of the items, however, being totally useless. It is therefore appropriate that terminology be standardised. An item of stock is said to be 'obsolete' when it is totally useless to everyone concerned[21]. 'Obsolescence' on the other hand, is a term concerning the degree of uselessness of an item[22]. Thus, while obsolescence is an everyday occurrence, an item of stock is rarely obsolete and while the state of

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17. For example: Aylward, G.M.: 'Towards a Theory for Describing and Designing Adaptability in the Built Environment', Transactions of the Bartlett Society, Vol. 7, 1968-69. Laboratories Investigation Unit: 'An Approach to Laboratory Building', Paper No. 1, August 1969. Lynch, Kevin: 'Environmental Adaptability', Journal of the American Institute of Planners, February, 1968. Rabeneck, A., et al. 'Housing Flexibility/Adaptability', Architectural Design, February, 1974.
18. For example: Goodacre, D.M.: 'Planning for a Changing Future',/...

being obsolete is unvariable, the process of obsolescence is not:

> "It is important to stress... that the process of becoming obsolete, that is obsolescence, will be perceived subjectively relative to a particular situation or condition, and that the perception of obsolescence will vary according to the viewpoint or interest of the observer, obsolescence should be viewed therefore as a function of human decision as well as natural forces."[23]

1.15 The concept of obsolescence may be more easily perceived in non-durable consumer goods, such as the automobile, than in durable artifacts such as buildings, or in the natural environment. A major type of obsolescence in non-durables is termed 'style' obsolescence. This type of obsolescence, built-in by many manufacturers, helps to stimulate the rapid turnover of these goods by visually making last year's model 'obsolete'[24]. Another, closely related type of obsolescence in non-durable goods is terms 'planned' obsolescence, or 'obsolescibles'[25].

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18. (contd.) Journal of the Town Planning Institute, July/August 1972. Weeks, J.: 'Indeterminate Architecture', Transactions of the Bartlett Society, Vol. 2, 1963-64. Weeks, J.: 'Indeterminate Disciplines', Architectural Review, November, 1971. Weeks, J.: 'Multi-strategy Buildings', Architectural Design, October, 1969.
19. For example: Architectural Forum, 'Uses for the Past', September, 1972. Educational Facilities Laboratory. School Renewal, New York, EFL, 1972. Papageorgiou, A.: Continuity and Change, London, Pall Mall Press, 1971. Ward, P. (ed.): Conservation and Development, Newcastle upon Tyne, Oriel Press, 1968.
20. For an introduction to the work of the Unit, see: Cowan, P.: 'Studies in the Growth, Change and Ageing of Buildings', Transactions of the Bartlett Society, Vol. 1, 1962-63. Cowan, P.: 'Depreciation, Obsolescence and Ageing', Architects' Journal, 16 June, 1965.
21. Cowan, P. et al.: Obsolescence in the Built Environment, Report No. 2: Some Concepts of Obsolescence, London, JUPR, 1970.
22. Ibid.
23. Ibid, p.35.
24. Papaneck, V.: Design for the Real World, London, Thames & Hudson 1972. This type of obsolescence, especially in automobiles manufactured in the United States depends to a large extent on the persuasive power of the advertising media. During the current recession it should be obvious that the resourcefulness of the media has been sorely taxed.

25./...

This type is concerned with the limited functional life of goods which will require more and more maintenance as they age. That is, they are planned to last only a certain length of time. Again, the automobile is a good example.

1.16 Both style and planned obsolescence of non-durable goods have their counterparts in durable consumer goods such as buildings. The 'style' of a building, generally interpreted as the external appearance of the building, has changed over the years in response not only to the aesthetic value of architects, but also due to the change in the factors[26]. One needs only to look at advertisements in the property columns of newspapers to see the saleability of style in buildings[27]. Planned obsolescence may also be perceived in buildings. An architect has an enormous choice of materials for use in a building, each material having a certain life-span[28]. The choice of the material, which contributes to

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25. Mazelish, B.: 'Obsolescence and Obsolescibles', in Anderson, S. (ed.): Planning for Diversity and Change, Cambridge (Mass.), The MIT Press, 1968. 'Obsolescibles' is a term coined by Mazelish to emphasise a notion of chance among different types of planned obsolescence, developing his concept from the idea of alternative futures expressed in Bertrand de Jouvenel's term 'futuribles'.
26. The style of a building not only provokes reactions from the public as to 'like' and 'dislike', gives clues to when it was built but also gives some clues to the astute observer as to the use of the stock and the economic solvency of its user. The style of the building and the materials used also describe the relative cost of labour vis-a-vis materials in the age in which it was constructed.
27. Notice, for example, that general offices and shops for sale or let tend to discuss the modernness of both the style and the facilities, but housing, in general will feature modern facilities in a traditional shell.
28. One problem, however, is that the life-span of materials in relation to the amount of maintenance required is never fully described by the manufacturers of the materials, or, indeed, by anyone else. Thus, cost estimates generally rely (and not only for this reason, see Chap. 5) on initial costs only. A useful exercise would be for manufacturers to state the length of life of materials under certain levels of maintenance and in particular conditions of wear.

the total physical life-span of the building must, of course, be balanced by its initial costs and costs-in-use[29].

1.17 Style and planned obsolescence are, therefore, two types of obsolescence which affect the existing stock. Other types of obsolescence, categorised by A) topic, and B) perceiver, are[30]:

A.1) Structural (Physical) Obsolescence: where a building becomes increasingly inadequate solely due to the deterioration of the building fabric. This type is clearly influenced by the planned obsolescence of materials, as well as the level of maintenance.

A.2) Functional Obsolescence: where the building is unable to contain effectively the activities which it currently contains.

A.3) Environmental Obsolescence: where the environmental conditions, natural or man-made, in the immediate neighbourhood render a building increasingly unfit for its current use. This is most familiar in decaying neighbourhoods, but may also occur where the upgrading of the environment renders the present use of the building or the building itself unfit for the context.

A.4) Communication Obsolescence[31]: where the building is no longer suitably sited for essential communication links to be satisfactorily

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29. For further discussion of this point, see Chap. 5.
30. Following: Cowan, P.: Obsolescence in the Built Environment, Report 2: Some Concepts of Obsolescence, op.cit.
31. Cowan (ibid) has called this locational obsolescence, however, in the context of this thesis, the definition of locational factors takes a wider meaning than simply communication links implied by this type of obsolescence. See Chap. 2 & 3.

maintained. Either the needs of the user of the building have changed to a point where the existing communication links (roads, fixed transit lines, electronic communication facilities, etc.) are no longer adequate, or better communication links have been developed elsewhere.

A.5) Financial Obsolescence: where necessary capital and recurrent costs such as rent and maintenance become greater than the return or benefits.

B.1) Tenant Obsolescence: when the tenant decides that he will gain in total satisfaction by moving out of a given building.

B.2) Rental Obsolescence: when the owner of a building decides that he will gain in satisfaction by altering the rent, either upwards or downwards.

B.3) Condition Obsolescence: when the owner decides that after taking account of the expenditures involved and the consequent change in expected income, or more exactly profit, that he will benefit by altering the building.

B.4) Site Obsolescence: where the potential value of the site to a developer is sufficiently high to off-set the loss of the building asset.

B.5) Control Obsolescence: where the regulations governing the construction and use of a building are rendering the building obsolete by imposing increasingly constricting control on the building.

1.18 In other work by the Unit[32] these two types of obsolescence, by topic and by perceiver, are discussed as placing 'constraints' on the existing stock to contain uses and activities. More specifically the type (A) (topic) obsolescence is influenced by the type of perceiver (type B) and the limits of the constraints will vary according to his perception.. Clearly, implicitly recognised but unstated by the Unit, the types of obsolescence in type (A) are an interrelated set of phenomena. That is, they affect each other in as yet undiscovered ways and the effect changes over time. Each of the two types of obsolescence described by the Unit is a manifestation of the change in the factors and their relative forces. By studying these underlying factors, a clearer description, not only of the types and processes of obsolescence, may be determined, but the life-span of the stock, the net effect of continuous obsolescence, may be understood.

1.19 Most attempts directed towards the understanding of the process of obsolescence view the phenomena as a continuous process which begins as soon as an item of stock is constructed and lasts until it is demolished. The methodology of understanding, however, varies. Some researchers trace typical 'cycles' within given organisations as they develop over time, change their items of stock, either by alteration or moving, and noting why certain items of stock and/or locations within an urban area become obsolete to that organisation. That is, they are essentially user-orientated undertakings[33]. Others look at the

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32. For example, see: Cowan, P.: 'Growth, Change, Adaptability and Location', London: Joint Unit for Planning Research, 1966. Cowan, P. and Nicholson, J.: 'Growth and Change in Hospitals', Transactions of the Bartlett Society, Vol. 3, 1964-65. Cowan, P. et al: The Office: A Facet of Urban Growth, London , Heinemann Educational Books, 1969. Nutt, B.B. et al: Housing Obsolescence, London, Joint Unit for Planning Research, April, 1974.
33. For example, see most of the work of the Joint Unit for Planning Research cited above.

development of obsolescence as a purely economic phenomena and trace patterns of expenditures and returns over time. That is, they are economic undertakings[34]. Finally, still others have examined the phases through which an item of stock or urban land passes - land purchase, development, occupancy, vacancy, adaptation, maintenance ... demolition. These may be termed stock-orientated undertakings[35]. Each of these, while contributing to the general body of knowledge about obsolescence, contributes but a single facet. This present undertaking crosses or touches upon each of these different orientations in an attempt to give an over-view of the interrelations of the factors involved in the first two parts, but develops more along the lines of the stock-orientated approach in the third part.

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34. For example: Lichfield, N. and Associates: 'Economics of Conservation' in Esher, Viscount: York: A Study of Conservation, London, HMSO, 1968. Stone, P.A.: Building Design Evaluation, London, Spon, 1964.
35. For example: Fisher, H.B.: 'Towards the Simulation of Urban Renewal', London, Joint Unit for Planning Research, Seminar Paper 5, 1969.

PART ONE

CHAPTER TWO

THE FACTORS AFFECTING THE LIFE-SPAN OF THE EXISTING STOCK

2.1 INTRODUCTORY SUMMARY

2.01 The factors affecting the life-span of the existing stock may be described as: operational factors - location, economic, social, legal; natural and technological; the use of the stock; its users; and the physical description of the stock itself. These factors are not independent of each other, rather they reciprocally affect one another. The life-span of the item of stock, its usefulness, may be described in terms of the 'match' or 'mismatch' between the physical description of that item of stock and a similar description of a proposed use as perceived by the different users of the stock and as influenced by the operational factors. This match or mismatch is not static over time, rather it changes as the operational factors respond to changes in the users collectively, thereby influencing changes in the users individually who in turn cause changes in the stock, thereby affecting its life-span.

2.2 INTRODUCTION

2.02 The factors which affect the life-span of the existing stock of urban buildings are divided into four distinct but interrelated categories:

1) the external or operational factors;
2) the internal or physical factors;
3) the use; and
4) the user.

The operational factors are those which influence the environment, both physical and non-physical, in which the stock exists or operates. The physical factors are those which are peculiar to each individual item of stock: the physical description of the stock; its size, shape, plan arrangement, structural capacity, type of structural system, services, access to the stock from the outside and between the spaces within the stock itself, etc. The physical factors also include the state of repair or level of maintenance of the stock. The size, shape, slope, etc., of the site associated with an item of stock may also be included in the physical factors. The description of the use to which an item of stock is put may be in terms of pre-determined categories such as 'school', 'office', 'house' or in terms of the set of activities which are contained within the item of stock: the physical requirements of the activities (space, services, etc.) and the degree of interconnectiveness of the activities. The characteristics of the user of an item of stock (type and size, and more importantly his perception and knowledge of consequences of alternative actions in regard to an item of stock) also has an affect on the life-span of the existing stock of urban buildings. This Chapter will examine the different factors and their interrelations.

2.3 THE OPERATIONAL FACTORS

2.3.1 INTRODUCTION

2.03 The operational factors may be grouped into the following broad categories:

1) Location: the placement of an item of stock in space. This may be with reference to some common geographical demarcation, such as the National Grid, or with reference to other items of stock, such as by street names and numbers. It is also possible to describe the physical location of an item of stock in three-dimensional terms in reference to its height above or below a common demarcation, such as sea-

level. Location may also be described in reference to physical systems, such as communication systems (roads, canals, railway lines) or service systems (electrical and gas lines)[1]. Location may also be described in terms of non-physical systems, such as patterns of use and user, economic systems, social systems, natural, legal and technological systems. These latter descriptions yield valuable information in regard to the life-span of the existing stock.

2) Economic: the economic factors which affect the life-span of the stock include the costs of construction, adaptation, and demolition; overheads and profit; rent; insurance; interest rates on loans; taxation; amount of money available for building; and running costs such as the cost of power, communications and maintenance. These factors may be fairly readily described in monetary terms and alternative actions and their probable costs may be compared and evaluated with a relatively high degree of accuracy after basic assumptions are made.

3) Social: the social factors may be divided into two distinct categories: non-legal and legal (see (4)). The non-legal factors may be common to a majority of the society in which case they are generally codified, or only to particular groups or individuals within the society. The social factors consist of time-structure, the symbolic quality of the stock, orientation and recognition derived from the stock as well as the population of the society.

4) Legal: the legal factors which affect the life of the stock include all building legislation as well as planning or zoning requirements. These regulations do not, however, affect all of the stock in

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1. These are included under technological factors in Table 2.1. However, also see Appendix 1 on Location Theory.

the same manner. The legal factors also include laws which indirectly affect buildings through altering the economic, social or technological systems in which the buildings operate.

5) Natural: the natural forces affect most explicitly the physical factors of any item of stock. They include the effects of nature (rain, snow, wind, earthquakes, etc.) on the fabric of the stock. These effects are due both to the natural factors themselves and the man-made effluents which they carry. These factors may be described as working in either one of two ways: slowly over a long period of time, such as with rain and wind (undramatic), or rapidly in a very short period of time, such as with earthquakes, floods, etc. (dramatic). These factors, except for the amount of man-made effluent that they carry, are almost totally uncontrollable by human action. That is, they are unlike the other factors, which may be directly or indirectly altered by human action.

6) Technological: the level of technological sophistication of a society and the type and amount of that technology which is incorporated, or expected to be incorporated into an item of stock also affects the life-span of the stock. The technological factors may be described in terms of systems: the energy system, communication system, transportation system and service system.

2.04 The description of the context in which the stock and its use and user operate may be examined on a number of different scales or 'levels of operation'. That is, one may only be concerned with a fine-grained scale at which an individual item of stock or a small group of items may be examined. Or one may wish to examine the operational factors in relation to a particular or easily identifiable section of an urban area. Or one may be concerned with the factors in a general manner, on an urban or regional scale. It is important to remember, however, that although the large-scale view of the context is constructed from a large number of decisions made at the fine-grained scale, the larger the scale, the more approximate the perception of the match or fit between an item of stock and its use and user. Thus, while the large-scale view may yield valuable general information as to trends and overall relationships, the finer-grained scale is important as the basis of individual action.

2.05 In this thesis, the level of operation is viewed on either one of two scales, at a small (specific context) scale concerned with a single or small group of buildings and on a scale involving a section of an urban environment (general context). This is done so that the effects of the factors at different levels may be evaluated[2]. The influence of the operational factors will, as stated above, alter due to the scale involved. The factors themselves may also change slightly. For example, legal restrictions as to the height and plot ratio of buildings will be different in different parts of an urban area during the same period of time. Conversely at particular locations(specific context) the legal factors may assume prominence whereas overall (general context) the economic factors may be most important.

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2. See Chaps. 7 & 8.

2.06 The operational factors will be perceived by different members of the society in different ways, have different emphases placed upon them and evoke different responses. In other words, the hierarchy or degree of importance of the factors will vary from user to user due to type and perception as well as knowledge of the factors[3]. This will influence the user's attitude towards the life-span of an item of stock. For example, part of a society (the general public) may decide that a certain building is worthy of preservation, thereby increasing its life-span almost indefinitely. Another user of the item of stock (the owner) may decide that the building is not worth preserving, and that it has become obsolete for his needs (generally, earning income) and should be replaced by something which fulfills his needs. Thus, for the same item of stock and set of operational factors, two interpretations, due to type of users of the stock and the manner in which they use the stock (the usefulness of that item) are derived. Similarly, within a single type of user, the knowledge and perception of an individual user will alter the definition of the usefulness of an item of stock.

2.07 Table 2.1 lists the most important factors under the six headings outlined above. This table is not meant to be definitive as it is not only affected by the scale at which the factors are viewed, but also by the society to which it is applied, and the date or time period over which it is viewed. Rather, it is included to give some indication of the most important factors which affected the life-span of the existing stock in most western societies during the last few hundred years.

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3. For discussion of user types see 2.6.

TABLE 2.1: THE CHARACTERISTICS OF THE OPERATIONAL FACTORS AFFECTING THE LIFE-SPAN OF THE EXISTING STOCK

FACTOR		CHARACTERISTICS
I.	Location	
II.	Economic	1. Rate of inflation 2. Rate of taxation 3. Interest rates 4. Amount available for building 5. Rental costs and profits 6. Construction, adaptation and demolition costs 7. Insurance 8. Costs-in-use
III.	Social	1. Time structure 2. Orientation/recognition 3. Symbolic/image 4. Population
IV.	Legal	1. Building regulations 2. Zoning/land use regulations 3. Preservation/conservation regulations 4. Environmental regulations 5. Redevelopment plans
V.	Natural	1. Undramatic 2. Dramatic
VI.	Technological	1. Energy systems 2. Communication systems 3. Transportation system 4. Service system

2.08 The significance of location to the other factors is critical to the later development of this thesis. The location of an item of stock not only allows its placement vis-a-vis other items of stock on the National Grid to be pin-pointed, it also allows the item of stock to be discussed in terms of the economic, social, legal, natural and technological factors operating at that location. Thus, location provides a basis for the discussion of the other factors[4].

2.3.2 ECONOMIC FACTORS[5]

2.09 The most important economic factors are:

1) the rate of inflation;
2) taxation - its rate and how it is assessed;
3) the availability of money for construction, particularly from the government and building societies;
4) interest rates;
5) rental costs and profits;
6) construction, adaptation, demolition and replacement costs;
7) insurance; and
8) costs-in-use, such as energy costs for lighting and heating, and the repair and maintenance of the stock.

Most of these factors are familiar and need little explanation at this point. However, the relationship of these factors to the life-span of the stock and the effect of the location of the stock on these factors should be briefly examined.

2.10 The economic factors contribute to the economic value of a particular item of stock. In a 'free' or market economy, this value is

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4. For a discussion of location as both a descriptive and predictive basis of (mainly) some of the economic factors, see discussion on Location Theory in Appendix 1.

5. See Chap. 5 for more discussion of these factors.

primarily reflected in the price which a person is willing to pay for a given item of stock and/or its site and more imperfectly in the value of building or its site set by the government for taxation purposes. (In Great Britain, this value is given the term 'rateable value'). The market value of the site and building is not only derived from their physical attributes: their size, shape, age, etc., but also from the location of the site within an urban environment. In different societies, the value determined for taxation purposes is derived in different ways. For example, in the United States most urban land is valued in relation to its location and any buildings upon it. In Britain, however, it is the building which is valued according to its location and physical attributes as well as according to the use to which it is put[6].

2.11 The value of a site due to its location and use is the central issue behind the body of knowledge known as Locational Theory[7]. Yeates[8] in his study of Chicago land values, demonstrates that the value is related to the location of a site in relation to the Central Business District (CBD), regional centres, the stations of the elevated and underground transit lines and the density and racial mixture of the residential

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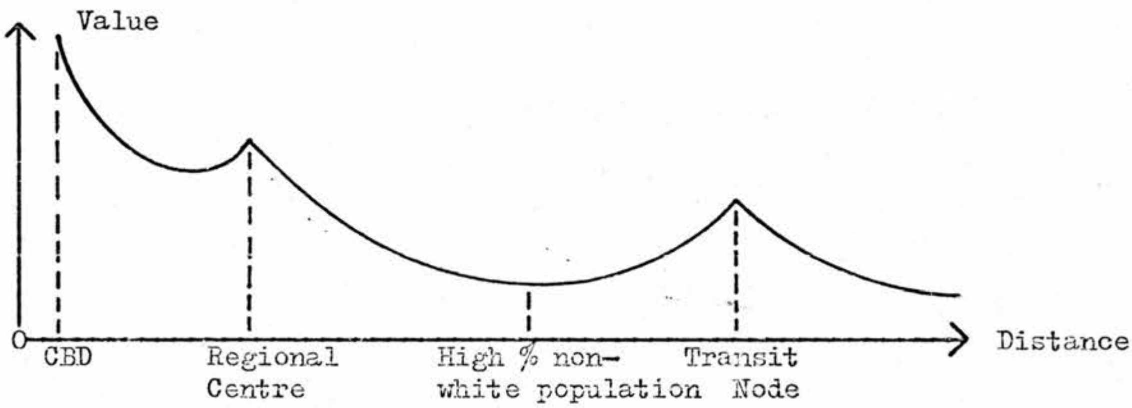
6. The valuation procedure in the United States allows one to directly assess the relative value of land due solely to location, while the procedure in Britain makes this extremely difficult. Most attempts at determining land value in this country have done so by analysing the sale price of non-urban land when it is sold for urban use for the first time. However, this does not attack the problem of location within established urban areas. See, for example: Anstey, B.: 'A Study of Certain Changes in Land Values in the London Area in the Period 1950-64', in Hall, P. (ed.): Land Values, London , Sweet & Maxwell, 1965. Clark, C. and Jones, J.T.: The Demand for Housing, London , Centre for Environmental Studies Working Paper II, September, 1971. (Escpecially Appendix 4: Land values in relation to values of buildings.) McAuslan, J.: 'Price Movements for Residential Land: 1945-49', The Chartered Surveyor, September, 1969. Singer, H.W.: 'An Index of Land Rents and House Rents in England and Wales: 1845 - 1913', Econometrica, July-October, 1941. Stone, P.A.: 'The Price of Building Sites in Britain' in Hall, P. (ed.): Land Values, op.cit. /...

population. The higher land values tend to cluster at the CBD, the regional centres and the transit nodes, while the higher the percentage of non-white residential population and the greater the density of that population, the lower the land values (see Fig. 2.1) It is expected that if the building value were substituted for the land value, a similar spatial distribution of value would occur. Indeed, graphs of rental rates, profits derived from the existing stock and taxation rates in Chicago, follow similar patterns[9].

Figure 2.1: VALUE OF SITE IN RELATION TO DISTANCE FROM CITY CENTRE



Source: Adapted from Yeates, M.H.:op.cit.

2.12 The economic value of an item of stock will also affect and be affected by the age of the item. It is observable that newer buildings are generally more valuable than older ones (if size, services, location, etc., are similar). It has also been demonstrated that owners of older buildings will assess the economic value, usually discussed in terms of profit derived per year, of the present building in

6. (contd.) Vallis, E.A.: 'Trends in Urban Land and Building Values: 1892–1968', B. Litt. dissertation, Oxford University, May 1971.
7. For a discussion of the development and aspects of Location Theory, see Appendix 1.
8. Yeates, M.H.: 'Some Factors Affecting the Spatial Distribution of Chicago Land Values: 1910–1960', Economic Geography, January, 1965.
9. Ibid.

relation to a new building and decide to retain or replace their present item of stock[10]. The life-span of an item of stock will also be affected by the economic value of its neighbouring items; for example, if a number of buildings in a given location are replaced, they will raise the general value of all the buildings in the area. However, the newer items will still generally be worth more than the older items. Thus, in order to be at parity with the newer stock, the owner of the older item of stock will either have to improve or replace his stock. The reverse of this is also true. If the general value of the neighbourhood drops, then the incentive to improve or even maintain his item is removed[11].

2.3.3 SOCIAL FACTORS

2.13 Like the economic factors, the non-legal social factors are discussed more fully elsewhere[12]. This section therefore serves only to outline the social factors and indicate the effects of location. These factors may be thought of as pertaining to the collective 'consciousness' of the society as a whole, to a large segment of the society, or to only small groups or individuals within the society. They are the unwritten legal factors and are directly at the root of most of the legal factors and, somewhat more indirectly, the root of the economic and technological factors. The social factors also include the size and structure of the population.

2.14 Some of the social factors of importance to the life-span of the stock are:

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10. For example, see: Cowan, P. et al.: Obsolescence in the Built Environment, op.cit. Cowan, P. et al.: Offices: A Facet of Urban Growth, op.cit.
11. For further discussion of economic factors, see Chap. 5.
12. See Chap. 4.

1) time structure - the scheduling of activities and events of the society as a whole or organisations or individuals within the society;

2) orientation and recognition - the mental 'map' produced by the existing stock and used by individuals to move through an urban environment;

3) symbolic/image - the imagery of the existing stock as a reflection of the society; and

4) population - the size and composition of the society.

2.15 The effect of the time structure in relation to the intensification of use of certain items of stock has been discussed[13]. The time structure of the society as a whole, however, since it is not as rigid as the time structure of the organisations discussed previously, must be discussed in a somewhat more general manner. The societal time structure can be divided into two types: natural time cycles, such as day and night, the seasons, lunar months and solar years; and artificial time cycles, such as minutes, hours, work days, weeks, months and years. The organisation of society is based more on the latter than the former and was made possible by the development of reliable mechanical 'time-keeping' instruments[14]. Whereas the former varies due to location over the earth's surface in both a longitudinal and latitudinal manner, the latter only varies due to somewhat arbitrary time zones. That is, artificial time is less locationally dependent than natural time. One manner in which the artificial time structure is related to the

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13. See Chap. 1.
14. Mumford, L.: Technics and Civilisation, London, George Routledge & Sons, 1947.

life-span of the stock is through the periods of repayments of loans which, in effect, determines the economic life-span of the stock[15].

2.16 Orientation and recognition (that is, the place within an urban environment where an observer is located) is derived in part from the mental 'map' which the existing stock imprints on the mind of the observer. That is, the items of stock serve as signposts to individuals familiar with an urban environment either in facilitating their own movement through that environment or for directing the movement of others unfamiliar with the environment[16]. The existing stock also helps to locate people in space, giving them judgement as to distances and directions to objectives. (Objectives, which are in fact usually an item of the stock.)

2.17 The symbolic or image value of an item of stock may be said to be derived from an association of its 'form and function': its appearance and use. Certain forms (or styles) of buildings symbolise to the general public a particular use for a particular building: the symbolism arising from a long-standing cultural association of style and use. For example, a building with flying buttresses, stained glass, towers and stone vaulting would immediately be associated with its use as a place of worship. Giedion[17] and Norberg-Schultz[18] both argue that the symbolic interpretation of a society's aspirations and values is one of the primary activities of architecture[19].

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15. See Chap. 5.
16. Lynch, K.: Image of the City, Cambridge (Mass.), the MIT Press, 1960.
17. Giedion, S.: Architecture and the Phenomena of Transition, Cambridge (Mass.), Harvard University Press, 1971.
18. Norberg-Schultz, C.: Intentions in Architecture, Oslo, Scandinavian University Books, 1966.
19. Both Giedion and Norberg-Schultz argue, although Giedion less/...

2.18 Symbolic imagery is at present used as much or more than it was in the past, albeit in a somewhat different manner at times. Certain building styles are associated with particular retail firms - for example, in the United States petrol firms, 'fast food' retailers, supermarket firms, etc., all have literally thousands of identical buildings throughout the country, making no concessions to site, climate or cultural heritage. These buildings themselves serve as signs or symbols of the product or firm[20]. Similarly, symbolism may also seem to be inherent in simply the age of an item of stock. A firm such as a bank or insurance company may demand a new building in part because its very newness will attract both capital and good employees, as well as publically stating that the firm is financially secure. Similarly, unestablished colleges and universities will use the newness of their stock and its facilities to attract staff. On the other hand, lawyers and (surprisingly?) architects tend to favour older stock in established areas, even though it may cost as much and be less functionally efficient.

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19. (contd.) strenuously than Norberg-Schultz, that today's featureless architecture reflects the aspirations and values of an uninspired and undirected age. The reason that a school building looks like an office building which looks like an apartment building is that capital is the main aspiration and value of modern society. While this may be so, the rapid diffusion of materials and methods of construction brought about by the transportation and communication 'revolution' of the industrial age as well as the standardisation of production allows regional and national styles to disappear. In fact, architectural theory of late encouraged this as well, thus standardised symbolism in buildings is becoming part of the psychic of the inhabitants of the 'global village'. The term 'global village' sums up very nicely the interrelatedness of the world today, not only in matters of architectural style, but in the foods we eat, clothes we wear, etc. It comes from McLuhan, M.: Understanding Media, New York, McGraw-Hill, 1967.
20. Venturi, R., and Brown, D.S.: Learning from Las Vagas, Cambridge (Mass.), the MIT Press, 1972.

2.19 The rate of population growth in the Western world, at least, has declined in recent years[21]. However, internal migration still creates problems of housing on a local or regional basis. In general, a rise in population will stimulate a growth in the number of buildings[22] while at the same time forcing the retention of items of the older stock which would probably have been demolished. At the same time, population increase will affect the rate of deterioration of the stock as it becomes subject to more wear[23].

2.3.4 LEGAL FACTORS

2.20 The legal factors may be understood as those social factors which define the limits of acceptable behaviour of members of a society. The legal factors operate both on a general and on a specific level, with the range of local variations usually falling within limits which would be acceptable to the society as a whole. Five main legal factors affecting the life-span of the stock are:

1) Building regulations and Acts which regulate the use and construction of buildings;
2) Zoning and Land Use regulations which also regulate the use of the stock and land;
3) Preservation/Conservation regulations which preserve certain items of stock deemed to be of architectural or historical importance (thus directly affecting the physical life-span of those items).
4) Environmental regulations which are concerned with increasing the

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21. Mesarovic, M. and Pestel, E.: Mankind at the Turning Point, London, Hutchinson, 1975.
22. Lewis, J.P.: Building Cycles and Britain's Growth, London, Macmillan, 1965.
23. For further disaussion of the effects of population on the life-span of the stock, see Chap. 6.

'quality of life' by controlling pollution; and

5) Redevelopment plans, which, although not necessarily laws in the same sense as the preceding factors, are statements of goals set for the improvement of certain urban areas, parts of which may be made legally binding in order to attain those goals.

2.21 In this and most developed countries, building regulations are a highly developed set of interrelated laws and regulations affecting the use and construction of the stock. Most of these regulations were originally enacted to ensure the health and safety of the public at large as well as the inhabitants of the stock itself. While regulations about buildings are not a recent phenomena, modern comprehensive regulations can be said to date from the late Victorian period[24].

2.22 In general terms, building regulations will affect the life-span of the stock in two main ways. When the life-span may be prolonged by a change of use of the stock, the regulations require that the building conforms to the minimum standards for the new use. In a number of cases, this will mean physical adaptation of the stock, which may place an unacceptable physical burden on the stock and will certainly change the economics of the new use[25]. The second major effect of the building regulations on the life-span of the stock is the fact

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24. Knowles, C.C. and Pitt, P.H.: The History of Building Regulations in London 1929-1972, London, The Architectural Press, 1973.

25. In practical terms, this may mean the upgrading of the daylight standard, additional fire escapes, the strengthening of floors, columns and walls to take the additional load, etc. It is possible, however, to obtain a waiver from a particular regulation or set of regulations by demonstrating that compliance would place unacceptable physical or economic burdens on the stock and its user.

that today most buildings are built to the legal minimum requirements (this is especially true of government-financed housing). In the future, this may impede the change of use of the stock, or require adaptation of the stock if the standards are raised, thus, the number of buildings which will legally accommodate a number of uses, such as the 'overbuilt' Georgian and Victorian structures will diminish in relation to the total stock of buildings[26].

2.23 Zoning regulations and land use controls, height restrictions and plot ratios, controls on vehicular parking and access will also affect the life-span of the stock. Zoning regulations, like building regulations, can be traced to rather ancient times. However, the modern set of regulations can be said to have been developed during the latter part of the nineteenth century[27]. Many critics[28] have demonstrated that land use controls, based on the separation of uses, have contributed to the problems of dormitory suburbs - empty during the day and filled at night, and central cities where the reverse is true, as well as cause traffic congestion at the interface. This may be slightly too critical. What the land use regulations have done

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26. For example, Hole and Attenburrow note that the average inter-war standards of construction and space in homes dropped below those of the pre-First World War period and that the substitution of the three bedroomed, two storey duplex (30% of the total housing stock in 1960) for the regular three storey terrace has yielded less freedom for internal modification as well as less built space. Similarly, Thring notes that:

    "It appears that standards of space and fabric have (again) fallen since 1950 to increase the speed of building as well as the speed of decay."

    Hole, V. and Attenburrow, J.: Houses and People, London, HMSO 1966. Thring, J.B.: 'The Case for Rehabilitation', Official Architecture and Planning, November 1969.
27. Knowles, C.C. and Pitt, P.H., op. cit.
28. For example: Lowry, I.S. : Model of Metropolis, Santa Monica, Calif., RAND Corp., RM-4125-RC, 1964. Forrester, J.W.: Urban Dynamics, Cambridge (Mass.), the MIT Press, 1969. Netzer, D.: Economics and Urban Problems, New York, Basic Books, 1974.

is to reinforce the natural tendency for like uses to congregate and thus 'unmix' the urban environment[29], while modern developments in transportation, particularly the automobile, have spread this 'unmixture' over a wider area. In a manner similar to the building regulations, the zoning and land use regulations impede the free exchange of uses within an item of stock or the use to which the site is put. Thus, the continued usefulness of stock based on the substitution of one use for another is affected adversely.

2.24 The use of height restrictions and plot ratios to control the bulk of buildings may be traced back to the Roman Empire[30]. Today, these restrictions are based more on the concept of the 'right to light' rather than fears of structural stability or fire hazards which formed the basis of the earlier codes. Height and plot ratio regulations have two general effects on the life-span of the stock. In an area which already contains buildings of the maximum allowable height and plot ratio, the incentive to replace the buildings by larger and thus more profitable stock is removed as long as the regulations are in force[31]. On the other hand, if the limits imposed are changed, or in the first instance greater than the existing stock, the new limits will allow the replacement of the existing stock. While the change in the restrictions themselves may not be the cause of the replacement, they will be changed in response to economic, social and political pressure. In doing so, they will facilitate the replacement of the stock.

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29. See Appendix 1 on Location Theory.
30. Knowles, C.C. and Pitt, P.H., op.cit.
31. Increasing the bulk of the building, while certainly making the site on which it is situated more profitable, may not necessarily make the per square metre profit of the building greater, though in practice, the newer stock generally commands more rent per square metre than the older.

2.25 Restrictions on vehicular access and parking, either due to legal regulations or congestion, will also affect the life of the stock. In most societies dependent on the automobile for personal transportation and lorries for the transport of goods, any restriction on the freedom of movement in a particular area is likely to restrict the usefulness of buildings in that area. If the freedom of movement becomes too restricted, while remaining free in other areas, the location of users will shift to the less restricted areas[32].

2.26 The preservation and conservation regulations such as the Civic Amenities Act, 1967, the Ancient Monuments Act, 1931, the Historic Buildings and Ancient Monuments Act, 1953 and the National Trust Act, 1939, legally embody the society's (or a majority of the society's) non-legal wish to protect a part of its past represented in particular items of the existing stock. These Acts and others like them, which will be explored in more detail in Chap. 5, have in effect prolonged the life of a number of items of the stock by protecting them from the influences of the other factors. In doing so, they have also removed some of them from everyday usefulness. That is, their usefulness as representations of the past is considered to be greater than their usefulness as functionally or economically efficient offices, shops, etc. In doing so, it places the economic burden not on the forces in the market, but on the public exchequer. This is recognised as the major drawback to preservation of stock, and thus to extending its physical life-span in this manner[33].

2.27 The environment regulations are a development of present-day

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32. For example: Cowan, P. et al: Offices: A Facet of Urban Growth, op.cit. Rhodes, J. and Kan, A.: 'Office Dispersal and Regional Policy', Cambridge, University of Cambridge, Department of Applied Economics, Occasional Paper 30, 1971.
33. Ward, P. (ed.): Conservation and Development, op.cit.

technology, both due to that technology's capacity to pollute and its capacity to overcome, or at least control, that pollution. These regulations in general seek to control pollution by smoke and particle emission, effluents, noise and bulk matter. Unlike most of the building and zoning regulations, the environmental regulations are empowered to enforce the new standards on the existing stock without a change in the stock being necessary, usually specifying a certain time limit within which the new standards must be complied with. It is possible that some marginally profitable industries and buildings may be closed because of the cost of meeting the new standards, however, it is very likely that the buildings and industries would have succumbed to the general economic factors in time[34].

2.28 Redevelopment plans (as distinct from development plans, which are generally associated, at least in building, with new towns or buildings on virgin sites) are included as a legal factor even though they may not be legal in the same sense as the factors discussed above. This is because they are usually instigated by a governmental body, on a national, but more usually local or regional, scale; serve to outline policies; and may have many of their recommendations enbodied in building or zoning ordinances[35]. The effects of these plans on the life of the stock has been well illustrated elsewhere[36]. Briefly,

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34. For example, new safety regulations and dust control in mines in the U.S. are said to account for the largest number of closures in the past few years. However, almost all of these were marginally productive and would probably have closed within a few years even without the new standards being imposed.
35. For example, the first storey pedestrian deck recommended in the 1947 Abercrombie Plan for Princes Street, Edinburgh, has been incorporated into the local zoning restrictions. Abercrombie, P. and Plumstead, D.: A Civic Survey and Plan for the City & Royal Burgh of Edinburgh, Edinburgh, Oliver & Boyd, 1949.
36. For example, Friedan, B.J.: The Future of Old Neighbourhoods/...

the critics of these plans demonstrate that by designating an area for comprehensive redevelopment, but not carrying out this plan immediately (which is the case in a large number of instances, usually due to the lack of finance) the government in effect sterilizes an area and accelerates its deterioration[37]. This is because the people in the area will not spend money to improve or maintain their stock as it is to be replaced, and even if they would, could not obtain loans from the government or building societies. The plans also have a tendency to accelerate emigration from the area, thus creating a stock of vacant buildings which are prone to vandalism[38].

2.3.5 NATURAL FACTORS

2.29 The natural factors are those which are the least susceptible to change by the intervention of human action. They work in one of two ways: dramatically, such as earthquakes, floods, etc., or undramatically, such as wind, rain, snow, etc. The causes of these factors, of course, lie in nature itself. However, their effect in physically deteriorating the stock is supplimented by man-made pollution or natural resource mismanagement. The dramatic factors act with equal effect on stock of any age. Buildings, however, must be exposed to the undramatic factors for a considerable length of time before any appreciable effect is recognised.

2.3.6 TECHNOLOGICAL FACTORS

2.30 The study of the impact of technological development on society as well as concern about that impact, is a relatively recent develop-

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36. (contd.) Cambridge (Mass.), the MIT Press, 1964. Wilson, J.Q. (ed.): Urban Renewal: The Record and the Controversy, Cambridge (Mass.), the MIT Press, 1966.
37. The effect is popularly known as 'planners' blight'.
38. Newman, O.: Defensible Space, London, The Architectural Press, 1974.

ment[39]. By technological development it is meant developments which can be attribuited to mechanical inventions. Certain of these inventions have transformed, in a relatively short period of time, life in the Western world and has had a dramatic effect on the existing stock (much of which was constructed before these inventions had been developed). The effects of technological development on the life of the stock is a rich enough field to warrant separate investigation on its own, therefore only a brief outline will be attempted here.

2.31 The four main technological factors have their beginnings in four relatively simple (at least by today's standards) inventions: the electric dynamo, the telephone, the internal combustion engine and the mechanical pump[40]. These four spawned the energy system, the communication system, the transportation system and the service system of today. These four systems affect the stock both internally and externally: by raising the expected standards of light, warmth and ventilation, and by allowing easy access between the stock, thus allowing urbanised spread. Technological development lead to the internal recrganisation of the use and user of the stock, thus necessitating the physical adaptation or replacement of the stock. For example, central heating allowed both rooms to become larger and more open as the need for open fires for heating was removed. Similarly, electric lights and mechanical ventilation decreased the dependence on windows as the source of both light and ventilation, allowing buildings to become deeper. Lifts freed the buildings from the ground

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39. For two early investigations, see: Giedion, S.: Mechanization takes Command, Oxford, Oxford University Press, 1948. Mumford, L.: Technics and Civilization, op.cit.
40. Mumford, L.: Technics and Civilization, op.cit.

and allowed the development of the skyscraper. Even improved sanitation allowed the growth of the population, not only in absolute terms, but in terms of concentrations[41]. Externally, the systems allowed the spread of the stock and at the same time necessitated improvements in the means of transportation by the replacement of some of the stock by roads. In doing so, this stimulated replacement of the stock surrounding the transport nodes[42]. Thus, technological developments have not only allowed the replacement of the stock, they have also caused it to happen.

2.3.7 SUMMARY OF THE OPERATIONAL FACTORS

2.32 The operational factors, discussed above, are those which are external to the stock itself and are generally independent of, though affected by, the use and user of the stock. They will vary in their effect on the stock due to the location of the stock as well as over time[43]. Thus, to develop a specific hierarchy of the factors would be difficult, while one constructed for a particular location and time would not serve the purpose of a general overview of the factors and their relationships attempted in this section of the thesis. However, a general hierarchy may be attempted. The social factors are important as they lie at the base of the legal, economic and technological factors and will lead to their alteration over time. The economic factors are also important as most immediate decisions as to the life-span of a given item of stock will ultimately be based on an economic decision. The location, or the context, of the economic and social factors will change the strength and composition of the factors.

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41. Banham, R.: The Architecture of the Well-Tempered Environment, London, the Architectural Press, 1969.
42. See Appendix 1.
43. For change over time, see Chap. 3.

Thus, a tentative direction for investigation may be established: the social and economic factors and their location[44]. First, however, the physical factors, the use and users must be further examined.

2.4 PHYSICAL FACTORS

2.3.3 The problem of defining the physical factors of the existing stock is one of categorising in a meaningful manner the physical attributes (floor area, number and relationship of the rooms, structural capacity, etc.) of the stock so that their effect on the life of the stock may be discovered. Since the description of the physical attributes is one of the major concerns of architects, a number of methods of description have been developed which help to establish a methodology useful in the present circumstances. One such method is the 'bill of quantity' which lists the components or elements of a building and the number of each component. It does not, however, describe the manner in which they are arranged[45]. Another common method of describing the physical factors could be called the 'bill of quality', this method is based on the evaluation of the state of repair of a building, noting such items as the condition of internal surfaces, roofs, and facades visually; recording the number of fixtures; and determining structural stability in a somewhat more scientific manner. This method, while descriptive of the state of repair, and the degree

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44. See chaps. 4, 5, 7 & 8.
45. Normally, the bill of quantity will group the elements and components of the stock under the following categories: substructure - the foundation and basement levels; superstructure - the frame, upper floors, roof, stairs and walls; internal finishes; fittings and fixtures; services; and external works. See, for example: Seeley, I.H.: Building Economics, London, Macmillan, 1972.

of sub-standardness of the stock, does not describe the manner in which the spaces are arranged[46]. A third system for describing the physical factors has been developed in conjunction with studies of the efficient utilisation of university buildings[47]. Some studies are more comprehensive than others; some only describing floor area and distribution[48], while others describe daylighting, views, services and noise as well as floor area, shape and distribution of rooms[49].

2.34 The description of the stock for the purposes of determining the effects of the physical factors on its life should be a combination of all three methods. That is the description should include a list of materials, their state of repair, the size, shape and distribution of rooms, the relationship of the rooms to the external environment as well as to each other, and the services available in the stock and the distribution of those services. A minimum list of the physical factors would thus include:

1. Space: The size, shape and distribution of rooms, their floor to ceiling height, materials used to form the space and the state of repair of the materials, as well as the overall spatial description of the stock.
2. Structure: The loading capacity of floors, walls and columns, the area, shape and volume described by the structural elements,

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46. See, for example: Duncan, T.L.C.: Measuring Housing Quality, Birmingham, Centre for Urban and Regional Studies, University of Birmingham, 1971.
47. See Chap. 1.
48. For example, University Grants Committee, op.cit. Facilities Planning Committee, Facilities Planning Manual, Toronto, January 1972.
49. For example: Musgrove, S., and Doidge, C.: The Use of Space and Facilities in University, Paper No. 1, Room Classification, London UCERG, September, 1969.

the materials used and their state of repair.

3. Services: The type, capacity, number and distribution of both artificial services, such as gas and electricity, and natural services such as daylighting and natural ventilation and the state of repair of the artificial service systems.

4. Access: Both to the building from the external environment and between the spaces within the building; the type, number and capacity of each of the points of access.

2.35 The description of the physical factors will describe the ability of an item of stock to contain uses and users. That is, a match (or mismatch) between the physical description of the stock and similar description of the needs of the use and user may be determined. This does not mean, however, that a match between the operational factors and the use and user will automatically ensue if the physical factors of the stock match the functional requirements of the use and user. However, description of the physical factors will give clues as to the feasibility, both physical and economic, of adapting the stock to produce a match or better match between the attributes of the stock and the needs of the use and user[50].

2.36 Along with the physical factors of the stock, a description of the physical attributes or factors of the stock's site must be developed. As discussed previously, the usefulness of an item of stock is very dependent on the usefulness of its site. For example, if the site may be more profitably used, the existing item of stock may be made useless

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50. See Chap. 3.

due to its site rather than anything inherent in the building itself. The physical description of the site may be categorised in a manner similar to the physical description of the stock:

1. Space: The area of the site; its shape, and the ratio of built-upon to open site.
2. Structure: The loading capacity of the subsurface and the slope of the land.
3. Services: The number, type and capacity of services on or near the site and whether they are artificial or natural.
4. Access: The number and types of access to the site, mainly from the transportation network.

2.37 As with the physical description of the stock, the physical description of the site will help to determine the match or mismatch between the site and its potential usefulness.

2.5 USE

2.38 Thus far, the life of the stock and its usefulness has been discussed in terms of the operational factors which affect (and are affected by) the stock and the physical description of the stock and its site. In order to be useful, the stock must, by definition, have a use. Before proceeding with a discussion of use and its effect on the life of the stock, a common terminology and understanding of the parameters of the term 'use' should be developed.

2.39 The use of a building is a convenient 'label' by which to identify a related set of activities. For example, a type of use such as 'school' describes activities such as teaching, studying, listening, as well as eating, recreation, etc. The term 'school' thus describes the use of a particular building as well as labelling the building. Similarly, the rooms within the building are often identified by the primary activities located in those rooms (classroom, dining hall, etc.). Therefore, the distinction between a use and an activity is one of aggregation and abstraction. The use factor can, therefore, be described in terms of the activities which make up that use.

2.40 Activity studies developed from a concern on the part of architects and others concerned with building with the functional description of activities in order to design spaces to contain those activities to a concern with the functional efficiency of the spaces[51]. Most recent activity studies have been concerned either with the functional obsolescence of the stock or the efficiency of its utilisation. The generating concept of some of these studies is that the existing stock should be reogranised in such a manner as to facilitate its effectiveness as a container of activities[52]. The other main basis for activity studies is the concept that activities should be organised or reorganised to fit into the existing stock more efficiently[53]. That is, a restructuring of both the stock and the activities will produce more efficient utilisation of the stock.

2.41 In order to measure the efficiency of the existing stock as containers for activities and how they or the activities may be restructured to produce a more efficient fit, it is necessary to understand

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51. Farbstein, J.: 'The Definition and Description of Activity', Journal of Architectural Research, Vol. 3, No. 1, 1974.
52. Ibid.
53. Musgrove, J. and Doidge, C.: The Use of Space and Facilities in University, Paper No. 1, Room Classification, op.cit.

the level of aggregation or abstraction of the activity under study, the participants in the activity and the location and duration of the activity. There is general agreement among investigators of activities that they are concepts rather than 'things'[54]. Further, it is recognised that these concepts follow one another in a continuous stream[55]. It depends on the level of abstraction as to whether or not two or more activities are seen as proceeding simultaneously. For example, a person may be said to be engaged in the activity of writing. At a further level of abstraction, this activity can be seen to be comprised of a number of activities such as manipulation of a pen, thinking, smoking, as well as a number of states of being, sitting on a chair, at a desk, etc. At this deeper level of abstraction, the activities are occurring in a continuous stream in certain states. At an aggregated level, the activities are seen as occurring simultaniously. Further, the state in which the activity occurs links the activity to the stock.

2.42 Participants in activities are generally studied by the analysis of cohorts of the population, and are described as being either actively or passively engaged in the activity. Some activity studies group the population by age, sex, socio-economic level, or race. Other studies, especially those concerned with the understanding of recognisable organisations, group the participants by role: manager or employee, instructor or student, etc. These cohorts are generally related to the

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54. Farbstein, J.: op.cit.
55. Bullock, N. : 'Development of an Activities Model', Cambridge, LUBFS Working Paper 41, 1971.

entire population under study to show the deviation of the particular cohorts from the norm. The reason that populations are categorised into cohorts is to enable predictions about similar cohorts to be made when they are placed within similar situations. Farbstein[56] suggests that better predictive powers may be derived by grouping populations by their activity patterns rather than by role, age, sex, etc. The passiveness or activeness of the participants in the activity is also important. In a single aggregated activity, such as a university lecture, the listeners are defined as being passively engaged while only one participant, the lecturer, is active. In seminars, on the other hand, all the participants are actively engaged, albeit not at the same time. Information about the passiveness or activeness of all the participants develops awareness of the need for proximity of one participant to another. For example, a lecture could be (and often is) delivered over television, close proximity of the active and passive participants not being critical to the success of that activity. On the other hand, activities in which all the participants are engaged actively usually requires the close proximity of those participants to each other for the activity to be carried on successfully. Cowan[57] has utilised this description of the participants to establish how and at what frequency people interact in an urban university location. By means of a 'sociograme' he recorded the frequency of communication by the participants as well as the mode of communication used (face-to-face, telephone, etc.) to yield 'bonds of relative strength' between the participants. Thus, he was able to

56. Farbstein, J.: op.cit.
57. Cowan, P.: 'Networks of urban activities: internal and external links in an urban university', London, Joint Unit for Planning Research, 1971.

base the need for physical proximity on communication[58].

2.43 The location of activities[59] (or their aggregated use) has received a great deal of attention in the past few decades. It is generally dealt with in two main ways: statically - the relationship and distance between activities, and dynamically - the study of the movement between activities. Most locational studies ask the question: Why do activities locate where they do?, while others are more concerned with how the time spent moving between activities may be minimised[60]. Activities or uses locate spatially for a number of economic, social, legal or technological reasons. If stock exists in the area where the use is likely to be located, it may or may not fulfill the requirements of that use. If it does not, the use will possibly be moved to another suitable location. However, if the locational attractiveness is strong enough, the stock will either be altered to fit the requirements of the use, the use or its pattern of activities may be altered to fit the stock, or the stock may be replaced by another which more nearly fulfills the requirements of the use.

2.44 The duration of the activity will also effect the use of the

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58. Also see: Meier, R.L.: A Communication Theory of Urban Growth, Cambridge (Mass), the MIT Press, 1962. This technique was first developed in office landscaping techniques and extensively used by the Quickboner Team in Germany and the United States.
59. Also, see Appendix 1.
60. This, for example, is the case with the work by most researchers in university activity patterns. However, other authors, such as Lynch and Alexander, do not see the time spent in moving between locations of activities as 'lost' time and therefore time which should be minimised. Rather, they see it as useful and meaningful activity in its own right, which provides for a number of chance encounters and unprogrammed interactions with other humans/...

stock. The description of duration is usually studied in terms of artificial (as opposed to natural) time[61], the beginning and ending of the activity being noted. This, of course, assumes an aggregation of activities. Farbstein[62] suggests that activity duration may be thought of as being either linear or cyclical in nature. Linear duration is the measure of more or less discreet, non-recurrent events occurring sequentially. Cyclical duration, on the other hand, is the common reoccurrance of patterns of activities or sequences of events[63]. Chapin and Logan[64] suggest four main types of cyclical duration; three artificial and one natural: the day, week, year, and lifetime. The duration of activities as well as their cyclical or linear nature affect the intensification of the utilisation of the existing stock to a much greater extent than they affect the life-span of the stock. However, the linear duration of the use of the stock may affect its life-span because a change of use may lead to a change in the stock[65].

2.45 The use to which an item of stock is put, or the pattern of activities contained within the stock, is the third critical factor affecting the life-span of the stock. The final factor is the user of the stock, and the characteristics of the user such as type,

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60. (contd.) as well as with the built environment. As such, the richness of the movement channels should be designed to enhance these possibilities. Alexander, C.: 'The City as a Mechanism for Sustaining Human Contact', in Ewald, W.R. (ed.): Environment for Man: The Next Fifty Years, Bloomington (Ind.), Indiana University Press, 1967. Lynch, K.: Image of the City, op.cit.
61. See section 2.3.3.
62. Farbstein, J., op.cit.
63. For example, daily occurrences such as waking, washing, eating, working, eating, working, eating, relaxing, sleeping, may be seen in a linear sense or as cyclical in nature over a number of days.
64. Chapin, F.S. and Logan, T.H.: 'Patterns of Time and Space Use', in Perloff, H. (ed.): The Quality of the Urban Environment, Washington, D.C., Resources for the Future, 1967.
65. See Chaps. 7 & 8.

size and knowledge or information about the other factors. It is the user's action or inaction, based on perception, which will ultimately affect the other factors[66] which affect the life-span of the stock.

2.6 THE USER

2.46 The user of an item of stock is generally thought of as the person who is engaged in the activities contained within that item of stock. In the context of this thesis, however, the term user has a somewhat more general meaning. For example, the owner of an item of stock may not be directly engaged in any of the activities contained within the stock, but he uses the stock in order to earn income. Similarly, members of the public, while not engaged in any activities within an item of stock, may use it as a reference point (or point of orientation), or obtain goods and services from the stock. The type of users may, therefore, be categorised as directly or indirectly using the stock, and as having a financial interest or not in the stock. The types of users are:

1. Owner/Occupier: Having direct use and financial interest in the stock.
2. Occupier: Having direct use, but no financial interest in the stock.
3. Owner: Having no direct use, but financial interest in the stock.
4. The Public: Having no direct use or financial interest in the stock.

2.47 The manner in which each of these users will perceive an item of stock will vary enormously, thus the perception of its usefulness,

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66. Except the natural factors, see section 2.3.5.

and hence its life-span, will also vary. Further, the users, who collectively affect the operational factors (except the natural factors) will individually be affected by those factors. On the other hand , individual users as well as the users collectively may affect the physical factors as well as the use to which the stock is put, as well as being affected by the use and the physical factors.

2.48 The perception of the users about the factors which affect the life of the stock is affected by their type and will thus structure their hierarchy of the factors. For example, one user (an owner) may consider the primary usefulness of an item of stock as a means of earning income. Thus, the life of the stock will be perceived as being primarily controlled by the economic factors. Another user (a member of the public) may be more conscious of the architectural heritage that the stock represents, thus affecting his perception of the stock's usefulness and life-span. The perception of the user is not only dependent upon his type, it is also dependent on his knowledge of the factors and their forces. Imperfect knowledge will lead to a different conclusion as to the useful life-span of the stock, than would perfect knowledge of the factors. The user's knowledge may be said to be obtained in two basic ways: from past experience, either personal or gained through external media, and new analysis, again acquired either through personal effort or outside inputs. It should be obvious that as more knowledge is gained, the user's perception of the usefulness of the stock will change.

2.7 CONCLUDING REMARKS - NETWORK OF THE FACTORS

2.49 The factors which affect the usefulness and hence the life-span of the existing stock of urban buildings - the operational factors, the physical factors, the use and the user - may be related to each other in a theoretical 'network'[67]. Figure 2.2 represents that network. The usefulness (or uselessness) of an item of stock can be described in terms of the match or mismatch (fit or misfit) between the physical factors of the stock and its site and the use to which the stock may be put as perceived by the users and influenced by the operational factors. This match or mismatch is not static, but will vary over time as the operational factors change in response to the collective users. The individual user will change his knowledge of the operational factors in response to these changes and if the user is in control of an item of stock, may also change that item of stock. As previously explained, the hierarchy of the importance of the operational factors may be described in terms of the location of the stock within the urban environment. The social and economic operational factors, in general, assume the most importance, but their relative importance is determined by the location of the stock within the urban environment.

2.50 Before discussing in more depth the social and economic factors as well as an empirical investigation of the effects of location on these factors, and the life-span of the stock, it is first important to examine the effects of change on the factors.

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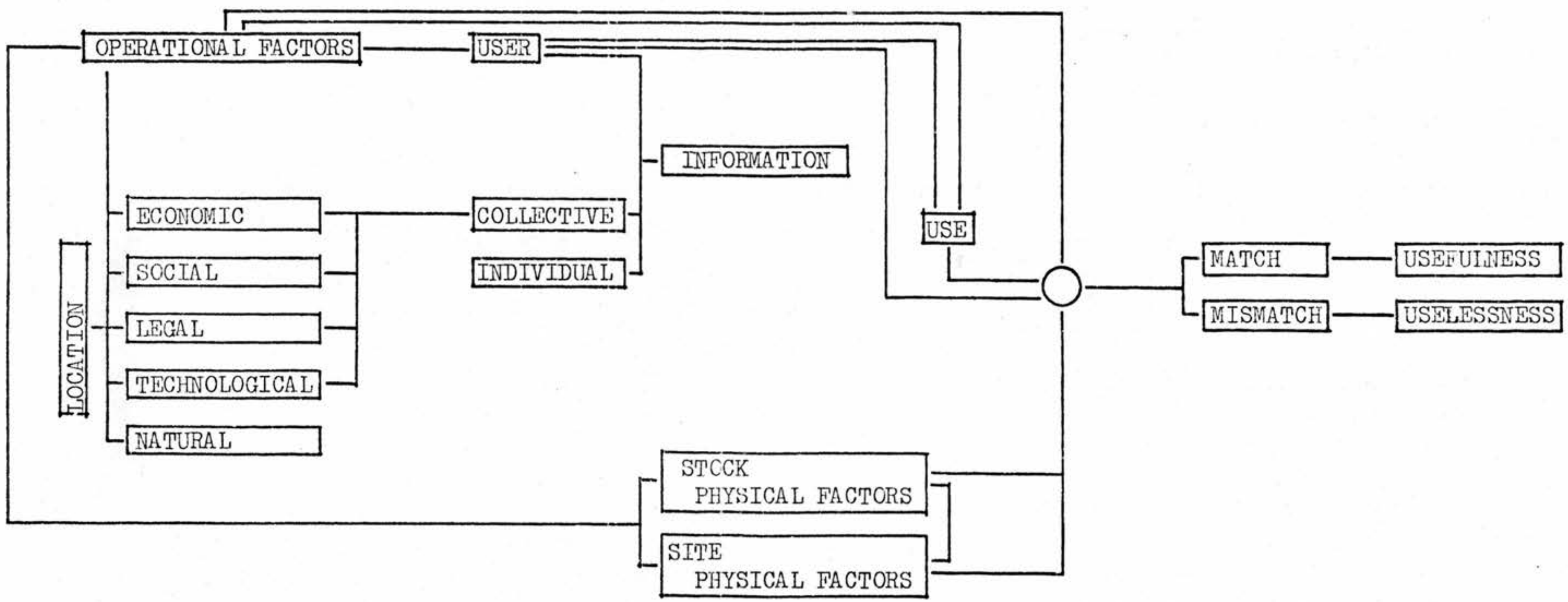
67. The term 'network' is used somewhat loosely here. It is not intended to represent a 'network analysis' of a system as the term is used in operations research; rather it is used as a structuring device to demonstrate how the factors are related to each other and thus to the usefulness of the stock. For a description of 'network analysis', see: Ackoff, R.L. and Sasieni, M.W.: Fundamentals of Operations Research, New York, John Wiley, 1968.

FIGURE 2.2: NETWORK OF THE FACTORS AFFECTING THE LIFE-SPAN OF THE EXISTING STOCK



PART ONE

CHAPTER THREE

THE EFFECTS OF CHANGE OF THE FACTORS AFFECTING THE LIFE-SPAN OF THE EXISTING STOCK

3.1 INTRODUCTORY SUMMARY

3.01 The operational factors, the use and the users of the stock, change over time. If the stock is to remain useful, it must also change in response to the changes in the factors. This will normally require the physical adaptation of the stock. Changes in four of the factors (three economic and one social) are examined theoretically as to their relationship to the alteration of the stock. These are: interest rates, value of the stock, the amount of capital available for construction and the size of the population.

3.2 INTRODUCTION

3.02 The operational factors which affect the life-span of the existing stock of urban buildings are not static; rather, they change over time. This change in part continuously restructures the effect that they have on the life of the stock. The user and use of the stock are also changing over time; both by replacement and alteration; the manner in which the stock is utilised, the size and organisation of the use and user and the perception and knowledge of the user. Similarly, the existing stock and its physical factors are not static, but are changed in response to the changes of the operational factors, the use and the users of the stock. Thus, as one may describe the network of factors (Fig. 2.2) as a system, it should be seen as a dynamic system.

3.03 The change of the factors over time is the result of either positive or negative action on the part of one or more of the users, that is, a user (owner) may decide to invest financially in an item of stock and precipitate a physical change to enhance the value and use of that item of stock. On the other hand, an owner may decide not to take any direct action in which case the stock will be indirectly affected by the action of other owners in relation to their stock which is in the immediate neighbourhood. Therefore, in regard to a single item of stock, a change may be said to be either directly or indirectly instigated.

3.04 Change may also be thought of as being either evolutionary or dramatic. The distinction between the two concerns the rate at which the change occurs. To use the natural operational factors as an obvious example, change may be the result of slow, undramatic natural processes such as the interaction of rain, wind and temperature over a long period of time; or it may be due to the dramatic effects of earthquake, floods, etc. Similarly, change in the stock may be the result of the action of all of the operational factors over time, or the result of any one, such as a redevelopment plan, in a relatively short period of time.

3.05 At the point in time when an item of stock is constructed, the operational factors have a certain relationship to each other. This relationship determines, to a large extent, the users of that item of stock (owner and occupier) and the use to which it is put. The use, users and the operational factors, determine the physical factors of the new building. Over time, the relationship between the operational factors, the use and users, and the stock, changes; the change precipitating the obsolescence of the stock. The life-span of the stock is determined not only by the rate of change of these factors, but how well the stock is able to be physically adapted or altered to accommodate these changes. Prolonging the life-span of the stock would therefore take one of two basic forms: adapting the stock to match the changes in other factors, or regulating the effects of change of the operational factors, use and user, so that the usefulness of the stock as it is continues.

3.3 ADAPTATION OF THE STOCK

3.06 Adaptation of an item of stock, changing its physical factors, is affected by the change in the relationship between the operational factor, the use and user of the stock, and the stock itself. Adaptation may be physically possible, but not economically, socially, etc. viable. On the other hand, adaptation may be economically, socially, etc., feasible, as well as in accord with the needs of the use and user, but not physically possible, except by the replacement of the stock. The life-span of an item of stock may, therefore, be directly related to its physical adaptability.

3.07 The adaptability of the existing stock has been one of the most intensely studied aspects of architecture in recent years. As with many new fields, the exact meaning of the terminology is often confused and the underlying basis of the need for action left unrecognised. Adaptation of the stock is normally said to be caused by the change of use or the pattern of activity in the stock. As discussed in Chap. 2, the operational factors lay behind the changes of use and user, and thus are the primary cause of the need for adapting the stock. Adaptation may be described as making the difference between the usefulness or uselessness of an item of stock or making a useful item of stock more useful (or more efficient).

3.08 One of the key problems with studies of the adaptability of the stock is how they analyse and describe the causes of adaptation and the potential of the stock to be adapted. In most cases, these studies describe the physical changes needed in order to accommodate a changing pattern of activity[1]. Does the site allow the building to be expanded horizontally? Does the structure allow it to be expanded vertically? Can the walls be removed?[2] These questions, while necessary, are generally the last that need to be asked. As stated above, the ability of the stock to respond to the changes in the operational factors and their effect on the use and user (which does not necessarily mean physical adaptation) is of first importance. Professor G.B. Oddie[3] has developed this theme in a similar manner. He states that the adaptive potential for the stock, its flexibility, is related to three concepts: modular courseness, adaptability and polyvalence. The first term is related to modular co-ordination of the components of an item of stock in that the greater the modular

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1. Andrew Rabeneck and his colleagues have described the need for a time scale of physical change. For example, does the wall need to be changed once a week, once a month or once a year. By time scaling the need for change and the components of the stock affected by that change, the potential adaptability of stock may be described. Rabeneck suggests that short-term change be described as flexible, while long-term change be described as adaptable. Rabeneck, A. et al.: 'Housing - Flexibility/Adaptability?', Architectural Design, February 1974.
2. Rabeneck et al. also suggest that physical adaptation may be termed add-in, add-on, or alteration. Add-in refers to increasing the floor area within the existing building's envelope; for example, gaining space by physically altering the attic so that it becomes useful or vertically sub-dividing a high ceilinged room. Add-on is extension of a building either horizontally or in some cases vertically. Alteration refers to the reorganisation of the existing floor area, while gaining no space, but making the building more useful, for example, changing the internal partitions. Rabeneck, et al.: 'Housing - Flexibility?' Architectural Design, November, 1973.
3. Oddie, G.B.: 'A Strategy for Felxibility in Educational Buildings', Paper delivered at UIA Conference, East Berlin, 1974.

courseness, the less flexibility in planning. Adaptability refers to the capacity of the stock to be physically altered to meet changing demands; that is, to be added to, altered, etc. The third concept, polyvalence[4], is related to the chemical term 'valence' or the power of one element to combine with another. Polyvalence, therefore, is the ability of one element to combine with many. An item of stock, (an element) which has the characteristic of polyvalence would, therefore, have the ability to combine with, or be 'adapted' to, the changes in the operational factors (the other elements). Thus, the usefulness of the stock would continue and the life-span of the stock would be prolonged. Oddie further suggests that the concept of polyvalence is related to the 'mix' of spaces within the stock: a proper 'mix' for different activity patterns giving polyvalence. As will be discussed in Chap. 8, the 'mix' of space for different activity patterns depends not only on the use of the stock, but also on the type and size of the users involved.

3.4 CHANGES OF SOME OF THE FACTORS AND THEIR EFFECT ON THE LIFE OF THE STOCK

3.09 In Chap. 2, it was concluded that the two most important operational factors generally were economic and social and that their importance was strongly related to location. Because of the intricacies of these factors, only a few will be examined theoretically in this section, while a more extensive examination will be developed in Chaps. 4 & 5. The four factors, three economic and one social,

4. For a similar use of the term, see: Alyward, G. and Lapthorne, K.: 'Designing for Stability in Designing for Change', Cambridge, Cambridge University, Department of Architecture, Technical Reserarch Division, Working Paper 3, June 1974.

which will be examined here are: the change in the value of the stock, the change in interest rates, the change in the amount available for construction, and the change in population.

3.4.1 CHANGE OF VALUE

3.10 The economic value of an item of stock may be described in a number of ways. It may refer to the price paid for that item of stock, the profit derived either directly (through leasing) or indirectly (through the use of the stock for the sale of goods or services) from the stock, or, as in this section, value may mean rateable value or the value derived for taxation purposes. The present system of rateable valuation in Great Britain was developed during the mid-nineteenth century and is at present interpreted (for Scotland) by the Valuation and Rating (Scotland) Act 1956[5]. This Act instructs the Assessors of the value (who are employed by the national government) to assume a balanced market, with neither scarcity nor surplus of stock and to calculate assessments using whatever rental and sales price information is available. It also gives statutory guidance in the 'factors'[6] which affect the value[7] of the stock and thus form the basis for assessment. These 'factors' include the size of the building, its age and condition, its location, the general amenities of that location, whether the assessed area is part of a building such as a flat or a complete building, and the use of the stock. The Act also provides for periodic re-assessment of the value, so that it may be adjusted not only to changes in the above 'factors', but also

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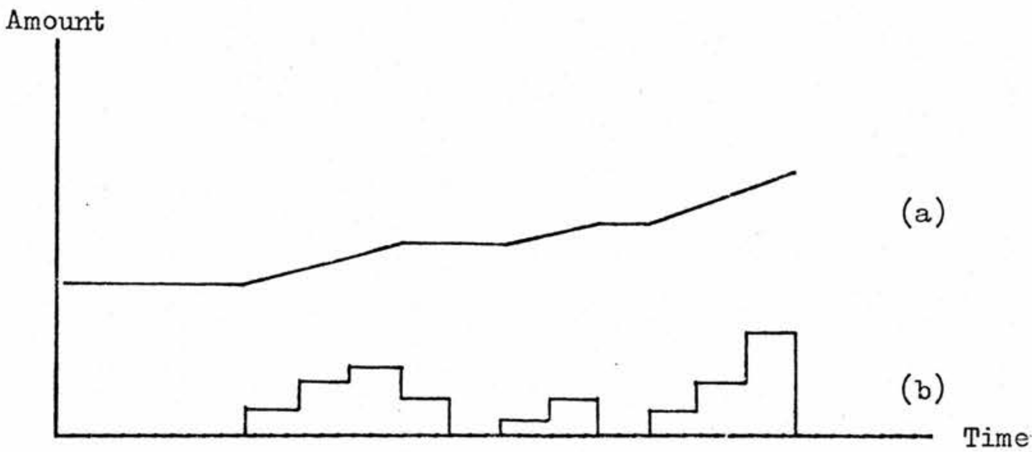
5. Valuation and Rating (Scotland) Act, 1956: London, HMSO, 1956.
6. These are the 'factors' officially recognised and are not to be confused with the factors discussed elsewhere in this thesis. See Chap. 2.
7. Meaning rateable value unless otherwise stated.

reflect inflationary trends.

3.11 The value of the stock may be discussed in adjusted or unadjusted monetary terms. Theoretically, since the value is adjusted periodically to allow for inflation, the unadjusted and adjusted values should be the same. However, in practice this does not seem to be the case, except during the last decade[8]. The unadjusted value of the stock should also reflect the change of use of the stock as well as its physical adaptation. It appears, however, to be more sensitive to replacement than to adaptation[9]. However, the adjusted value appears to be equally as sensitive to both adaptation and replacement if they are measured as the rate of change of the stock[10]. Therefore, while in theory the unadjusted value is sensitive to changes of use, the stock and inflationary trends, in practice the adjusted value is actually more sensitive.

FIGURE 3.1: THEORETICAL RELATIONSHIP BETWEEN VALUE OF THE STOCK AND CHANGE OF THE STOCK



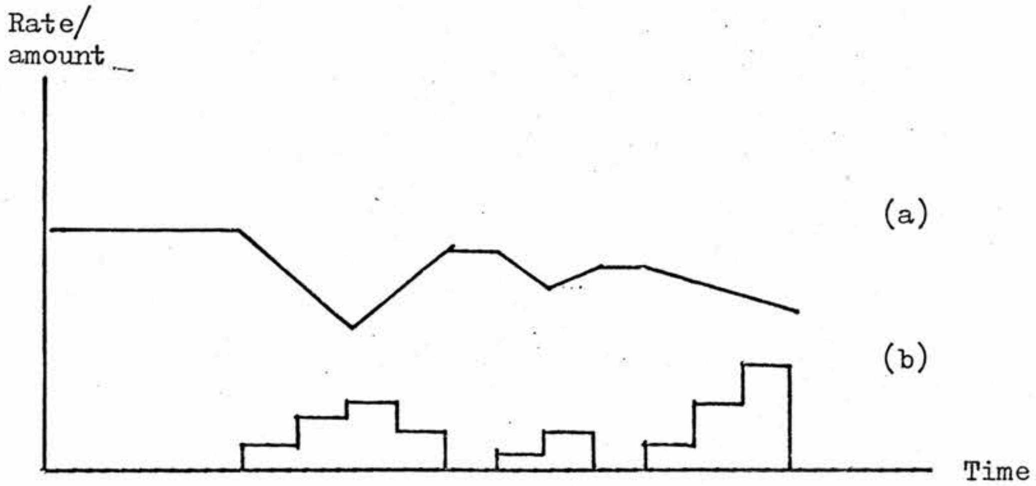
Notes: (a) Value (unadjusted) (b) Amount of change of the stock.
Source: see section 3.4.1

8. See Chaps. 7 & 8.
9. See Chap. 8.
10. See Chap. 8.

3.4.2 CHANGE OF INTEREST RATE

3.12 Interest rates are related to the life-span of the stock in three main ways: the cost of maintenance and adaptation, total capital cost of the stock, and the ability or willingness of users to borrow money to construct, alter or maintain buildings[11]. Lewis[12] has shown that in the British experience, interest rates and the amount of new building are inversely related. That is, when interest rates are high, due to a tight monetary policy or shortage of available finance brought on by external conflict, etc., new building activity is low. On the other hand, when interest rates fall, the amount of new construction rises. What has not been previously investigated, until this thesis, is the relationship between the change of interest rates and the location of new building within an urban environment and the relationship between the change of interest rates and alterations of the stock[13].

FIGURE 3.2: THEORETICAL RELATIONSHIP BETWEEN RATE OF INTEREST AND CHANGE OF THE STOCK



Notes: (a) Rate of interest (b) Amount of change of the stock.
Source: See section 3.4.2.

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11. For more discussion on these points, see Chap. 5.
12. Lewis, J.P.: op.cit.
13. See Chaps. 7 & 8.

3.13 Interest ratas themselves are affected by a number of 'factors'. Lewis[14] cites the Usury Laws of the eighteenth century as one of these 'factors'. These Laws prohibited borrowers of capital (other than the State) from offering or lenders receiving more than 6% interest (later changed to 5%). He also states that once the Yield on Consuls[15] had reached 3.5 or 4%, the rate of interest was pushed beyond 5%, which was, however, forbidden. Thus, the lending of capital ceased, as did building activity until the Yields increased. In turn, the Yields were affected by external conflicts such as the American Revolution as well as by more mundane matters such as crop failures or bounty harvests. For example, the good harvest of 1843 allowed a large amount of both public and private debt to be converted, thus lowering the rate of interest and stimulating new building activity. Interest rates are also affected by the amount of reserves which are held. For example, in 1857 the bank rate rose to nearly 10% because reserves had fallen to a mere ½ million pounds (which was precipitated by the October 1857 collapse of rail bonds in the United States).

3.14 The relationship between the change of the rate of interest and major alterations of the stock would be expected to be the same

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14. Lewis, J.P.: op.cit.
15. Consols is an abbreviation of Consolidated Annuities, the government security of Great Britain. It originally consolidated a large number of public securities, including a large part of the National Debt, in 1751 and bore a nominal rate of interest of 3%. This rate was changed in 1889 to 2¾% and in 1903 to 2½%, where it remains today. Mitchell has stated that Yields on Consols are the best continuous indicator of the economy since 1751. Mitchell, B.R. and Dean, P.: Abstracts of the British Historical Statistics, Cambridge; Cambridge University Press, 1962.

as the relationship between interest rates and new building, because the capital to undertake major alterations is also normally borrowed. Minor alterations, however, present a different problem. As the level of new construction drops, the building industry works increasingly below capacity, thus theoretically freeing manpower to undertake work which in more prosperous times would have been considered too minor to be considered. Thus, the level of minor work might be expected to rise. However, this does not appear to have happened. Minor work also appears to have been affected, though not to the same extent, by the change in the rate of interest in a manner similar to that of major alterations and new construction[16]. Also, the building industry is so organised that it does not easily shift its capacity from major new work to minor alterations and maintenance work[17].

3.4.3 CHANGE OF THE AMOUNT OF CAPITAL AVAILABLE FOR CONSTRUCTION

3.15 Capital for building construction is obtained from two primary sources: building societies and directly from the government. The government, of course, will affect the amount available from the building societies. In turn, the amount available, as discussed above, will affect the rate of interest. In general terms, the more available, the less the rate of interest. From this, one would expect a positive relationship between new construction and the amount available, which has indeed been shown to be true of new housing construction[18]. However, what has not been examined previous to this thesis, is the relationship between the amount of capital available and the location of new construction within an urban area and the re-

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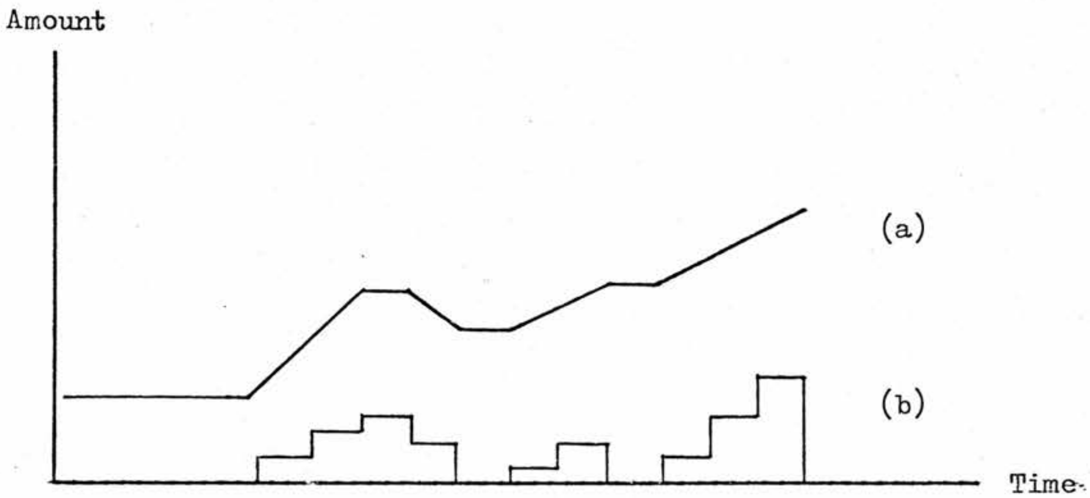
16. See Chaps. 7 & 8.
17. See Chap. 6.
18. Lewis, J.P.: op.cit.

FIGURE 3.3: THEORETICAL RELATIONSHIP BETWEEN THE AMOUNT OF CAPITAL AVAILABLE FOR CONSTRUCTION AND THE CHANGE OF THE STOCK



Notes: (a) Amount available for construction
(b) Amount of change of the stock.

Source: See section 3.4.3

lationship between the amount available and alteration of the existing stock. One would expect to find a similar relationship as discussed above; that is, the more capital available, the more alteration of the stock, the less available, the less alteration[19].

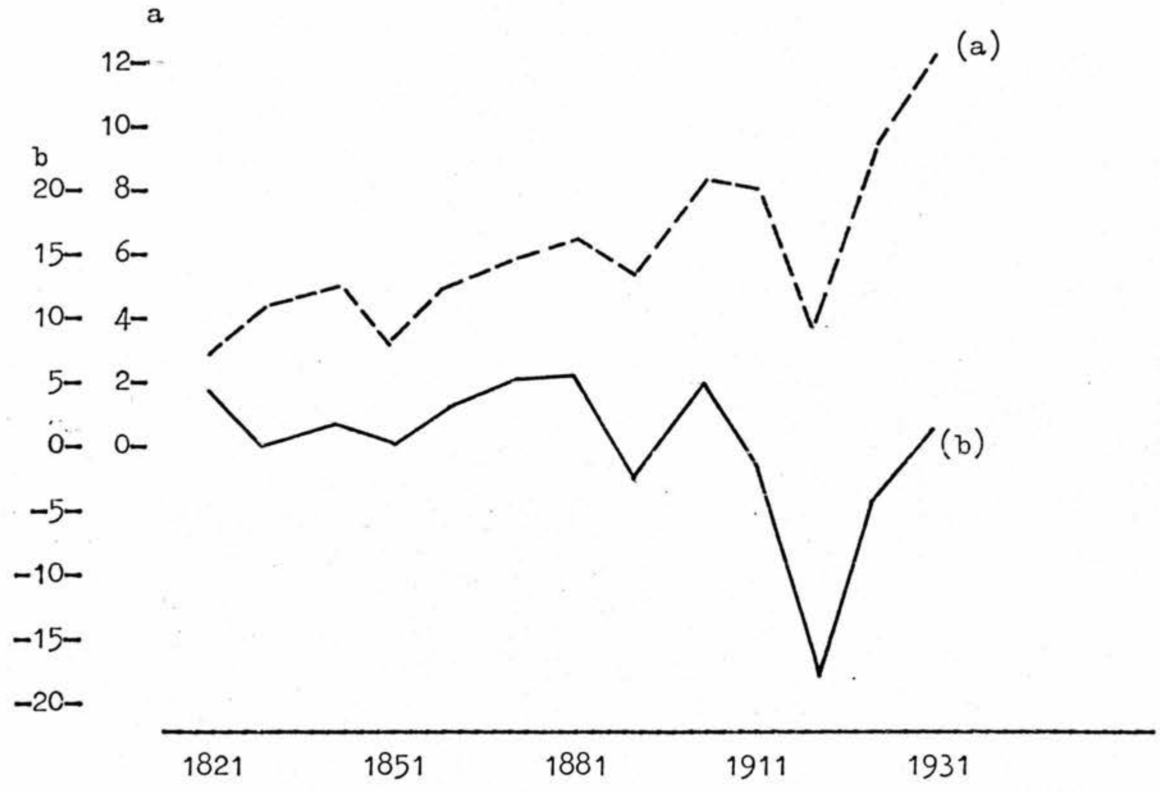
3.4.4 CHANGE OF POPULATION

3.16 The final relationship which will be investigated in detail in the empirical part of this thesis[20] will be the relationship between the change in the population and the change in the stock. Population changes may be divided into change of size, that is growth or decline, stemming from either natural increase or decrease, or from migration; and change of structure, the sex and age mixture, racial and ethnic mixture, etc. The concern of this thesis is mainly with the former,

19. See Chap. 7.
20. See Chaps. 7 & 8.

the change in the size of the population. The natural increase or decrease of a population is a function of the marriage, fertility and death rate of the population. Migration, either immigration or emmigration is mainly a function of economic attractiveness or agricultural productivity.

FIGURE 3.4: RELATIONSHIP BETWEEN CHANGE OF POPULATION AND INCREASE IN HOUSING STOCK, GREAT BRITAIN



Notes: a) Decennial increase in housing stock, Great Britain ('00,000)
b) Inter-decennial second difference in population, Great Britain. ('00,000).

Source: Lewis, J.P.: op.cit., p.165.

3.17 Lewis[21] again provides much of the background information on the reltionships between new building activity, especially housing, and the population change in Great Britain. He found that increased population growth stimulated (with a one to two year lag) the rise in the production of new housing. Further, that the relationship between the marriage rate and fertility rate and new housing rate was similar. More interestingly, Lewis shows that there is a direct relationship between the marriage rate and the state of the economy and the abundance of harvest of basic crops such as grains and potatoes. However, as above, what has not been investigated until now is the relationship between the change in population and the location of new construction in an urban environment and between the change of population and the alteration of the stock[22]. One would expect to find a similar relationship to that of population change and new housing as discussed above.

3.5 CONCLUDING REMARKS

3.18 Before the empirical investigations discussed above between the change of some of the operational factors and the change of the stock is undertaken, it is important to develop more fully our understanding of the effects of different rates and types of change on a society as well as their effect on the life-span of the stock. That is, are certain types and rates of change detrimental to individuals or the society? If so, can they be avoided? How do individuals view change, especially change in the existing stock of buildings? Similarly, a more extensive investigation of the economic cost of change and the life-span of the existing stock is necessary. Finally,

21. Lewis, J.P.: op.cit.
22. See Chaps. 7 & 8.

the capacity of the building industry, the instrument by which physical change of the stock is implimented, needs to be examined. These are the concern of Part Two of this thesis.

PART TWO

CHAPTER FOUR

INFLUENCE OF DIFFERENT RATES AND TYPES OF CHANGE ON SOME OF THE SOCIAL FACTORS: A DISCUSSION

4.1 INTRODUCTORY SUMMARY

4.01 Change is perceived by comparing the past 'state' of a thing with its present 'state'. The rate of change of that thing is measured with the help of time. Evidence exists that too rapid a change, or too radical a change, is both physically and mentally disturbing. This is one of the reasons that the past practices of urban renewal have been called into question. Further, the sense of 'place' given by the existing urban environment is disrupted. However, it is not possible to overcome this problem by strict preservation of the existing stock. Rather, a need exists to regulate the change of the stock, its amount and the manner in which it is implemented.

4.2 INTRODUCTION

4.02 While it is difficult to separate the influences on the life-span of the stock by the different factors, an attempt to do so has been undertaken in the following two chapters, so that two of the most critical (social and economic) can be examined more fully. In particular, the influence of different rates and types of change on the social factors and the society, needs to be examined because the evidence presented below suggests that too rapid and radical a change may be detrimental to the society and to individuals within that society.

4.3 RATES OF CHANGE

4.03 Alvin Toffler[1] in his treatise on change, asks how an individual knows that change is occurring, let alone the general consensus

1. Toffler, A.: Future Shock, New York, Random House, 1970.

that the rate at which change occurs is increasing. The problem arises because nothing in nature is actually static, all things, from amoebas to galaxies, are constantly changing. The perception of change, therefore, must arise out of the differing rates at which all things change. That is, if everything changed at the same rate, change perceived as an on-going process would be impossible. The only perception of change would come from comparing the present state of all things to some known past state. Therefore, the differing rates of change are important for the perception of change as a process and not a 'thing' in itself.

4.04 In order to measure change and the rate at which it is occurring, some device is necessary by which the process may be calibrated. The device most often used is time. Mumford[2] suggests that with the construction of reliable mechanical clocks at the beginning of the Rennaissance, the ability of man to perceive and begin to regulate change was greatly enhanced. Man perceives change in a number of ways. One way, noted above, is the comparison of the present 'state' of things (artificially freezing a moment in time) with a past 'state'. With the aid of time as a measuring device, the rate at which the change occurred can be measured. Another method of perceiving change comes from the novelty of a new 'state': the 'first-time-ever' perception. This state is often used as a mental 'footnote' in time, marking the 'beginning' or 'ending' of an era. For example, the application of assembly-line techniques by Ford to the motor car, is said to represent the beginning of the motor car age. A third

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2. Mumford, L.: Technics and Civilization, op.cit.

method, similar to the preceding one, is the use of political upheavals and wars to mentally distinguish different states. For example, one speaks of pre-war and post-war developments in housing, technology, etc., thus, while change is in reality a process, it is often perceived of as a series of states.

4.05 Toffler[3] suggests that because the occasions which mentally demarcate one age from another are becoming closer and closer together, the perception of change is itself changing in two ways: the perceived rate of change is accelerating and the significance of change is diminishing. It was 1500 years between the birth of Christ and the discovery of the New World, 300 years from that discovery to the invention of the steam engine, 100 years to the aeroplane, 50 years to the atomic bomb, and only 20 years to the landing of men upon the moon. This tremendous acceleration begins to wear the novelty value from these monumental occurrances. This not only causes the need for an even more monumental change to be significant, it also, seemingly, causes people to expect that change on a very large scale must occur. But, is the expectation of rapid, monumental change "healthy" physically and mentally? Physiologically, present-day man is essentially the same as man existing 2000 years ago, man who did not have to cope with the present rate and scale of change. Psychologically, however, we are extremely different, in that we appear to accept and expect the accelerated rate of change. Toffler[4] suggests that our psychological adaptation may not be rapid enough and our physiological adaptation certainly is not. In support of his contentions, he exhibits various items of research from the United States and elsewhere which attempt to establish a cause - effect relationship

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3. Toffler, A.: op.cit.
4. Ibid.

between the rapid rate of change and the rise in mental illnesses (which in turn may manifest themselves in physical disorders). For example, he cites the work of a number of psychophysiologists who have studied the capacity of the nervous system of a number of the higher order animals, including man. They have found that all the systems have a finite capacity for collecting, sorting, storing and reacting to stimulii. If the system is overloaded, it will become confused, a state which will manifest itself in false reactions, disorientation, distortion of reality, or even total mental and physical breakdown. The overstimulation of the nervous system, and the effects of this overstimulation, is what Toffler terms 'future shock'.

4.06 Whilst Toffler may paint a rather black picture of the dilemma of expecting change while at the same time incurring harm from that change, he does offer some hope. He postulates that the current renewed interest in the past, from buildings to dances, is an inbuilt safety mechanism to help individuals to cope with change. By re-emphasising the past, the pace of life may be slowed, at least for a time, and thus allow the nervous system to 'catch-up' on its processing and storing of information, thus decreasing the risk of overload[5].

4.4 SOCIAL DISRUPTION AND CHANGE OF THE STOCK

4.07 In the past few years, a number of critics[6] have discussed

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5. It is extremely difficult to comment on the validity of Toffler's hypothesis, both in connection with the renewed interest in the past and the effect of rapid change on the nervous system. It is made more difficult because his book was written for a popular rather than an academic audience. I believe that his value is not so much in what he says, but in the implicit recognition/...

the detrimental effects of radical physical change of the environment on society, particularly segments of that society which hitherto had been 'closely-knit', easily recognisable social units. They have argued, often quite convincingly, that large-scale urban renewal destroys in a very short period of time the 'neighbourhoodness' which the communities had evolved over a very long period of time. Numerous examples are cited where the intended re-inhabitation by the original population of an area which was redeveloped had not been accomplished due to a number of factors: the 'unexpected' high costs of the new stock making it impossible for the original inhabitants to be able to afford to live in the area; the number of years passing between removal and re-inhabitation during which time the original population had been moved elsewhere; the general trend of renewal areas to decrease density, making it physically impossible for all of the original inhabitants to be rehoused in the area; and the removal and non-replacement of the neighbourhood shops and other places of employment which, while marginally economic in the old stock, are not economically feasible in the new. These criticisms should be very familiar; indeed, a major reassessment of the current urban renewal policies seems to be under way. The social disruption caused by the wholesale replacement of the stock has been recognised and alternative methods of providing housing of sufficient standards, such as selective replacement, rehabilitation, etc., have been experimented with.

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5. (contd.) that he gives to the need to study change as a process which itself can be changed through human intervention, both the rate at which it occurs and the direction which it takes.
6. For example, see: Friedan, B.J.: op.cit. Jacobs, J.: The Death and Life of Great American Cities, New York, Vintage Books, 1961. Wilson, J.Q.: op.cit.

4.08 These arguments also help to illuminate the symbolic concept of 'place' which is derived from the existing stock. A concept which has been studied by a number of disciplines. Sociologists[7] have noted that juvenile gangs will designate a 'turf' over which they 'rule', allowing no rival gangs to enter the area. Anthropologists[8] have noted the same 'territorial imperative' in the higher order animals. Urbanologists[9] have noted that people are extremely familiar with their neightbourhoods (places) but only recognise particular landmarks outside their immediate environment. By uprooting the population, or radically changing the physical environment, this sense of 'place' is destroyed.

4.5 ORIENTATION, RECOGNITION AND CHANGE OF THE STOCK

4.09 The existing stock, as well as lending a sense of place, also introduces mentally a series of 'maps' - signs and symbols - which allow one to move from place to place. These maps have been shown to vary from culture to culture, thus, are said to be culturally rather than genetically produced[10]. Lynch[11] has defined five basic types of elements, comprised of the existing 'stock'[12], which serve to shape these mental maps. They are:

1. paths - channels such as streets, walkways and transit lines, along which pedestrians and vehicles move; the possible routes between the existing stock of buildings;

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7. Patrick, J.: A Glasgow Gang Observed, London, Eyre Methuen, 1973.
8. Ardrey, R.: Territorial Imperative , London, Collins, 1967.
9. Lynch, K.: Image of the City, op.cit.
10. See: Kepes, G. (ed.): Sign, Image and Symbol, New York, George Braziller, 1966. Morris, C.W.: Foundation of the Theory of Signs, Chicago, University of Chicago Press, 1938.
11. Lynch, K.: Image of the City, op.cit.
12. The term 'stock' is used here somewhat more broadly than in the rest of this thesis. See following.

2. edges - paths which are used to define districts;
3. districts - medium or large sections of the urban environment usually having a two-dimensional quality, where the pedestrian feels he is either 'inside' or 'outside' of;
4. nodes - strategic points in an urban environment which serve as focal points for a number of paths such as a traffic circle or railway terminal, or serve as the focal point of a district, such as a green square, or park, or a particular building; and
5. landmarks - physical objects, such as a building, a hill or a sign, which serve as a reference point to the pedestrian and allows him to know his location (orientation), estimate his time of arrival at his objective and regulate his direction of travel.

The importance of the existing stock to the orientation of an individual should be apparent. The replacement of the stock at too rapid a rate could lead to disorientation, both in the sense used here and in the sense used by Toffler in the preceding section.

4.6 CONSERVATION/PRESERVATION OF THE STOCK

4.10 Thus far, it has been argued that the retention of the existing stock is socially valuable because it is helpful in retaining a psychological balance in an era of rapid change, and that it gives a sense of place to inhabitants and that it is a device which helps to facilitate movement by structuring mental 'maps'. But, since one cannot retain all of the stock for all time, because of the pressures of population and economic growth, naturally caused deterioration, technological change, etc., a method has had to be devised by which to measure the relative value of the stock to society. This method, the preservation and conservation of 'precious' buildings, is based on the standard of the 'architectural' or 'historical' importance of an item of stock to the society as a whole. A number of problems arise, however, from the laws enacted to ensure the preservation of these items of stock. While an item of the existing stock may be perceived to be important to the society as a whole, it may not be perceived as worthy of preservation by its owner, usually because it impedes his maximising the profits which could be accumulated by replacing the stock with a larger item of stock[13]. Thus, while increasing the physical life-span of the stock, these laws do not necessarily increase the economic or useful life-span of the stock (as perceived by the owner). A second problem is that preserving a single item of stock, while allowing its immediate neighbourhood to change, will alter the item's worth by placing it out of context. A number of ways to rectify this problem have been developed, including the conservation of entire districts[14] or the preservation of whole towns[15].

4.7 CONCLUDING REMARKS

4.11 The social costs and benefits of retaining the existing stock in general and prolonging its life-span are exceedingly hard to measure

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13. An interesting experiment to circumvent this problem has been developed in Chicago and involves what is known as 'development rights transfer'. This is where the development air-space above a historic building may be sold to surrounding areas, thus procuring income for the stock from other sites. See: Costonis, J.J.: Space Adrift: Landmark Preservation and the Marketplace, Urbana (Ill.), National Trust for Historic Preservation and the University of Illinois Press, 1974.
14. For example, see the New Town area of Edinburgh, north of Princes Street.
15. For example: Williamsburg, Virgina. Interestingly enough, by preservation of the entire town, the items of stock have not only had their physical life-span prolonged, but also their useful/...

in a meaningful way. While the physical life-span of the stock may be easily recognised, (either the item exists physically or it does not) the useful life of the stock (to whom, for what?) and the economic life-span are much more open to interpretation. Also, whilst the costs of social disruption, disorientation, etc., may be described in social terms, they are hard to describe in economic terms. One is also confronted with the problem that what may seem to be socially disruptive today, may in fact be valued socially in the futnre. For example, it is easy to imagine the social disruption caused at the time by Hausseman's rebuilding of Paris for Louis Napoleon. Today, however, it is a much valued social (as well as economic) aspect of Paris. Of course, much of the world has changed since Hausseman 'created' Paris, heavy-handed replanning of cities is no longer socially acceptable, nor politically viable. Nor is it possible to justify social disruption today by citing its possible value to the future. Change must be based on the values of today, not on possible values of the future. (It should be remembered that Paris was replanned not for our benefit but to control social unrest at the time.) In summary, the social costs and benefits of change of the stock and the rate at which that change occurs, must be considered in defining the life-span of the stock.

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15. (contd.) and economic life-spans as well, by creating a totally different useful (as educational, relaxation) and economic (tourist) basis for the town and insulating it from competing uses and economies. While this may be possible on a town or large district scale, it is not possible on the scale of a single building within an urban environment. For further discussion of these points, see: Lynch, K.: What Time is this Place?, Cambridge (Mass.): the MIT Press, 1972.

PART TWO

CHAPTER FIVE

INFLUENCE OF THE ECONOMIC FACTORS ON THE LIFE-SPAN OF THE STOCK: A DISCUSSION

5.1 INTRODUCTORY SUMMARY

5.01 The economic life-span of an item of stock is generally shorter than its physical life-span, while the useful life-span of the stock depends on the users of the stock. The costs involved in the economic life-span of the stock are divided between initial costs and costs in use. While the economic life-span of the stock is generally deemed to be determined by the repayment period of the initial costs, a more exact measure of the economic life-span must take into account the costs in use. A critical question concerning the life-span of the stock is whether it is more economic to prolong that life-span (rehabilitate the stock) or complete the life of the stock (replacement by new stock). While overall, it appears that the former is more economically viable, it may not be so for all of the interested parties. Further, a basic question concerning the ability of the construction industry to undertake either rehabilitation or replacement of the stock needs to be investigated.

5.2 INTRODUCTION

5.02 It is a well accepted fact that the economic life-span of the stock, particularly the privately-owned stock, is generally shorter than its physical life-span[1]. It has also been argued that the economic life is much more important than the physical life and that the planned life of buildings should reflect this fact[2]. The economic life-span of the stock is generally regarded as the amount of time that it takes to amordize the capital costs of the stock (normally between twenty and sixty years, depending on the size and type of

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1. For example, see: Seeley, I.H.: op.cit. Stone, P.A.: Building Economy, op.cit.
2. Switzer, J.F.Q.: 'The Life of Buildings in an Expanding Economy', The Chartered Surveyor, August, 1963.

the use and user of the stock[3]), while the physical life-span normally exceeds one hundred years or more depending on the amount of maintenance expended and the soundness of the original construction[4]. Thus, one is faced with an exceedingly short economic life, which is in conflict with the physical and useful life-spans.[5]

5.3 COSTS INVOLVED

5.03 The economic costs involved in the life of an item of stock may be divided into initial costs and costs in use. Initial costs are the cost of erecting the building, including professional fees, such as design and document fees, material and labour construction costs, and the costs of furnishings, fixtures and equipment for use in the stock. Costs in use include the repayment of loans undertaken to cover the initial costs plus the interest on those loans; running costs, such as the cost of electricity, water, gas, etc; maintenance costs, such as cleaning and repairs; adaptation costs; and the cost of insurance and taxation. The cost of demolishing the stock at the end of its life-span could also be included in the total economic costs of the stock. To balance the costs involved, the private user

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4. With a high level of maintenance, the physical life-span of an item of stock could be extended indefinitely. However, the physical life-span is not, in reality, a single entity. Different parts of the item will have different physical (as well as economic, functional, etc.) life-spans. For example, paint will have a physical life-span of 5-10 years, while the structural system's life-span, assuming proper installation and no discontinuity of integrity by alteration, will easily exceed 100 years.
5. The useful life-span of an item of stock, of course, depends on how one perceives the usefulness of the stock; as an economic investment, as a physical representative of the past, as a functional representation, etc.

will derive income either directly from the stock, by its rental or sale, or indirectly, by earning income through the building by the sale of goods or services, or by earning income in other items of stock. Publically-owned stock, such as hospitals, schools and universities, on the other hand, will derive only a small part of their income directly from the use of the stock, usually through the sale of services. The major portion of their costs will be borne by the government (either national or local) by subsidies granted towards the cost of the stock. The finance of the subsidies to the publically-owned stock will, of course, be derived in part from the taxation of the privately-owned stock.

5.3.1 INITIAL COSTS

5.04 Initial costs consist of professional fees, the cost of construction of the stock, including site work such as roads, services and landscaping, and the cost of fixtures in the stock. They may also include the cost of demolishing an existing item of stock. Initial costs will obviously vary depending on the size of the building constructed and the degree of quality of the materials used in the stock. They will also vary due to the shape[6], use[7] and location[8] of

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6. For a discussion of the effect of the shape of a building on its initial costs, see for example: March, L.: 'Elementary Models of Built Form', in March, L. and Martin, L. (eds.): Urban Space and Structure, Cambridge, Cambridge University Press, 1972. Seeley, I.H.: op.cit. Treqenza, P.: 'Association between Building Height and Costs', Architects' Journal, 1 November 1972. Treqenza, for example, shows a comparison of the costs per square metre of fourteen office buildings built between 1942 and 1971 (with the costs adjusted to 1971 prices) between one and eighteen storeys high. He found that costs overall ranged from £72/m^2 for the one storey building and rose steadily to over £120/m^2 for the 18 storey structure. If one takes into account the amount of useable (rentable) floor space, which decreases per floor with height, the costs range between £74/m^2 to £225/m^2. He was careful to select buildings constructed for a similar market, thus containing a similar degree of quality.

7./...

the item of stock. Initial costs are usually paid for by borrowing capital in the case of private construction, or by subsidy or in some cases, by the issuing of bonds[9], in the case of public construction. As noted above, the amount of time needed to repay the loan or the bond is usually considered to be the economic life-span of that item of stock.

5.05 Initial costs are also derived from the cost of land for the building. The cost of land varies primarily due to its location and is influenced by its size, shape, encumberances (such as buildings), geological composition, the type of seller and buyer[10], as well as by the date at which it is sold. Richardson[11], in a survey of land

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7. It should be obvious that the use of a building will have an effect not only on the total costs, but on the component parts of that cost. For example, Seely gives the following figures (in 1971 prices):

Use	Cost/m^2 (£s)
factory workshop	40–50
semi-detached house	35–50
office block	60–100
bank	100–150
hospitals	90–140
department stores	75–90
churches	80–120
schools	55–75

In housing, the initial costs of services are approximately 5–10% of the total initial costs, whilst with hospitals, they may run as high as 50–60%. Seeley, I.H.: op.cit.

8. For example, Stone found a 30% difference in the building costs for identical houses (exclusive of land) in London and the North of England. Similar conclusions were reached by the Department of the Environment about the costs of local authority offices. Department of the Environment: Local Authority Offices: Areas and Costs, London, HMSO, 1972. Stone, P.A.: Urban Development in Britain: Standards, Costs and Resources 1964-2004, Vol. 1, 'Population Trends and Housing', Cambridge, Cambridge University Press, 1970.

9. A case in point being the construction of public housing in New York City by the Central Development Agency (CDA). This/...

purchases by the local authority in Edinburgh between 1952 and 1967, found that the most important determinants of land prices were: the date of the sale and the distance of the site from the city centre, with "time overshadowing distance"[12].

5.06 The initial costs of an item of stock are usually budgetted separately from the costs in use. This gives a different representation of the total costs over the life-span of an item of stock than if they were budgetted together. Initial costs reflect not only on the interest paid on loans and the length of time over which the capital is repaid, but also on the amount of maintenance and repair which is necessary over the life of the stock[13]. For example, an initially cheaper material may be used instead of a more expensive one, but it is likely to be less durable, thus increasing future maintenance and repair costs. The determination of which material overall is more economical is extremely difficult. In order to determine the overall economics, the physical life of the alternative materials must be known as well as the degree of maintenance that each will require. Further, the life-span of the stock, the rate of interest and inflation over that life must

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9. (contd.) method in New York is in financial difficulties of late because of the chaotic state of the City's finances.
10. For example public purchase costs of land may be below private costs as local governments usually have the right of eminant domain and may purchase a site at a 'fair' (as opposed to the highest) market price.
11. Richardson, H.W., et al: 'Land Prices in Edinburgh: 1952 - 1967', Scottish Journal of Political Economy, Vol. 21, No. 1, February 1974.
12. Richardson, H.W. et al: SSRC Grant No. HR 946/1 - 'Final Report', May, 1974. (Supplied to the author by R. Furbey.) The reason that the time factor was more influential was due to the rate of sinking in the value of the pound during the years studied.
13. Browning, C.D.: Building Economics and Cost Planning, London, B.T. Batsford, 1961.

also be taken into account. In order to compare the economics of the two materials, these factors must be known or assumed. Once this is done, the comparison is rather simply through the use of the principle of discounting future costs[14]. However, since it is almost impossible to know or even assume with any accuracy these factors over 60 or 100 years life-span of the stock, discounting techniques are extremely suspect as to accuracy over the physical life of an item of stock.

5.07 Nevertheless, the principle is used to some extent today and is worth a brief examination. The discounting principle is based on the premise that capital not initially spent would be invested elsewhere and would thus be earning interest. For example, £100 invested at 5% compound interest will accumulate £168.88 at the end of ten years. (Inflation, however, running at the same rate, would mean in real terms the capital would be worth only £100). In the following example of the principle, the inflation rate is ignored. The life of the stock as well as alternative live-spans of one of the elements is also assumed (60 years and 30 and 60 years respectively) so that the principle may be illustrated. An element (A) lasts 30 years and has an initial cost of £500. An alternative element (B) lasts 60 years and

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14. The basic expression for discounting is: $P = \frac{S}{(1+r)^n}$ where:

P = present value of sum invested
S = value of sum at the end of term of years
r = rate of interest
n = number of years invested.

Discounting enables one to calculate the present worth of payments occurring in the future so that theoretically one can compare alternative design solutions not only on the basis of their capital cost but also taking into account their maintenance and operating costs, which must, of course, be assumed. For further discussion see: Drake, B.E.: 'The Economics of Maintenance', The Quantity Surveyor, July/August, 1969.

costs £750 initially. (The normal maintenance required by each is the same per year, thus it can also be ignored.) In order to have £500 in 30 years, to replace element (A), £115.69 must be invested today at 5%. Thus, the total cost of element (A) is £500 + £115.69 = £615.69. Thus, element (A) is £134.31 less expensive than element (B) over the life of the stock (£750 - £615.69).

5.08 The economic effect of errors in predicting the life of the stock is illustrated in Table 5.1. Errors may arise from a change in the factors or the strength of their forces, which affect the life of the stock[15]. From the table, it could be argued that errors of a lower actual life are less economical than errors of a life-span greater than that predicted. Whether this is so or not, of course, depends on the rate of interest and inflation.

TABLE 5.1: ECONOMIC EFFECTS OF ERRORS IN PREDICTING LIFE OF BUILDINGS

Life X (Years)	Annual Equivalent per £100 of initial cost with interest @ 5% (£)	Percentage Errors when Life taken as X instead of:	
		40 (years)	60 (years)
20	8.02	+38	+52
30	6.51	+12	+23
40	5.83	-	+10
50	5.48	- 1	+ 4
60	5.28	- 9	-
70	5.17	-11	- 2
80	5.10	-13	- 3

Source: Stone, P.A.: 'The Economics of Building Design', Journal of the Royal Statistical Society, Part 3, Series A, 1960.

15. See Chap. 2.

5.3.2 COSTS IN USE

5.09 Costs in use consist of the repayment of the capital with interest, running costs, maintenance and repair costs, the costs of adaptation, and the insurance and tax costs. Costs in use (sometimes termed future costs) are extremely difficult to predict with any degree of accuracy. Some of these difficulties arise from the factors discussed above - change of interest rates and inflation, the life-span of materials and the stock. Other difficulties arise from the change in taxation and the laws governing taxes, the uncertainty of the type and amount of physical adaptation of the stock necessary over its life and the fact that the building may be sold before the end of its economic life, thus altering which user must pay for the costs in use.

5.10 Stone[16] has argued that the initial cost of a building is not the amount paid to construct it, but rather the total amount repaid on the loan taken out to cover the capital costs. This total amount, of course, is affected by interest rates and the amount of time required for repayment, thus making the initial costs (in Stone's terms) difficult to determine exactly. Tables 5.2 and 5.3 show the effects of different rates of interest on 20 and 60 year repayment periods respectively.

5.11 The effect of interest rates on the total cost of the building is, in practice, modified in two ways: by taxation[17] and by inflation. Inflation, of course, deflates in real terms the purchasing power of the pound. Between 1946 and 1964 in the United Kingdom, the inflation rate was approximately 3% per year. Thus, £100 in 1966 would be re-

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16. Stone, P.A.: Building Economy, op.cit.
17. See paragraph 5.13 for discussion of taxation.

quired to purchase the same amount of goods that £55 purchased in 1946.

TABLE 5.2: CAPITAL AND RATES OF INTEREST - ANNUAL REPAYMENT OVER 20 YEARS

CAPITAL COST (£)	RATES OF INTEREST				
	3%	4%	5%	6%	7%
800	£ 54	£ 59	£ 64	£ 70	£ 76
900	60	66	72	78	85
1000	67	74	80	87	94
1100	74	81	88	96	104
1200	81	88	96	105	113

Source: Stone, P.A.: Building Economy, op.cit.

TABLE 5.3: CAPITAL AND RATES OF INTEREST - ANNUAL REPAYMENT OVER 60 YEARS

CAPITAL COST (£)	RATES OF INTEREST				
	3%	4%	5%	6%	7%
800	£ 29	£ 35	£ 42	£ 50	£ 57
900	33	40	48	56	64
1000	36	44	53	62	71
1100	40	49	58	68	78
1200	43	53	64	74	85

Source: Stone, P.A.: Building Economy, op.cit.

5.12 The running costs of building - the cost of heat, light, water, sewage and gas supplies, as well as the salaries of any attendants of these services - will vary from building to building on a square metre basis, mainly due to the intensity which they are serviced. Stone[18]

18. Stone, P.A.: 'The Economics of Building Design', op.cit.

has estimated the running costs for various types of buildings as a percentage of the total annual costs in use (see Table 5.4). These vary from 1/5 of the total for scantily serviced buildings, such as schools and housing to 1/2 of the total for highly serviced buildings such as industrial buildings. Running costs will not generally rise in response to the ageing of the building as will maintenance costs, but will rise rather in response to factors external to the building itself, such as the cost of acquiring and transporting the raw material to produce the service as well as the rise in the labour costs involved. It has also been noted[19] that the running costs of a building will usually exceed the initial costs, even if the initial costs are defined as the amount repaid plus interest, over the life of the item of stock.

TABLE 5.4: RUNNING COSTS AS A PERCENTAGE OF TOTAL ANNUAL COSTS IN USE

RUNNING COSTS	HOUSES	HIGH FLATS	INDUSTRIAL BLDGS. (ALL TYPES)	SCHOOLS	OFFICES
HEATING	15	15	42	11	19
LIGHTING	12	9	8	7	18
TOTAL	21%	24%	50%	18%	32%

Source: Adapted from Stone, P.A.: 'The Economics of Building Design' op.cit.

5.13 Taxation will affect the total cost of buildings in two ways: directly by annual assessment of the value of the stock and/or its site and indirectly through tax allowances on the depreciation of the stock,

19. Ibid.

its fittings and fixtures and on the initial cost repayments and other costs in use, such as fuel and energy consumption. The first type of effect is rather obvious and needs little explanation. As noted before[20] buildings are rated as to their value depending on their age, condition, location and use. The indirect effects of taxation are somewhat more complicated. Stone[21] demonstrates the effect of tax relief on industrial buildings which can be obtained on the initial cost through depreciation allowances, investments, initial and cash allowances. He postulates that the current (1971) regulations and levels of taxation tend to favour low initial costs and high costs in use. For example, a typical industrial concern might obtain £45 for each £100 in tax relief for maintenance costs (including in the tax definition physical adaptation of the stock) but only £25 in £100 for initial costs. Seeley[22], however, speculates that this advantage will largely be removed by valued added tax. Seeley[23] also argues that because taxation allowances are more favourable to maintenance and repair than to new construction, maintenance work is increasing at the expense of new work[24], and beyond the point where it would normally make economic sense, thus prolonging the life of the industrial stock artificially[25].

5.14 Taxation allowances are also one way of comparing the physical

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20. See Chap. 2.
21. Stone, P.A.: 'The Application of Design Evaluation Techniques', Building, 20 March, 1970.
22. Seeley, I.H., op.cit.
23. Ibid.
24. This contention is refuted by a Ministry of Public Buildings and Works working party which concluded that no fiscal inducement will retain basically uneconomic buildings in the long run, a view partially substantiated by Chap. 6 of this thesis. See: Ministry of Public Buildings and Works: 'Report of the Party on Implications of Taxation Provision for Building Maintenance', London, HMSO, 1969.
25. The age of the industrial stock in Great Britain is generally/...

life of the stock to its economic life. This is done by legally defining physical life in terms of the economic and technological life of the building's elements. In the United States, taxation allowances on the stock recognise that the different elements of the stock have different economic and technological life-spans, while the economic life-span of the entire building is related to its use. Tables 5.5 and 5.6 show the life-span of the stock and its elements respctively, as defined by the Internal Revenue Service.

5.15 Insurance costs and the method by which these costs are derived also affect the total cost of the stock. Stone[26] has pointed out that for industrial buildings this assessment is related to floor area, ceiling heights, the loading capacity and the level of amenities such as heating and cooling provided. Similarly, fire insurance premiums are related to the degree of fire risk involved due to the construction of the building and its contents. Thus, reductions in these premiums may be obtained when certain features such as the use of non-inflammable materials, spread resistant materials or fire-fighting equipment such as sprinklers are incorporated into the original design[27]. In order to be economically justifiable over the total life-span of the building, the initial higher cost of these features must be lower than the savings

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25. (contd.) older than that of any other industrialised country, a fact which is said to contribute to the increasingly non-competitiveness of British products. However, whether this age is due to tax incentives or not is questionable.
26. Stone, P.A.: 'The Economics of Building Design', op.cit.
27. These features are, of course, over and above the minimum standards for fire resistance and containment set by the Building Regulations.

TABLE 5.5: USEFUL LIFE DEPRECIATION GUIDELINES BY BUILDING TYPE FOR 1250 PROPERTY

BUILDING TYPE	USEFUL LIFE IN YEARS	BUILDING TYPE	USEFUL LIFE IN YEARS
Apartments	40	Hotels	40
Banks	50	Loft Buildings	50
Dwellings	45	Office Buildings	45
Factories	45	Stores	50
Garages	45	Theatres	40
Grain Elevators	60	Warehouses	60

Source: Nielsen, K.R.: 'Tax Considerations in Building Design', American Institute of Architects' Journal, September, 1973.

TABLE 5.6: TYPICAL COMPONENT DEPRECIATION ANALYSIS FOR AN OFFICE BUILDING

COMPONENT	USEFUL LIFE IN YEARS	COMPONENT	USEFUL LIFE IN YEARS
Main Structure	45	Vinyl & Plastic Wall Finish	10
Building Roofing	10	Brick & Tile Wall Finish	15
HVAC	20	Ceiling Finishes	15
Plumbing Fixtures & Equipment	20	Tile & Waterproof Floor Covering	20
Steel Pipe	25	Resiliant Tile Floor Covering	10
Cast Iron Pipe	35	Rubber Mat Floor Covering	5
Copper Pipe	30	Computer Floor	10
Fire Protection	25	Painting	5
Electrical Equipment & System	20	Special Equipment	15
Fluorescent Fixtures	10	Site Improvements	20
Other Fixtures	15	Site Lighting	20
Elevator	25	Site Plumbing	30
Building Partitions	15		

Source: Adapted from Nielsen, K.R.: op.cit.

made through the reduction of premiums.

5.16 Maintenance and repair[28] costs are another type of costs in use. The elements of an item of stock which require the most maintenance will vary due to the quality of the original construction as well as due to the use of the stock. In general, however, the largest portion of annual maintenance costs involves the service systems of a building (Table 5.7). Maintenance costs account for between 13 and 20% of the total annual costs in use of a building, depending on the use of the stock. (Table 5.8). However, due to the difference in the total annual cost of the stock, the maintenance costs will vary greatly. For example, in 1961 the maintenance costs of schools (for $30m^3$) averaged £0.90 for post-war secondary schools, £1.10 for post-war primary schools, £1.75 for pre-war secondary, and £2.60 for pre-war primary schools[29]. On the other hand, hospitals spent an average of £13.00/ $30m^3$ for maintenance costs[30], while offices, on the other hand, averaged £11.50/$30m^3$ in 1961[31].

5.4 COMPARATIVE ECONOMICS OF THE COST OF REHABILITATION AND REPLACEMENT

5.17 From the above discussion on the costs involved in the life of

28. The term maintenance is sometimes used to include the adaptation costs of the stock (as with the taxation definition discussed above). In this thesis, however, the term is confined to normal annual expenditures such as cleaning, painting, etc., while the term repair refers to the replacement or repair of damaged or worn equipment. Adaptation costs, the alteration of the physical factors to make the building more useful, are discussed in the following section, but see also Chap. 6.
29. Based on data from: Clapp, M.A. and Cullen, B.D.: 'The Maintenance and Running Costs of School Buildings', BRS/GP72/68.
30. Based on data from: Ministry of Health: 'Hospital Costing Returns', London, HMSO, 1961.
31. Based on data from: Ministry of Public Buildings & Works: 'The/...

TABLE 5.7: SOURCES AND CAUSES OF TYPICAL LOCAL AUTHORITY HOUSING MAINTENANCE COSTS

ITEM	PERCENTAGE OF TOTAL MAINTENANCE COST	MAIN CAUSES
Structural & Cladding Repairs	10	Roofs, Windows and External Doors
External Redecoration	25	Protection of Wood and Metalwork
Internal Repairs and Renovation	25	Redecoration and Minor Repairs
Services, Installations and Sanitation	40	Ball Valves, Tanks, Cylinders, burst and blocked Pipes

Source: Browning, G.P.: op.cit.

TABLE 5.8: ANNUAL EQUIVALENT COSTS IN USE FOR TYPICAL BUILDINGS, EACH PROVIDING 100 UNITS OF ACCOMMODATION

TYPE OF BUILDING	OFFICE	HIGH FLATS	HOUSES	LIGHT INDUS. BDGS.	HOSPS.	SECOND. SCHOOLS
Type of Unit	Work Spaces %	Bed Spaces %	Bed Spaces %	Work Spaces %	Bed Spaces %	Pupil Spaces %
Construction[1]	52	61	58	56	66	59
Maintenance	14	13	15	16	19	19
Fuel & Attendance	34	26	27	28	15	22

Source: Adapted from Drake, B.E.: 'The Economics of Maintenance', op.cit.

Note: 1. Annual construction costs refers to major rehabilitation as well as repayment of loan and interest.

the stock and the factors which affect those costs, it is easy to understand why the economic life-span of the stock is difficult to predict and is thus assumed to be the period required to repay initial costs. In this section, another examination based on certain assumptions will be undertaken: comparing the economcis of extending the life-span of an item of the stock, or alternatively, replacing the building. This examination will include a brief discussion of existing theoretical techniques, some empirical study, as well as discussing the effect of government policy on the economics. In order to simplify this undertaking, this discussion will be limited to the housing stock.

5.18 The basic problem is to decide whether it is more economic to replace the stock or rehabilitate it (and thus prolong the life-span). The two major underlying factors which affect this decision are the growth in the demand for housing based on the growth of the population (a social factor) and the unfitness of some of the present stock caused by its aging (a physical factor) and the general rise in standards and expectations (legal and social factors). Stone[32] in a national survey has shown the average costs of rehabilitation under different combinations of the age, size, cost standard, condition and expected future life of the stock. The costs (in 1964 £s) range from an average of £44 for low cost rehabilitation of stock in good condition which contains two habitable rooms, 40 years of age with an expected future life of 15 years, to £2501 for a medium cost rehabilitation of stock in poor condition which contains eight habitable rooms, 100 years of age with an expected future life of 40 years.

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31. (contd.) Relationship between Capital, Maintenance and Running Costs: A Case Study of Two Crown Office Buildings', London, HMSO, 1970.
32. Stone, P.A.: Urban Development in Britain, op.cit.

5.19 A number of comparative studies have been undertaken to determine the economics of rehabilitation and replacement. (An underlying assumption of all of these studies is that the choice can be based solely on economics. That is, they disregard the social implications as well as the capacity of the building industry to shift from one form of construction to another[33].) Jones'[34] study of a housing area in Liverpool compared the two alternatives based on builders' estimates (see Tables 5.9 & 5.10). The typical costs for rehabilitating the 80 year old terraced houses and converting them into four-bedroom houses and one bedroom flats was first determined and then compared to the cost of providing new housing of the same mix. It was found that the rehabilitation would cost approximately $\frac{2}{3}$ of the cost of new construction. Overall costs for the two schemes, including the costs of land, roads, services and fees, show that the cost per person of rehabilitation would be approximately $\frac{5}{8}$ of the cost of new construction, even though the total overall costs of the former is approximately twice the cost of new construction. Thus, if the same number of people were housed in the new scheme as in the rehabilitation scheme, the costs per person for the new scheme would be almost fifteen times as great. (Assuming costs rise directly in proportion to the number of people housed.) Savings would be made in the rehabilitation scheme in the cost of land, roads and services, which could be applied directly to the housing. Professional fees on the other hand, would be greater because of the need to examine each item of the stock and the need to

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33. See Chaps. 4 & 6.
34. Jones, F.M. et al: The Long-Term Implications of Obsolescence in Housing, Liverpool, Housing Research Unit, Department of Architecture, University of Liverpool, 1967.

TABLE 5.9: COMPARISON OF REHABILITATION AND REDEVELOPMENT COSTS IN A FOUR BEDROOM HOUSE AND A ONE BEDROOM FLAT

	REHABILITATION (£)*	REDEVELOPMENT (£)*
Four-Bedroom House		
Repair	780	–
Conversion	230	–
Total for Structure	1010	2600
Heating	175	155
Bed. & Kit. Fits.	305	148
Plumbing	180	32
Drainage	70	57
Wiring	160	60
Total for Services	890	452
TOTAL	1900	3052
One-Bedroom Flat		
TOTAL	1310	2870

* (1967 £)

Source: Jones, F.M. et al: The Long-Term Implications of Obsolescence in Housing, op.cit.

produce individual plans. The rehabilitated houses would also be less expensive for the inhabitants as the rateable value would only rise 20% as opposed to almost 50% in the new scheme[35].

35. McKie and Kumar have found that the rise in the rateable value is one of the reasons why owner/occupiers of housing do not take more advantage of government rehabilitation grants. They have suggested that this can be overcome by not increasing the rates when an improvement is undertaken to improve a sub-standard house with a government grant, for a certain number of years, or until the house is sold to a new owner. See: McKie, R. and Kumar, W.K.: 'House Improvements and Rateable Value', Urban Studies, Vol. 8, No. 3, October 1971. For a discussion and analysis of the/...

TABLE 5.10: COMPARISON OF REHABILITATION AND REDEVELOPMENT COSTS - TOTALS

	REHABILITATION	REDEVELOPMENT
Population	5928	1844
Dwellings	2601	324
Area: Acres (Hectares)	65(26)	9.7(3.9)
Gross Density (PPA)	91	190
(PPHA)	226	471
Gross Density (DPA)	40	39
(DPHA)	99	98
	(£)*	(£)*
Roads & Services	100,000	30,000
Housing	2,880,000	1,190,000
Fees	360,000	120,000
Land	-	80,000
TOTAL	3,340,000	1,420,000
Cost per person	565	780
Cost per dwelling	1290	3720
Average Rateable Value	52	67

* (1967 £)
Source: Adapted from Jones, F.M. et al: The Long-Term Implications of Obsolescence in Housing, op.cit.

5.20 A similar type of study was undertaken by Brown[36] on 377 dwelling units in Islington. He also found that overall rehabilitation was more economical than redevelopment (£520 vs. £720 per person). He also assumed that the work would be carried out by the local authority (as did the Liverpool study), but found that the cost to the local authority would be greater in the case of rehabilitation (by £10 per dwelling) due to the difference in subsidies from the national exchequer.

35. (contd.) grant system, see: Pepper, S.: Home Improvements: Goals and Strategy, London, Architectural Association Paper No. 8, Lund Humphries, 1971.
36. Brown, D.: 'Housing: Rehabilitate or Rebuild?', Building Design, 1 August, 1970.

5.21 Both of these studies dealt only with the initial costs of rehabilitation and redevelopment. As discussed before, the total costs of an item of stock must also include the costs in use, which, in order to calculate the life-span of the stock, must be assumed. Another study[37] undertaken in Liverpool attacks the problem of the difference in the costs in use of rehabilitation and redevelopment. In this study, it was assumed that the running costs, adaptation costs and the costs of demolition would be similar for the two alternatives. Thus, they were ignored. The study concentrated on the difference between maintenance costs and the repayment of the capital with interest. Table 5.11 gives the capital costs and annual and weekly loan charges for the two alternatives over an assumed 60 year life-span for the new stock and 30 year life-span for the rehabilitated stock. This was based on the assumption that the life-span of rehabilitated stock would be one half of the length of the new stock. The annual maintenance costs for the two alternatives (Table 5.12) were based on figures for post and pre-war corporation housing, regardless of the size of the dwelling. These were given as £13.20 and £21.30 respectively. While the total weekly costs for the rehabilitation scheme was less expensive overall, the weekly cost to the local authority was slightly higher, due to the subsidies from the national exchequer and thus supports the contention of Brown. Thus, a curious conflict of economics is apparent, which reflects on the economic life-span of the stock. For the local authority, it is more economic to replace than to rehabilitate housing, while overall the reverse appears to be true.

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37. Liverpool University (Housing Research and Development Group), op.cit.

TABLE 5.11: COMPARISON OF LOAN CHARGES FOR REHABILITATED AND NEW LOCAL AUTHORITY HOUSING

	CAPITAL COST (£) *	LOAN CHARGES $6\frac{7}{8}\%$ (£) * Annual	Weekly
		(30 YEARS)	
REHABILITATION			
3 Bedroom Maisonette	2503	199	3.83
1 Bedroom Flat	1686	134	2.58
4 Bedroom House	2596	207	3.98
		(60 YEARS)	
NEW			
3 Bedroom Maisonette	3700	259	4.98
1 Bedroom Flat	2500	175	3.37
4 Bedroom House	3520	247	4.75

* (1966 £)

Source: Adapted from: Liverpool University (Housing Research and Development Group) 'Maintenance and Adaptation as Factors in House Design and Finance', 1969.

5.22 A number of authors[38] have attempted to develop formulae independent of empirical data to determine whether it is less expensive to rehabilitate or replace the existing housing stock. In so doing, they are forced to make a number of assumptions about the stock, its age, condition, expected future life; the rates of interest and inflation; the demand for housing; the rate at which it is becoming unfit

38. For example, see: Lewis, J.P.: op.cit. Needleman, L.: 'The Comparative Economics of Improvement and New Building', Urban Studies, Vol. 6, No. 2, June, 1969. Needleman, L.: The Economics of Housing, London, Staples Press, 1966. Needleman, L.: 'Rebuilding or Renovation? A Reply', Urban Studies, Vol. 5, No. 1, February, 1968. Sigsworth, E.M. and Wilkinson, R.K.: 'Rebuilding or Renovation?', Urban Studies, Vol. 4, No. 2, June, 1967. Stone, P.A.: Urban Development in Britain, op.cit.

TABLE 5.12: COMPARISON OF TOTAL WEEKLY CHARGES FOR REHABILITATED AND NEW LOCAL AUTHORITY HOUSING

	LOAN CHARGES (£) WEEKLY	MAINTENANCE (£)		TOTAL CHARGES (£)	SUBSIDY (£)	TOTAL CHARGES TO LOCAL AUTHORITY (£)
		ANNUAL	WEEKLY	WEEKLY	WEEKLY	WEEKLY
	30 YEARS					
REHABILITATION						
3 Bedroom Maisonette	3.83	21.30	0.41	4.24	0.45	3.79
1 Bedroom Flat	2.58	21.30	0.41	2.79	0.44	2.55
4 Bedroom House	3.98	21.30	0.41	4.39	0.42	3.97
	60 YEARS					
NEW						
3 Bedroom Maisonette	4.98	13.20	0.25	5.23	1.80	3.43
1 Bedroom Flat	3.37	13.20	0.25	3.62	1.10	2.52
4 Bedroom House	4.75	13.20	0.25	5.00	1.55	3.45

Source: Adapted from: Liverpool University (Housing Research and Development Group), op.cit.

and the standard to which it should be raised, etc. Needleman[39], for example, suggests that it would be economically feasible to spend up to £1000 on rehabilitation of a house with a life expectancy of five years, up to £1600 for a life expectancy of ten years, and up to £2100 for a house with a life expectancy of fifteen years. Sigsworth and Wilkinson[40], however, suggest that this is unrealistic; that it would only be economic to spend about half as much.

5.5 CONCLUDING REMARKS

5.23 The two major problems with either the theoretical or empirical approaches to the economcis of rehabilitation or replacement, as noted at the beginning of the chapter, is that they do not take into consideration the social 'costs' involved in the alternatives, nor the ability of the building industry to undertake either rehabilitation or replacement. The first is not surprising and is usually recognised by the authors cited in this chapter as it is difficult, if not impossible, to equate social benefits with economic capital. The second, however, is usually not discussed, possibly because it is unrecognised or because it is considered to be outside the scope of the investigations. However, as will be shown in the next chapter, the ability of the building industry to undertake the alternatives (rehabilitation or new building), as well as the overall capacity of the industry, is critical, not only to the choice of the alternatives, but to the life-span of the existing stock.

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39. Needleman, L.: The Economics of Housing, op.cit.
40. Sigsworth, E.M. and Wilkinson, R.K.: op.cit.

PART TWO

CHAPTER SIX

THE FUTURE DEMAND FOR STOCK AND THE CAPACITY OF THE BUILDING INDUSTRY: A DISCUSSION

6.1 INTRODUCTORY SUMMARY

6.01 The building industry consists of four sectors: the professionals, the suppliers of goods and materials, the construction firms and the employees of those firms who are normally termed 'operatives'. The latter two sectors are the concern of this chapter. The future capacity of the industry, as well as the future demand for stock (quantitatively) is based ultimately on the future size of the population. For the past 120 years, the percentage of the population employed by the industry has remained fairly stable and will continue to be so for the foreseeable future. The measure of the capacity of the industry is based on the value of the output per employee. Demand for stock is similarly measured in terms of value. In the next twenty-five years, the capacity of the industry only exceeds demand if the life-span of the presently existing stock of buildings is prolonged.

6.2 ORGANISATION OF THE BUILDING INDUSTRY

6.02 The building industry may be generally defined as consisting of all individuals and groups of individuals that are directly or indirectly involved in the construction of the built environment. For our purposes, however, this definition must be narrowed somewhat. The building industry can be divided into four sections: the employees of contractors, the contractors or firms[1], the suppliers of materials and goods, and the professionals[2]. In this chapter, the main concern will be with the firms and their employees, however, the other two sectors are worth a brief examination first.

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1. The contractors (firms) and their employees are sometimes termed the 'construction industry'. In a later section of this chapter this term is employed to distinguish these sections of the industry from the professionals and suppliers of materials.

2./...

6.03 The professionals include architects, engineers, quantity surveyors and lawyers, and may also include city planners and civil servants directly involved in the control and interpretation of building and zoning regulations. This sector of the industry is generally concerned with the design of buildings, the preparation of bills of quantity, specifications and contracts and the overall supervision of the standards of construction. The manufacturers and suppliers of building materials, components, plants, etc., are those firms and their employees which are engaged in extracting, refining, processing and transporting finished and unfinished building materials as well as owners of contract plants such as concrete mixers, cranes, etc. Unfinished materials include such items as sand, cement and stone, which will be further processed on the construction site. Finished materials include such items as bricks, blocks, wood, etc., which may or may not be further processed on site, and components or elements, such as window and door frames, steel beams and columns, etc., which will be secured in place with no further processing. Most suppliers of unfinished materials will, because of their bulk and weight (and therefore high transport costs) confine their activity to a fairly small area. On the other hand, manufacturers and suppliers of finished materials and components, especially highly specialised ones, will distribute over a much larger area. This is because the ratio of transport cost to material

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2. Seeley and Lichfield both divide the industry into these four sections. Stone, on the other hand, distinguishes only three sectors: the professionals, the suppliers and the contractors (including their employees). See: Lichfield, N.: Economics of Planned Development, London, Estates Gazette, 1966. Seeley, I.H.: op.cit. Stone, P.A.: Urban Development in Britain, op.cit.

cost is low[3]. Lichfield[4] suggests a thirty mile distribution radius for unfinished materials, while finished goods may be distributed nationally, or even internationally.

6.04 The employees of the firms are divided into on-site labour (operatives) and the administrative, technical and clerical staff, which may be termed the supportive staff. In the case of small firms, the supportive staff is generally the same as the operative, while large firms will tend to concentrate different people in the roles. Further, the operatives have traditionally been divided into skilled and unskilled labour. The skilled labour is, in turn, divided along traditional lines of the materials which they use and the trades which they perform, such as joiners, masons, plasterers, plumbers, etc. The skilled operatives may move from firm to firm as their skills are required, acting as sub-contractors. Very large firms, however, may employ their own skilled operatives as the volume of work in which these firms are normally engaged warrants the hiring of the skilled operatives on a permanent basis. Unskilled operatives, who make up approximately 50% of the total work force of the construction industry[5], tend not to be permanently employed by any firm, no matter what its size. Rather, they are hired as necessity dictates. Because of this, they are the least job secure sector of the building industry.

6.05 The firms are responsible for organising and carrying out the actual construction work in the building industry. Firms are generally classified by the number of operative and supportive staff which they employ[6] and by the type of building activity in which they are

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3. This, of course, is related to the study of transport costs and the location of industry, discussed in Appendix 1.
4. Lichfield, N.: op.cit.
5. Ibid.
6./...

normally engaged. Seeley[7] suggests the following categories for classifying the firms: civil engineering contractors, building and civil engineering contractors, general builders and specialist firms. The civil engineering contractors, usually large firms in size, are those which limit their work to projects such as dams, bridges, tunnels, roads, etc., while the building and civil engineering firms, also usually large, will undertake traditional building contracts as well as projects similar to those of the civil engineering firms. General builders are normally only engaged in traditional building activity and may be further classified according to their size. For example, Seeley[8] gives five basic size classifications for general builders:

1. large firms of over 1000 employees which operate on a national or sometimes international scale, and will undertake the construction of most types of buildings;
2. medium size firms which operate on a regional scale and undertake all but very large jobs;
3. speculative firms which specialise in building speculative housing or office development and usually will not undertake contract work;
4. small firms which operate on a local scale and will undertake small jobs of a limited nature, such as housing or offices, on a contract basis; and
5. very small firms which will normally confine their activities to repair, conversion and maintenance work on a local level.

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6. Because the number of operatives fluctuates to such a large extent, the number employed by the firms is normally determined by the average number employed over a certain period of time, such as a month, but morenormally over a year.
7. Seeley, I.H.: op.cit. For similar classification, see: Lichfield, N.: op.cit. Stone, P.A.: Urban Development in Britain, op.cit.
8. Seeley, I.H.: op.cit.

The final classification, specialist firms, are those which concentrate on a particular trade, such as plumbing or electrical work, or particular aspects of the building, such as roofing, lift installation, etc., or specific types of maintenance and repair work, such as stone cleaning, dry rot correction, etc. The specialist firms normally operate on a local scale if they are engaged in traditional trades, but may work on a regional or national scale, especially if they are engaged in non-traditional trades, such as stone cleaning or lift installation.

6.06 In 1968, large firms (those with over 1200 employees) accounted for less than 1% of the total number of firms, but for nearly 25% of the total number of employees in the construction industry (see Table 6.1). On the other hand, very small firms, those with under 14 employees each, accounted for only 18% of the total number of employees, but 82% of the total number of firms. The trend since World War II has been for the growth in the number of employees employed by the large firms (but not a significant growth in the number of large firms themselves) and a decline in both the number of firms and employees at the lower end of the scale[9]. The reasons for this trend have been discussed by a number of authors. One reason concerns the scale at which building is undertaken at present. With the large redevelopment and development schemes of the post-war period, firms have had to grow in size in order to be able to undertake the work[10]. The expense of owning or hiring construction plant to facilitate work has tended to price them above what

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9. Lichfield, N.: op.cit.
10. Stone points out that there is no optimum size for a firm, rather:

> "... the best size is dependent on the nature of the work, the conditions under which the work is to be carried out, and the nature of the organization and the ability of the management."

Stone, P.A.: Building Economy, op.cit., p.163.

TABLE 6.1: EMPLOYMENT IN CONSTRUCTION INDUSTRY BY SIZE OF FIRM IN 1968

NUMBER OF EMPLOYEES IN FIRM	NUMBER OF FIRMS	% OF TOTAL	NUMBER OF EMPLOYEES	% OF TOTAL
0– 13	65,699	82.0	243,083	18.0
14– 34	8,870	11.0	186,151	13.0
35–114	4,034	5.0	238,381	11.0
115–299	953	1.0	168,334	12.0
300–599	282	*	119,860	8.0
600–1199	134	*	115,468	8.0
1200+	87	*	275,496	24.0
TOTALS	80.059	100.0	1,346,773	100.0

Source: Adapted from Seeley, I.H.: op.cit.
Note: * = less than 1.0%

the smaller firms could afford, thus depriving them of one means of increasing productivity and thus lowering costs[11]. Management skills, which may be obtained by the large firms through the hiring of consultants or supportive staff, are generally too costly for the smaller firms to acquire, thus depriving them of another means by which productivity might be increased[12]. Fluctuations in the general economic climate, or local climates, are generally better weathered by the larger firms due to their cash resources, ability to borrow capital in order to retain key personnel, or their ability to shift their operation to a more favourable climate[13]. Other causes of the increase in the size of large firms at the expense of the smaller ones include strikes by employees or the employees of material manufacturers and suppliers, or the bankruptcy of the suppliers and producers which are more easily

11. Stone, P.A.: Urban Development in Britain, op.cit. Also: Seeley, I.H.: op.cit.
12. Seeley, I.H.: op.cit.
13. Ibid. For example, Seeley notes that in 1970, 1027 small/...

adjusted to by the larger firms[14]. The trend towards fewer, larger firms presents a serious problem to prolonging the life of the stock. As will be discussed further, the very firms which are most suitable to physically implement the adaptation of the stock in order to prolong its life-span, the smaller firms, are the very ones which are going out of business at the fastest rate.

6.3 FUTURE CAPACITY OF THE CONSTRUCTION INDUSTRY

6.07 The capacity for productivity of the construction industry is dependent on a number of factors, including the capital available for construction and the cost of that capital, the supply of materials, the supply of labour and the demand for construction. The demand for building will be discussed in the next section, while the supply of capital and materials will only briefly be discussed here. The main discussion in this section will concern the supply of labour as it will ultimately control the capacity of the industry.

6.08 The supply of capital is dependent on a number of factors, including the national and local economic climates, the capital available from building societies, the interest rate, and governmental monetary policies. The supply of materials, obviously, varies from material to material. In general, the natural resources used to manufacture common building materials, such as brick and concrete, are in fairly good supply, or other materials such as wood, are renewable. The access to these raw materials or the energy required to process them, however, may become increasingly difficult. Thus, their supply

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13. (contd.) building firms went out of business due to bankruptcy while none of the large ones did.
14. Ibid.

may either be low or expensive, or both. Another factor involved in the supply of materials is the labour involved in their processing, which may either be in short supply or participating in industrial action. A third factor is the demand for the material, which may be difficult or expensive to stockpile, thus creating shortages when demand is high[15].

6.09 The future capacity of the construction industry to undertake building based on the labour supply is calculated below. The supply of labour is ultimately based on population. Population, of course, is a function of the fertility, marriage and death rates. In the calculations below, the projected total population[16] for Great Britain has been used, based on three separate projections, which are, in turn, based on high, medium and low birth rate projections[17]. This

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15. Another factor which could affect the capacity of the industry would be the long awaited 'revolution' of the construction industry. Stone states that the industrialisation of building in the last 20 - 25 years was supposed to portend this revolution, but has produced no great affect on the level of overall productivity. (That is, industrialisation, while responsible for raising some of the on-site output per worker, has shifted some of this work into other sectors of the economy, such as manufacturing, and thus made a true measure of overall productivity very difficult.) Both Stone and Seeley assume that no great revolution will take place in the construction industry in the foreseeable future. Stone, P.A.: Urban Development in Britain, op.cit. Seeley, I.H.: op.cit.
16. Local variations in projected population, while important, have not been included in this study, due to the complexity which they would introduce, as well as increasing the size of the data to unmanageable proportions.
17. The different birth rates are based on different marriage and fertility rates, the death rate, however, is assumed to be stable for all three, thus decreasing the complexity of this study.

was done so that a range of the capacity may be discussed and thus minimise errors based on a single projection. Figure 6.1 shows the actual population in Great Britain between 1850 and 1970 and the three projections of population[18] between 1970 and 2000[19]. Within the next thirty years, the total population will rise either 43% (the high projection) or 18% (the low projection) with a medium projected rise of 26%.

6.10 Figure 6.2 gives the actual working age population and the employed population between 1850 and 1970 and their three projections from 1970 to the end of the century[20]. The employed population[21] consists of the number of people counted by the Registrar General as being employed, on average for each year. The Registrar General's definition of employed has remained fairly stable over these years, while the definition of working age has changed slightly. At the beginning of the period, working age was defined as being above twelve years of age with no upper age limit considered, while at present it is defined as being between sixteen and sixty-five years of age. Again, an approximate rise of 18% for the low projection, 26% for the medium and 43% for the high projection for both the working age and employed population was obtained.

6.11 The number of employees in the construction industry between

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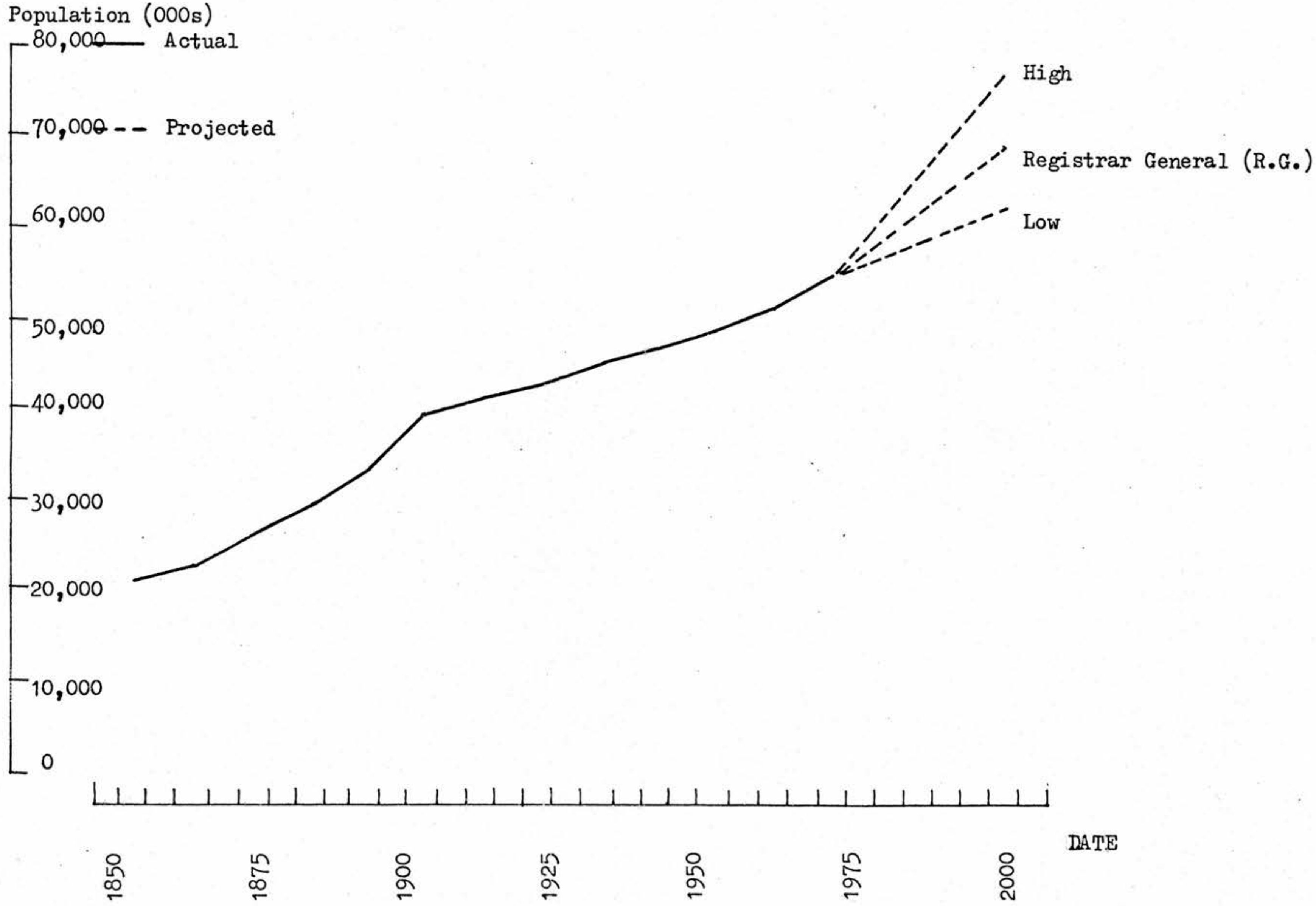
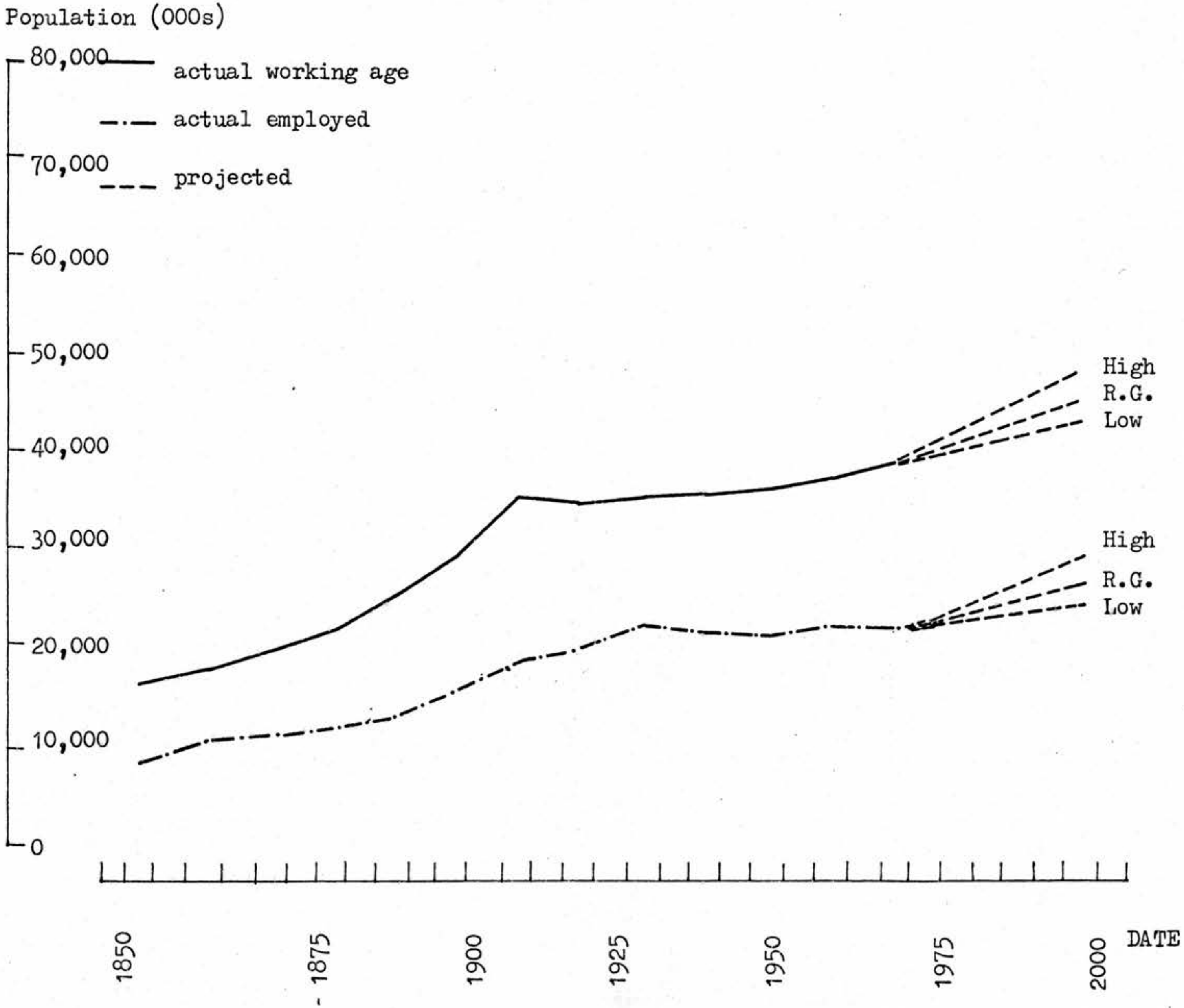
18. The high and low projections are based on Stone's calculations, while the medium calculation is derived from the Registrar General. Registrar General: Statistical Review Part 2 - Population, London, HMSO, 1971. Stone, P.A.: Urban Development in Britain, op.cit.
19. Also see Table A.4.1 (in Appendix 4).
20. Also see Table A.4.2 & A.4.3.
21. For method of projecting unemployed population, see Tables A.4.4 - A.4.6 and explanation in Appendix 4.

FIGURE 6.1: POPULATION 1850 - 2000: GREAT BRITAIN



Source: See Table A.4.1.

FIGURE 6.2: WORKING AGE AND EMPLOYED POPULATION 1850 - 2000: GREAT BRITAIN



Source: Tables A.4.2 - A.4.4.

1850 and 1970 and the projected number from 1970 until 2000 are shown in Figure 6.3[22]. Table 6.2 gives the actual number of employees in the industry as a percentage of the total, working age and employed population. Between 1850 and 1970, the mean number of employees in the industry was 2.76%, 3.71% and 6.01% of the total, working age and employed populations respectively, with variations of ± 0.38%, ± 0.81% and ±0.47% respectively[23]. The projections in Figure 6.3 are based on the projection of three different percentages for each of the three population groups. From the total population 2.5, 3.0 and 3.5% was used, 3.5, 4.0 and 4.5% from the working age population, and 6.0, 6.5 and 7.0% from the employed population[24]. The high, low and medium percentages for each population group was then averaged to give the three projections found in Figure 6.3[25]. During 1970, the actual population employed in the building industry was approximately 1.5 m. rising to a projected low of 1.85 m. and a projected high of 2.25 m. in 2000 (the medium projection being just over 2.0 m.).

6.12 Having developed the projections for the number of employees in the construction industry, the next problem is to translate this into the capacity of the industry - the amount of building which it can undertake. For this the proxy of value[26] of the output was used. Figure 6.4 gives the actual value of building completions[27] on an

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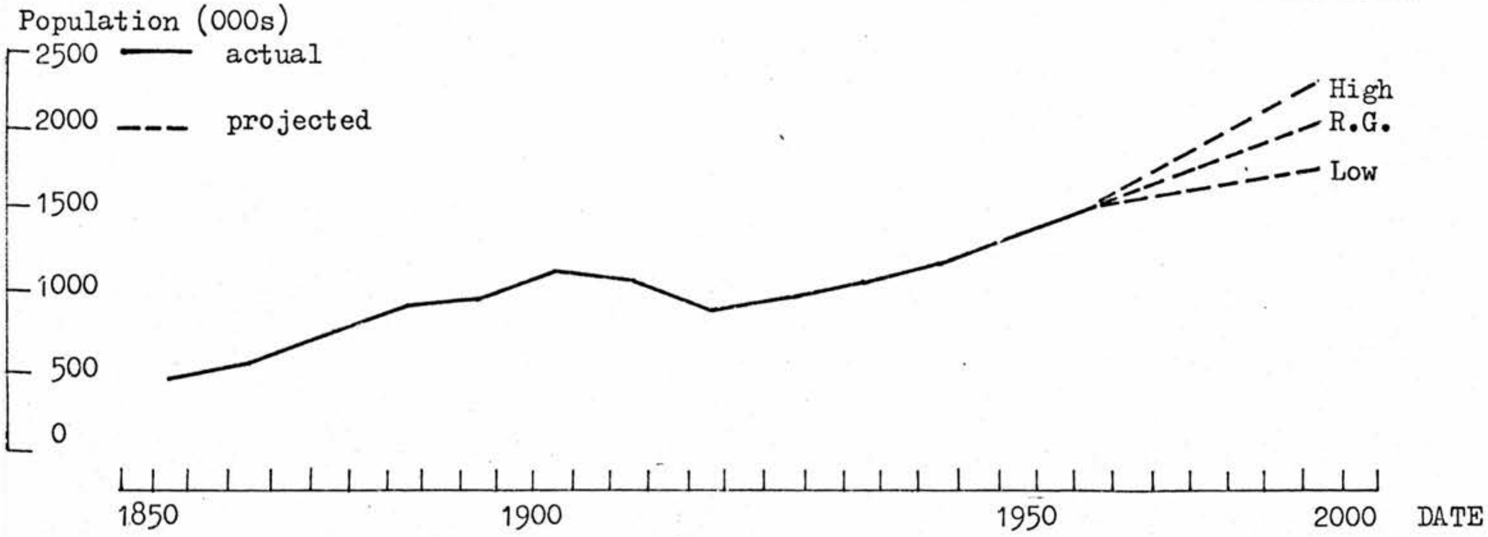
22. See Table A.4.7.
23. Since the number of employees in the industry as a percentage of total working age and employed population has been relatively stable over the 120 year period an increase in that percentage, thus raising the total capacity of the industry, is discounted. Even if this increase did occur, it would probably be at the expense of other sections of the economy.
24. See Tables A.4.8 and A.4.9.
25. See Tables A.4.10 and A.4.11.
26. Meaning value in its general sense, not rateable value as used elsewhere in this thesis.
27. The value of the output of completed buildings in any one year /...

FIGURE 6.3: POPULATION EMPLOYED IN THE CONSTRUCTION INDUSTRY 1850-2000: GREAT BRITAIN



Source: Tables A.4.7 – A.4.13.

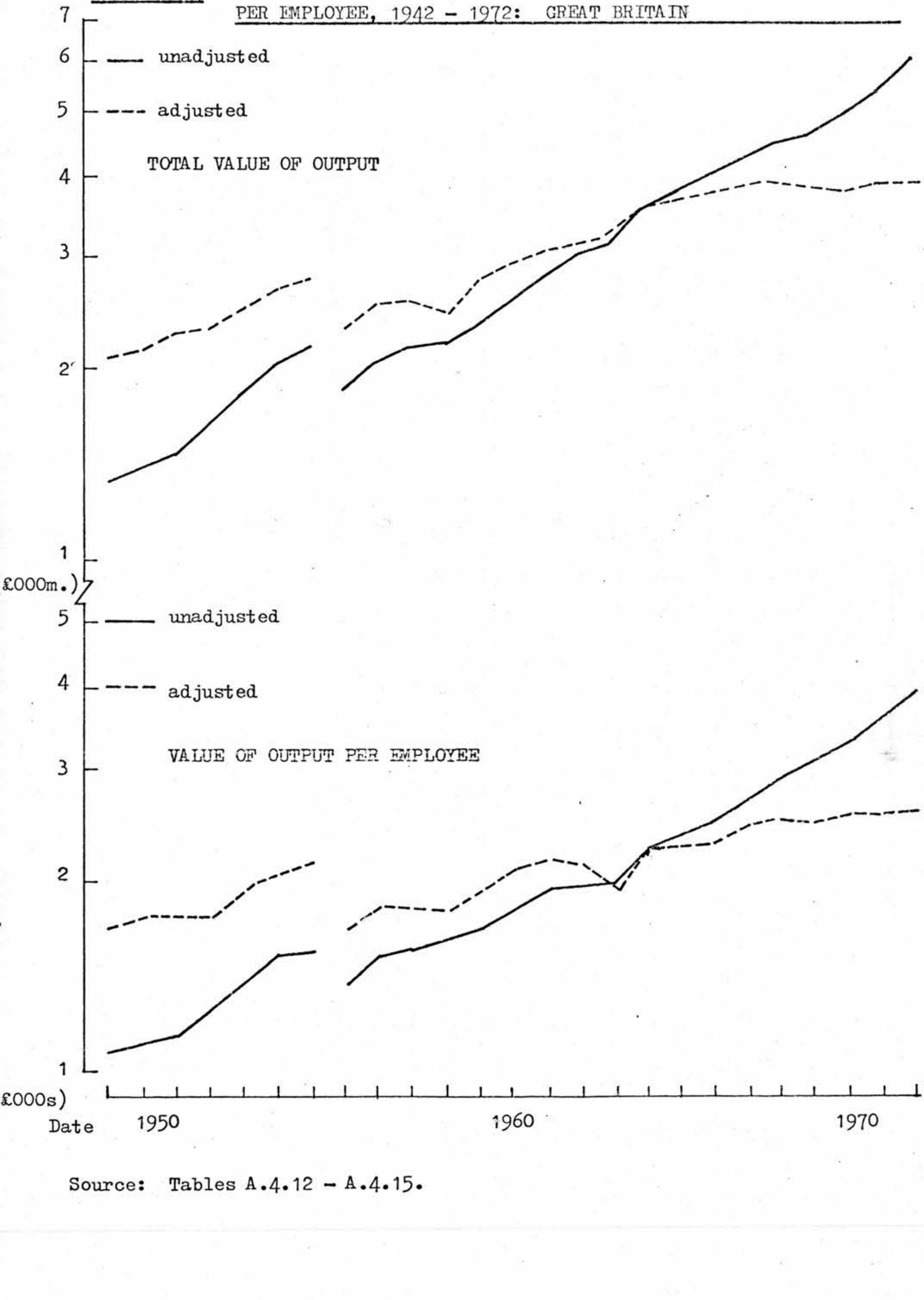
TABLE 6.2: POPULATION EMPLOYED IN THE CONSTRUCTION INDUSTRY 1850-1970: GREAT BRITAIN – AS A PERCENTAGE OF TOTAL, WORKING AGE AND EMPLOYED POPULATIONS

1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1955	1960	1965	1970	MEAN	
2.39	2.57	2.74	2.95	2.73	3.29	2.80	2.10 1.74	2.20	N.A.	2.68	2.69	2.77	3.14	2.92	2.76	of Total Population
3.18	3.36	3.68	3.97	3.59	4.23	3.34	2.69 2.24	2.87	N.A.	3.63	N.A.	N.A.	4.52	4.03	3.71	of Working Age Population
5.30	5.64	6.09	6.88	6.22	7.48	6.31	4.64 3.26	4.69	N.A.	6.37	6.35	6.45	7.15	4.64	6.01	of Employed Population

Source: Tables A.4.7 – A.4.13.

Note: The two figures in 1920 reflect a change in the definition of the term 'construction industry'.

FIGURE 6.4: VALUE OF OUTPUT OF CONSTRUCTION INDUSTRY AND VALUE OF OUTPUT PER EMPLOYEE, 1942 - 1972: GREAT BRITAIN



Source: Tables A.4.12 - A.4.15.

annual basis between 1948 and 1972 in both unadjusted and adjusted (to 1964) pounds [28]. It also gives the output per employee in the industry in similar terms[29]. In current pounds, the output of the industry rose 2-3% at the beginning of the period, and 8-10% towards the end of the period, while the rise in output per employee was slightly less. However, in real terms, the rise in productivity was, on average, only 1-2% for either total production or productivity per employee.

6.13 Table 6.3 gives the total projected capacity of the industry between 1975 and 2000 in terms of value[30]. This table is derived from the three population projections of total population, the three projections of the population employed in the building industry and a 2.0, 2.5 and 3.0% real rise in productivity per employee[31]. The total possible output of the industry varies from £128,000 m. to £186,000 m. (in 1964 £s) over the next twenty-five years.

6.4 FUTURE DEMAND FOR STOCK

6.14 Having determined the range of the capacity of the construction industry for the next twenty-five years, the demand for stock

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27. (contd.) is different from the value of the buildings begun or under construction in the same year, because buildings may not be completed in the same year in which they are begun, or may be abandoned before they are finished. In general, completions represent 95-98% of the amount of work begun. Seeley, I.H.: op.cit.
28. See Tables A.4.12 and A.4.13.
29. See Tables A.4.14 and A.4.15.
30. See Tables A.4.16 - A.4.25.
31. Stone considers a 3% rise average per year in real productivity as the maximum possible for the next thirty years (90% overall). For the period 1948-1972, the overall increase in real productivity was 46.3% or 1.93% per year on average, which gives an annual compounded rate of just over 1.60% (see Table A.4.14). Stone, P.A.: Urban Development in Britain, op.cit.

during this period must also be analysed. The most exhaustive study to date on the demand for stock was undertaken by Stone[32], but only with reference to the demand for housing stock. Thus, this thesis uses his work as a basis for undertaking the analysis of the future demand for all stock.

TABLE 6.3: TOTAL FUTURE CAPACITY OF THE CONSTRUCTION INDUSTRY (1975-2000): GREAT BRITAIN

Rise in Real Productivity	% of Population Employed in Construction Industry	TOTAL POPULATION HIGH	R.G.	LOW
2%	Low	135,604	130,463	128,409
	Medium	154,894	149,124	146,693
	High	173,000	167,764	165,069
2.5%	Low	140,171	138,481	132,666
	Medium	160,109	154,093	148,552
	High	178,810	173,354	170,540
3%	Low	145,887	140,264	137,980
	Medium	166,636	159,306	157,627
	High	186,081	180,344	177,374

(1964 £m.)

Source: See Tables A.4.16 - A.4.25

32. Stone, P.A.: Urban Development in Britain, op.cit. Stone in turn relies heavily on NIESR estimates of demand and costs.

6.15 Stone[33] based his projections on the three projections of total population discussed above, as well as three 'programmes' of demolition and replacement of the stock based on the age of the existing housing stock. These three programmes were:

Programme A which would demolish and replace a total of 2.9 million dwellings by the end of the century, accounting for almost all of the stock over 119 years old at the end of the century;

Programme B which would demolish and replace 4.8 million dwellings, or those over 79 years of age by the end of the century; and

Programme C which would demolish and replace 7.6 million dwellings, or those over 59 years old by the year 2000[34].

Stone estimates that if the demolition and replacement of the stock in any of the programmes is confined only to those below the present Parker Morris standard, then by 1999 42% of the total housing stock will be above that standard with Programme A, 51.3% with Programme B, and 65.2% with Programme C[35].

6.16 The cost of these programmes is calculated by Stone by taking into account regional differences in costs, as well as differences arising from density, amenities, and the height of buildings[36].

Also included in the calculations are the costs of site work, utilities and streets (12% of total), the cost of providing garages (8%) and the cost of demolition (3%), as well as the cost of regular maintenance

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33. Ibid.
34. It will be recalled that 60 years is normally considered to be the economic life-span of the existing stock. See Chap. 5.
35. Stone, P.A.: Urban Development in Britain, op.cit. Table 12.11.
36. See Chap. 5 for discussion of the effects of height and location differences in cost.

and repair and the cost of correcting past arrears in maintenance. The total cost of providing new housing (excluding site work, garages and demolition) for the next twenty-five years is between £70,000 m. and £101,000 m., with maintenance and repair accounting for between £31,000 m. and £32,000 m. respectively, depending on the demolition programme and population projection used. As can be seen from Table 6.4, by retaining more of the present stock, thereby increasing its life-span (Programme A), the savings in cost would be approximately 10% over the most ambitious replacement programme (Programme C). However, in so doing it would mean accepting a greater percentage of the stock being below the present standard.

6.5 COMPARISON OF THE CAPACITY OF THE CONSTRUCTION INDUSTRY AND THE DEMAND FOR STOCK

6.17 In comparing the projected capacity of the construction industry and the demand for stock, in the next twenty-five years, the figures given in Table 6.3 must first be broken down into their component parts - new housing, other new work, repair and maintenance, and labour employed directly by the local authority. (Table A.4.26[37] shows the percentage of each of these component parts over the period 1948 - 1972 with the mean over the period being 25.1% for new housing, 38.6% for all other new work, 21.0% for repair and maintenance and 15.3% being done by labour directly employed by the local authorities[38].) Table 6.5 gives this breakdown. With a 2% real rise in productivity, the total housing capacity of the industry varies from £32,000 m. to £43,000 m., increasing to a maximum of £46,700 m. if the real rise in productivity

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37. Appendix 4.
38. The exact nature of this work is unspecified, however, it is most likely to be non-building construction and maintenance.

TABLE 6.4: DEMAND FOR STOCK: COMPARISON OF COSTS OF HOUSING FOR DEMOLITION PROGRAMMES A, B & C (1975 - 2000)

BIRTH RATE	COST OF NEW HOUSING (DEMOLITION PROGRAMME)			COST OF MAINTENANCE AND REPAIR (DEMOLITION PROGRAMME)			TOTAL HOUSING COSTS (DEMOLITION PROGRAMME)		
	A	B	C	A	B	C	A	B	C
Low	38,213	46,706	59,965	31,920	31,642	31,415	70,133	72,590	80,238
R.G.	40,600	49,093	62,348	31,990	31,755	31,685	78,348	80,848	88,318
High	47,443	55,930	69,187	32,795	32,388	32,313	91,380	94,033	101,500

(1964 £m.)

Source: Adapted from Stone, P.A.: Urban Development in Britain, op.cit.

TABLE 6.5: TOTAL FUTURE CAPACITY OF CONSTRUCTION INDUSTRY BY SECTOR (1975 - 2000)

Sector of Industry	% Population Employed in Construction Industry	2.0%			2.5%			3.0%			Rise in Real Prod./Yr.
		HIGH	R.G.	LOW	HIGH	R.G.	LOW	HIGH	R.G.	LOW	Population Projection
New Housing	Low	34,073	32,746	32,231	35,182	34,758	33,299	36,618	35,202	34,673	
	Medium	38,878	37,430	36,819	40,187	38,677	37,287	41,826	39,986	39,564	
	High	43,423	42,108	41,432	44,881	43,512	42,806	46,706	45,266	44,521	
Other New Work	Low	52,343	50,359	49,566	54,106	53,454	51,209	56,312	54,135	53,260	
	Medium	59,789	57,562	56,623	61,802	59,480	57,341	64,321	61,492	60,844	
	High	66,778	64,757	63,717	69,020	66,915	65,826	71,827	69,613	68,466	
Repair/ Mainten-ance	Low	28,476	27,397	26,966	29,436	29,081	27,860	30,636	29,452	28,976	
	Medium	32,578	31,316	30,806	33,623	32,360	31,196	34,994	33,454	33,102	
	High	36,330	35,230	34,664	37,550	36,404	35,813	39,077	37,872	37,249	
Labour of Local Authors.	Low	20,748	19,961	19,646	21,446	21,188	20,298	22,321	21,458	21,111	
	Medium	23,699	22,816	22,444	24,497	23,576	22,728	25,495	24,374	24,117	
	High	26,469	25,668	25,256	27,358	26,523	26,093	28,470	27,593	27,138	

(1964 £m.)

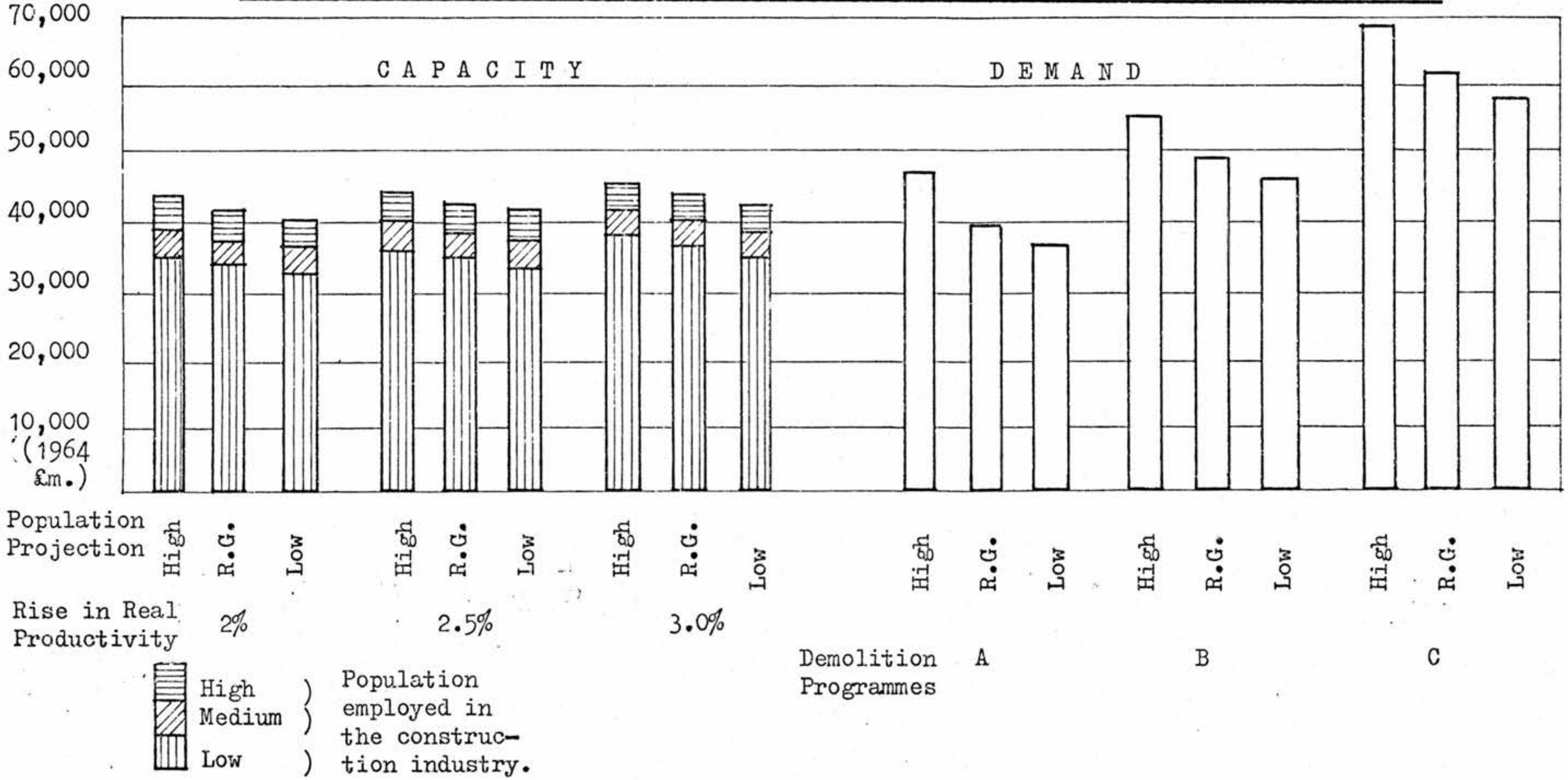
Source: Tables A.4.26 and 6.3.

is 3% over the twenty-five year period. Maintenance, on the other hand, varies from a low of £27,000 m. to a high of £39,000 m. Figure 6.5 compares the capacity of the industry to undertake new housing with the demand for new housing. Programme A, the one which includes the least demolition and replacement of the stock, is shown to be the most feasible, but only if the percentage of the population employed in the industry is high. If the more ambitious programmes are undertaken (i.e., Programmes B and C) the capacity of the industry falls short of the projected demand. Figure 6.6 shows the total capacity for maintenance and repair of the industry with the projected demand for housing maintenance under the three demolition and replacement programmes. While the demand for each of these programmes is slightly below any one of the projected capacities, it must be remembered that the non-housing stock also requires maintenance at the same or a higher level than that of housing[39]. Therefore, the total maintenance and repair demand will exceed the total capacity of the industry to provide these services.

6.18 The method for overcoming the deficits in demand, by increasing productivity per employee by more than 3% per year has been discussed previously and found not to be feasible. Increasing the percentage of the population employed by the construction industry would be equally impossible. The 'borrowing' of labour from other sectors of the industry (from new work and labour employed directly by the local authorities) would be impossible because of the organisation of the industry[40] and because, if one assumes that non-housing demand/capacity will remain in the same proportion to housing demand/capacity[41], a

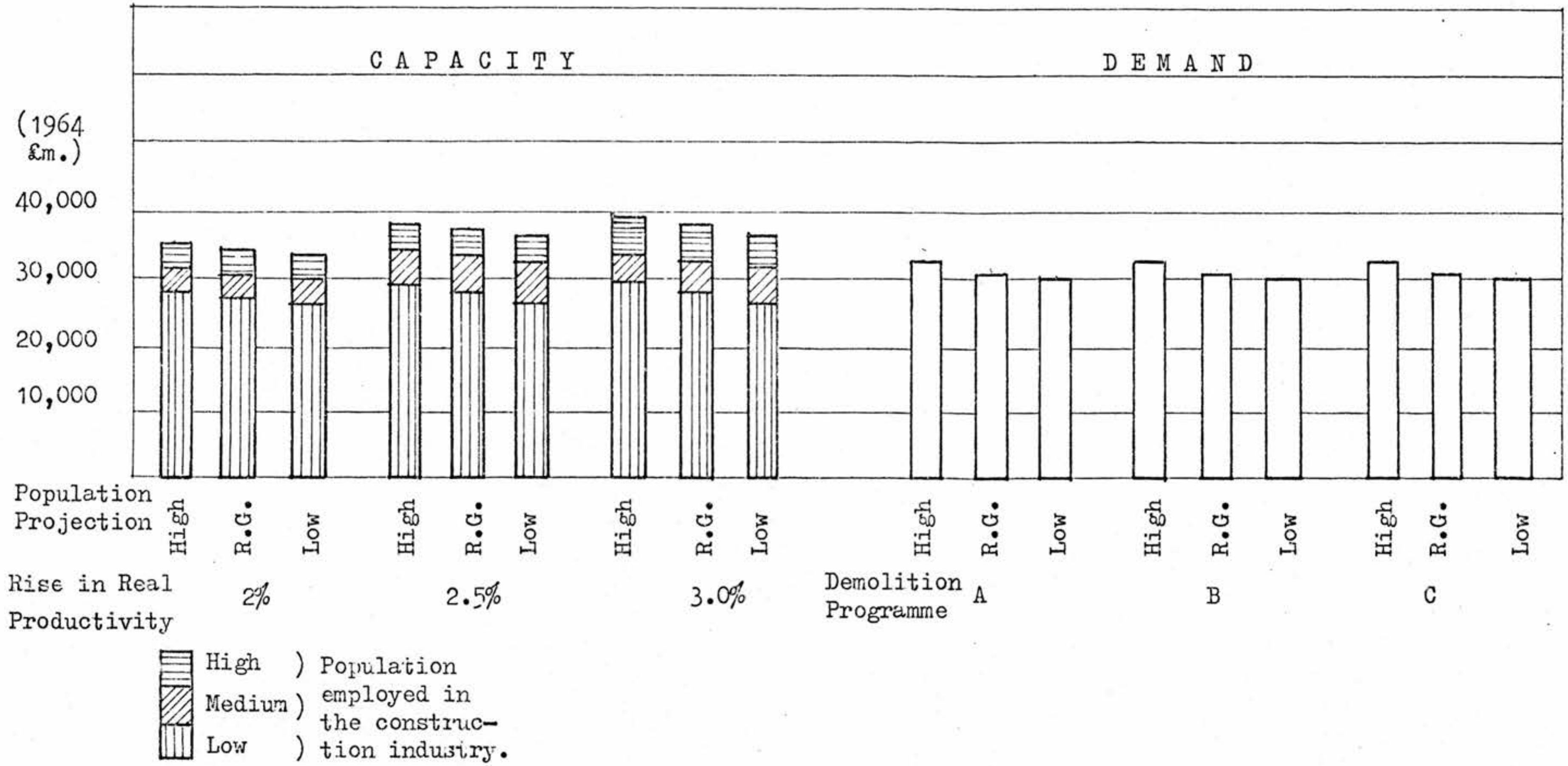
39. See Table 5.8.
40. See Section 6.1.
41. See Table A.4.25.

FIGURE 6.5: COMPARISON OF CAPACITY OF THE CONSTRUCTION INDUSTRY TO SUPPLY HOUSING AND THE DEMAND FOR HOUSING (1975 - 2000)



Source: Tables 6.4 and 6.5

FIGURE 6.6: COMPARISON OF CAPACITY OF THE CONSTRUCTION INDUSTRY TO SUPPLY MAINTENANCE AND THE DEMAND FOR HOUSING MAINTENANCE



Source: Tables 6.4 and 6.5

deficit will occur in those sectors, except under Programme A. Thus, the most feasible solution would be to retain the stock longer (Programme A), while attempting to offset the deficit in the maintenance sector by the slight surplus of capacity in the other sectors, which would occur under this Programme.

6.6 CONCLUDING REMARKS

6.19 While it is possible to consider the building industry as a 'factor' which affects the life-span of the existing stock of urban buildings, it is not a factor in the same sense as the operational or physical factors, the use or the users discussed in Chap. 2. Rather, the building industry is the implement by which physical changes of the stock are brought about in response to the changes in the operational factors, the use and the users as well as the physical deterioration of the stock. As such, it affects the feasibility of that change. The question of whether it is socially and economically 'better' to replace or continue to use the existing stock is influenced not only by the socially and economically measured implications of the alternatives, but also by the capacity of the building industry to undertake the physical changes necessary. This chapter would conclude that the most feasible "answer" to the question would be in favour of prolonging the life-span of the existing stock. However, as with the social and economic "answers" it must be remembered that a true evaluation is dependent on the context in which the factors operate. In some areas, the feasibility of replacement may be greater than the feasibility of the retention of the stock.

6.20 Having discussed at some length the social and economic implications of prolonging the life of the stock and the capacity of the building industry to physically alter or replace the stock in this part of the thesis, it is now possible to undertake an empirical analysis of the influence of some of the operational factors, the use and users, on the life-span of the stock. Part 3 is devoted to this undertaking.

PART THREE

CHAPTER SEVEN

A CROSS SECTION OF AN URBAN ENVIRONMENT: A SURVEY OF CHANGE

7.1 INTRODUCTORY SUMMARY

7.01 A section of Edinburgh, comprised of eleven square kilometres, and containing some ten thousand items of stock, was examined for the amount, type and location of physical change of the stock occurring between 1860 and 1970. The ten basic types of changes recorded were grouped into three types, which showed dissimilarities in location and date of change. These three types were then compared to the change in the total population of Edinburgh, the change in the value of all stock and housing prices in Edinburgh, and the change in interest rates and amounts advanced by building societies over the period. It was concluded that the adaptation of the stock (as opposed to the construction of new stock) is slightly more sensitive to these operational factors.

7.2 INTRODUCTION

7.02 Having theoretically examined the factors which affect the life-span of the stock of urban buildings in Part One, and discussed some of the social and economic implications of prolonging that life-span in Part Two, this Part will empirically examine the relationship, over time, of phvsicial change of the stock, and some of the factors. Physical change will not only be described in terms of the construction of new stock, either on virgin land or on land already occupied by urban development, but also by the type of adaptation which the stock has undergone. The factors considered in this Chapter will be population (a social factor) and interest rates, the value[1] of the stock,

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1. Value in this and the next Chapter means the Yearly Rent or Value from 1860 - 1925 and the Gross Annual Value from 1930 - 1970; that is, the value determined by the government for taxation purposes (commonly called rateable value).

and the amount available for construction (economic factors). In Chapter 8, the same four operational factors will be considered along with a detailed consideration of the change of use and user[2].

7.03 A cross section of Edinburgh, Scotland, was chosen for analysis in this Chapter. The section runs from Newhaven Harbour in the North through Central Edinburgh (the New Town and the Ancient Royalty) to the present City Boundary in the South near Mortonhouse Mains. It is comprised of eleven square kilometres (11 km. x 1 km.) bounded on the East by National Grid (NG) 260 and on the West by NG 250, on the North by NG 780 and on the South by NG 670[3]. The section is divided, also by use of the National Grid, into squares of 10,000 m^2 each[4]. This particular section was chosen for a number of reasons: the data as to the physical changes of the stock was available; the section runs from a non-expandable fringe (at Newhaven) to an expandable fringe in the South[5]; it encompasses almost all of the original and present centre of the urban area (the Ancient Royalty and the New Town respectively); contains a diverse number of uses of the stock, thus the effects of a succession of uses may be studied[6]; and the section contains buildings

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2. Both of these Chapters could be considered to be rather extensive 'pilot' studies which demonstrate the feasibility of larger, more complex undertakings, both in the availability of data and the information derived. For further discussion see Chap. 9.
3. See Map 1 in supplement. (Base Map).
4. Identification number for each square is given by its north-west NG co-ordinates. For example, the co-ordinates for the top left hand square on the base map is 780/250, the one immediately to the south is 779/250, while the one immediately to the east is 780/251. The number before the / (the north-south NG number) is termed the primary National Grid co-ordinate (PNG), while the number after the / (the east-west NG number) is termed the secondary National Grid co-ordinate (SNG).
5. The expandability of a city, like the expandability of an item of stock, will have an effect on the life-span of the stock in that area. The presence of barriers to lateral growth will cause/...

of both high and low value.

7.04 A transectional analysis was chosen over an analysis of an entire urban area because of the amount of data which would have had to be handled with the latter. It was chosen over a 'chequer-board' approach because the growth of Edinburgh followed closely the theoretical formula of Hoyt and Burgess[7], thus allowing the section to be fairly representative of the whole, even though it is bounded on two sides by water[8]. This type of analysis was also chosen over a random selection technique, because the way in which the raw data was organised would have necessitated re-organisation before random selection could have been properly applied[9]. The major shortcomings of this technique lie in the over-representation of the centre of the city (almost fully covered) and the under-representation of the fringes as a percentage of each ring sector. Thus, while a very complete compilation of data is obtained on the central part of the city, only a partial compilation of the fringes is represented. However, this is not seen as seriously affecting the validity of the conclusions based

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5. (contd.) a city to be contained within its boundaries and thus stimulate redevelopment to a higher density. This could have been perceived in Edinburgh when it had a town wall. For a theoretical examination of barriers to city growth, see: Kozlowski, J. and Hughes, J.T. with Brown, R.: Threshold Analysis: A Quantitative Planning Method, London, the Architectural Press, 1972.
6. See Appendix 2 for discussion of land use succession theory.
7. See Appendix 1.
8. Most cities on the edge of a large body of water will grow landward from the water's edge, such as Chicago or Boston, because the centre developed at the point of transport mode transfer. Edinburgh, however, developed from Castlehill (a defensive position), while Leith (now incorporated into the city) was the point of transport mode transfer. However, the defensive and administrative importance of the town always overshadowed the trading aspect.
9. It has also been argued recently that random selection is not/...

on this data.

7.05 The data obtained included all of the physical changes of the stock[10] within the section between 1860 and 1970. This represents over 11,000 separate changes of the stock, recorded in respect to the type of change, date of change and the location of the stock. This data was gathered from the Card File of the Dean of Guild Court in Edinburgh. The File is composed of all Warrants issued for physical change of the stock in Edinburgh from 1860 to the present, incorporating files from the separate municipalities, such as Leith, Newhaven and Portobello, as they were incorporated into the city. The File is divided into two sections, Minor Warrants, those changes costing less than £500 (until 1971, when this was changed to £2,500) and Full Warrants, those changes costing more than £500. For this study, it was decided only to incorporate data in the Full Warrant section of the File, as the inclusion of the Minor Warrant data would have increased the amount of data by 50% without significantly altering the analysis[11]. The File is arranged alphabetically by the name of the street and lists, in order of the date of issue of the warrant, in regard to the building number and giving the name of the petitioner[12]. The Card File also contains

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9. (contd.) truly a representative selection technique. See: Chaitin, G.S.: 'Randomness and Mathematical Proof', Scientific American, May, 1975.
10. With the exception of physical changes of Register House, West Register House and New Register House, the Central Post Office and the Castle; due to their ownership they were not required to obtain warrants for change from the Dean of Guild Court. The other two examples of exempted buildings in Edinburgh, which were not included in this survey, are the Royal Botanical Gardens and Holyrood House, also because of their ownership.
11. This was determined by comparing the amount of change by location on the File. However, it would be interesting to determine if the amount of minor changes occur in the same time pattern as the full changes (see Section 7.3 below).
12. It was hoped to include the user of the stock in this survey/...

information as to the type of change (called operation) involved. The File is 'keyed' to the Archives of the Dean of Guild Court where a copy of the plans, sections, specifications of each operation, and any extra-ordinary court action concerning the petition is kept. Because of the Archives, which contain complete information of the operation, the information on the File is of a rather abbreviated form which is, nonetheless, usable for the present purposes. For example, the File notes the operation or change as 'alteration', 'addition', 'new facade', etc., but does not specify the location within the stock or the exact nature of the 'alteration', the square frontage of the 'addition', etc.[13]. Because of the immense amount of labour involved in obtaining more detailed descriptions of the type and extent of the changes from the Archives, this was not undertaken for this survey[14]. The completeness of the data is probably extremely high as it was (and is) illegal to alter the stock without first obtaining a Warrant. However, two exceptions should be noted. Demolition was, and still is, not required by law to be undertaken only after permission is granted[15].

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12. (contd.) However, the name of the petitioner is not always synonomous with the user or even the owner of the stock. Thus, user changes had to be obtained from other data sources (see Chapter 8) - too labourious to be included in this analysis.
13. It is also a great pity that the cost of the changes is not noted at all, as this could be very helpful in determining the economics of change.
14. However, in Chapter 8 a more exact analysis of change in a small area of Edinburgh did utilise the information contained in the Archives.
15. That is, permission only needs to be obtained on listed buildings at present. However, a recent report by G. Dobry on development control contains a section of the control of demolition, originally submitted separately from the main report, which would require consent before demolition could occur. See: Dobry, G.: <u>Control of Demolition</u>, London, HMSO, September, 1974.

Thus, the demolitions recorded in this survey were all in conjunction with rebuilding warrants. It is possible that a few buildings, demolished but not replaced, were missed by the survey. The second exception concerns the difference in the amount of change occurring before and after 1880[16]. This leads to the suspicion that the data before that date is not as complete as the data after that date[17]. However, neither reservation, while worth noting, appears to alter critically the validity of the data.

7.06 The data on the type of physical change of the stock contained in the File has been categorised under the following ten headings:

1. Alterations - which include everything from moving partitions to changing services;
2. Additions - extension of the stock either horizontally or vertically;
3. Alterations/Additions - when they were undertaken at the same time;
4. New building - original construction on a virgin site;
5. Rebuilding - original construction on a site previously occupied by an item of stock;
6. Demolition - the removal of an item of stock (usually in conjunction with rebuilding);
7. Sub-division - the division of an item of stock into separate self-contained units;
8. Conversion - where physical adaptation was undertaken at the same time as a change of use.
9. New facade - the external refacing of the stock;

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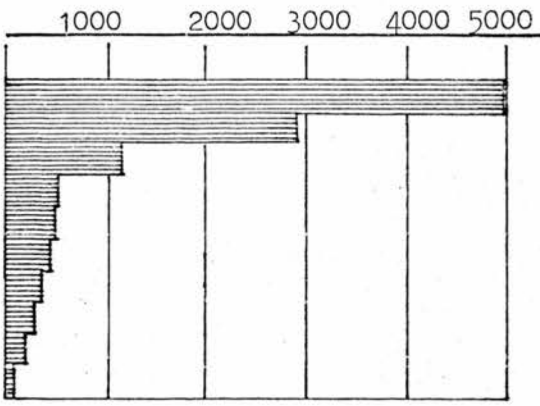
16. See Figure A.5.11.
17. In discussing this point with the Depute Clerk of the Court/...

10. Other changes - including the erection and alteration of police call boxes, public conveniences and automatic telephone and electrical sub-stations.

Figure 7.1 shows the number and percentage of the types of changes recorded.

FIGURE 7.1: CHANGE OF STOCK BY TYPE: SURVEY SECTION, EDINBURGH (1860 - 1970)



No. of Operations	%	Type of Operation
4,999	44	Alt.
2,947	26	New Bdg.
1,124	10	Add.
490	4	Rebuild.
477	4	Demo.
359	3	New Fac.
351	3	Alt/Add.
313	3	Sub-Div.
255	2	Conv/C.of U.
91	1	Other

Source: see Section 7.2

7.07 Other data used in this analysis included the land covered by stock in the section in 1860, 1915 and 1970 which was obtained from Ordinance Survey Maps; the change in the population of Edinburgh and the value of the stock in the city for the survey period; the change in the interest rates and the amount of capital advanced by the building societies for the nation as a whole; the price of housing in

17. (contd.) I was assured that, as far as he knew, no changes occurred at that date which would not have been reflected in the change of control over physical change in the stock.

Edinburgh from 1910 - 1970, and the date at which areas first entered urban use[18].

7.3 PHYSICAL CHANGES OF THE STOCK BY DATE, TYPE AND LOCATION

7.08 A series of Figures (7.2 - 7.11) represent the physical changes of the stock in the trans-section by type, date and location from 1860 - 1970. Each type of change is examined separately below; it should be noted first, however, that while new building and rebuilding represent approximately 60-70% of the total economic value of the output of the construction industry[19], they only represent 30% of the number of warrants issued in this study. Thus, on average, it can be said that new building and rebuilding represent twice the economic investment of other changes within the trans-section. It should also be noted that it is not the intention of this thesis to give a detailed historical analysis of the growth and change of the stock within the trans-section, but rather a broad over-view of the relationship between physical change of the stock, the type, date and location of that change and certain economic and social factors. Thus, a detailed description of the physical changes, although possible with the data considered, would be best reserved for a more ambitious undertaking[20].

7.09 The 1100 additions to the stock recorded in the survey are fairly evenly distributed over the section with peaks occurring between the Water of Leith and Queen Street, immediately north of the Meadows, and near Grange Loan. In the northern and southern section, the date of additions is more closely concentrated in the latter part

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18. For explanation and examination of each of these factors, see Section 7.4.
19. See Chap. 6.
20. See Chap. 9.

of the period, while in the centre, they tend more towards the earlier dates. This is due to the growth of the city from the centre (PNG 740) outward, with the earlier urban areas being filled in first[21]. Additions in the Water of Leith to Queen Street area and the Grange Loan area are associated with the change of use of these areas, although physical change of the stock generally occurred 10-15 years after the change of use. In the northern area, the change of use was from single family attached dwellings to multi-family dwellings, or to small professional offices, hotels or private clubs. The additions in the Meadows area (PNG 730) were mainly caused by the expansion of public education and health facilities (The Royal Infirmary, Chalmers Hospital, and the Edinburgh College of Art) as well as the expansion of private educational facilities (Heriot's School). The additions in the Grange Loan area were associated also with a change of use, from single family detached dwellings to multi-family dwellings, private schools, hospitals and sanatoriums. Again, a time lag of 10-15 years between the actual change of use and additions to the stock was recorded[22]. Additions in time can be seen to flow outward from the centre (PNG 740), thus following the general pattern of new building.

7.10 Alterations present a different picture to additions. As can be seen in Figure 7.3, they are concentrated at the centre of the section (Queen Street to Princes Street) and taper towards the fringes of the section. (The dips in the figure at PNG 743 and PNG 738 are caused by the Queen Street and Princes Street Gardens.) Alterations

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21. Also see Map 2 in supplement.
22. Both the northern and southern peaks of additions can be seen as/...

are concentrated mainly on the non-housing stock and in areas where the 'highest and best'[23] use has been previously attained. That is, alterations appear to be mainly undertaken to improve the usefulness of an item of stock within its current use, rather than to facilitate a change of use. Over time, the two concentrations of alterations at the centre of the section were the last two decades of the nineteenth century and the last two decades measured (1950 - 1970).

7.11 Alterations undertaken at the same time as additions are not as numerous as either undertaken separately. This would suggest that spacial and functional obsolescence[24] do not occur at the same time. Alterations/additions are concentrated in two main areas of the section, PNG 740 and PNG 731, that is, they are associated with areas in which change occurs to facilitate a present use rather than a change of use. Over time, they occur near the beginning of the study period as the land available for expansion of the stock is not normally available towards the present.

7.12 As would be expected, new building on virgin land is almost, non-existant in the centre of the section, but is concentrated towards the fringes. From Newhaven to immediately south of the Water of Leith the construction of new stock is concentrated in the period 1930 - 1970, with a drop in the 1940 - 1950 period. In the southern concentration, south of the Meadows, new building activity is mainly concentrated in

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22. (contd.) an example of the filtration process described in Appendix 3. Gordon shows that the areas changed from social class 1 to either 2 or 3, where the change was from single to multi-family dwellings. The process of upward filtration (as well as land use succession) may be perceived to operate in the northern area. Gordon, G.: 'The Status Areas of Edinburgh', Ph.D. Dissertation, University of Edinburgh, 1970.
23. See Appendix 2 for discussion of 'highest and best' use.
24. See Chap. 1 for discussion of types of obsolescence.

the 1880-1910 period, with a small concentration around PNG 681 in 1930 - 1940 and 1960 - 1970. In the northern concentration, the new stock was mainly housing, single family dwellings (either detached or semi-detached) in the centre of the area (PNG 765-760) and multi-family attached dwellings for the remainder. In the area immediately south of the Meadows to PNG 719, the new building was again mainly housing, attached multi-family to the west, and semi-detached to the east of SNG 255. From PNG 719 to the Blackford Hills, the new construction was mainly large single family dwellings. Again, single family detached housing constituted most of the new building in the extreme southern concentration, although these dwellings are generally smaller in size than those constructed from PNG 719 to the Blackford Hills.

7.13 The sub-division of the existing stock follows closely the locational pattern of additions, although generally at a slightly earlier date. Sub-division is a particular type of conversion (see para. 7.15 below) which is associated with the change of use from single family to multi-family dwellings, almost exclusively. It should be noted that sub-division of the stock is concentrated in the 1900-1910 period and the 1940-1950 period, when other types of construction were relatively low. Thus, sub-division was an immediate way of increasing the size of the housing stock.

7.14 The demolition and rebuilding of the stock (Figures 7.7 and 7.8) are very closely associated and will thus be discussed together. They follow the locational pattern of alterations rather closely, peaking at the centre and tapering towards the finges; this, of course, would be expected as they do not generally occur until the site of the stock has almost completely been filled[25], when spatial obsolescence may only be overcome by replacement of the stock. In time, they are concentrated in two periods, 1890-1900 and 1960-1970.

7.15 Conversion of the stock is when physical alteration is undertaken to facilitate a change of use, normally a major change; for example, from a house to an office. Figure 7.10 shows that this is fairly low over most of the study period, except for the last decade (1960-1970). This suggests that until recently the change of use of the stock did not necessarily instigate an immediate change in the stock itself. That is, at present, the 'fit' between the attributes of the existing space and the requirements of the stock are much less satisfactory than formerly, possibly due more to the requirements than to the space. Locationally, conversion is concentrated towards the centre of the section, from Queen Street to Princes Street.

7.16 New facades, or the external face-lifting of the stock (normally confined to the front facade) follow closely the locational pattern of alterations. Thus, they are mainly associated with a single use in transition rather than a change of use (the use being mainly commercial). In time, new facades are concentrated in the 1900-1910 and 1960-1970 periods.

7.17 Other changes, mainly the erection and alteration of public conveniences, telephone and automatic electrical stations and police boxes, are concentrated towards the centre of the section and in the latter two decades (1950-1970) of the study period.

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25. See Chap. 8.

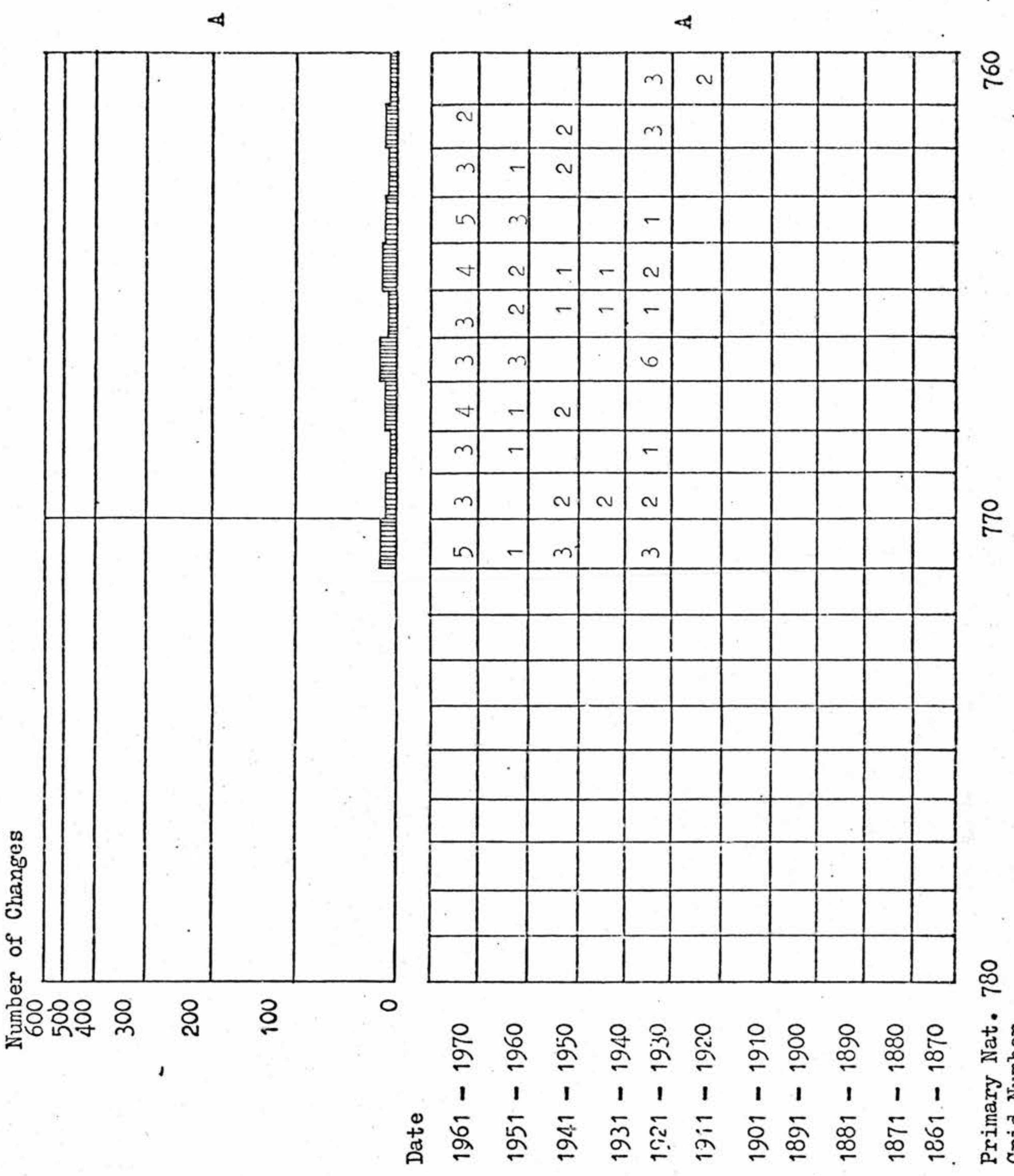


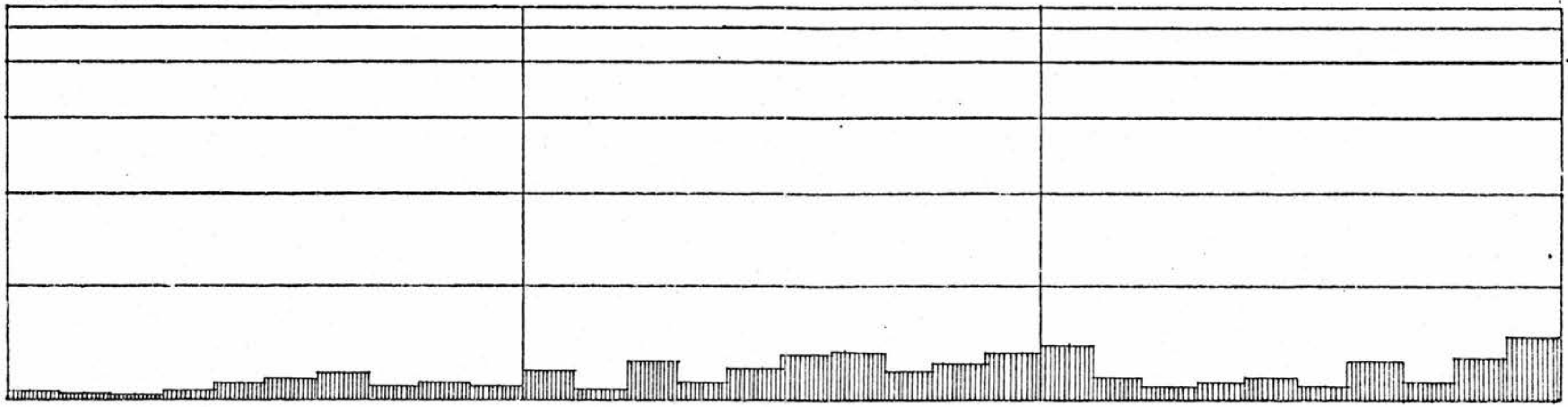
FIGURE 7.2: ADDITIONS TO THE STOCK: SURVEY SECTION, EDINBURGH

Source: See Section 7.3

Notes: Top figure: total changes by location.

Bottom figure: changes by date and location.

FIGURE 7.2: (contd.)



2	1	1	2	2	1	3	3	2	3	3		8	5	6	8	3		6	9	6	1	1		1	1	3	1	5	3
2	1	1	3	4	4	4	4	7	3	5	1	7	4	4	1	2	3		3	6	1			2		3		3	10
1			1	1	1	3		4		1	2	3	1	1	1		1	1	2			1	1	1					2
	1		1	1	1	1	2		1			2	1	3	2	2		2	1	2	2		1		1	6	1	1	
				1	5	5		2	2	11	1	5	3	4	11	5	1		3	4	2		2	1	2	5	3	3	6
				1	2	2	1			1	1	1	1	1	1	6	4	2		2			1	1		4		6	6
				1	4	4	1	2	1	4	1	1	1	1	6	7	3	6	7	5	2		3	4	1	3		5	8
				4	3	3		2	3	2	2	3	2	1	7	10	7	8	8	8	9	3	2	2	3	2	5	4	13
				4	1	1	1		2	1	2	3		3	4	7	6	4	2	8	4	5	2	5	1	7	2	7	5
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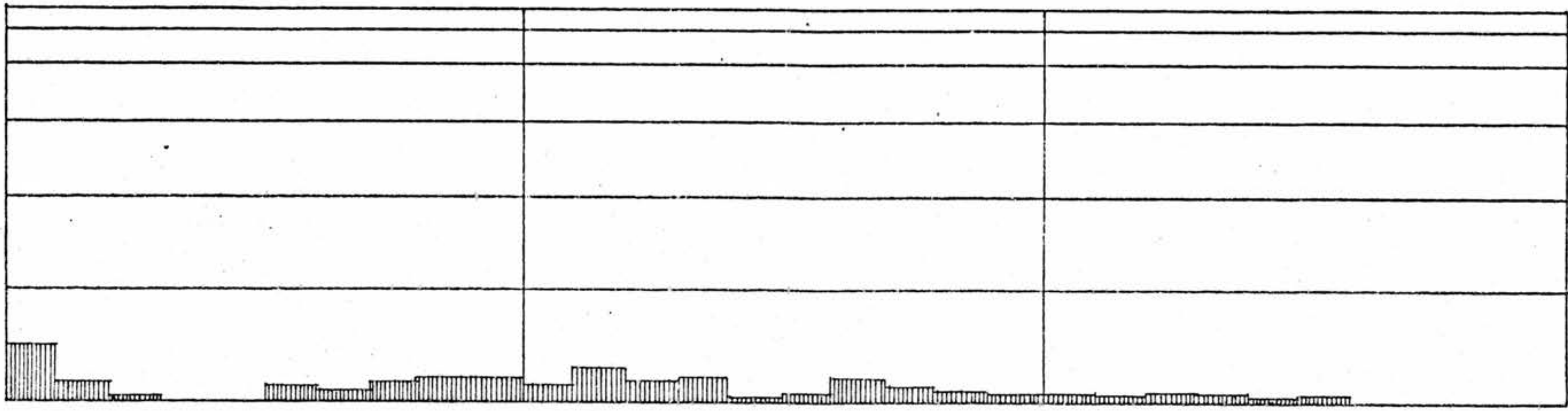
																			2										

A B

760 750 740 730

FIGURE 7.2: (contd.)



B

2	1					1		4	7	3	4	6	5			6	2	1	3	2		2	2						
2	5					1	4		3	2	3	3	5		2	2	4			1		1							
2	2					1		3	1							4		1							1				
2		1			1		1	5				2	3	1		1	1	3	2										
9	1	1			4	2	6	3	6	7	6	2	2			5	2	4	2	2	2	2	1	1	1				
9	1				2		2	2		1	3	1	3			1	1	1		1	1								
6		1			2		1	1	1	2	4	4	1			3		2	1	1	1		1						
10	5	1			2	2	3	4	2		7	1	2		1	1	4	2	1										
5	5				4	1	1	3	5	4	3	4	3			2	4												
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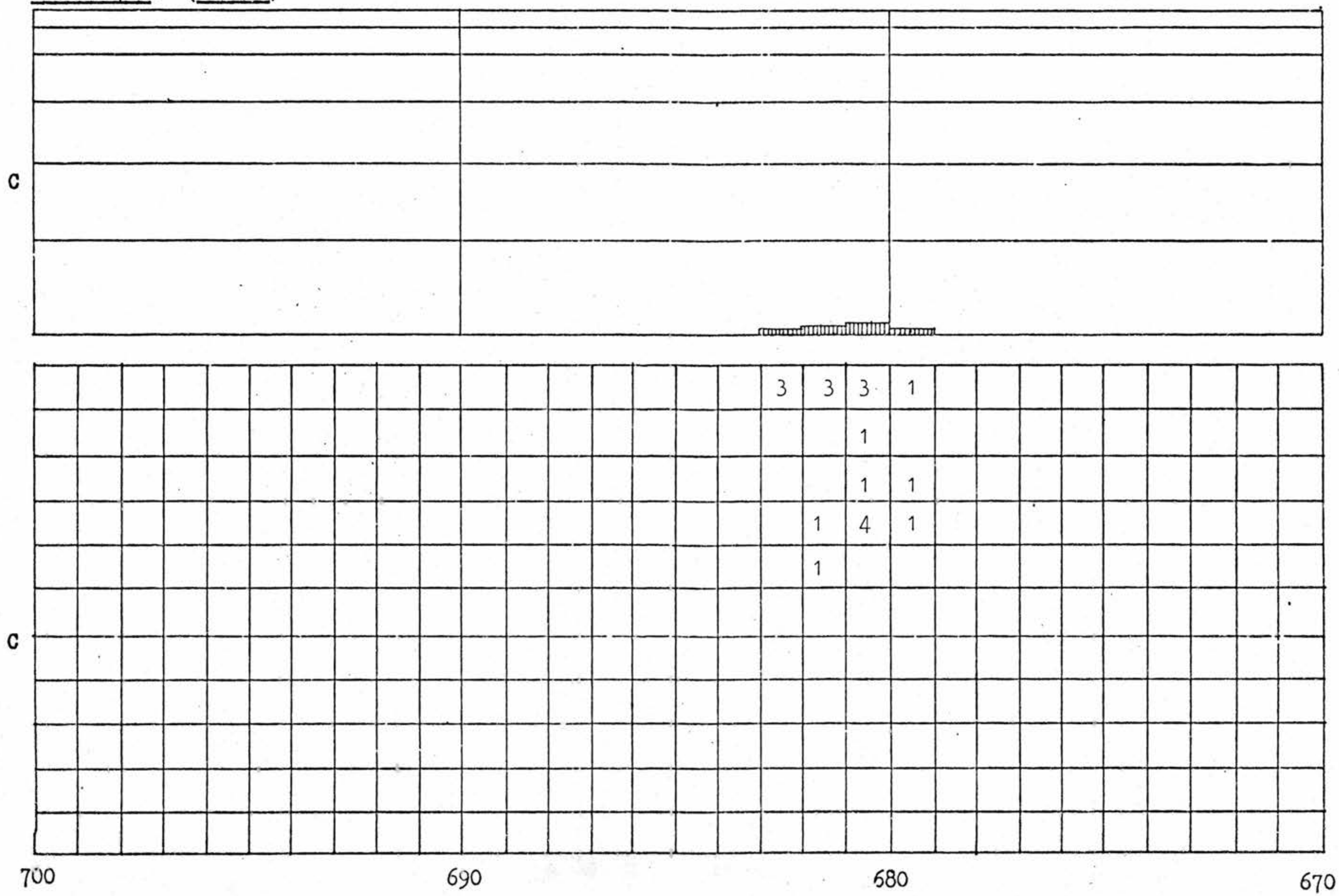
C

730 720 710 700

FIGURE 7.2: (contd.)



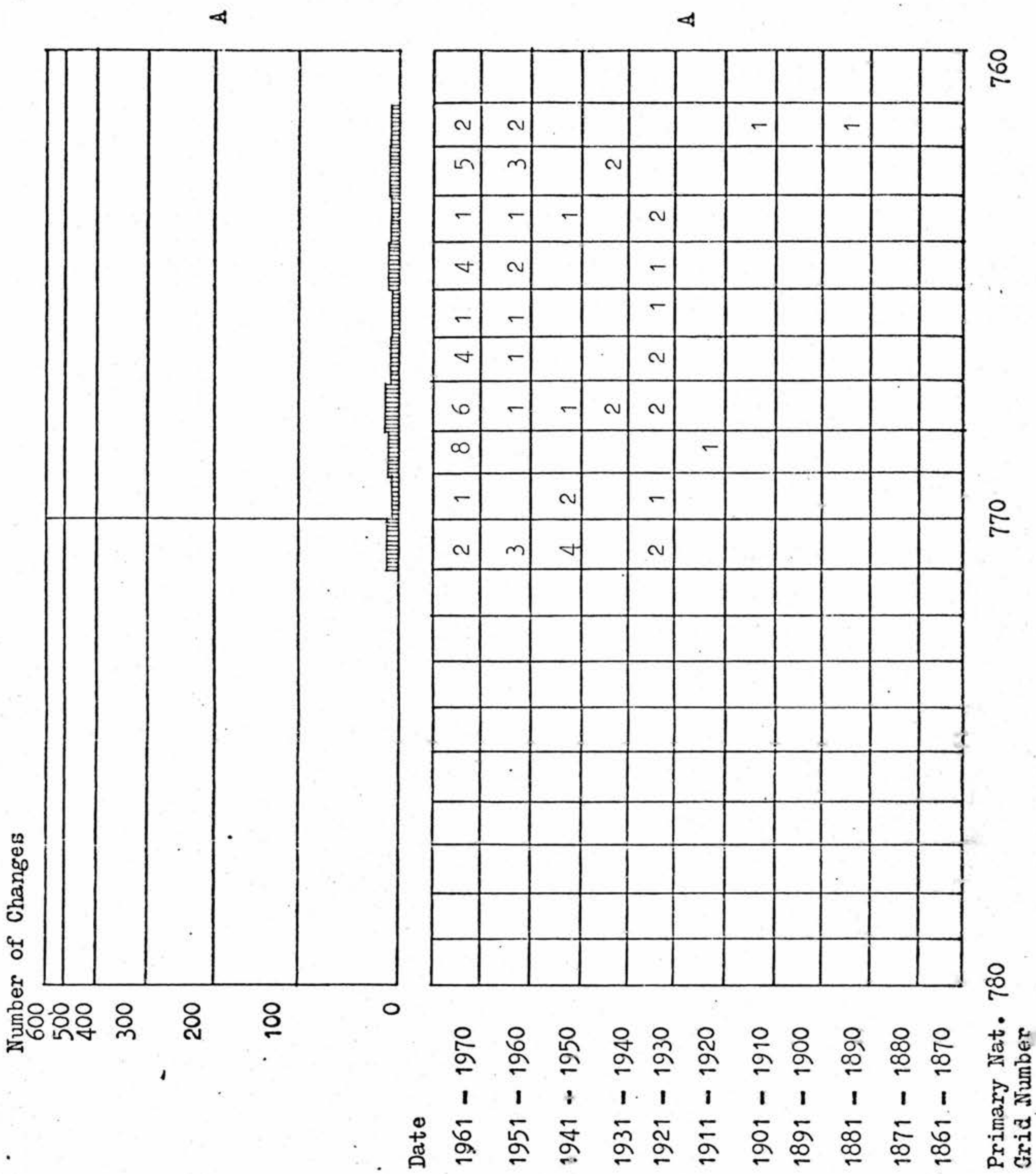


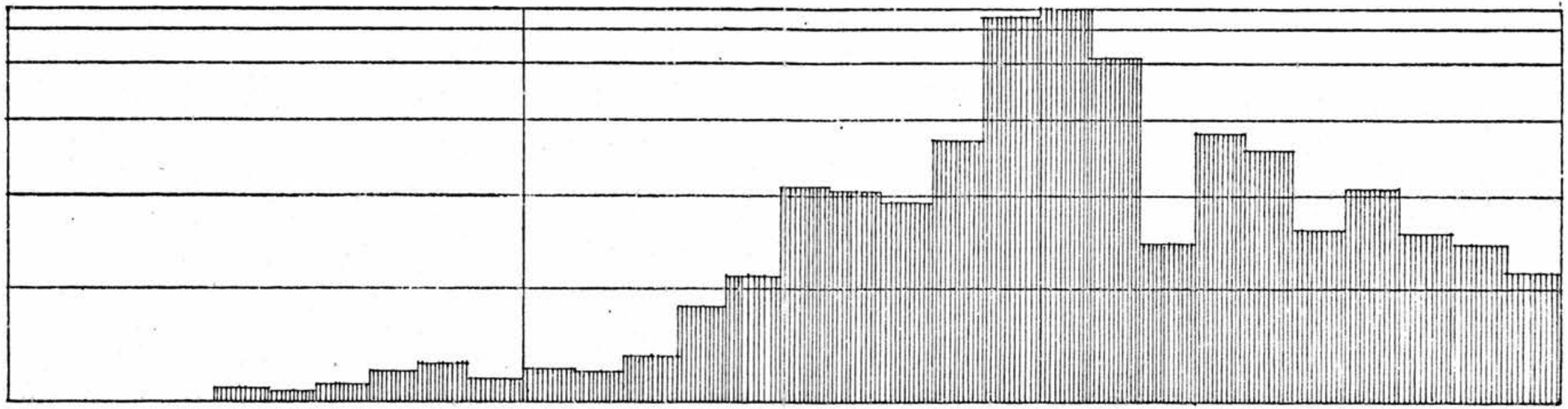
FIGURE 7.3: ALTERATIONS OF THE STOCK: SURVEY SECTION, EDINBURGH

Source: See Section 7.3

Notes: Top figure: total changes by location.

Bottom figure: changes by date and location.

FIGURE 7.3: (contd.)



A — B

				3	2	6	8	6	6	11	10	9	26	47	54	37	22	45	83	82	53	16	31	34	26	37	15	36	9
				2	2	1	4	6	1	3	2	4	4	5	20	15	15	28	47	53	34	23	17	23	19	21	14	24	10
					2			1		1	2	1		2	9	5	2	15	10	20	14	5	6	6	7	6	2	4	5
				1			2	1	4			1	4	4	16	8	8	14	33	21	19	6	8	11	6	10	4	6	2
						2	7		4	3	2	2	4	9	18	10	16	24	32	54	42	10	22	10	13	7	11	12	15
				1		1	1				2	4	5	4	8	9	12	8	28	50	38	8	7	9	5	9	8	6	5
				1	2			2	2	4	4	2	16	14	13	24	12	11	39	58	46	9	27	19	14	10	13	6	10
				1	1	5	3	10	6	3	4	6	11	16	22	33	41	35	82	86	62	26	47	47	15	34	27	15	20
				2			3	4	1	4	2	9	9	11	33	29	30	53	82	104	42	30	50	66	24	39	29	12	21
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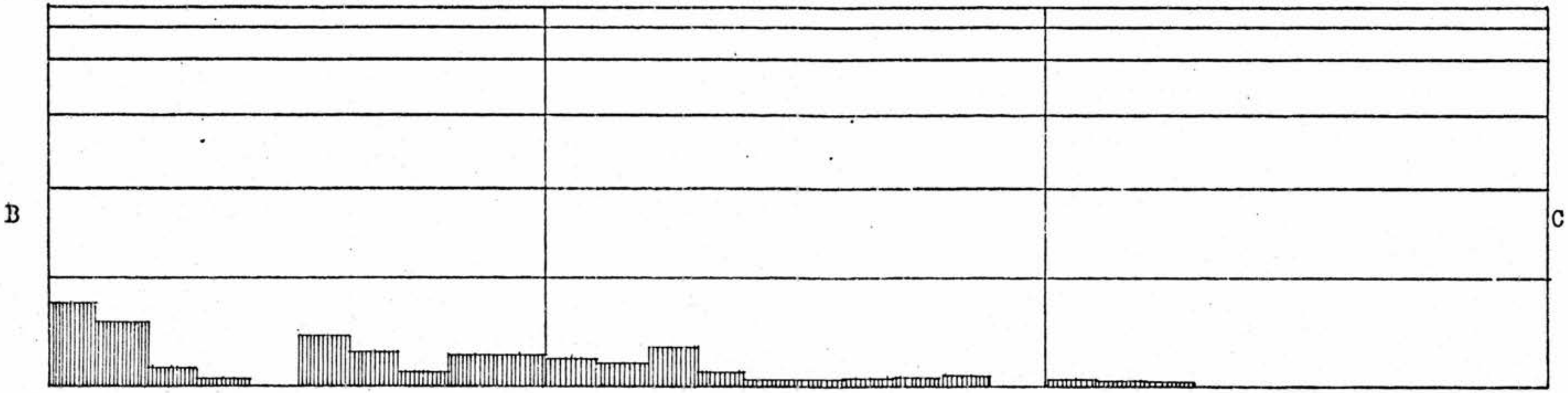
760 — 750 — 740 — 730

FIGURE 7.3: (contd.)



B ... C

10	11	4	2		17	9	3	8	8	7	5	7	3	2	2	3	4	3		2	1								
12	16	2			8	2	1	3	2	1	2	1				1		1											
4	2	1			1	1				1	1				2	1		1											
2					1			4	2	2		1	2			1													
2	3	2	2		3		1	1	1	1	2	9	1			1	1				1	1							
6	1					4		1	1	2	1	3	1					1											
8	9	3			2	1	2	1	1	3	2	3	1	1			1												
10	5	2			4	4	3	2	7	2	2	6					2	1											
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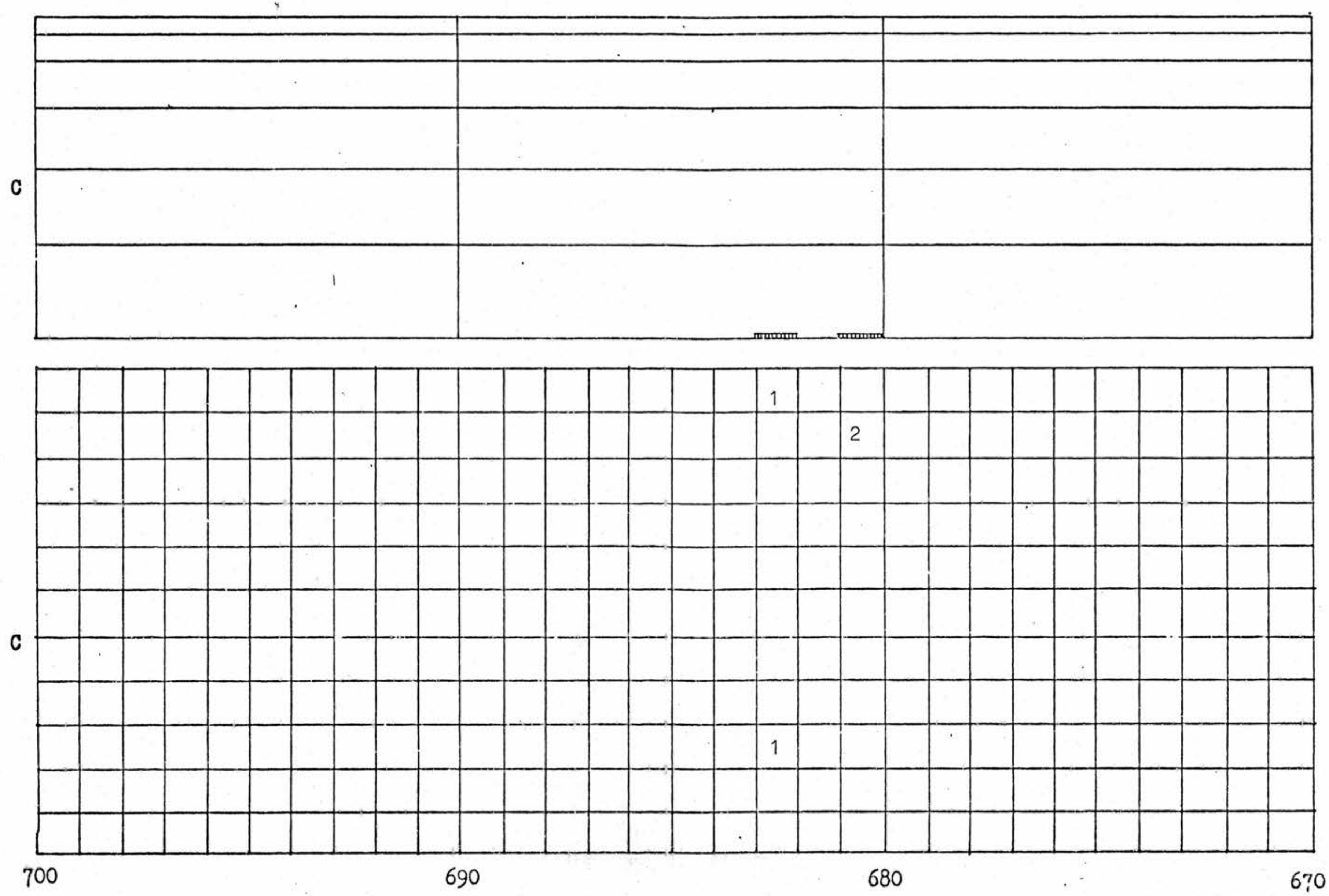
730 720 710 700

FIGURE 7.3: (contd.)



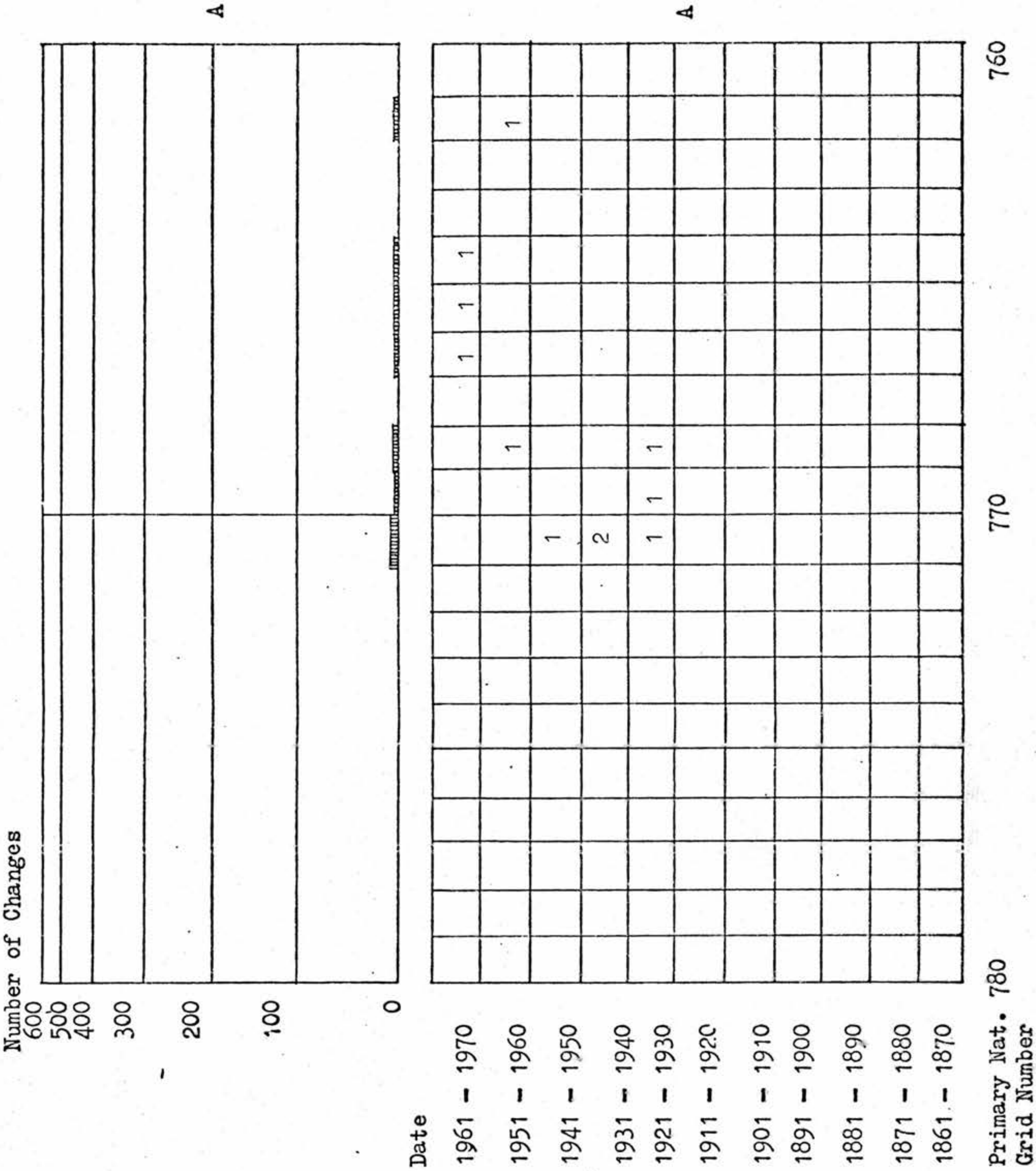


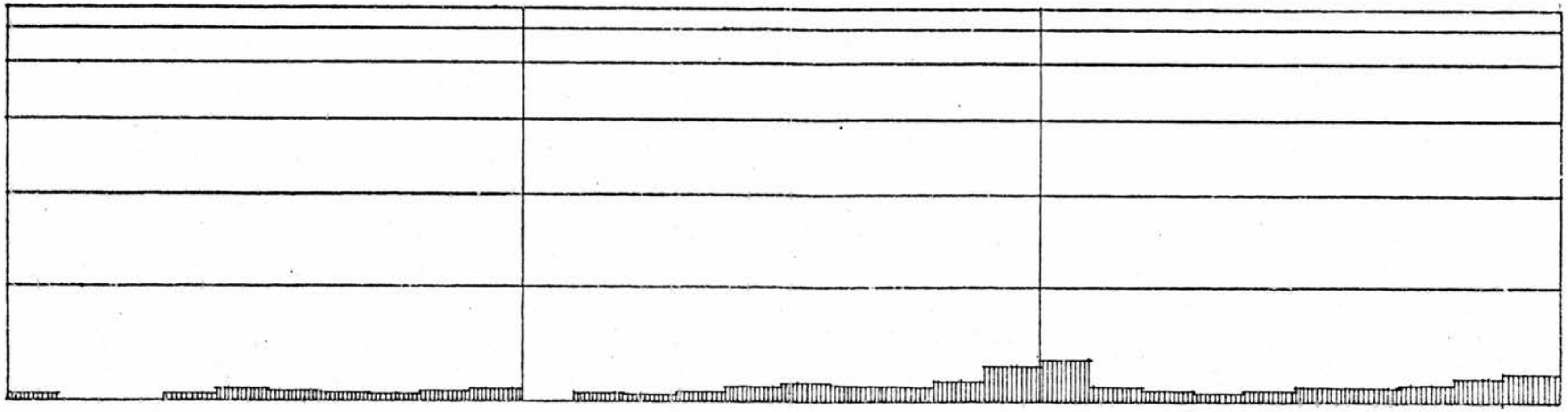
FIGURE 7.4: ALTERATIONS/ADDITIONS OF THE STOCK: SURVEY SECTION, EDINBURGH

Source: See Section 7.3

Notes: Top figure: total changes by location.

Bottom figure: changes by date and location.

FIGURE 7.4: (contd.)

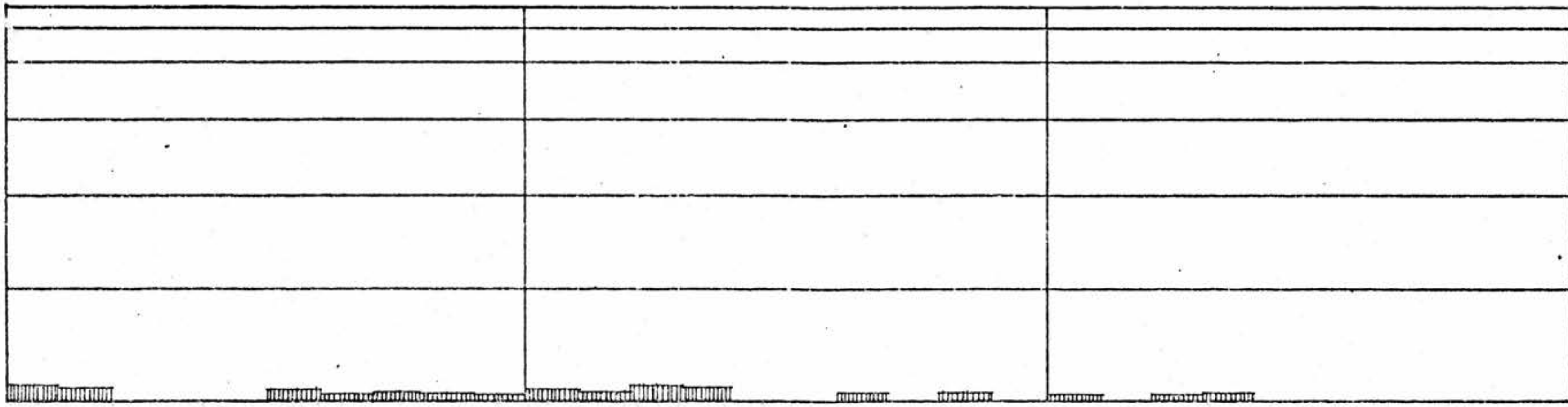


A | B

			1	1		4			1		1				2	1	2	3	4	2						1		4	1
					1				3			1		3			1	2	1	2						2	2	1	
				1	1						1			3		1			3	1	2					1		2	1
				2									1	1	1	1		4	4	4				2		3	2	1	2
						1	1	1										4	1	1	1				1				3
							2	1							2	2		1				1	1						
				2	1				1					1	5	1	6	1	2	7	1			1	2		2	3	4
1					1				1				1	1	4	5	3	6	13	18	4	2	2	1	4	1	1	2	5
								1	2				1		2	3		2	1		1	1			1	1	3		
																		1		1					1				1
																						2							

760 750 740 730

FIGURE 7.4: (contd.)

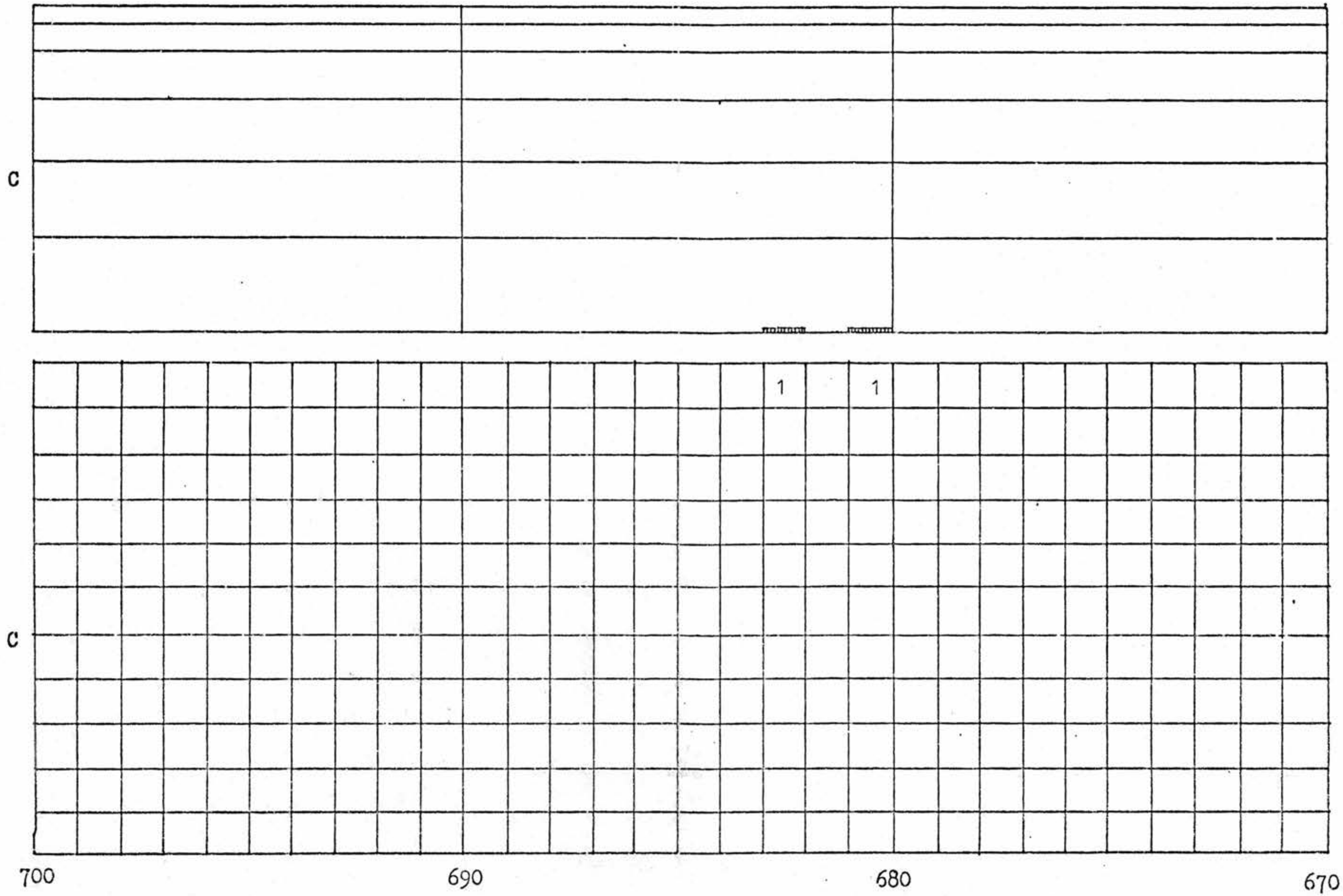
B  C

						1		1	1	2		1								1		1							
2	1						2			1			1			1		1											
							1					1																	
2	5					1		2		1	2	3				1		1					1						
1					2				1	1		3	1					1					1						
2									1				1																
1	1									1	1	1	2																
4	2												1	1		1													
1					3		1	2			1	2																	
												1																	

B ... C

730 720 710 700

FIGURE 7.4: (contd.)



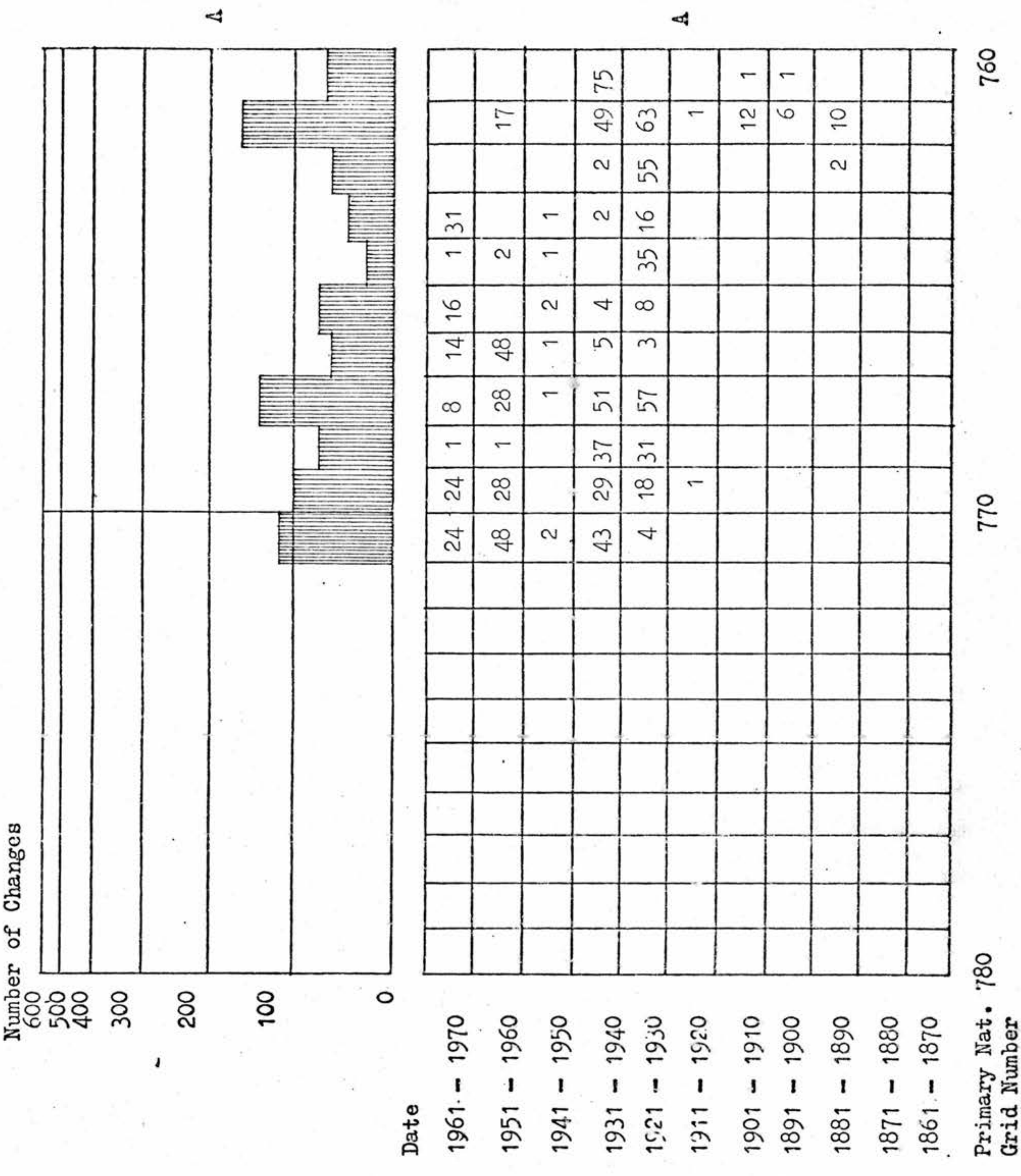


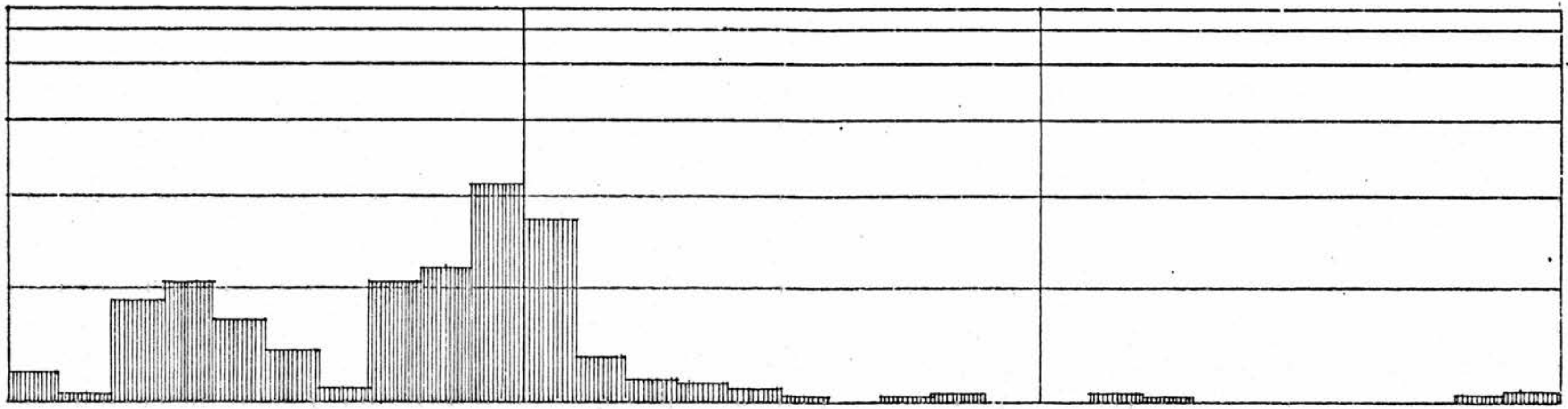
FIGURE 7.5: NEW BUILDINGS: SURVEY SECTION, EDINBURGH

Source: See Section 7.3

Notes: Top figure: total changes by location.

Bottom figure: changes by date and location.

FIGURE 7.5: (contd.)

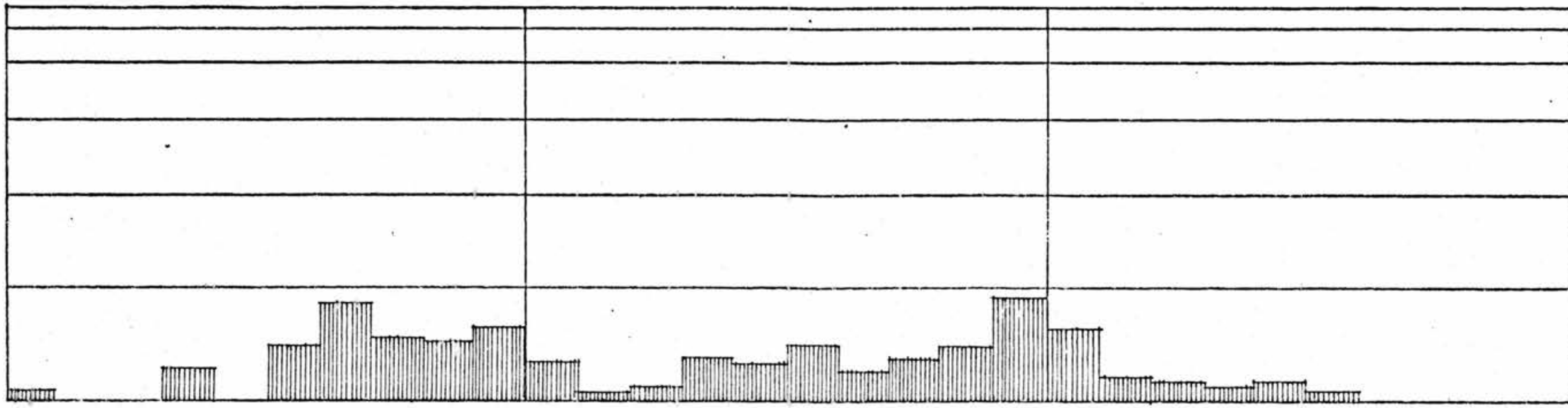
A  B

				5	8	1							1																
		42	4	59	6					36											1								
1	1	1				1			1		1																		
25	1	8	77	5	12	1	76	102	151	90		1		7															
1		36	24	2	3	6	2		2	2		2	1																
							4	1	3	1			1																
				1	8	2	7	13	10	17	13	6	3					1										1	1
					2	6	13	15	32	17	10	1	5		2			1			1	1						2	2
				2	4	3	5	2	6	7	19	10	5	3	1		1				1							1	1
					7				2	5	2		1	1															2
										1				3															

A — B

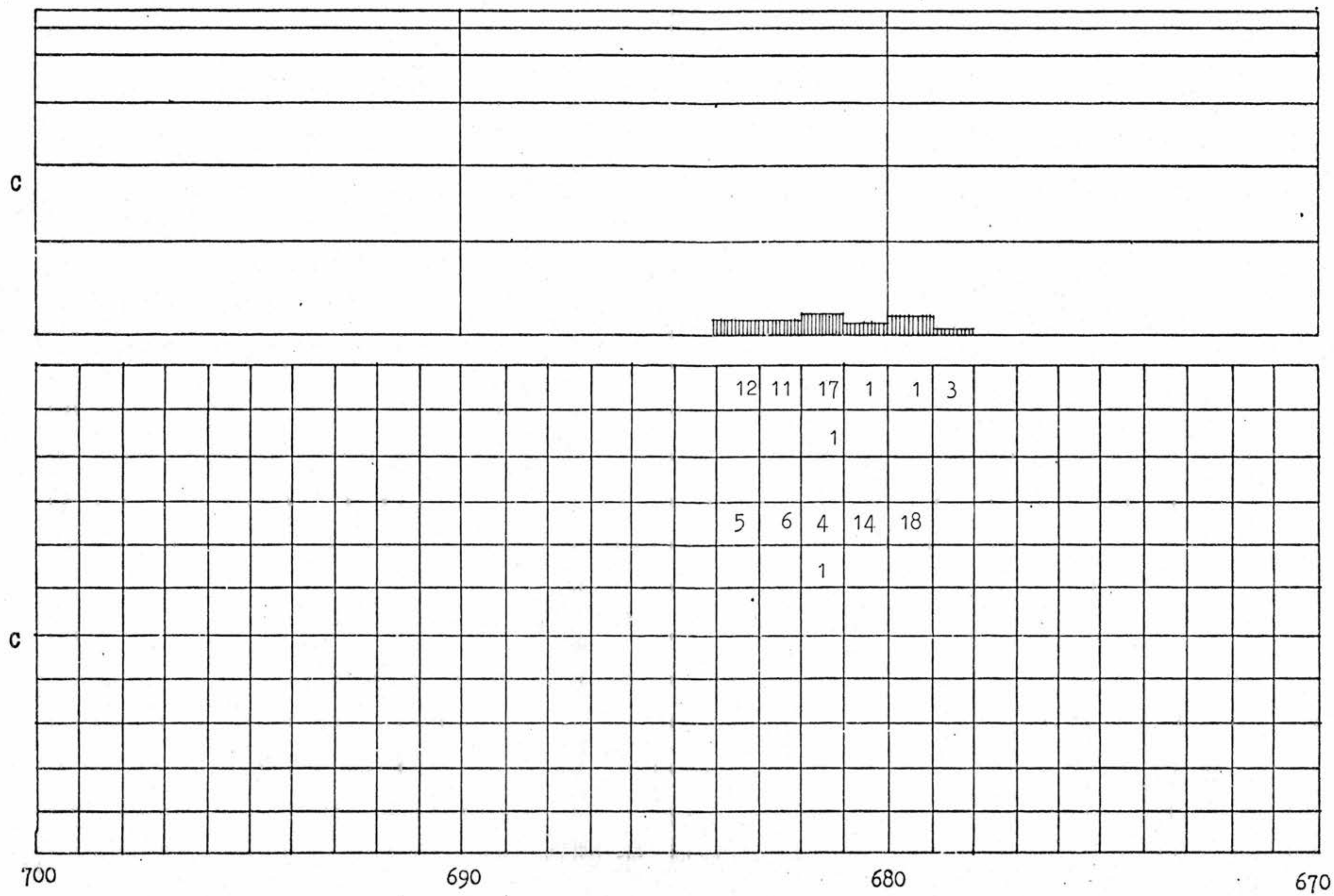
760 750 740 730

FIGURE 7.5: (contd.)

B  C

	730										720										710										700	
									4	1	2	2		1	19	25			10	9	2	6	1									
														10						53	2				1							
														2																		
				1		2	1				5		1	19	1	12	8	3			2		1									
						22					3				7		18	8		4	9		1			3						
									6		1																					
B							12	38	34	41	20		5			3		2		12	2	4	7	5	7	2						C
				1			18	11	4	3	2			1				12	34	10	29	3		1								
	4			10		13	52	9	7	16	4		1	2		3		8	4	1	15	2										
	2			14		12	2?			10	1		1			4																

FIGURE 7.5: (contd.)



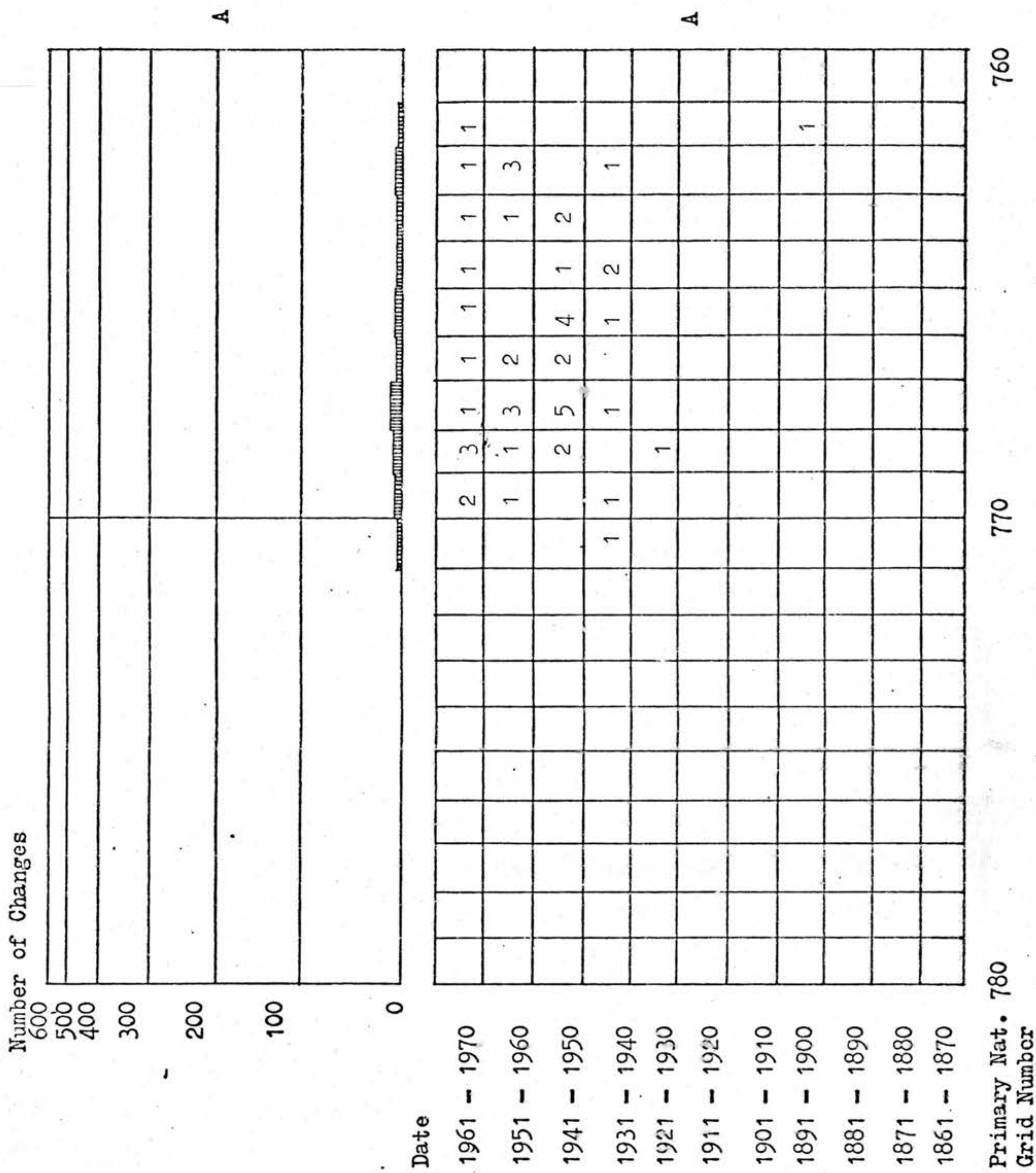


FIGURE 7.6: SUBDIVISION OF THE STOCK: SURVEY SECTION, EDINBURGH

Source: See Section 7.3

Notes: Top figure: total changes by location.

Bottom figure: changes by date and location.

FIGURE 7.6: (contd.)

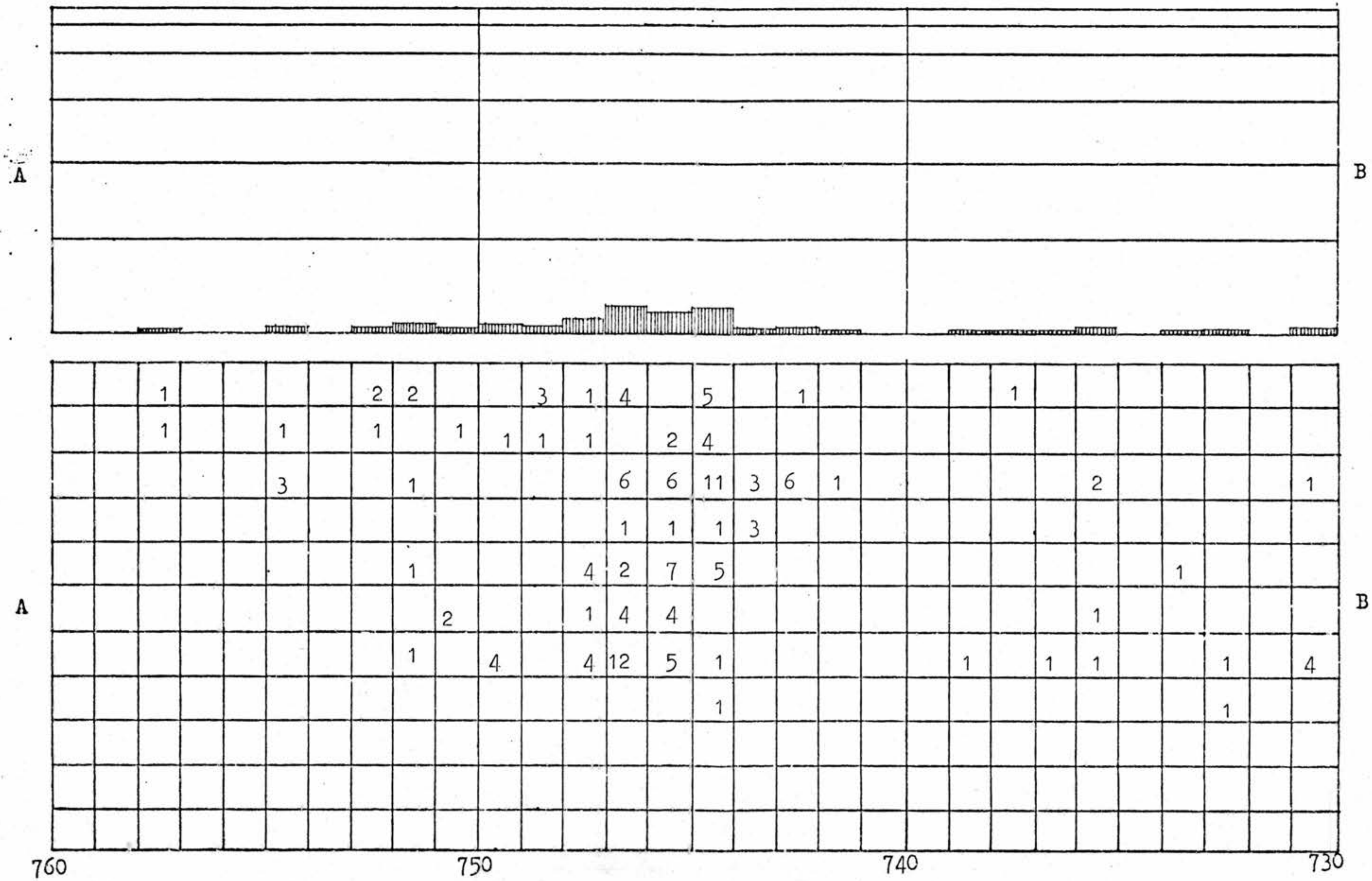


FIGURE 7.6: (contd.)

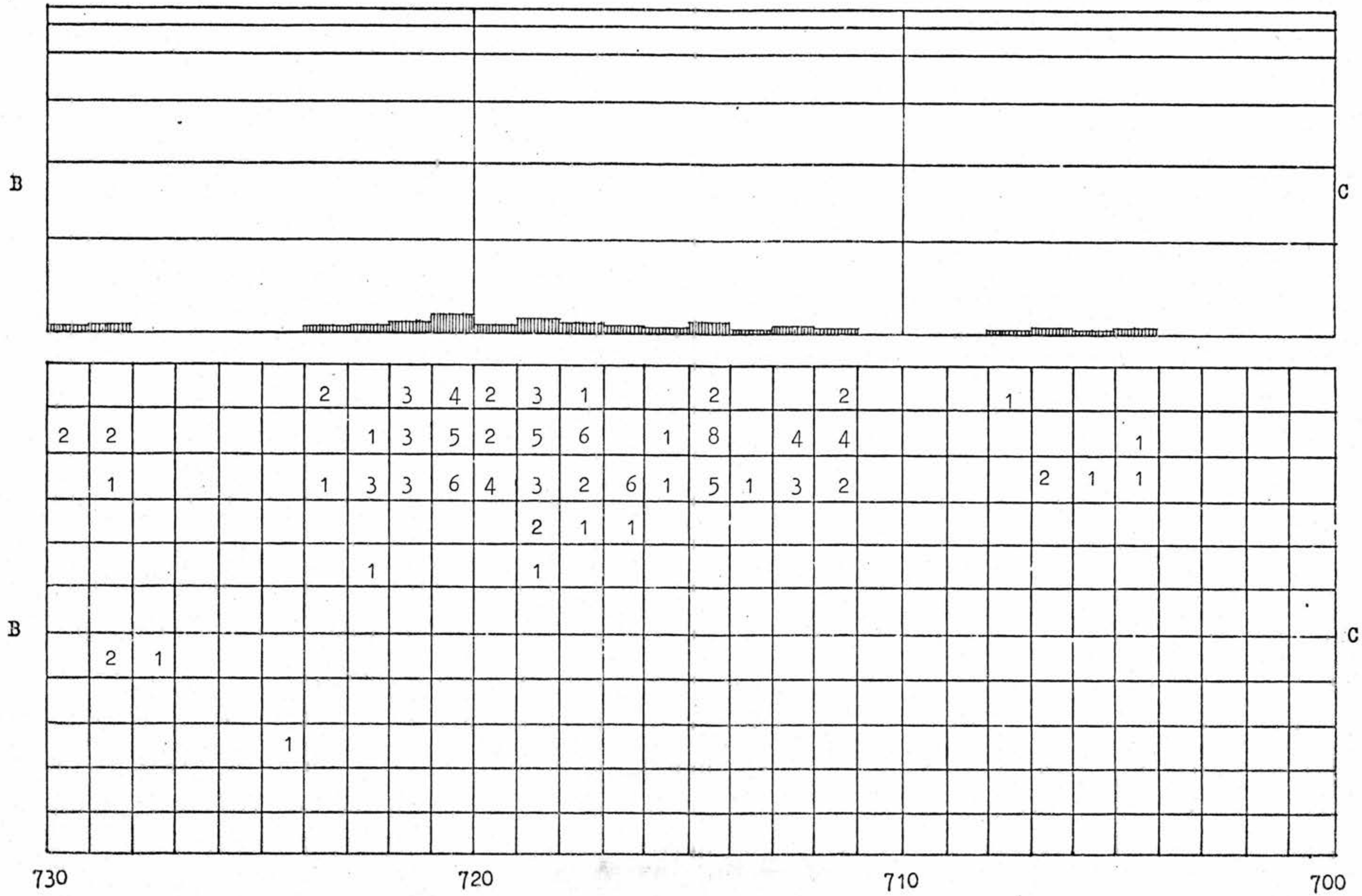
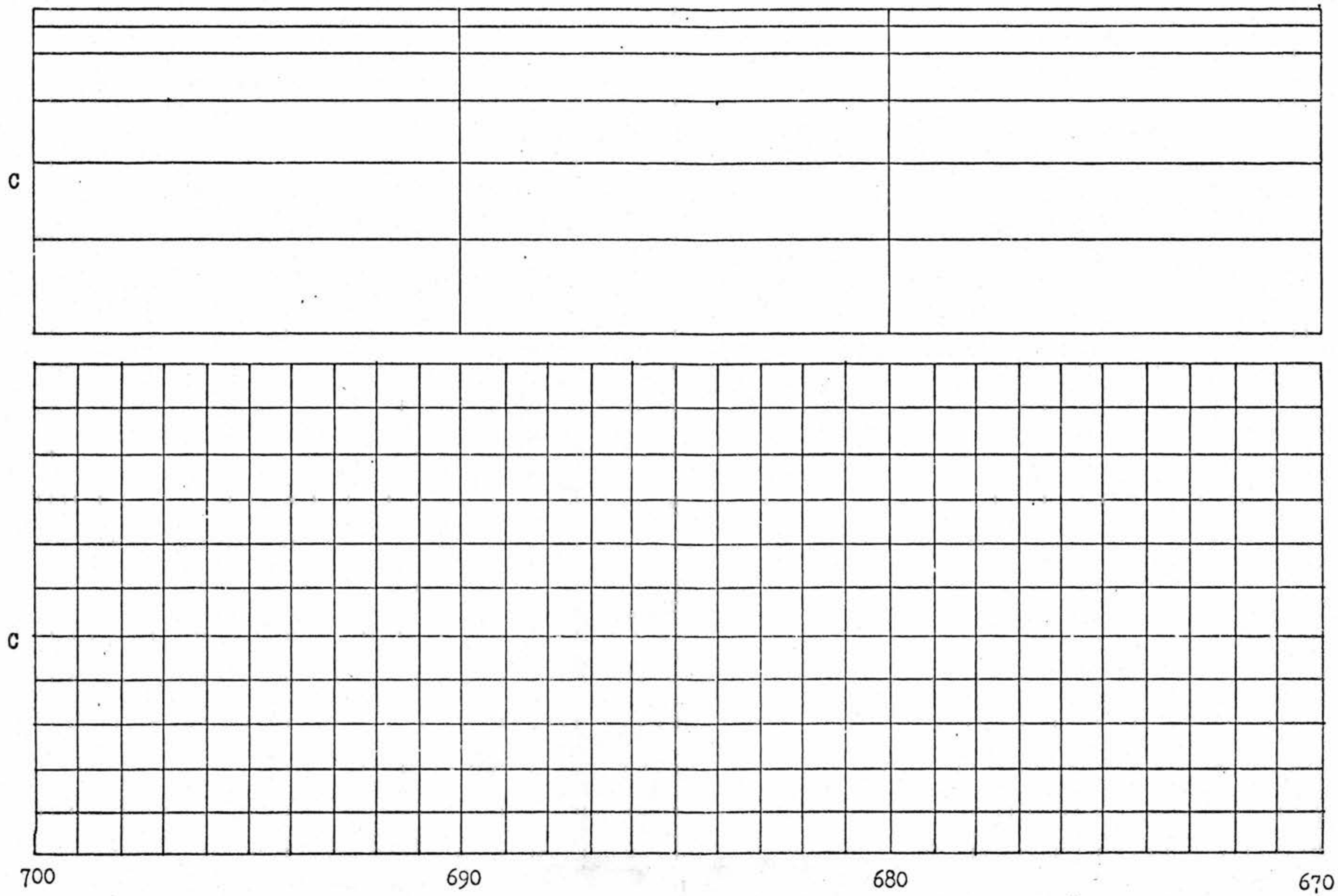


FIGURE 7.6: (contd.)



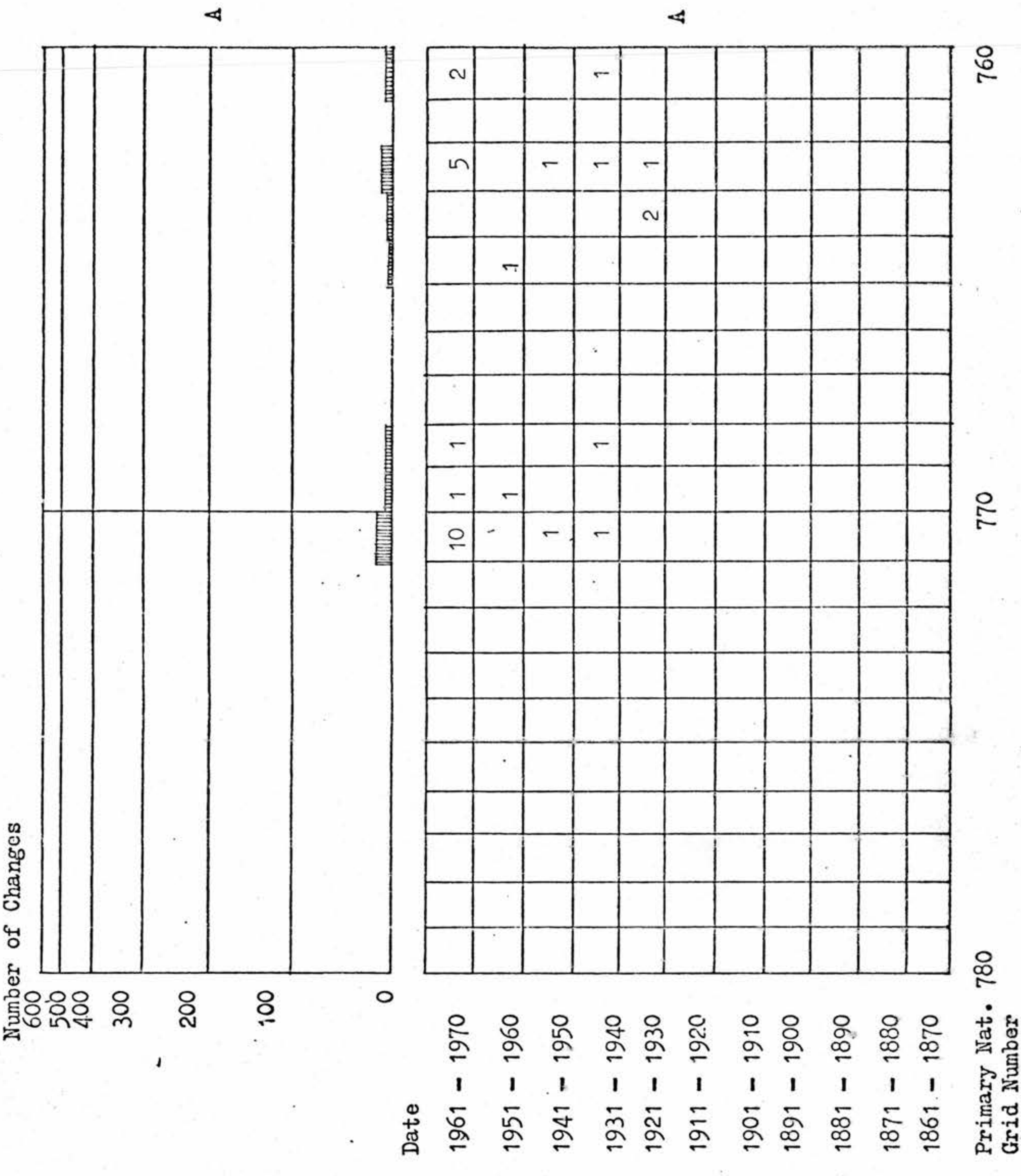


FIGURE 7.7: DEMOLITION OF THE STOCK: SURVEY SECTION, EDINBURGH

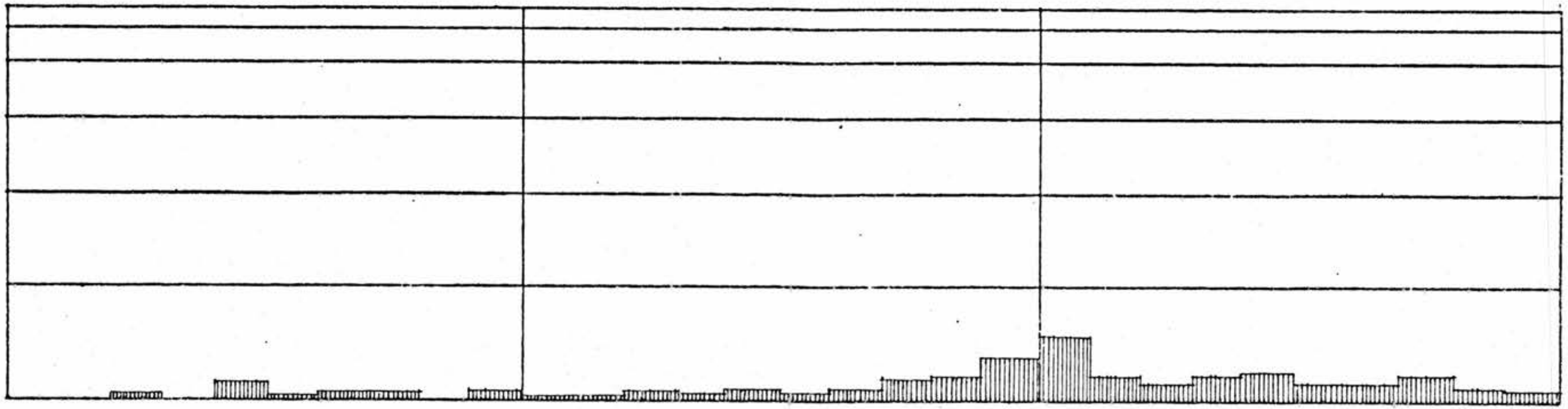
Source: See Section 7.3

Notes: Top figure: total changes by location.

Bottom figure: changes by date and location.

FIGURE 7.7: (contd.)

A



B

A … B

		1		4	1	2			6			1	1	2	2	6	19	16	14	12	12	1	1	3	1	4	7	7	6
		1		2		2	1			1		3		2		1	1	3	4	8	3	2	1	2				5	
				3			2					1	1		1				1		1		1		1	3			1
				1								1		3	1			3	4	7	2	2	4	2	6	4	1	6	1
				1			1												4	3	3	1	5	2	5	3	2		
																			3	4	1								
															1	1	1	1	3	10	2		2	2	1	4	5	2	1
											1						1	4	8	6	1	6	7	4		3	6		
																		2	3	6	1	1	6	11	8	1	10	1	
																						1	1	1		1	1	1	
																						1	2	2					

760 750 740 730

FIGURE 7.7: (contd.)

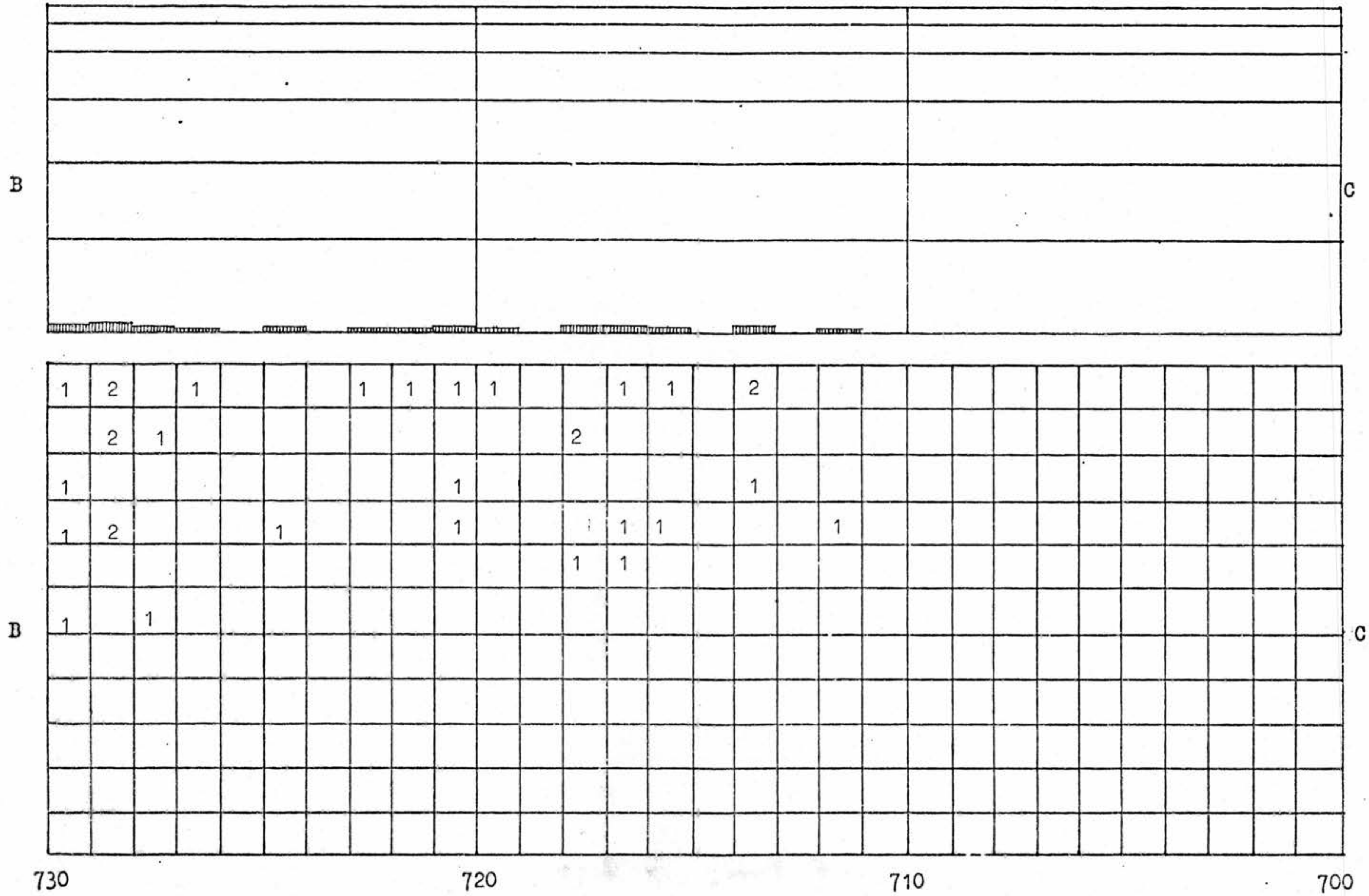
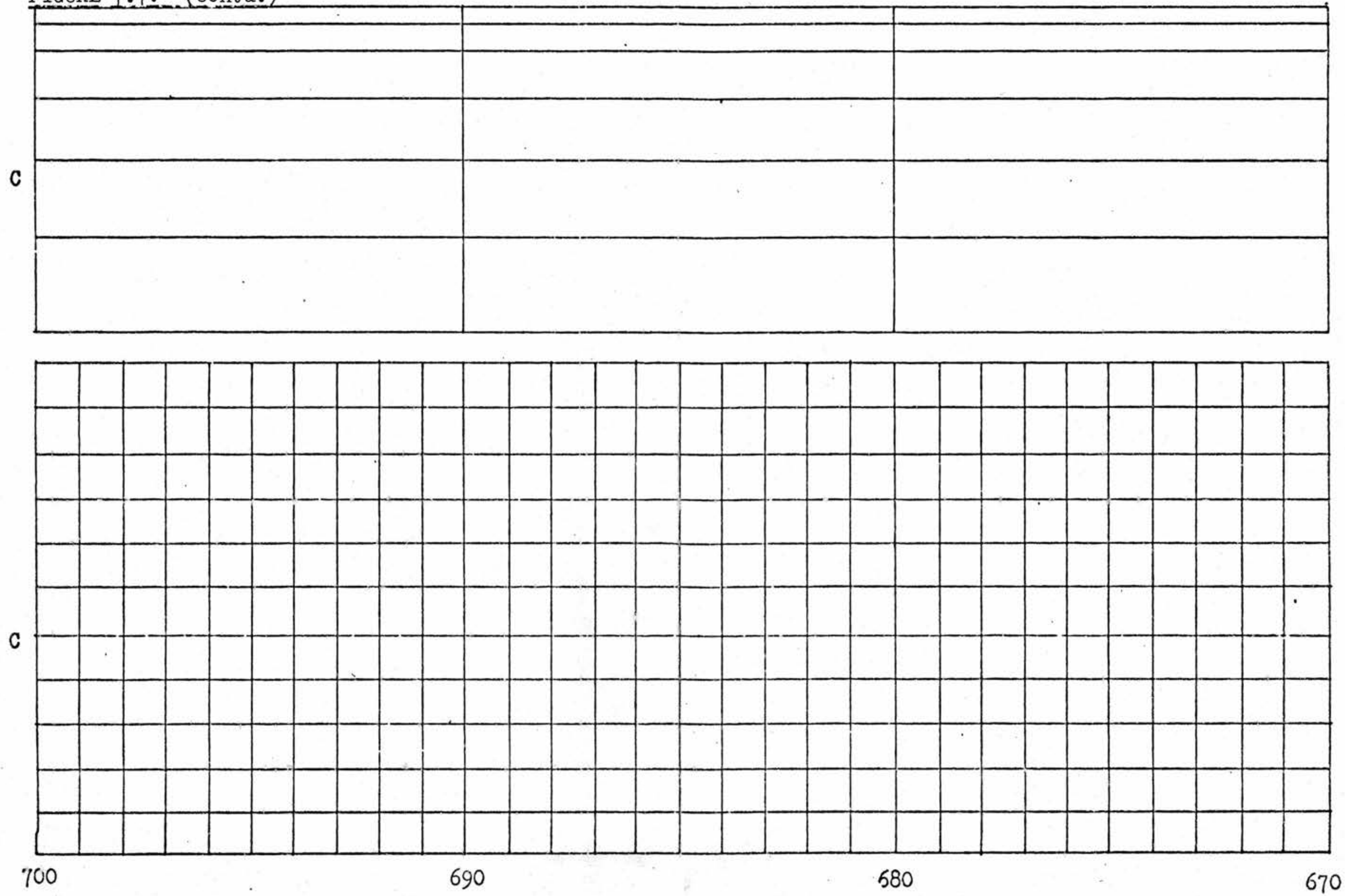


FIGURE 7.7: (contd.)



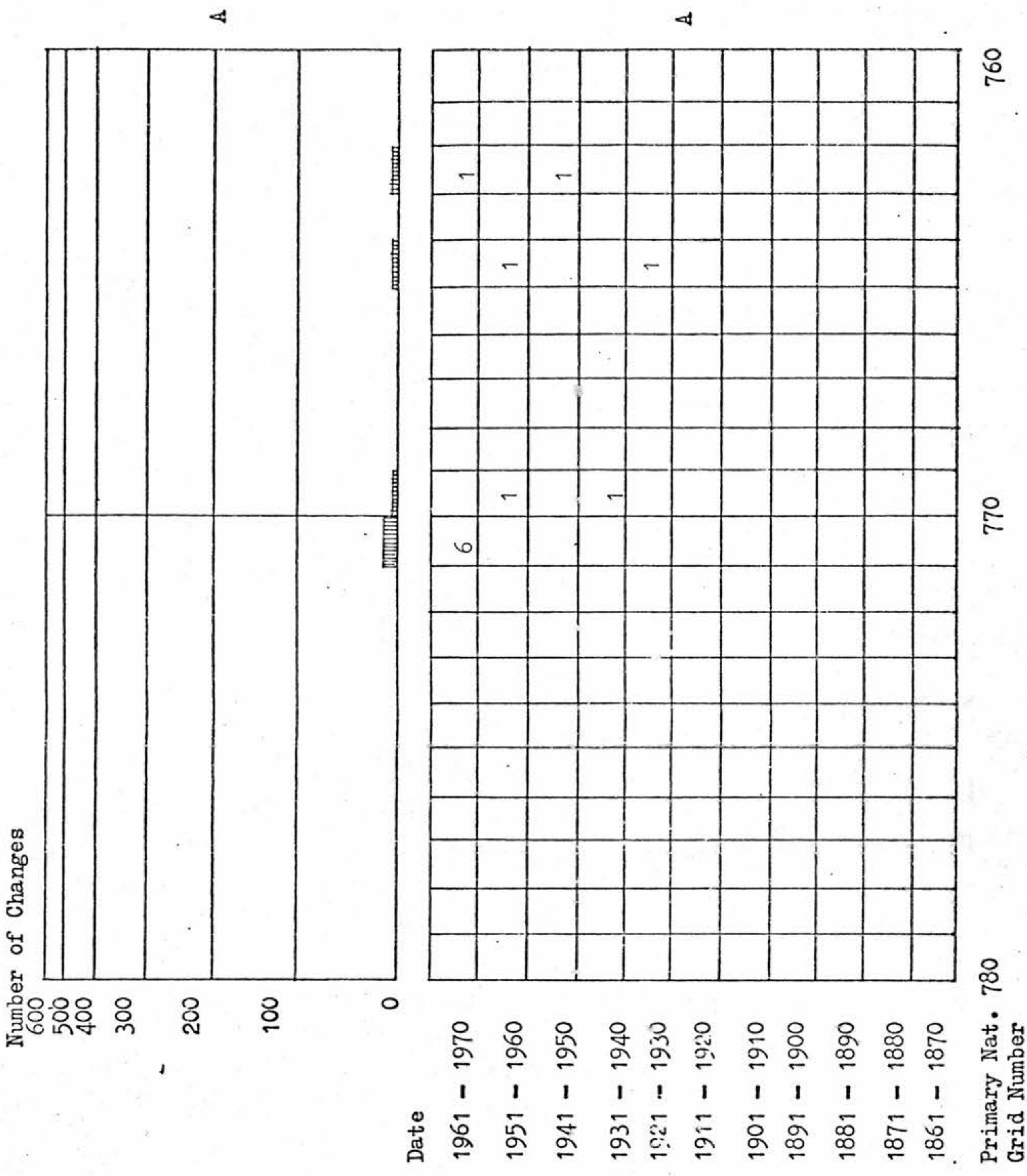


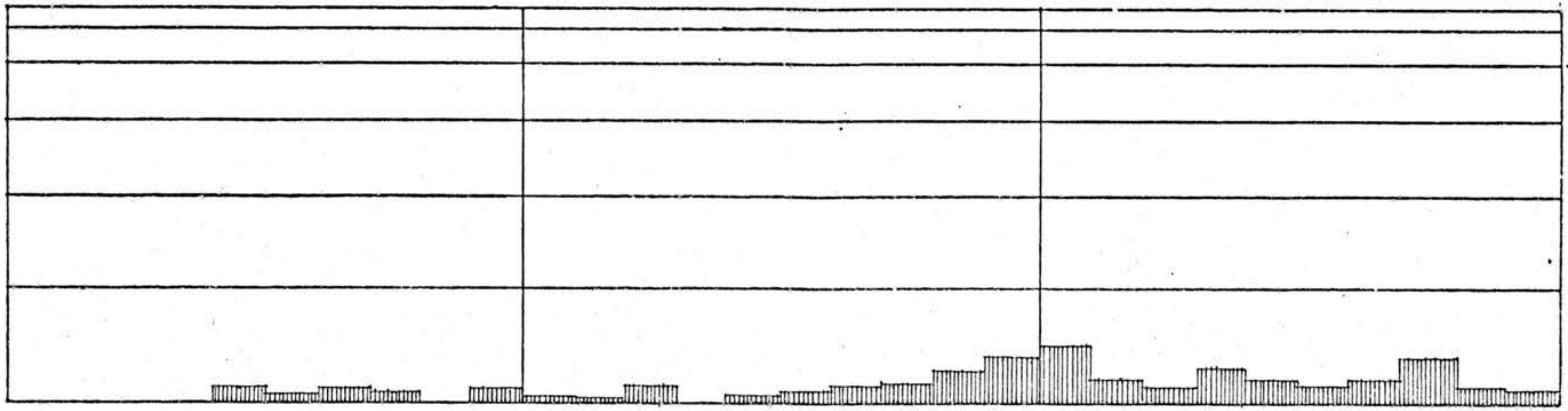
FIGURE 7.8: REBUILDING OF THE STOCK: SURVEY SECTION, EDINBURGH

Source: See Section 7.3

Notes: Top figure: total changes by location.

Bottom figure: changes by date and location.

FIGURE 7.8: (contd.)

A  B

				2		1			6			3		1	1	3	4	13	7	8	10	1	2	3	2	2	5	1	4
				2		1	1			1		3				4	1	5	7	10	3	2	4	1	2	2	3	3	2
				2	2	3	2					2			1	1	1		3	1	2		4			2			1
					1	1	1					1		2	1	2	3	3	4	6	3	2	4	1	4	4	1	4	2
				1	1										1		1	1	4	5	4	1	4	1	3	9	4		
										1		1			2			2	3	4	1			1			2		
												1			1	3	3	5	4	11	3		1	2	3	4	6	3	1
											1	1		1	1	1	3	5	10	7	1	5	9	7	1	2	5	2	
																		4	3	6	2	2	8	13	5	1	13	3	
																						2		1			1	1	
																						1		2	2				

A B

760 750 740 730

FIGURE 7.8: (contd.)

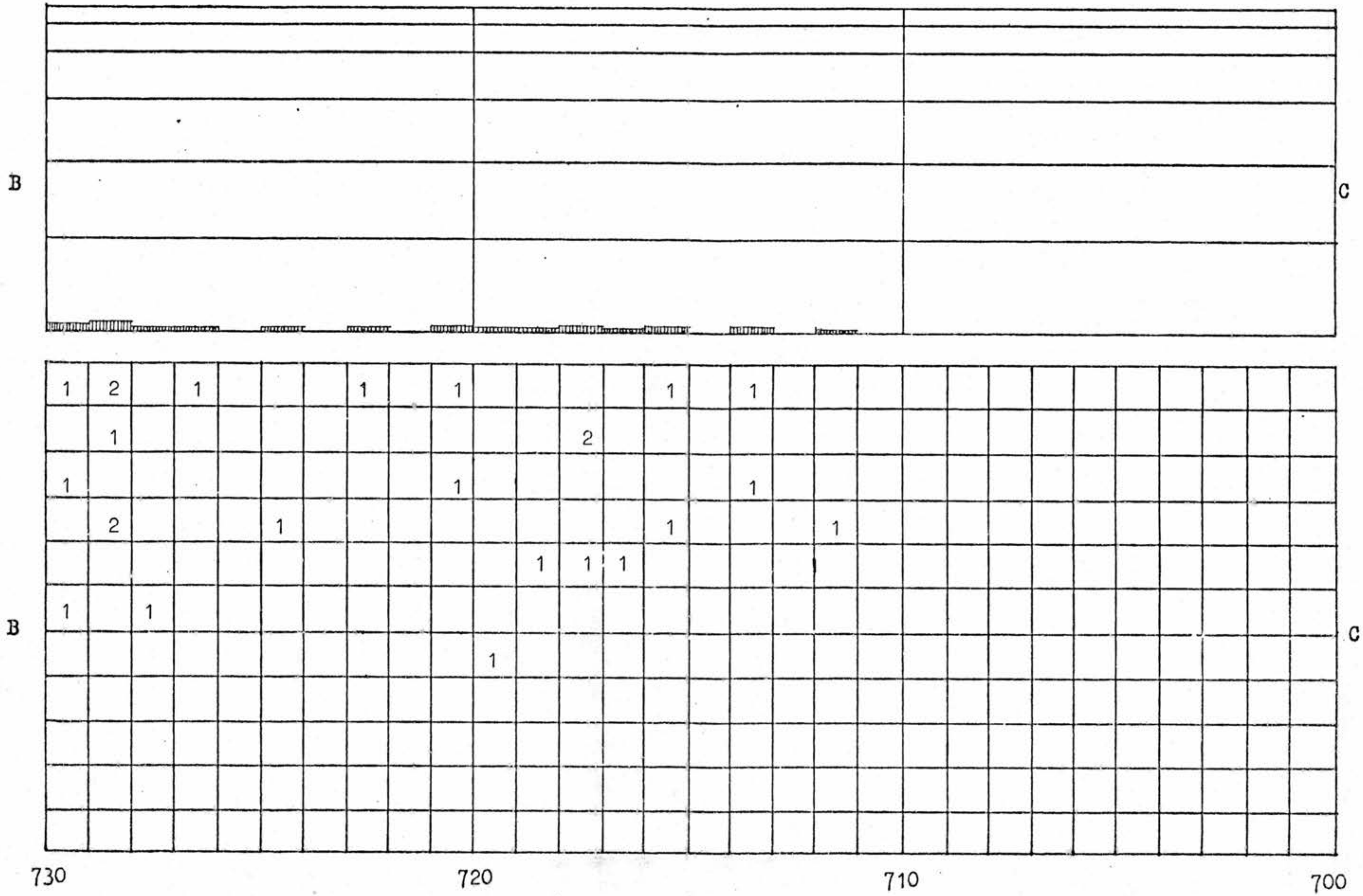
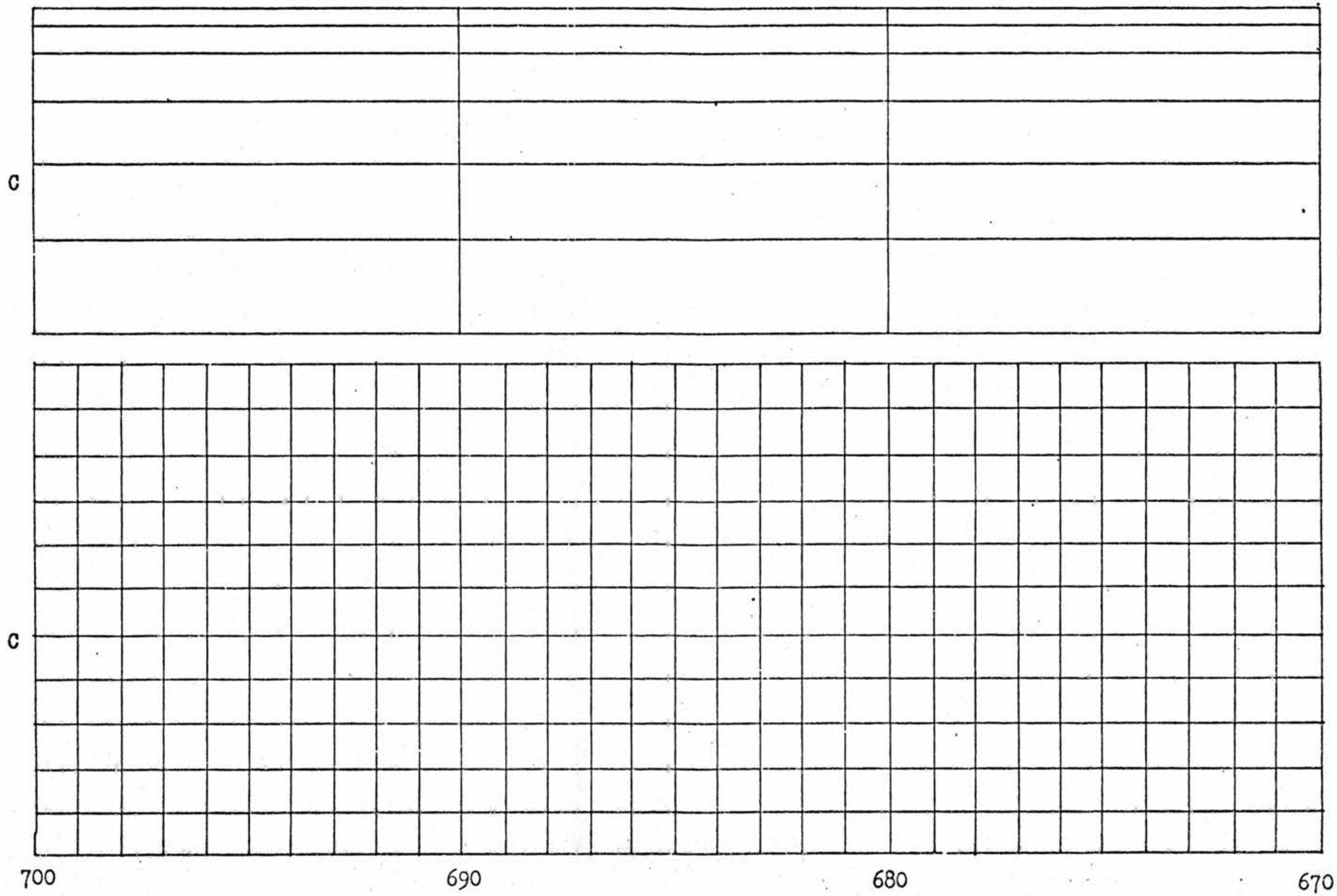


FIGURE 7.8: (contd.)



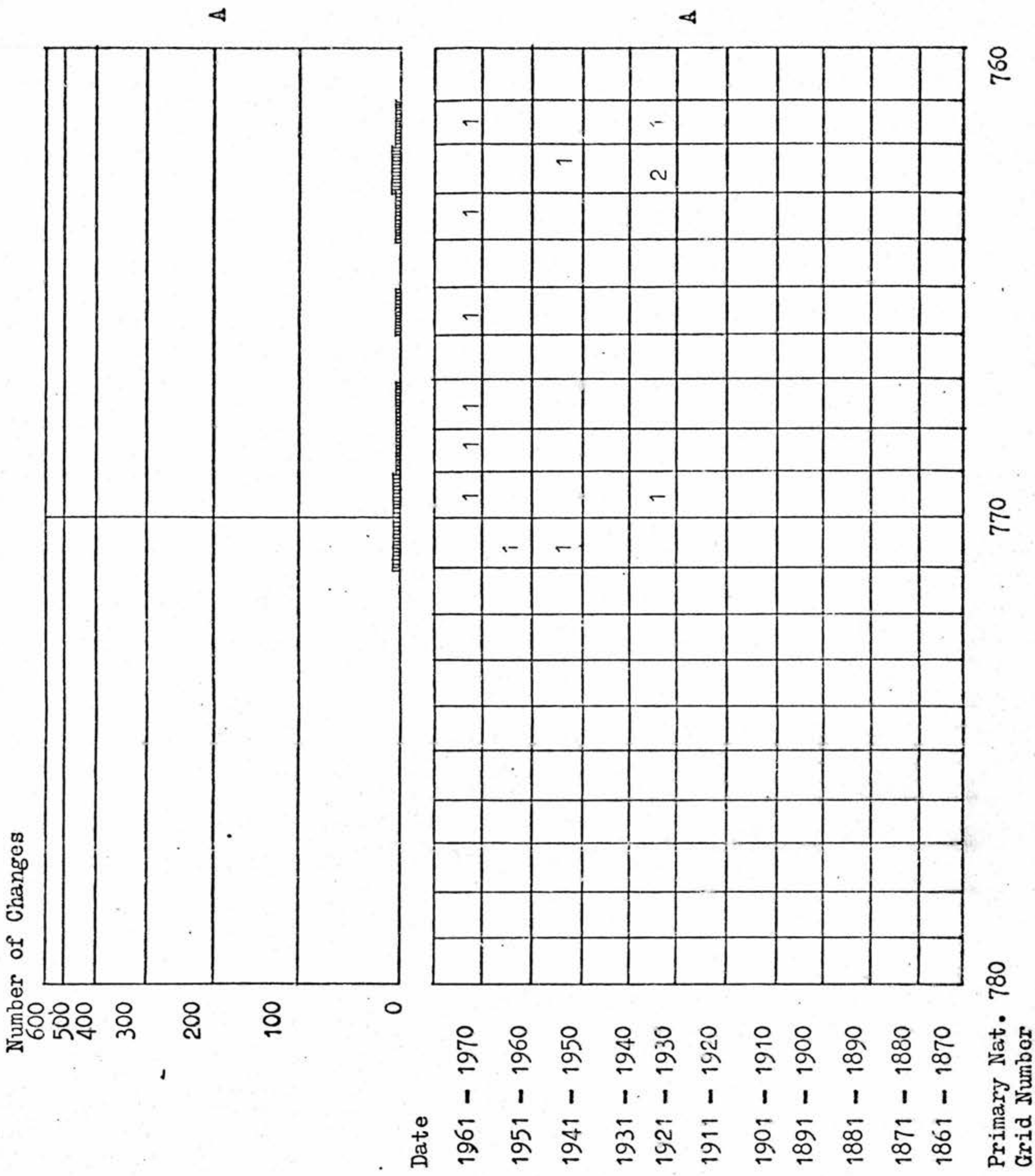


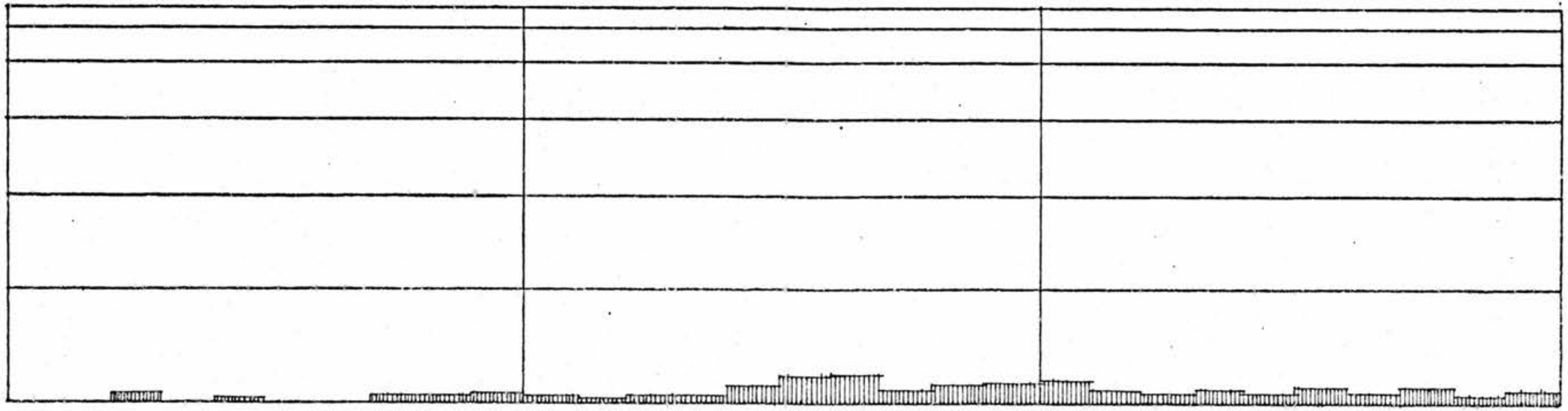
FIGURE 7.9: CONVERSION OF THE STOCK: SURVEY SECTION, EDINBURGH

Source: See Section 7.3

Notes: Top figure: total changes by location.

Bottom figure: changes by date and location.

FIGURE 7.9: (contd.)

A  B

A – B

							1	2	2	2	1	3	2	11	21	13	2	12	11	5	7	3	5	3	8	2	6	3	3
		1							1							3	1			3	1	1					1	1'	
		1					1					1			2	1	3		1	1			1	1	1				
																1	1			3			1						
				1										2		4	3	1	2		1								2
									1	1			1	1	2	3		1							2		1		1
													1		1		1	1		3							1	1	
																	1		1	3	1	1							
																	1		2										

760 750 740 730

FIGURE 7.9: (contd.)

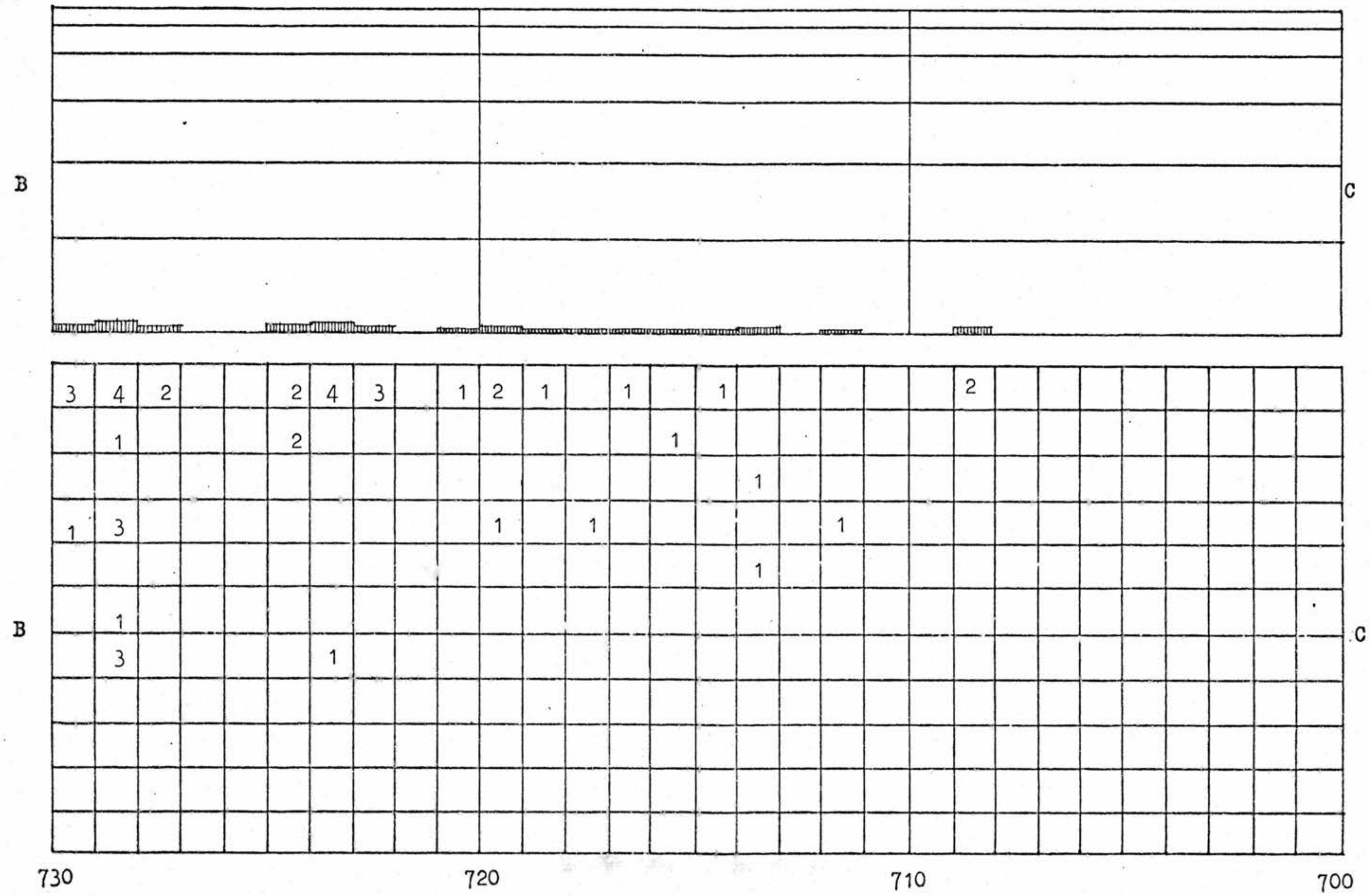
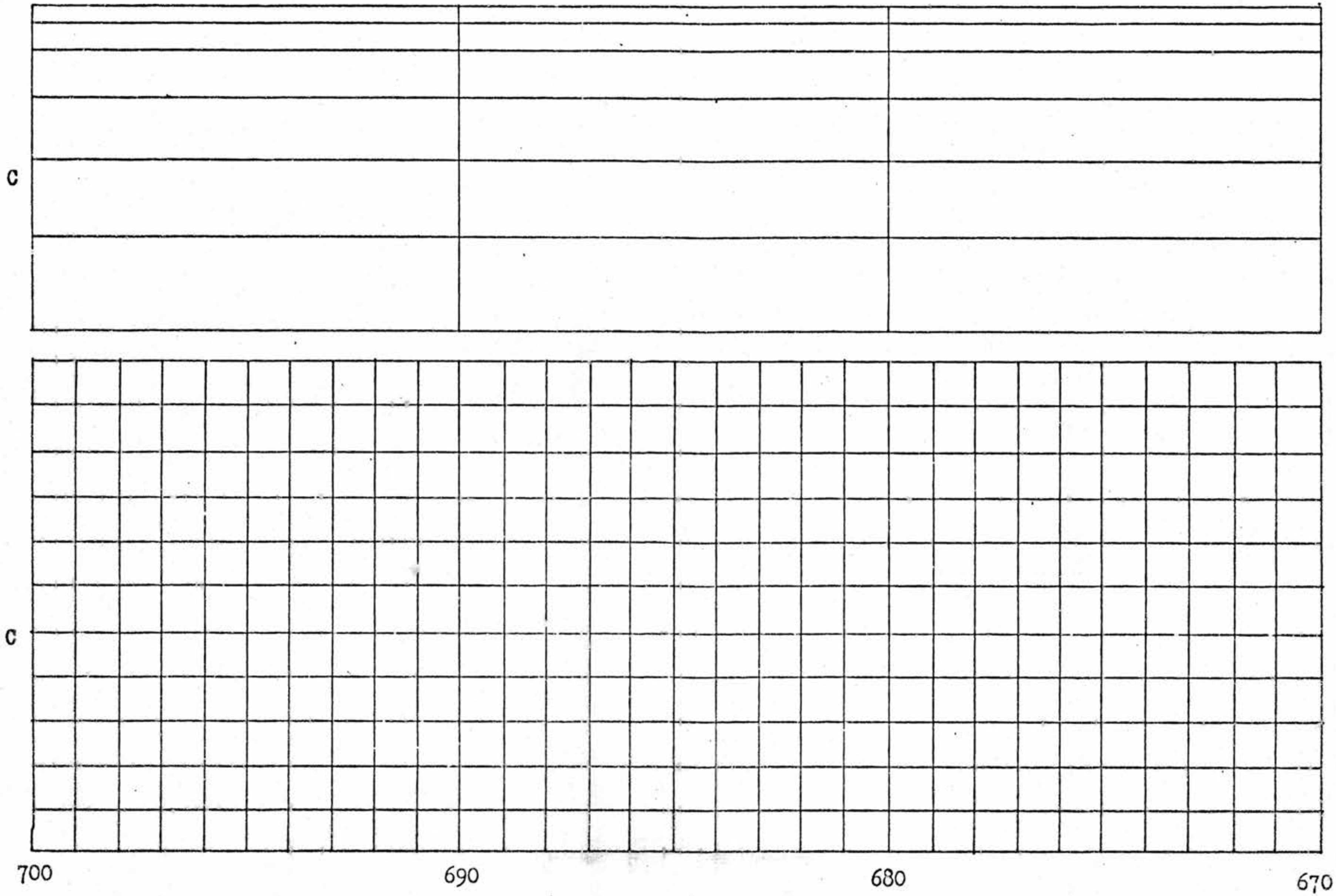


FIGURE 7.9: (contd.)



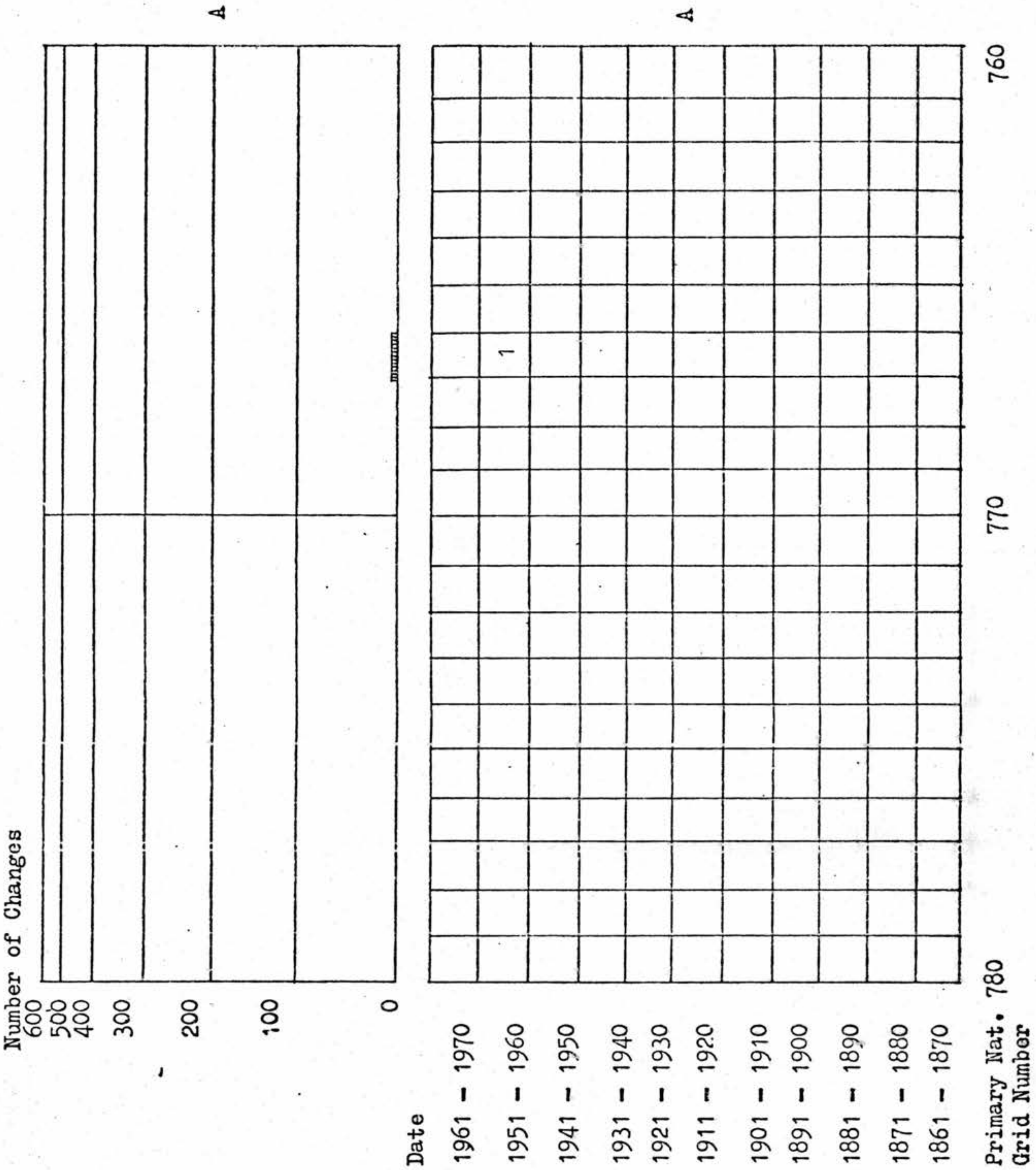


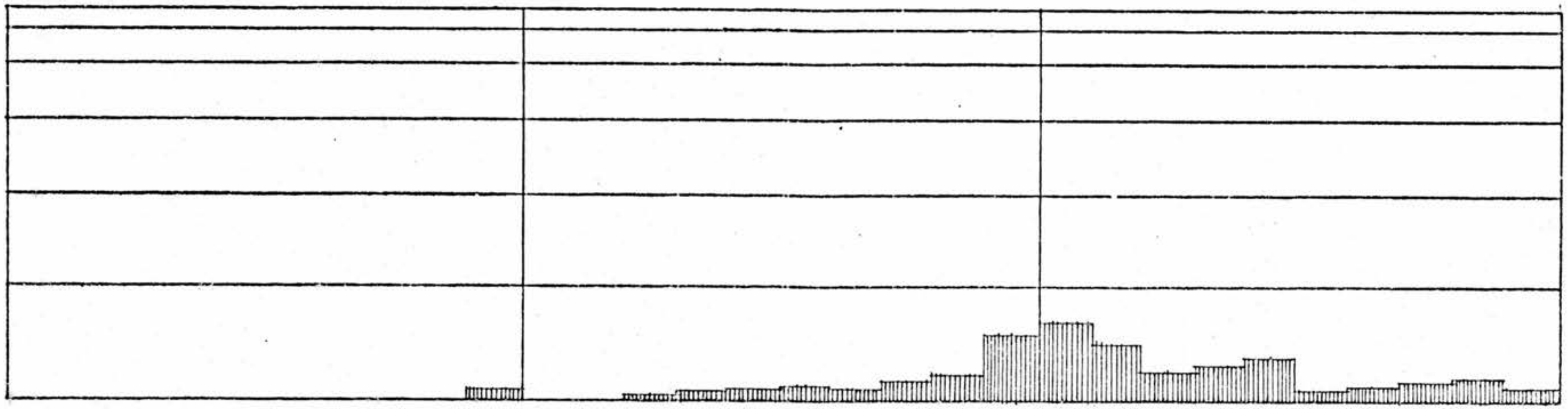
FIGURE 7.10: NEW FACADES OF THE STOCK: SURVEY SECTION, EDINBURGH

Source: See Section 7.3

Notes: Top figure: total changes by location.

Bottom figure: changes by date and location.

FIGURE 7.10: (contd.)

A  B

A B

									2					1	4	1		3	18	21	11	6	5	5		1		5	
									2			1			3	1	8	4	13	12	11	3	2	3			2	1	3
																	2	1	1	2			2						1
																	1	5		5	4	3	1	4	2	1		4	
																	2	4	6	8	7			1	3	1	1	1	
															1	2		3	2	2	2			2	1		3	1	
													2	2	2		4	3	13	13	4	3	5	5		2	4		2
															1	2	1	4	8	6	3	1	4	2		2	1		3
																			1			1		3					

760 750 740 730

FIGURE 7.10: (contd.)

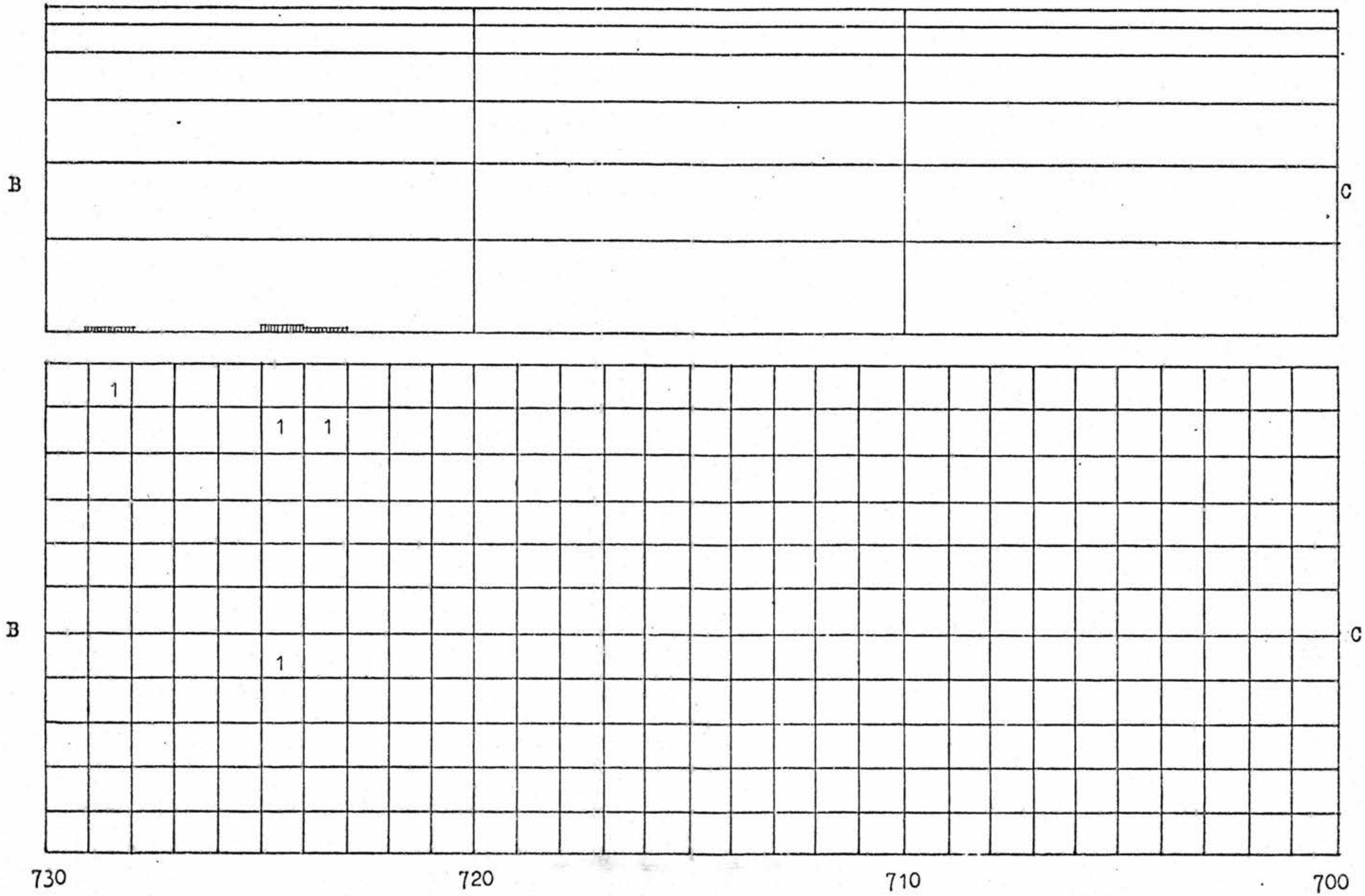
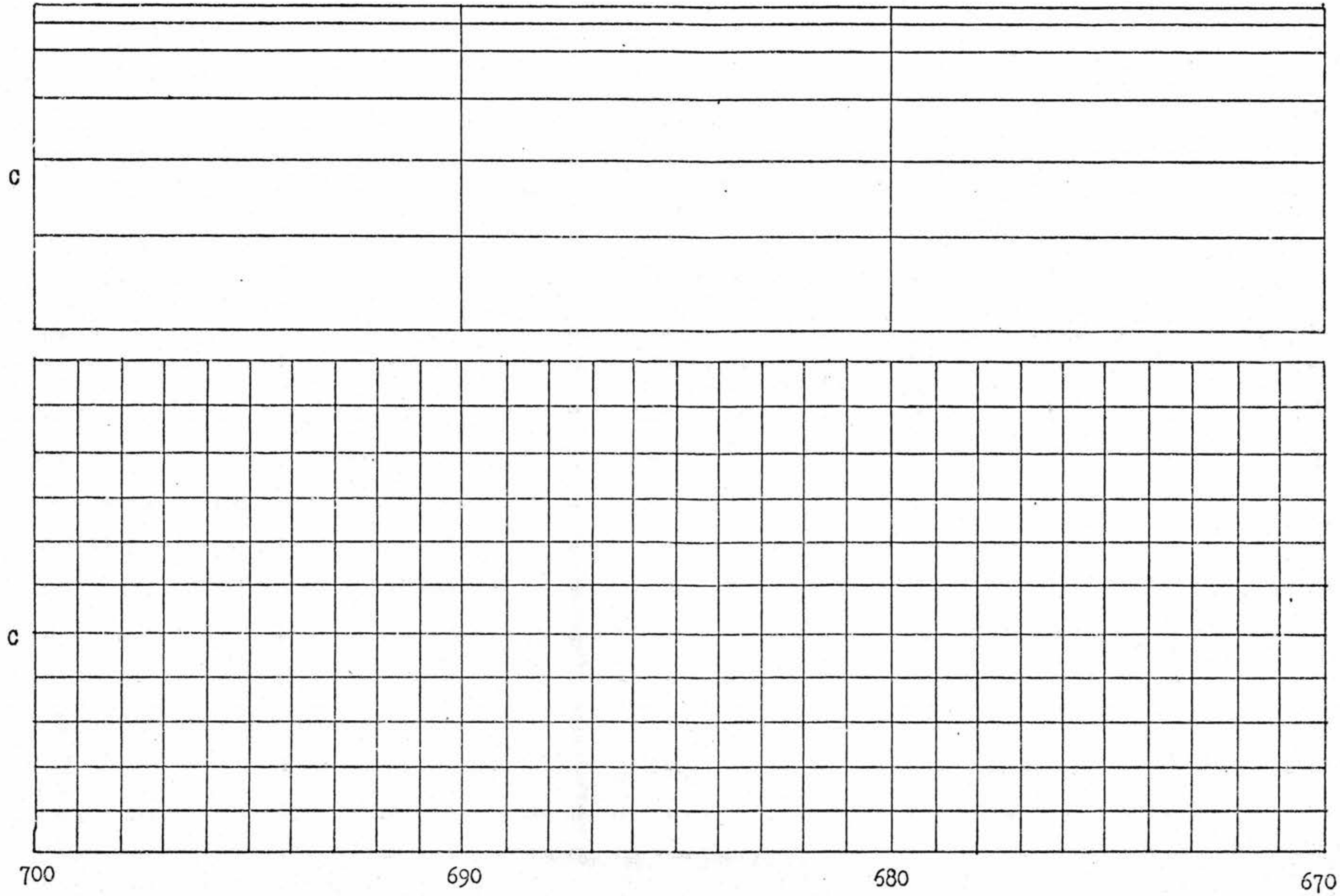


FIGURE 7.10: (contd.)



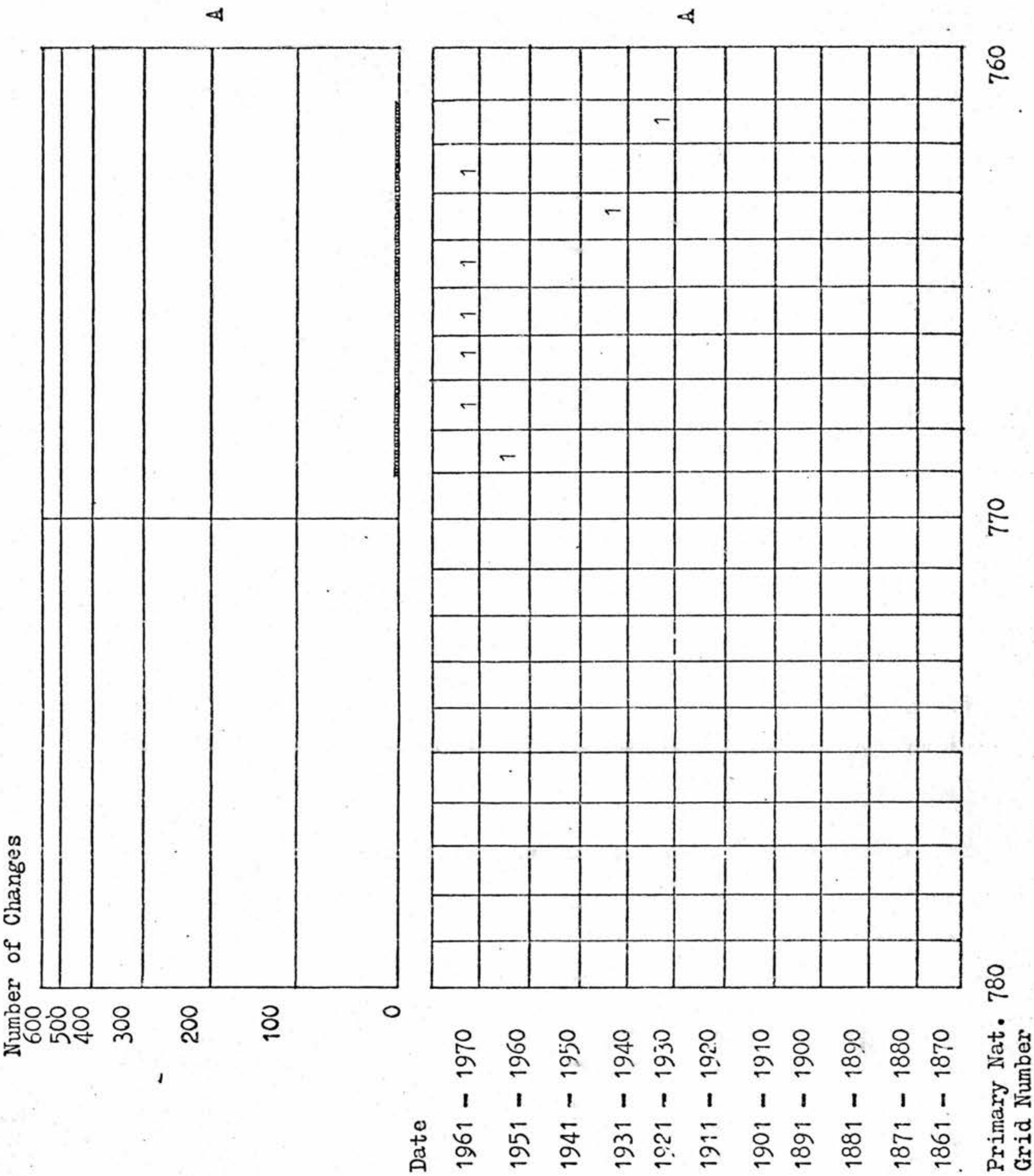


FIGURE 7.11: OTHER CHANGES OF THE STOCK, SURVEY SECTION, EDINBURGH

Source: See Section 7.3

Notes: Top figure: total changes by location.

Bottom figure: changes by date and location.

FIGURE 7.11: (contd.)

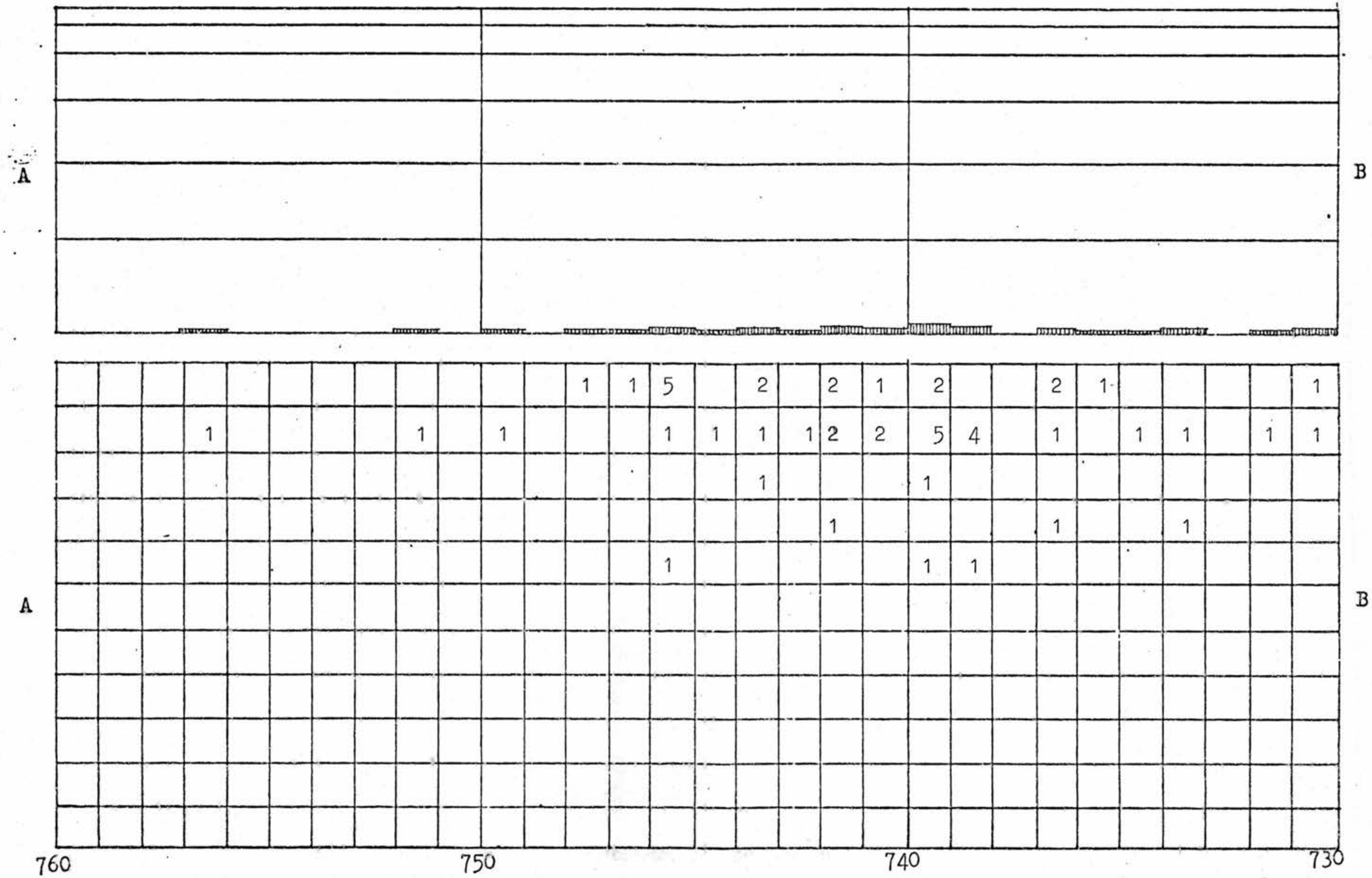


FIGURE 7.11: (contd.)

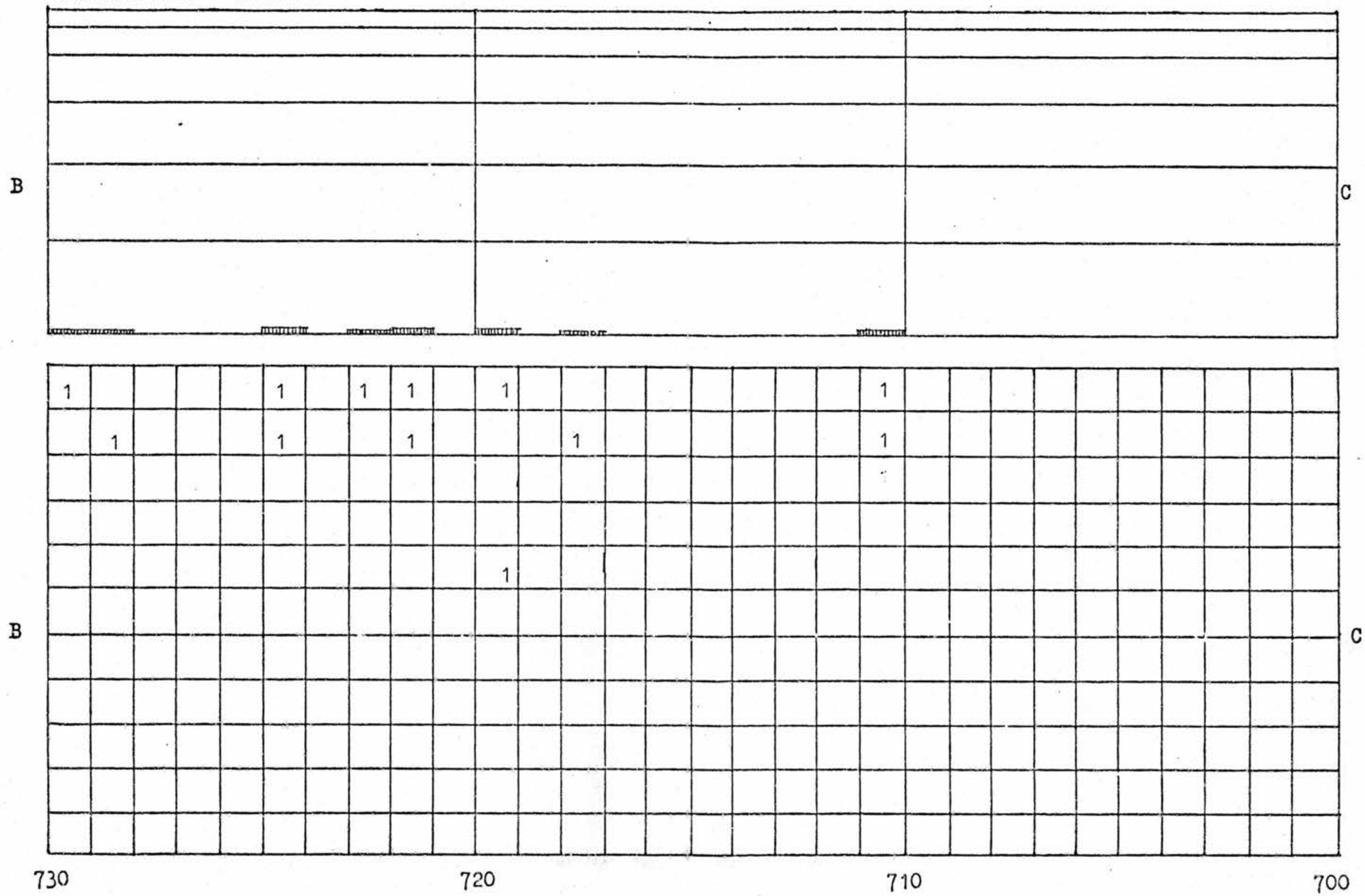
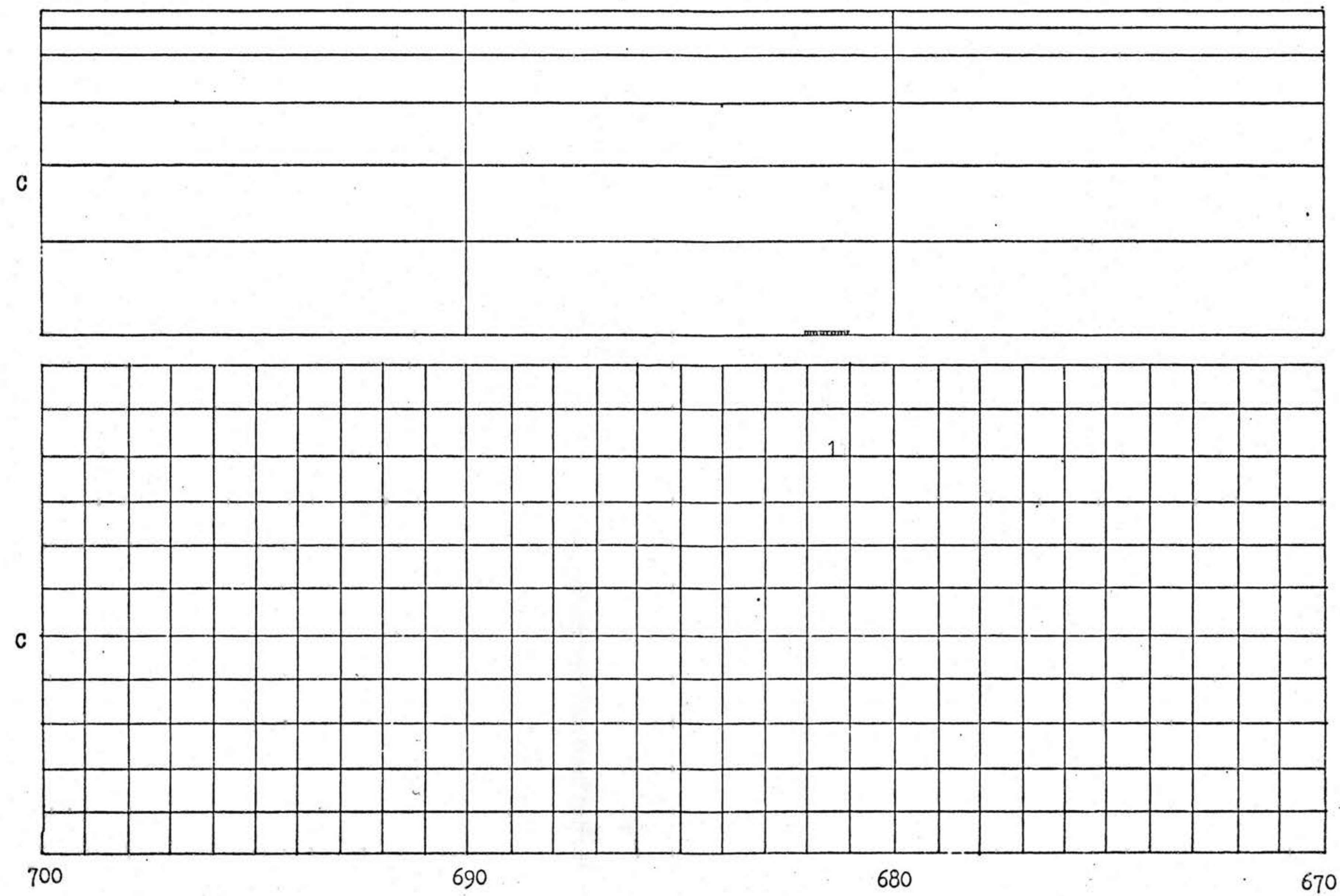


FIGURE 7.11: (contd.)



7.18 Locationally, the ten types of physical changes of the stock can be grouped into three general categories:

Type One consists of a single 'change' – that of new building, which is concentrated in two peaks, PNG 770–750 and PNG 725–710;

Type Two consists of additions, conversions and sub-divisions which peak at three points, PNG 745, 730 and 720.

Type Three consisting of the remainder of the changes, shows a definite peaking at the centre of the section (PNG 740) and a lesser peak near PNG 720.

Type two changes are generally associated with the change of use of the stock, while Type three changes are more general and occur when the 'highest and best'[26] use of the area has already been attained. Thus Type three changes are in association with the consolidation and development of this 'highest and best' use.

7.19 Over time, the three types of changes follow different patterns. (See Figures 7.12 – 7.14[27].) Type one changes reach their greatest peak in the 1930s with lesser peaks in 1880–1900 and 1950–1970. Type two changes exhibit a similar pattern of peaking over time, however, the peaking between the World Wars occurred in the 1920s and was lower than the peaking in the 1950–1970 period. The same is true for Type three changes, which differ from Type two in that the peaking in the 1920s is lower than either the peaking in the 1880–1900 period or the 1950–1970 period.

7.20 The type of change, when and where it occurred, is also associated with the age and density of the area[28]. Obviously, the first

26. See Appendix 2.
27. Also Figures A.5.1 – A.5.11.
28. See Figure A.5.12, Appendix 5.

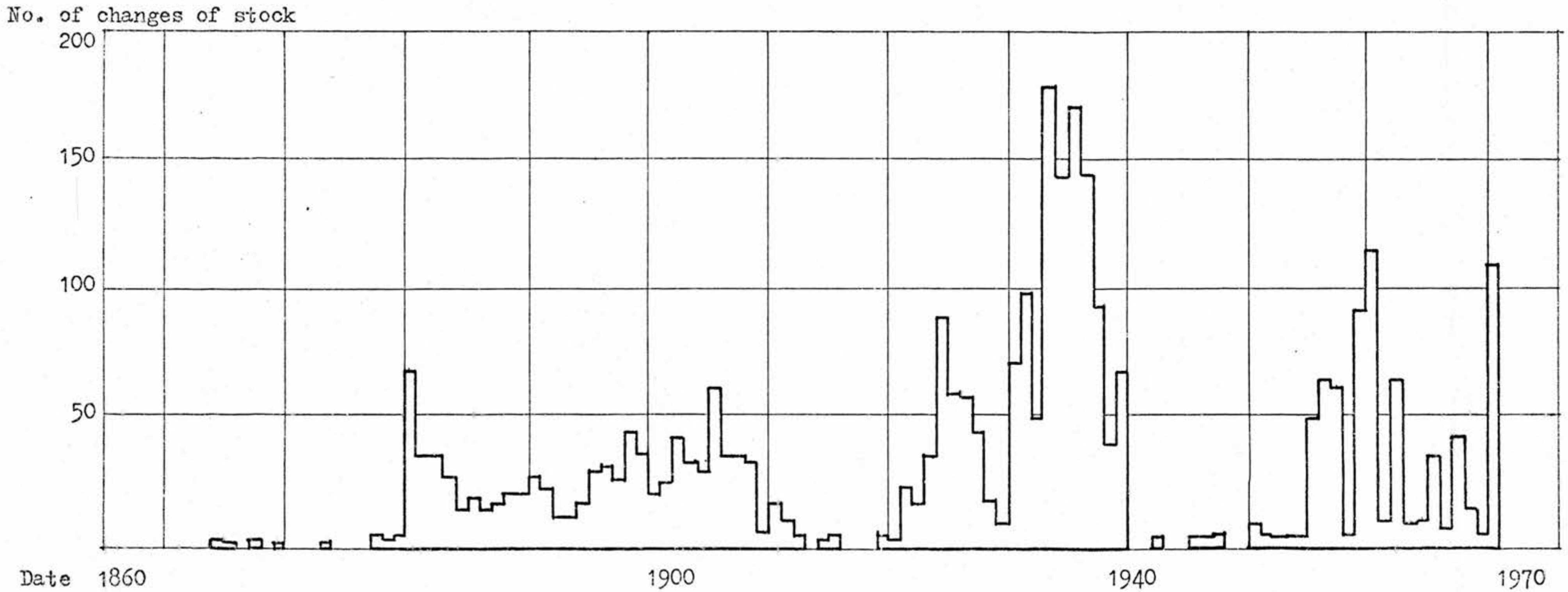


FIGURE 7.12: CHANGE OF STOCK, SURVEY SECTION EDINBURGH: TYPE I

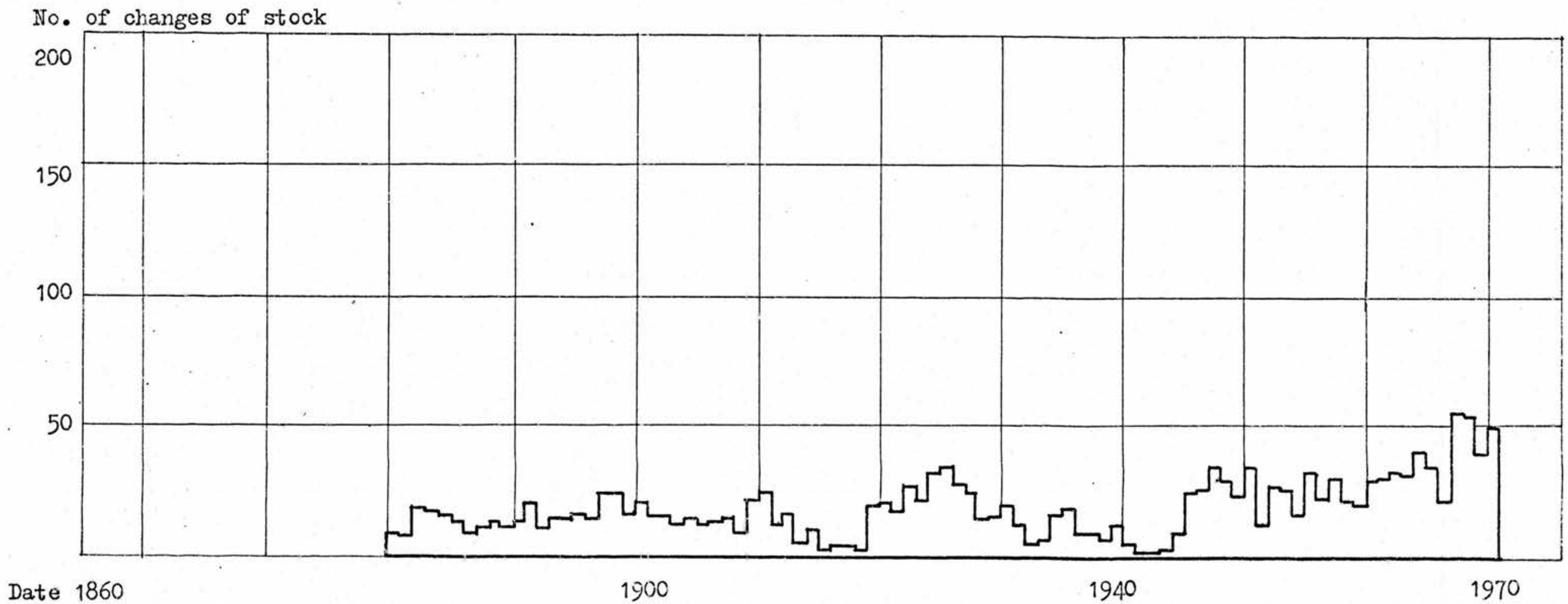


FIGURE 7.13: CHANGE OF STOCK, SURVEY SECTION EDINBURGH: TYPE II

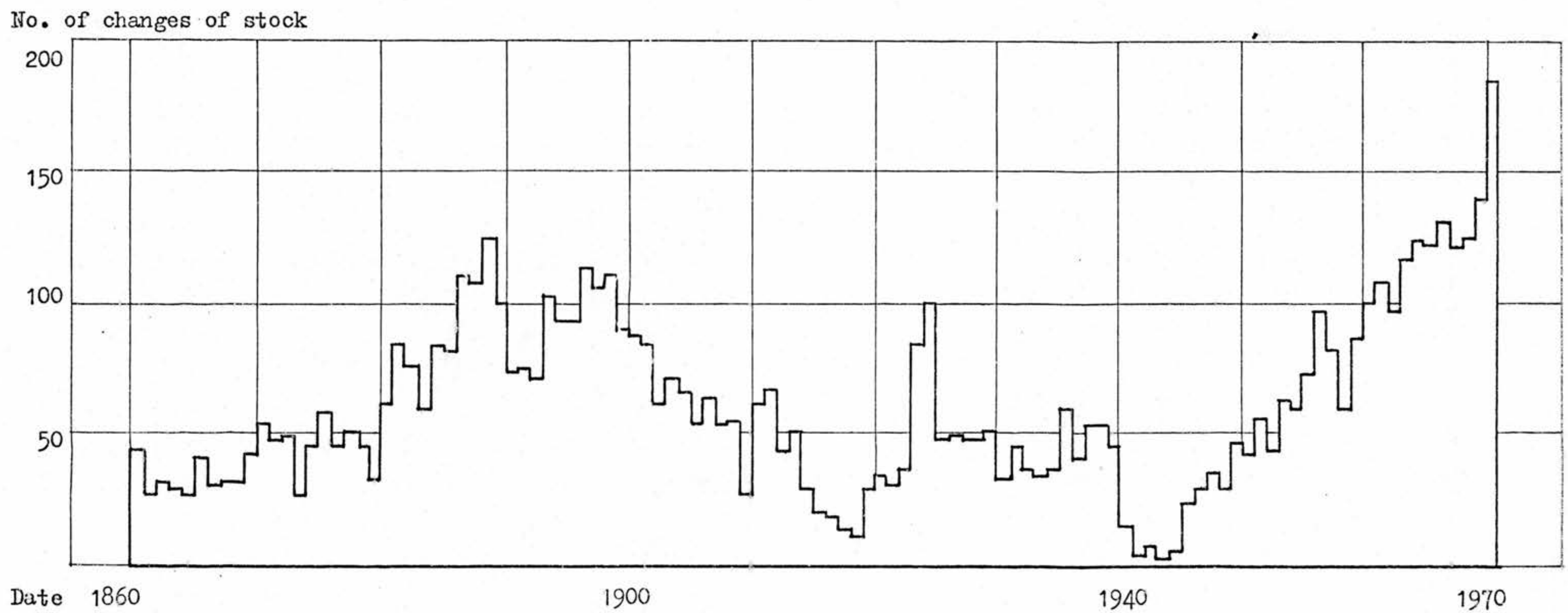


FIGURE 7.14: CHANGES OF STOCK, SURVEY SECTION EDINBURGH: TYPE III

type of 'change', new building, occurred at the earliest dates at the centre and progressed outwards in a more or less classical pattern[29], occurring first in the most accessible areas and later infiltrating the less accessible ones. Following new building, additions and adaptations of the stock (alteration, conversion, new facades, etc.) occurred following the same general spread of the stock. Then, as individual sites became filled, demolition and rebuilding occurred, again from the centre outwards, followed this time almost exclusively by alteration. In terms of use, new building coincided with the change of use of the land from non-urban to urban. The first wave of adaptation may be generally considered to accompany change of use of the stock, while rebuilding and the second wave of adaptation may be seen as the consolidation of the 'highest and best' use of the area.

7.4 PHYSICAL CHANGE OF THE STOCK IN RELATION TO SOME OF THE SOCIAL AND ECONOMIC FACTORS

7.21 In this section, a brief analysis of the relationship between the three types of physical changes and some of the social and economic factors will be undertaken. Specifically, the factors examined will be the population of Edinburgh, the total value of the stock and the average prices paid for housing in Edinburgh, and the interest rate and amounts advanced by building societies on a national scale.

7.22 Some of these factors in relation to new house construction have been studied on a national scale. Lewis[30] cites the relationship between population growth and the increase in the housing stock[31]. He also shows the relationship between the change in the interest rate

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29. See Map 2, in supplement.
30. Lewis, J.P.: op.cit.
31. See Chap.3.

and the construction of new housing[32]. This thesis has also theoretically examined the relationship between the amount of capital advanced by building societies, the change in the value of the stock and the change in new construction, as well as discussed the relationships between all of these factors and the adaptation of the stock[33].

7.4.1 PHYSICAL CHANGE OF THE STOCK AND POPULATION

7.23 Figures 7.15 - 7.17 show the relationship between the change in the population of Edinburgh and Types One, Two and Three changes respectively. As theoretically examined, one would expect a positive relationship between an increase in population and new building (Type One). This is true until 1940. However, between 1950 and 1970 the population dropped slightly, while new construction increased. This is probably due to the rise in standards as well as the rise of general affluence of the society, which allowed people to inhabit new stock as well as increased the demand for new stock. A similar occurrence, though not to the same extent, can be noted for the period 1920-1940 when the population rose only slightly, but new construction in the section increased dramatically.

7.24 Type Two changes - additions, conversions and sub-divisions - are other means by which to house the increase in population without creating totally new stock. In the early part of the period, when the growth of population was rapid, one finds a rather steady, but low, amount of Type Two changes occurring. As with Type One changes, when the rate of growth of the population dropped between 1900-1910, the amount of Type Two changes also declined. Between 1920 and 1930 a slight peaking of Type Two changes occurred, even though the rise of

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32. See Chap. 3.
33. See Chap. 2.

FIGURE 7.15: COMPARISON OF CHANGE OF POPULATION AND TYPE ONE CHANGES OF THE STOCK, SURVEY SECTION EDINBURGH

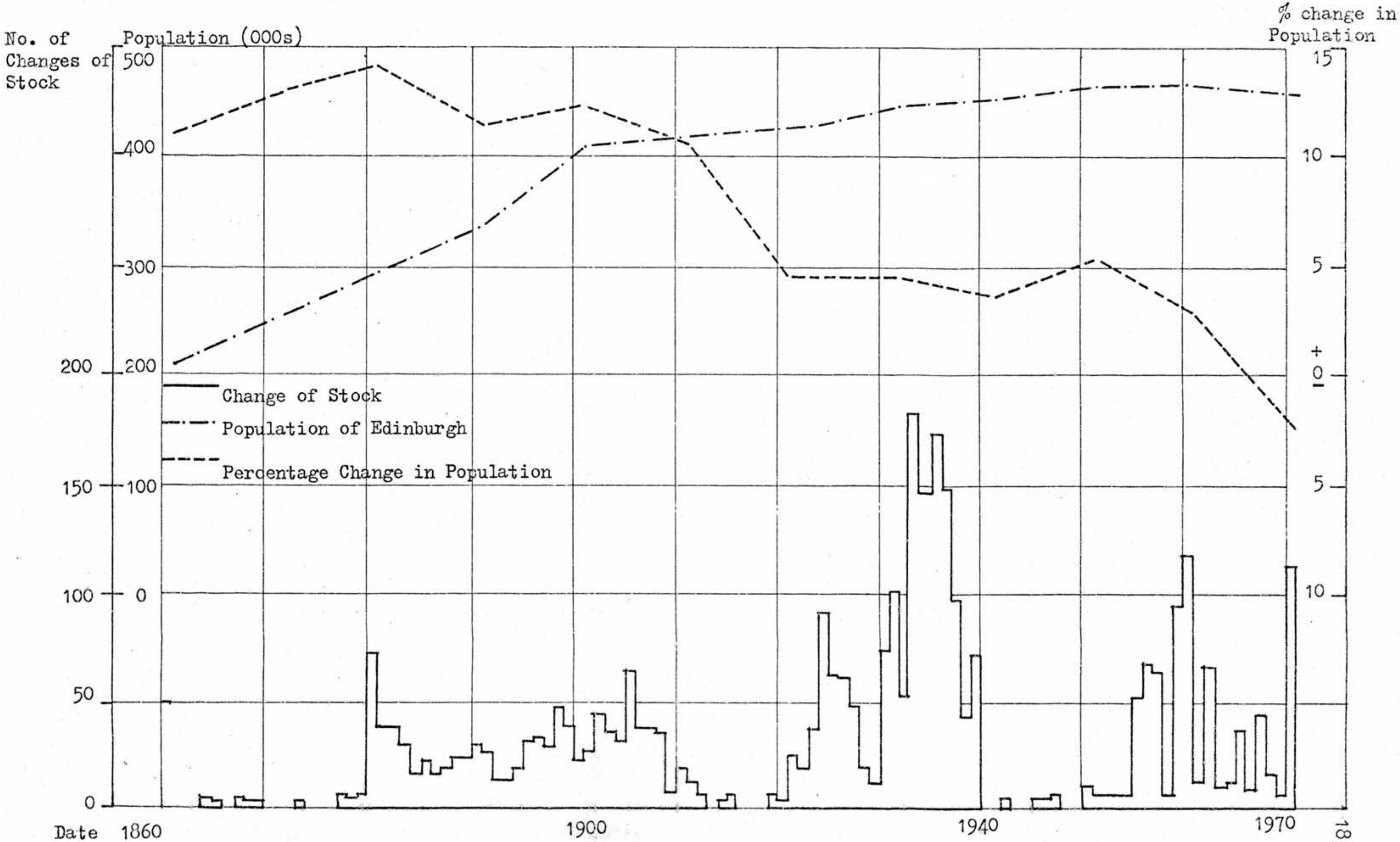


FIGURE 7.16: COMPARISON OF CHANGE OF POPULATION AND TYPE TWO CHANGE OF THE STOCK, SURVEY SECTION EDINBURGH

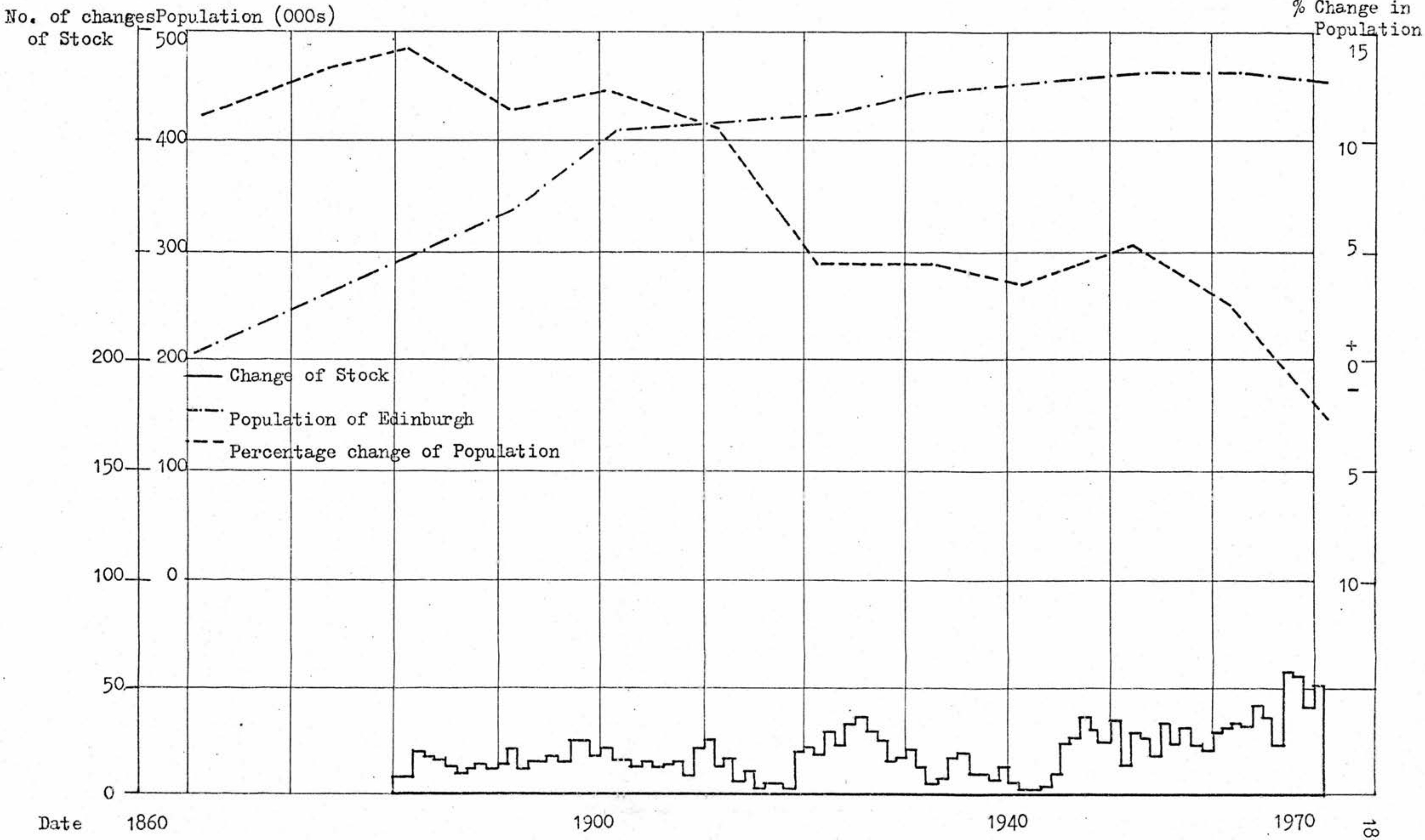
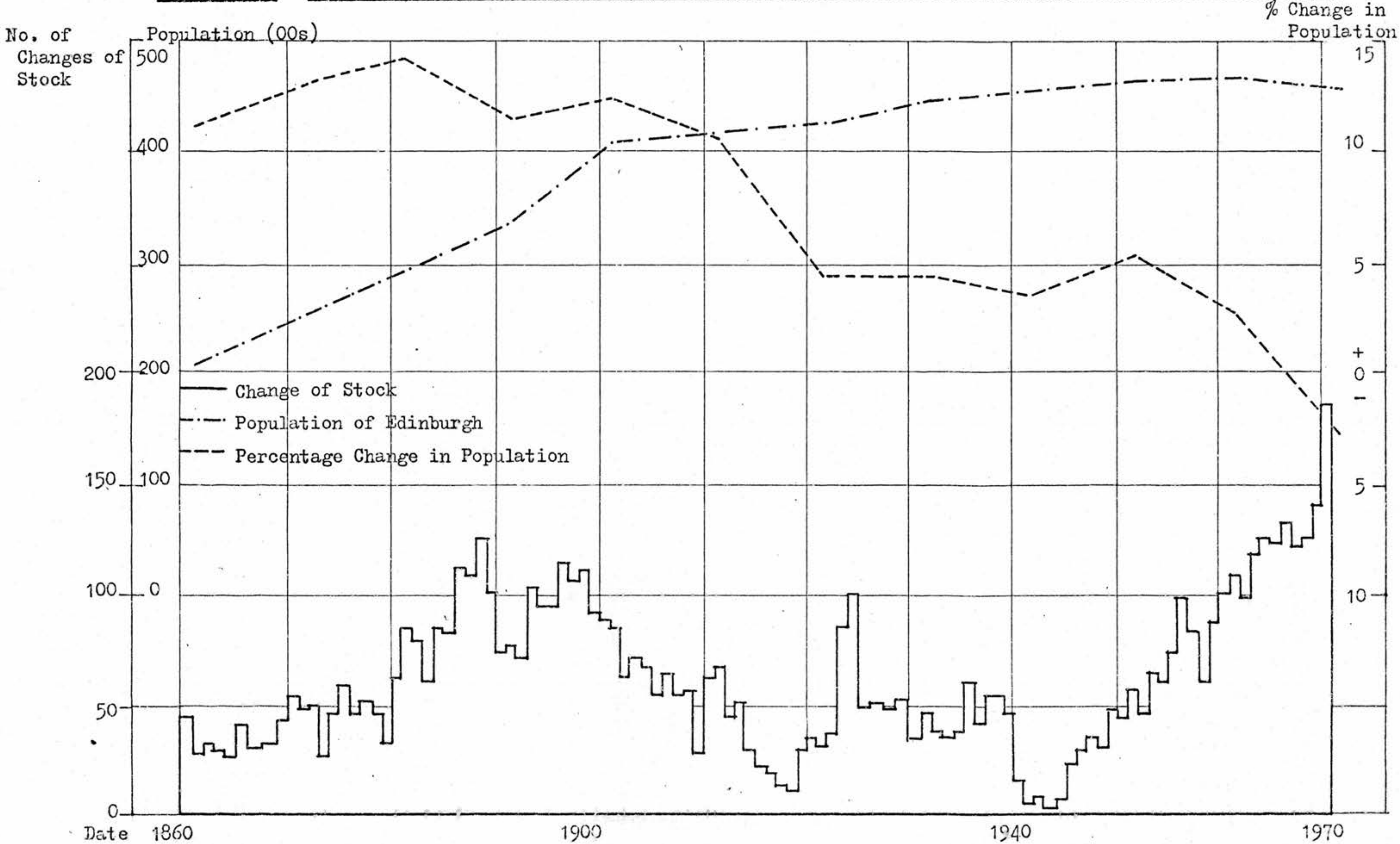


FIGURE 7.17: COMPARISON OF CHANGE OF POPULATION AND TYPE THREE CHANGE OF THE STOCK, SURVEY SECTION, EDINBURGH



the population was slight. A similar relationship to Type One changes occurred in the 1950 - 1970 period, when the population dropped slightly, but the amount of Type Two changes increased. This may be attributed to two main causes. As with Type One changes, the rise of standards and affluence after World War II allowed not only better housing accommodation, but also the mobility of the people to seek housing outside the centre. Thus, the existing stock was abandoned and converted to other uses. Similarly, as the upper socio-economic classes vacated the large housing for newer stock outside the city, the lower socio-economic classes were able to inhabit (and sub-divide) the older stock[34]. Also, as the stock changed use, additions to the stock occurred (although generally at a later date) because of the need for more space of the new uses[35].

7.25 Type Three changes are similar in their relationship to the change of population as Type Two, thus it can be said that stock undergoing transition within a use follows the same general pattern in relation to population growth as does stock undergoing the transition from one use to another.

7.26 In general, the fit between changes to the stock and changes in the population becomes less positive as the period ages. That is, the fit is much closer at the beginning than at the end of the study period. This is probably due to two main factors: the growing affluence of the population, and with that affluence, the change in the expectations and standards of the stock. Thus, it can be concluded that the change in

34. See Appendix 3 on Filtration Theory.
35. See Appendix 2 on Land Use Succession Theory.

the size of the population is not an extremely good reflection, at present, of either new construction or the adaptation of the existing stock. Rather, the affluence of that population is also a critical factor.

7.4.2 PHYSICAL CHANGE OF THE STOCK AND THE CHANGE OF VALUE AND HOUSING PRICES

7.27 The relationship between the adjusted (to 1964 £s) and unadjusted or current value[36] of all stock in Edinburgh and the amount of change of the stock is shown in Figures 7.18 - 7.20. The rise in the unadjusted value is a reflection of the growth in the number of items of stock in the city as well as periodic re-adjustments to reflect the change of use, adaptations and desirability of the location of the stock. The unadjusted value is also supposed to reflect adjustments made due to inflation, but as can be seen in the figures, only during the last fifteen years can this be said to be true. The unadjusted value appears to be a poor reflection of the amount of change occurring over time. However, a much better reflection is obtained by adjusting the value to a common pound. For all three types of change, the adjusted value of the stock follows closely the amount of change of the stock.

7.28 A different situation occurs, however, with the relationship between the change in mean housing prices in Edinburgh and the amount of change of the stock. (See Figures 7.21 - 7.23). Here, a much closer relationship is found between the unadjusted price and the amount of Type Two and Three changes than between the unadjusted price and the

36. Value means the Yearly Rent or Value from 1860 - 1925, and the Gross Annual Value from 1930 - 1970.

FIGURE 7.18: COMPARISON OF THE VALUE OF THE STOCK AND TYPE ONE CHANGE OF THE STOCK, SURVEY SECTION, EDINBURGH

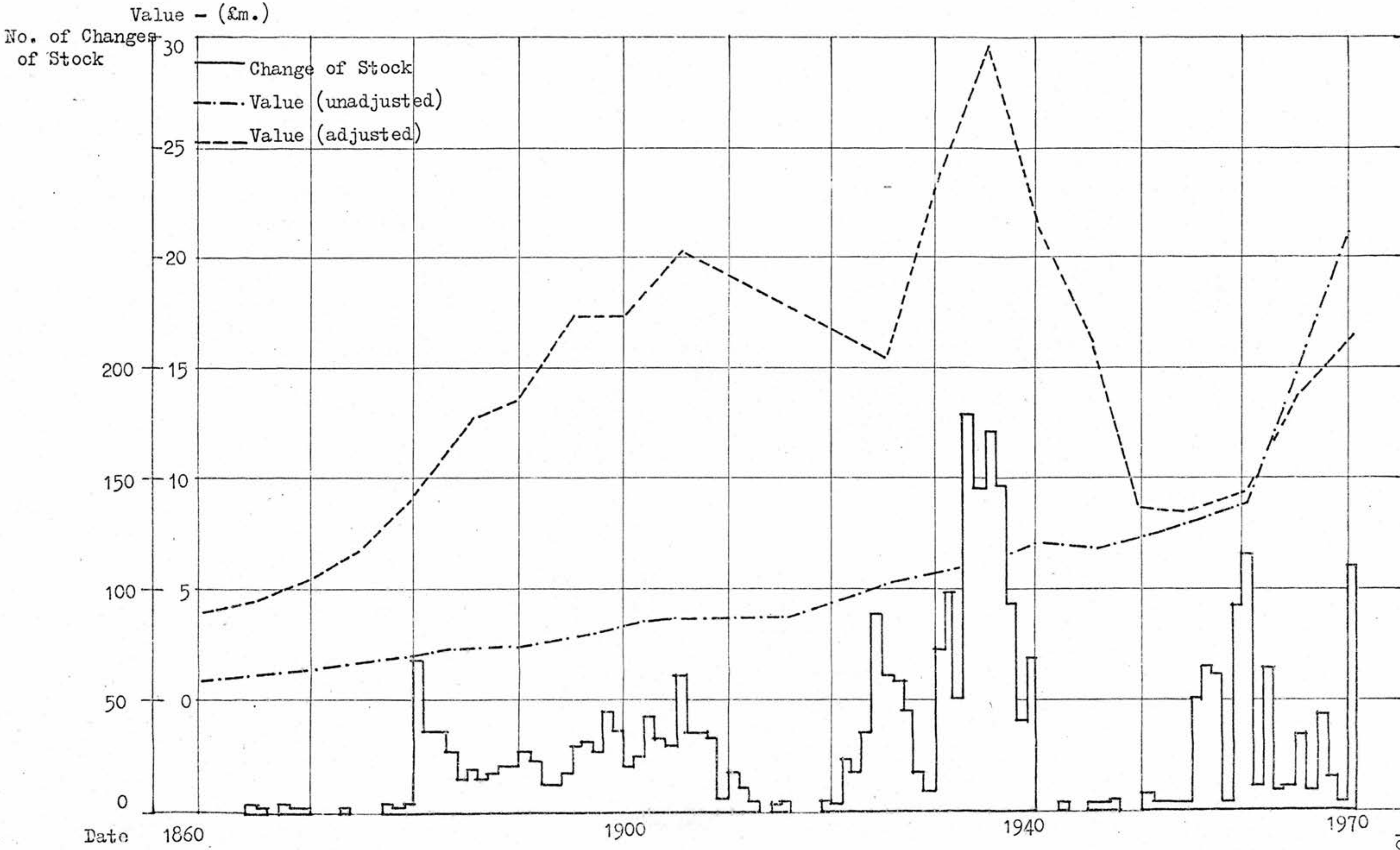


FIGURE 7.19: COMPARISON OF VALUE OF THE STOCK AND TYPE TWO CHANGE OF THE STOCK, SURVEY SECTION, EDINBURGH

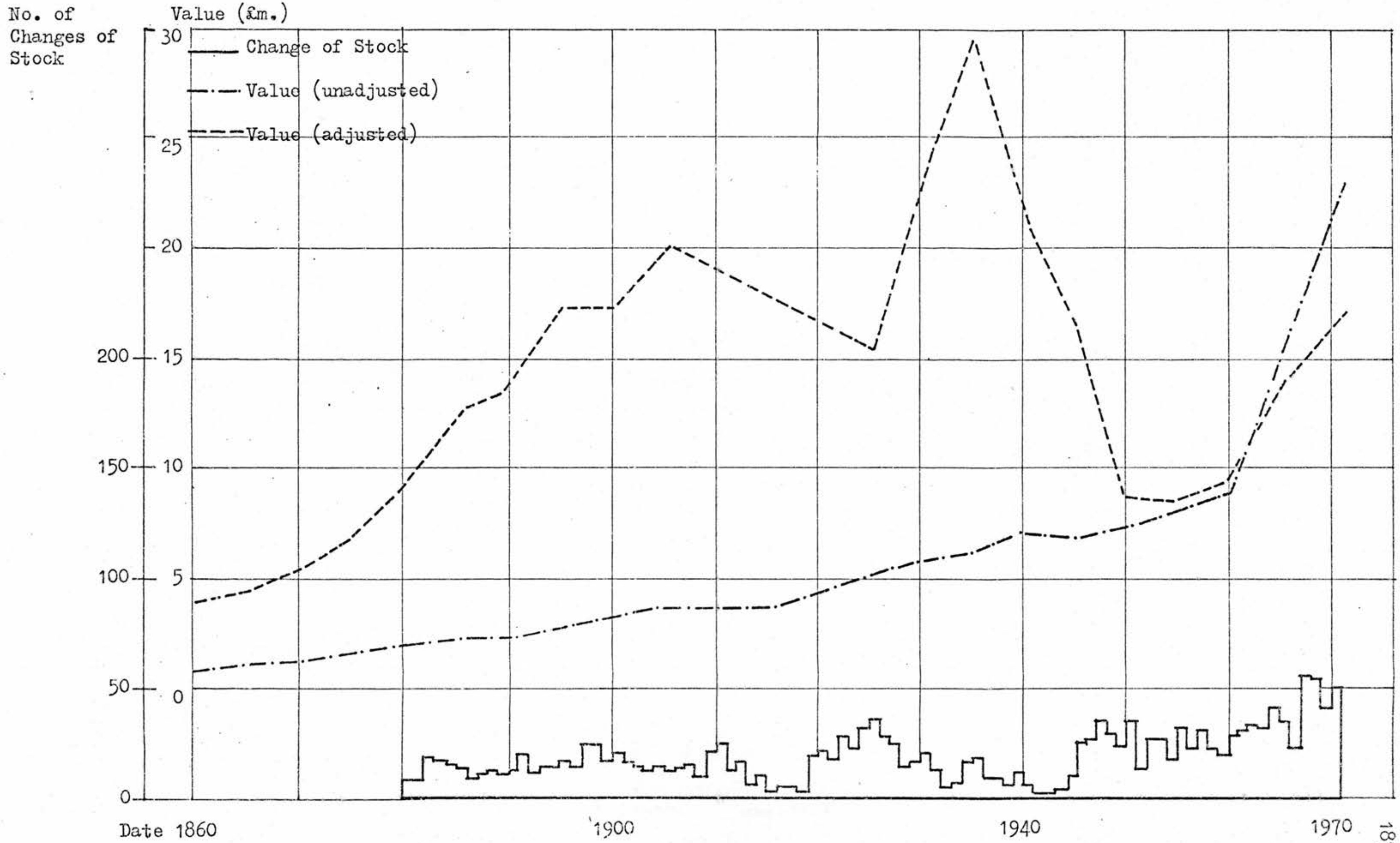


FIGURE 7.20: COMPARISON OF VALUE OF THE STOCK AND TYPE THREE CHANGE OF THE STOCK, SURVEY SECTION, EDINBURGH

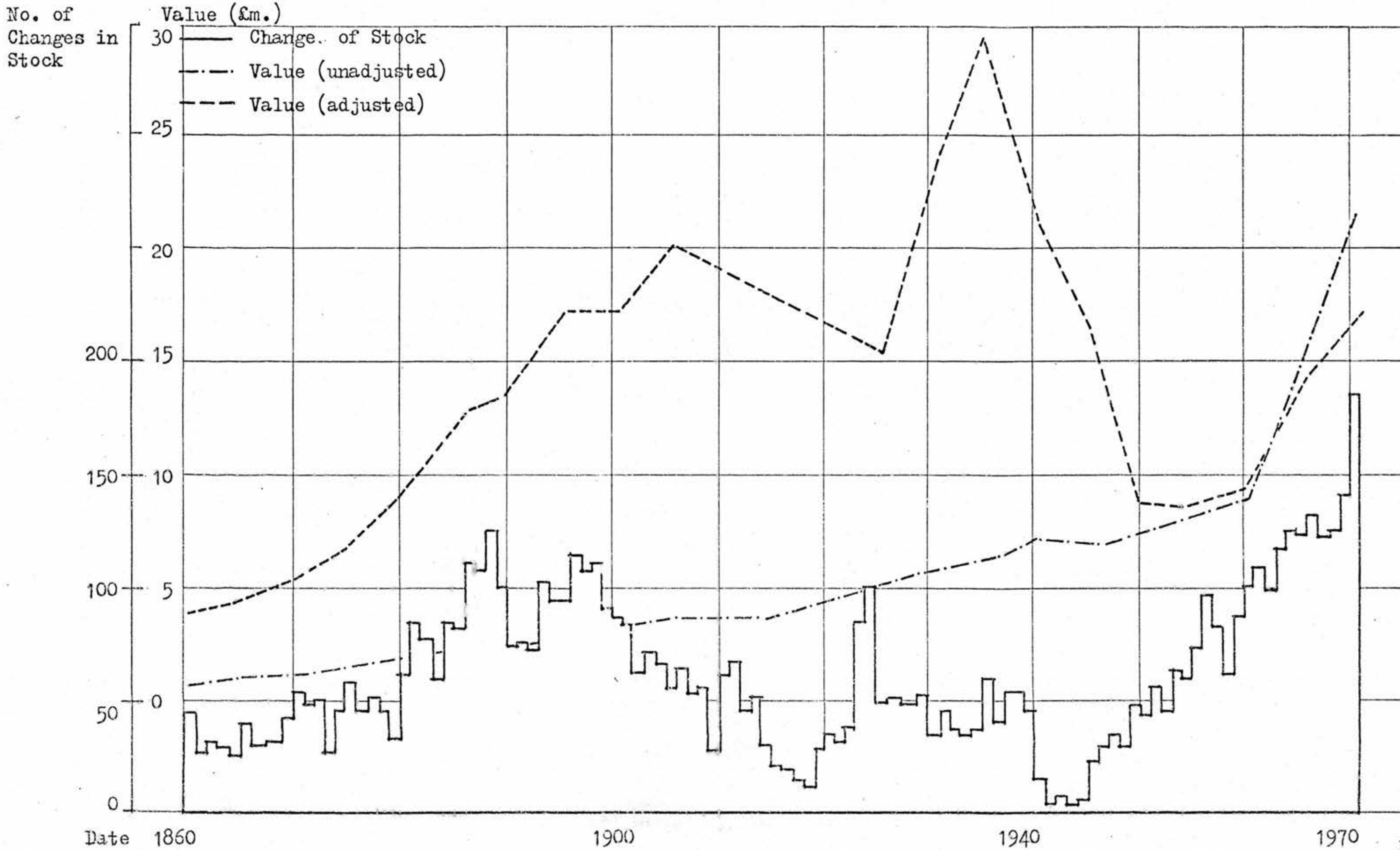


FIGURE 7.21: COMPARISON OF MEAN HOUSING PRICES AND TYPE ONE CHANGE OF THE STOCK, SURVEY SECTION, EDINBURGH

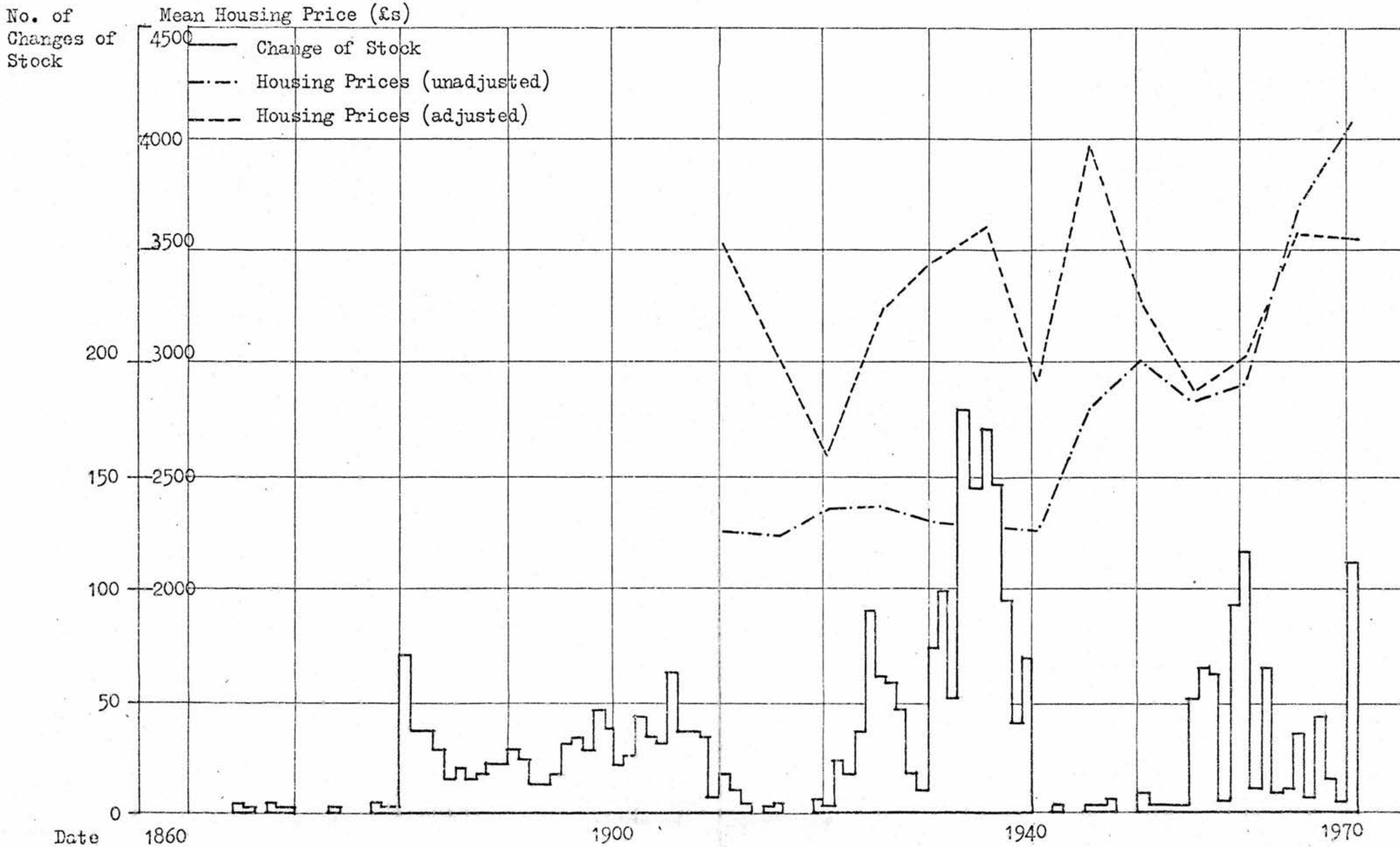


FIGURE 7.22: COMPARISON OF MEAN HOUSING PRICES AND TYPE TWO CHANGE OF THE STOCK, SURVEY SECTION, EDINBURGH

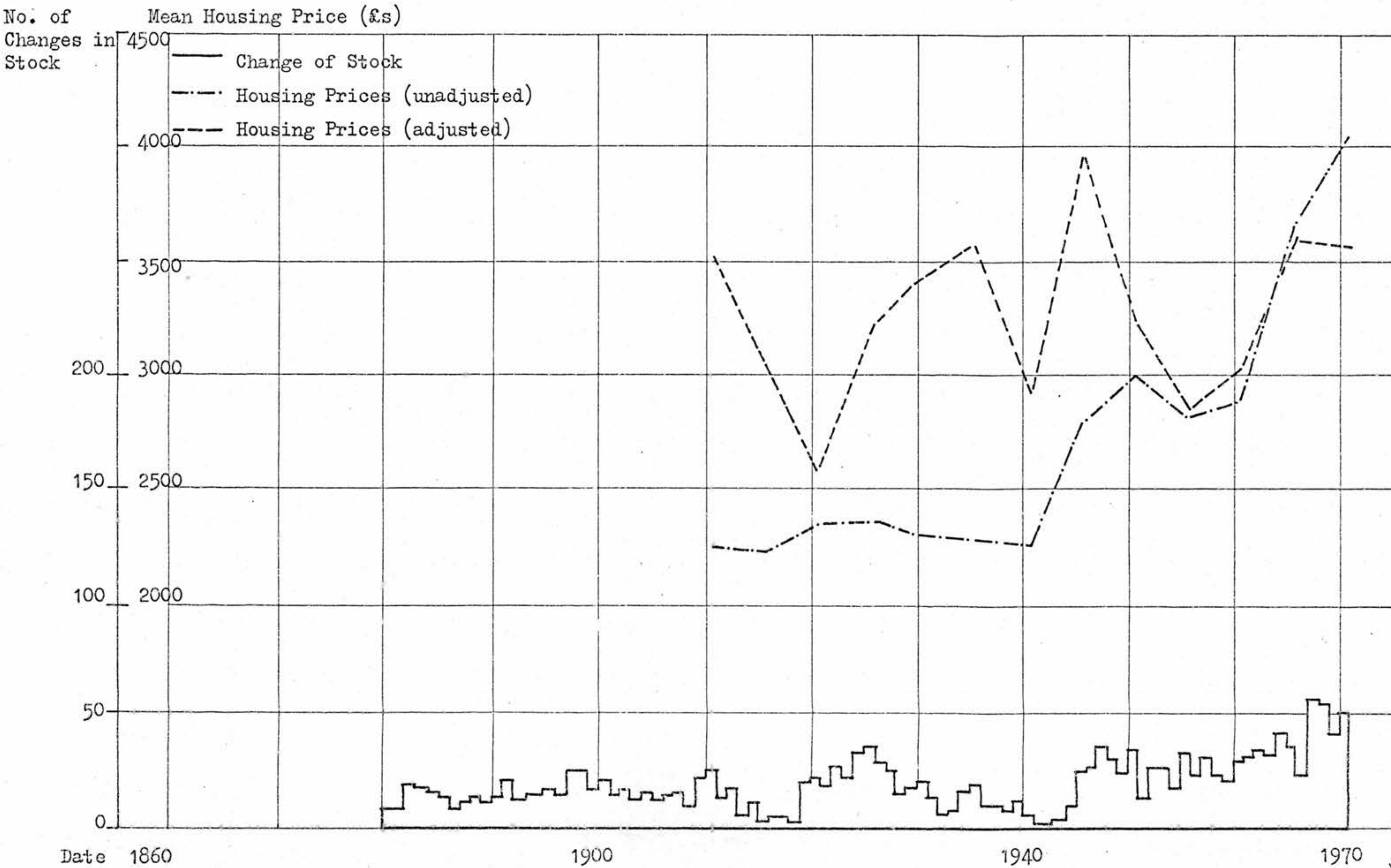
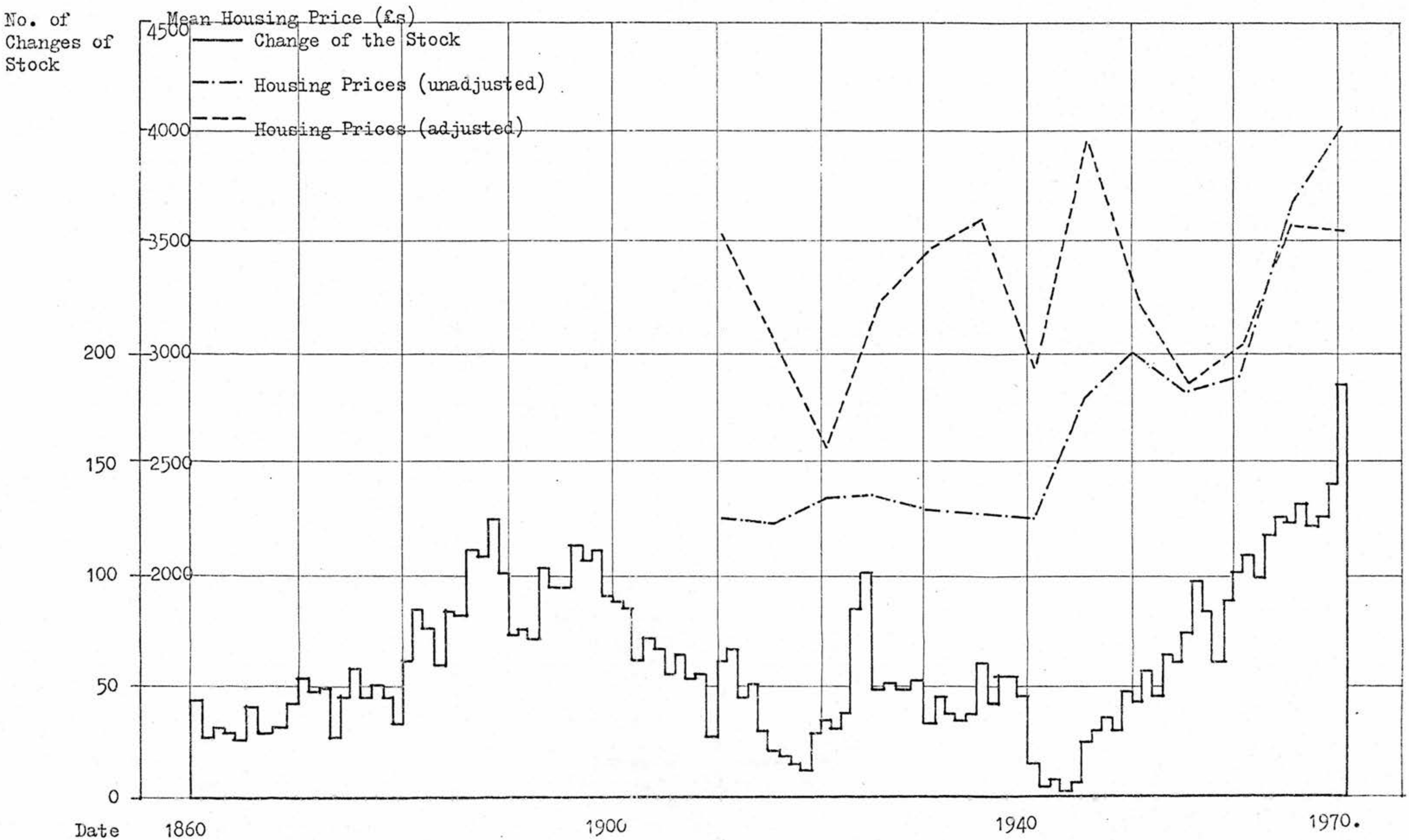


FIGURE 7.23: COMPARISON OF MEAN HOUSING PRICES AND TYPE THREE CHANGE OF THE STOCK, SURVEY SECTION, EDINBURGH



amount of new housing construction (Type One). This could be partially attributed to the lack of building land in the section during the latter part of the period.

7.29 One would expect that when prices were high the amount of change would be low, while when prices were low the amount of change would rise. If one considers the adjusted value this trend can be seen in Types Two and Three changes. With the drop in real prices in 1915, the amount of change begins to accelerate until 1925, when it again falls. At the end of World War II, the real price of housing reached its maximum; prices then fell until 1955, while change again accelerated. Both prices and changes continued to climb until 1965, when prices fell, but change in general continued to rise. A different relationship is found, however, in Type One change (which consists mainly of new housing). Here, we find a positive relationship between price and amount of new building between 1910 - 1940 and 1955 - 1970, while the centre period (1940-1955) shows an inverse relationship held. This may be attributed to shortages caused by World War II. Thus, two different relationships between the change in prices and the changes of the stock are observed: one for new building, and a second for adaptation of the stock. In general, however, housing prices are not as good an indicator of the amount of change as the adjusted value.

7.4.3 PHYSICAL CHANGE OF THE STOCK AND CHANGE OF INTEREST RATES AND AMOUNT ADVANCED BY BUILDING SOCIETIES

7.30 Interest rates should reflect the amount of change inversely[37].

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37. Chap. 3.

That is, when the costs of borrowing capital is high, the amount of change should be low and vice-versa. In all three types of change, this is in general true for the pre-war period, but does not hold true for the post-war period. (See Figures 7.24 - 7.26[38].) This change is possibly due to the continued demand for change during this period creating a scarcity of capital, change in government attitude towards control of the economy and the general rise of affluence of the society, thus enabling the individual to bear a greater interest burden. The change in the rate of interest, however, does not seem to be as good an indicator of change of the stock as does value.

7.31 The amount advanced by building societies can also be used as an indicator of change. Figure 7.27[39] shows the relationship between the adjusted and unadjusted amount advanced and the amount of new construction in the section. As can be seen, the adjusted value follows the amount of new building more closely in the early part of the period than in the post-war period. Again, this can be explained by the lack of available building land in the post-war period in the section. Types Two and Three changes (Figures 7.28 & 7.29) do fit the curves in the post-war period more readily than in the pre-war period. This is due, in part, to government intervention in the market between 1930 and 1940 to stimulate the economy.

7.5 CONCLUDING REMARKS

7.32 The ten types of physical change of the stock may be grouped into three which exhibit similar characteristics, both in the location

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38. See also Table A.5.4.
39. See also Table A.5.5.

FIGURE 7.24: COMPARISON OF INTEREST RATE AND TYPE ONE CHANGE OF THE STOCK, SURVEY SECTION, EDINBURGH

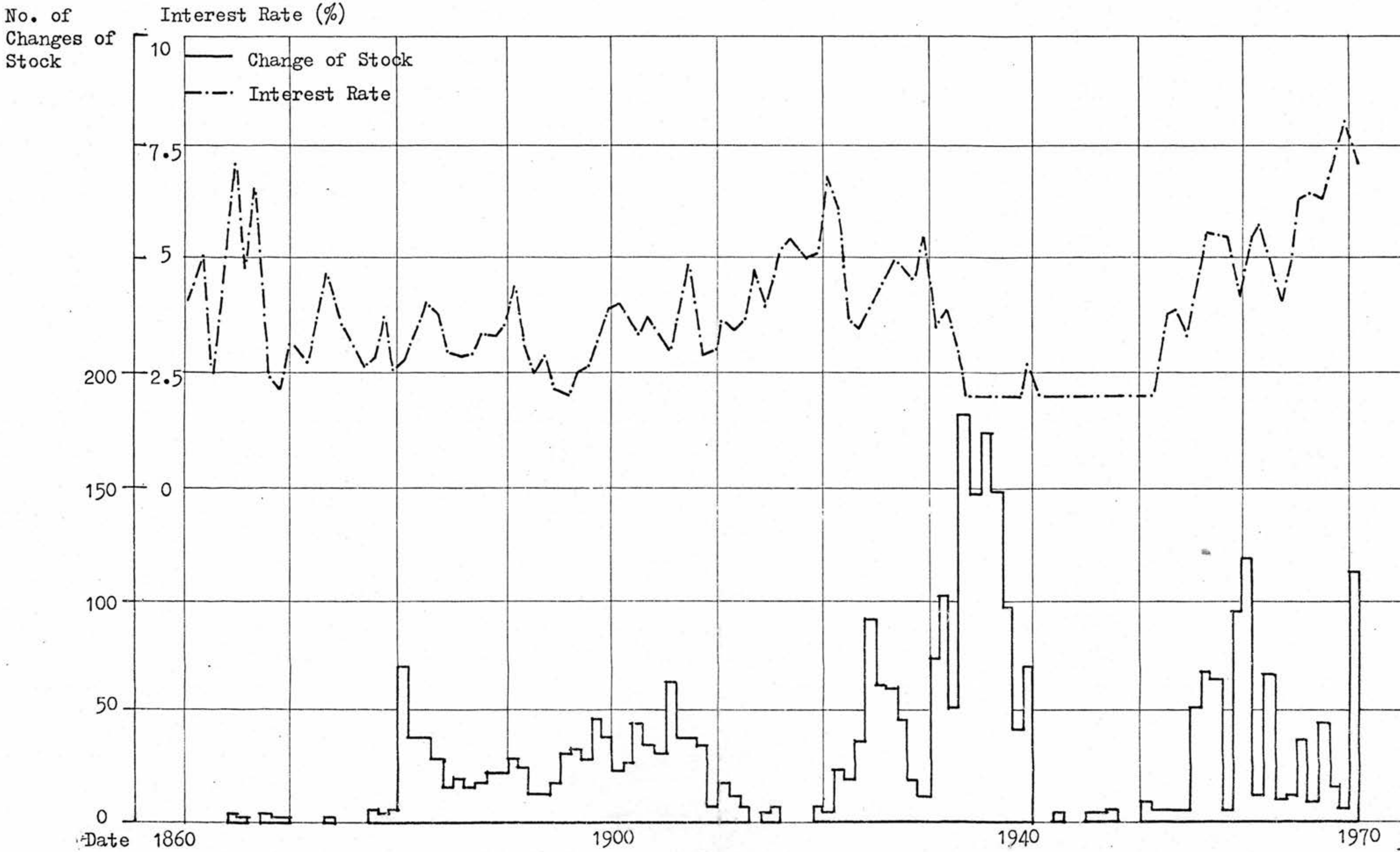


FIGURE 7.25: COMPARISON OF INTEREST RATE AND TYPE TWO CHANGE OF THE STOCK, SURVEY SECTION, EDINBURGH

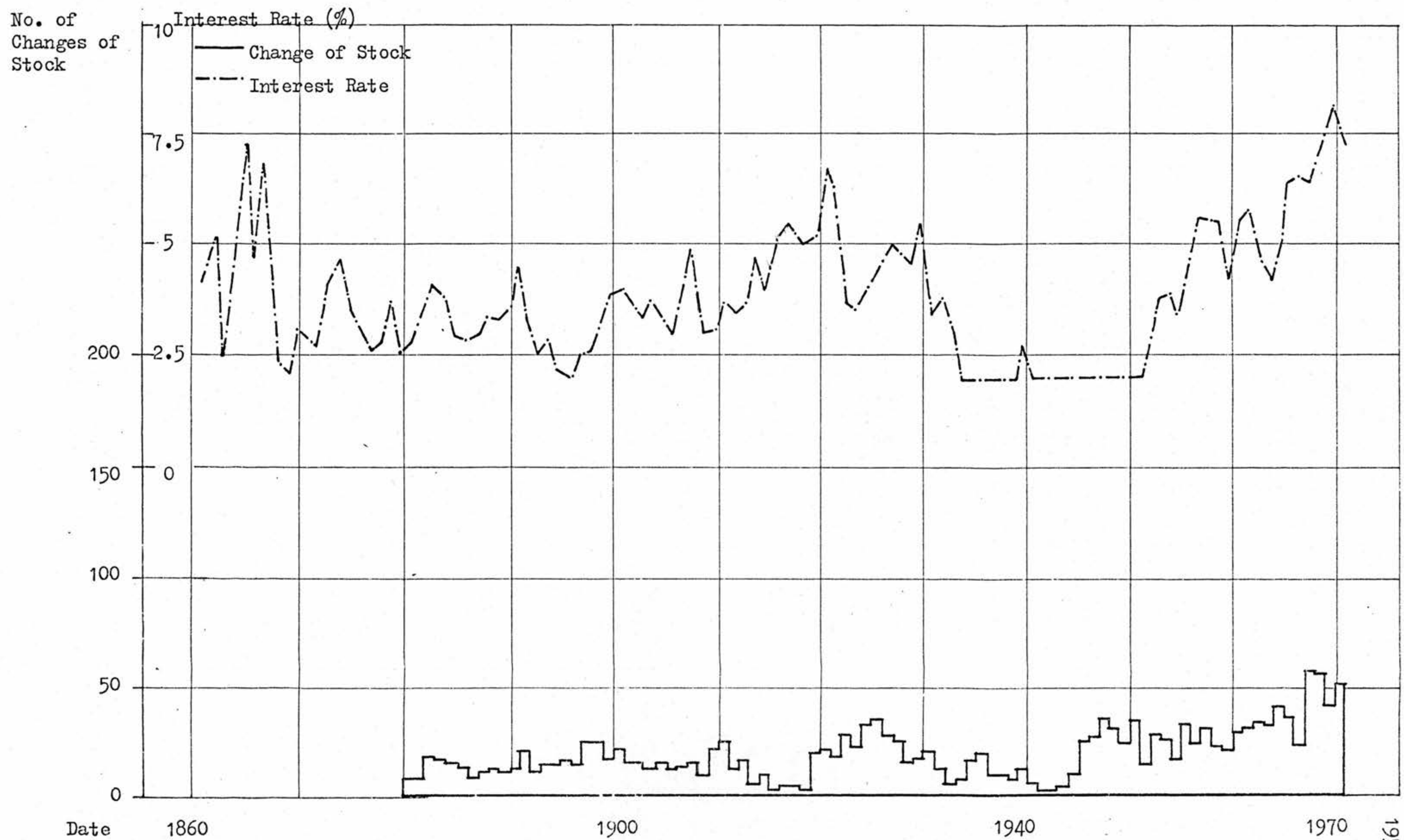


FIGURE 7.26: COMPARISON OF INTEREST RATE AND TYPE THREE CHANGE OF THE STOCK, SURVEY SECTION, EDINBURGH

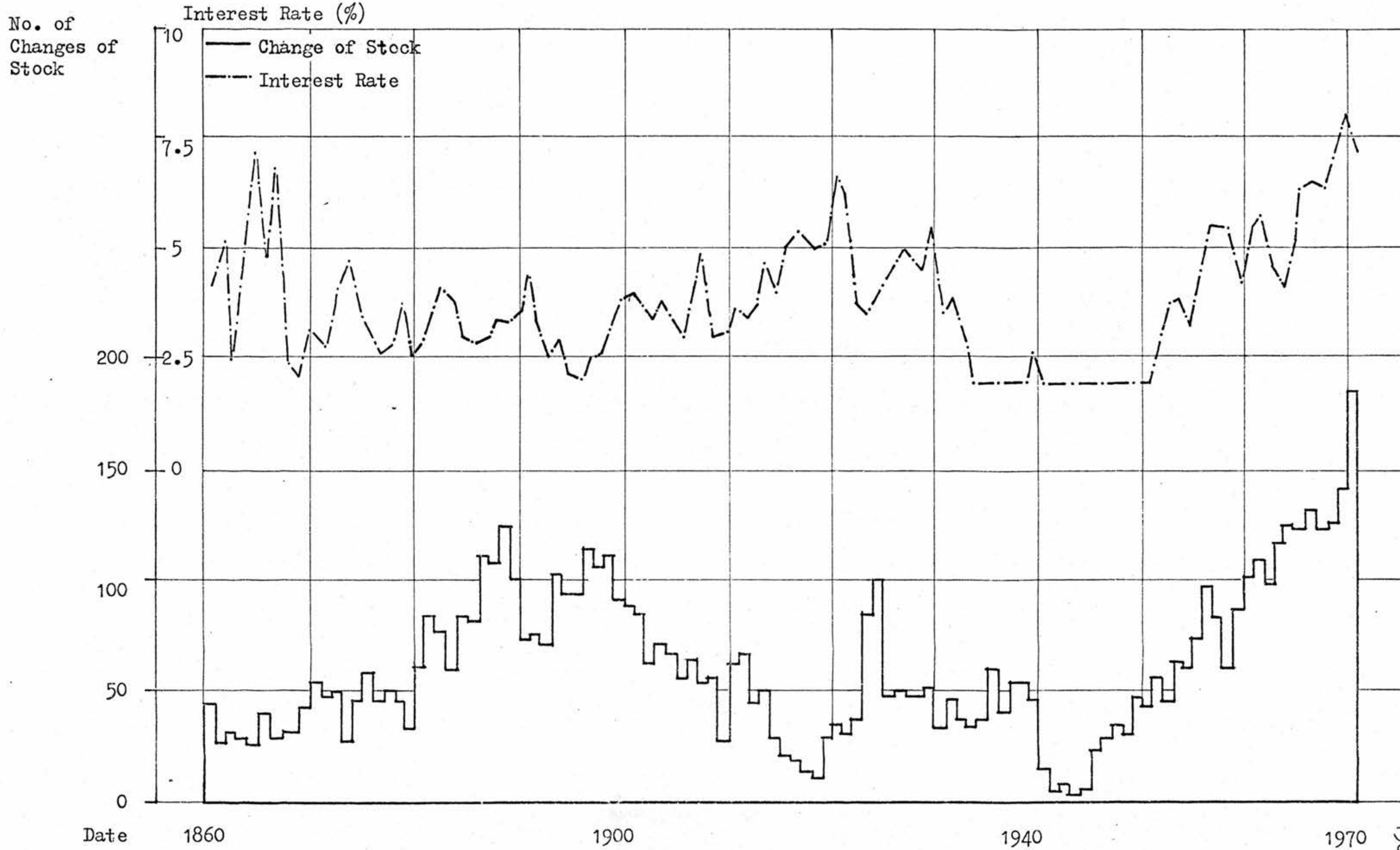


FIGURE 7.27: COMPARISON OF AMOUNT ADVANCED BY BUILDING SOCIETIES AND TYPE ONE CHANGE OF THE STOCK, SURVEY SECTION, EDINBURGH

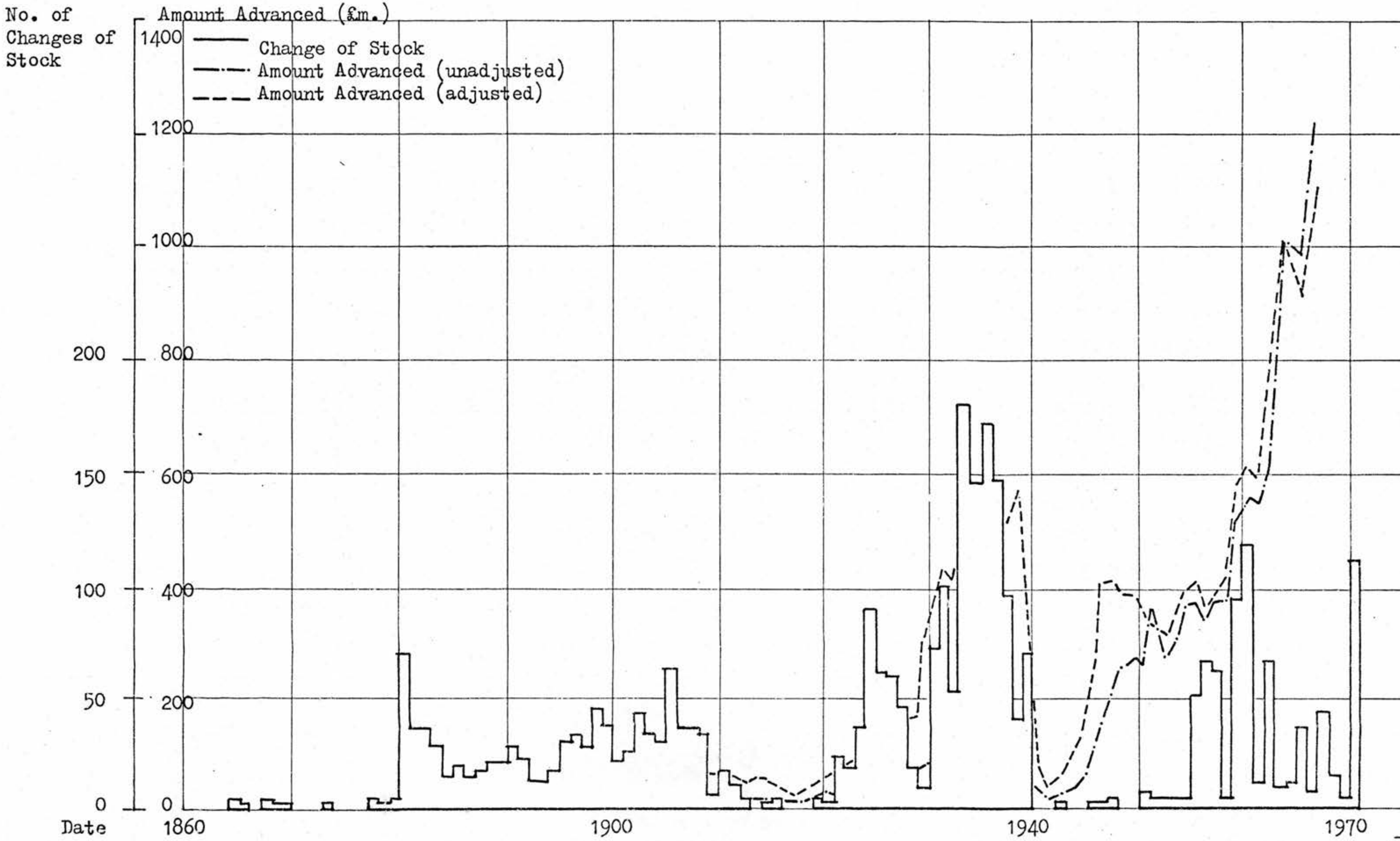


FIGURE 7.28: COMPARISON OF AMOUNT ADVANCED BY BUILDING SOCIETIES AND TYPE TWO CHANGE OF THE STOCK, SURVEY SECTION, EDINBURGH.

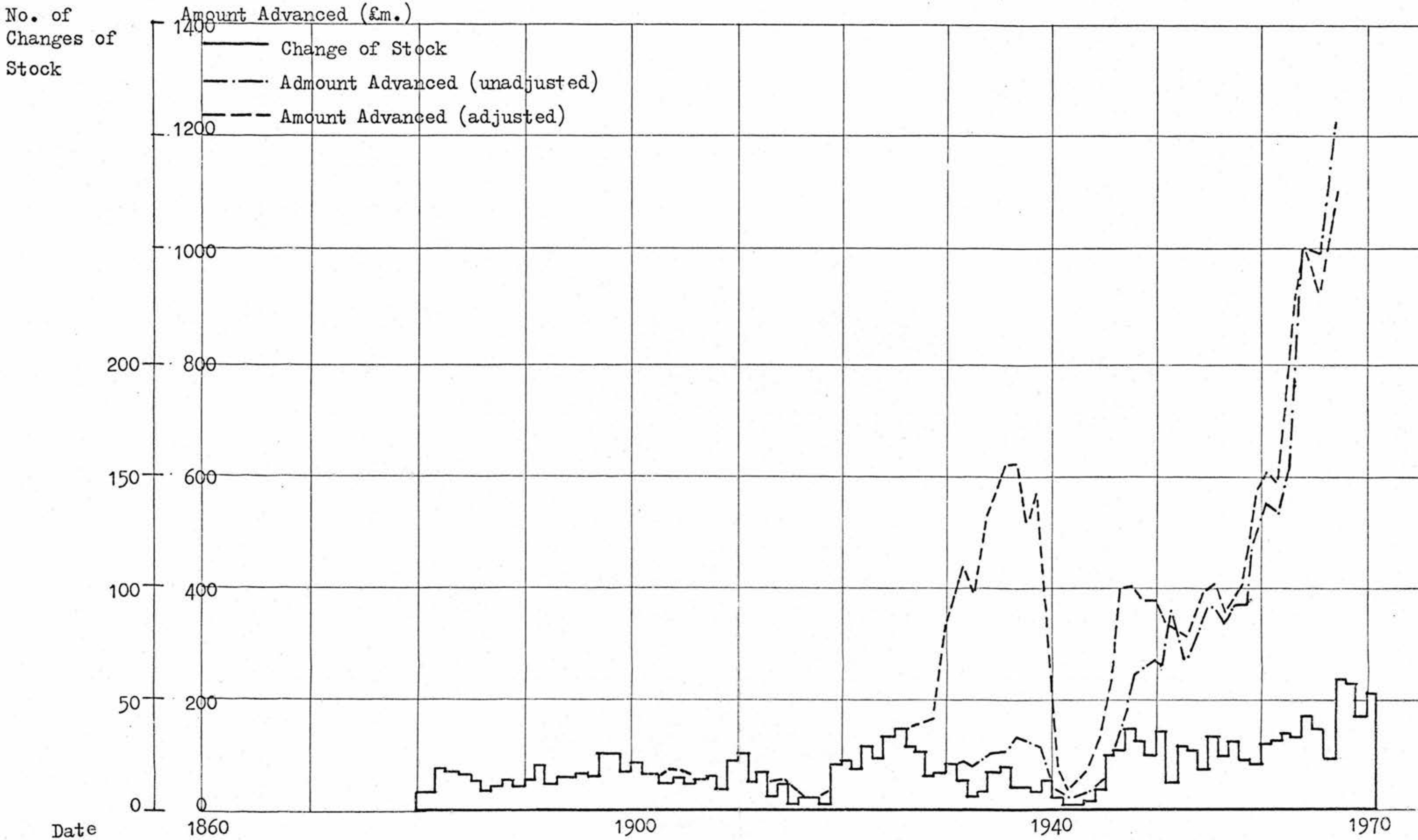
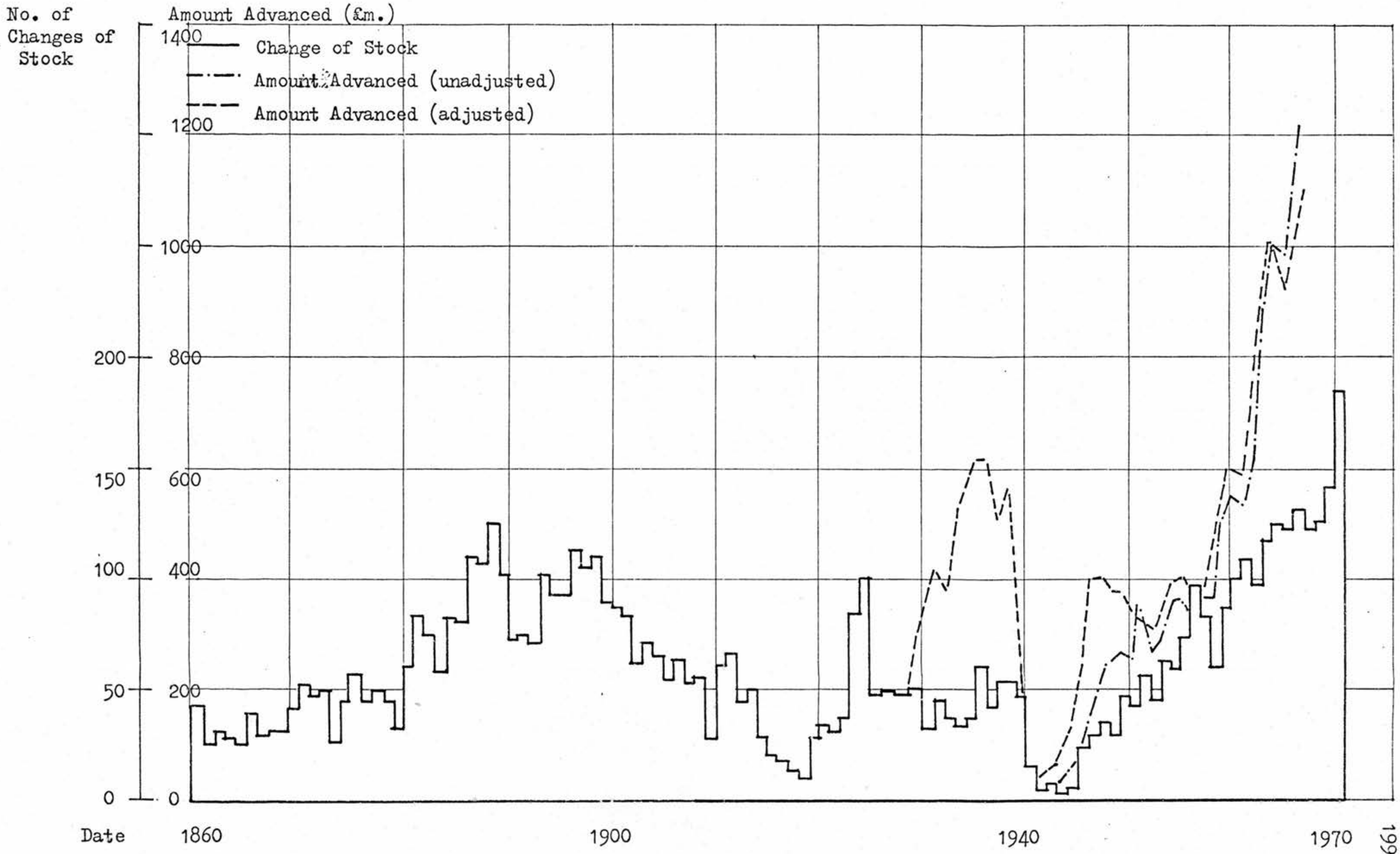


FIGURE 7.29: COMPARISON OF AMOUNT ADVANCED BY BUILDING SOCIETIES AND TYPE THREE CHANGE OF THE STOCK, SURVEY SECTION, EDINBURGH



of the change and the date of the change. While Types Two and Three changes are similar in location, but slightly dissimilar in date, Type One change is significantly different in both location and date. Locationally, it occurred outside the centre of the section, while in time, it shows a marked peak in the 1930s. If one compares the indices of new buildings in the section[40] (which consists mainly of new housing) and new housing construction in Great Britain as a whole[41], one finds that they are very similar for this period. Why then, is new housing construction dissimilar from other changes, including rebuilding of the stock? Lewis[42] supplies a number of suggestions: the ten-fold increase of housing built by the local authorities between 1915 and 1930 (6-60% of total housing constructed); a number of Acts such as the Town Planning Act, 1919, which required local authorities to prepare schemes for working class housing with rent fixed at pre-war levels and the Housing (Additional Powers) Act, which gave subsidies to private home builders; as well as the unsatisfied demand generated during the First World War. While all of these stimulated new house building in the 1920s, the even greater amount of new construction in the 1930s maybe attributed to two important factors: the adoption of the recommendations that the Morley Committee made in 1930 that the rent controls operating for the past fifteen years be suspended for most of the housing stock[43], and the political expedience

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40. See Table A.5.8.
41. See Table A.5.9.
42. See Lewis, J.P.: op.cit.
43. The Committee divided housing into three classes: Class A contains those over £45 rateable value and were to be decontrolled immediately; Class B contains those between £26/5 and £45 rateable value and were to be decontrolled on a change of tenancy; and Class C, those under £26/5 rateable value, which were to remain under control. The effect of these recommendations was to/...

of stimulating the economy during the 1930s by encouraging the construction of new housing. Thus, while a number of factors helped to stimulate new housing construction during the inter-war period, they did not affect non-housing new building, nor the adaptation of the stock to any great extent.

7.33 The relationship of the amount of change of the stock and the various economic and social factors examined in this Chapter appears to shift after World War II. It may also be observed in the relationship between the change of the stock and the purchasing power[44] of the pound (see Figures 7.30 - 7.32). Whereas in the pre-war period a rise in the purchasing power of the pound follows a rise in the amount of change undertaken, the post-war period exhibits the reverse relationship, a drop in the purchasing power corresponding to a rise in the amount of physical change. The most prominent cause of this shift is probably the increased affluence of the members of the society, which allowed them to make changes, even though the cost, in real terms, was high.

7.34 The examination of the location and date of physical changes in this Chapter provides a basis upon which a much more detailed analysis of the relationship between changes of the stock and the economic and social factors, may be developed. In the next Chapter, a particular area of the trans-section will be analysed to further develop these relationships, as well as detail the relationship between the change of the stock and the user of that stock.

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43. (contd.) stimulate new construction in the housing sector most profitable to builders, the middle and upper cost sector.
44. The purchasing power of the pound is the inverse of the wholesale price index, see Table A.5.4.

FIGURE 7.30: COMPARISON OF THE PURCHASING POWER OF THE POUND AND TYPE ONE CHANGE OF THE STOCK, SURVEY SECTION, EDINBURGH

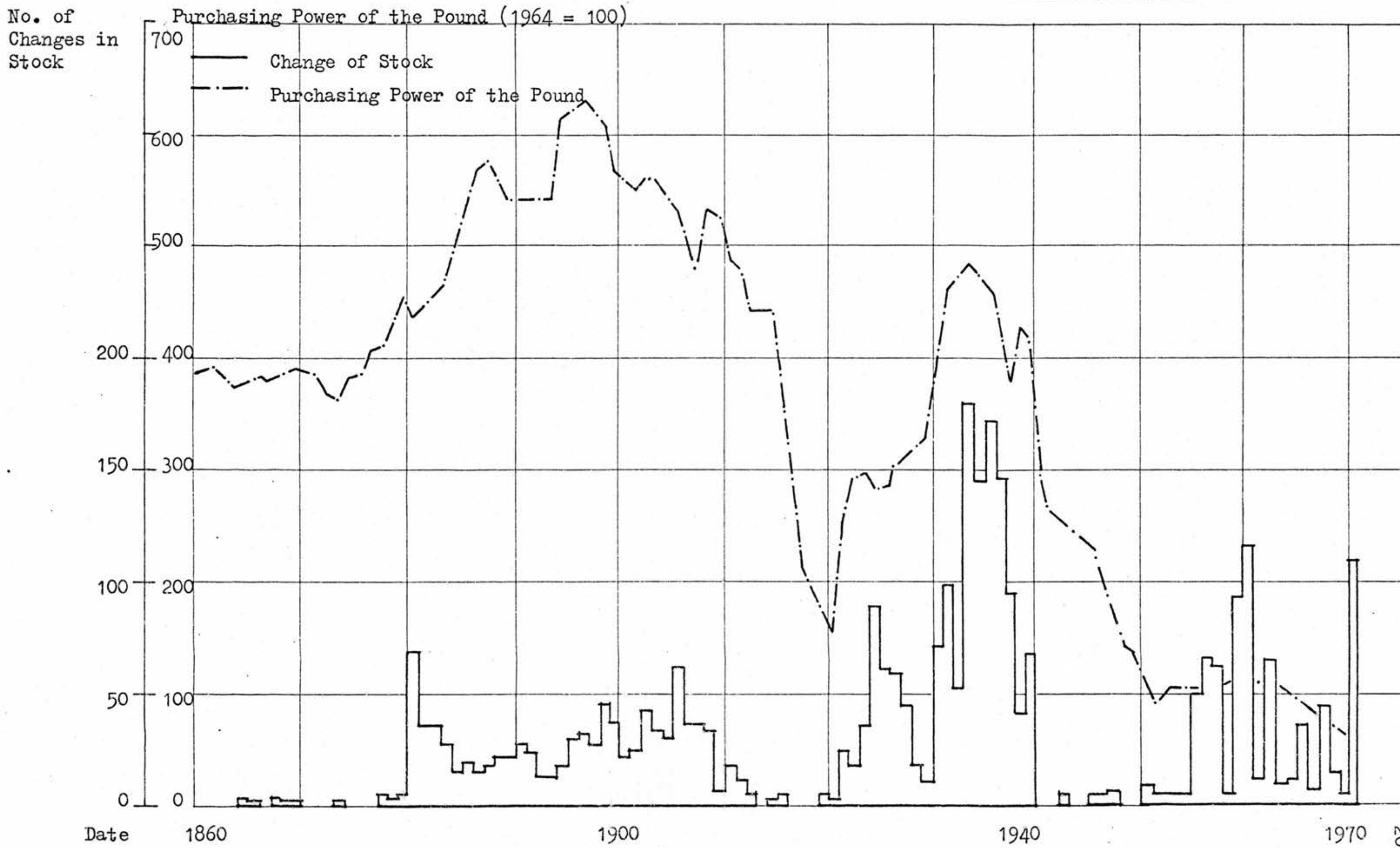


FIGURE 7.31: COMPARISON OF THE PURCHASING POWER OF THE POUND AND TYPE TWO CHANGE OF THE STOCK, SURVEY SECTION, EDINBURGH

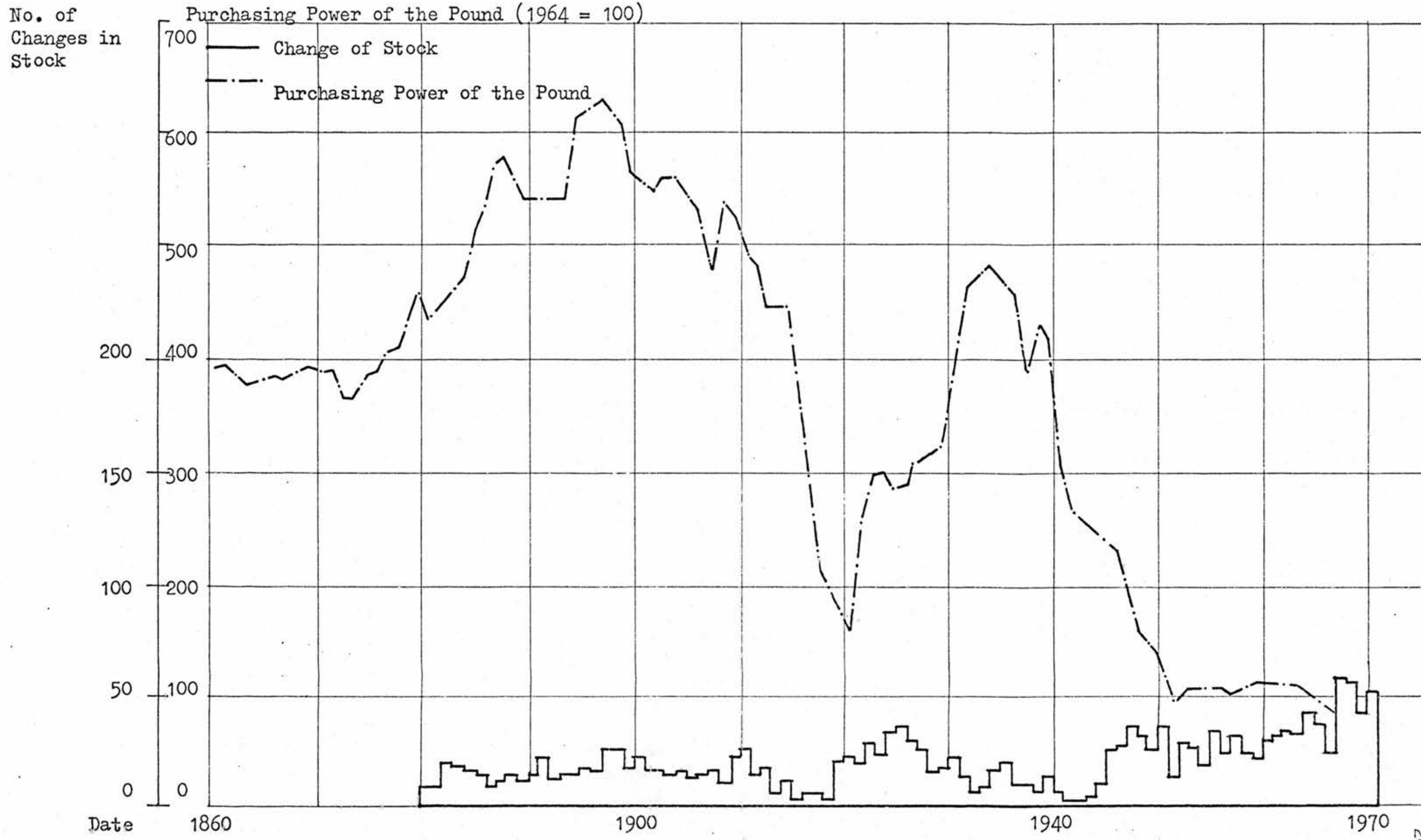
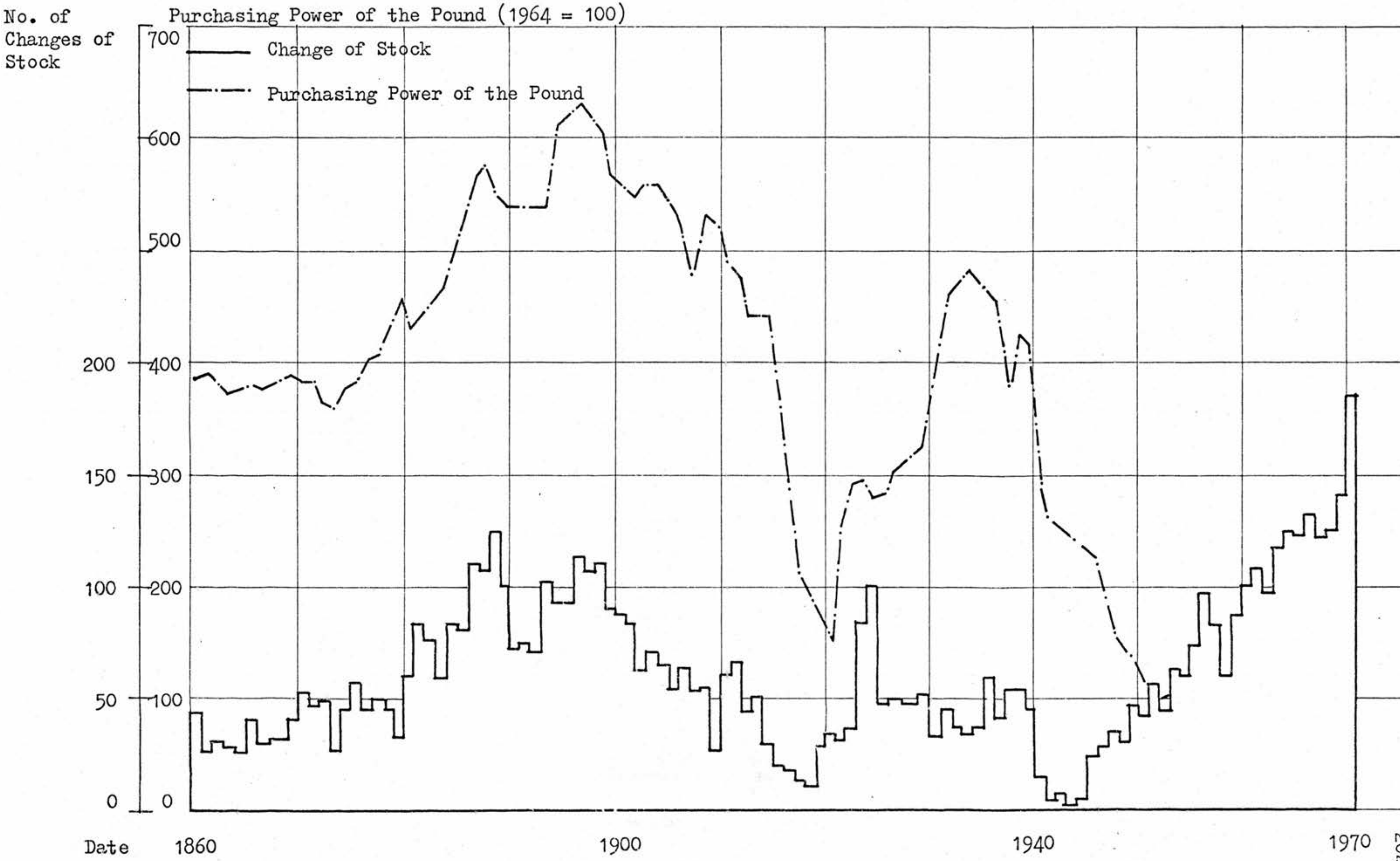


FIGURE 7.32: COMPARISON OF THE PURCHASING POWER OF THE POUND AND TYPE THREE CHANGE OF THE STOCK, SURVEY SECTION, EDINBURGH



PART THREE

CHAPTER EIGHT

AN AREA OF AN URBAN ENVIRONMENT: A SURVEY OF CHANGE

8.1 INTRODUCTORY SUMMARY

8.01 An area within the trans-section is analysed in regard to the change of stock, its use and user, the value of the stock and the wholesale price index. The frequency of the change of use and user affects the change of the stock and is related to the change in the wholesale price index. Further, the analysis suggests that the size of the user and his type is critical to the life-span of the stock.

8.2 INTRODUCTION

8.02 In the previous Chapter, the amount of physical change of the stock, its type, date and location, within a trans-section of an urban environment was examined in some detail. In this Chapter, a more detailed examination of the relationship between physical change of the stock, its date and type, certain economic factors, and the use and user of the stock will be undertaken with regard to a single area near the centre of the trans-section. The factors to be examined are: the change of use and user[1] of the stock; the value of the stock, and the wholesale price index. Before discussing the data and its compilation, a brief historical description of the area is presented as a means by which a description of the effects of all of the operational factors may be examined.

8.3 ST. ANDREW SQUARE AND THE EFFECTS OF THE OPERATIONAL FACTORS

8.03 The area chosen for detailed examination, St. Andrew Square, is situated at the eastern edge of the original New Town (National Grid 740/258-259). St. Andrew Square was originally constructed between 1775 and 1785. In Craig's plan[2], the Square was to have contained

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1. User in this Chapter means the primary occupier of the stock.
2. For a history of the growth of the New Town, see, for example: Youngson, A.J.: The Making of Classical Edinburgh, Edinburgh, Edinburgh University Press, 1966. Forward, A.C.M.: 'The/...

a church at its eastern edge, facing down George Street to another church on the western side of Charlotte Square (the present West Register House, previously St. George's Church). However, before the church in St. Andrew Square could be constructed, Sir Lawrence Dundas purchased the site and constructed a town house to the design of Sir William Chambers. This house was to have a great influence on the subsequent use of the stock in the Square[3]. Flanking this house are two houses said to be designed by Robert Adam (there is, however, some dispute about the southern house). Chambers also constructed another house in the Square, No. 24. All four of these buildings are luckily still remaining in the Square, even though they have been added to and internally altered to some extent.

8.04 St. Andrew Square was the first section of the New Town to be completed and originally contained, as did the remainder of the New Town, only upper class housing. Over the years, however, the use of the stock in the Square has changed to contain at present primarily commercial and business uses. During the two hundred year life-span of the Square all of the original buildings have been altered and approximately 60% of the stock has been replaced. The pattern of the change of use of the New Town, also at present almost totally commercial and office, followed approximately that of the original construction; that

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2. (contd.) Architecture and Planning of Edinburgh New Town: An Historical and Critical Survey', Ph.D. dissertation, University of Edinburgh, 1968. Forward states that the area of Edinburgh known as the New Town consists of four separate 'New Towns', the original New Town, based on Craig's plan of 1769, consists of an area slightly larger than the Ancient Royalty and is defined as being between St. Andrew Square on the east, Charlotte Square on the west, Princes Street on the south and Queen Street on the north. The next three New Towns lie to the north and east of the original New Town.
3. See para. 8.06 following.

is, for the south-east to the north-west.

8.3.1 LOCATIONAL CONSIDERATIONS[4]

8.05 St. Andrew Square is situated immediately north of the junction of the North Bridge, the head of Leith Walk and Princes Street[5]. North Bridge was opened in 1772 and was constructed to facilitate access to the Ancient Royalty from the north and east (as well as the south via London Road, which enters the town from the east) and open the lands of the New Town to construction. It was, in the words of an advertisement which invited tenders for the project:

> "... greatly desired, for the public utility, that a road of communication be made betwixt the High-Street of Edinburgh and the adjacent grounds belonging to the city (the site of the New Town) and other neighbouring fields; as well as the port of Leith, by building a stone bridge over the east end of the Nor' Loch ...."[6]

With the construction of the Bridge, the junction to the south of the Square became the focal point for traffic entering and leaving the city, a position which it held until Johnston Terrace and the Mound were constructed in the 1820s. However, with the loss of some road traffic, the construction of the railway near this junction in the 1840s more than made up for this deficit[7]. Thus, the area immediately to the south of the Square was, and remains, a crucial transport node.

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4. The locational consideration discussed here, the transport system, is listed under the technological factors in Chap. 2; the reason for discussing it here is because of the concern of locational theory has for transportation as a factor affecting the location of activities. See Appendix 1.
5. See Map 1 in supplement.
6. Youngson, A.J.: op.cit., p.60. The Nor' Loch was the site of the present Princes Street Gardens and Waverley Station.
7. See para. 8.07 below.

8.06 This fact was not lost on either the public or private entrepreneurs of the city. In 1769, the Town Council decided to erect Register House (for Scotland) on the site between the junction and St. Andrew Square. By 1772, the elevation and plans by Robert Adam and his brother, James, were in existence and in 1774 the cornerstone was laid[8]. Because of its proximity to the junction, St. Andrew Square was not only the first area of the New Town to be constructed, it was also the first to change its use. By 1810, a scarce thirty-five years after the Square was begun, a number of the houses had been changed into hotels or boarding houses to take advantage of the transportation links. The Royal Bank of Scotland, which had been founded in 1727 in connection with the Treaty of Union, moved into Adam's building on the north side of Dundas' house in the late 1810s. In 1825, it moved into the town house itself, where its headquarters have remained ever since. The Bank became a strong 'magnet' (or locational attracting force) for the financial institutions of the city. Other banks moved into the Square between 1820 and 1850, at one time numbering as many as fifteen. Along with the banks came insurance and assurance institutions, building societies and the Stock Exchange. By the 1850s, the Square had become the financial centre of the town, a position which it still holds today.

8.07 Along with the banks, the Exchange and insurance companies came the offices of lawyers and stock brokers. During the early part of the Square's existence, until the 1840s, the professionals both lived and worked in the same building, usually reserving the ground floors as their offices with living accommodation in the upper two or

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8. See Youngson for the problems connected with the construction of this building. Youngson, A.J.: op.cit., especially pp. 66-69.

three floors. As their businesses grew, they removed their living quarters to other areas and utilised the entire stock as offices[9].

8.08 Transportation companies, at first rail and later motorbus, also found the area of the Square immensely suitable for their offices and terminals. In 1844, a railway was opened connecting the present Waverley Station with the present Haymarket Station, thus providing a direct connection between London and the north of Scotland. (This connection ran through the present Princes Street Gardens, after much opposition from the feuers along Princes Street.) This brought to the Square the offices of a number of railway companies[10] as well as a number of insurance companies specialising in insuring rail travel. After World War II, when the motorbus began to replace rail as the major means of public transport, the Scottish Omnibus Company sited their main Edinburgh terminal and offices on the north-eastern side of the Square. Thus, the Square today is not only a financial centre, but also a transport centre[11].

8.3.2 <u>ECONOMIC CONSIDERATIONS</u>

8.09 The initial cost of the stock in the Square, while not considerable by today's standards, was sufficiently high to exclude all but the wealthy from purchasing houses in the Square[12]. Unfortunately, no research appears to have been undertaken on the running and maintenance

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9. That is, the area was developing into its 'highest and best' use. See section 8.5 as well as Appendix 2.
10. Such as the Stirling and Dunfermline Railway Company, the Edinburgh and Bathgate Railway Company, the Edinburgh and Northern Railway Company and the North British Railway Company.
11. For an examination of the development of public transport in Edinburgh, see: Page, P.J.: 'The Influence of Public Transportation on the Growth of Edinburgh', M.Sc. dissertation, University of Edinburgh, 1972.
12. Youngson states that the initial cost of the houses in Charlotte Square were between £3000 and £3500. Thus, it may be assumed that the housing in St. Andrew Square would have cost slightly less. Youngson, A.J.: op.cit.

costs of the stock. However, it should be noted that the stock has been kept in a good state of repair generally, and contained a high standard of heat, light, etc., and that the stock has always been inhabited by individuals or firms who could afford relatively high costs. Thus, it can be assumed that the costs in use of the stock were relatively high. The relative high costs of taxation of the stock in the Square also reinforces this assumption. Originally, taxes were assessed on the number of windows that the houses contained. This system, however, appears to have fallen into disuse rather early in the life of the Square. In 1855, the concept of rateable value was introduced; that is, taxing the buildings according to the amount of rent which they would be able to command. Originally, a single value, the Yearly Rent or Value, was assessed, which was changed to the present tripartite system in the late 1920s.

8.3.3 SOCIAL CONSIDERATIONS

8.10 The development of a square for housing was a relatively new concept in Edinburgh in the mid-eighteenth century. Previously, two smaller squares, Brown's and Argyle's, had been constructed on the southern approaches to the city, near the present Chambers Street. In the 1760s, George Square was constructed, which immediately became a popular housing area for wealthier citizens of the city, thus setting a precedent for St. Andrew Square and assuring its popularity. As a commentator of the time noted:

> "... the novelty of a Square in Edinburgh, and the overwhelming degree of elegance which this one (St. Andrew Square) was expected to possess, made it more popular at first, as a situation for building, than any other part of (Craig's) plan."[13]

Thus, the image that the Square, as well as the housing in the Square,

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13. Chambers, R.: Traditions of Edinburgh, Vol. I, Edinburgh, 1825, p.67.

projected was one of elegance and refinement. This not only attracted the wealthier individuals to the housing in the Square, but also the financial institutions.

8.11 The growth in population of the town did not affect the Square directly, in that it housed much of the expanding population. Rather, it affected it indirectly through the growth of firms which catered not only to the changing size of the population, but were also affected by the growth in the affluence of that population.

8.3.4 LEGAL CONSIDERATIONS

8.12 The feus for lands in the Square, as in the remainder of the New Town, were sold to the inhabitants of the stock by the city. The lands were sold in five-foot increments along the principle frontage, after an initial fifteen feet. This corresponded to the 'bays' of the original buildings. In 1767, the first law pertaining to the layout of the New Town was passed. It pertained to such matters as the width of pavements (which were to be kept at the expense of the feuers, as was the practice of the time), the line of building and a ban on signs projecting from the front facades. It also discussed the laying of the streets and provision of a stone sewer in the middle of the principle street (George Street). In 1768, another Act was passed by the Town Council pertaining to the 'areas' (the open wells in front of the original buildings to allow light into the basements) and further particulars about the streets, as well as the provision of a reservoir on Castlehill to supply water to the New Town. Another clause in this Act dealt with the layout of the buildings and the treatment of their facades, but was remarkably laissez-faire in its attitude:

> " ... as people's taste in building is so different, it is not possible to lay down a fixed and determined rule of what dimension each (house) should be ..."[14]

8.13 In 1781, six years after the start of construction in the Square, another Act regulating the construction of buildings was enacted. This Act, according to Youngson[15], was almost universally disregarded by the feuers and builders. Accordingly, the next year saw the passage of a much stricter Act which included a penalty clause for disobedience. While this Act, which was re-affirmed in 1785, was too late to affect the construction of the original stock in the Square, it is worth outlining it here as it was passed to a large extent on the self-imposed restrictions used by the feuers of St. Andrew Square, and thus may be taken as operative in the Square. The Act contained the following five clauses pertaining to the construction of the stock[16]:

1. The plan and front elevation of a proposed house had to be approved by a Committee, constituted for that purpose by the Town Council, before a feu could be sold by the Council.
2. The houses were not to be above three storeys high exclusive of the basement and garret, and the total height of the side walls from the basement floor was not to exceed forty-eight feet.
3. The mews lanes were to be used solely for the erection of stables, coach houses and 'other such offices', which were not to be allowed on the principle streets.
4. The houses in the secondary streets (Rose, Hill and Thistle) were not to exceed two storeys in height, exclusive of the basement and

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14. Youngson, A.J.: op.cit., p.81.
15. Ibid.
16. Ibid, pp.81-83.

garret, with a total height of the side walls not to exceed thirty-three feet.

5. The casings of the roofs were to be run along the side walls, starting immediately above the upper storey windows, with no gables or other windows, excepting skylights, being permitted in the roof.

The pitch of the roof was not to exceed one third of its breadth. The Act also contained a clause levying a penalty of £30 on anyone found acting contrary to the regulations as well as being liable to correct the infringement. There was also a clause which insured the prompt erection of a building after the sale of a feu. If a purchaser failed to erect a dwelling within a year, he was liable for a £30 fine as well as having his feu revert to the Town Council.

8.14 Other Acts were passed in the nineteenth century concerning building controls and the general improvement of the New Town. These provided for, among other things, the installation of street lighting, a gas distribution system and the improvement of the water and sewage systems. Originally, the power to enforce these regulations lay with the Commissioners of Police, however, in 1856 it was transferred to the Magistrates and the Town Council. In 1877, the counties of Scotland were empowered to make and enforce building regulations and in 1903 the Burgh Police Act introduced a standard set of building regulations for the burghs, which were, however, optional. In 1932, the Department of Health for Scotland issued a set of model by-laws, which were also non-compulsory, but which were adopted by a number of the smaller burghs. In 1954, the Guest Committee was established to study the feasibility of introducing a single set of building regulations for all of Scotland, and to indicate the form that these regulations should take.

The Committee published its report[17] three years later and as a result the Building (Scotland) Act 1959 was passed by Parliament. The present regulations[18] were developed from this Act, and include a number of regulations which had hitherto been enforced under separate legislation.

8.15 Besides the present building regulations and other related building Acts, St. Andrew Square is affected by a number of other legal factors. One is the recent restriction on parking and the provision of parking spaces in new buildings, based on the recommendations of the 1972 Buchanan transportation study of Edinburgh[19]. Another set of restrictions, controlling the height and plot ratio of the stock, are based on the Holford Report[20] of the same year. Other height controls are based on the Clean Air Act, 1956, controlling the height of chimneys (as well as the emmission from them); the flight path of Turnhouse Airport; and the controls on the height of stock within half a mile of a Royal Park[21]. Other statutory controls are based on the recommendations of the Princes Street/George Street Panel[22], including plot ratios and height restrictions, as well as the external cladding of buildings. In the case of St. Andrew Square, the Panel recommended that the plot ratio not exceed 4.5:1, while the maximum height be seventy-five feet

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17. Guest, C.W.G.: 'The Report of the Committee on Building Legislation in Scotland', London, HMSO, 1957.
18. The Building Standards (Scotland) (Consolidation) Regulations, 1971, Edinburgh, HMSO, 1971.
19. C. Buchanan and Partners, and F. Fox and Associates: 'Edinburgh, the Recommended Plan', 1972.
20. W. Holford and Associates: 'High Buildings Policy', 1972.
21. In Edinburgh, the Royal Parks are the Palace of Holyrood House, Holyrood Park and the Royal Botanical Gardens.
22. Princes Street/George Street Panel: 'Report on the New Town', 1970.

measured from pavement level of George Street to the nearest point of the building. This report also strongly recommended that the external cladding of the stock be of natural stone on the principle facade, and of 'natural rather than synthetic' materials for the other facades.

8.16 Also operative in St. Andrew Square, as well as the rest of the New Town, are the current preservation and conservation regulations. In the first three New Towns, some six hundred and fifty-five buildings are statutorily listed either Grade A, B or C[23], and a further ninety-six buildings are on the provisional list. In St. Andrew Square, Nos. 23, 23a, 26, 35, 36 and 37-39, as well as the Royal Bank of Scotland headquarters, are listed category A; Nos. 2, 3, 21, 22, 24 and 25 as B; and 41 as C. This includes virtually the whole of the north and east sides of the Square, but only two buildings on the south and none on the west sides. The final set of regulations affecting the Square are the zoning (land use) regulations. As with the rest of the New Town, the Square is zoned for office and commercial use of the stock.

8.3.5 NATURAL CONSIDERATIONS[24]

8.17 Edinburgh is situated in the Scottish Lowlands on the southern bank of the Firth of Forth. It lies very close to the 57° north latitude and 5° longitude west meridian. The marco-climate of the city is influenced both by the North Sea and the Gulf Stream. The city receives an average of thirty inches of rainfall a year and five inches

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23. Hewitson, T.T.: Conservation Report: Zone 1 of the New Town, Edinburgh, 1969.
24. Based on information in: Plant, J.A.: The Climate of Edinburgh, Edinburgh, The Meteorological Office, 1968.

of snow and sleet. However, it only receives an average of two hours sunshine per day in the winter and six hours in the summer. Thus, the relative humidity is rather high and dampness of the building stock is a constant problem. The mean temperature throughout the year is remarkably even, being 38°F in January and 59°F in July. The winds come mainly from the west at about 12 m.p.h. over level ground, but because of the topography of the land, which is reinforced by the buildings, localised wind conditions can be extreme. However, also due to the topography, as well as the geology of the area, Edinburgh does not suffer from dramatically acting natural forces (such as floods and earthquakes).

8.18 St. Andrew Square is situated on a rise of land (formerly called Mulberry Hill) approximately one and a half miles south of the Forth. Because of the exposed position of the site, and the large open space in the middle of the Square, the buildings are relatively unprotected from the natural elements. Fortunately, the original buildings in the Square, as the original buildings in the rest of the New Town, were constructed of Craigleith Stone, a very hard granite. This stone is not only remarkably weather resistant, but is also capable of being finely worked, thus prevent moisture from penetrating between the blocks (which were laid in very thin mortar beds)[25]. The more recent stock, however, is mainly constructed of a softer red sandstone or of concrete, which have not proved as resistant to the weather.

8.3.6 TECHNOLOGICAL CONSIDERATIONS

8.19 The development of the transport system and its effects on the Square has been previously discussed[26]. The development of the

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25. Craig, G.: Building Stones Used in Edinburgh, Edinburgh, Edinburgh Geological Society, 1892.
26. See Section 8.3.1.

other three systems mentioned in Chapter 2 have not been adequately researched in regard to Edinburgh to describe fully here. However, it is eminently probable that since the Square was one of the wealthiest sections of the town, the installation of the systems in the stock was effected soon after their development. Indeed, because of the use of the Square from the mid-nineteenth century onwards, the need for communication and service technology was at a premium.

8.4 THE DATA CONSIDERED

8.20 The data analysed in the following sections consists of all physical changes in the stock, their date and type; the date of the change of use of the stock; the changes of users of the stock and the value of the stock from 1855-1970. Data concerning the physical changes of the stock was obtained both from the Card Files and the Archives of the Dean of Guild Court[27]. The use of the stock and its value was obtained from the Valuation Rolls, obtainable from Register House. The user of the stock (and the use prior to 1855) was obtained from the Edinburgh and Leith Post Office Directories which are held in the Edinburgh Room of the Central Public Library[28]. The other basic data utilised in this survey, the amount of land covered by the stock and the square meterage and height of the stock, was obtained from the Archives with the land coverage checked against the Ordinance Survey Maps.

8.21 The quality of the data concerning the physical changes of the stock prior to 1860, while acceptable, is not as good as the data after that date because records of change were not required and thus the Card File is not keyed to the Archives prior to that date. Thus,

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27. For discussion of the Card File and Archives, see Chap. 7.
28. Thus the user in this study is the occupier. See Chap. 2 for types of users.

to obtain the pre-1860 records required sifting an enormous amount of unorganised material and thus introducing the possibility of incomplete data collection. The information from the Valuation Rolls, concerning the use and value of the stock from 1855 to 1970 may be considered unimpeachable. The data from the Post Office Directories concerning the user of the stock may be likewise accepted, however, the use of the stock prior to 1855 had to be construed from the rather loose descriptions contained in the Directories and thus must be treated with some caution, although in general it may be considered to be acceptable.

8.22 The choice of St. Andrew Square as the area for detailed examination was based on a number of factors. Firstly, generally reliable information as to the physical changes of the stock, its use, user and value was obtainable for the entire period that the Square has been utilised for urban building. Secondly, the Square has been through a significant amount of physical change, both alteration of the stock and replacement. Thirdly, the use of the stock has changed from housing to office and commercial, and can be said to illustrate the processes of land use succession[29] and upwards filtration[30]. Fourthly, information as to the change of user was obtainable; and fifthly, the Square is located near the centre of the city, is a highly desirable site and is a recognisable use location, thus exhibiting typical pressures examined by locational theory[31].

8.23 In the following section, the eastern side of the Square (buildings No. 30-42) has, unfortunately, had to be excluded from some

29. See Appendix 2.
30. See Appendix 3.
31. See Appendix 1.

analyses. This was due to the problems encountered in obtaining access to the plans of the buildings which at present are in use as banks. However, the remaining three sides of the Square, consisting of eighteen buildings at present (twenty-nine originally) has proved sufficient for this undertaking.

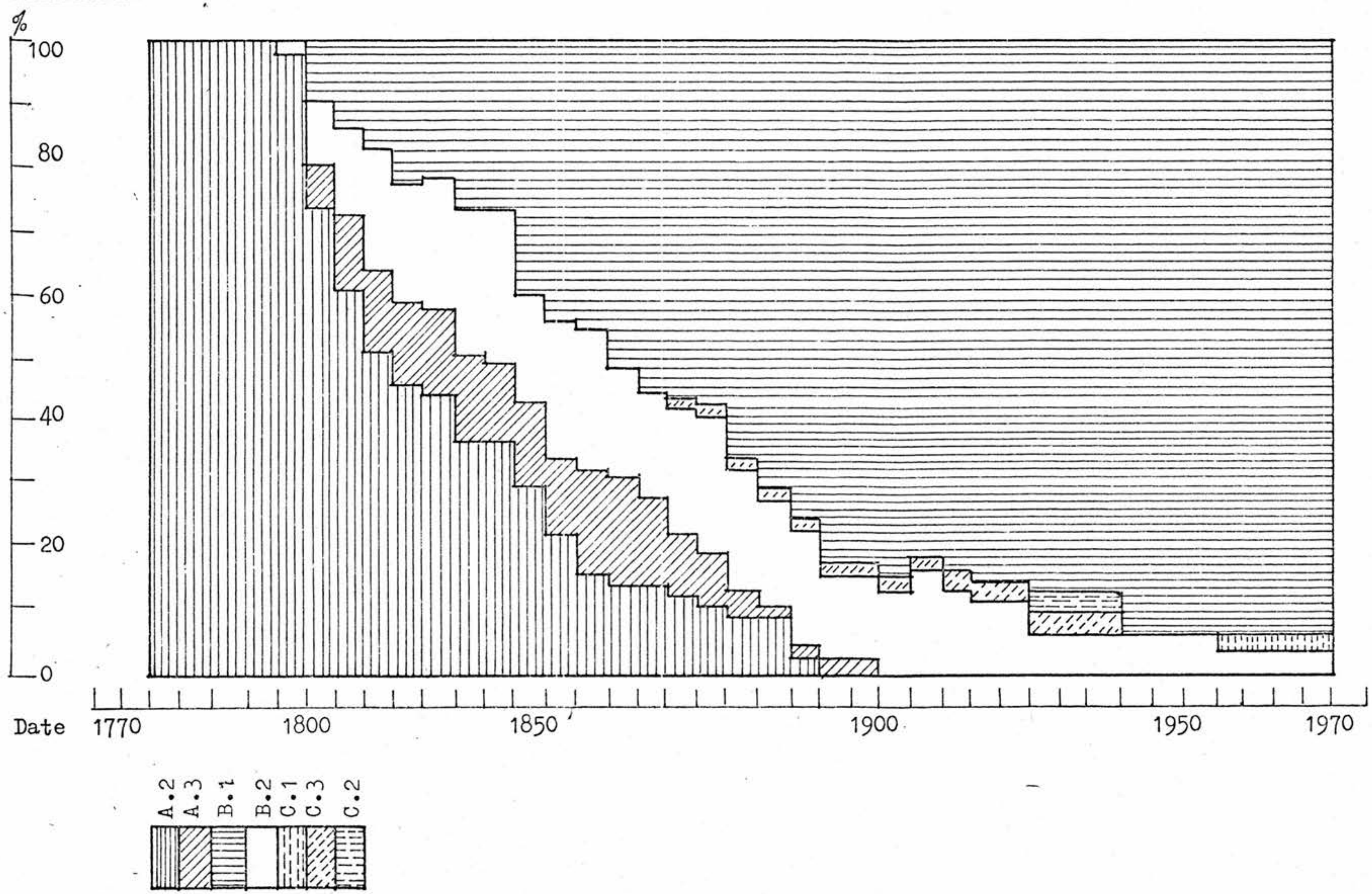
8.5 CHANGE OF THE USE, USER AND VALUE OF THE STOCK

8.24 The original use of all of the stock in St. Andrew Square, as noted above, was single family housing. This continued unchanged for only fifteen years, when a long period (one hundred and forty years) of changing use of the stock was entered. From 1940 to 1970, a second phase of stability of the use of the stock ensued (see Figures 8.1 and 8.2). If one compares this to the theory, then 1940 would mark the entrance into the maturity phase[32]. Thus, the present use of the stock (mainly office) would be termed the 'highest and best' use of the stock in the Square.

8.25 Figures 8.3 and 8.4 show the change of use of the stock as a percentage of the total number of uses. Three distinct phases, or 'waves' may be discerned in Figure 8.4. The first phase, from 1800-1835, is relatively short and characterised by a sharp increase in the amount of change and an equally sharp drop to 1835. This coincides with a period of relatively even mix in the number of uses in the Square (see Figure 8.3). The second phase can be said to last from 1835 to 1930 and is characterised by a sharp increase in the amount of change at the beginning of the phase, but a relatively slow even drop to 1930. The third phase, from 1935 to 1970, and presumably continuing into the foreseeable future, has only a small amount of change at the beginning

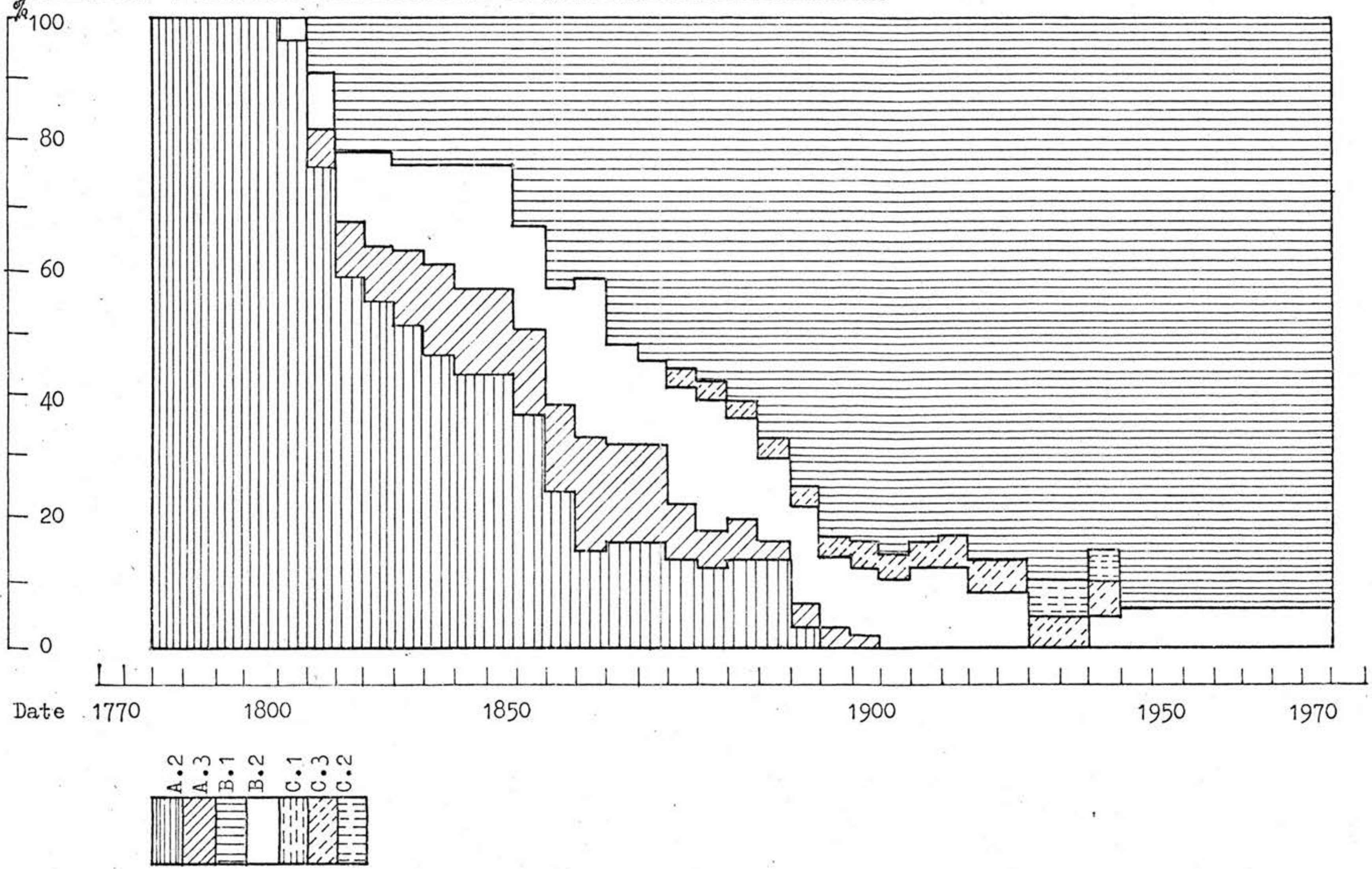
32. Land use succession theory (Appendix 2). If the criteria of 'highest and best' use is applied.

FIGURE 8.1: CHANGE OF USE OF THE STOCK (NOS. 1-42) ST. ANDREW SQUARE



Notes: A.2, A.3, etc., refer to occupancy categories in The Building Regulations - Schedule Two

FIGURE 8.2: CHANGE OF USE OF THE STOCK (NOS. 1-29) ST. ANDREW SQUARE



Notes: A.2, A.3, etc., refer to occupancy categories in The Building Regulations - Schedule Two

FIGURE 8.3: CHANGE OF USE OF THE STOCK AS A PERCENTAGE OF TOTAL NUMBER OF USES (NOS. 1-42) ST. ANDREW SQUARE

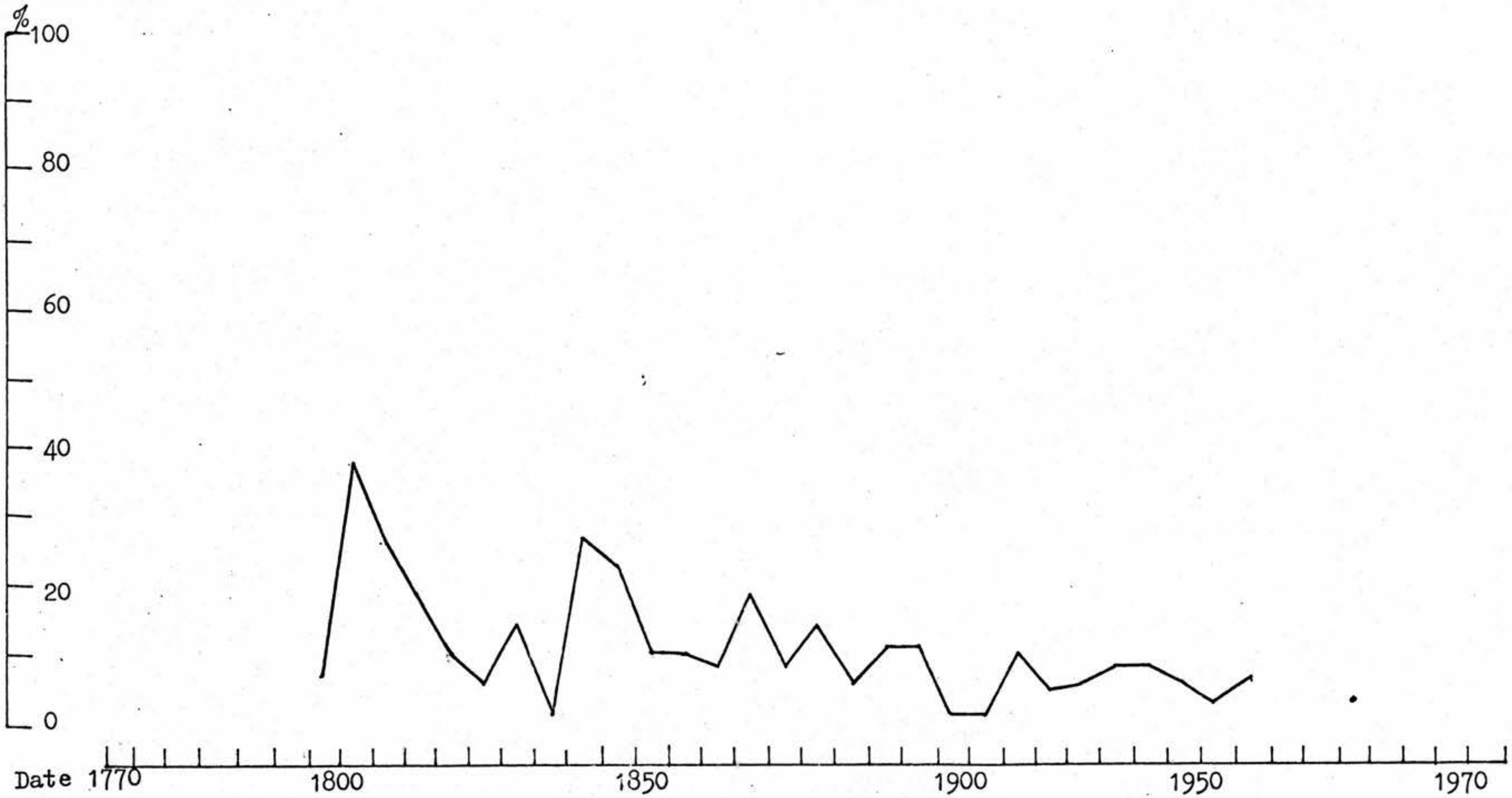
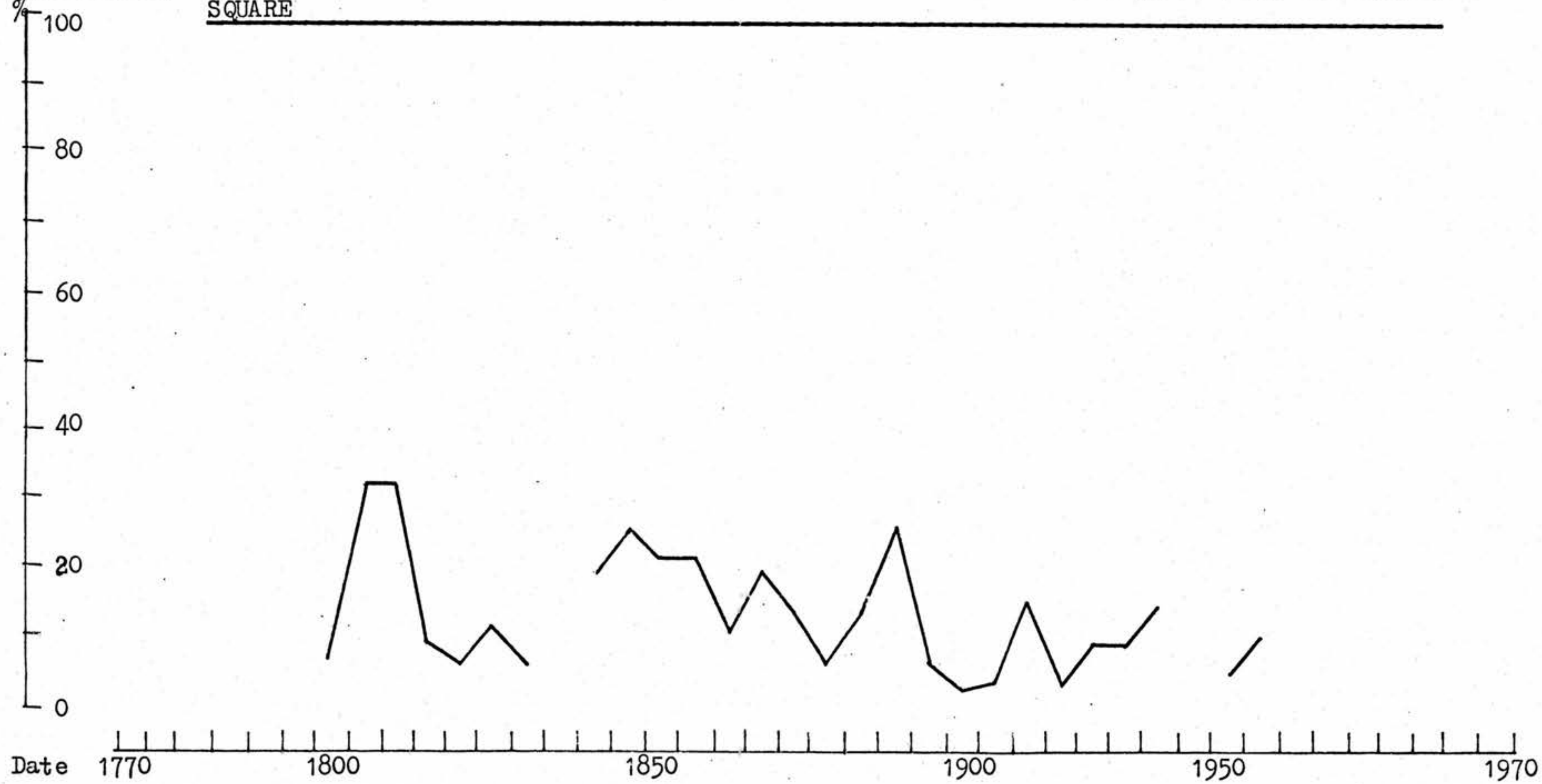


FIGURE 8.4: CHANGE OF USE OF THE STOCK AS A PERCENTAGE OF TOTAL NUMBER OF USES (NOS. 1-29) ST. ANDREW SQUARE



of the phase and none from 1945 onwards. Similar phases can be discerned in Figure 8.5 with the second phase lasting to 1945. This discrepancy, while not extremely significant, would suggest that even within an area as small as St. Andrew Square, the factors affecting the change of use of the stock do not affect all of the stock equally.

8.26 Originally, each building in the Square contained only one principal user[33]. In 1800, the number of users in the Square began to rise, reaching a peak of almost 245 in 1900 and dropping to 35 in 1970 (see Figure 8.5). Figures 8.6 and 8.7 show the change in the number of users as a percentage of the total number of users. Again, the same three phases may be described. The first phase, from 1800 to 1835, is characterised by a sharp increase in the number of changes of users, dropping rather quickly to zero in 1835. The second phase exhibits two distinct peaks, in 1860 and 1885, and minor peaks in 1920 and 1935. The third phase, from 1935 to 1970, is again characterised by a growth in the number of changes of users. Comparing Figures 8.4 and 8.7 (see Figure 8.8) one finds that in the first phase a marked similarity between the percentage changes of use and user occurs. This coincides with the beginning of the change of use of the Square, and suggests a close association between the change of use and the emigration of the Square's original inhabitants. In the second phase, while the curves are similar, they do not match exactly. This suggests that while the use of the stock is evolving into its 'highest and best' (it was in 1850 that offices first constituted 50% of the stock's use), the size of the user was still in a state of flux. Be-

33. As explained above, the data on users of the stock was obtained from the Post Office Directories. The Directories listed only the head of the household, or name of the firm. Thus, originally, only 45 users of the stock were recorded, even though more than 45 people inhabited the stock. Hereafter 'user' refers to principal occupier.

FIGURE 8.5: NUMBER OF USERS OF THE STOCK: ST. ANDREW SQUARE

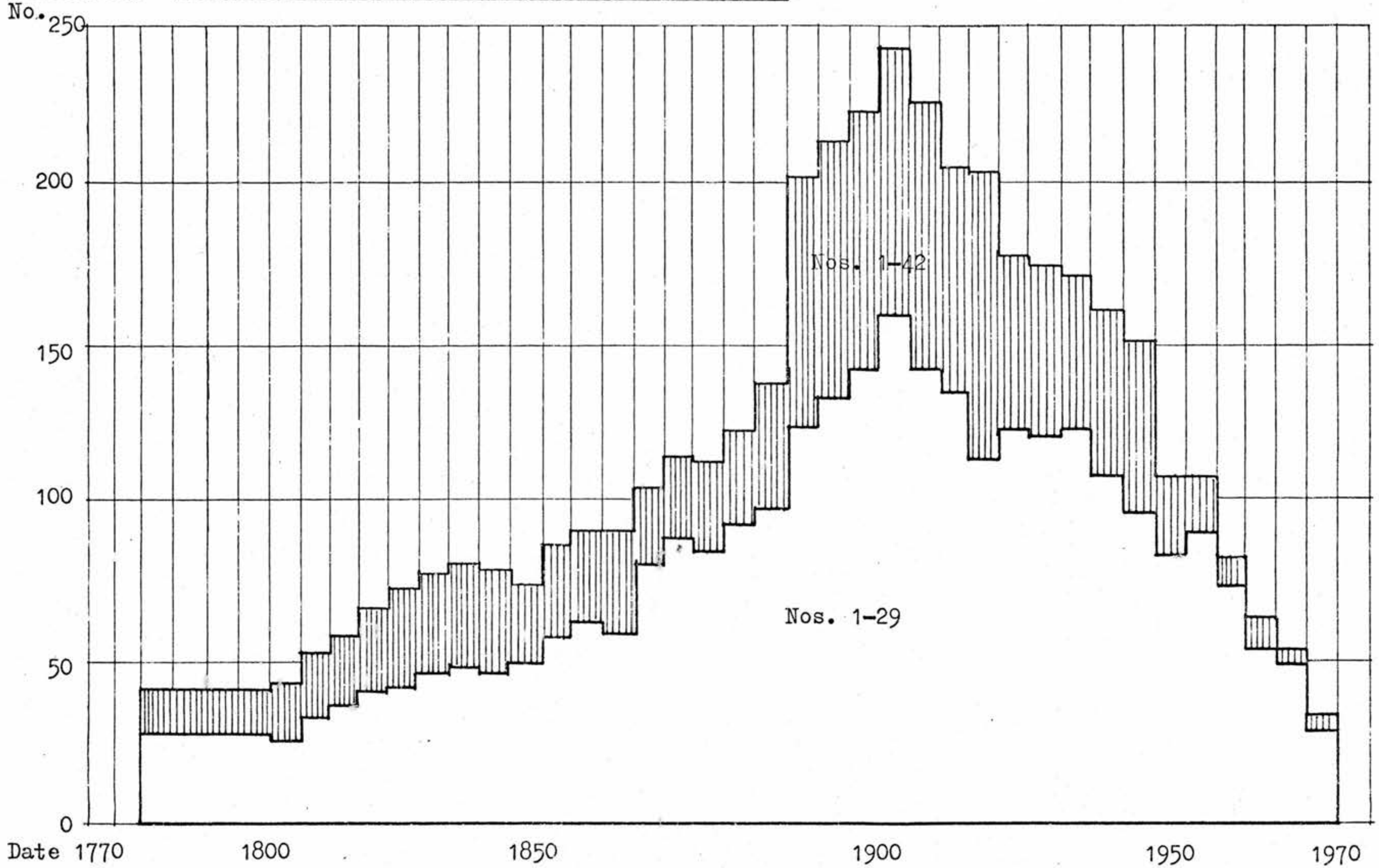


FIGURE 8.6: CHANGE OF USER AS A PERCENTAGE OF TOTAL NUMBER OF USERS (NOS. 1-42): ST. ANDREW SQUARE

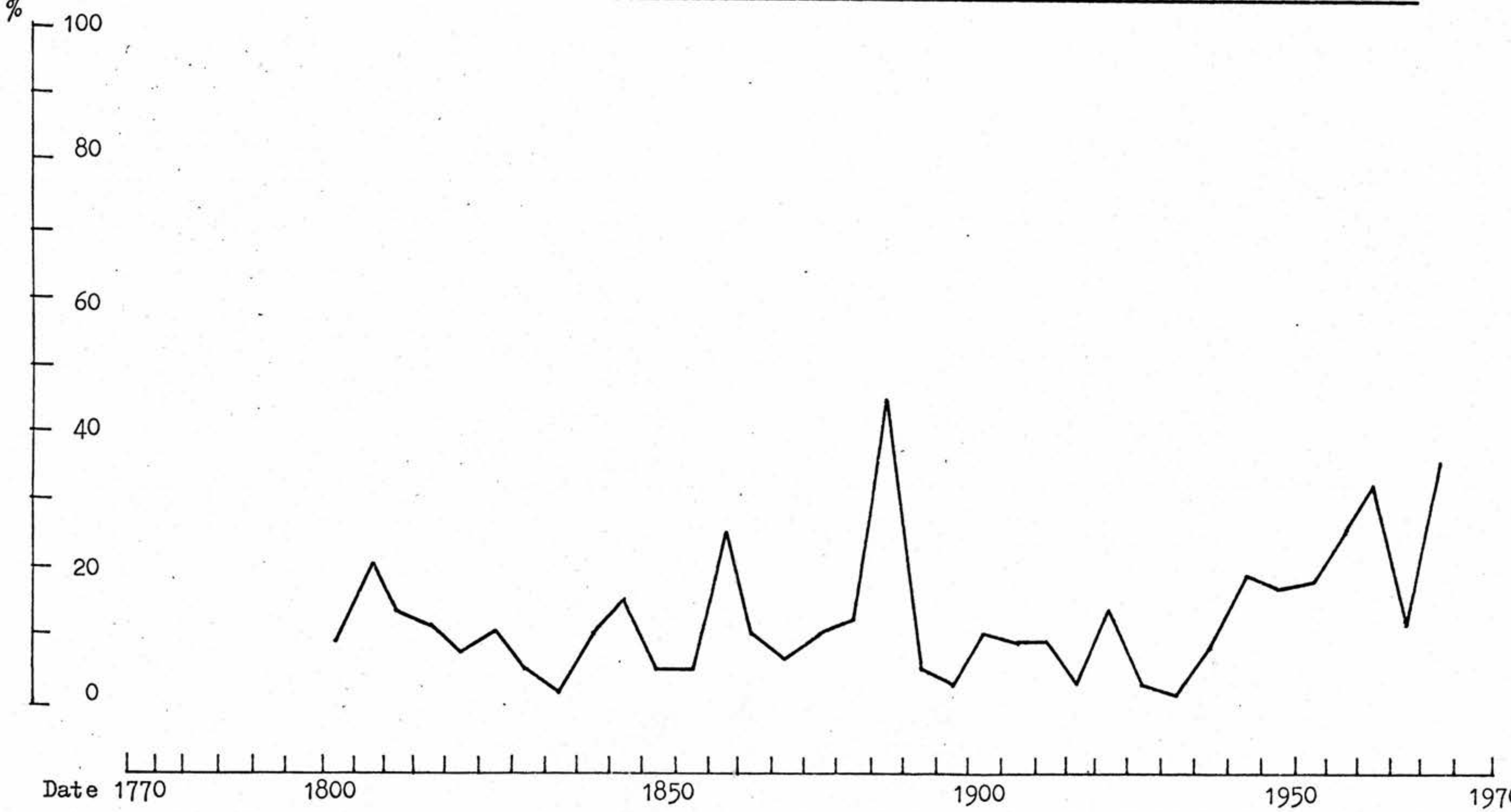


FIGURE 8.7: CHANGE OF USER AS A PERCENTAGE OF TOTAL NUMBER OF USERS (NOS. 1-29): ST. ANDREW SQUARE

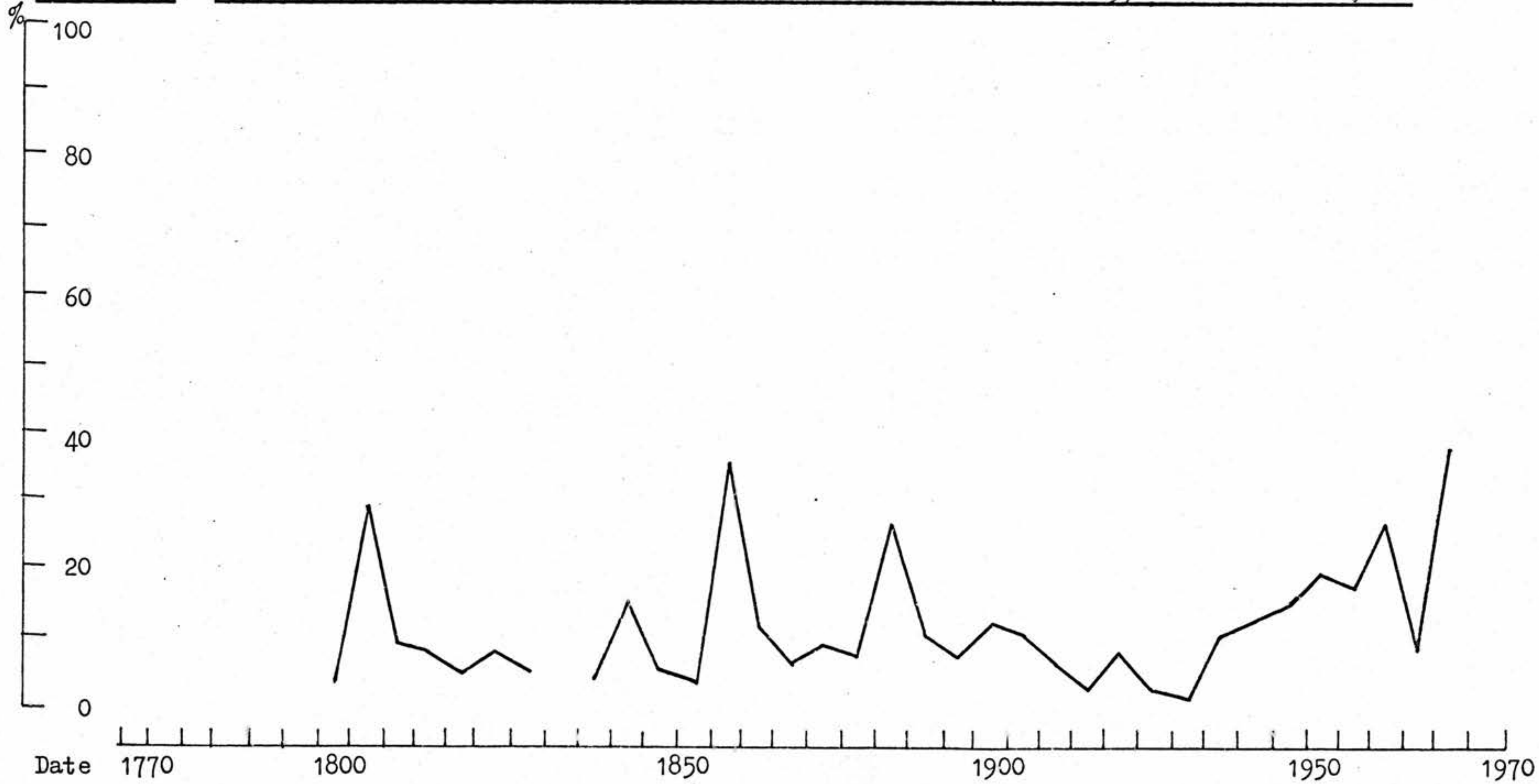
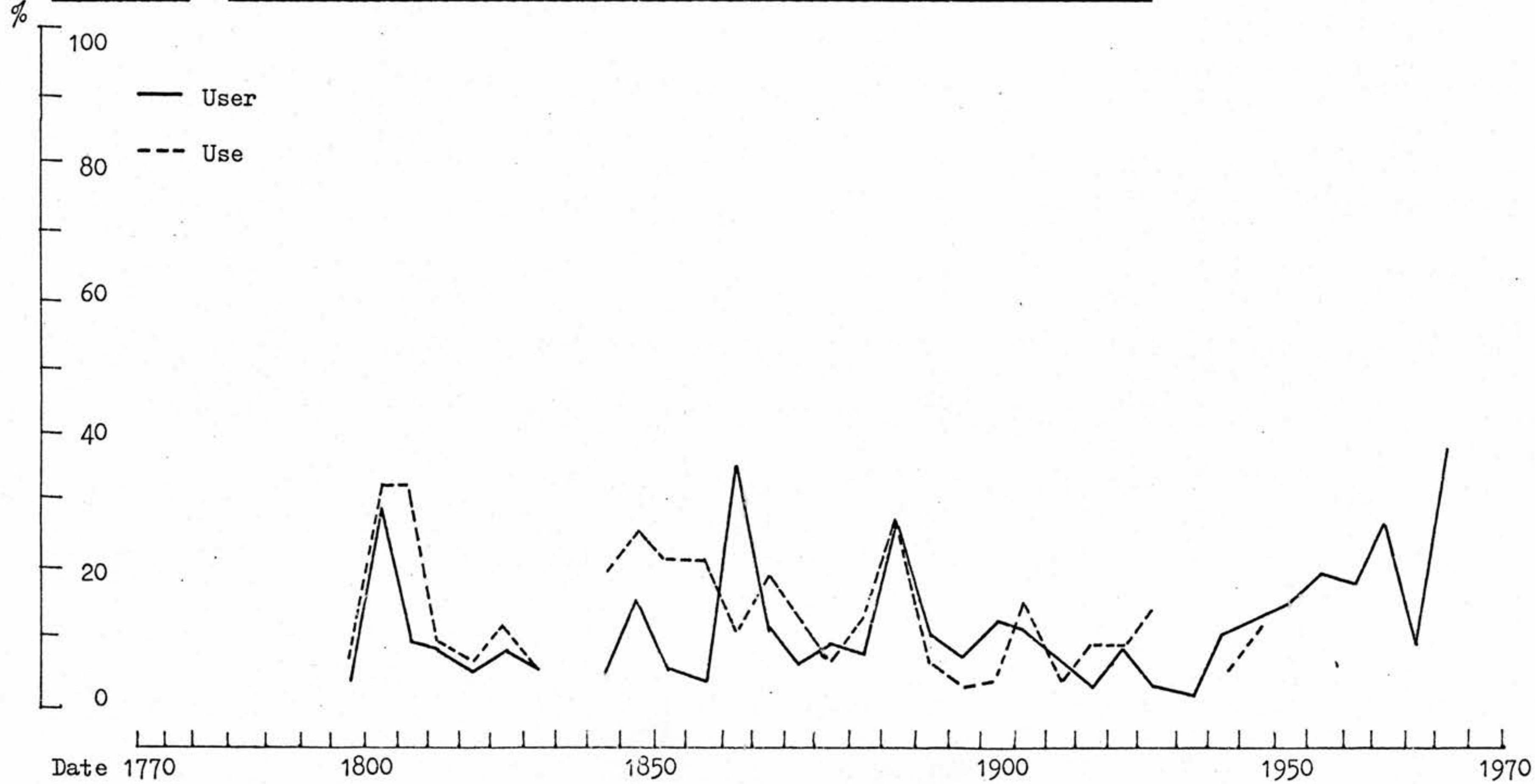


FIGURE 8.8: COMPARISON OF CHANGE OF USE AND USER (NOS. 1-29): ST. ANDREW SQUARE



tween 1930 and 1970, the use of the stock was more or less stable, but the users continued to decrease in number. Thus, the size of each user, or the average amount of space which he occupied, grew (see Figure 8.9).

8.27 The unadjusted value of the stock in the Square changed from approximately £0.24 per square metre in 1855 to over £1.80 per square metre in 1970. A large amount of this increase (over £1.20/m^2) was due to the two re-evaluations in 1965 and 1970 (see Figure 8.10). The adjusted value (to 1964 £s), however, demonstrated three distinct peaks over the period, in 1900, 1930 and 1970, each subsequent peak being slightly lower than the previous one. As is to be expected, an inverse relationship between the adjusted value of the stock and the wholesale price index occurs (see Figure A.6.1)[34].

8.28 The relationship between the change of the use, user and the adjusted value of the stock is more easily perceived through the use of the wholesale price index. This also allows pre-1855 relationships to be investigated (see Figures 8.11 and 8.12). The first phase of the change of use and user coincides with a general drop in the wholesale price index. The length of the second phase of the change of use and user coincides with the period in which the wholesale price index was at a relatively stable low. The eruption in the index between 1915 and 1930 served to prolong this phase by fifteen years, as a peak in the use and user change may also be noted during this period. The third phase of the change of use and user coincides with the thus far

34. See Appendix 6.

FIGURE 8.9: SQUARE METRES PER USER (NOS. 1-29): ST. ANDREW SQUARE

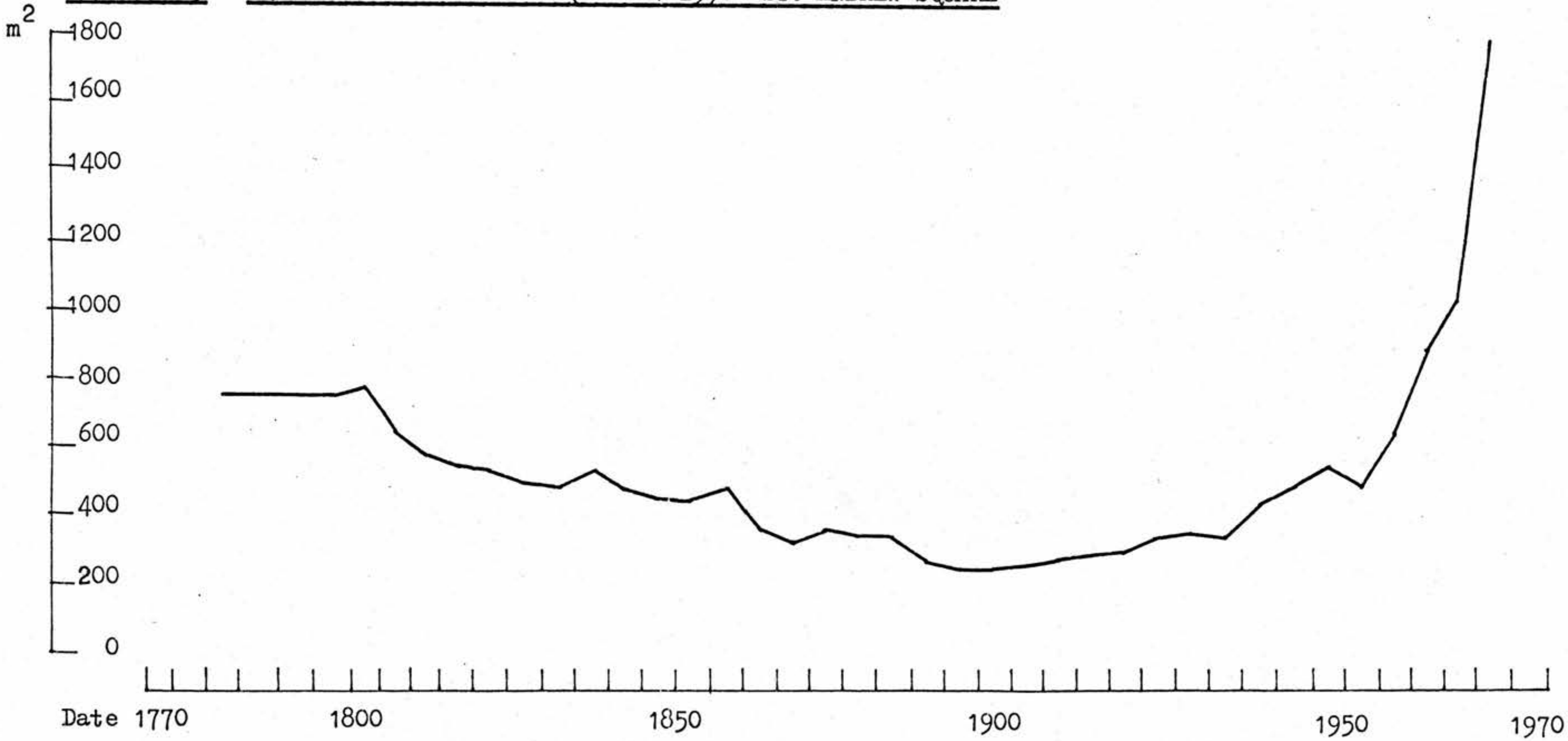
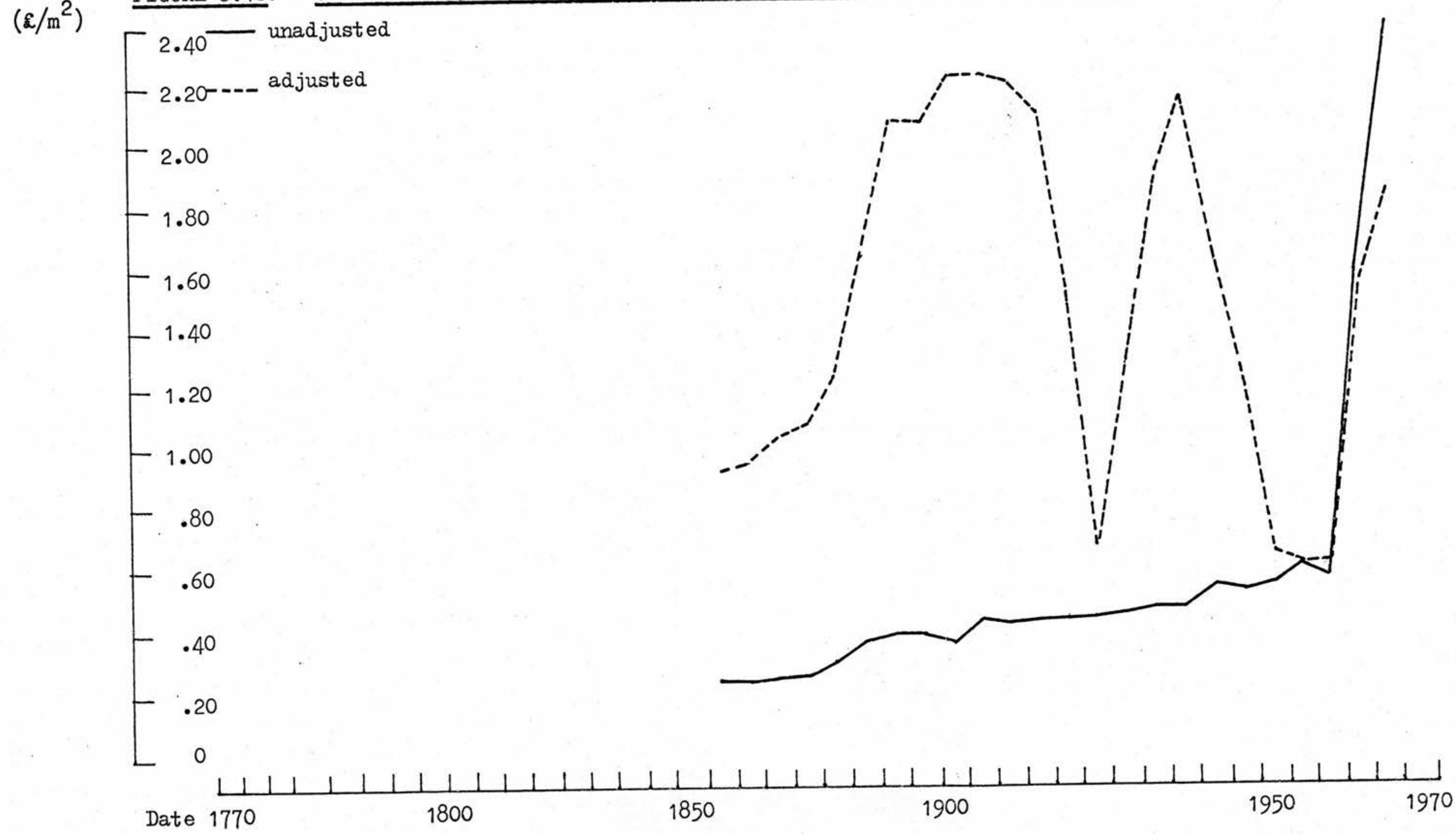
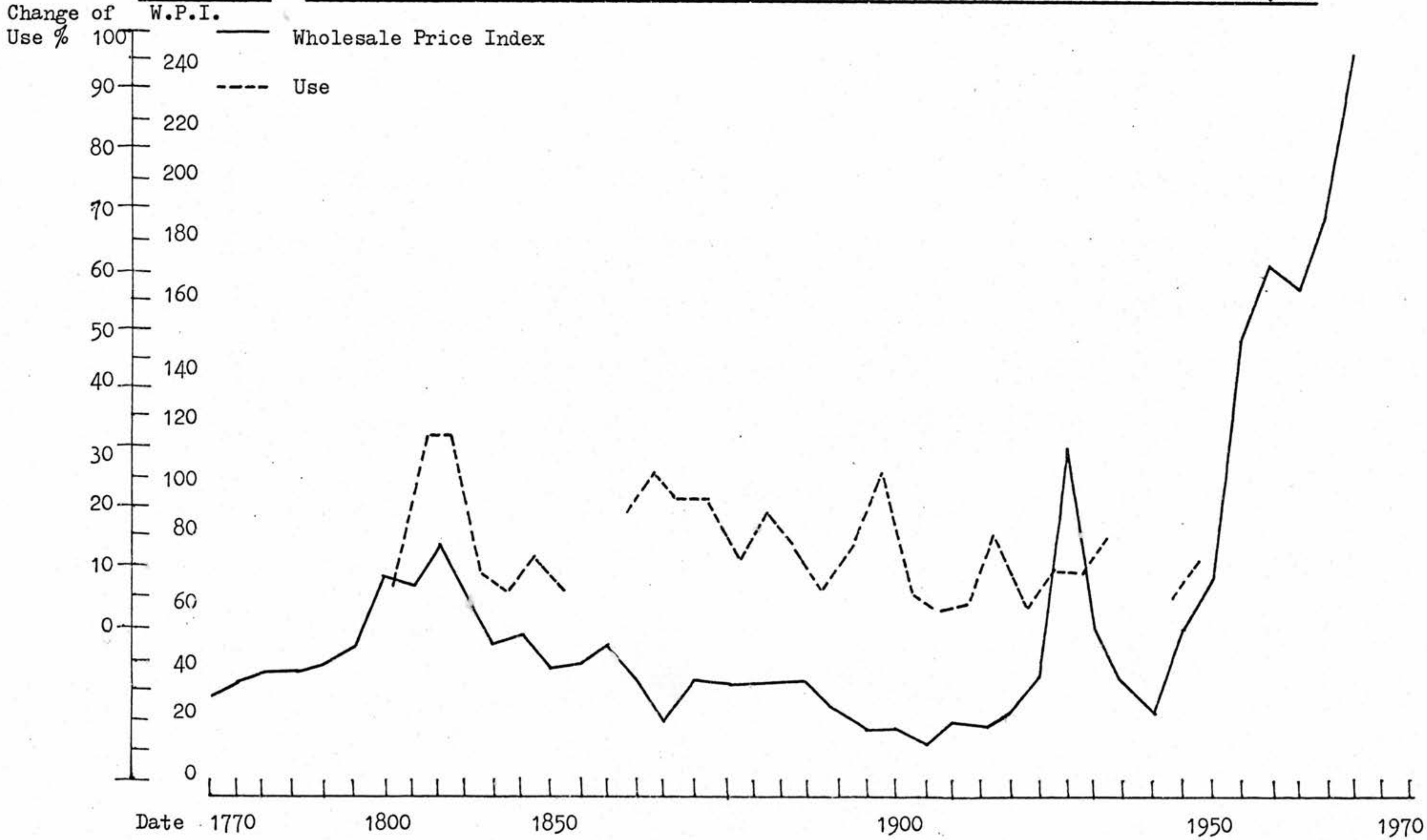


FIGURE 8.10: VALUE PER SQUARE METRE OF THE STOCK (NOS. 1-29): ST. ANDREW SQUARE



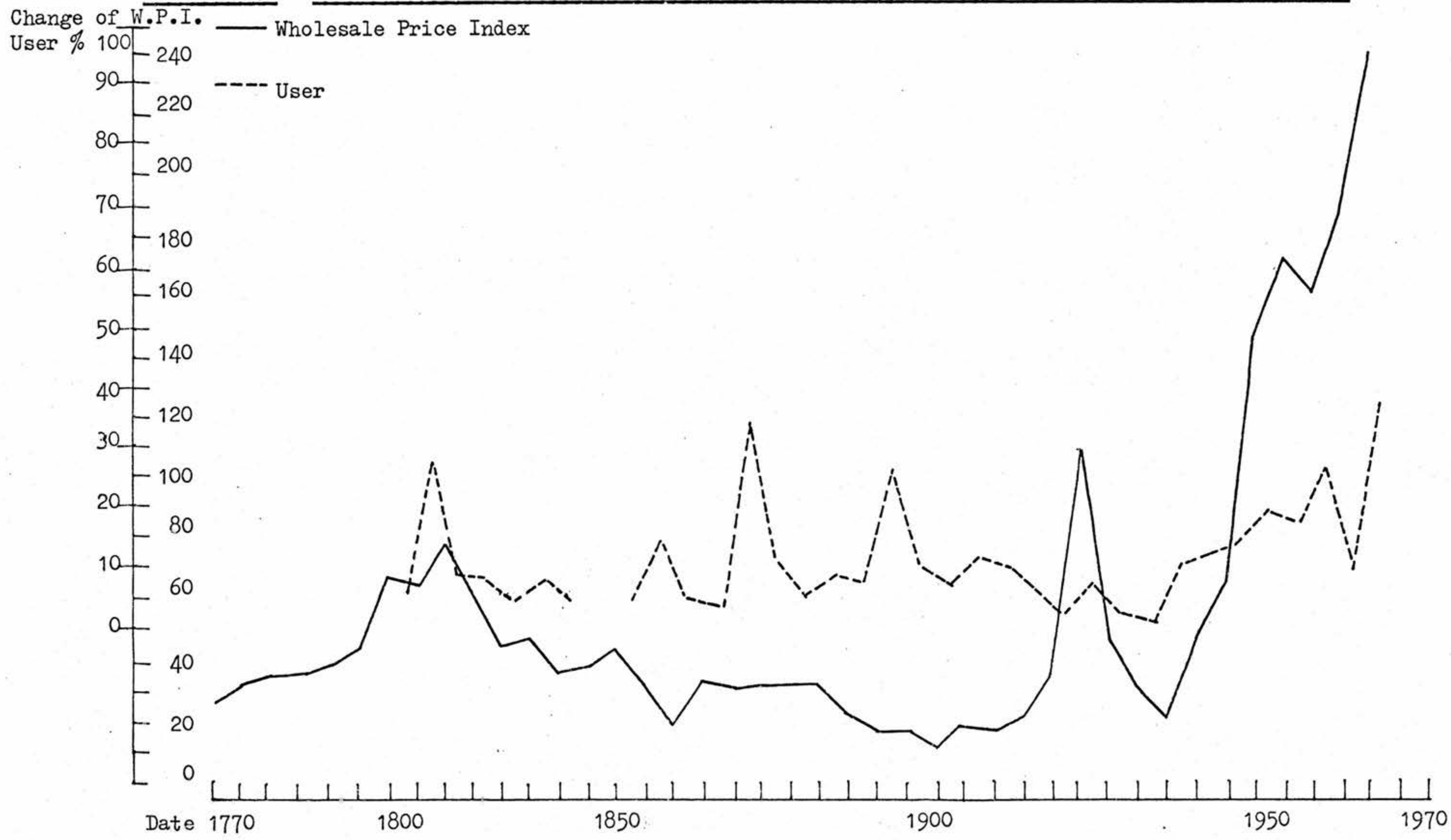
Note: 1964 = 100.

FIGURE 8.11: COMPARISON OF CHANGE OF USE (NOS. 1-29) AND WHOLESALE PRICE INDEX: ST. ANDREW SQUARE



Note: 1964 = 100.

FIGURE 8.12: COMPARISON OF CHANGE OF USER AND WHOLESALE PRICE INDEX (NOS. 1-29): ST. ANDREW SQUARE



Note: 1964 = 100.

sustained rise in the index from 1935 onwards. Thus, it can be concluded that the length of the phases of the change of use and user were in general affected by the general economy.

8.6 PHYSICAL CHANGES OF THE STOCK AND THE CHANGE OF USE, USER AND VALUE

8.29 Figure 8.13 shows the changes of the stock in St. Andrew Square over the study period. In general, the stock first went through a period of expansion, either horizontally, or in some cases vertically[35], beginning around 1820. Next a period of addition and alteration ensued until 1885 when the first item of the original stock was totally demolished and replaced. Between 1915 and 1925, a general hiatus in physical change of the stock occurred, followed by a second peak of change during the 1930s. Between 1945 and 1950 a second period of stability of the stock occurred, followed by a second wave of alteration and rebuilding. As is to be expected, a rather good fit between the amount of physical change and the adjusted value of the stock is obtained (see Figure 8.14). Thus, an inverse relationship between the physical change of the stock and the wholesale price index occurs (see Figure 8.15), except for the last twenty years[36].

8.30 Figures 8.16 and 8.17 show the relationships between the physical change of the stock and the change of use and user respectively. The first phase of the change of use and user corresponded to

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35. Since the structural system of the original stock was load-bearing stone walls, whose thickness was determined not so much by its loading capacity as by its slenderness ratio, vertical additions of one, or in some cases two, storeys occurred without the need for reinforcement of the existing load-bearing members. Thus, a structural 'overbuilding' occurred, which facilitated future adaptation of the stock.
36. See Chap. 7.

FIGURE 8.13: CHANGE OF THE STOCK (NOS. 1-29): ST. ANDREW SQUARE

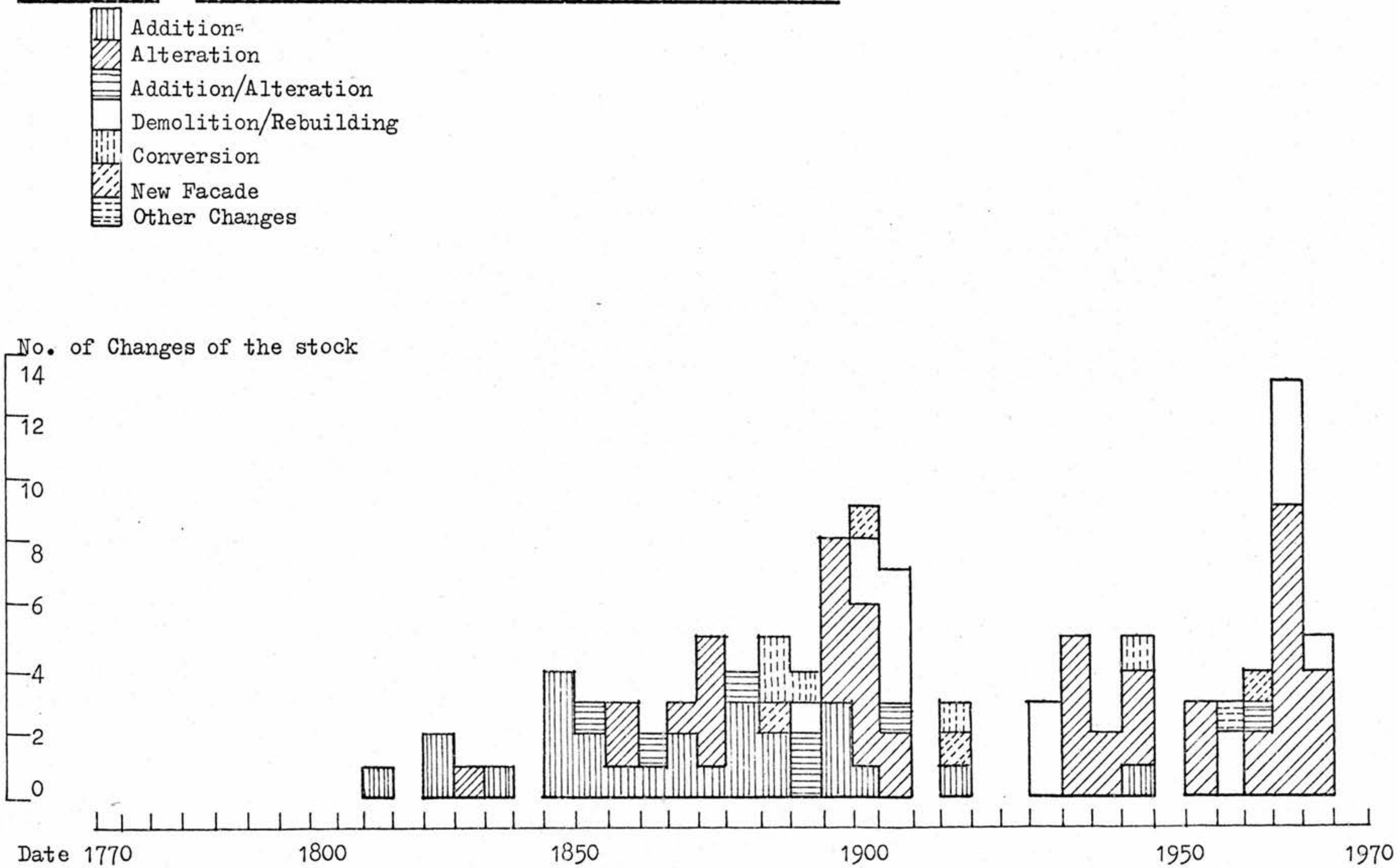


FIGURE 8.14: COMPARISON OF CHANGE OF THE STOCK AND VALUE OF THE STOCK (NOS. 1-29): ST. ANDREW SQUARE

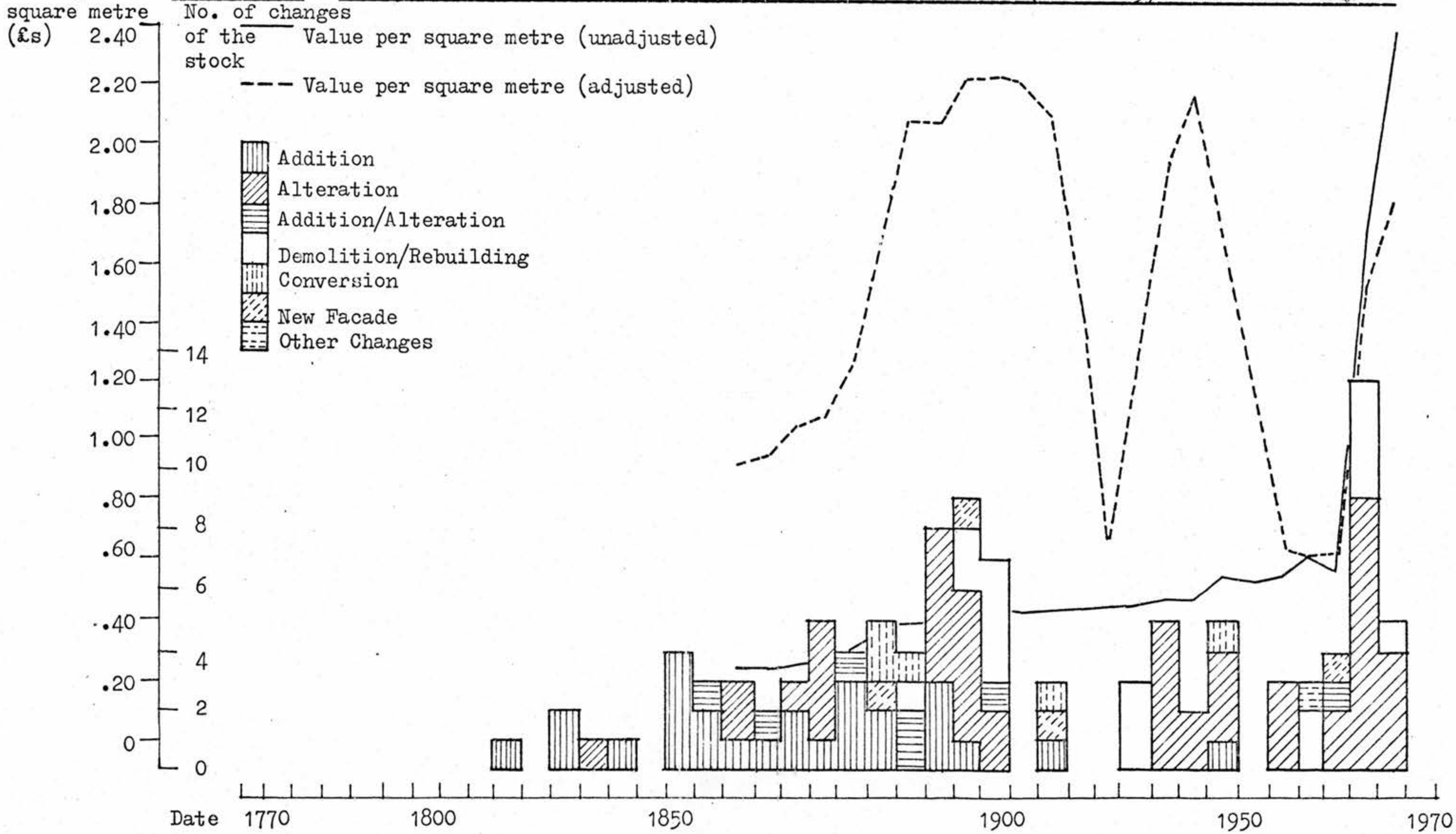
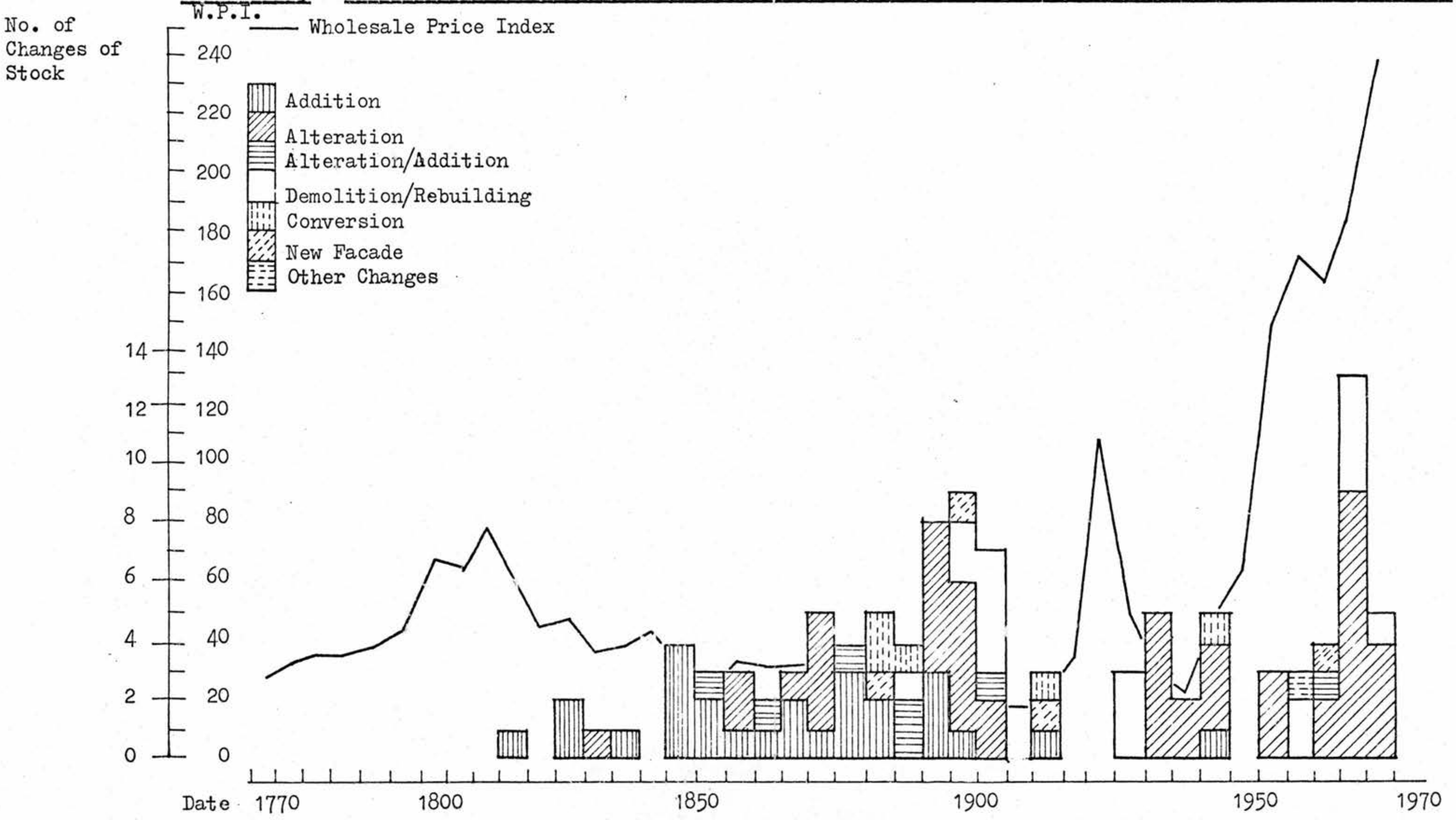


FIGURE 8.15: COMPARISON OF CHANGE OF THE STOCK AND THE WHOLESALE PRICE INDEX (NOS. 1-29): ST. ANDREW SQUARE



Note: 1964 = 100.

FIGURE 8.16: COMPARISON OF CHANGES OF THE STOCK AND CHANGE OF USE (NOS. 1-29): ST. ANDREW SQUARE

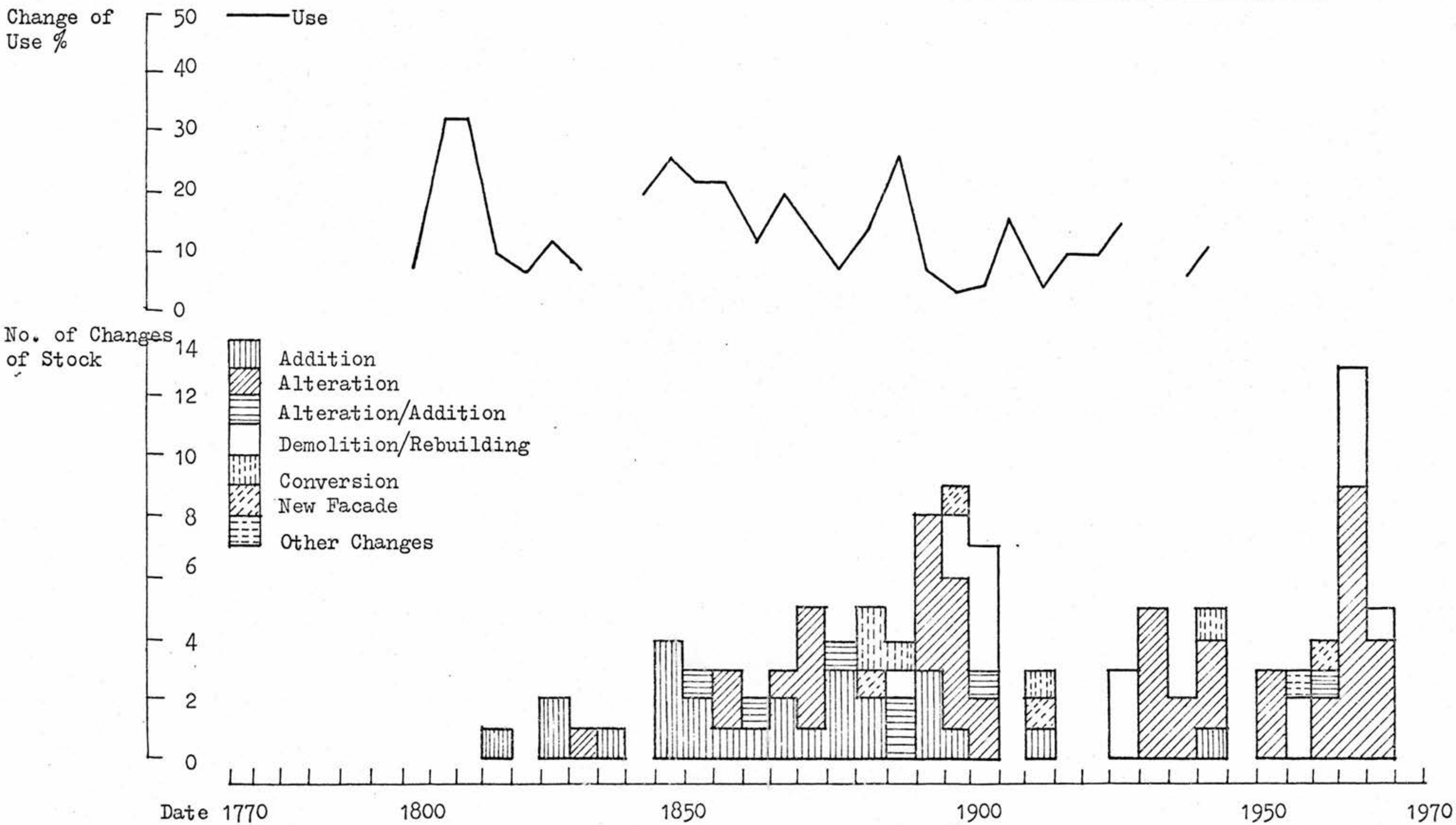
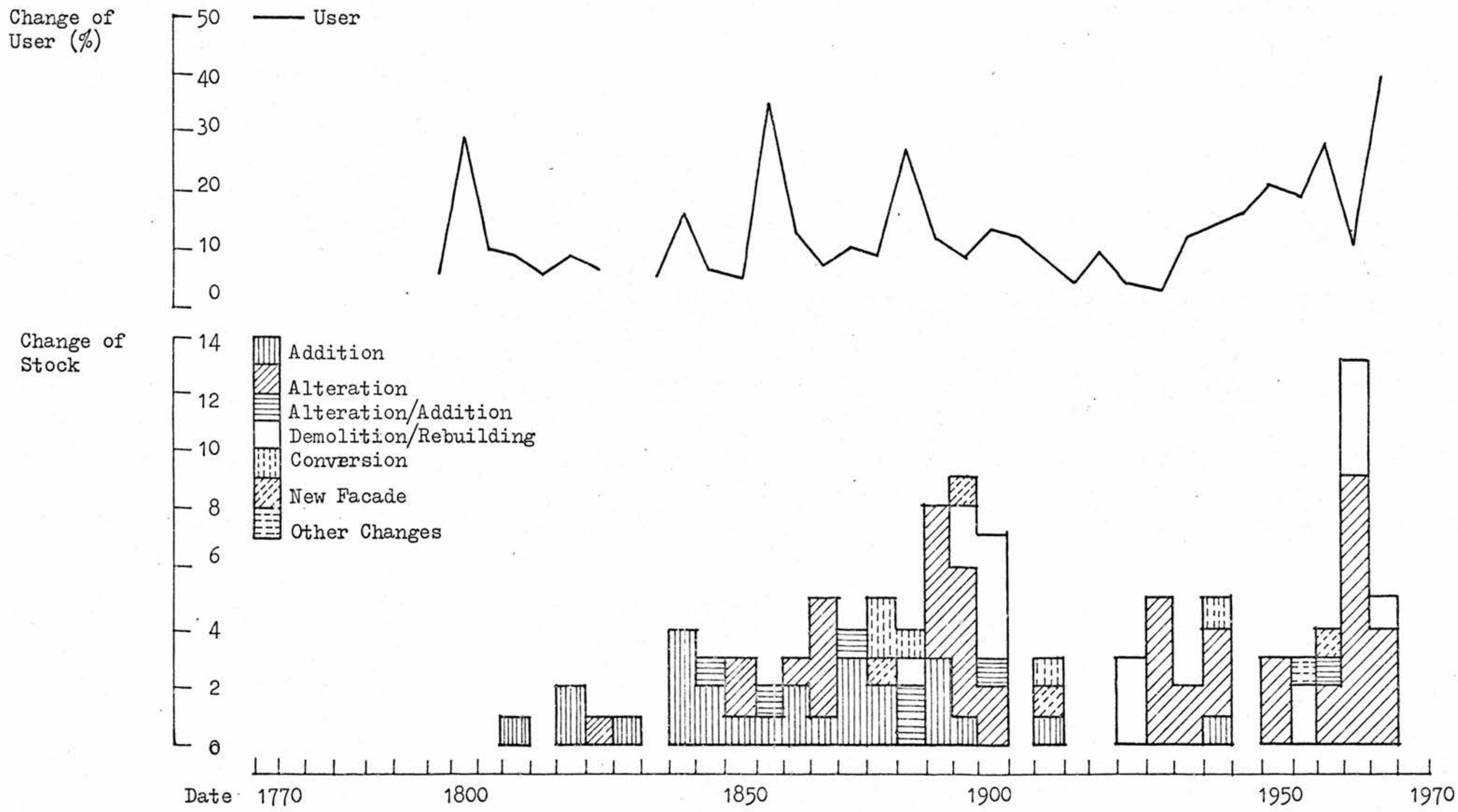


FIGURE 8.17: COMPARISON OF CHANGE OF THE STOCK AND CHANGE OF USERS (NOS. 1-29): ST. ANDREW SQUARE



very little physical change. Bearing in mind the reservations expressed above as to the quality of the data for physical change, this would suggest that during this period the fit between the physical factors and the requirements of different uses and users was rather loose. A similar relationship may be noted for the first phase of the change of user. During the second phase of the change of use and user, a general inverse relationship between their change and the change of the stock developed. That is, when the change of the stock peaks, the changes of the use and user dropped. This could be due to the long time lag between the alteration of the stock and change in habitation. During the last phase of the change of use and user, the use of the stock had stabilised, thus the rise in the change of the stock was due to the changing requirements of the users or the manner in which they utilised their stock.

8.7 CONCLUDING REMARKS

8.31 The physical changes of the stock in the Square followed closely Types 2 and 3 changes discussed in the trans-sectional analysis in Chapter 7. They also show a positive relationship to the adjusted value of the stock and an inverse relationship to the wholesale price index.

8.32 The changes of use and user can be described in terms of three phases: the use and user both changed in the first two phases, but the user only in the third. These are generally related to the change of the stock and are affected by the rise and fall of the wholesale price index. Therefore, the rebuilding of the stock in the third phase of the change of use and user, as well as its adaptation, may be attributed mainly to the change of user, who is in turn affected by the change in the wholesale price index.

PART FOUR

CHAPTER NINE

IMPLICATIONS OF THE RESEARCH

9.1 SUMMARY OF FINDINGS

9.01 The causes of obsolescence of the existing stock of urban buildings, or the factors which influence the life-span of the stock, are both internal, or physical, and external, or non-physical. The internal and external factors are reciprocally affected. When an item of stock is constructed, two of the external factors (the operational factors and the user) determine to a large extent the use of the stock. These three factors[1] then determine the physical description of the stock. As the stock ages, the external factors change, thus requiring complementary physical change of the stock if it is to remain useful. When this is no longer possible, the stock becomes useless and is replaced.

9.02 Change of the external factors can either be positive or negative. Positive change is related to direct decisions of the users of the stock to take some action, while negative change is the result of a lack of action on the part of the users. Positive change normally results in the physical adaptation of the stock or its replacement, while negative change is exemplified by the physical deterioration of the stock. The decision of the users to act or not is, to some extent, determined by his type and perception. However, his decision is always affected by the operational factors which determine the parameters of his freedom to act, either in a positive or a negative manner.

9.03 The operational factors are classified as being locational,

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1. The operational factors, the user and the use.

economic, social, legal, natural and technological. The location of an item of stock is used to relate the other operational factors together, and to determine the relative importance of each. In general, however, the economic and social factors may be said to be the most critical to the life-span of the stock. Location is also used to determine the use of an item of stock and to some extent, its user.

9.04 Change, the rate and manner in which it is accomplished, is critical to its acceptance by society. On the one hand, the present society expects and welcomes change and has built its economy upon it. On the other, too rapid and misdirected change appears to be both physically and mentally damaging. Rapid replacement of the stock may contribute to social discontinuity and disorientation. Retaining all of the stock as it is would also produce instability. Thus, the change of the stock must be at a rate and in such a manner as is acceptable not only to society as a whole, but to the constituent parts of that society.

9.05 The economic evaluation of the alternatives of retaining or replacing the existing stock not only depends on the physical description of the stock, but on its use, user and financier. It also depends to a large extent upon the projected life-span of the alternatives, the rate of inflation and the interest rate on capital borrowed, as well as running costs of the alternative solutions.

9.06 The construction industry, defined as the contracting firms and their employees, will also affect the alternatives of retention or replacement of the existing stock. The size of the industry, as a percentage of the total, working age, or employed populations has remained fairly stable for the past twenty-five years. However, the composition of the industry has changed from a large number of small firms to a few large firms. The productivity per employee, measured in terms of annual real value of output per employee, has risen less than 2% per year for the last twenty-five years. If this trend continues, the projected output of the industry will fall below the projected needs for construction, unless the existing stock is utilised for a longer period of time. However, in order to retain the stock for this period of time, a redistribution of the industry's sectors towards maintenance and repair must occur.

9.07 Thus, socially, economically and logistically, the prolonging of the life-span of the existing stock appears to be possible.

9.08 The type and amount, as well as the date, of physical change of the stock, is locationally dependent. That is, certain patterns of change may be described in relation to the location of the stock within an urban environment. The physical changes of the stock which are affected by the operational factors, in turn reinforce those factors. Physical change is also influenced by the change in the size of the population, and its general affluence, as well as the local and national economy, which may be measured in terms of interest rates, amount advanced by building societies, the wholesale price index, or the adjusted value of the stock.

9.09 The change of use and user of the stock also influences physical change of the stock. The change of use of the stock and the change in the size of the user are in turn influenced by the operational factors.

9.2 PROLONGING THE LIFE-SPAN OF THE STOCK

9.10 The life-span of the existing stock may be prolonged artificially or naturally. Natural prolongation would take the form of adjusting the factors which influence the life-span of the stock so that the life-span may be prolonged. Artificial prolongation would mean the removal of the stock from the influences of the factors, in effect insulating the stock. At present, this latter form of extending the life-span of the stock is accomplished by listing buildings as historically or architecturally interesting. Society has assumed the financial burden of these items of stock because their usefulness as reminders of the past outweighs their economic or functional usefulness. However, artificially prolonging the life-span of all the stock, either by this or some other similar means, is impractical. Furthermore, since naturally prolonging the life of the stock means altering the factors or the forces exerted by the factors, the problem becomes one of economic, soical and ultimately political, rather than one of merely architectural importance.

9.11 The basis for some of the actions necessary for prolonging the life-span of the stock 'naturally' have been examined in this thesis. It is important to remember, however, that by no means all the ramifications of these actions have been explored, as the main purpose of this research is to establish the factors which influence the life-span of the stock. Ensuring that the present mix of use as well as user size and type was retained would help to prolong the life-span of the present stock of urban buildings. In Chapters 7 and 8, it was found that the stock changed not only due to the influence of a change of use, but also due to the size and type of user in the stock. Thus, present zoning regulations which only refer to the use of the stock are little help in retaining the existing stock. However, they do present a precedent for zoning based not only on use, but user type and size.

9.12 This, of course, raises a number of complications. By attempting to describe the use and user of the stock, one is attacking the symptoms, not the cause, of either the change of the stock or the use or user. That is, the root cause of the changes are the operatational factors. However, it has also been argued that except for the natural factors, the operational factors are influenced by the collective users' actions or inactions. Thus, by attacking the problem at the level of the individual users circumvents the roots of the change. Even if it were possible for the collective users to alter the operational factors enough to affect the users individually, the use of the stock, and thus the life-span of the stock, it must be obvious that the collective users in Great Britain are not free agents, but are in turn affected by nationally external decisions. Thus, an attempt to alter the operational factors, particularly the economic factors, would be extremely difficult.

9.13 A further problem arises in that the present mix of use and users of the stock in an area of an urban environment may not be socially acceptable. That is, the stock may at present be sub-standard in its accommodation as well as economically non-viable. Thus, techniques must be established by which to prescribe a proper 'mix' of use and user.

9.14 A third problem is related to the first. Since the users are not free agents, and since they live in a 'growth' economy, the need to grow in size as well as technological sophistication, etc., in order to retain parity is evident. In recent years, the technique of attempting to disperse this growth outside established city centres has been tried, but has resulted in no real success. In theory, with the sophistication of communication technology, the 'cause' of locational attractiveness, the need for proximity in order to facilitate communication, should have been removed. This, however, does not appear to be the case. It has been suggested that the reasons for this lie in the depth of the art of communication[2]. Writing is one of the worst forms of communication, as rise and fall of voice pitch are not conveyed. Similarly, while the telephone transmits both symbology and expression, it does not communicate facial change, hand gestures, etc. The development of the visual telephone would take communication to this deeper level, but, as anyone who has sat in on a televised lecture, or seen a play on television, knows, the depth of communication is still less than when in the physical presence of the communicator[3].

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2. Meier, R.: A Communication Theory of Urban Growth, Cambridge (Mass.) The MIT Press, 1962.
3. Nor is the increased rapidness of transport much help, since while the time to get from Edinburgh to London has been cut from two weeks to two hours, to move across an urban area takes as long as it did fifty years ago.

Thus, locational attractiveness, and the need for growth and change of the stock in the established centres, will continue.

9.3 IMPLICATIONS FOR FURTHER RESEARCH

9.15 The analyses in Chapters 7 and 8 show the practicality of more sophisticated and enlarged undertakings in the study of the change of the stock and the relationship of that change to various economic and social factors. With the use of computer storage and handling of data, not only could the scope and depth of the analyses be extended, but a number of sophisticated techniques, such as regression analysis, could be undertaken. At the same time, the non-quantifiable factors, such as the effects of change on society need to be examined in more depth. Similarly, the social and economic implications of actions taken to prolong the life-span of the stock, both naturally and artificially, need to be examined further. Also, the laws affecting the use and user of the stock, and their effect on the life-span of the stock need to be examined more fully. Finally, the role of the architect in, and the means at his disposal for, prolonging the life-span of the stock should be analysed.

A P P E N D I C E S

APPENDIX ONE

LOCATION THEORY: A DISCUSSION

A.1.1 INTRODUCTION

1.01 Economic activity is unevenly distributed over space. This is true whether one is discussing global distribution, national distribution or regional or local distribution. The body of inquiry, known as locational theory, seeks to model this distribution and explain the factors which have lead to this unevenness. In this Appendix, a short review of the main features of locational theory is included for those readers who may be unfamiliar with the subject. It also cites a number of particularly important writings on the theory which readers may wish to refer to. For the sake of simplicity, the highly developed mathematics of the theory have not been included in this Appendix.

1.02 Location theory may be divided into two parts, that which is concerned with point agglomerations, that is why activities locate at one point in space and not another, and the benefits derived and costs incurred at those points; and hypotheses concerned with the use of land (land use) at any point in space. The first category, point agglomeration, may be divided into three main classes[1]: the first may be called Weberian Theory (after Alfred Weber, an early proponent of location theory), which seeks to analyse the location of industrial manufacturing firms under theoretically perfect competition conditions. It explores the relative attractiveness of labour, raw materials and market locations. The second class of point agglomeration is termed central place theory. These studies are also concerned mainly with the location of industrial firms, but assume

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1. Weber, M.J.: Impact of Uncertainty on Location, Cambridge (Mass.), the MIT Press, 1972.

imperfect competition conditions. They do, however, usually disregard the cost of raw materials. The third class may be termed interdependence theory, which, like central place theory, assumes imperfect competition and disregards the cost of raw materials and is more concerned with individual decisions taken that affect the location of firms. The second major part of location theory, land use theory, may be divided into two classes: agricultural land use theory, which is concerned with the location of agricultural activity; and urban land use theory, which is concerned with the location of urban activities.

1.03 Land use theory differs from point agglomerations in two main ways: one, the type of question posed by the two parts of location theory is different. Whereas point agglomeration asks 'where does this firm locate?', land use theory will ask 'what is the overall pattern of location of this industry?'[2]. The second major difference lies in the concern for rent in the two parts. In point agglomeration theory, rent is usually ignored or considered to have only a minor influence; in land use theory, rent is viewed as having a major impact on the overall pattern of location and the patterns of utilisation of the land.

A.1.2 <u>POINT AGGLOMERATIONS</u>

1.04 Weber[3] provided one of the earliest foundations for location

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2. Isard, W.: <u>Location and Space Economy</u>, Cambridge (Mass.), The MIT Press, 1956.
3. For an examination of Weber, see: Friedrich, C.S.: <u>Alfred Weber's Theory of the Location of Industry</u>, Chicago, the University of Chicago Press, 1929.

theory. His fundamental concept, that firms locate to minimise transport and labour costs, has been used in empirical analyses by many other writers, such as Hoover[4], McLoughlin and Roebuck[5]. Weber wished to construct a pure theory of location, thus he analysed and incorporated into his theory only the general factors which influence the location of all industries. These he divided into those influencing inter-regional location and those influencing intra-regional location, or 'agglomerating' factors[6]. His factors were raw material costs, transport costs and labour costs. Transport costs were seen to be central to location, thus he postulated that when raw materials were large and bulky, thus incurring high transport costs, the industry would locate close to the source of the raw materials. On the other hand, if the transport costs of the finished product were greater than that of the raw materials, the industry would tend to locate closer to their markets. From this hypothesis, Weber developed a 'Materials Index' which related the cost of transport of materials to the location of the industry.

1.05 The second part of Weberian Theory deals with labour costs. However, he neglects two important points: that organisational and technical efficiency of labour varies from point to point, and that the amount of labour at any point is different from any other point[7]. Nevertheless, Weber postulated that a firm would locate where labour costs, seen in terms of wages only, are the lowest if the savings in labour were to offset the increased transport costs of raw materials or finished products. The attractiveness of cheap labour was also

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4. Hoover, E.M.: The Location of Economic Activity, New York, McGraw-Hill, 1948.
5. McLoughlin, G.E. and Roebuck, S.: Why Industry Moves South, Washington, D.C., Brookings Institute, 1949.
6. Friedrich, C.J.: op.cit.
7. Ibid.

said to be the strongest for labour intensive industries, rather than labour saving industries.

1.06 Isard[8] used Weber's hypotheses for his own theoretical and empirical analysis of location. First, he examined the effects of transport costs, then labour, power and other production costs were examined as factors affecting the transport costs. Finally, he introduced the concept of the economics of scale and the influence of urban environments on location.

1.07 Several criticisms of Weber have arisen since he introduced his theory. By far the most critical deal with his assumption of a perfectly competitive market[9]. Other criticisms include the fact that in reality firms seek to maximise profit locations rather than minimise cost locations[10]; that he assumed that the scale of production had no effect on costs[11]; that transport costs are directly proportional to distance[12]; and that the assumptions about a fixed, unlimited supply of labour are not a reflection of reality[13]. However, Weber is important in that he supplied the basis for a large body of subsequent work.

1.08 Some of this subsequent work has developed into what is now known as central place theory, mainly examined by Losch[14] and later by Christaller[15]. Losch presented new ideas about the size and

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8. Isard, W.: op.cit.
9. Greenhut, M.L.: Plant Location in Theory and Practice: The Economics of Space, Chapel Hill, N.C., the University of North Carolina Press, 1956.
10. Losch, A.: The Economics of Location, New Haven, Yale University Press, 1959.
11. Hoover, E.M.: op.cit.
12. Ibid.
13. Ibid.
14. Losch, A.: op.cit.
15. Christaller, W.: Central Places in Southern Germany, Englewood/...

shape of market areas, the function of towns, and the concept of locational equilibrium. His basic assumption, used to develop his model, was that of the homogeneous, unbounded plain. That is, the surface upon which economic activity occurs is flat, contains no barriers such as mountains and rivers, and is unbounded in all directions. This allowed him to circumvent the problems of uneven distribution of resources and barriers to trade. His importance, however, is in the concept of locational equilibrium, that is, firms will locate so that a balance between competing firms will be established and maintained. The five assumptions of this equilibrium are[16]:

1. The location for the firm is a maximum profit location;
2. Locations are so numerous that the entire space is occupied;
3. So many firms exist that no-one can make abnormal profits;
4. The areas of supply, production, and sales are as small as possible; and
5. At the boundary between two firms, individuals are supplied equally by each.

Losch then develops the concept that firms will locate at the centre of their supply/distribution areas (central places) so as to equalise the transport costs over their market areas. Firms supplying different goods will all wish to locate at this central place, thus the development of towns and their function as points of manufacture and supply.

1.09 Christaller's theory about central places is developed along lines similar to Losch's. He assumes[17]:

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15. (contd.) Cliffs (N.J.), Prentice-Hall, 1966.
16. Losch, A.: op.cit.
17. Christaller, W.: op.cit.

1. An even distribution of population in an unbounded plain;
2. That central places provide services for surrounding hinterlands of fixed sizes;
3. That central places are located at a maximum distance apart, subject to the constraints of the size of their market areas; and
4. That a central place provides a function or service on the order of x if and only if it also provides functions on the order of 1 through x - 1 .

Thus, Christaller assumes a hierarchy of services or functions which is dependent on the size of the market area, and thus the population, served by the central place.

1.10 The theories about central places have also been subjected to criticism: they do not really account for the function of towns[18] and they are not related to reality in that they assume a featureless plain[19]. However, these theories do provide some explanation of the location and size of towns which have been modified by subsequent writers generally by developing the model in a featured landscape rather than a featureless plain[20].

1.11 Interdependence theory is not utilised to any great extent at present in locational analysis, due to the fact that many of its conclusions seem to contradict reality. It does, however, provide one crucial criticism of central place theory: that locational equilibrium is likely to be at odds with a socially optimum pattern.

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18. Mumford, for example, has suggested that towns formed as defensive positions, while Moholy-Nagy argues that they were places for exchanging rather than originating goods, although she does argue that they originated organised religions. Moholy-Nagy, S.: Matrix of Man, London, Pall Mall Press, 1968. Mumford, L./...

Interdependence theory was developed by Hotelling[21] and culminated in the work of Smithies[22]. Greenhut[23] summarises the basic arguments of interedependence theory thus:

1. The shape of the demand curve: an infinitely in-elastic demand curve promotes concentration of firms, while a more elastic one encourages dispersal;
2. The slope of the marginal cost curves: negatively sloping marginal cost curves strengthen tendencies towards dispersal, while positively sloping cost curves promote agglomerations;
3. Transport costs: transport costs are positively associated with the degree of dispersion; and
4. Degree of competition: the greater the belief among firms that their actions will be met by equal reactions from competing firms, the more those firms disperse. Thus, competing firms would repel one another, where in fact competing firms tend to congregate.

1.12 Two problems with all of the three point agglomeration theories which have not thus far been discussed are that they all assume that the decision of firms is based on perfect knowledge of the market and that firms are free to locate or relocate to gain either lowest costs or highest profit. In reality, neither of these is true.

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18. (contd.) Mumford, L.: The City in History, Harmondsworth (Middlesex), Penguin Books, 1966.
19. Dacey, M.J.: 'A Probability Model for Central Place Locations', Annals of the Association of American Geographers, September, 1966.
20. For example: ibid. Tobler, W.: 'Geographic Area and Map Projection', Geographical Review, January, 1963.
21. Hotelling, H.: 'Stability in Competition', Economic Journal, March, 1929.
22. Smithies, A.: 'Optimum Location in Spatial Competition', Journal of Political Economy, June, 1941.
23. Greenhut, M.L.: op.cit.

The knowledge that the firms have about the market will vary from firm to firm, much in the same way that knowledge about the operational factors will vary from user to user[24]. Similarly, firms are not completely free to relocate or locate at the points of lowest cost or highest profit. The location of firms is regulated by legal restrictions as well as investments in land and stock. Thus, the location of firms as argued by the theories is only at best an approximation of reality. They do, however, serve the purpose of providing an imperfect reflection and description of some of the factors affecting the location of activities as well as providing the theoretical basis for answering the question 'Where does this firm locate?'.

A.1.3 LAND USE THEORY

1.13 The second category of location theory models is concerned with the questions 'What is the overall pattern of an industry?' and 'What to produce at a particular location?'. The models that attempt to answer these questions can be classified as agricultural land use models and urban land use models. As the second class is more germane to this thesis, the first will only be briefly discussed.

1.14 The basic work in agricultural land use theory was developed in Prussia by Von Thunen[25], and more fully developed in the United States by Losch[26] and Dunn[27]. Dunn explains the theory thus: the land use (since it is only agriculture, the difference lies in the use of land as crop raising or pasture and the type of crop), which provides the greatest rent on a piece of land will outbid other uses

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24. See Chap. 2.
25. For an examination of Von Thunen, see: Hall, P.: Von Thunen's Isolated State, Oxford, Oxford University Press, 1966.
26. Losch, op.cit.
27. Dunn, E.S.: The Location of Agricultural Production, Gainsville, (Fla.), University of Florida Press, 1954.

and thus displace them. The equilibrium in the industry is derived from eight basic assumptions:

1. Only agricultural goods are produced;
2. The income of the consumers is known;
3. Non-land factors of production are perfectly mobile and divisible;
4. Yields do not vary over space;
5. The supply factor is adequate for all production and is available at a constant price;
6. The transport costs are constant over time and space;
7. The agricultural industry is supplying only a single market; and
8. The transport network is undifferentiated over space.

It follows, then, that as proximity to the market is attempted, the cost of rent of the land rises and the suitability of one crop, which yields more per acre than another, increases in relatinn to a second crop. In support of this hypothesis, Chisholm[28] studied the imports of agricultural goods to the United Kingdom based on the weight of the product in metric tons per one million litres of milk, the percentage of the product imported, and the distance to London of the place of origin. He found a direct correlation between weight, percentage of imports and distance among the six products analysed.

1.15 Agricultural land use theory, however, does not take into account such factors as the production decision of farmers based on the market nor the influence of government expenditure on those decisions[29], nor the transition of the urban rural fringe over time[30].

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28. Chisholm, M.D.I.: Rural Settlements and Land Use, London, Hutchinson University Library, 1962.
29. Haggett, P.: Locational Analysis and Human Geography, London, Edward Arnold, 1965.
30. Sinclair, R.: 'Van Thunen and Urban Sprawl', Annals of the Association of American Geographers, December, 1967.

1.16 Early theories of urban land use identified many of the factors important in the subsequent development of models of urban structure. In 1903, for example, Hurd[31] indicated that land is allocated to the highest bidder and that the value of a site, which he defined as the rent which it could command, depended on its location, particularly in relation to the city centre. Haig[32] introduced the concept of transportation 'friction' or costs and stated that location is dependent on both land value, as defined by Hurd, and the cost of transportation. More recently, Wingo[33] has constructed a model which depends upon very detailed assumptions about the demand for and the cost of transport in cities, while Muth[34] and Alonso[35] have constructed and tested similar models. Alonso added the factor of the size of a parcel of land and its affect on value, while Yeates[36] added the concept of racial mix and its effect on the value of an item of land.

1.17 These models are usually constructed to be predictive rather than descriptive. However, most of them owe some acknowledgement to two very familiar descriptive models of urban land use: those of Burgess[37] and Hoyt[38], which seek to describe urban growth. Burgess saw cities as growing outwards from the centre in five concentric rings, which he identified as:

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31. Hurd, R.M.: Principles of City Land Values, New York, The Record and Guide, 1924.
32. Haig, R.M.: 'Towards an Understanding of the Metropolis', Quarterly Journal of Economics, February and May, 1926.
33. Wingo, L.: Transportation and Land Use, Washington, D.C., Brookington Institute, 1961.
34. Muth, R.F.: 'The Spatial Structure of the Housing Market', Regional Science Association, Vol. 7, 1961.
35. Alonso, W.: Location and Land Use: Towards a General Theory of Land Rent, Cambridge (Mass.), Harvard University Press, 1964.
36. Yeates, M.H.: op.cit.
37. Burgess, E.W.: 'The Growth of the City', in Park, R.E.,/...

1. The Central Business District (CBD), which is the industrial, commercial and transport focus of the city;
2. A transition zone of deteriorating residential properties, which is being invaded by business firms and light manufacturing industry;
3. A working class residential zone, occupied by families which have left the second zone;
4. A residential zone of high class apartments and single family dwellings; and
5. A commuters' zone of the more affluent residential families.

(See Figure A.1.1). Burgess argued that as a city grew, each zone expanded into the next outer one, a process which he termed succession[39]. Hoyt modified Burgess' model by introducing the concept of sectors (see Figure A.1.2). Hoyt recognised that the rings do not grow outwardly with equal velocity, but rather the rate of growth is controlled by the transport routes radiating from the city centre and that certain types of land use tend to concentrate in certain areas of a city. Recently, this theory has been tested in terms of social classes by Gordon[40], and in terms of housing prices by Richardson[41]. Another important factor, that of the ease with which land is developed, (that is, a topographical factor) has been added by Kozlowski and Hughes[42].

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37. (contd.) Burgess, E.W., and McKenzie, R.D. (eds.): The City, Chicago, University of Chicago Press, 1967 (4th ed.).
38. Hoyt, H.: The Strcuture and Growth of Residential Neighbourhoods in American Cities, Washington D.C., Homer Hoyt Associates, 1939.
39. For a discussion of succession, see Appendix 2.
40. Gordon, G.: op.cit.
41. Richardson, H.W., Vipond, J. and Furbey, R.A.: 'Dynamic Tests of Hoyt's Spatial Model', op.cit.
42. Kozlowski, J. and Hughes, J.T. with Brown, R.: Threshold Analysis: A Quantitative Planning Method, The Architectural Press, 1972.

FIGURE A.1.1: BURGESS' CONCENTRIC RING MODEL OF URBAN LAND USE

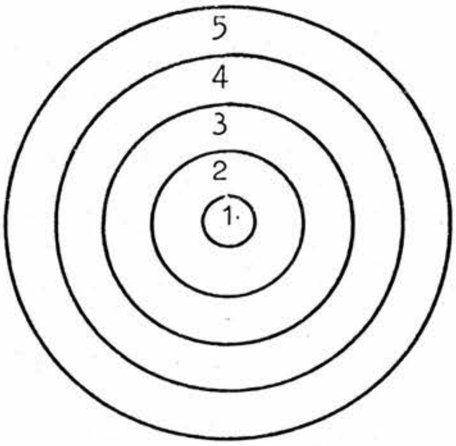
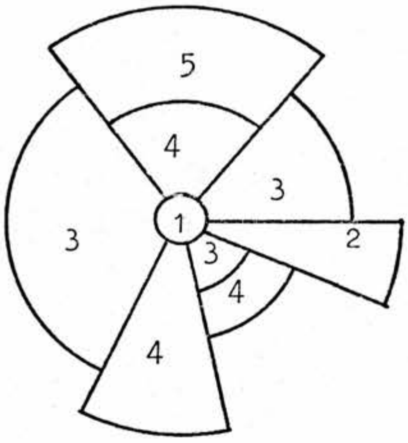


FIGURE A.1.2: HOYT'S SECTOR MODEL OF URBAN LAND USE



Source: Haggett, P.: op.cit., p.178.

Notes: Figures A.1.1 & A.1.2:

1. CBD.
2. Transition Zone.
3. Working Class Housing.
4. Higher Class Housing.
5. Commuter Zone.

1.18 One important weakness of these theories of urban land use is the simplicity with which they view the structure and growth of a city. The intricacies of development and change are overlooked, so that a manageable model may be formulated. Another important omission is the lack of analysis of the change of the stock in relation to the growth and change of the city and the underlying factors which influence that change. However, the urban land use models do provide part of the theoretical basis for this present undertaking.

APPENDIX TWO

LAND USE SUCCESSION THEORY: A DISCUSSION

A.2.1 INTRODUCTION

2.01 This Appendix is devoted to an examination of land use succession theory, a not very well developed part of land use locational theory. The interest of this theory to this study lies in its principal objective: it seeks to explain the use of land, or the buildings upon the land, at a particular location, in terms of the economic value at that location.

A.2.2 EXAMINATION OF LAND USE SUCCESSION THEORY

2.02 In general terms, land use succession theory seeks to describe the change in the value[1] of an item of urban land as a function of the change of use of that land or the buildings upon the land. It holds that an item of land evolves into its 'highest and best' use[2]. This highest and best use is usually measured as the most economically profitable use of the land. A primitive form of land use succession theory was discussed by Patrick Geddes[3] in his book on the evolution of cities. He recognised that the use of a parcel of land changed as society evolved from hunting and gathering, agriculture and husbandry, to urbanised commerce.

2.03 Land use succession theory is divided into three relationships of change:

1. when change of use occurs without any physical change of the stock;

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1. In land use succession theory, value is usually seen in terms of price. However, as discussed in Chap. 3, value may also be seen in terms of rateable value.
2. Ratcliff, R.V.: Urban Land Economics, New York, McGraw-Hill, 1949.
3. Geddes, P.: Cities in Evolution, London, Ernest Benn, 1968 (3rd ed.)/..

2. when change of use results in the physical adaptation of the stock; and

3. when change of use results in the demolition and replacement of the stock.

Most studies[4] hold that these three changes occur in sequence. This, however, is not always the case[5]. Land use succession is usually represented in the form of a line graph with the horizontal axis being the uncalibrated time scale and the vertical axis the uncalibrated value scale (see Figure A.2.1). It is also seen as being cyclical in nature; that is, when one full 'cycle' is completed, the next will follow a similar pattern. The cycle is divided into three phases: the growth, maturity and decline phases. The growth phase is begun when the land use changes from a non-urban use, such as agriculture, to urban use, generally assumed by the theory to be housing. The maturity phase is reached when the rise in the value of the land begins to level off and the curve tends to the horizontal. The decline phase begins when the value of the land begins to drop steadily. Within the last phase Andrews[6] has described a 'zone of uncertainty' within which decisions made by the users[7] of the stock about whether to take action or not are taken. The type of action taken will determine whether or not the decline phase will be ended, the curve levels off, and a new cycle begins.

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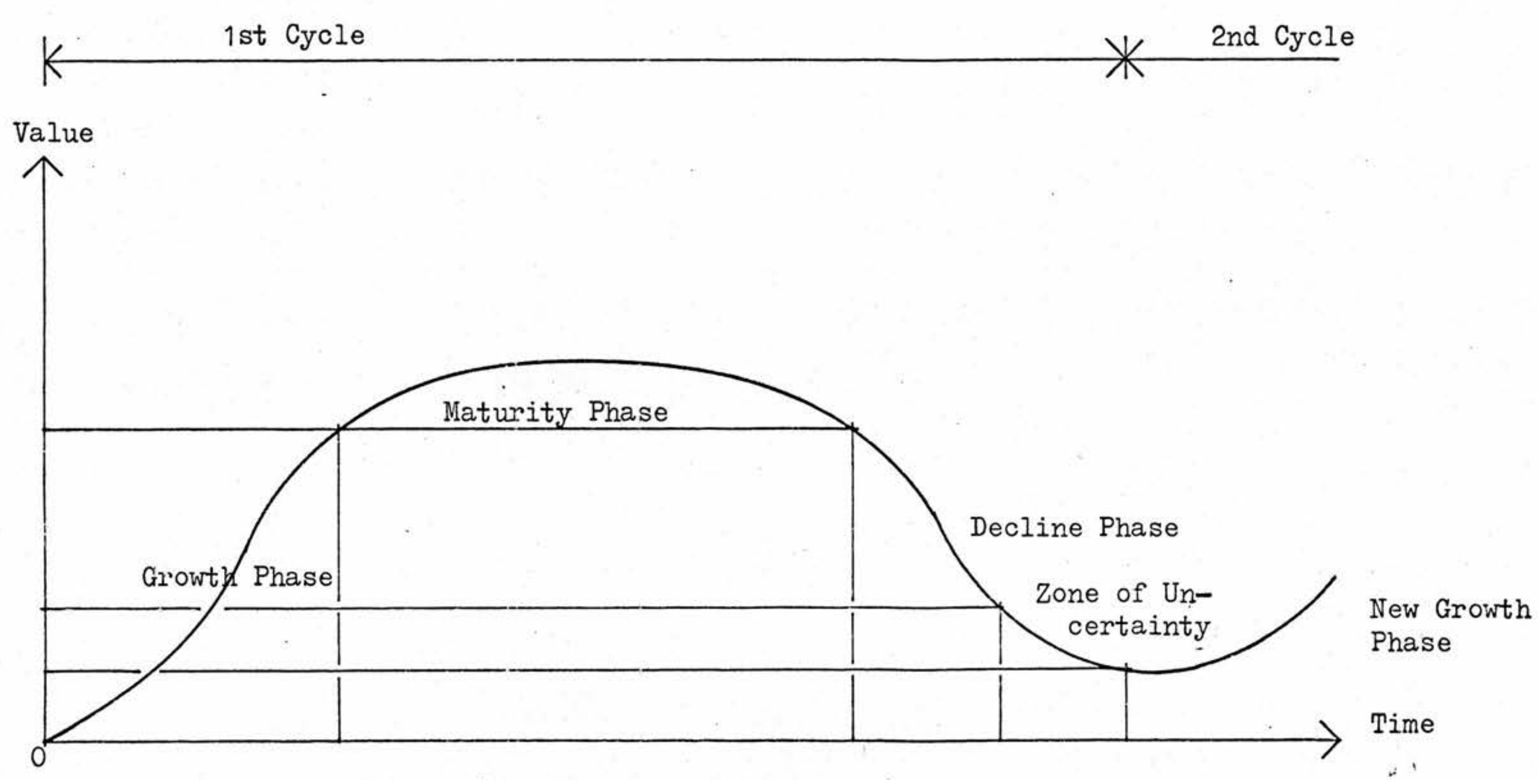
3. (contd.) Also see a discussion of Geddes' theories in: Broadman, P.: Patrick Geddes: Maker of the Future, Chapel Hill, (N.C.),University of North Carolina Press, 1944.
4. For example, see: Andrews, R.B.: op.cit. Fisher, E. & R.: Urban Real Estate, New York, Holt, Rinehart and Wilson, 1954.
5. See Chaps. 7 and 8; also section A.3.3.
6. Andrews, R.B.: op.cit.
7. For a discussion of the types of users, see Chap. 2. Users in this Appendix, normally means owners or owner/occupiers, i.e., those with direct financial interest in the stock.

FIGURE A.2.1: LAND USE SUCCESSION CYCLE



Source: Adapted from Andrews, R.B.: op.cit., p.100.

2.04 The curve during the growth phase is characterised by a rise in value and a change of the urban use of the land is prevalent. For example, single family dwellings will be succeeded by multi-family dwellings, which in turn will yield to the land's use as offices, shops, etc. Whether this change of use occurs in conjunction with adaptation or replacement of the stock is a function of the match between the needs of the use and the physical factors of the stock and the site[8]. Curve a in Figure A.2.2 represents the normal curve during this phase, the slope being 'normal' enough to allow the stock to live out its economic life-span[9] before being replaced. However, the curve during this phase may also attain the maximum value much more quickly (curve a^1 in Figure A.2.2) which is influenced by a rapid change of use to the 'highest and best'[10]. If this happens, the economic life-span, as well as the physical life-span of the stock is shortened due to the rapidly increasing value of the site. A second deviation from the norm (curve a^2 in Figure A.2.2) occurs when the land has been developed for urban use without an accompanying demand for that development. Andrews[11] cites the case of a housing sub-division which is speculatively developed, thus raising the value of the land, but not occupied due to lack of demand. If this happens, the value will drop and remain stable until demand becomes present.

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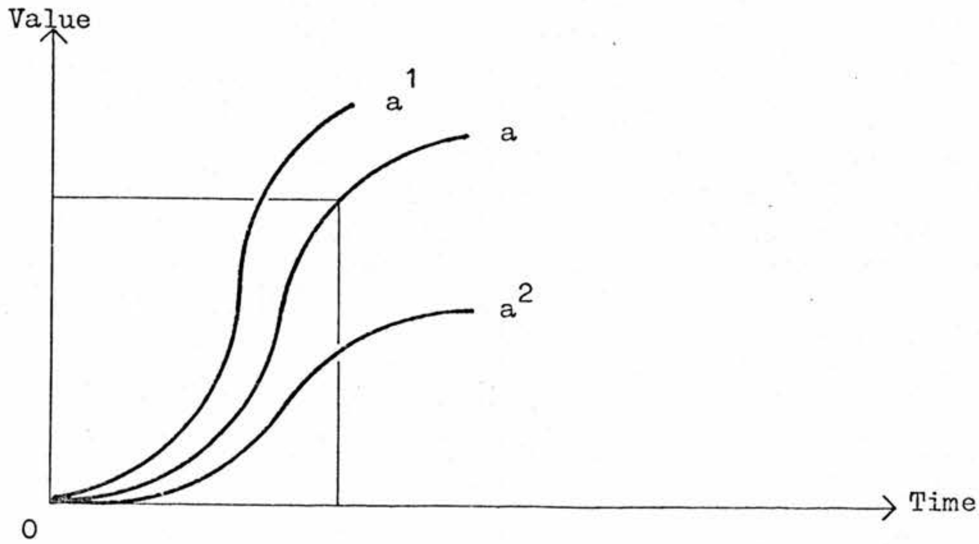
8. See Chap. 2.
9. The economic life of the stock may be taken as being sixty years. See Chap. 5.
10. This may be due to rapid development of the area due to external factors, such as the introduction of a motorway in the area. For example, see: Yeates, M.H.: op.cit.
11. Andrews, R.B.: op.cit.

FIGURE A.2.2: GROWTH PHASE IN THE LAND USE SUCCESSION CYCLE



Source: Adapted from Andrews, R.B.: op.cit., p.103.

2.05 For the normal curve in the growth phase, the rate of vacancy of the stock will be low and the amount of undeveloped land in the area will rapidly diminish. This will, of course, not only stimulate the rise in value of the remaining vacant land, but also the developed land. The expenditure on maintenance during this phase will be low, due to the relative newness of the stock. Costs of adaptation, however, will rise as the period progresses.

2.06 When the land has reached its 'highest and best' use, the curve will level off and the maturity phase is said to have begun. The exact point when the phases shift is clearly one of judgement as the curve may continue to rise, although at a decreasing rate during the early part of the maturity phase. This is due to the consolidation of the 'highest and best' use in the area as the value of immediately neighbouring land will affect each individual site. It may also be due to improvements in the stock or the land or the raising of the level of general amenity in the neighbourhood. By definition, the economic profitability of the land and the stock during this phase will be maximised as will its value. The length of time that the land is within the phase is, therefore, of critical importance to the owners of the stock and land. If the phase can be prolonged, then the maximum economic profit, both to the owners and to the government, in the form of taxes, is also prolonged. This may have a critical effect on the life of the stock: if the replacement of the stock is necessary in order to prolong the phase, then it will be replaced.

2.07 Vacancy of the stock during this phase will tend to be low while the amount of open land will be very small. Maintenance expenditure, on the other hand, will be greater than in the growth phase, as the stock ages and as the amenities are increased. The number of different uses in an area will, of course, be much less than in the growth phase.

2.08 The final phase of the cycle is the decline phase which is typified by a drop in the value of the land. It contains, according to Andrews[12], a critical sub-phase, the zone of uncertainty (see below). As with the phase shift from growth to maturity, the point where the decline phase begins is one of judgement. For the sake of convenience, it is generally taken as the same value as the first phase change (see Figure A.2.1). Andrews[13] asserts that the slope of the curve during this phase is dependent on the length of time that the previous phase lasted. He argues that if the maturity phase is prolonged, the slope in the decline phase will be steep as the value has

12. Andrews, R.B.: op.cit.
13. Ibid.

been artificially maintained at the high level. During this phase, the number of vacancies of the stock will rise as will the amount of unbuilt land as stock is demolished but not replaced. Similarly, the amount of maintenance of the stock will decline and the number of different uses will increase, as will the rate at which they succeed one another.

2.09 The point where the decline phase curve begins to level off, thus bringing an end to the first cycle, is dependent upon the actions taken by the owners of the stock during the 'zone of uncertainty' (see Figure A.2.3). These actions may be categorised as 'experimental' and 'wait and see'[14]. Experimental action is where certain owners try to arrest the decline in value by physically improving or replacing their items of the stock, hoping that others will take similar action. The 'wait and see' attitude belongs to those users who do not experiment, but will wait and see if the actions of the experimentalists are successful or not. Andrews[15] has also pointed out that governments too often take the latter attitude as they are perhaps justifiably afraid of charges of fiscal mis-management if they experiment and fail. Further, by allowing the whole area to decline to a low point, they can institute wholesale renewal at a lower initial cost, which is both less taxing bureaucratically than dealing with a number of small projects and also has more visual political impact.

A.2.3 CRITICISM OF LAND USE SUCCESSION THEORY

2.10 Land use succession theory as discussed above may be criticised for four main omissions, which will be described briefly here.

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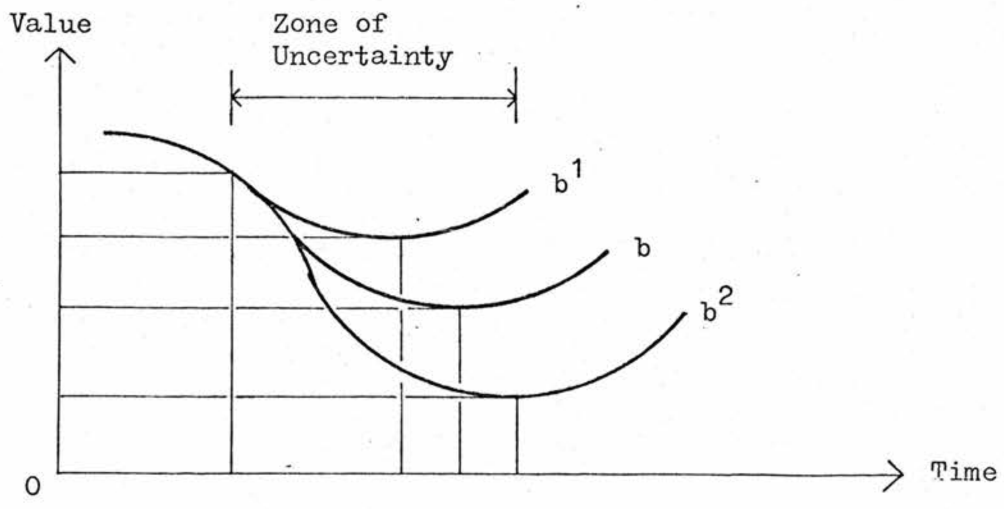
14. Ibid.
15. Ibid.

FIGURE A.2.3: DECLINE PHASE IN THE LAND USE SUCCESSION CYCLE



Source: Adapted from Andrews, R.B.: op.cit., p.124.

They are:

1. the lack of scale on the horizontal and vertical axes in the figures;
2. the implicit inference that all land goes through the same phases;
3. the lack of significance given to inflation as a cause of the change in value; and
4. the lack of concern for the change of user on the value of the stock.

The lack of scale may be explained by the lack of empirical evidence applied to the theory. In Chap. 8 of this thesis, the study of the change of use and the stock and value in an area of Edinburgh is discussed and suggests that the growth phase at this location lasted approximately one hundred and fifty years, if the measure of the change of use to the 'highest and best' is applied. The investigations in Chap. 7 would suggest that all locations do go through this cycle, and that the time scale of the phases vary. For example, an area of one hundred years of age was found to exhibit little or no change of use and another of two hundred years of age is just beginning to significantly change its use. However, if the criteria of the change in value (unadjusted) is used, then the area investigated in Chap. 8 would still be in the growth phase as would the areas cited in Chap. 7. The problem of using the current rather than the adjusted value must also be more fully examined if the theory is to be of value. The investigations in Chap. 8 suggest that while the unadjusted value rose, and is still rising, the adjusted value at present is actually only slightly higher than at the beginning of the growth phase and exhibited two peaks and three troughs. Thus, if the change in the adjusted value of the stock is used as the criteria for demarcating the cycles and phase changes, this would mean that the area is in its third full cycle, while the unadjusted value would suggest that the area is still in the growth phase. Further, if the criteria of the change of use is used to note the phase changes, it would suggest that the area is in the maturity phase. The lack of concern for the effect of the change of user on the stock and its value is also a criticism of the present theory. The investigation in Chap. 8 again suggests that the change in the size of the user and his type will also raise the value of the individual items of stock (by influencing physical change) and thus of the area in general.

APPENDIX THREE

FILTRATION THEORY: A DISCUSSION

A.3.1 INTRODUCTION

3.01 Filtration theory is a development of location analysis which seeks to examine the life of the stock in terms of its use and value utilising data concerning the socio-economic class of its users[1]. That is, it differs from land use succession theory in that it does not directly rely on information about the use and value of the stock, but on information about the users' socio-economic level to explain changes in the stock. Filtration theory has also been limited, thus far, to the housing stock and information related to a decline in the socio-economic class of the users. In general terms, filtration theory states that as the housing stock ages, it loses both quality and value and will be successively inhabited by lower and lower socio-economic classes. As Ratcliff[2] states:

> "This process (filtration) is described most simply as the changing of occupancy as the housing that is occupied by one economic group becomes available to the next lower income group as a result of decline in market price; i.e., the sales price or rent value."

3.02 Filtration theory is usually discussed from a non-quantitative viewpoint; that is, the theory was developed from observation and not by comprehensive analysis of data[3]. Ratcliff[4] distinguishes three main requirements necessary for filtering to occur:

1. a surplus number of dwellings in a given price range;

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1. In this case, the users are those directly utilising the stock, whether they be owners or renters.
2. Ratcliff, R.V.: op.cit., p.321.
3. See for example: Fine, D.: Filtering, London, Joint Unit for Planning Research, Paper 13, 1964. Lowery, I.S.: 'Filtering and Housing Standards', Land Economics, November 1960. However, a source of quantitative data on filtering, showing that the process does indeed function for housing is: Gordon, G.: op.cit.
4. Ratcliff, R.V.: op.cit.

2. a change in the relative quality of those dwellings; and
3. a strong emphasis on new construction of housing for the middle and upper socio-economic groups on virgin lands.

Also of importance is the upward mobility of people through the socio-economic stratum.

3.03 A surplus of dwellings may be created in two ways: either by overbuilding or by a decrease in the demand for dwellings which may arise from depopulation, family dissolution or the upward mobility of the family. This surplus must be made available to the market at a favourable price for filtering to occur, usually at a price below the original. This lower price may be the result of the deterioration of the quality of the dwellings and their immediate neighbourhood in absolute or relative (to new stock) terms. A national absolute surplus of housing is, of course, an impossibility[5]. Surplusses can, however, occur on a regional or local level in an absolute or relative sense[6].

3.04 The creation of the surplus, while necessary to the instigation of the process, also interrupts the process. When surplusses occur, building activity slows until demand once again exceeds supply. Thus, the process of filtering is not a smooth, flowing process, but a halting, stop-go process. For this reason, as well as the size of the populations in the various socio-economic groups[7], filtering can

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5. See Chap. 6.
6. Absolute surplusses are brought on by local or regional employment depressions due to loss of industry or the basis of employment of the population. Relative surplusses occur when housing is constructed for the upper classes, which they inhabit, vacating their older dwellings which may come onto the market as available to the next lower class. See, for example: Kenward, J.: 'The Modern Movement Rehabilitated', Architects' Journal, June 4, 1975.
7. In 1961, the five social classes distinguished by the Registrar/...

only provide for a fraction of the housing needs of the lower classes. Housing acquired by the process also tends to carry some social stigma. The stock is old and unwanted by the upper classes, possibly in poor state of repair (which could be more easily rectified by the upper rather than the lower classes) and in many areas becomes inhabited by particular ethnic or racial groups, thus creating ghettoes in the modern sense of the word.

A.3.2 CRITICISM OF FILTRATION THEORY

3.05 This section will argue that the process of filtration also occurs in stock not utilised as housing as well as operating in a reverse direction; that is, certain items of the stock inhabited by the lower classes is being inhabited successively by the upper classes. To distinguish the two directions of filtering, the process where the lower socio-economic classes succeed the upper classes, discussed above, will be termed 'filtering down' while the reverse, to be discussed in this section, will be termed 'filtering up'.

3.06 Filtering up of the existing stock is a relatively recent, but nevertheless observable process, involving certain items of the older housing stock. For example, in the United States, this process

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7. (contd.) General were composed of the following:

Class	% England & Wales	% Scotland
1	3	2
2	16	14
3	50	50
4	23	24
5	8	10

Based on information from the 1961 Census - 'England & Wales', London, HMSO, 1964. Scotland, Edinburgh, HMSO, 1964, and the 'Classification of Occupation', London, HMSO, 1960.

can be observed within areas of most major cities, especially on the east coast; such as the Society Hill district in Philadelpha, the Brownstone area of Lower Manhatten, and the Bolton Hill area in Baltimore. Each of these areas, until very recently, was an overcrowded semi-slum ghetto, comprised of the original stock of brick or stone town houses[8]. For a number of reasons, including the rise in property taxes and the removal of the lower classes to government housing elsewhere, these buildings came onto the market. Because of their location, basic structural soundness, possible historical value, and representation of a slower, easier life-style, they attracted the middle and upper classes who easily outbid the other classes that might have occupied them or the city which would probably have demolished them[9]. Thus, the housing was re-inhabited by the upper classes (as this class originally built them), repaired and modernised them and their life-spans were extended. This process, after it began, was passively or actively encouraged by the local governments. Not only were they spared the cost of replacing the stock, they also gained a more profitable tax base by the influx of the wealthier population. Filtering up, however, could be criticised because, as with filtering down, it does not solve the housing problems of the poor, it merely displaces them.

3.07 Non-housing stock, especially office and commercial accommodation, will also be included in the filtering process in either the

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8. These houses were generally three or four storey buildings in rows facing the street with small open spaces in the rear. Originally they were single family dwellings which had been altered to multi-family housing as the upper and middle classes abandoned them for the suburbs. When they filtered up, they were generally returned to single family dwellings or re-divided into two family dwellings.
9. Huxtable, A.L.: Will They Ever Finish Bruckner Boulvard?, New York, Macmillan, 1970.

'up' or 'down' direction. As offices and shops increase in size and profitability, they will expand either by enlarging or replacing their present item of stock or by moving. In moving, the effects of locational attractiveness will enter into the decision. An insurance company, for example, may be started in an area of small mixed businesses. As it becomes more successful, it will not only need to expand, but wish to be relocated in an area of prestige offices as well as near other financial institutions[10]. Thus, as the business becomes upwardly mobile, its vacated stock becomes available to other smaller firms. The same problems of maintenance expenditure, etc., illustrated by filtering down of the housing stock, will be encountered in the commercial stock.

3.08 The filtering up process of business stock is a slightly different one from the filtering up of housing, as it will normally involve a major change of use. The main outcome though, the 'rescue' of the stock from the lower economic groups, is the same. The stock in this process may have been originally single family housing which has filtered down as housing to the lower classes. Again, because of the stock's location, structural soundness, possible historical value, etc., the latter inhabitants are outbid for the stock by small, generally prestige office users, such as professional practices or branch offices of large users. Again, the stock is modernised and upgraded and thus its life-span is extended. This activity is also encouraged by local governments as it increases their tax base as well as upgrading the stock.

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10. See for example, office mobility study in: Cowan, P., et al.: The Office: A Facet of Urban Growth, op.cit.

A.3.3 CONCLUDING REMARKS

3.09 Filtering in either the upward or downward direction tends to prolong the use and thus the life-span of the stock by the very nature of the process. What has become a useless item of stock to one user or group of users is passed on and used by another user or group. An examination of this process, while based on observation rather than empirical research, helps to illustrate the difference in perception of usefulness or uselessness of the stock by different socio-economic groups. Another method which may be more to the point, would be to study the pattern of activities in the stock as the users change. As suggested in Chap. 2, the activity patterns of the user may be a more precise way of typifying him, than by his socio-economic class, race, sex, etc.

APPENDIX FOUR

BASIC DATA FOR CHAPTER SIX

TABLE A.4.1: POPULATION 1850 - 2000: GREAT BRITAIN

1850	1860	1870	1880	1890	1900	1910	Birth Rate
							High
20,816	23,128	26,072	29,710	33,028	36,999	40,831	R.G.
							Low

1920	1930	1940	1950	1955	1960	1965	Birth Rate
							High
42,769	44,795	46,466	48,854	50,076	51,299	52,657	R.G.
							Low

1970	1975	1980	1985	1990	1995	2000	Birth Rate
	57,040	59,885	63,120	67,029	71,833	77,892	High
54,613	56,594	58,576	60,611	62,957	65,696	68,709	R.G.
	56,594	58,407	59,957	61,374	62,776	64,129	Low

(Thousands)

Sources:
1. Data from 1850-1930, 1950-1970, based on Census 1961 'England and Wales'. Census 1971 'Scotland'.
2. Data for 1940 based on estimate, June 1939, reported in Census 1971 'Scotland'.
3. Data for 1955 based on author's estimate.
4. Data for 1975-2000 based on a) Stone, P.A.: Urban Development in Britain, op.cit. b) Registrar General Statistical Review 'Part 2 - Population', op.cit.

TABLE A.4.2: WORKING AGE POPULATION 1850 - 2000: GREAT BRITAIN

1850	1860	1870	1880	1890	1900	1910	Birth Rate
							High
15,606	17,339	19,456	22,076	25,099	28,769	34,233	R.G.
							Low

1920	1930	1940	1950	1955	1960	1965	Birth Rate
							High
33,339	34,662	N.A.	35,615	N.A.	N.A.	36,621	R.G.
							Low

1970	1975	1980	1985	1990	1995	2000	Birth Rate
	37,836	38,722	40,062	42,123	44,524	47,611	High
37,327	37,836	38,782	40,015	41,677	43,215	45,102	R.G.
	37,836	38,722	40,015	41,677	43,046	44,448	Low

(Thousands)

Source:

1. Data for 1850 - 1920 and 1950 based on 1911 Census categories - from Department of Enployment: British Labour Statistics 1886 - 1968, London, HMSO, 1971.
2. Data for 1930, 1965 and 1970, based on 1951 Census categories - from ibid.
3. Data for 1975 - 2000 based on: a) Stone, P.A.: Urban Development in Britain, op.cit. b) Registrar General: Statistical Review, 'Part 2 Population', op.cit.

TABLE A.4.3: EMPLOYED POPULATION 1850 - 2000: GREAT BRITAIN

1850	1860	1870	1880	1890	1900	1910	Birth Rate
							High
9,373	10,523	11,752	12,731	14,499	16,280	18,286	R.G.
							Low

1920	1930	1940	1950	1955	1960	1965	Birth Rate
							High
19,354* 19,357**	21,055	N.A.	20,318	21,258	22,036	23,147	R.G.
							Low

1970	1975	1980	1985	1990	1995	2000	Birth Rate
	22,758	23,594	24,643	26,042	27,224	29,162	High
22,645	22,669	23,382	24,127	25,096	26,104	27,272	R.G.
	22,669	23,298	23,996	24,778	25,469	26,160	Low

(Thousands)

Source:

1. Data for 1850-1920* based on 1911 Census categories - from British Labour Statistics, 1886-1968, op.cit.
2. Data for 1920** and 1930 based on 1951 Census categories - from ibid.
3. Data for 1950 and 1955 based on 1948 Standard Industrial Classification - from ibid.
4. Data for 1960-1970 based on 1958 Standard Industrial Classification - from ibid.
5. See Tables A.4.4 - A.4.7 and explanation.

EXPLANATION OF TABLE A.4.3

The projections of the employed populations from 1975 - 2000 in Table A.4.3 are based on the author's own extrapolations from data contained in Stone[1] and the British Labour Statistics[2]. Table A.4.4 shows the employed population as a percentage of 1) the total population, and 2) the working age population between 1850 and 1970. As can be seen from this table, the lowest percentage recorded of employed population based on the total population was in 1970 (41.5%). Similarly, the lowest percentage based on the working age population was 53.4% in 1910. Conversely, the highest percentages of employed population were 45.5% and 63.2% of the total and working age population respectively. Using this data, a mean percentage of 43.9% of the total population and 58.9% of the working age population was derived. Therefore, it was decided to project the employed population based on 35, 40 and 45% of the total and 55, 60 and 65% of the working age population. These projections are contained in Tables A.4.5 and A.4.6 respectively. From these tabulations, it was decided to average the figures in the two tables to give the figures shown in Table A.4.3.

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1. Stone, P.A.: Urban Development in Britain, op.cit.
2. British Labour Statistics 1886 - 1968, op.cit.

TABLE A.4.4: EMPLOYED POPULATION AS A PERCENTAGE OF TOTAL AND WORKING AGE POPULATION

1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1955	1960	1965	1970	Mean	%
45.0	45.5	45.0	42.8	43.9	44.3	44.9	45.2	47.0	N.A.	41.6	42.4	42.9	43.9	41.5	43.9	of Total Population
60.0	60.6	60.4	57.6	59.7	56.5	53.4	58.0	60.7	N.A.	57.0	N.A.	N.A.	63.2	60.7	58.9	of Working Age Pop.

Source: See explanation, previous page.

TABLE A.4.5: EMPLOYED POPULATION AS 35, 40 and 45% OF TOTAL POPULATION

Birth Rate	1975	1980	1985	1990	1995	2000
			35 %			
High	19,964	20,960	22,092	23,460	25,142	27,263
R.G.	19,808	20,512	21,214	22,035	22,994	24,048
Low	19,808	20,443	20,985	21,481	21,971	22,445
			40 %			
High	22,816	23,954	25,248	26,811	28,733	31,157
R.G.	22,630	23,530	24,244	25,183	26,278	27,484
Low	22,638	23,363	23,983	24,550	25,110	25,652
			45 %			
High	25,668	26,948	28,404	30,163	32,325	35,051
R.G.	25,467	26,359	27,275	28,331	29,563	30,919
Low	25,467	26,283	26,981	27,618	28,249	28,858

(Thousands)

TABLE A.4.6: EMPLOYED POPULATION AS 55, 60 and 65% OF WORKING AGE POPULATION

Birth Rate	1975	1980	1985	1990	1995	2000
	55%					
High	20,810	21,297	22,034	23,168	24,480	26,186
R.G.	20,810	21,297	22,008	22,922	23,768	24,806
Low	20,810	21,297	22,008	22,922	23,675	24,446
	60%					
High	22,702	23,233	24,037	25,274	26,714	27,167
R.G.	22,702	23,233	24,009	25,006	25,929	27,061
Low	22,702	23,233	24,009	25,006	25,828	26,667
	65%					
High	24,593	25,169	26,040	27,380	28,941	29,547
R.G.	24,593	25,169	26,005	27,090	28,090	29,316
Low	24,593	25,169	26,005	27,090	27,980	28,899

(Thousands)

TABLE A.4.7: POPULATION EMPLOYED IN THE CONSTRUCTION INDUSTRY 1850 - 2000: GREAT BRITAIN

1850	1860	1870	1880	1890	1900	1910	Birth Rate
							High
497	594	716	877	902	1,219	1,145	R.G.
							Low

1920	1930	1940	1950	1955	1960	1965	Birth Rate
							High
899* 748**	987	N.A.	1294.4	1351.9	1422.7	1656.0	R.G.
							Low

1970	1975	1980	1985	1990	1995	2000	Birth Rate
	1758.8	1814.0	1880.8	1963.0	2017.5	2148.8	High
1505.8	1563.6	1612.2	1671.6	1743.9	1814.7	1908.7	R.G.
	1368.1	1411.5	1462.3	1525.6	1590.3	1672.7	Low

(Thousands)

Sources:

1. Data from 1850 to 1920* based on 1911 Census categories - from British Labour Statistics 1886 - 1968, op.cit.
2. Data for 1920** and 1930 based on 1951 Census categories - from ibid.
3. Data for 1950 and 1955 based on 1948 Standard Industrial Classification - from ibid.
4. Data for 1960 to 1970 based on 1952 Standard Industrial Classification - from ibid.
5. Data for 1975 to 2000 - see explanation Chap. 6, and Tables A.4.8 - A.4.13.

TABLE A.4.8: POPULATION EMPLOYED IN CONSTRUCTION INDUSTRY 1975 - 2000. BASED ON 2.5, 3.0 and 3.5% OF TOTAL POPULATION

Birth Rate	1975	1980	1985	1990	1995	2000
	2 . 5 %					
High	1425.0	1497.1	1578.0	1675.7	1795.8	1947.3
R.G.	1414.9	1464.4	1515.3	1573.9	1642.4	1717.7
Low	1414.9	1460.2	1498.9	1534.4	1569.4	1603.2
	3 . 0 %					
High	1711.2	1796.6	1893.6	2010.3	2155.0	2335.9
R.G.	1697.8	1757.3	1818.3	1888.7	1970.9	2062.3
Low	1697.8	1752.2	1798.7	1841.2	1883.3	1923.9
	3 . 5 %					
High	1996.4	2096.0	2209.3	2345.9	2514.1	2725.3
R.G.	1980.7	2050.1	2121.3	2203.4	2298.8	2405.8
Low	1980.7	2044.2	2098.4	2148.0	2197.1	2244.5

(Thousands)

Source: See Chap. 6.

TABLE A.4.9: POPULATION EMPLOYED IN CONSTRUCTION INDUSTRY 1975 - 2000 BASED ON 3.5, 4.0 and 4.5% OF WORKING AGE POPULATION

Birth Rate	1975	1980	1985	1990	1995	2000
		3.5%				
High	1324.3	1355.3	1402.2	1474.3	1558.3	1666.4
R.G.	1324.3	1355.3	1400.5	1458.7	1512.5	1578.6
Low	1324.3	1355.3	1400.5	1458.7	1506.6	1555.7
		4.0%				
High	1513.4	1548.9	1602.5	1648.9	1780.9	1904.4
R.G.	1513.4	1548.9	1600.6	1667.1	1728.6	1804.1
Low	1513.4	1548.9	1600.6	1667.1	1721.8	1777.9
		4.5%				
High	1702.6	1742.5	1802.8	1895.5	2003.5	2152.4
R.G.	1702.6	1742.5	1800.6	1875.4	1944.6	2029.6
Low	1702.6	1742.5	1800.6	1875.4	1937.0	2000.5

(Thousands)

Source: See Chap. 6.

TABLE A.4.10: POPULATION EMPLOYED IN CONSTRUCTION INDUSTRY 1975 - 2000 BASED ON 6.0, 6.5 and 7.0% OF EMPLOYED POPULATION

Birth Rate	1975	1980	1985	1990	1995	2000
		6.0%				
High	1365.5	1415.6	1478.6	1562.5	1633.4	1749.7
R.G.	1360.2	1402.9	1447.6	1505.8	1566.2	1636.3
Low	1360.2	1397.9	1439.8	1486.7	1528.1	1569.6
		6.5%				
High	1479.3	1533.6	1601.8	1692.7	1739.6	1895.5
R.G.	1473.5	1519.8	1569.3	1631.2	1696.8	1772.7
Low	1473.5	1514.4	1559.7	1610.5	1655.5	1700.4
		7.0%				
High	1590.0	1651.5	1725.0	1822.9	1875.7	2041.3
R.G.	1586.8	1636.7	1689.9	1756.6	1827.3	1909.0
Low	1586.8	1630.8	1679.6	1744.3	1782.8	1831.2

(Thousands)

Source: See Chap. 6.

TABLE A.4.11: AVERAGE POPULATION IN CONSTRUCTION INDUSTRY 1975 - 2000: GREAT BRITAIN

Birth Rate	1975	1980	1985	1990	1995	2000
	L O W S					
High	1371.6	1422.6	1486.2	1570.8	1662.5	1787.8
R.G.	1366.4	1407.5	1454.4	1512.8	1573.7	1644.2
Low	1366.4	1404.4	1446.4	1493.2	1534.7	1576.1
	M E D I U M S					
High	1567.9	1626.3	1699.3	1796.1	1891.8	2045.8
R.G.	1561.5	1608.8	1662.7	1729.0	1798.7	1897.7
Low	1561.5	1601.5	1653.0	1706.8	1753.6	1800.7
	H I G H S					
High	1763.0	1830.0	1912.3	2021.4	2056.9	2306.3
R.G.	1756.7	1809.7	1870.8	1945.1	2023.5	2114.8
Low	1756.7	1802.5	1859.5	1922.5	1972.3	2025.4

(Thousands)

Source: See Chap. 6.

TABLE A.4.12: UNADJUSTED VALUE OF OUTPUT OF CONSTRUCTION INDUSTRY (1948 - 1972): GREAT BRITAIN

1948	1949	1950	1951	1952	1953	1954	1955	1956	Sector
545	575	685	773	924	1066	1144	549	568	New Housing
							621	767	Other New Work
586	623	581	633	670	683	705	367	399	Repairs/Mainten.
195	209	215	223	259	290	320	327	343	Labour Emp'd L.A.s
1326	1407	1481	1629	1853	2039	2169	1864	2077	Total Value

1957	1958	1959	1960	1961	1962	1963	1964	1965	Sector
553	518	568	629	689	738	784	995	1051	New Housing
834	887	946	1024	1192	1268	1267	1472	1580	Other New Work
403	415	462	493	522	548	546	625	671	Repairs/Mainten.
354	357	423	435	442	457	473	522	549	Labour Emp'd L.A.s
2144	2177	2399	2581	2845	3011	3110	3614	3851	Total Value

1966	1967	1968	1969	1970	1971	1972	Sector
1064	1172	1256	1178	1134	1246	1423	New Housing
1670	1734	1834	1989	2189	2421	2590	Other New Work
716	748	791	826	864	921	1083	Repairs/Mainten.
589	653	688	705	747	847	970	Labour Emp'd L.A.s
4039	4307	4569	4697	4933	5435	6066	Total Value

(£s m.)

Sources:

1. Data for 1948 - 1954 from Annual Abstract of Statistics, No. 93 (1956).
2. Data for 1955 - 1961 from Annual Abstract of Statistics, No. 99 (1962).
3. Data for 1961 - 1972 from Annual Abstract of Statistics, No. 110 (1973).

Notes:

1. Figures for 1948 - 1954 for repair and maintenance are according to earlier classification and those after 1955 are according to standard industrial classification, therefore, they are not strictly comparable.
2. Figures in Labour Employed by Local Authorities (Labour Emp'd L.A.s) includes both new works and repair and maintenance.

TABLE A.4.13: ADJUSTED VALUE OF OUTPUT OF CONSTRUCTION INDUSTRY (1948 - 1972): GREAT BRITAIN

1948	1949	1959	1951	1952	1953	1954	1955	1956	Sector
898	925	1072	1109	1251	1420	1496	694	688	New Housing
							785	929	Other New Work
966	1002	909	908	907	909	922	464	483	Repairs/Mainten.
321	336	336	320	351	386	419	413	415	Labour Emp'd L.A.s
2185	2263	2321	2337	2509	2715	2837	2356	2515	Total Value

1957	1958	1959	1960	1961	1962	1963	1964	1965	Sector
649	592	645	707	752	776	810	995	1006	New Housing
979	1014	1074	1151	1302	1334	1309	1472	1512	Other New Work
473	474	524	554	570	576	564	625	642	Repairs/Mainten.
416	408	480	489	483	481	489	522	525	Labour Emp'd L.A.s
2517	2488	2728	2901	3107	3167	3172	3614	3685	Total Value

1966	1967	1968	1969	1970	1971	1972	Sector
978	1054	1079	960	870	872	931	New Housing
1536	1559	1575	1621	1679	1695	1694	Other New Work
658	672	679	673	663	645	708	Repairs/Mainten.
542	537	591	575	573	593	634	Labour Emp'd L.A.s
3714	3872	3924	3829	3785	3805	3967	Total Value

(1964 £s m.)

Source: Tables A.4.12 and A.5.6.

TABLE A.4.14: UNADJUSTED VALUE OF OUTPUT OF CONSTRUCTION INDUSTRY PER EMPLOYEE (1948 - 1972): GREAT BRITAIN

1948	1949	1950	1951	1952	1953	1954	1955	1956	
1233.0	1263.7	1294.4	1305.9	1317.4	1328.9	1340.4	1351.9	1366.0	(a)
1326	1407	1481	1629	1853	2039	2169	1864	2077	(b)
1075	1113	1152	1247	1407	1534	1544	1379	1520	(c)

1957	1958	1959	1960	1961	1962	1963	1964	1965	
1380.2	1394.3	1408.5	1422.7	1469.3	1515.0	1609.3	1656.0	1656.0	(a)
2144	2177	2399	2581	2845	3011	3110	3614	3851	(b)
1553	1634	1702	1814	1936	1986	1989	2246	2325	(c)

1966	1967	1968	1969	1970	1971	1972	
1626.0	1596.0	1566.0	1536.0	1505.8	1517.8	1528.8	(a)
4039	4307	4569	4697	4933	5435	6066	(b)
2484	2698	2917	3051	3276	3648	3967	(c)

Source: Tables A.4.12 and A.4.7.

Notes:

(a) Population employed in construction industry (thousands).
(b) Value of output of industry (unadjusted) (£s m.).
(c) Value per employee (unadjusted) (£s.).

TABLE A.4.15: ADJUSTED VALUE OF OUTPUT OF CONSTRUCTION INDUSTRY PER EMPLOYEE (1948 - 1972): GREAT BRITAIN

1948	1949	1950	1951	1952	1953	1954	1955	1956	
1233.0	1263.7	1294.4	1305.9	1317.4	1328.9	1340.4	1351.9	1366.0	(a)
2185	2263	2321	2337	2509	2715	2837	2356	2515	(b)
1772	1790	1793	1790	1905	2043	2117	1742	1841	(c)
-	+1.0	+0.2	-0.2	+6.4	+7.2	+3.6	-	+5.7	(d)

1957	1958	1959	1960	1961	1962	1963	1964	1965	
1380.2	1394.3	1408.5	1422.7	1469.3	1516.0	1609.3	1656.0	1656.0	(a)
2517	2488	2723	2501	3107	3167	3172	3614	3685	(b)
1825	1784	1933	2039	2115	2029	1971	2182	2225	(c)
-0.9	-2.2	+8.4	+5.5	+3.7	-1.2	-5.6	+10.7	+2.0	(d)

1966	1967	1968	1969	1970	1971	1972	
1626.0	1596.0	1566.0	1536.0	1505.8	1517.8	1528.8	(a)
3714	3872	3924	3829	3785	3805	3967	(b)
2284	2426	2505	2492	2514	2507	2594	(c)
+2.7	+6.2	+3.2	-0.5	+0.9	-0.3	+3.5	(d)

Source: Tables A.4.14 and A.5.6.

Notes:

(a) Population employed in construction industry (thousands).
(b) Value of output of construction industry (1964 £s m.)
(c) Value per employee (1964 £s).
(d) Percentage increase or decrease - value per employee.

TABLE A.4.16: LOW ESTIMATE OF OUTPUT OF CONSTRUCTION INDUSTRY (1975 - 2000): GREAT BRITAIN. 2% RISE IN PRODUCTIVITY

Date	Value per Emp'ee (£s)	Birth Rate (000s) High	Birth Rate (000s) R.G.	Birth Rate (000s) Low	Total Value (£s m.) Birth Rate (000s) High	Total Value (£s m.) Birth Rate (000s) R.G.	Total Value (£s m.) Birth Rate (000s) Low
1975	2720.73	1371.6	1366.4	1366.4	3731.75	3717.61	3717.61
76	2764.23	1381.8	1374.6	1374.0	3819.65	3799.75	3798.09
77	2808.49	1392.0	1382.8	1381.6	3909.42	3883.58	3880.21
78	2853.42	1402.2	1391.0	1389.2	4001.07	3969.11	3963.97
79	2900.07	1412.4	1399.2	1396.8	4096.06	4057.78	4050.82
1980	2946.47	1422.6	1407.5	1404.4	4191.65	4147.16	4138.02
81	2993.61	1435.3	1416.9	1412.8	4296.73	4241.65	4229.37
82	3041.51	1448.0	1426.3	1421.2	4404.11	4338.11	4322.59
83	3090.17	1460.7	1435.7	1429.6	4513.81	4436.56	4417.71
84	3139.61	1473.4	1445.1	1438.0	4625.90	4537.05	4514.76
1985	3189.84	1486.2	1454.4	1446.4	4740.74	4639.30	4613.78
86	3240.88	1503.1	1466.1	1455.7	4871.37	4751.45	4717.75
87	3292.73	1520.0	1477.8	1465.0	5004.95	4865.99	4823.85
88	3345.41	1536.9	1489.5	1474.3	5141.56	4982.99	4932.14
89	3398.94	1553.8	1501.2	1483.6	5881.27	5101.75	5042.67
1990	3453.32	1570.8	1512.8	1493.2	5424.48	5224.18	5156.50
91	3508.57	1589.1	1525.0	1501.5	5575.47	5350.57	5268.12
92	3564.71	1607.4	1537.2	1509.8	5729.91	5479.67	5382.00
93	3621.75	1625.7	1549.4	1518.1	5887.88	5611.54	5498.18
94	3679.70	1644.0	1561.6	1526.4	6049.43	5746.22	5616.69
1995	3738.58	1662.5	1573.7	1534.7	6215.39	5883.40	5737.60
96	3798.40	1687.6	1587.8	1543.0	6410.18	6031.10	5860.93
97	3859.17	1712.7	1601.9	1551.3	6609.60	6182.00	5986.73
98	3920.92	1737.8	1616.0	1559.6	6813.77	6336.21	6115.07
99	3983.65	1762.9	1630.1	1567.9	7022.78	6493.75	6245.96
2000	4047.39	1787.8	1644.2	1576.1	7235.92	6654.92	6379.09
					135,604.85	130,463.20	128,409.32

Notes:

1. Value per employee - interpolated between five yearly intervals - see Table A.4.14.
2. Population - interpolated between five yearly intervals - see Table A.4.7.
3. Productivity (in 1964 £s) raised by: 2.0% overall, = 1.60% compounded rise.
   2.5% overall, = 1.80% compounded rise.
   3.0% overall = 2.03% compounded rise.

TABLE A.4.17: MEDIUM ESTIMATE OF OUTPUT OF CONSTRUCTION INDUSTRY (1975 - 2000): GREAT BRITAIN. 2% RISE IN PRODUCTIVITY

Date	Value per Emp'ee (£s)	Birth Rate (000s) High	Birth Rate (000s) R.G.	Birth Rate (000s) Low	Total Value (£s m.) Birth Rate (000s) High	Total Value (£s m.) Birth Rate (000s) R.G.	Total Value (£s m.) Birth Rate (000s) Low
1975	2720.73	1567.9	1561.5	1561.5	4265.83	4248.42	4248.42
76	2764.36	1579.6	1571.0	1569.5	4366.43	4342.65	4338.51
77	2808.49	1591.3	1580.5	1577.5	4449.51	4438.82	4430.39
78	2853.42	1603.0	1590.0	1585.5	4574.03	4536.94	4524.10
79	2900.07	1614.7	1599.5	1593.5	4682.74	4638.66	4621.26
1980	2946.47	1626.3	1608.8	1601.5	4791.84	4740.28	4718.77
81	2993.61	1640.9	1619.6	1611.8	4912.21	4848.45	4825.10
82	3041.51	1655.5	1630.4	1622.1	5035.22	4958.88	4933.63
83	3090.17	1670.1	1641.2	1632.4	5160.89	5071.59	5044.39
84	3139.61	1684.7	1652.0	1642.7	5289.30	5186.64	5157.44
1985	3189.84	1699.3	1662.7	1653.0	5420.50	5303.75	5272.81
86	3240.88	1718.7	1676.0	1663.7	5570.10	5431.71	5391.85
87	3292.73	1738.1	1689.3	1674.4	5723.09	5562.41	5513.35
88	3345.41	1757.5	1702.6	1685.1	5879.56	5695.89	5637.35
89	3398.94	1776.9	1715.9	1695.8	6039.58	5832.24	5763.92
1990	3453.32	1796.1	1729.0	1706.8	6202.51	5970.79	5894.13
91	3508.51	1815.2	1742.9	1716.2	6368.76	6115.09	6021.41
92	3564.71	1834.3	1756.8	1725.6	6538.75	6262.42	6151.26
93	3621.75	1853.4	1770.7	1735.0	6712.55	6413.03	6283.74
94	3679.70	1872.5	1784.6	1744.4	6890.24	6566.79	6418.87
1995	3738.58	1871.8	1798.7	1753.6	7072.65	6724.58	6555.47
96	3798.40	1922.6	1814.9	1763.0	7302.80	6893.72	6696.58
97	3859.17	1953.4	1831.1	1772.4	7538.50	7066.53	6839.99
98	3920.92	1984.2	1847.3	1781.8	7779.89	7243.10	6986.30
99	3983.65	2015.0	1863.5	1791.2	8027.05	7423.53	7135.51
2000	4047.39	2045.8	1879.7	1800.7	8280.15	7607.88	7288.14
					154,894.32	149,124.87	146,693.91

Note: See Table A.4.16.

TABLE A.4.18: HIGH ESTIMATE OF OUTPUT OF CONSTRUCTION INDUSTRY (1975 - 2000): GREAT BRITAIN. 2% RISE IN PRODUCTIVITY

Date	Value per Emp'ee (£s)	Birth Rate (000s) High	Birth Rate (000s) R.G.	Birth Rate (000s) Low	Total Value (£s m.) Birth Rate (000s) High	Total Value (£s m.) Birth Rate (000s) R.G.	Total Value (£s m.) Birth Rate (000s) Low
1975	2720.73	1763.0	1756.7	1756.7	4796.65	4779.51	4779.51
76	2764.26	1776.4	1767.3	1765.9	4910.43	4885.28	4881.41
77	2808.49	1789.8	1777.9	1775.1	5026.64	4993.21	4985.35
78	2853.42	1803.2	1788.5	1784.3	5145.29	5103.34	5091.36
79	2900.07	1816.6	1799.1	1793.5	5268.27	5217.52	5201.28
1980	2946.47	1830.0	1809.7	1802.5	5392.04	5332.23	5311.02
81	2993.61	1846.5	1821.9	1813.9	5527.70	5454.06	5430.11
82	3041.51	1863.0	1834.1	1825.3	5666.33	5578.43	5551.67
83	3090.17	1879.5	1846.3	1836.7	5807.97	5705.38	5675.72
84	3139.61	1896.0	1858.5	1848.1	5952.70	5834.97	5802.31
1985	3189.84	1912.3	1870.8	1859.5	6099.93	5967.55	5931.51
86	3240.88	1934.1	1885.7	1872.1	6268.19	6111.33	6067.25
87	3292.73	1955.4	1900.6	1884.7	6440.25	6258.16	6205.81
88	3345.41	1977.7	1915.5	1897.3	6616.22	6405.13	6347.25
89	3398.94	1999.5	1930.4	1909.9	6796.18	6561.31	6491.64
1990	3453.30	2021.4	1945.1	1922.5	6980.54	6717.05	6635.01
91	3508.57	2028.5	1960.8	1932.5	7117.13	6879.60	6779.83
92	3564.71	2035.6	1976.5	1942.5	7256.32	7045.65	6924.45
93	3621.75	2042.7	1992.2	1952.5	7398.15	7215.25	7071.47
94	3679.70	2049.8	2007.9	1962.5	7542.65	7388.47	7221.41
1995	3738.58	2056.9	2023.5	1972.3	7689.88	7565.04	7373.60
96	3798.40	2106.8	2041.7	1982.9	8002.47	7755.19	7531.84
97	3859.17	2156.7	2059.9	1993.5	8323.07	7949.50	7693.26
98	3920.92	2206.6	2078.1	2004.1	8651.90	8148.06	7857.90
99	3983.65	2256.5	2096.3	2014.7	8989.11	8350.93	8025.86
2000	4047.39	2306.3	2114.8	2025.4	9334.50	8559.42	8197.58
					173,060.51	167,764.57	165,069.67

Note: See Table A.4.16

TABLE A.4.19: LOW ESTIMATE OF OUTPUT OF CONSTRUCTION INDUSTRY (1975 - 2000): GREAT BRITAIN. 2.5% RISE IN PRODUCTIVITY

Date	Value per Emp'ee (£s)	Birth Rate (00s) High	R.G.	Low	Total Value (£s m.) Birth Rate (000s) High	R.G.	Low
1975	2736.61	1371.6	1366.4	1366.4	3753.53	3739.30	3739.30
76	2785.87	1381.8	1374.6	1374.0	3849.52	3829.46	3827.79
77	2836.01	1392.0	1382.8	1381.6	3947.73	3921.63	3918.23
78	2887.06	1402.2	1391.0	1389.2	4048.24	4015.90	4010.70
79	2939.02	1412.4	1399.2	1396.8	4151.07	4112.28	4105.22
1980	2991.92	1422.6	1407.5	1404.4	4256.31	4211.13	4201.85
81	3045.77	1435.3	1416.9	1412.8	4371.59	4315.55	4303.06
82	3100.59	1448.0	1426.3	1421.2	4489.65	4422.37	4406.56
83	3156.40	1460.7	1435.7	1429.6	4610.55	4531.64	4512.39
84	3213.22	1473.4	1445.1	1438.0	4734.36	4643.42	4620.61
1985	3271.06	1486.2	1454.4	1446.4	4861.45	4757.43	4731.26
86	3329.94	1503.1	1466.1	1455.7	5005.23	4882.03	4847.39
87	3389.88	1520.0	1477.8	1465.0	5152.62	5009.56	5966.17
88	3450.90	1536.9	1489.5	1474.3	5303.69	5140.12	5087.66
89	3513.02	1553.8	1501.2	1483.6	5458.53	5273.75	5211.92
1990	3576.25	1570.8	1512.8	1493.2	5617.57	5410.15	5340.06
91	3640.62	1589.1	1525.0	1501.5	5785.31	5551.95	5466.39
92	3706.15	1607.4	1537.2	1509.8	5957.27	5697.09	5595.55
93	3772.86	1625.5	1549.4	1518.1	6133.54	5850.32	5727.58
94	3840.77	1644.0	1561.6	1526.4	6314.23	5997.75	5862.55
1995	3909.90	1662.5	1573.7	1534.7	6500.21	6153.01	6000.52
96	3980.27	1687.6	1587.8	1543.0	6717.10	6319.87	6141.56
97	4051.91	1712.7	1601.9	1551.3	6939.71	6490.75	6285.73
98	4124.84	1737.8	1616.0	1559.6	7168.15	6665.74	6433.10
99	4199.09	1762.9	1630.1	1567.9	7402.57	6844.94	6583.75
2000	4274.67	1787.8	1644.2	1576.1	7642.25	7028.41	6737.31
					140,171.98	138,481.55	132,666.21

Note: See Table A.4.16.

TABLE A.4.20: MEDIUM ESTIMATE OF OUTPUT OF CONSTRUCTION INDUSTRY (1975 - 2000): GREAT BRITAIN. 2.5% RISE IN PRODUCTIVITY.

Date	Value per Emp'ee (£s)	Birth Rate (000s) High	Birth Rate (000s) R.G.	Birth Rate (000s) Low	Total Value (£s m.) Birth Rate (000s) High	Total Value (£s m.) Birth Rate (000s) R.G.	Total Value (£s m.) Birth Rate (000s) Low
1975	2736.61	1567.9	1561.5	1561.5	4290.73	4273.22	4273.22
76	2785.87	1579.6	1571.0	1569.5	4400.56	4376.60	4372.42
77	2836.01	1591.3	1580.5	1577.5	4512.94	4482.31	4473.81
78	2887.06	1603.0	1590.0	1585.5	4627.96	4590.47	4577.43
79	2939.02	1614.7	1599.5	1593.5	4745.63	4700.96	4683.33
1980	2991.92	1626.3	1608.8	1601.5	4865.76	4813.40	4791.56
81	3045.77	1640.9	1619.6	1611.8	4997.80	4932.93	4909.17
82	3100.59	1655.5	1630.4	1622.1	5133.03	5055.20	5029.47
83	3156.40	1670.1	1641.2	1632.4	5271.50	5180.28	5152.51
84	3213.22	1684.7	1652.0	1642.7	5413.31	5308.24	5278.36
1985	3271.06	1699.3	1662.7	1653.0	5558.51	5438.79	5407.06
86	3329.94	1718.7	1676.0	1663.7	5723.17	5580.98	5540.02
87	3389.88	1738.1	1689.3	1674.4	5891.95	5726.52	5676.02
88	3450.90	1757.5	1702.6	1685.1	6064.96	5875.50	5815.11
89	3513.02	1776.9	1715.9	1695.8	6242.29	6027.99	5957.38
1990	3576.25	1796.1	1729.0	1706.8	6423.30	6183.34	6103.94
91	3640.62	1815.2	1742.9	1716.2	6608.45	6345.24	6248.03
92	3706.15	1834.3	1756.8	1725.6	6798.19	6510.96	6395.33
93	3772.86	1853.4	1770.7	1735.0	6992.62	6680.60	6545.91
94	3840.77	1872.5	1784.6	1744.4	7191.84	6854.24	6699.84
1995	3909.90	1891.8	1798.7	1753.6	7396.75	7032.74	6856.40
96	3980.27	1922.6	1814.9	1763.0	7652.47	7223.74	7017.22
97	4051.91	1953.4	1831.1	1772.4	7915.00	7419.45	7181.61
98	4124.84	1984.2	1847.3	1781.8	8184.51	7620.00	7349.64
99	4199.09	2015.0	1863.5	1791.2	8461.17	7825.00	7521.41
2000	4274.67	2045.8	1879.7	1800.7	8745.12	8035.10	7697.40
					160,109.52	154,093.81	148,552.60

Note: See Table A.4.16.

TABLE A.4.21: HIGH ESTIMATE OF OUTPUT OF CONSTRUCTION INDUSTRY (1975 - 2000): GREAT BRITAIN. 2.5% RISE IN PRODUCTIVITY

Date	Value per Emp'ee (£s)	Birth Rate (000s) High	R.G.	Low	Total Value (£s m.) Birth Rate (000s) High	R.G.	Low
1975	2736.61	1763.0	1756.7	1756.7	4824.64	4807.40	4807.40
76	2785.87	1776.4	1767.3	1765.9	4948.82	4923.49	4919.57
77	2836.01	1789.8	1777.9	1775.1	5075.89	5042.14	5034.20
78	2887.06	1803.2	1788.5	1784.3	5205.95	5163.51	5151.38
79	2939.02	1816.6	1799.1	1793.5	5339.02	5287.59	5272.75
1980	2991.92	1830.0	1809.7	1802.5	5475.21	5414.48	5392.94
81	3045.77	1846.5	1821.9	1813.9	5624.01	5549.09	5524.72
82	3100.59	1863.0	1834.1	1825.3	5776.40	5686.79	5659.51
83	3156.40	1879.5	1846.3	1836.7	5932.45	5827.66	5797.36
84	3213.22	1896.0	1858.5	1848.1	6092.27	5971.77	5938.35
1985	3271.06	1912.3	1870.8	1859.5	6255.25	6119.50	6082.54
86	3329.94	1934.1	1885.7	1872.1	6440.44	6279.27	6233.87
87	3389.88	1955.9	1900.6	1884.7	6630.27	6442.81	6388.91
88	3450.90	1977.7	1915.5	1897.3	6824.85	6610.20	6547.40
89	3513.02	1999.5	1930.4	1909.9	7024.28	6781.53	6709.52
1990	3576.25	2021.4	1945.1	1922.5	7229.03	6956.16	6875.34
91	3640.62	2028.5	1960.8	1932.5	7384.99	7138.53	7035.50
92	3706.15	2035.6	1976.5	1942.5	7544.24	7325.21	7199.20
93	3772.86	2042.7	1992.2	1952.5	7706.82	7516.29	7366.51
94	3840.77	2049.8	2007.9	1962.5	7872.81	7711.88	7537.51
1995	3909.90	2056.9	2023.5	1972.3	8042.27	7911.68	7711.50
96	3980.27	2106.8	2041.7	1982.9	8385.63	8126.52	7892.48
97	4051.91	2156.7	2059.9	1993.5	8738.75	8346.53	8017.48
98	4124.84	2206.6	2078.1	2004.1	9101.87	8571.83	8266.59
99	4199.09	2256.5	2096.3	2014.7	9475.25	8802.55	8459.91
2000	4274.67	2306.3	2114.8	2025.4	9858.67	9040.07	8657.92
					178,810.08	173,354.48	170,540.36

Note: See Table A.4.16.

TABLE A.4.22: LOW ESTIMATE OF OUTPUT OF CONSTRUCTION INDUSTRY (1975 - 2000): GREAT BRITAIN. 3% RISE IN PRODUCTIVITY

Date	Value per Emp'ee (£s)	Birth Rate (000s) High	Birth Rate (000s) R.G.	Birth Rate (000s) Low	Total Value (£s m.) Birth Rate (000s) High	Total Value (£s m.) Birth Rate (000s) R.G.	Total Value (£s m.) Birth Rate (000s) Low
1975	2755.21	1371.6	1366.4	1366.4	3779.05	3764.72	3764.72
76	2811.14	1381.8	1374.6	1374.0	3884.43	3864.19	3862.51
77	2868.21	1392.0	1382.8	1381.6	3992.55	3966.16	3962.72
78	2926.43	1402.2	1391.0	1389.2	4103.44	4070.66	4065.39
79	2985.84	1412.4	1399.2	1396.8	4217.20	4177.79	4170.62
1980	3046.45	1422.6	1407.5	1404.5	4333.88	4287.88	4278.80
81	3108.29	1435.3	1416.9	1412.8	4461.33	4404.14	4391.39
82	3171.39	1448.0	1426.3	1421.2	4592.17	4523.35	4507.18
83	3235.17	1460.7	1435.7	1429.6	4726.49	4645.59	4625.86
84	3301.46	1473.4	1445.1	1438.0	4864.37	4770.94	4747.50
1985	3368.48	1486.2	1454.4	1446.4	5006.24	4899.12	4872.17
86	3436.86	1503.1	1466.1	1455.7	5164.94	5038.78	5003.04
87	3506.63	1520.0	1477.8	1465.0	5330.08	5182.09	5137.21
88	3577.81	1536.9	1489.5	1474.3	5498.74	5329.15	5274.77
89	3650.44	1553.8	1501.2	1483.6	5672.05	5480.04	5415.79
1990	3724.54	1570.8	1512.8	1493.2	5850.51	5634.48	5561.48
91	3800.15	1589.1	1525.0	1501.5	6038.82	5795.23	5705.93
92	3877.29	1607.4	1537.2	1509.8	6232.36	5960.15	5853.93
93	3956.00	1625.7	1549.4	1518.1	6431.27	6129.43	6005.60
94	4036.31	1644.0	1561.6	1526.4	6635.69	6303.10	6161.02
1995	4118.25	1662.5	1573.7	1534.7	6846.59	6480.89	6320.28
96	4221.85	1687.6	1587.8	1543.0	7124.79	6703.45	6514.31
97	4307.55	1712.7	1601.9	1551.3	7377.54	6900.26	6682.30
98	4394.99	1737.8	1616.0	1559.6	7637.61	7102.30	6854.43
99	4484.21	1762.9	1630.1	1567.9	7905.21	7309.71	7030.79
2000	4575.24	1787.8	1644.2	1576.1	8179.61	7522.61	7211.04
					145,887.96	140,246.23	137,980.78

Note: See Table A.4.16.

TABLE A.4.23: MEDIUM ESTIMATE OF OUTPUT OF CONSTRUCTION INDUSTRY (1975 - 2000): GREAT BRITAIN. 3% RISE IN PRODUCTIVITY

Date	Value per Emp'ee (£s)	Birth Rate (000s) High	Birth Rate (000s) R.G.	Birth Rate (000s) Low	Total Value (£s m.) Birth Rate (000s) High	Total Value (£s m.) Birth Rate (000s) R.G.	Total Value (£s m.) Birth Rate (000s) Low
1975	2755.21	1567.9	1561.5	1561.5	4319.89	4302.26	4302.26
76	2811.14	1579.6	1571.0	1569.5	4440.47	4416.30	4412.08
77	2868.21	1591.3	1580.5	1577.5	4564.18	4533.21	4524.60
78	2926.43	1603.0	1590.0	1585.5	4691.07	4653.02	4639.85
79	2985.84	1614.7	1599.5	1593.5	4821.23	4775.85	4757.94
1980	3046.45	1626.3	1608.8	1601.5	4954.44	4901.13	4878.89
81	3108.29	1640.9	1619.6	1611.8	5100.40	5034.19	5009.94
82	3171.39	1655.5	1630.4	1622.1	5250.24	5170.63	5144.31
83	3235.77	1670.1	1641.2	1632.4	5404.06	5310.55	5282.07
84	3301.46	1684.7	1652.0	1642.7	5561.97	5454.01	5423.31
1985	3368.48	1699.3	1662.7	1653.0	5724.06	5600.77	5568.04
86	3436.86	1718.7	1676.0	1663.7	5906.93	5760.18	5717.90
87	3506.63	1738.1	1689.3	1674.4	6094.87	5923.75	5871.50
88	3577.81	1757.5	1702.6	1685.1	6288.00	6091.58	6028.97
89	3650.44	1776.9	1715.9	1695.8	6486.47	6263.79	6190.42
1990	3724.54	1796.1	1729.0	1706.8	6689.65	6439.73	6357.04
91	3800.15	1815.2	1742.9	1716.2	6898.03	6623.28	6521.82
92	3877.22	1834.3	1756.8	1725.6	7112.11	6811.63	6690.65
93	3956.00	1853.4	1770.7	1735.0	7332.05	7004.89	6863.66
94	4036.31	1872.5	1784.6	1744.4	7557.99	7203.20	7040.94
1995	4118.25	1891.8	1798.7	1753.6	7790.91	7407.50	7221.76
96	4221.85	1922.6	1814.9	1763.0	8116.94	7662.24	7443.12
97	4307.55	1953.4	1831.1	1772.4	8414.37	7887.55	7634.70
98	4394.99	1984.2	1847.3	1781.8	8720.54	8118.87	7830.99
99	4484.21	2015.0	1863.5	1791.2	9035.68	8356.33	8032.12
2000	4575.24	2045.8	1879.7	1800.7	9360.03	8600.08	8238.64
					166,636.58	159,306.52	157,627.53

Note: See Table A.4.16.

TABLE A.4.24: HIGH ESTIMATE OF OUTPUT OF CONSTRUCTION INDUSTRY (1975 - 2000): GREAT BRITAIN. 3% RISE IN PRODUCTIVITY

Date	Value per Emp'ee (£s)	Birth Rate (000s) High	Birth Rate (000s) R.G.	Birth Rate (000s) Low	Total Value (£s m.) Birth Rate (000s) High	Total Value (£s m.) Birth Rate (000s) R.G.	Total Value (£s m.) Birth Rate (000s) Low
1975	2755.21	1763.0	1756.7	1756.7	4857.44	4840.08	4840.08
76	2811.14	1776.4	1767.3	1765.9	4993.71	4968.13	4964.19
77	2868.21	1789.8	1777.9	1775.1	5133.52	5099.39	5091.36
78	2926.43	1803.2	1788.5	1784.3	5276.94	5233.92	5221.63
79	2985.84	1816.6	1799.1	1793.5	5424.08	5371.82	5355.10
1980	3046.45	1830.0	1809.7	1802.5	5575.00	5513.16	5490.94
81	3108.29	1846.5	1821.9	1813.9	5739.46	5662.99	5638.13
82	3171.39	1863.0	1834.1	1825.3	5908.30	5816.65	5788.74
83	3235.77	1879.5	1846.3	1836.7	6081.63	5974.20	5943.14
84	3301.46	1896.0	1858.5	1848.1	6260.16	6136.34	6101.43
1985	3368.48	1912.3	1870.8	1859.5	6441.55	6301.71	6263.69
86	3436.86	1934.1	1885.7	1872.1	6647.23	6489.89	6434.14
87	3506.63	1955.9	1900.6	1884.7	6858.62	6664.70	6608.94
88	3577.81	1977.7	1915.5	1897.3	7075.83	6853.30	6788.18
89	3650.44	1999.5	1930.4	1909.9	7299.05	7046.81	6971.97
1990	3724.54	2021.4	1945.1	1922.5	7528.79	7244.60	7160.43
91	3800.15	2028.5	1960.8	1932.5	7708.60	7451.33	7343.79
92	3877.29	2035.6	1976.5	1942.5	7892.61	7663.46	7531.64
93	3956.00	2042.7	1992.2	1952.5	8080.92	7881.14	7724.09
94	4036.31	2049.8	2007.9	1962.5	8273.64	8104.51	7921.26
1995	4118.25	2056.9	2023.5	1972.3	8470.82	8333.28	8122.42
96	4221.85	2106.8	2041.7	1982.9	8894.59	8619.75	8371.51
97	4307.55	2156.7	2059.9	1993.5	9290.09	8873.12	8587.10
98	4394.99	2206.6	2078.1	2004.1	9697.98	9133.23	8807.99
99	4484.21	2256.5	2096.3	2014.7	10,118.62	9400.25	9035.91
2000	4575.24	2306.3	2114.8	2025.4	10,551.88	9675.72	9266.69
					186,081.06	180,344.48	177,374.50

Note: See Table A.4.16.

TABLE A.4.25: PERCENTAGE OF VALUE OF OUTPUT OF CONSTRUCTION INDUSTRY BY SECTOR (1948 - 1972): GREAT BRITAIN

1948	1949	1950	1951	1952	1953	1954	1955	1956	
{41.1	40.8	46.2	47.4	49.3	52.7	52.7}	29.4	27.3	(a)
							33.3	36.9	(b)
44.2	44.2	39.2	39.4	36.1	33.4	32.5	19.7	19.2	(c)
14.7	15.0	14.6	13.2	14.6	13.9	14.8	17.6	16.6	(d)
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	

1957	1958	1959	1960	1961	1962	1963	1964	1965	
25.8	23.8	23.7	24.3	24.2	24.4	25.2	27.5	27.3	(a)
38.9	40.7	39.4	39.7	41.8	42.1	40.7	40.7	41.0	(b)
18.8	19.0	19.2	19.1	18.3	18.2	17.5	17.3	17.8	(c)
16.5	16.5	17.7	16.9	15.7	15.3	16.4	14.5	13.9	(d)
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	

1966	1967	1968	1969	1970	1971	1972	Average	
26.3	27.2	27.5	25.0	22.9	22.9	23.4	25.1	(a)
41.2	40.3	40.1	42.3	44.3	44.7	42.6	38.6	(b)
17.7	17.3	17.3	17.6	17.5	18.9	17.8	21.0	(c)
14.8	15.2	15.1	15.1	15.3	13.5	16.2	15.3	(d)
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	

Source: Table A.4.12.

Notes: (a) New Housing
(b) Other New Work
(c) Repair/Maintenance
(d) Labour Employed Directly by Local Authorities.

A P P E N D I X F I V E

B A S I C D A T A F O R C H A P T E R S E V E N

TABLE A.5.1: POPULATION CHANGE: EDINBURGH, GREAT BRITAIN (1851 - 1971)

Date	Edin.	Leith	Porto-bello	Total	% Change	G.B. (000s)	% Change
1851	160,302	30,919	3,497	194,718		20,816	
1861	168,121	34,888	4,366	207,375	6.5	23,128	11.1
1871	196,979	44,721	5,481	247,181	19.2	26,072	12.7
1881	228,357	59,485	6,794	294,636	19.2	29,710	14.0
1891	261,225	68,707	8,182	338,114	14.8	33,028	11.2
1901	316,837	77,439	9,180	403,456	19.3	36,999	12.0
1911	320,318	80,488	11,039	411,843	2.1	40,831	10.4
1921	420,264			420,264	2.0	42,769	4.7
1931	439,010			439,010	4.5	44,795	4.7
1941	452,885*			452,885*	3.2	46,466*	3.7
1951	466,761			466,761	3.1	48,854	5.1
1961	468,361			468,361	0.3	50,076	2.5
1971	453,584			453,584	3.2	51,299	2.4

Source: Registrar General <u>Statistical Review</u> 'Part 2 - Population' op.cit.

Note: * estimated population.

TABLE A.5.2: VALUE OF STOCK: EDINBURGH (1855-1970)

	VALUE	UNADJUSTED (£ s)				Value Adjusted (1964=100) (£s)
Date	Edinburgh	Leith	Porto-bello	Other	Total	Total
1855/56	749,906	126,276	16,841		893,023	3,416,705
60/61	849,308	147,635	19,770		1,016,713	3,968,231
65/66	1,010,572	185,752	25,173		1,221,497	4,673,448
70/71	1,225,402	236,558	31,500		1,493,460	5,787.158
75/76	1,429,054	289,588	36,869		1,755,511	6,802,605
80/81	1,742,115	339,770	46,927		2,128,812	9,351,871
85/86	1,948,684	356,882	46,130		2,351,696	12,621,552
90/91	2,120,704	387,989	47,334		2,556,027	13,718,196
95/96	2,277,166	423,019	50,435		2,750,620	17,150,115
1900/01	2,357,757			993,209	3,350,966	17,267,527
05/06	3,182,749			561,200	3,743,949	20,093,774
10/11	3,362,178			499,524	3,861,712	19,134,782
15/16	3,361,542			587,980	3,949,522	17,954,527
20/21	3,232,874			1,204,202	4,437,076	6,828,660
25/26	5,458,047				5,548,047	15,506,311
30/31	5,838,042				5,838,042	23,264,597
35/36	6,397,406				6,397,406	29,434,465
40/41	7,153,878				7,153,878	21,590,403
45/46	6,989,085				6,989,085	16,466,284
50/51	7,342,728				7,342,728	8,752,531
55/56	8,159,046				8,159,046	8,518,044
60/61	8,854,081				8,854,081	9,526,991
65/66	14,378,579				14,378,579	13,745,921
70/71	21,339,799				21,339,799	16,324,746

Source: Valuation Rolls.

Notes: a) Value from 1855 - 1925 = Yearly Rent or Value.
b) Value from 1930 - 1970 = Gross Annual Value.

TABLE A.5.3: MEAN HOUSING PRICE: EDINBURGH (1910 - 1970)

Date	UNADJUSTED £ s	ADJUSTED (1964=100) £s
1910	623	3087
15	612	2190
20	828	1274
25	869	2469
30	743	2961
35	713	3281
40	629	1898
45	1666	3925
50	2081	2481
55	1713	1788
60	1899	2043
65	3382	3233
70	4143	3169

Source: Richardson, H.W. et al.: 'Determinants of Urban House Prices', op.cit.

TABLE A.5.4: INTEREST RATE (1860 - 1970)

Date	Interest Rate %	Date	Interest Rate %	Date	Interest Rate %
1860	4.18	1897	2.63	1934	2.00
61	5.27	98	3.24	35	2.00
62	2.53	99	3.75	36	2.00
63	4.41	1900	3.96	37	2.00
64	7.40	01	3.72	38	2.00
65	4.77	02	3.33	39	2.26
66	6.99	03	3.75	1940	2.00
67	2.54	04	3.30	41	2.00
68	2.10	05	3.01	42	2.00
69	3.21	06	4.27	43	2.00
1870	3.10	07	4.93	44	2.00
71	2.88	08	3.01	45	2.00
72	4.10	09	3.10	46	2.00
73	4.79	1910	3.72	47	2.00
74	3.69	11	3.47	48	2.00
75	3.23	12	3.77	49	2.00
76	2.60	13	4.77	1950	2.00
77	2.90	14	4.04	51	2.08
78	3.78	15	5.00	52	3.71
79	2.52	16	5.46	53	3.88
1880	2.77	17	5.15	54	3.17
81	3.50	18	5.00	55	4.29
82	4.11	19	5.15	56	5.33
83	3.57	1920	6.72	57	5.54
84	2.95	21	6.12	58	5.42
85	2.88	22	3.69	59	4.00
86	3.05	23	3.49	1960	5.42
87	3.35	24	4.00	61	5.83
88	3.30	25	4.55	62	4.90
89	3.55	26	5.00	63	4.00
1890	4.52	27	4.65	64	5.00
91	3.26	28	4.50	65	6.40
92	2.53	29	5.50	66	6.50
93	3.05	1930	3.42	67	6.42
94	2.11	31	3.93	68	7.25
95	2.00	32	3.00	69	8.00
96	2.48	33	2.00	1970	7.25

Sources: a) Annual Abstract of Statistics (1971), op.cit. (1937 - 1970).
b) Mitchell, B.R. and Dean, P.: op.cit. (1860 - 1937).

Note: Interest Rate reflects average for year.

TABLE A.5.5: AMOUNT ADVANCED BY BUILDING SOCIETIES (1901 - 1966)

Date	£s m.	Adjusted 1964=100 £s m.	Date	£s m.	Adjusted 1964=100 £s m.
1901	8.9	49.1	1934	124.6	587.3
02	8.9	49.8	35	130.9	602.3
03	9.7	54.3	36	140.3	609.2
04	9.4	51.9	37	136.9	517.4
05	9.0	48.3	38	137.0	588.1
06	9.2	46.1	39	44.3	387.7
07	9.6	46.3	1940	21.2	63.9
08	8.9	47.1	41	10.0	27.2
09	9.0	47.0	42	16.3	41.7
1910	9.3	46.0	43	28.1	70.1
11	8.9	42.9	44	52.9	127.8
12	8.3	37.7	45	97.6	229.9
13	9.1	41.3	46	188.2	408.4
14	8.8	40.0	47	242.5	405.2
15	6.5	23.2	48	264.0	392.3
16	4.9	13.9	49	276.0	389.0
17	4.9	9.7	1950	269.7	321.5
18	7.0	14.0	51	367.6	354.4
19	15.8	29.6	52	266.1	270.6
1920	25.1	38.6	53	299.5	316.3
21	19.7	49.1	54	376.2	399.3
22	22.7	66.9	55	394.4	411.8
23	32.0	95.8	56	334.9	336.9
24	40.6	112.9	57	374.1	384.6
25	49.8	141.4	58	374.7	408.0
26	52.2	160.0	59	517.3	561.8
27	55.9	177.0	1960	559.8	602.3
28	58.7	189.0	61	545.8	596.0
29	74.7	273.4	62	613.0	657.1
1930	88.8	353.9	63	849.4	877.4
31	90.3	420.4	64	1042.5	1042.5
32	82.1	396.5	65	955.4	913.4
33	103.2	504.9	66	1244.7	1145.1

Source: Mitchell, R.B. and Dean, P.: op.cit.

TABLE A.5.6: WHOLESALE PRICE INDEX (1770 - 1972)

Date	WPI	PP	Date	WPI	PP	Date	WPI	PP	Date	WPI	PP
1770	23.7	427.9	1800	43.6	229.4	1830	27.2	367.9	1860	25.6	390.3
71	24.7	404.9	01	46.9	214.6	31	27.9	358.4	61	25.4	394.3
72	26.4	378.8	02	37.9	263.9	32	27.2	367.6	62	26.1	382.6
73	26.7	374.5	03	40.1	249.4	33	26.7	374.5	63	26.7	375.1
74	26.2	381.7	04	39.7	251.9	34	27.9	358.4	64	26.5	377.4
75	25.4	393.7	05	42.4	235.8	35	27.9	358.4	65	26.1	382.6
76	26.4	378.8	06	41.4	241.5	36	30.7	325.7	66	26.4	378.0
77	25.7	389.1	07	40.1	249.4	37	29.4	340.1	67	25.9	386.5
78	27.2	367.6	08	47.3	211.4	38	29.6	337.8	68	25.6	390.3
79	26.9	371.7	09	51.3	193.9	39	32.4	308.6	69	25.4	394.3
1780	27.2	367.6	1810	48.1	207.9	1840	31.9	313.5	1870	25.8	387.5
81	27.4	365.0	11	44.6	224.2	41	30.2	331.1	71	25.9	386.5
82	28.4	352.1	12	48.8	204.9	42	27.6	362.3	72	28.2	354.5
83	29.9	334.4	13	50.6	197.6	43	26.2	381.7	73	28.7	348.1
84	28.7	348.4	14	50.4	198.4	44	26.9	371.7	74	26.4	378.8
85	27.4	365.0	15	40.9	244.5	45	25.5	392.2	75	25.8	387.5
86	28.2	354.6	16	35.9	278.6	46	22.2	450.5	76	24.6	406.7
87	27.7	361.0	17	40.1	249.4	47	23.6	423.7	77	24.3	411.0
88	28.7	348.4	18	39.9	250.6	48	19.4	515.5	78	22.5	444.1
89	27.7	361.0	19	36.6	276.2	49	19.2	520.8	79	21.5	465.5
1790	28.4	352.1	1820	32.9	303.9	1850	19.9	501.9	1880	22.8	439.3
91	27.9	358.4	21	30.2	331.1	51	19.4	515.2	81	22.0	454.6
92	28.6	349.7	22	28.9	346.0	52	20.2	495.5	82	21.7	460.1
93	30.6	326.8	23	30.0	333.3	53	24.6	406.7	83	21.2	470.7
94	31.1	321.5	24	30.4	328.9	54	26.4	378.8	84	19.7	508.4
95	32.1	311.5	25	33.2	301.2	55	26.1	382.6	85	18.6	536.7
96	34.4	290.7	26	29.2	342.5	56	26.1	382.6	86	17.4	560.2
97	35.9	278.6	27	39.2	342.5	57	27.2	368.1	87	17.6	568.3
98	34.9	286.5	28	37.9	358.4	58	23.3	424.6	88	18.1	552.2
99	35.9	278.6	29	27.4	364.9	59	24.3	411.1	89	18.6	536.7

TABLE A.5.6: (contd.)

Date	WPI	PP	Date	WPI	PP	Date	WPI	PP	Date	WPI	PP
1890	18.6	536.7	1911	20.7	483.0	1932	20.7	482.9	1953	94.7	105.6
91	18.6	536.7	12	22.0	454.6	33	20.4	489.2	54	93.5	107.0
92	17.6	568.3	13	22.0	454.6	34	21.2	471.3	55	95.8	104.4
93	17.6	568.3	14	22.0	454.6	35	21.7	460.1	56	99.4	100.6
94	16.3	613.4	15	27.9	357.8	36	23.0	434.2	57	97.3	102.8
95	16.0	623.5	16	35.2	284.1	37	26.4	378.8	58	91.8	108.9
96	15.8	633.4	17	46.3	215.8	38	23.3	429.3	59	92.1	108.6
97	16.0	623.5	18	49.7	201.2	39	24.3	411.1	1960	92.9	107.6
98	16.6	603.8	19	53.3	187.6	1940	33.1	301.8	61	91.6	109.2
99	17.6	568.3	1920	65.0	153.9	41	36.8	272.1	62	93.3	107.2
1900	19.4	515.3	21	40.1	249.3	42	39.1	255.9	63	96.8	103.3
01	18.1	552.2	22	33.9	295.1	43	40.1	249.3	64	100.0	100.0
02	17.9	560.2	23	33.4	299.5	44	41.4	241.6	65	104.6	95.6
03	17.9	560.2	24	36.0	278.1	45	42.4	235.6	66	108.7	92.0
04	18.1	552.2	25	35.2	284.1	46	46.1	217.0	67	111.4	89.8
05	18.6	536.7	26	32.6	306.7	47	59.6	167.9	68	116.4	85.9
06	19.9	502.2	27	31.6	316.7	48	67.3	148.6	69	122.7	81.5
07	20.7	483.0	28	31.1	322.0	49	70.9	141.0	1970	130.7	76.5
08	18.9	530.0	29	29.8	336.1	1950	83.9	119.2	71	142.9	70.0
09	19.1	522.3	1930	25.1	398.5	51	103.7	96.4	72	152.9	65.4
1910	20.2	495.5	31	21.5	465.6	52	98.3	101.7			

Sources:

a) Annual Abstract of Statistics (1973), op.cit. (1966 - 1972).
b) Mitchell, B.R. and Jones, H.G.: Second Abstract of British Historical Statistics, Cambridge, Cambridge University Press, 1971. (1938 - 1965).
c) Mitchell, B.R. and Dean, P.: op.cit. (1770 - 1937).

Notes:

WPI: Wholesale Price Index.
PP : Purchasing Power.
1964 = 100.

TABLE A.5.7: INDEX OF BUILDING COSTS (1850 - 1970)

Date	Index	Date	Index	Date	Index
1850	10.8	1891	11.2	1932	20.9
51	10.6	92	11.1	33	20.5
52	10.8	93	10.9	34	20.5
53	12.0	94	10.8	35	21.0
54	12.4	95	10.7	36	21.8
55	12.2	96	10.8	37	22.9
56	11.5	97	11.1	38	23.3
57	11.8	98	11.6	39	24.8
58	11.5	99	12.2	1940	28.2
59	11.3	1900	12.9	41	32.5
1860	11.4	01	12.7	42	35.0
61	11.2	02	12.0	43	35.9
62	11.0	03	11.7	44	37.6
63	11.3	04	11.4	45	42.7
64	11.5	05	11.7	46	47.9
65	11.3	06	11.7	47	52.1
66	11.7	07	12.1	48	55.6
67	11.6	08	11.6	49	57.3
68	11.4	09	11.5	1950	59.0
69	11.6	1910	11.8	51	68.4
1870	11.7	11	12.3	52	75.2
71	11.9	12	12.8	53	73.5
72	13.0	13	13.1	54	75.2
73	14.4	14	13.3	55	78.6
74	13.9	15	16.0	56	82.9
75	13.0	16	18.7	57	84.6
76	12.7	17	21.5	58	85.5
77	12.5	18	26.8	59	84.6
78	11.9	19	33.3	1960	86.3
79	11.5	1920	39.1	61	90.6
1880	12.2	21	32.0	62	94.0
81	11.8	22	25.9	63	96.6
82	12.0	23	24.4	64	100.0
83	11.7	24	25.3	65	105.1
84	11.3	25	25.3	66	109.4
85	11.2	26	24.6	67	113.0
86	10.9	27	24.2	68	118.0
87	10.8	28	23.2	69	123.0
88	10.8	29	23.2	1970	131.0
89	11.1	1930	22.8		
1890	11.5	31	21.9		

Sources:

a) Annual Abstract of Statistics, op.cit. (1966 - 1970).
b) Mitchell, B.R. and Jones, H.G.: op.cit. (1939 - 1965).
c) Mitchell, B.R. and Dean, P.: op.cit. (1845 - 1938).

Note: 1850 - 1938 index for United Kingdom.
1939 - 1970 index for Great Britain.

TABLE A.5.8: INDEX OF BUILDING ACTIVITY: TRANS-SECTION (1860 - 1970)

Date	Add.	Alt.	Alt./ Add.	New Bdg.	Sub-Div.	Dem.	Rebd.	Conv.	New Fac.	Oth.	Total
1860	9.5	55.6	22.2			7.7	6.7				26.6
61		34.7				7.7	6.7				15.6
62		43.1									17.9
63		40.3									16.8
64		36.1		20.0							16.2
65		52.8		10.0		15.4	13.3				24.9
66		40.3				7.7	6.7				17.9
67		43.1		10.0			6.7				19.1
68		44.4									18.5
69		59.7		10.0							25.4
1870		73.3									30.6
71		61.1	11.1			7.7	6.7				27.2
72		68.1									28.3
73		36.1		10.0							15.6
74		63.9									26.6
75		79.2				7.7	6.7				34.1
76		63.9									26.6
77		68.1		30.0			6.7				30.6
78		63.9		20.0							27.7
79		43.1		30.0							19.7
1880	47.6	69.4	44.4	690.0		30.8	20.0				80.9
81	38.1	104.2	44.4	340.0	12.5	15.4	6.7		25.0		74.0
82	85.7	69.4	88.8	340.0		61.5	53.3	10.0	8.3		74.0
83	85.7	80.5	22.2	260.0		38.5	26.7		8.3		65.9
84	76.2	93.1		150.0		53.8	66.7				66.5
85	61.9	94.4	55.5	180.0		23.1	33.3	10.0			65.3

TABLE A.5.8: (Contd.)

Date	Add.	Alt.	Alt./ Add.	New Bdg.	Sub-Div.	Dem.	Rebd.	Conv.	New Fac.	Oth.	Total
1886	42.9	134.7	55.5	140.0		23.1	33.3				76.9
87	52.4	115.3	33.3	150.0		76.9	73.3				76.9
88	57.1	158.3		200.0		46.2	33.	10.0			91.3
89	53.1	125.0	33.3	200.0		23.1	26.7				76.3
1890	61.9	86.1	11.1	260.0		30.8	40.0				64.7
91	100.0	97.2		210.0		7.7	26.7				67.6
92	53.4	93.1	11.1	110.0		7.7	13.3				53.8
93	71.4	136.1		110.0		7.7	20.0				74.0
94	66.7	115.3	11.1	160.0		30.8	33.3		8.3		71.7
95	66.7	97.2	33.3	280.0		61.5	53.3	20.0	25.0		78.6
96	71.4	120.8	188.8	310.0	12.5	38.7	33.3				92.5
97	100.0	77.7	255.5	260.0		46.2	60.0	20.0	91.6		89.6
98	95.2	90.3	200.0	430.0	12.5	61.5	66.7	40.0	83.3		102.9
99	61.9	86.1	88.8	360.0	12.5	38.5	46.7	20.0	58.3		81.5
1900	85.7	75.0	144.4	190.0	12.5	53.8	60.0	10.0	50.0		74.0
01	61.9	66.7	122.2	230.0	12.5	61.5	60.0	20.0	75.0		71.7
02	71.4	52.8	77.7	410.0	12.5	23.1	46.7		50.0		68.2
03	57.1	61.1	22.2	310.0	12.5	61.5	73.3		58.3		67.1
04	57.1	55.6	44.4	270.0	37.5	38.5	60.0		66.6		62.4
05	57.1	50.0	44.4	600.0	12.5	15.4	26.7		50.0		72.3
06	38.1	63.9	55.5	250.0	75.0	23.1	20.0		66.6		60.0
07	57.1	58.3	33.3	340.0	37.5	23.1	20.0		25.0		59.5
08	19.0	58.3	55.5	310.0	62.5			10.0	66.6		55.5
09	76.2	29.2	33.3	40.0	75.0	7.7	6.7		8.3		30.6
1910	52.4	58.3	33.3	150.0	137.5	23.1	26.7	30.0	75.0		58.4

TABLE A.5.8: (Contd.)

Date	Add.	Alt.	Alt./ Add.	New Bdg.	Sub-Div.	Dem.	Rebd.	Conv.	New Fac.	Oth.	Total
1911	52.4	69.4	33.3	80.0	25.0	23.1	20.0	10.0	58.3		50.9
12	61.9	48.6	11.1	30.0	37.5	7.7	13.3	10.0	16.6		35.3
13	23.8	51.4	44.4		12.5	23.1	26.7		16.6		32.4
14	42.9	31.9	11.1	10.0	12.5	15.4	13.3	20.0	8.3		24.3
15	4.2	23.6		30.0			6.7	10.0	16.6		14.5
16	14.3	19.4	33.3				6.7		8.3		12.7
17	4.8	12.5	11.1					30.0	33.3		10.4
18	9.5	13.8			12.5		6.7				8.1
19	61.9	38.9	11.1	30.0	25.0			40.0			29.5
1920	71.4	37.5		10.0	25.0	7.7	33.3	30.0	8.3		31.8
21	42.9	33.4	11.1	220.0	50.0		13.3	50.0	16.6		39.9
22	90.5	37.5	11.1	150.0	62.5	7.7	20.0	20.0	25.0		43.9
23	90.5	86.1	22.2	340.0	25.0	30.8	46.7		75.0		80.4
24	133.4	116.7	33.3	880.0	25.0	23.1	46.7	20.0	25.0		127.2
25	123.8	48.6	44.4	570.0	37.5	15.4	20.0	50.0	25.0		79.8
26	104.8	55.6	44.4	550.0	25.0	15.4	13.3	30.0	8.3		75.7
27	90.5	44.5	44.4	410.0	37.5	38.5	20.0	20.0	25.0		64.7
28	52.4	33.4	66.6	150.0	12.5	46.2	40.0	10.0	41.6	33.3	43.9
29	61.9	34.7	22.2	80.0		61.5	66.7	10.0	41.6		41.6
1930	76.2	31.9	11.1	700.0	12.5	30.8	13.3	20.0	8.3	66.6	70.5
31	47.6	43.1	66.6	980.0	12.5	30.8	6.7		16.6		88.4
32	19.0	29.2	33.3	470.0		46.2	33.3		8.3		50.3
33	23.8	22.3	55.5	1780.0		30.8	20.0		41.6		130.6
34	52.4	27.8	77.7	1420.0	37.5	30.8	20.0	10.0	16.6	33.3	112.2
35	61.9	40.3	111.1	1700.0	50.0	38.5	60.0		33.3	33.3	141.6

TABLE A.5.8: (Contd.)

Date	Add.	Alt.	Alt./ Add.	New Bdg.	Sub-Div.	Dem.	Rebd.	Conv.	New Fac.	Oth.	Total
1936	23.8	31.9	55.5	1400.0	37.5	46.2	20.0		16.6		109.8
37	28.6	29.2	55.5	430.0	12.5	84.6	53.3	10.0	50.0		87.9
38	19.0	31.9	44.4	390.0	25.0	76.9	66.7		33.3		55.5
39	42.9	30.6	33.3	660.0	25.0	53.8	60.0		25.0		70.0
1940	9.5	12.5			12.5	15.4	13.3	10.0			9.8
41	4.8	4.2	22.2								3.5
42	4.8	8.3		10.0							4.6
43	9.5	1.4									1.7
44	19.0	5.6	11.1		25.0			10.0			6.9
45	28.6	19.4	11.1	30.0	200.0	23.1	33.3	10.0			28.3
46	19.0	26.4	44.4	20.0	225.0	7.7	13.3	30.0	25.0		32.4
47	47.6	30.6	11.1	40.0	237.5	23.1	53.3	40.0		33.3	41.6
48	61.9	25.0	33.3		125.0	15.4	20.0	40.0	16.6		31.8
49	33.4	43.1	55.5		187.5	30.8	26.7	10.0	16.6		40.0
1950	47.6	26.4	33.3	70.0	262.5	61.5	60.0	20.0	16.6	33.3	47.4
51	19.0	58.3	33.3	40.0	87.5	15.4	26.7	10.0	16.6	66.6	41.0
52	66.7	41.7	22.2	30.0	150.0	30.8	26.7			33.3	34.7
53	85.7	59.7	11.1	40.0	75.0	15.4	40.0	10.0	50.0	133.3	52.7
54	52.4	41.4	11.1	40.0	50.0	38.5	40.0		66.6	66.6	45.1
55	80.9	56.9	33.3	480.0	112.5	61.5	66.7	60.0	66.6	66.6	89.0
56	76.2	87.5	33.3	640.0	25.0	53.8	66.7	30.0	66.6	166.6	104.6
57	71.4	70.8	66.6	600.0	125.0	23.1	26.7	20.0	100.0	166.6	97.1
58	61.9	59.7	22.2	20.0	87.5	15.4	20.0		58.3	66.6	46.8
59	52.4	65.3	33.3	900.0	62.5	84.6	53.3	30.0	100.0	166.6	112.7
1960	95.2	94.4	66.6	1130.0	75.0	30.8	46.7	20.0	91.6	133.3	139.3

TABLE A.5.8: (Contd.)

Date	Add.	Alt.	Alt./ Add.	New Bdg.	Sub-Div.	Dem.	Rebd.	Conv.	New Fac.	Oth.	Total
1961	76.2	98.6	33.3	90.0	125.0	84.6	40.0	30.0	108.3	133.3	84.4
62	104.8	75.0	55.5	640.0	87.5	100.0	53.3	20.0	58.3	300.0	110.4
63	90.5	98.6	66.6	70.0	100.0	61.5	66.7	30.0	133.3	166.6	88.4
64	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
65	66.7	113.9	66.6	330.0	25.0	146.2	53.3	180.0	50.0	33.3	109.3
66	76.2	129.2	22.2	60.0	37.5	130.8	53.3	10.0	66.6	100.0	90.8
67	109.5	111.1	22.2	410.0	50.0	161.5	73.3	260.0	50.0	33.3	124.3
68	52.4	133.3	44.4	150.0	50.0	92.3	53.3	370.0	41.6		111.0
69	61.9	151.4	22.2	40.0	12.5	130.0	46.7	240.0	41.6		105.2
1970	138.1	183.3	33.3	1090.0	37.5	215.4	93.3	170.0	50.0		197.1

Source: See Chap. 7.

Note: 1964 = 100.

TABLE A.5.9: INDEX OF HOUSE BUILDING ACTIVITY: GREAT BRITAIN (1856 - 1970)

Date	Index	Date	Index	Date	Index
1856	14.1	1895	24.0	1934	90.1
57	12.7	96	28.7	35	93.8
58	13.6	97	34.9	36	97.7
59	11.9	98	42.2	37	96.9
1860	12.1	99	41.8	38	96.1
61	12.1	1900	37.4	39	68.4
62	15.5	01	37.4	1940	25.5
63	17.2	02	41.2	41	6.3
64	16.3	03	42.0	42	3.5
65	14.3	04	36.6	43	2.5
66	14.8	05	34.1	44	2.2
67	17.5	06	34.9	45	3.7
68	18.8	07	32.5	46	37.1
69	20.6	08	27.0	47	49.8
1870	23.0	09	26.4	48	65.8
71	24.2	1910	23.0	49	52.9
72	25.1	11	18.1	1950	53.0
73	21.7	12	14.3	51	52.1
74	24.3	13	14.5	52	64.2
75	32.2	14	12.9	53	85.3
76	35.0	15	8.8	54	93.1
77	33.2	16	4.5	55	84.9
78	28.5	17		56	80.4
79	23.0	18		57	80.6
1880	22.2	19		58	73.3
81	21.2	1920	7.9	59	74.0
82	21.8	21	20.4	1960	79.7
83	21.9	22	22.6	61	79.2
84	22.0	23	17.7	62	81.7
85	20.5	24	35.1	63	80.0
86	20.1	25	46.6	64	100.0
87	21.1	26	59.5	65	102.3
88	21.4	27	68.2	66	103.1
89	21.3	28	55.4	67	108.2
1890	20.3	29	56.8	68	110.7
91	21.2	1930	54.2	69	98.1
92	22.5	31	56.2	1970	93.7
93	23.0	32	58.4		
94	24.4	33	73.6		

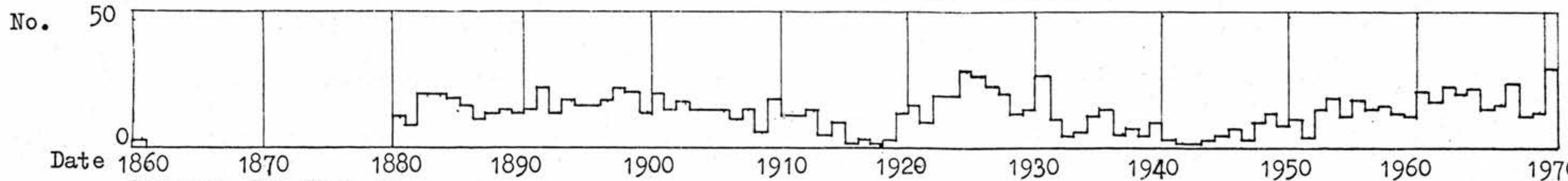
Sources:

a) Annual Abstract of Statistics 1973: op.cit. (1966 - 1970)
b) Mitchell, B.R. and Jones, H.G.: op.cit. (1956 - 1965)
c) Mitchell, B.R. and Dean, P.: op.cit. (1856 - 1955)

Note:

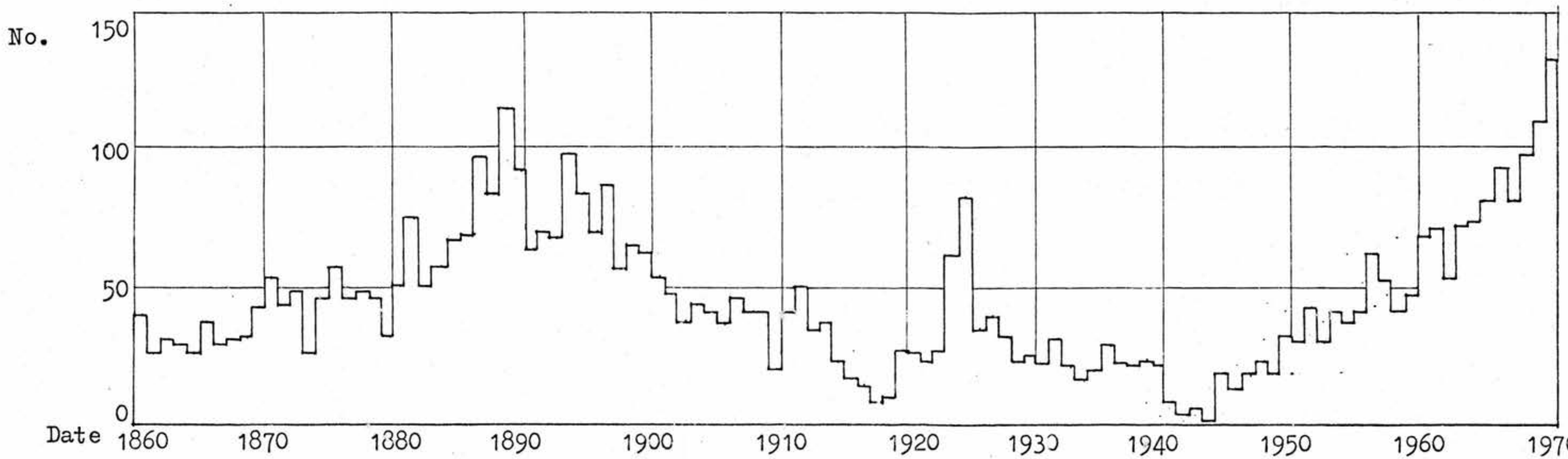
1964 = 100.

FIGURE A.5.1: ADDITIONS TO STOCK: SURVEY SECTION, EDINBURGH (1860 - 1970)



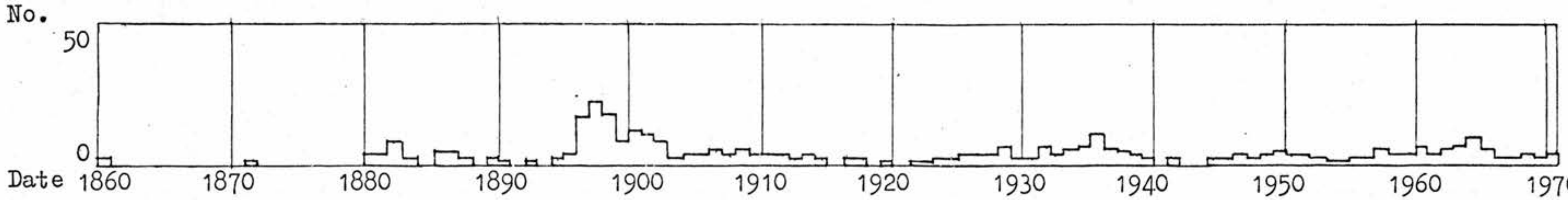
Source: See Chap. 7.

FIGURE A.5.2: ALTERATIONS TO STOCK: SURVEY SECTION, EDINBURGH (1860 - 1970)



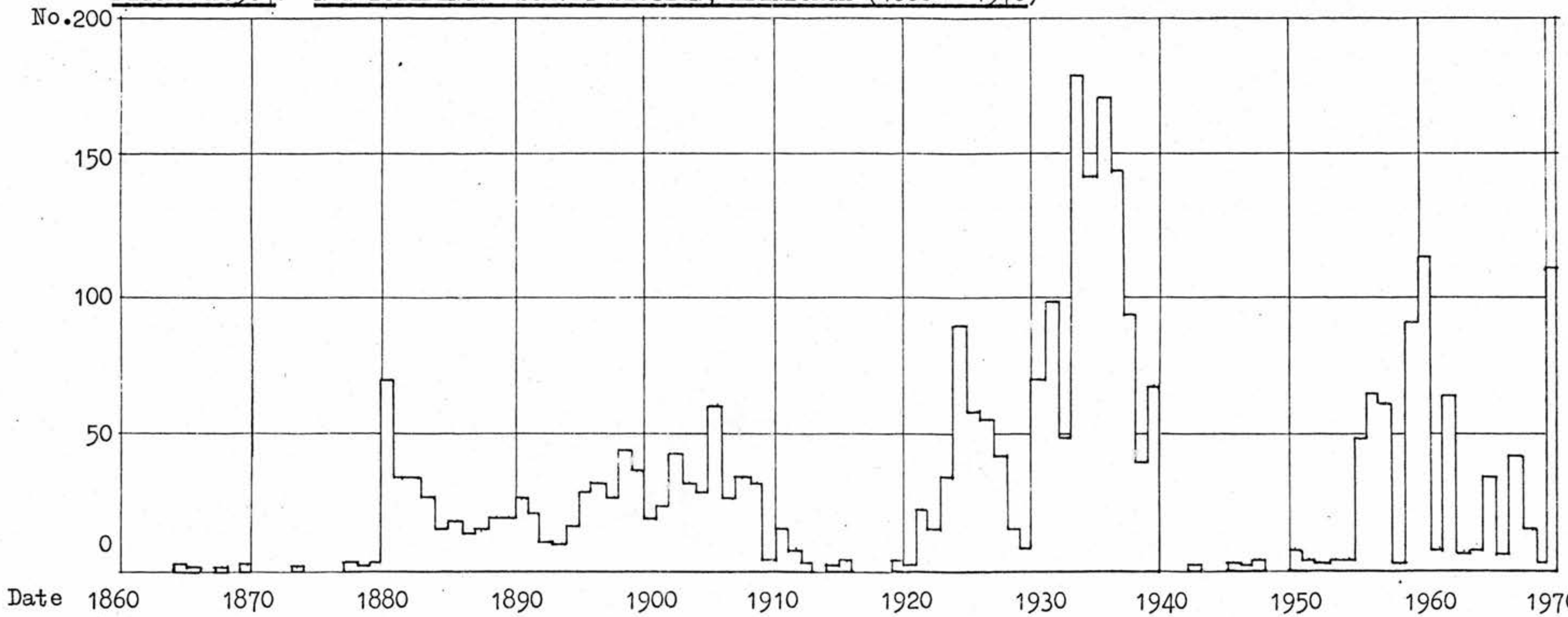
Source: See Chap. 7.

FIGURE A.5.3: ADDITIONS/ALTERATIONS TO STOCK: SURVEY SECTION, EDINBURGH (1860 - 1970)



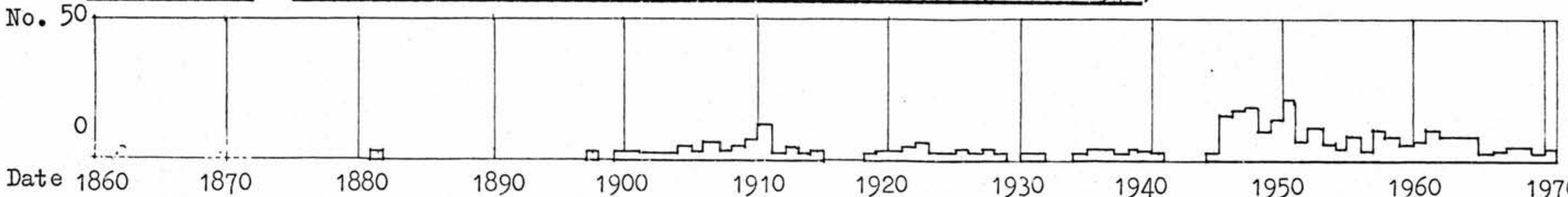
Source: See Chap. 7.

FIGURE A.5.4: NEW BUILDING: SURVEY SECTION, EDINBURGH (1860 - 1970)



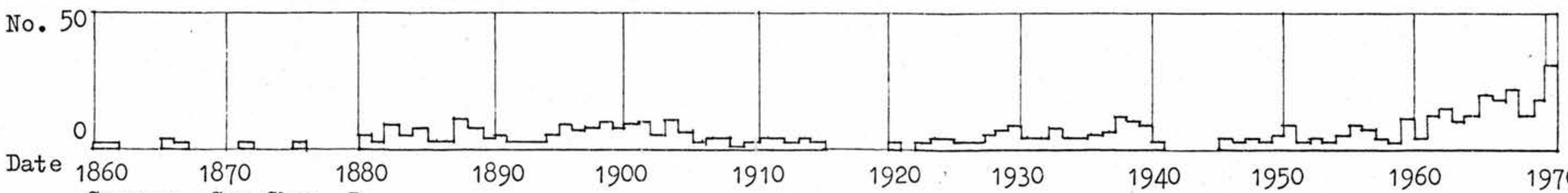
Source: See Chap. 7.

FIGURE A.5.5: SUB-DIVISION OF STOCK: SURVEY SECTION, EDINBURGH (1860 - 1970)



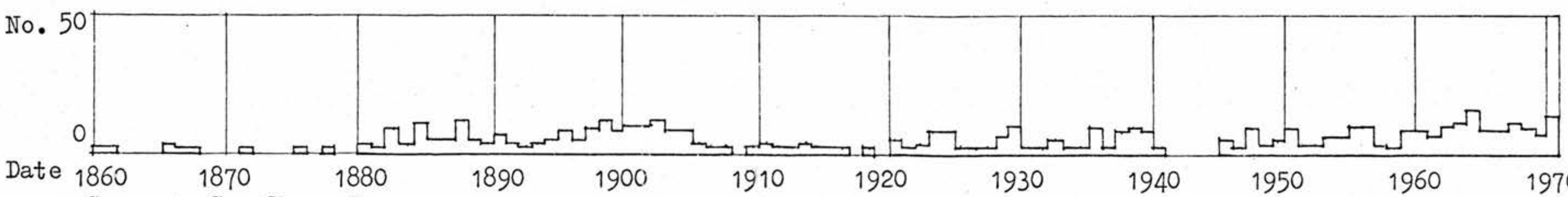
Source: See Chap. 7.

FIGURE A.5.6: DEMOLITION OF STOCK: SURVEY SECTION, EDINBURGH (1860 - 1970)



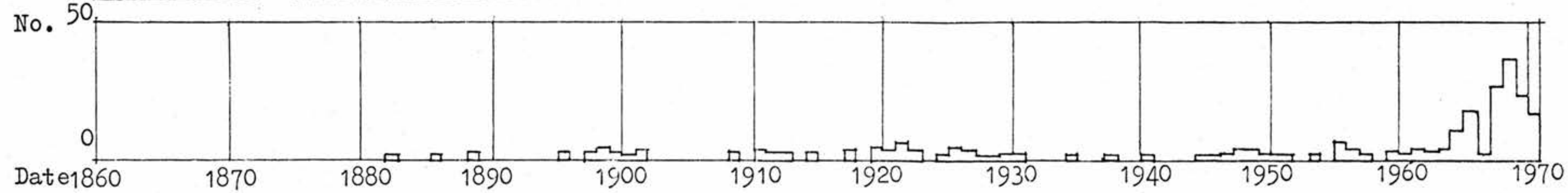
Source: See Chap. 7.

FIGURE A.5.7: REBUILDING OF STOCK: SURVEY SECTION, EDINBURGH (1860 - 1970)



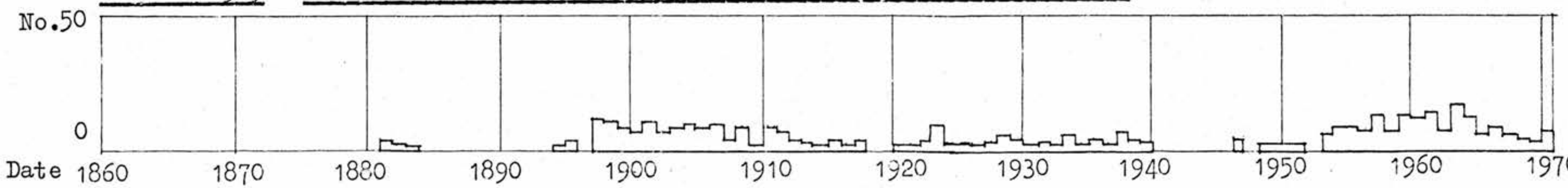
Source: See Chap. 7.

FIGURE A.5.8: CONVERSION OF STOCK: SURVEY SECTION, EDINBURGH (1860 - 1970)



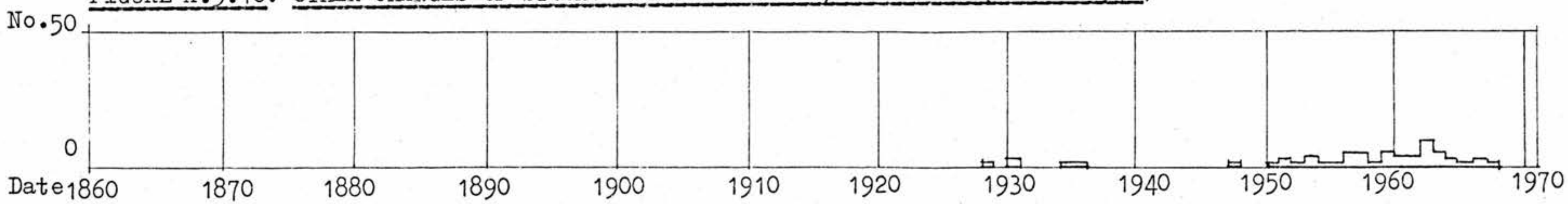
Source: See Chap. 7.

FIGURE A.5.9: NEW FACADE OF STOCK: SURVEY SECTION, EDINBURGH (1860 - 1970)



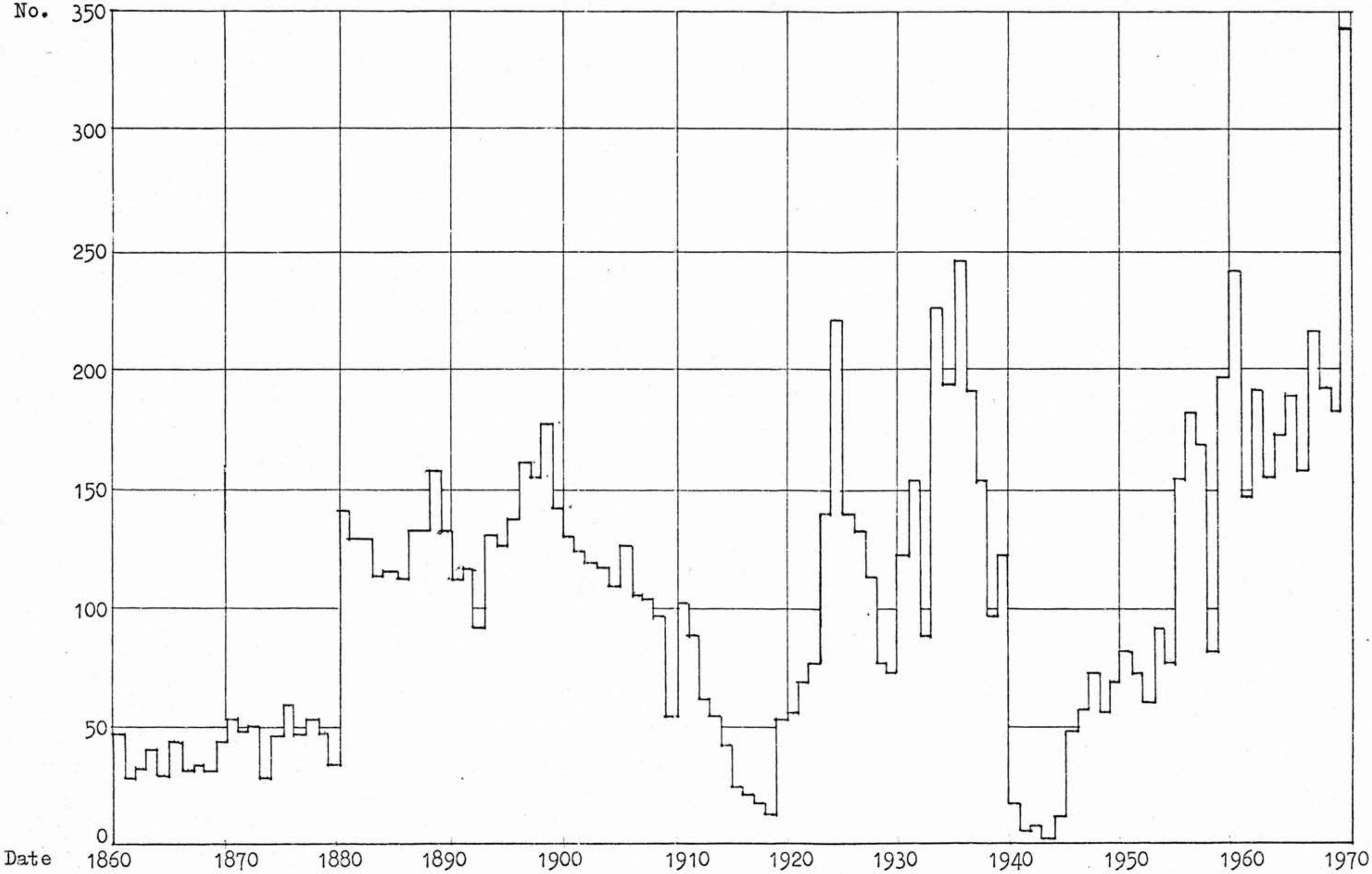
Source: See Chap. 7.

FIGURE A.5.10: OTHER CHANGES OF STOCK: SURVEY SECTION, EDINBURGH (1860 - 1970)



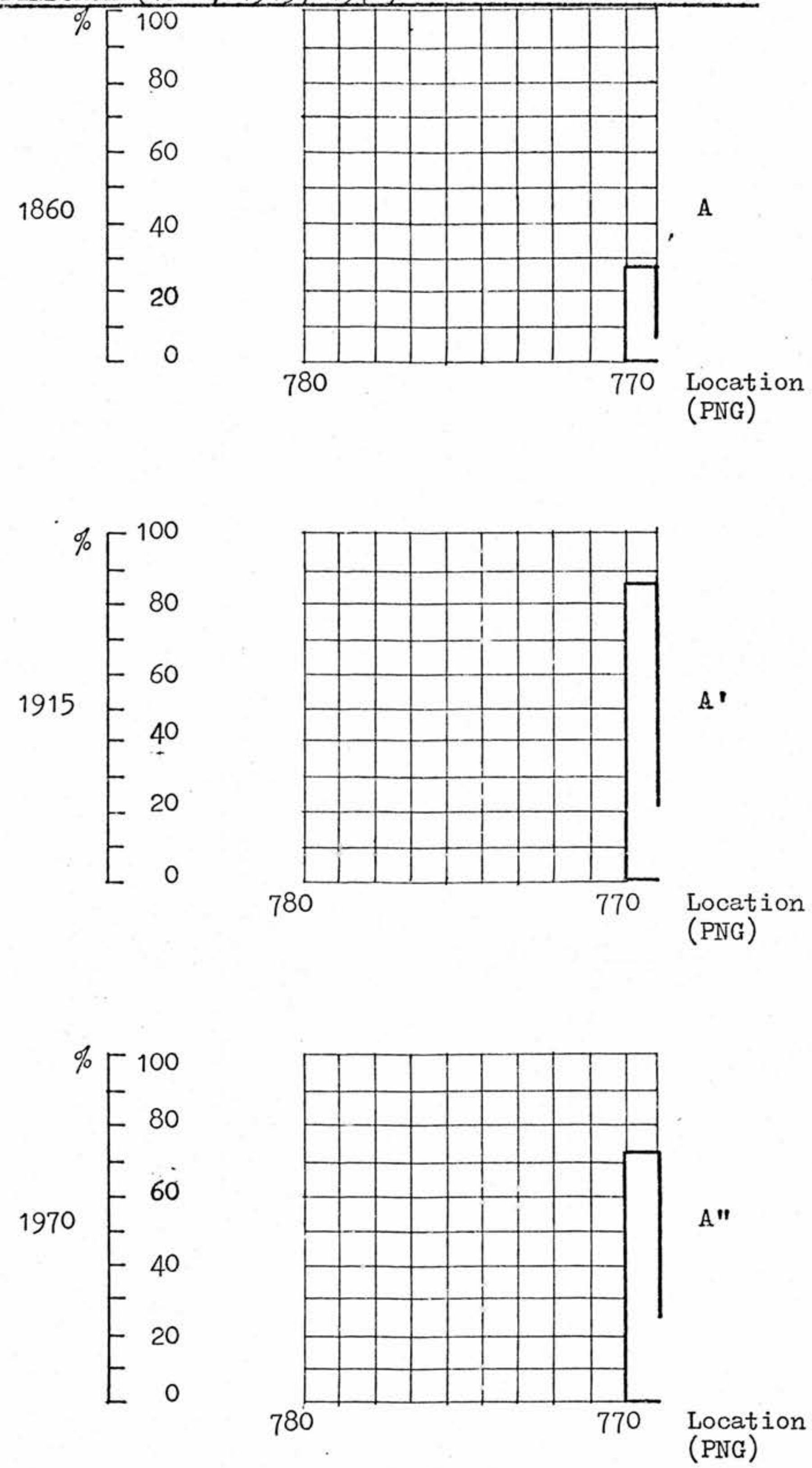
Source: See Chap. 7.

FIGURE A.5.11: TOTAL CHANGES OF STOCK: SURVEY SECTION, EDINBURGH (1860 - 1970)



Source: See Chap. 7.

FIGURE A.5.12: PERCENTAGE OF SITE COVERED BY STOCK: SURVEY SECTION, EDINBURGH (1860, 1915, 1970)



Sources: Ordinance Survey Maps. 1860, 1915. 1970.

FIGURE A.5.12: (Contd.)

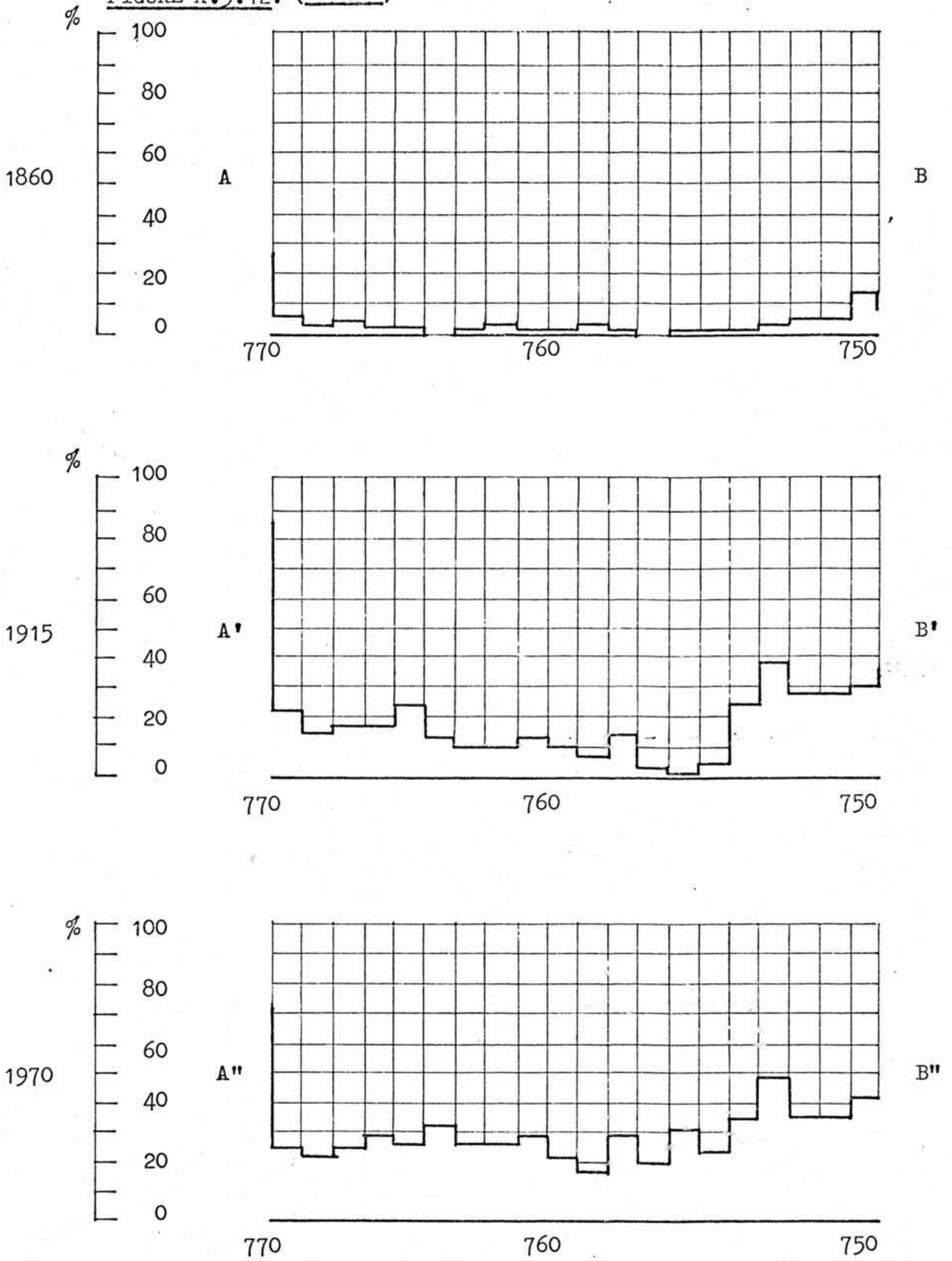


FIGURE A.5.12: (Contd.)

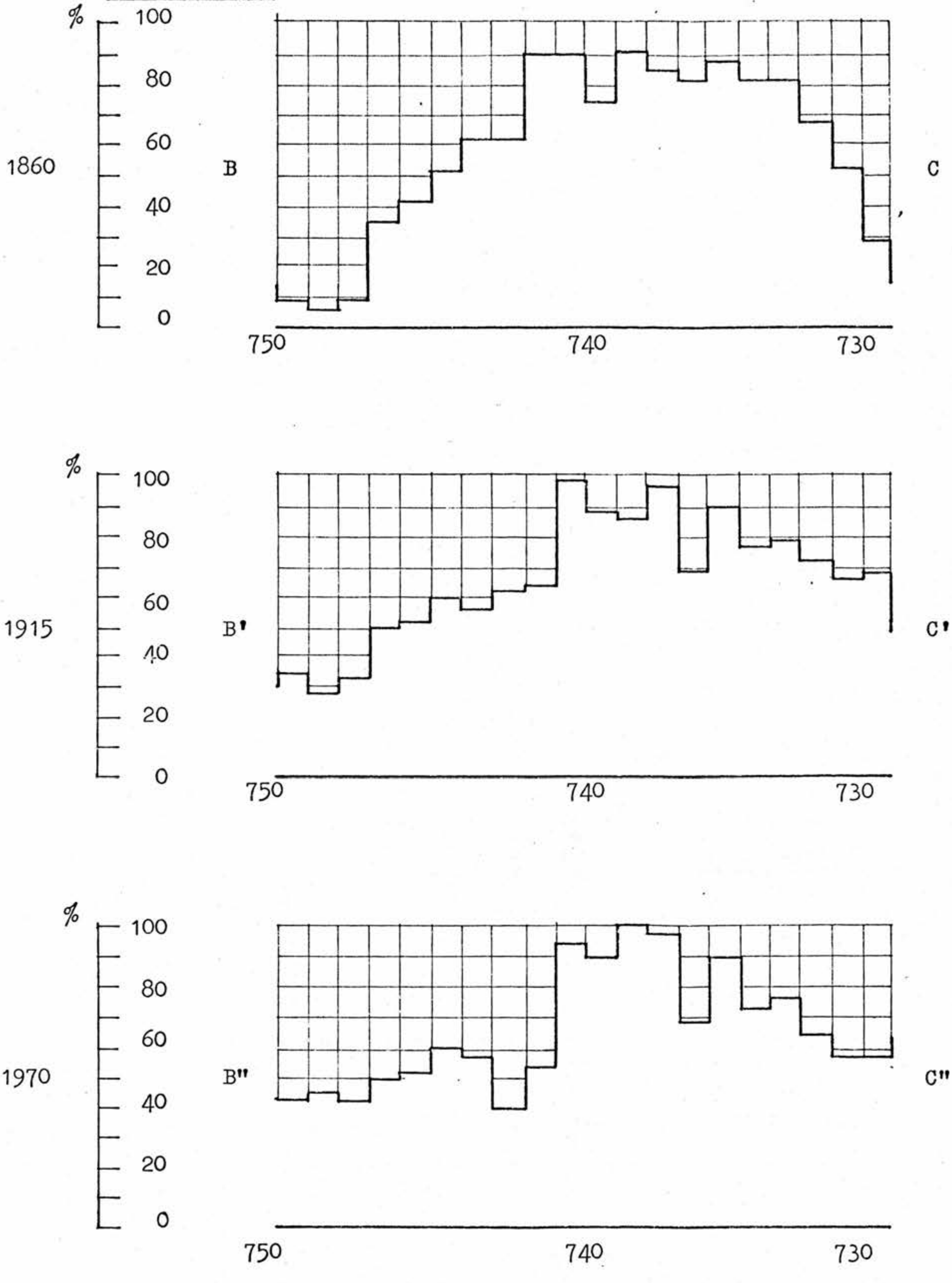


FIGURE A.5.12: (Contd.)

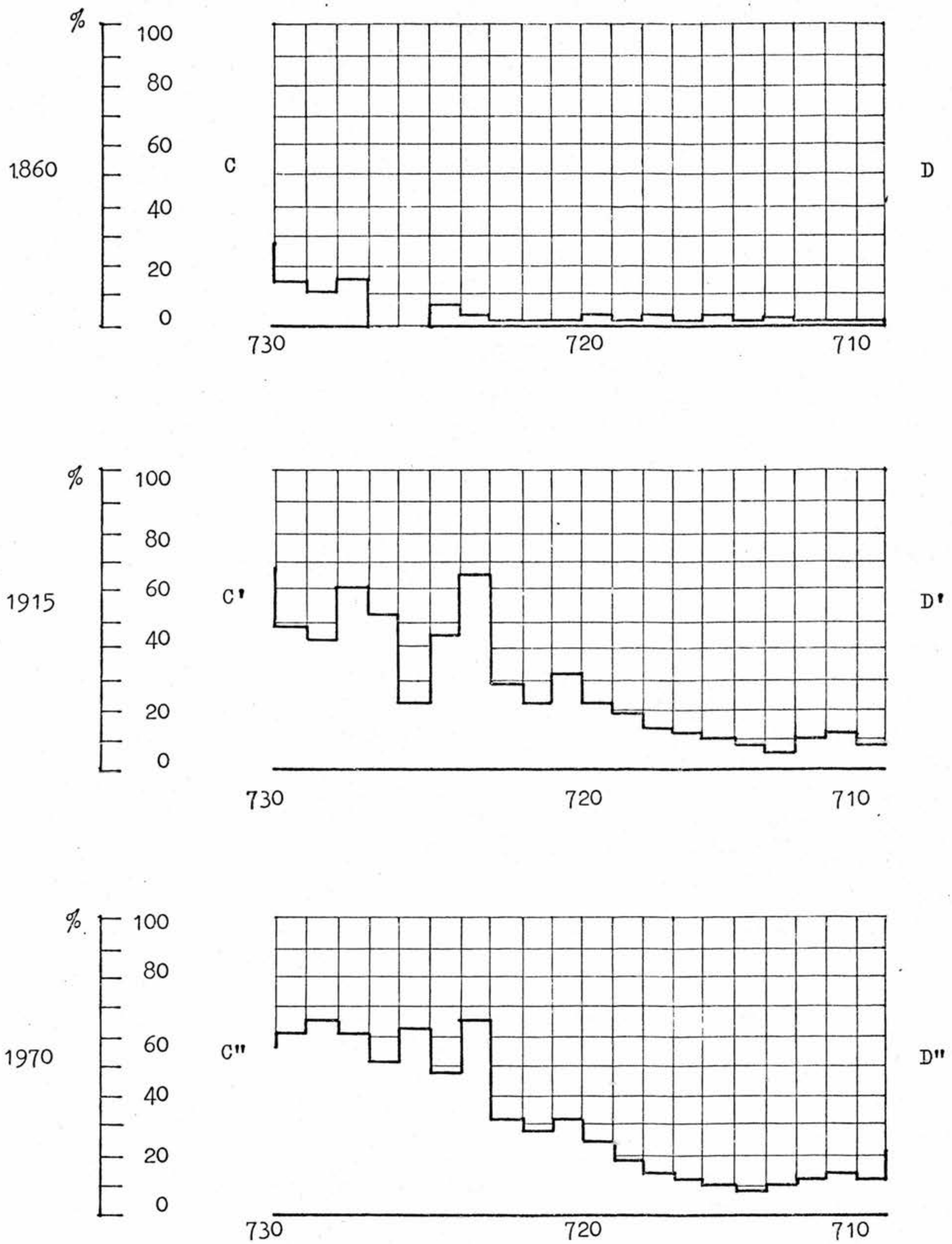


FIGURE A.5.12: (Contd.)

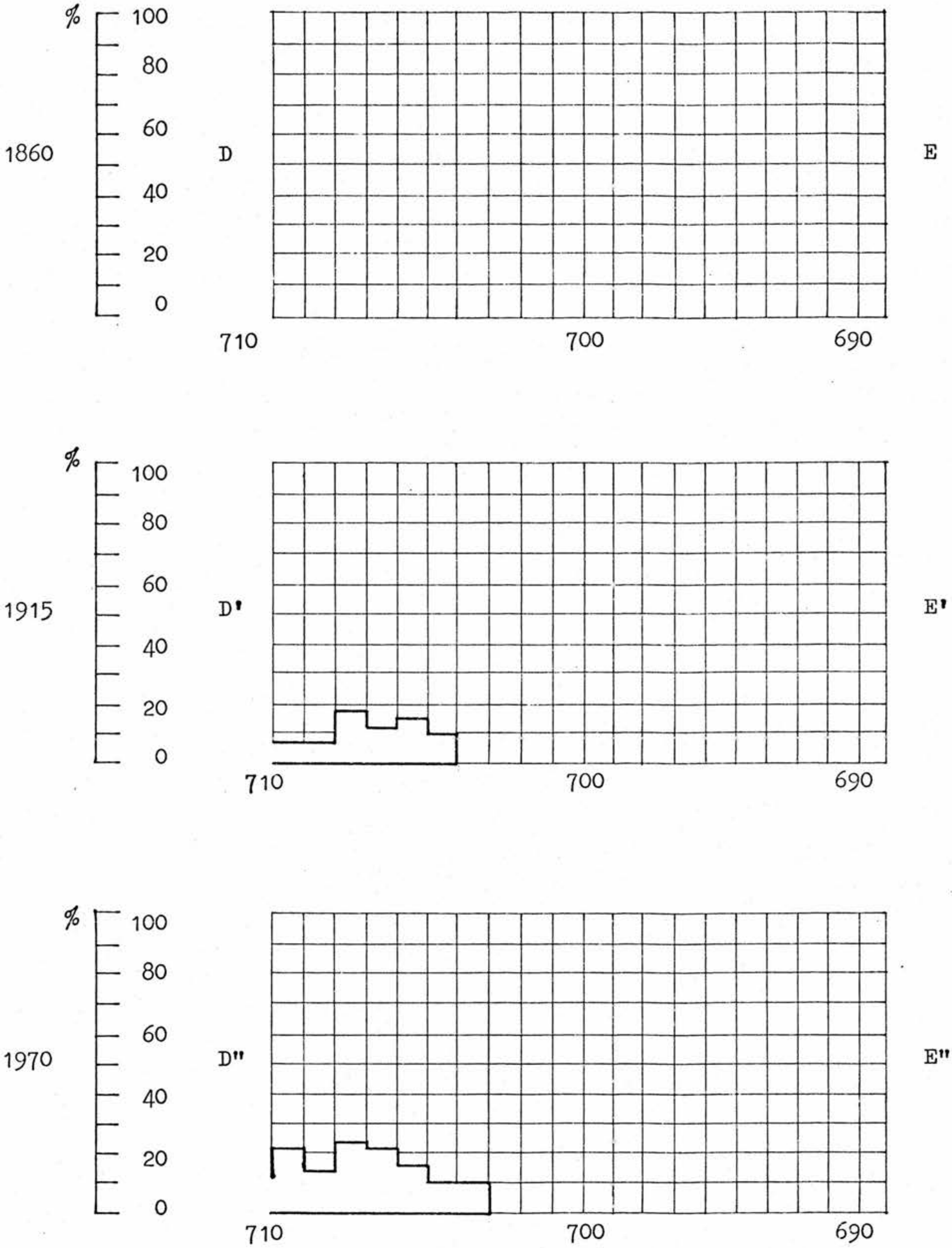
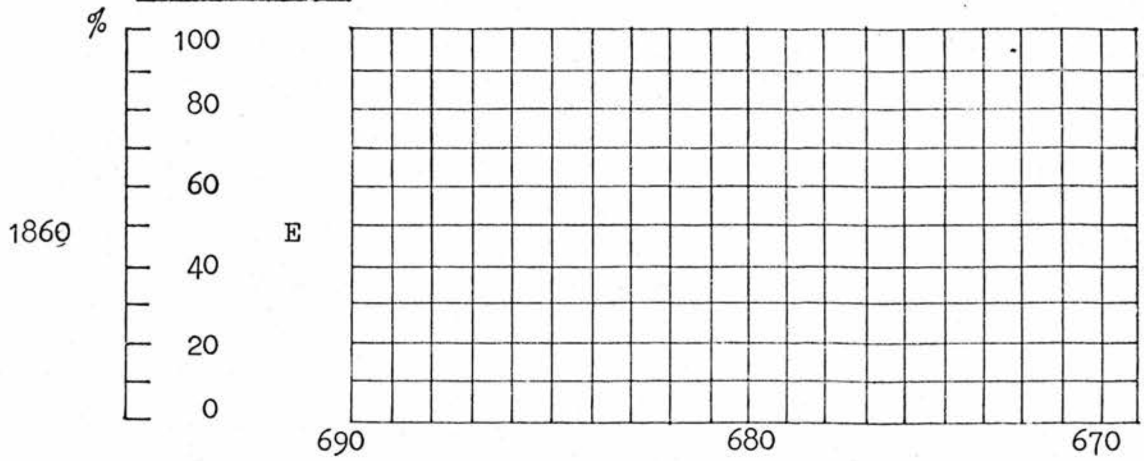
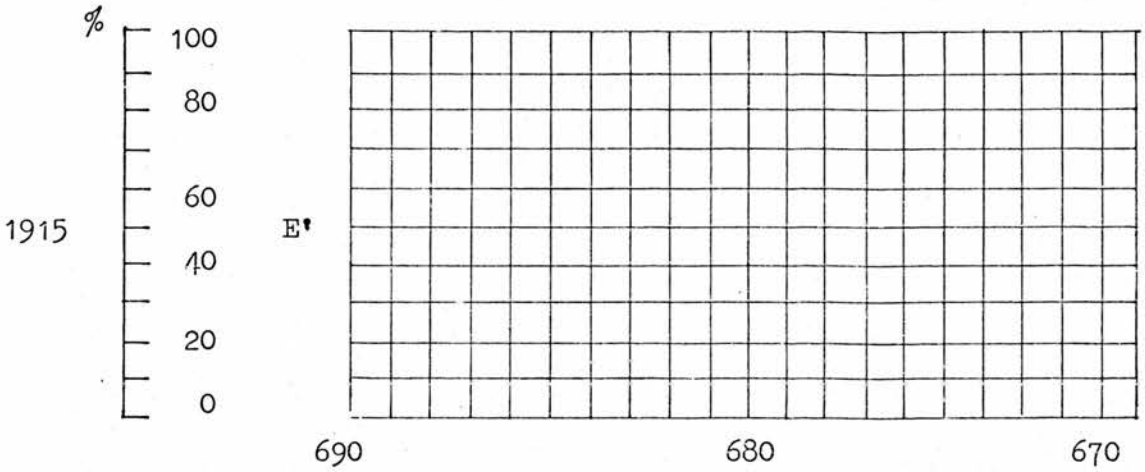
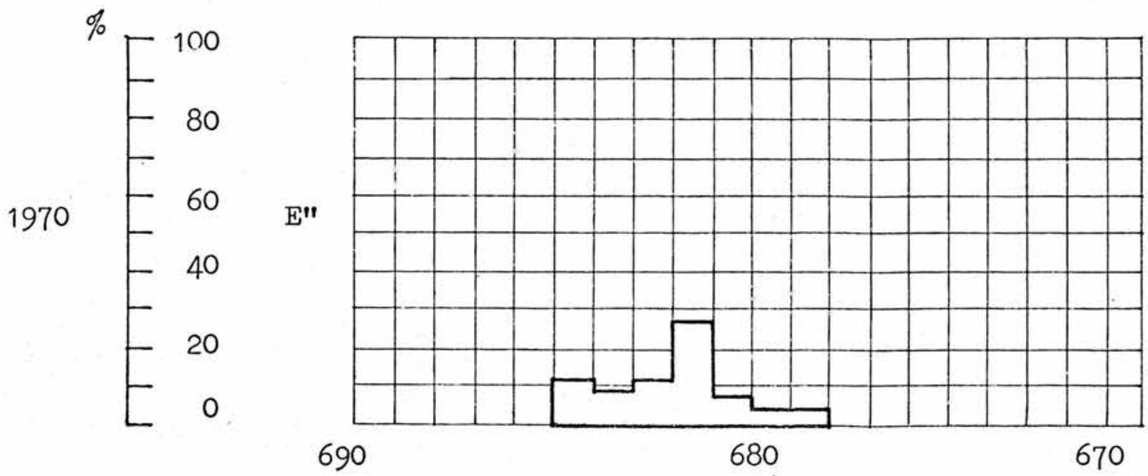


FIGURE A.5.12: (Contd.)







APPENDIX SIX

BASIC DATA FOR CHAPTER EIGHT

TABLE A.6.1: AREA OF STOCK: ST. ANDREW SQUARE, EDINBURGH (1770 - 1970)

	BUILDING NUMBER							
Date	1	2	3	4	5	6	7	8
1770								
75								
80	555	955	794	916	1046	1226	627	504
85								
90								
95								
1800								
05								
10								
15								
20								
25								
30								
35								
40					2053	1520	1007	
45								
50			1349	1901				
55								
60								
65					2249			
70					2045			
75								
80		1255	1552					
85				2086				
90			1699					
95								607
1900	3577					1822	1309	
05					2445			
10								
15								
20								
25								
30			4661					
35								
40								
45								
50								
55								
60								862
65								
70						6692		

TABLE A.6.1: (Contd.)

	BUILDING NUMBER											
Date	9	10	11	12	13	14	15	16	17	18	19	20
1770												
75												
80	1072	435	885	437	750	750	500	570	450	669	669	714
85												
90												
95												
1800												
05												
10												
15	1659											
20												
25												
30												
35												
40												
45									550	688	688	
50												
55	1300		1271	487								
60												
65												
70												
75				506								
80												
85				581				730				
90									631			
95												
1900							1460					
05												
10												
15												
20												
25												
30					3746					1647		
35												
40												
45												
50												
55												
60		6394										
65								4570			2714	
70												

TABLE A.6.1: (Contd.)

Date	21	22	23	24	25	26	27	28	29
	BUILDING NUMBER								
1770									
75									
80	556	1223	1083	918	966	1423	836	320	200
85									
90									
95							961	420	
1800									
05									
10									
15									
20									
25									
30									
35							1086	520	
40									
45				962	1151				
50									
55			1269						
60									
65									
70			2754						
75						1454	1337		
80									
85									
90		1443							
95					1505				
1900				1296				5776	
05									
10									
15								6203	
20									
25									
30									
35									
40				1340					
45									
50									
55									
60									
65					2070			6287	
70				2014					

Source: See Chap. 8.

Note: Area in square metres.

TABLE A.6.2: PERCENTAGE OF SITE COVERED BY STOCK: ST. ANDREW SQUARE EDINBURGH (1770 - 1970)

	BUILDING NUMBER							
Date	1	2	3	4	5	6	7	8
1770								
75								
80	100	60.0	43.8	49.2	40.9	45.4	100	88.8
85								
90								
95								
1800								
05								
10								
15								
20								
25								
30								
35								
40					76.3	97.2		
45								
50			72.1	100				
55								
60								
65					100			
70								
75								
80		100	80.0					
85				96.1				
90								
95	94.4							100
1900						100		
05								
10								
15								
20								
25								
30			96.0					
35								
40								
45								
50								
55								
60								
65								
70						100		

TABLE A.6.2: (Contd.)

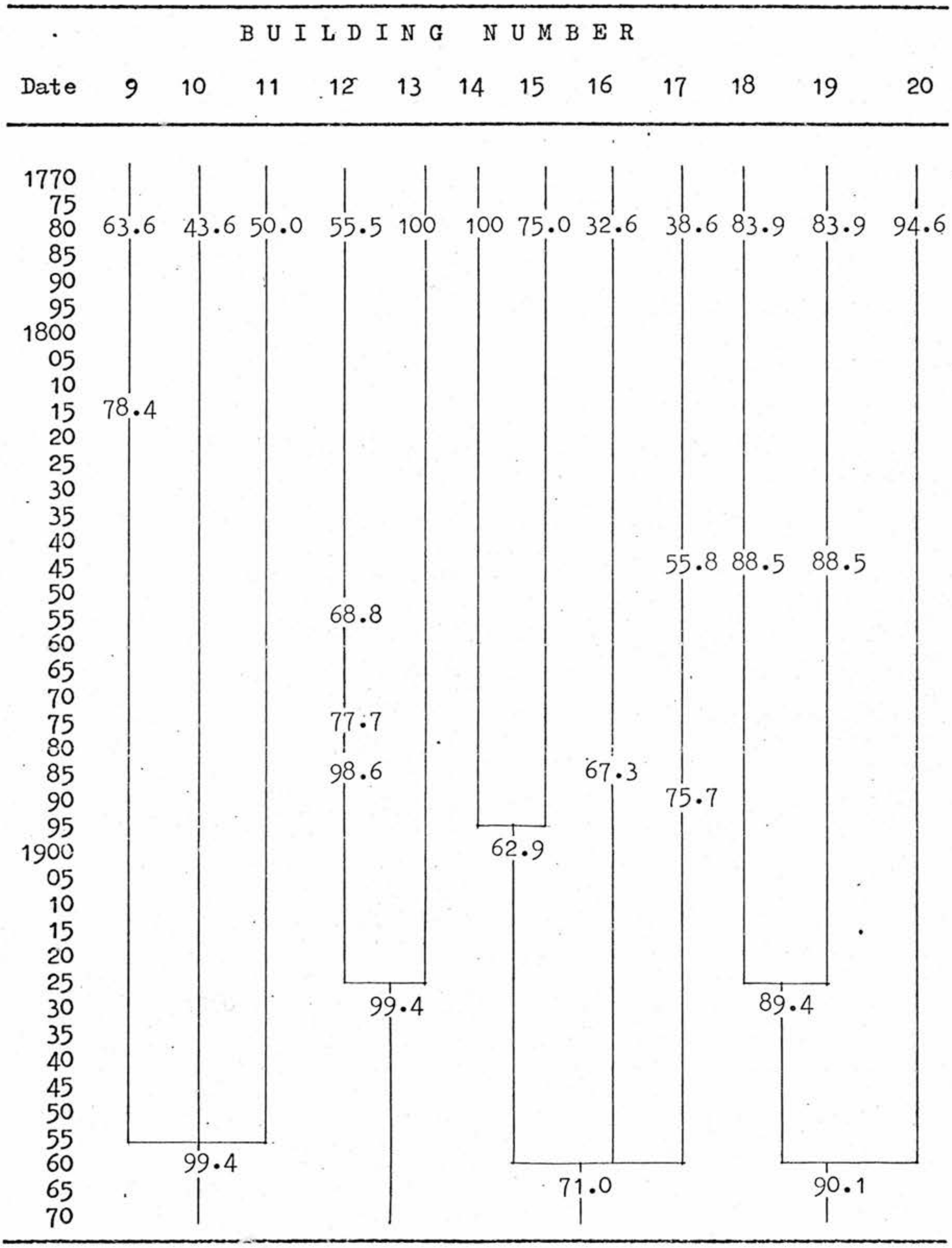


TABLE A.6.2: (Contd.)

	BUILDING NUMBER								
Date	21	22	23	24	25	26	27	28	29
1770									
75									
80	100	70.0	45.8	41.6	50.0	56.1	34.8	21.6	21.6
85									
90									
95							43.1	34.1	
1800									
05									
10									
15									
20									
25									
30									
35							51.5	47.0	
40									
45				56.6	62.5				
50									
55			61.3						
60									
65									
70			97.3						
75						61.3	61.5		
80									
85									
90		100							
95					95.0				
1900				72.5				79.5	
05									
10									
15									
20									
25									
30									
35									
40				76.6					
45									
50									
55									
60									
65					99.6			76.9	
70				92.0					

Source: See Chap. 8.

Note: Figures expressed as ratio of ground floor area to site area.

TABLE A.6.3: PLOT RATIOS, ST. ANDREW SQUARE, EDINBURGH (1770 - 1970)

	BUILDING NUMBER							
Date	1	2	3	4	5	6	7	8
1770								
75								
80	3.9	3.8	1.4	1.6	1.9	2.2	4.1	3.7
85								
90								
95								
1800								
05								
10								
15								
20								
25								
30								
35								
40					3.7	2.7	2.1	
45								
50			2.4	3.4				
55								
60								
65					4.0			
70								
75								
80			2.8					
85				3.7				
90			3.0					
95	6.6							4.5
1900						2.9	3.5	
05					4.4			
10								
15								
20								
25								
30			8.4					
35								
40								
45								
50								
55								
60								6.4
65								
70						7.6		

TABLE A.6.3: (Contd.)

	BUILDING NUMBER											
Date	9	10	11	12	13	14	15	16	17	18	19	20
1770												
75												
80	2.1	1.7	2.2	1.2	5.3	5.0	2.5	1.2	1.5	3.3	3.3	4.7
85												
90												
95												
1800												
05												
10												
15	2.2											
20												
25												
30												
35												
40												
45									1.7	3.4	3.4	
50												
55	2.6		2.6	1.3								
60												
65												
70												
75				1.4								
80												
85				1.9				2.3				
90									2.1			
95												
1900						2.5						
05												
10												
15												
20												
25												
30					5.7					4.3		
35												
40												
45												
50												
55												
60		5.5										
65							4.1				4.9	
70												

TABLE A.6.3: (Contd.)

	BUILDING NUMBER								
Date	21	22	23	24	25	26	27	28	29
1770									
75									
80	3.1	3.3	1.8	1.5	1.6	2.3	1.3	1.1	1.1
85									
90									
95							1.6	1.2	
1800									
05									
10									
15									
20									
25									
30									
35							1.8	1.5	
40									
45				1.6	1.9				
50									
55			2.1						
60									
65									
70			4.5						
75						2.4	2.2		
80									
85									
90		3.9							
95					2.5				
1900				2.1				4.8	
05									
10									
15								5.1	
20									
25									
30									
35									
40				2.7					
45									
50									
55									
60									
65					3.4			5.2	
70				3.3					

Source: See Chap. 8.

Note: Plot ratio = floor area of stock/area of site.

TABLE A.6.4: NUMBER OF PRINCIPAL OCCUPIERS OF THE STOCK: ST. ANDREW SQUARE, EDINBURGH (1770 - 1970)

BUILDING NUMBER

Date	1	2	3	4	5	6	7	8
1770								
75								
80	1	1	1	1	1	1	1	1
85								
90								
95								
1800						2		
05							3	3
10				2				
15					2	3		
20								4
25	2							
30				5				
35					4	5		
40						7		5
45	1	2		7				
50				11				
55				13	8			1
60		1						
65			2	6		3		
70					19	7		
75				4				
80			1		22	6		
85								
90						2		
95				2	25		1	
1900	21				20	1		
05					23			
10	24		2					
15				1				
20								
25					21			2
30			1					
35								
40					19			3
45	16							
50	11				14			
55	6							
60	11				6			1
65	4							
70	3				3	1		

TABLE A.6.4: (Contd.)

	BUILDING NUMBER											
Date	9	10	11	12	13	14	15	16	17	18	19	20
1770												
75												
80	1	1	1	1	1	1	1	1	1	1	1	1
85												
90												
95												
1800												
05		2										
10	2											
15												
20												
25												
30			2									
35				2								
40			3	3			4			3	3	
45		1	4		2					4	4	4
50	1											
55			1	5	3		1					
60		8							2			
65					2						3	
70												
75				6							4	
80										6		
85				3								
90				7					4			2
95											2	4
1900				5			1			7	1	
05									2			
10		4		3								
15										3		2
20		5							1	2		
25									2			1
30		3			1						1	2
35												
40		1										
45												
50								2				
55												1
60		1										
65								1			1	
70												

TABLE A.6.4: (Contd.)

Date	21	22	23	24	25	26	27	28	29
	BUILDING NUMBER								
1770									
75									
80	1	1	1	1	1	1	1	1	1
85									
90									
95									
1800									
05	4								
10									
15									
20									
25									
30									
35									
40	7								
45			2	2					
50									
55			4						
60									
65				1					
70	6								
75	8								
80		2	5						
85	12				4		2	2	2
90		4		4					
95		6	10				1		
1900		4	8	3	7			1	
05						4			
10	13								
15		3	4			3			
20	10	2		2					
25									
30					5				
35	6	1	6						
40				3	6				
45	3					1			
50	4				2				
55			4		1				
60	2		3						
65	1		2						
70				1					

Source: See Chap. 8.

TABLE A.6.5: NUMBER OF PRINCIPAL USES OF THE STOCK, ST. ANDREW SQUARE, EDINBURGH (1770 - 1970)

	BUILDING NUMBER							
Date	1	2	3	4	5	6	7	8
1770								
75								
80	1	1	1	1	1	1	1	1
85								
90								
95								
1800								
05						2		2
10				2				
15								
20								
25	2					3	2	
30								
35								
40	1			3		2		
45		2						
50				2			1	1
55								
60		1				1		
65				1	2			
70								
75								
80								
85								
90								
95	1							
1900								
05								
10			2					
15								
20								
25								
30								
35								
40					1			
45								
50								
55								
60								
65								
70						1		

TABLE A.6.5: (Contd.)

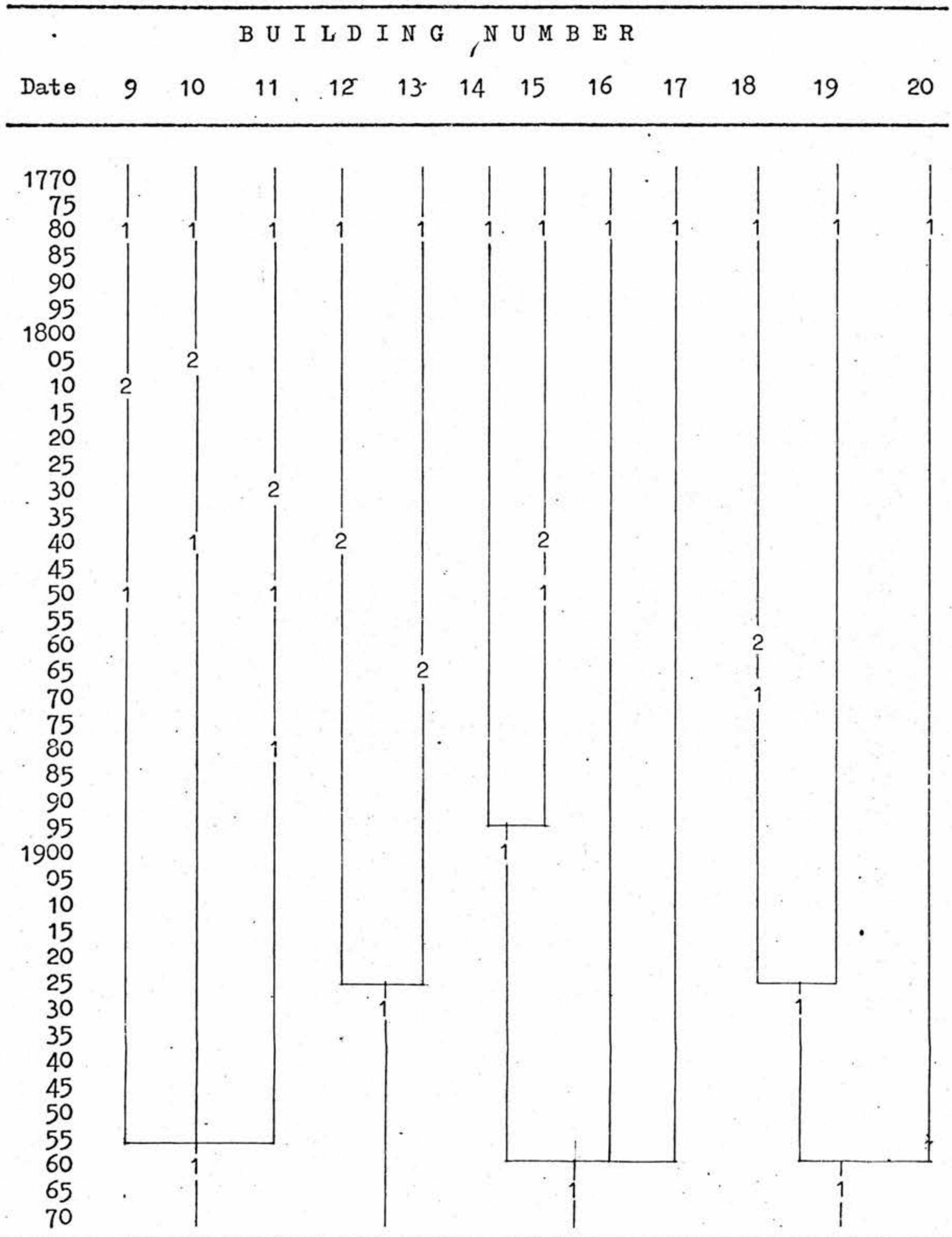


TABLE A.6.5: (Contd.)

	BUILDING NUMBER								
Date	21	22	23	24	25	26	27	28	29
1770									
75									
80	1	1	1	1	1	1	1	1	1
85									
90									
95									
1800									
05									
10									
15									
20					2				
25									
30									
35									
40									
45					1				
50									
55									
60									
65									
70									
75									
80									
85									
90									
95									
1900								1	
05									
10									
15									
20									
25									
30									
35									
40									
45									
50									
55									
60									
65									
70									

Source: See Chap. 8.

TABLE A.6.6: RATEABLE VALUE OF STOCK, ST. ANDREW SQUARE, EDINBURGH (1855 - 1970)

BUILDING NUMBER

Date	1	2	3	4	5	o	7	8
1770								
75								
80								
85								
90								
95								
1800								
05								
10								
15								
20								
25								
30								
35								
40								
45								
50								
55	400	100	213	551	320	403	165	
60	420	100	240	573	320	536		
65	632		230	456	321	955		186
70	647		230	698	603	1033		198
75	850			1095	653	1087		224
80	700		745	785	774	1292		224
85	600		1040	1155	594	1334		226
90	800		1040	1227	616	1327		226
95			1040	1113	630	1329		244
1900	1844		1100	1270	616	1675		420
05	1557		600	1235	894	1675		445
10	1467		600	980	872	1960		345
15	1400		590	968	869	1925		345
20	1744		590	1018	856	1925		345
25	1774		100	1057	1079	1925		300
30	698		910	1045	1163	2125		300
35	1945		810	1048	1149	2225		300
40	1988		710	1245	1149	2225		300
45	1721		588	1003	1147	2225		300
50	2156		688	1229	1235	2255		300
55	2487		688	979	1416	2255		360
60	2632		688	579	1426	2255		1350
65	4863		1775	2945	3402	5850		2325
70	6476		3310	4067	5195	21,761		4340

TABLE A.6.6: (Contd.)

Date	BUILDING NUMBER 9	10	11	12	13	14	15	16	17	18	19	20
1770												
75												
80												
85												
90												
95												
1800												
05												
10												
15												
20												
25												
30												
35												
40												
45												
50												
55		850		723	300	187		165	100	110		340
60		865		669	280	187		165	100	134	180	315
65		1035		595	260	257		165	140	183	180	181
70		1060		615	292	205		165	140	184	180	340
75		1763		440	310	160		210	140	184	232	360
80		2188		460	410	195		210	140	201	247	430
85		2271		450	410	210			140	218	218	400
90		2201		435	410		300		160		467	400
95		2208		435	410		335		230		618	400
1900		2190		435	410		625				650	400
05		2175		435	410		625				650	400
10		2381		405	450		800				650	400
15		2326		450	430		795				630	430
20		2330		445	430		770				635	330
25		2444		565	565		825				675	445
30		2521		1270			850				1175	
35		2545		1300			850				1200	
40		2500		3930			850				1125	
45		2500		1330			850				1050	
50		2500		3930			850				1120	
55		2500		4010			1625				1125	
60		1600		4010			1625				2335	
65		16,550		12,840			10,125				7100	
70		26,800		14,000			12,250				15,575	

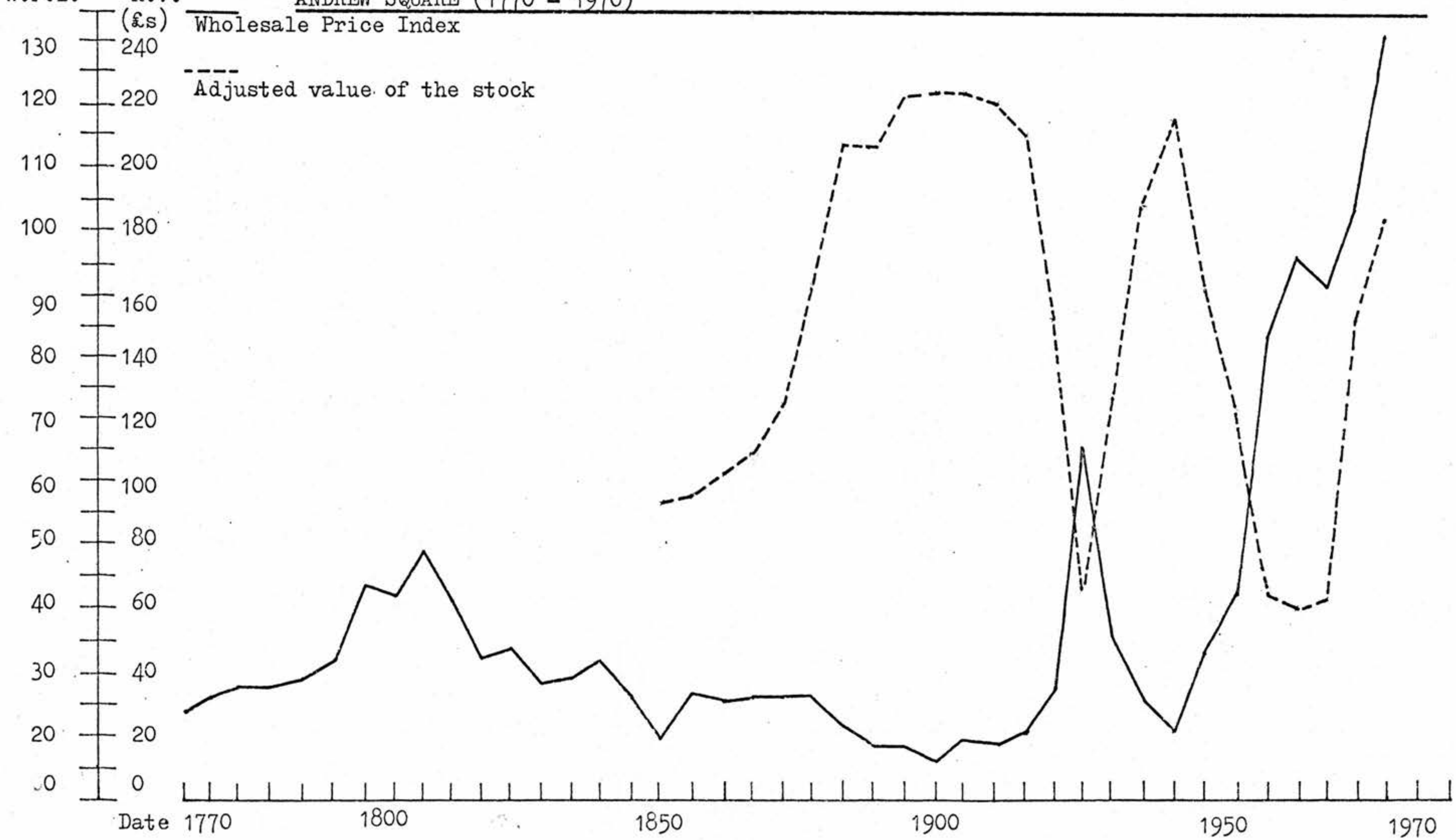
TABLE A.6.6: (Contd.)

Date	21	22	23	24	25	26	27	28	29
	BUILDING NUMBER								
1770									
75									
80									
85									
90									
95									
1800									
05									
10									
15									
20									
25									
30									
35									
40									
45									
50									
55	277	360	150	200	170	225	170		230
60	277	160	192	220	170	220	150		255
65	282	160	212	250	170	220	150		270
70	292	160	242	250	170	280	150		177
75	305	160	242	250	170	280	150		319
80	354	450	245	250	170	350	280		338
85	404	200	285	250	400	350	280		435
90	375	300	265	250	400	350	250		361
95	419	260	591	250	400	475	125		357
1900	425	260	647	350	495	600		2319	
05	437	300	647	350	220	432		2368	
10	310	300	679	475	565	380		2496	
15	467	300	679	475	565	421		2619	
20	439	378	682	475	540	525		2705	
25	439	410	757	515	555	525		2706	
30	495	410	410	515	605	525		3602	
35	514	426	1229	515	605	525		3602	
40	515	500	1229	515	605	525		4035	
45	534	500	1229	515	605	525		3770	
50	638	512	1215	515	975	525		3712	
55	649	500	949	515	1020	525		5186	
60	809	500	1326	515	1049	525		5856	
65	1350	1150	2565	1200	5600	1300		10,125	
70	2210	1950	3700		9160	2200		11,500	

Source: See Chap. 8.

Note: Current Pounds.

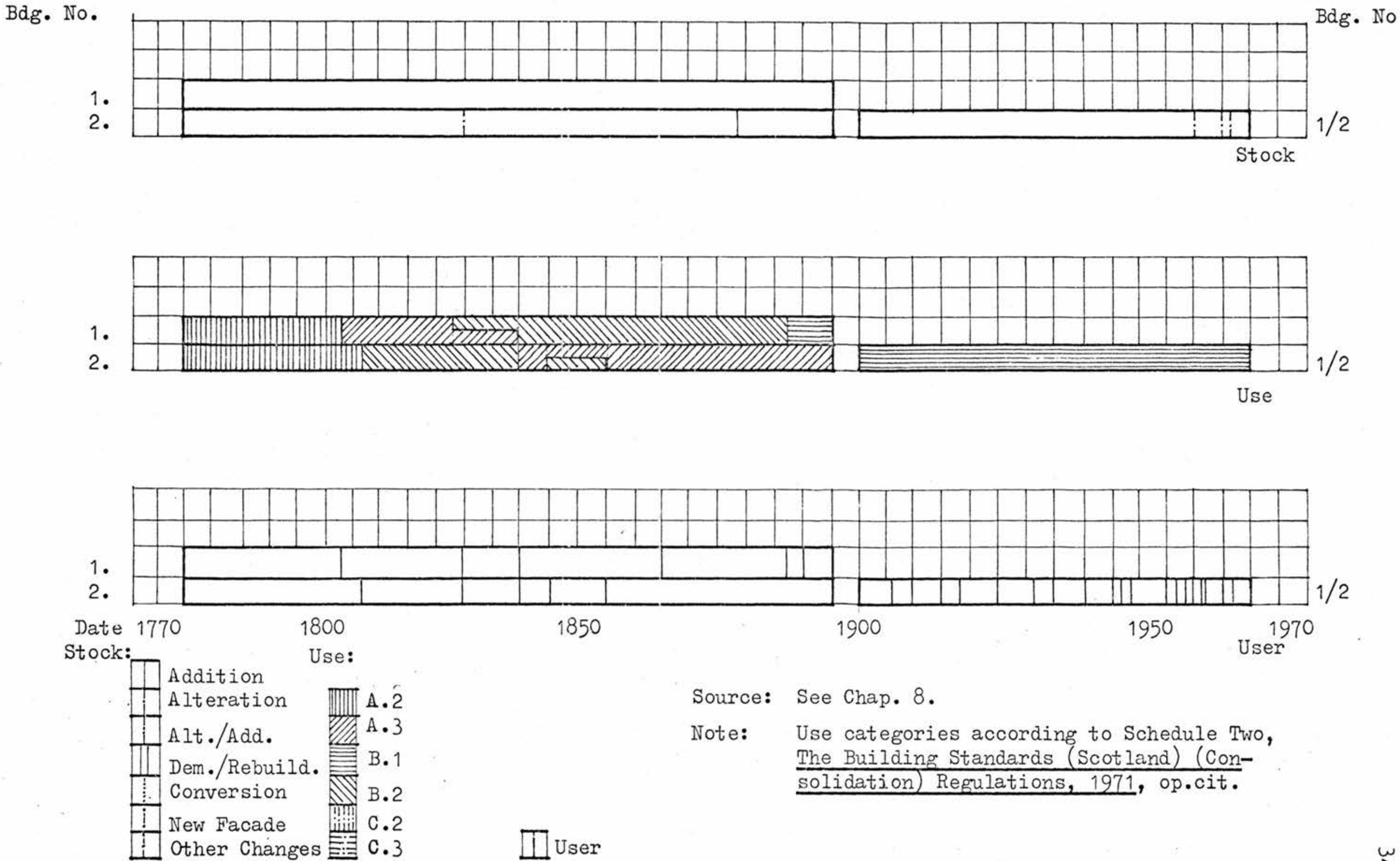
FIGURE A.6.1: COMPARISON OF WHOLESALE PRICE INDEX AND RATEABLE VALUE PER SQUARE METRE OF THE STOCK: ST. ANDREW SQUARE (1770 - 1970)



Source: Tables A.5.6 and A.6.6.

Note: 1964 = 100.

FIGURE A.6.2: CHANGE OF USE, USER, STOCK: ST. ANDREW SQUARE, EDINBURGH (NOS. 1 - 29) (1770 - 1970)



Source: See Chap. 8.

Note: Use categories according to Schedule Two, The Building Standards (Scotland) (Consolidation) Regulations, 1971, op.cit.

FIGURE A.6.2: (Contd.)

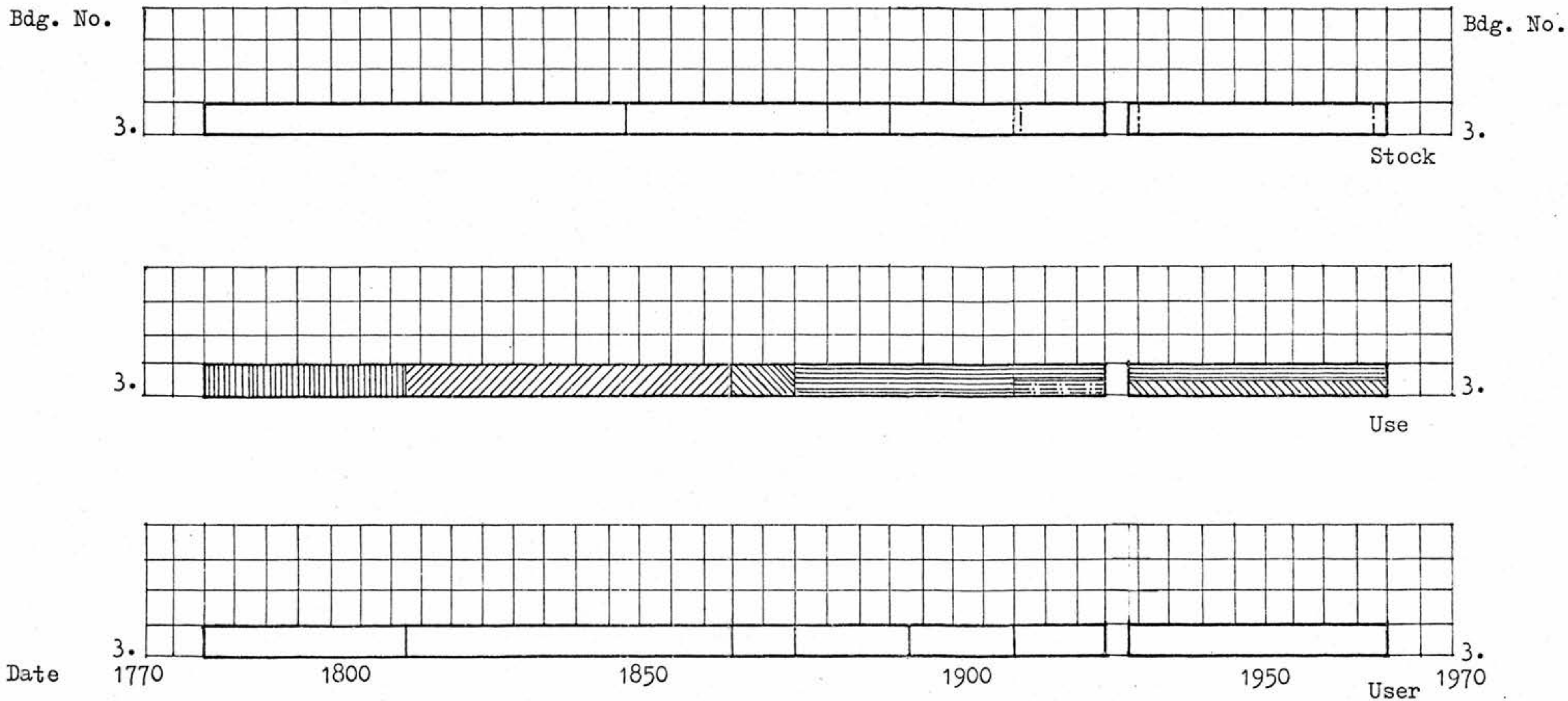


FIGURE A.6.2: (Contd.)

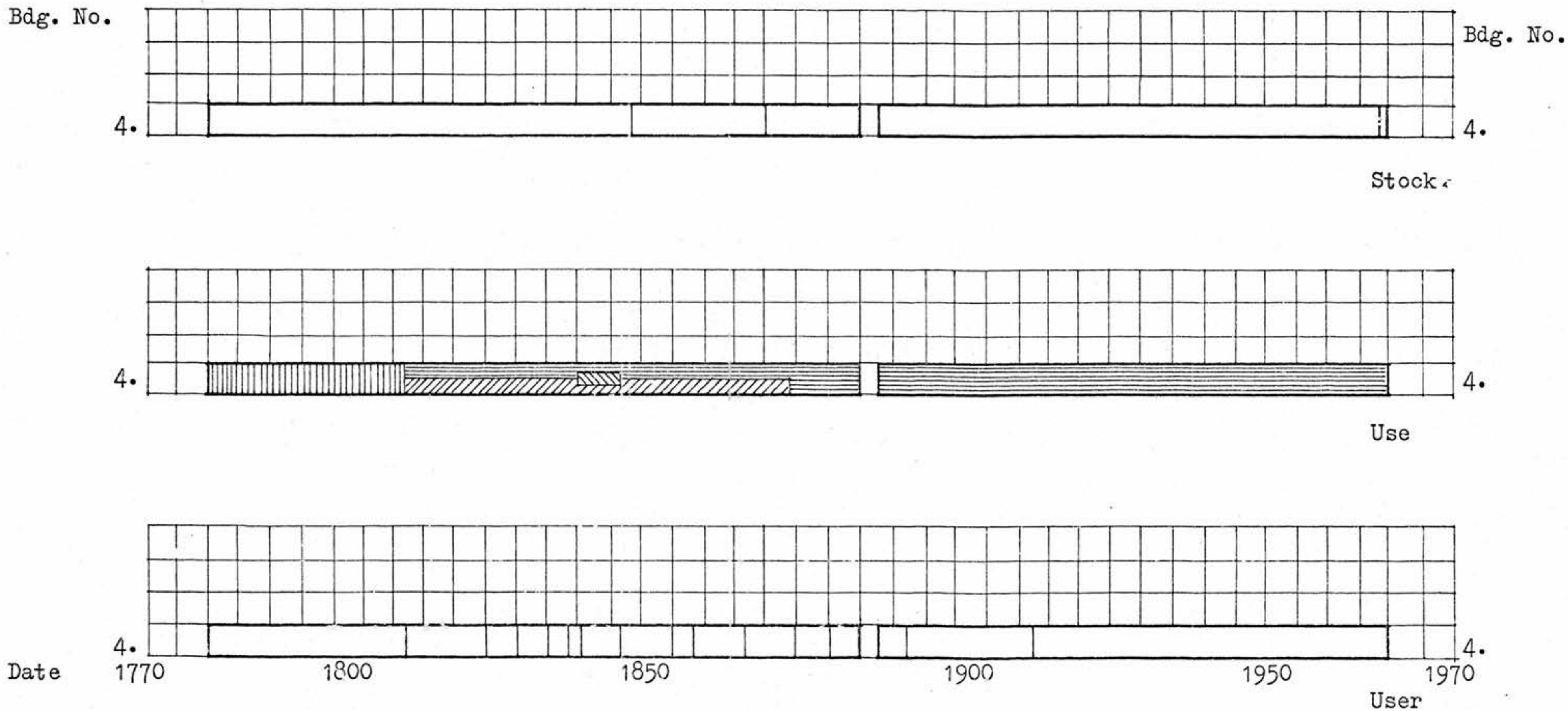


FIGURE A.6.2: (Contd.)

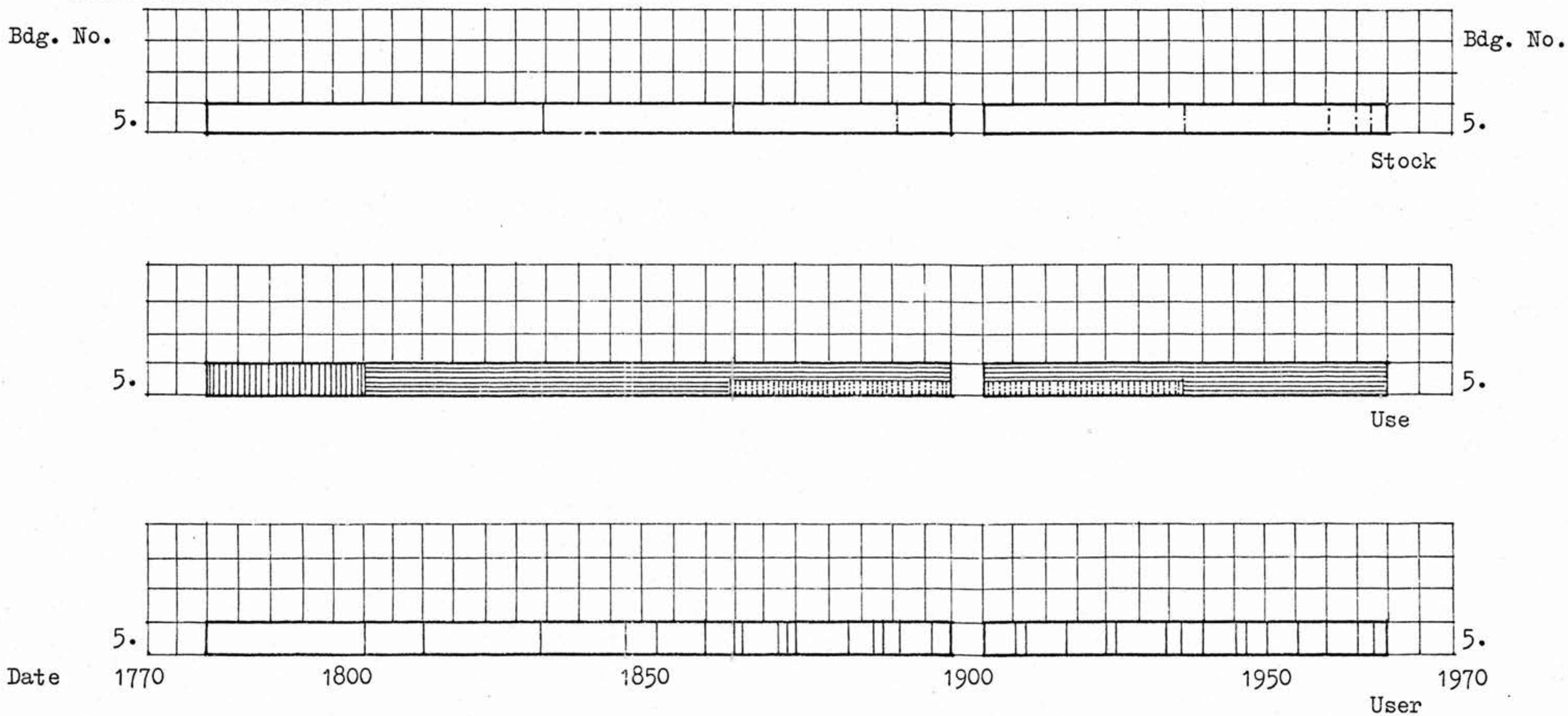


FIGURE A.6.2: (Contd.)

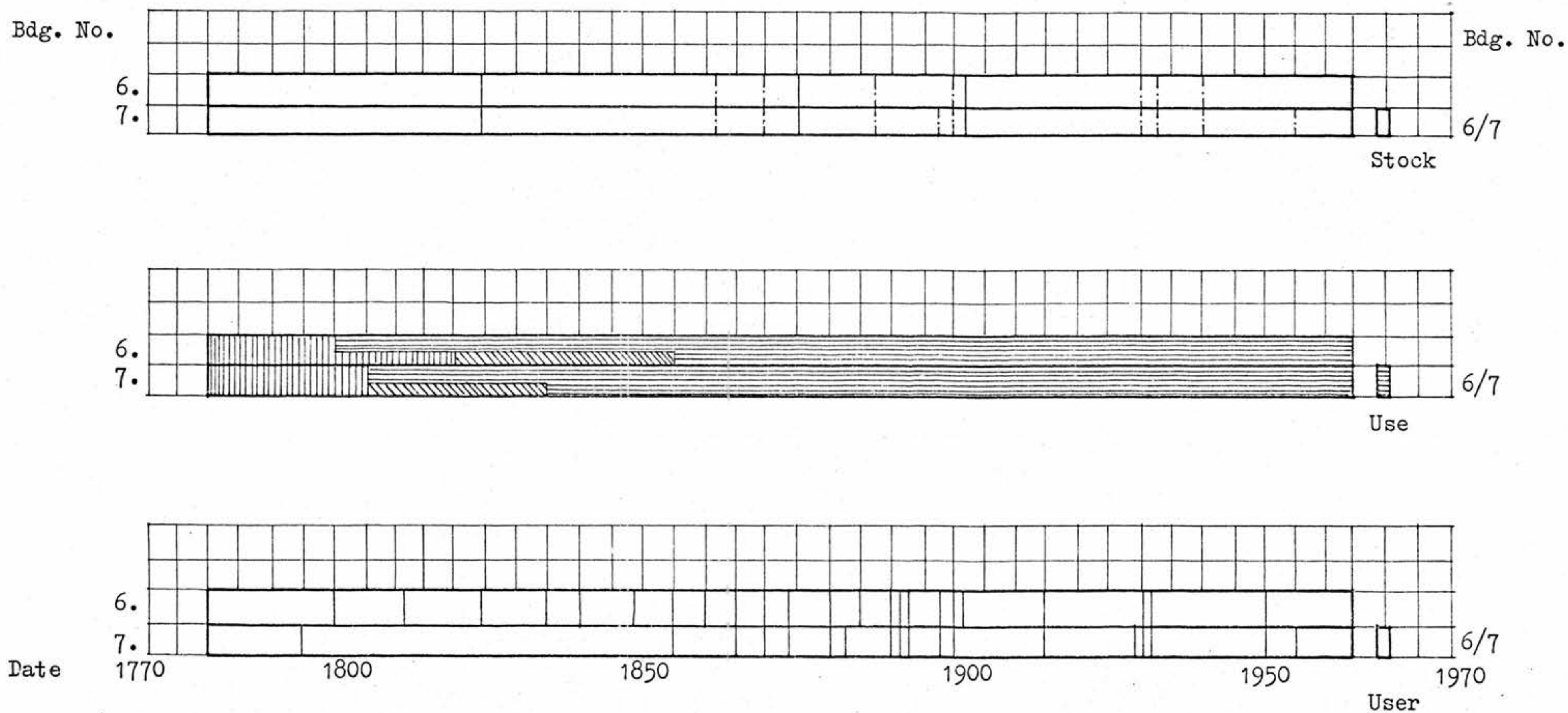


FIGURE A.6.2: (Contd.)

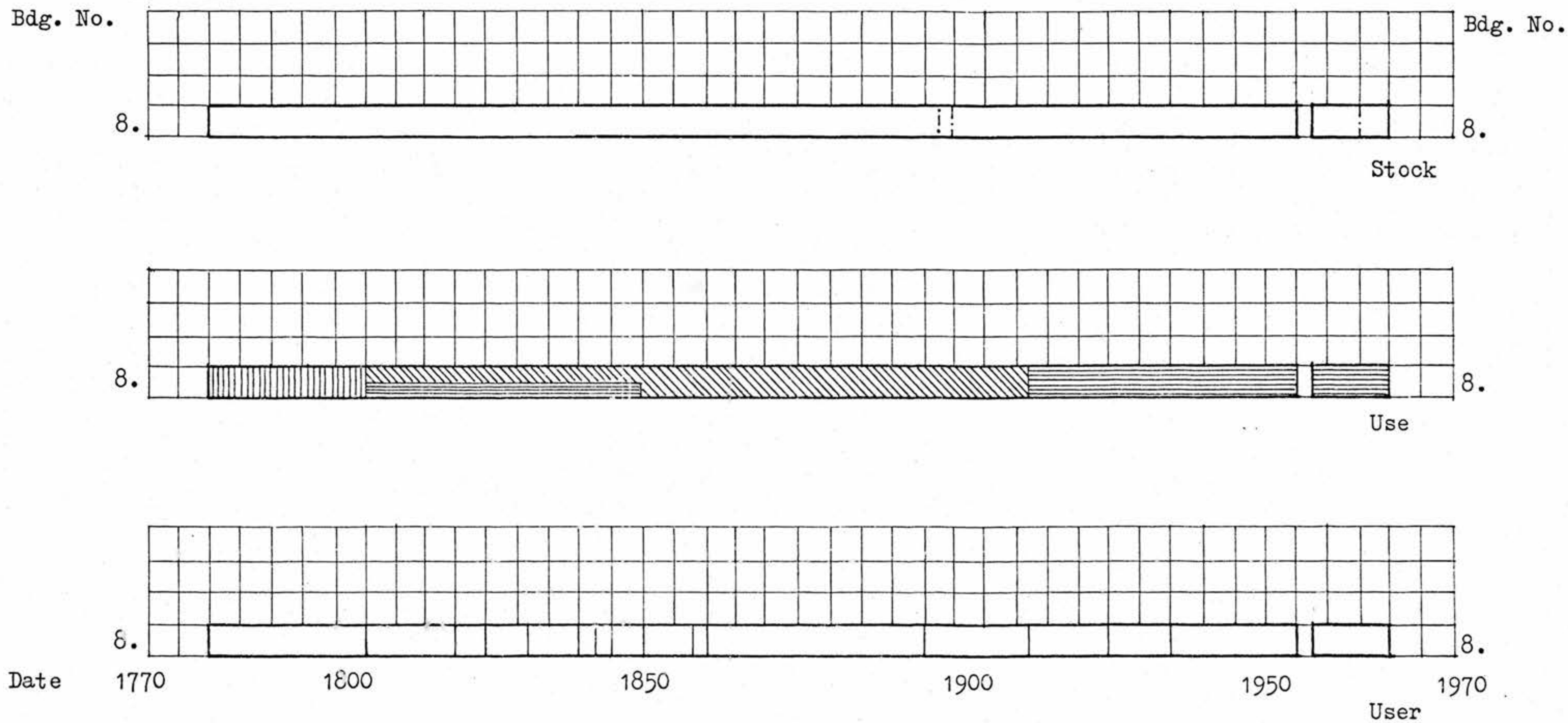


FIGURE A.6.2: (Contd.)

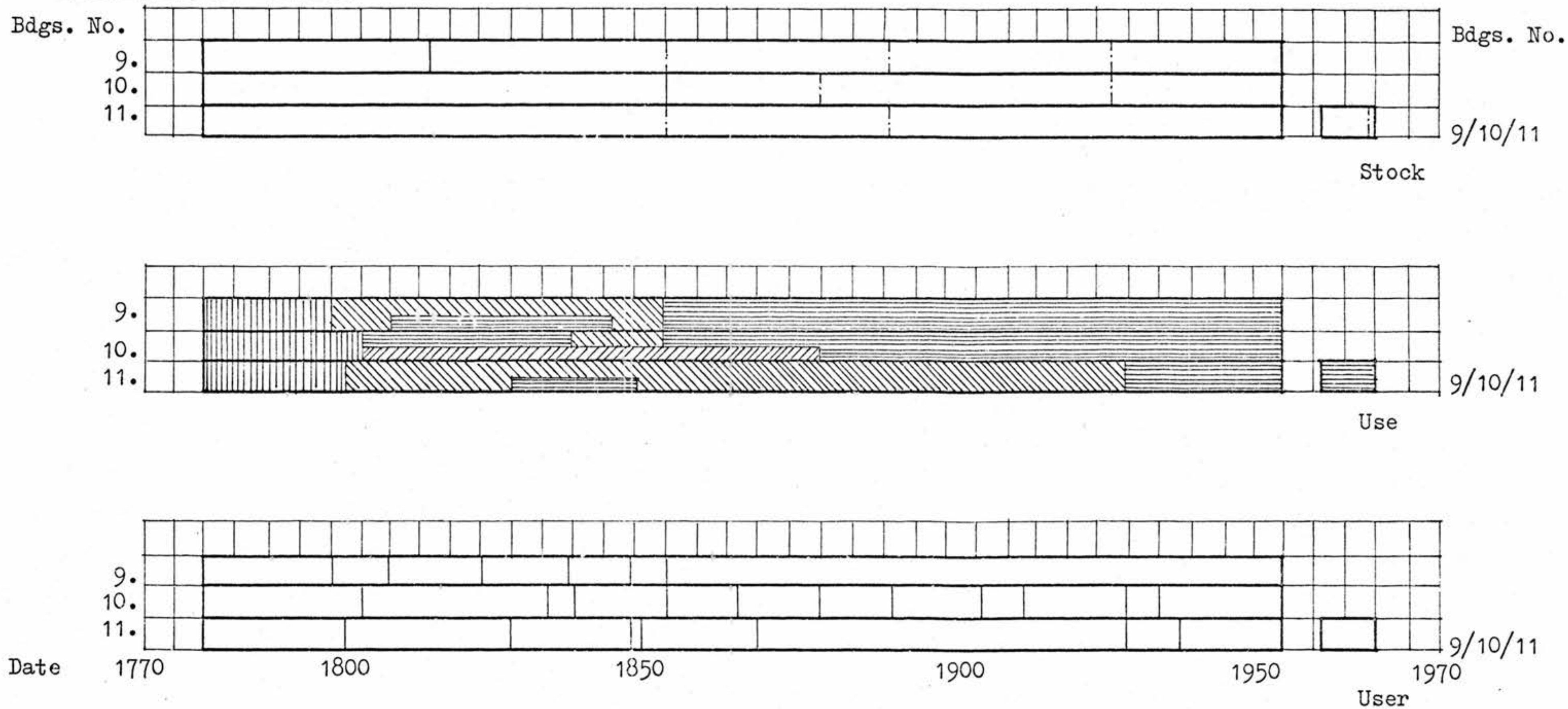


FIGURE A.6.2: (Contd.)

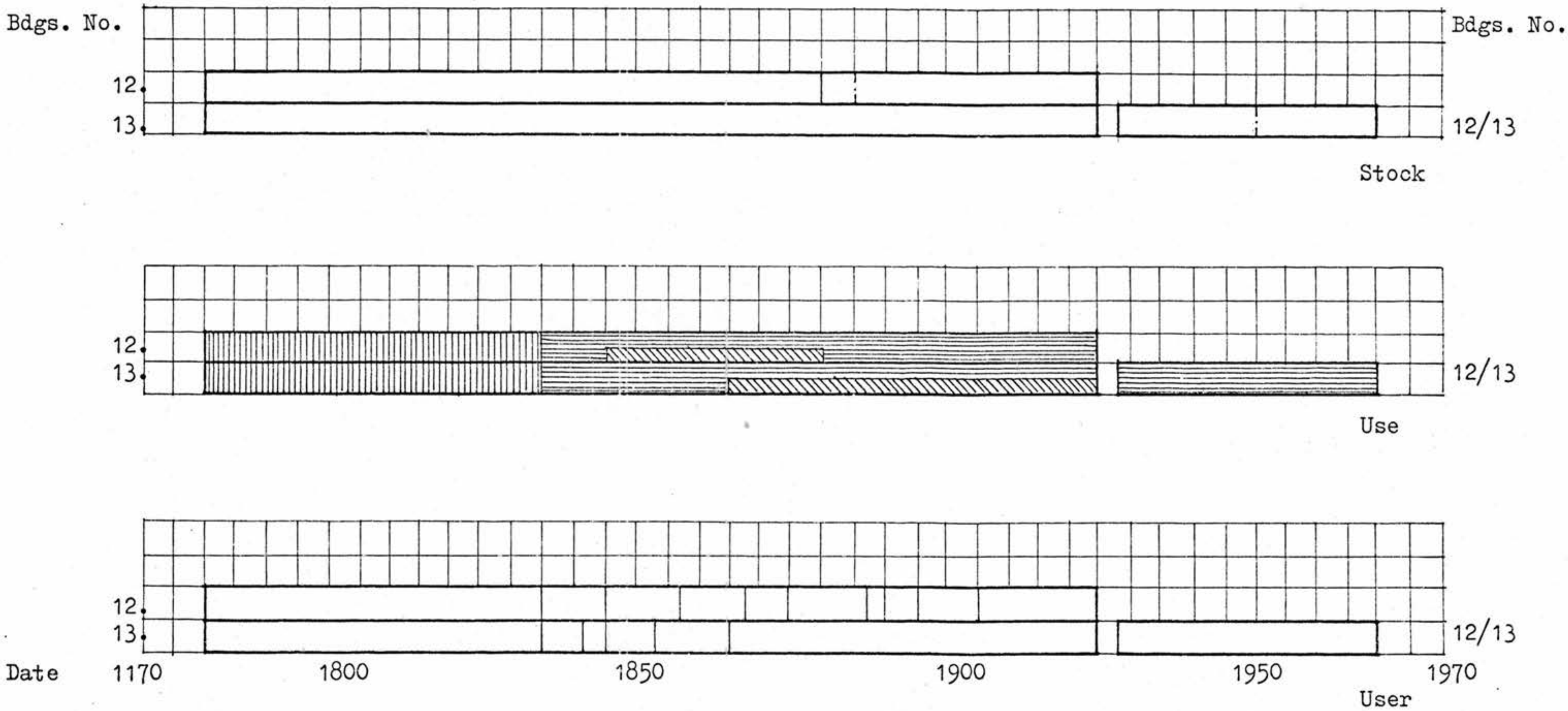


FIGURE A.6.2: (Contd.)

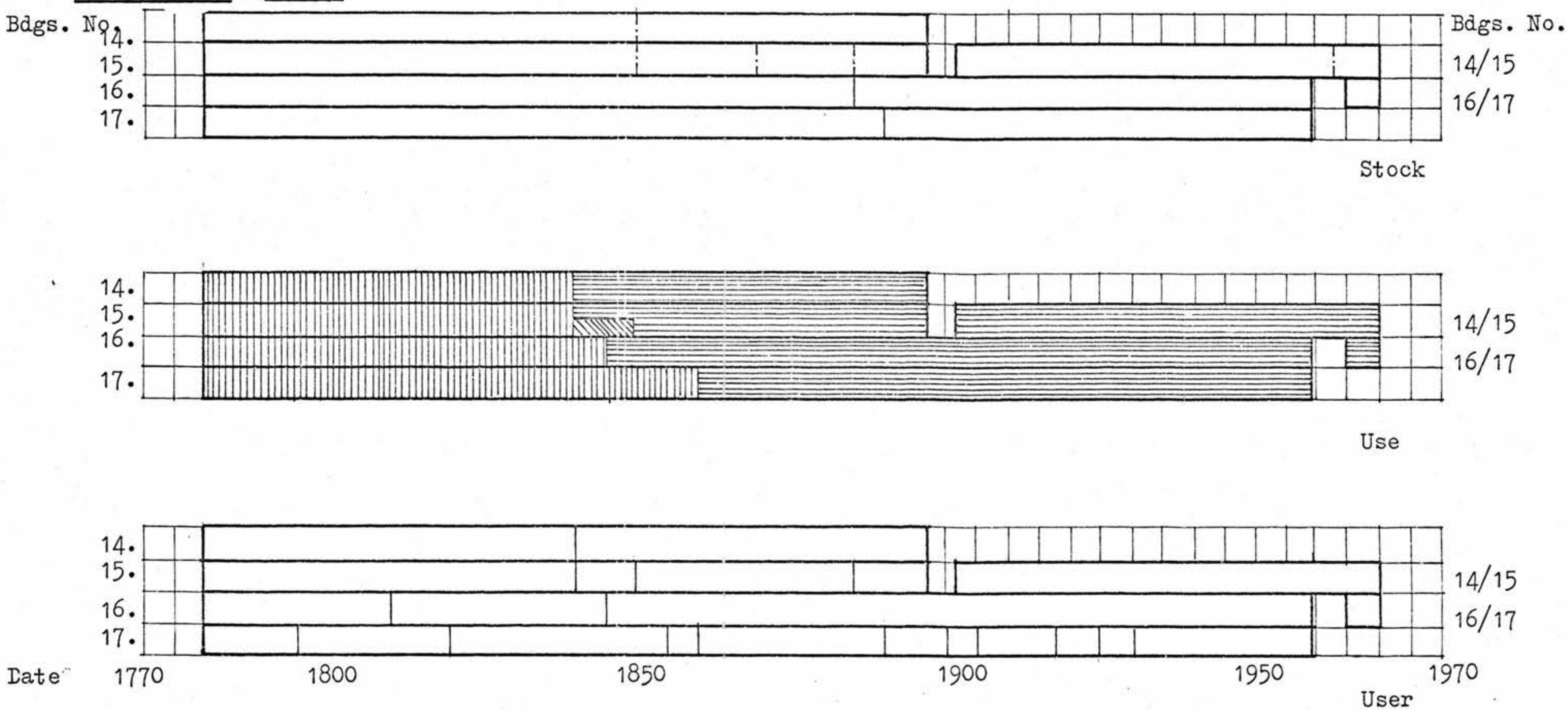


FIGURE A.6.2: (Contd.)

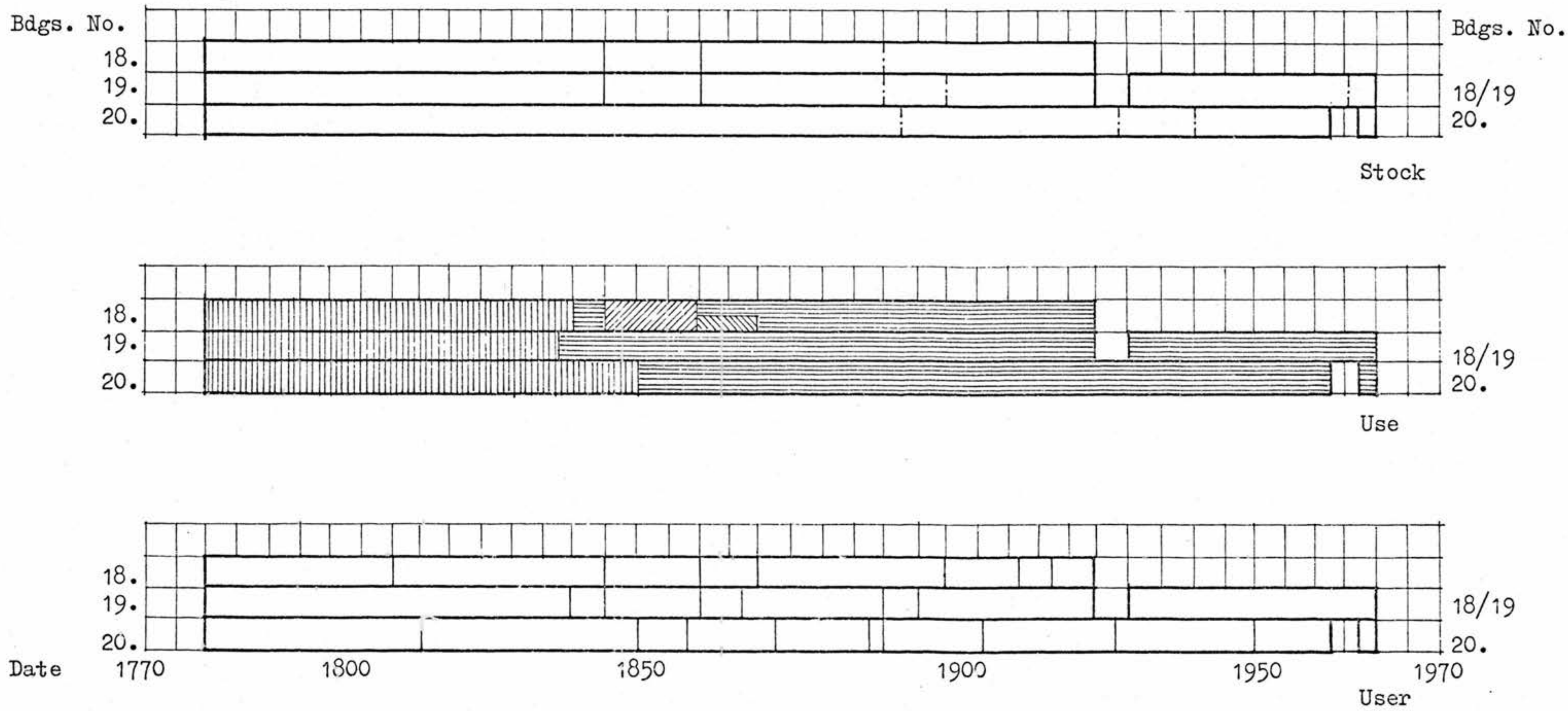


FIGURE A.6.2: (Contd.)

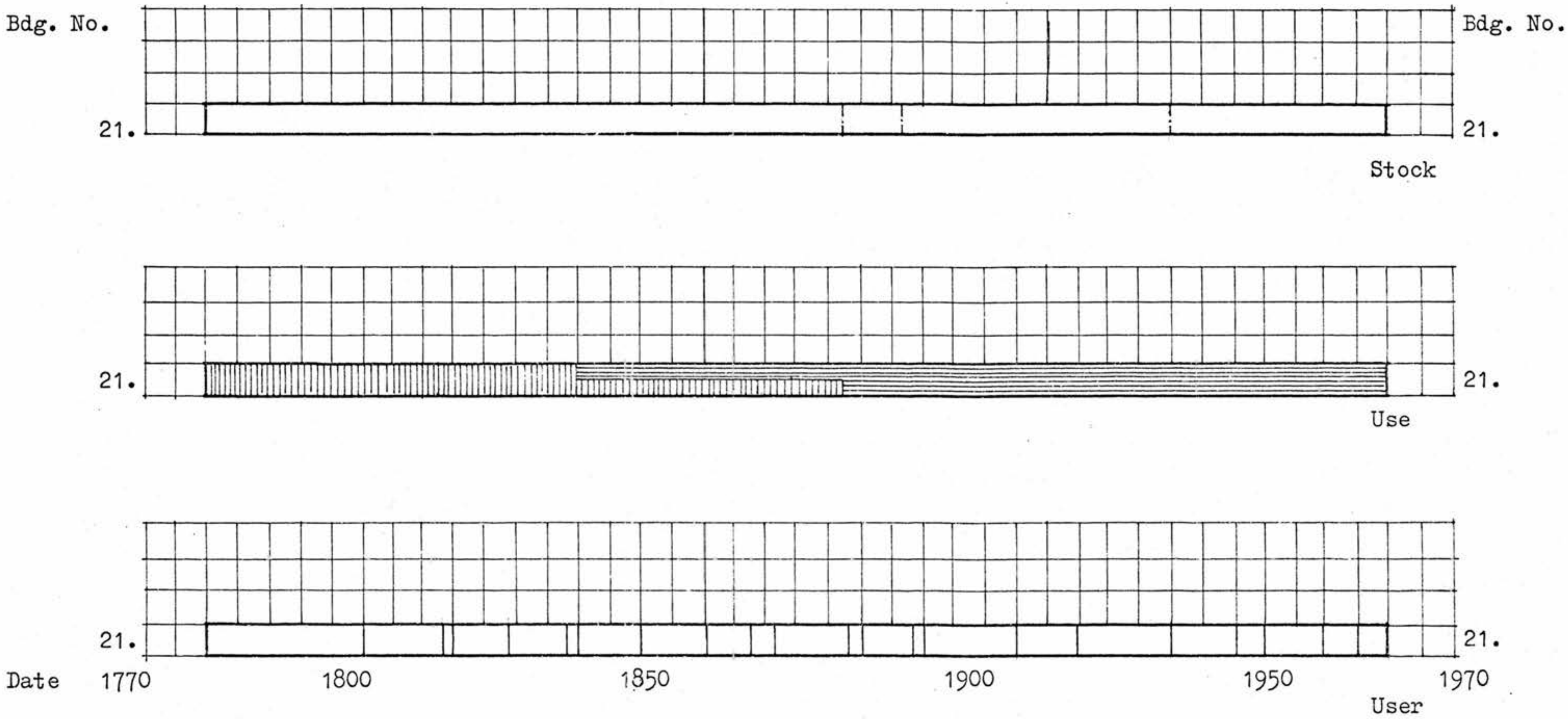


FIGURE A.6.2: (Contd.)

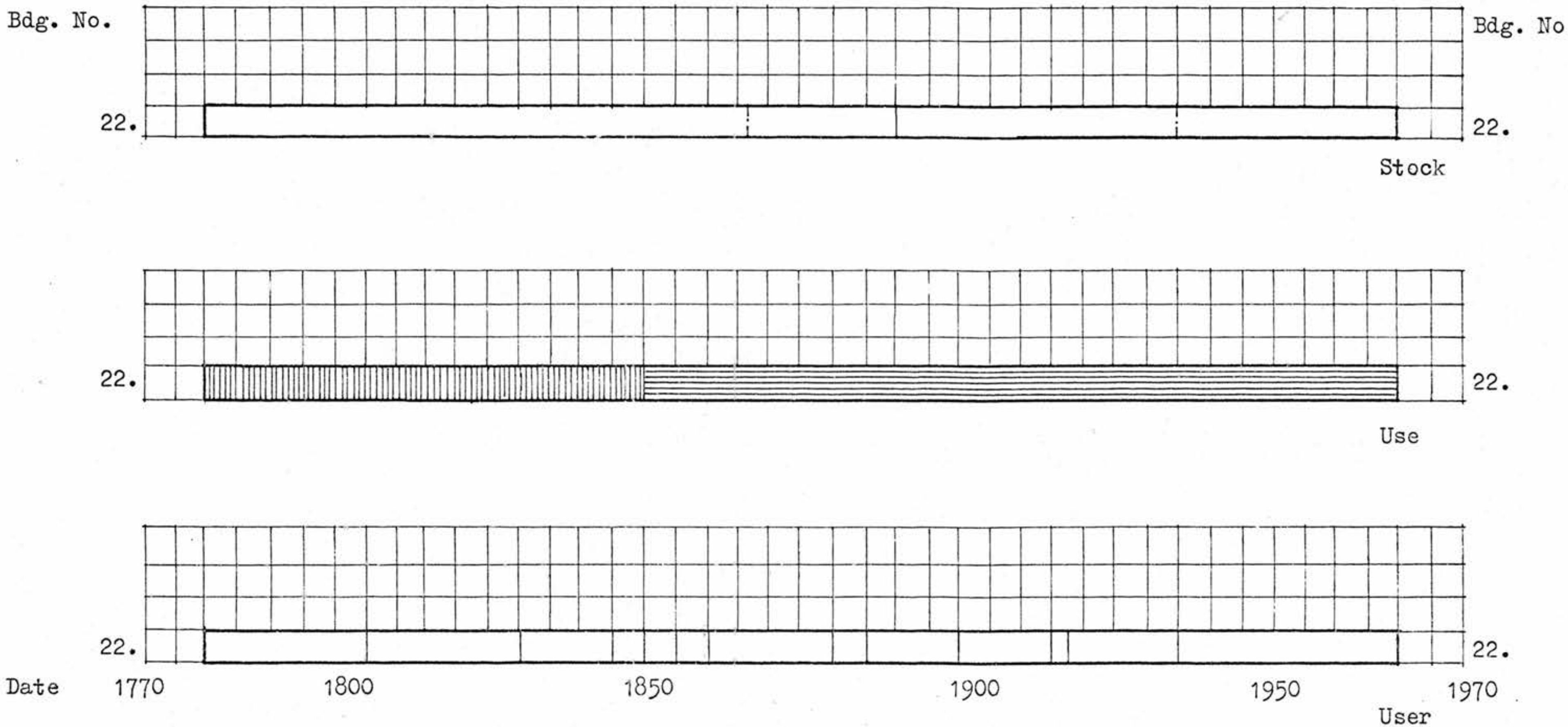


FIGURE A.6.2: (Contd.)

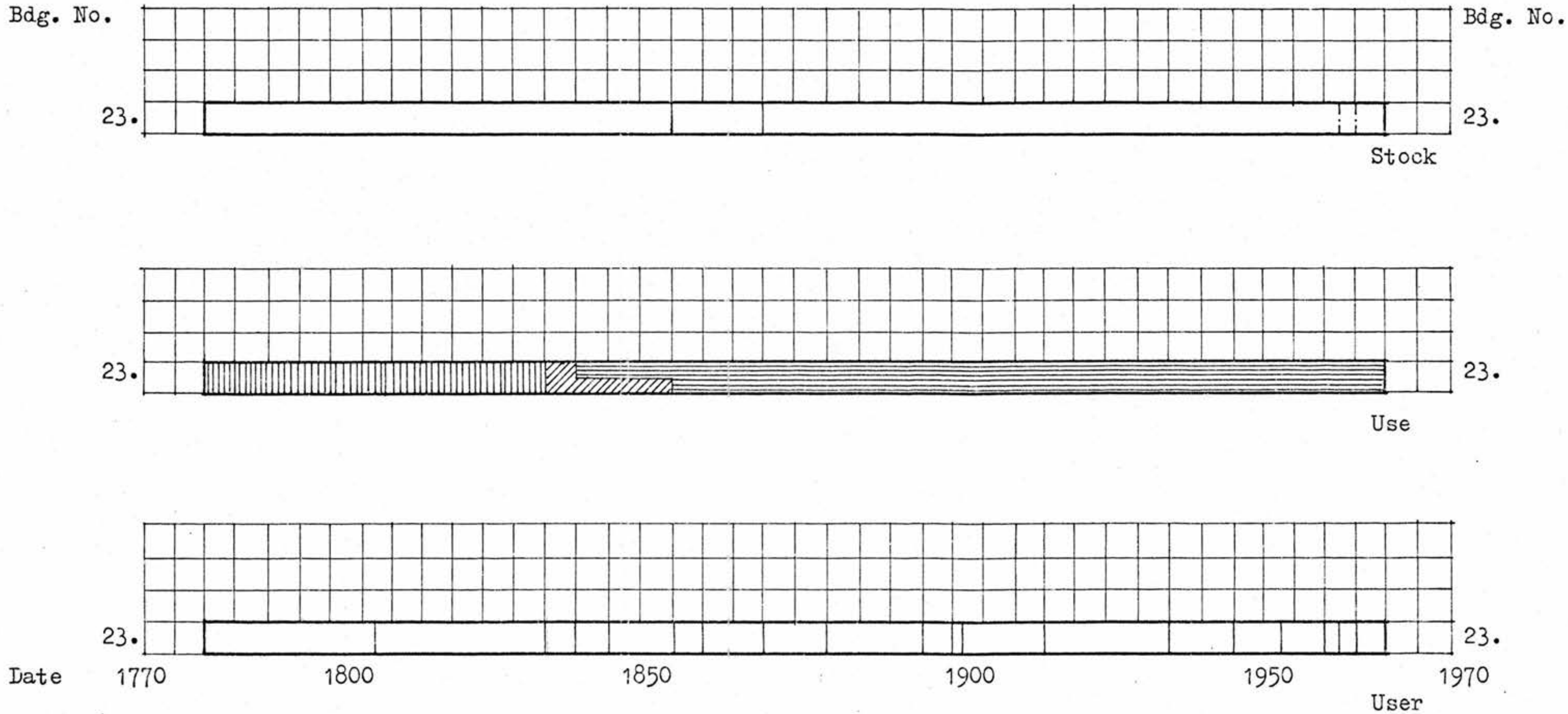


FIGURE A.6.2: (Contd.)

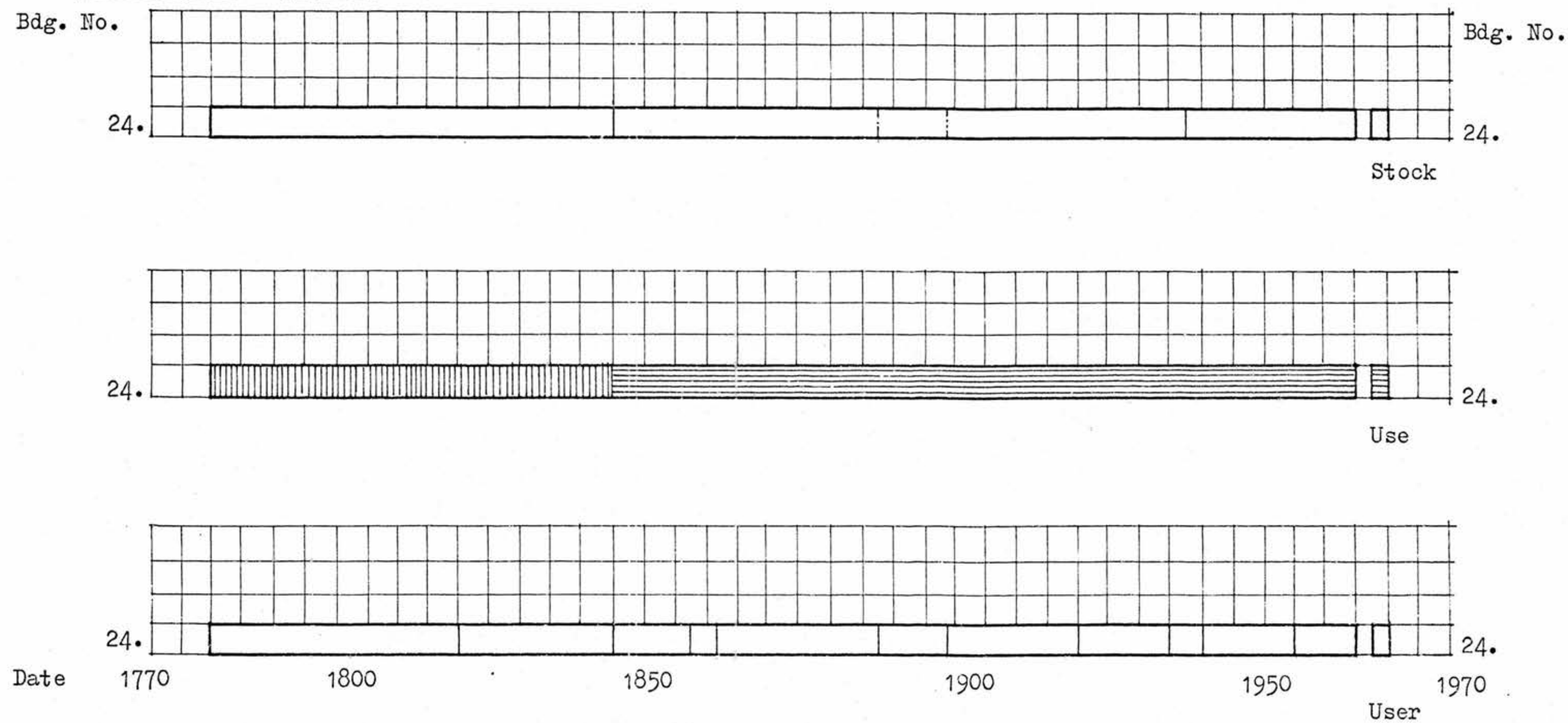


FIGURE A.6.2: (Contd.)

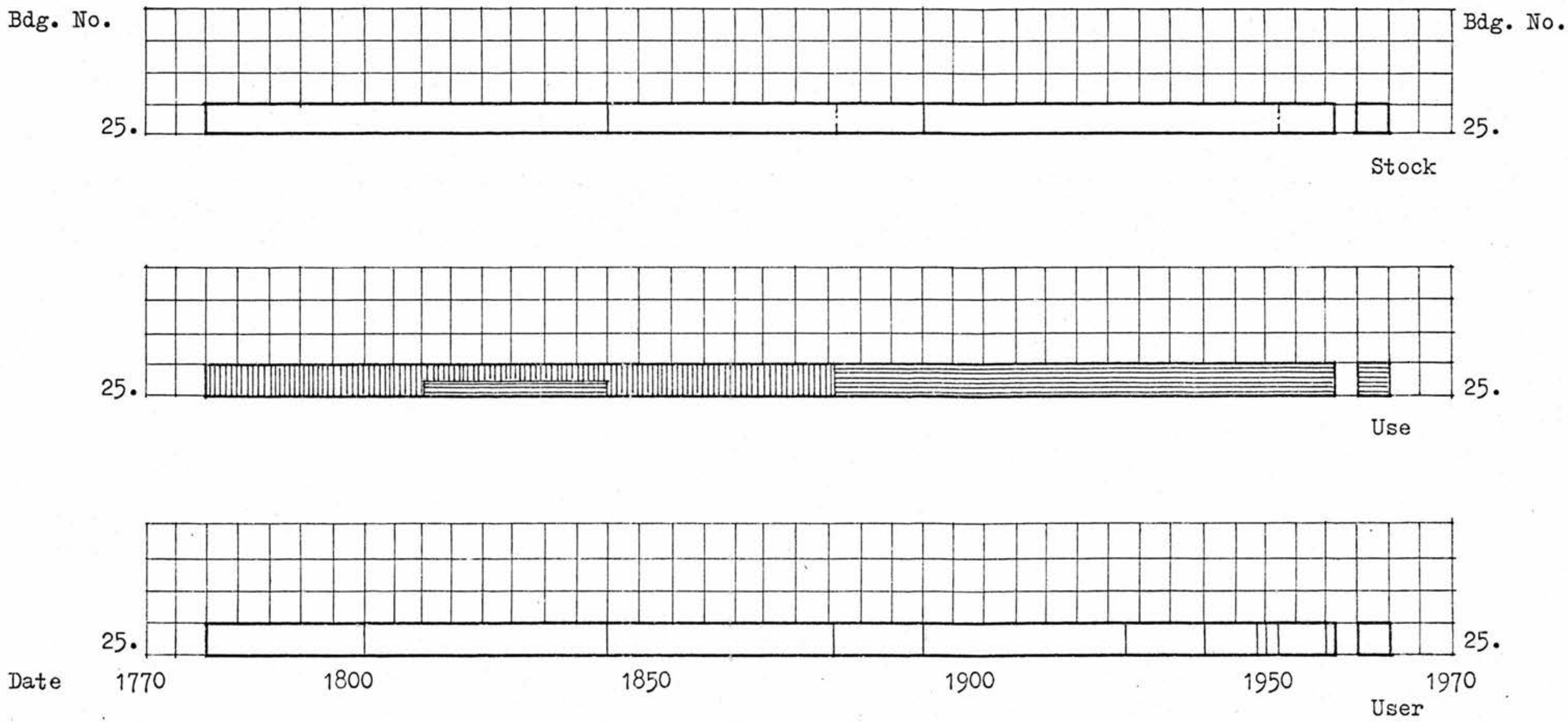


FIGURE A.6.2: (Contd.)

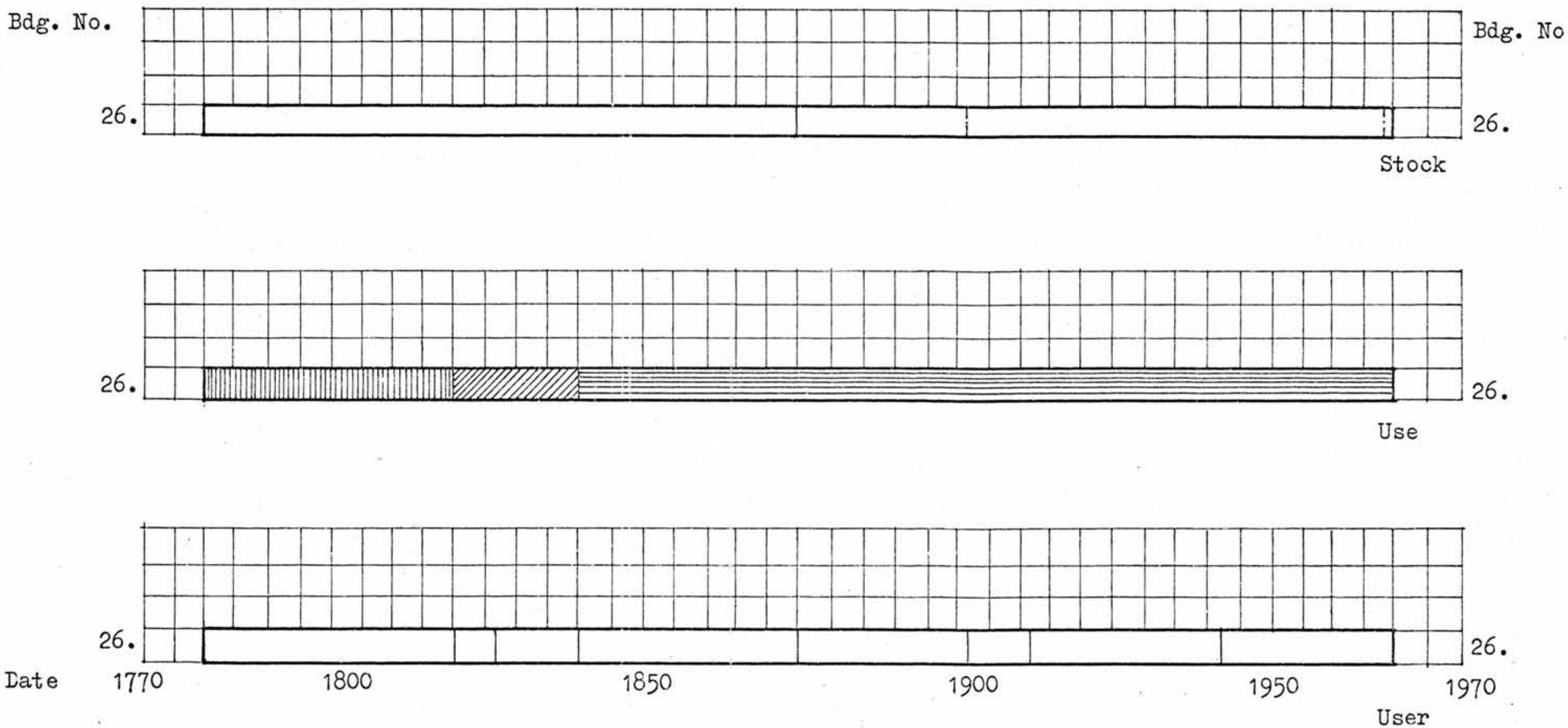
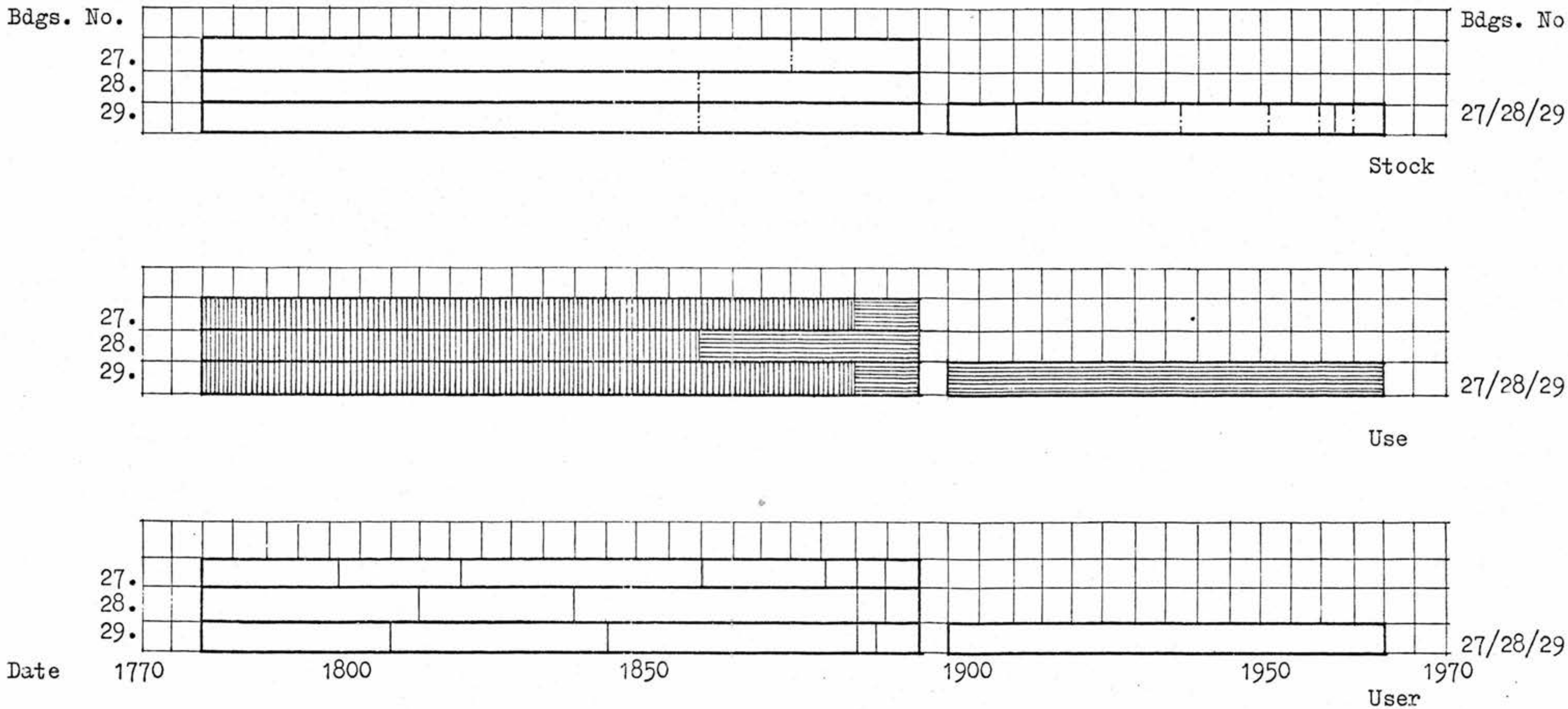


FIGURE A.6.2: (Contd.)



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(Because of the size and complexity of this bibliography, an attempt has been made to organise the material by subject matter. Where references to this material has been cited in the text, the appropriate chapter (C) or Appendix (A) numbers are given at the end of the reference, otherwise references are of general interest to the subject.)

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INFLUENCES ON THE LIFE-SPAN OF URBAN BUILDINGS:

An examination of some locational, economic and social factors affecting the existing stock.

(Supplement)

Richard Donald Wagner

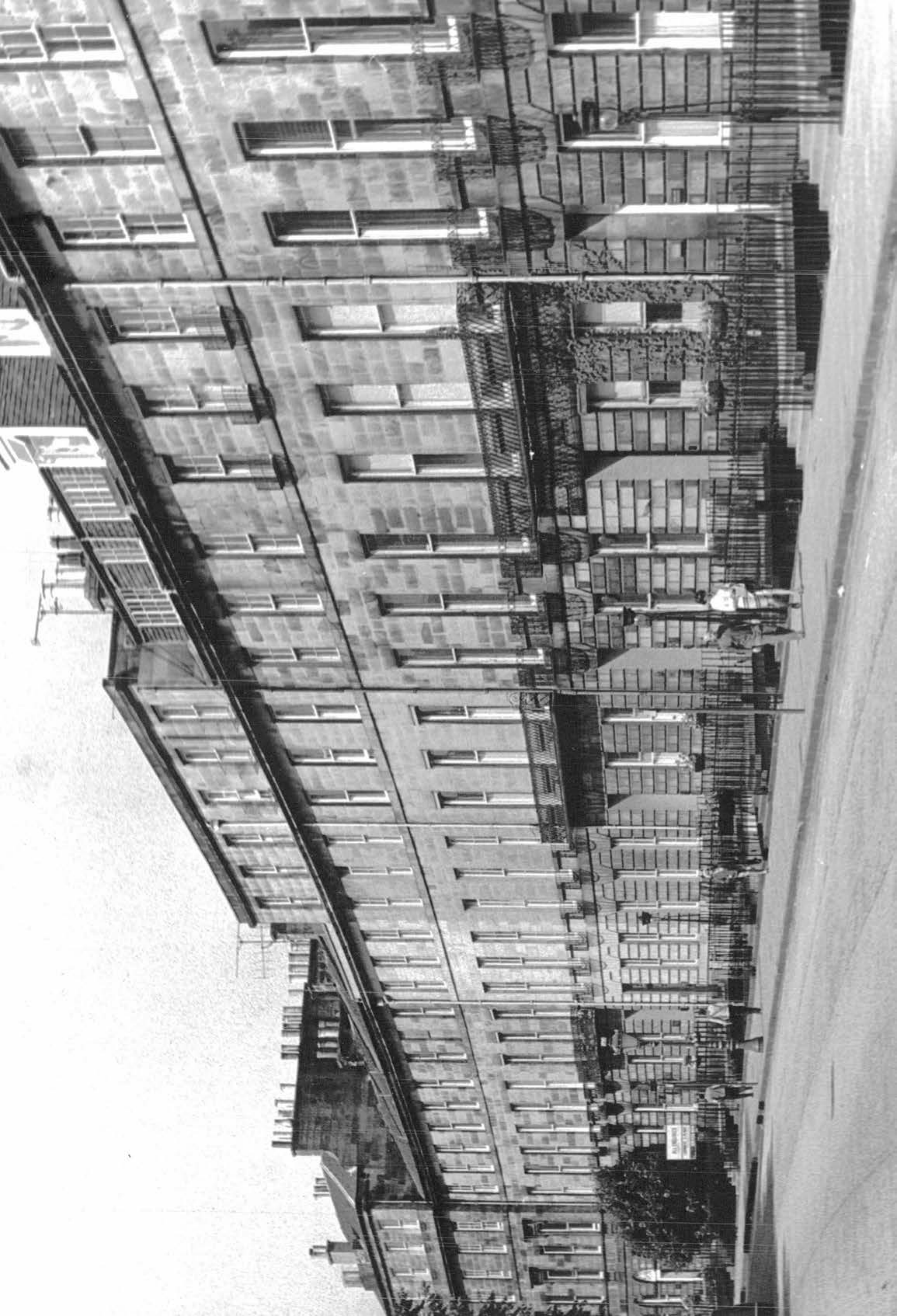
Ph.D.
University of Edinburgh
1975.

P H O T O G R A P H S

N E W H A V E N   H A R B O U R

N E W T O W N H O U S I N G

A B E R C R O M B I E P L A C E



S T .   J A M E S   C E N T R E


ST JAMES CENTRE

G E O R G E   S Q U A R E
W E S T   S I D E

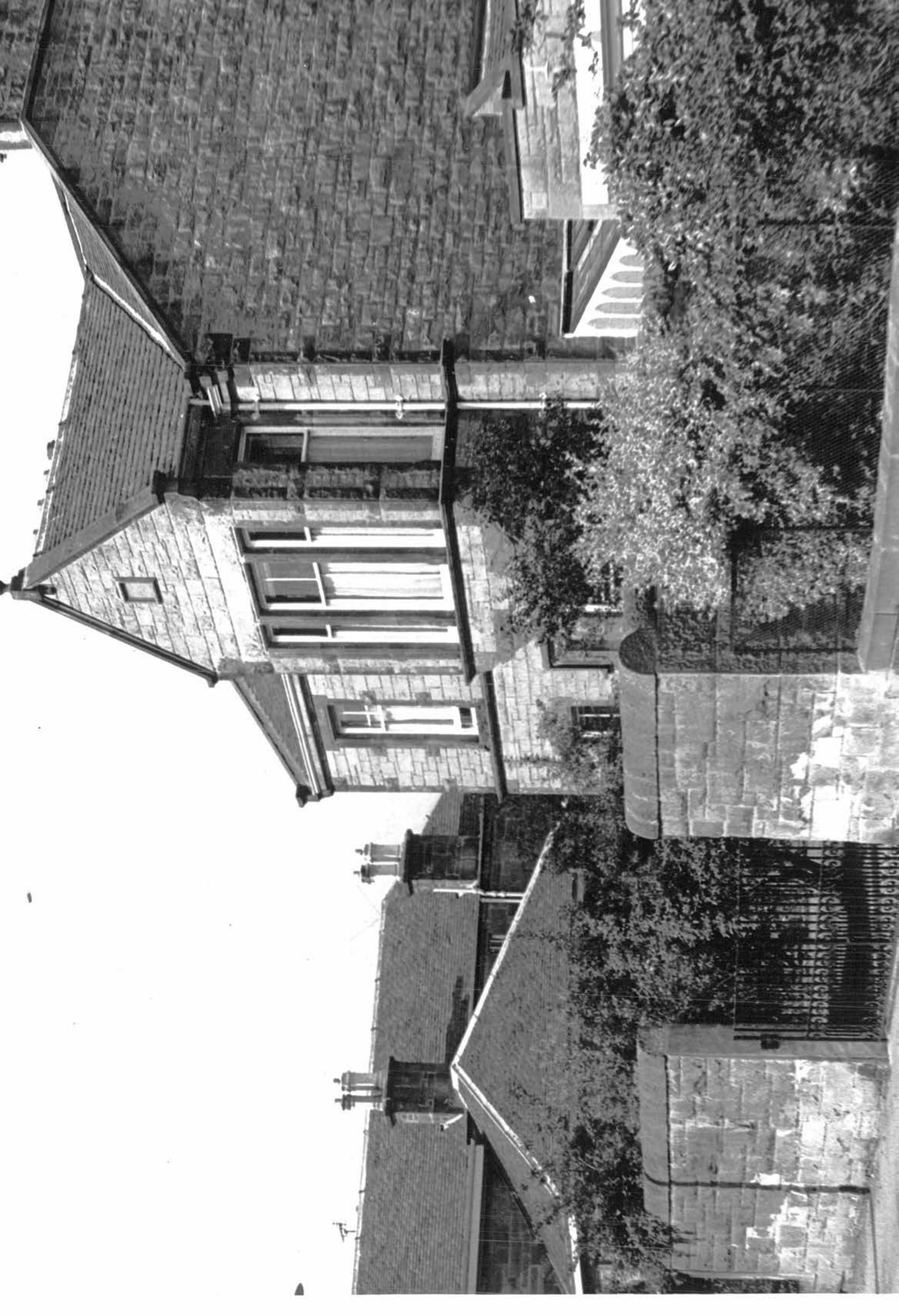
M A R C H M O N T   H O U S I N G

W A R R E N D E R   P A R K

S T. A N D R E W S Q U A R E

D U N D A S H O U S E

G R A N G E   L O A N   H O U S I N G



S T. A N D R E W S Q U A R E

S O U T H S I D E

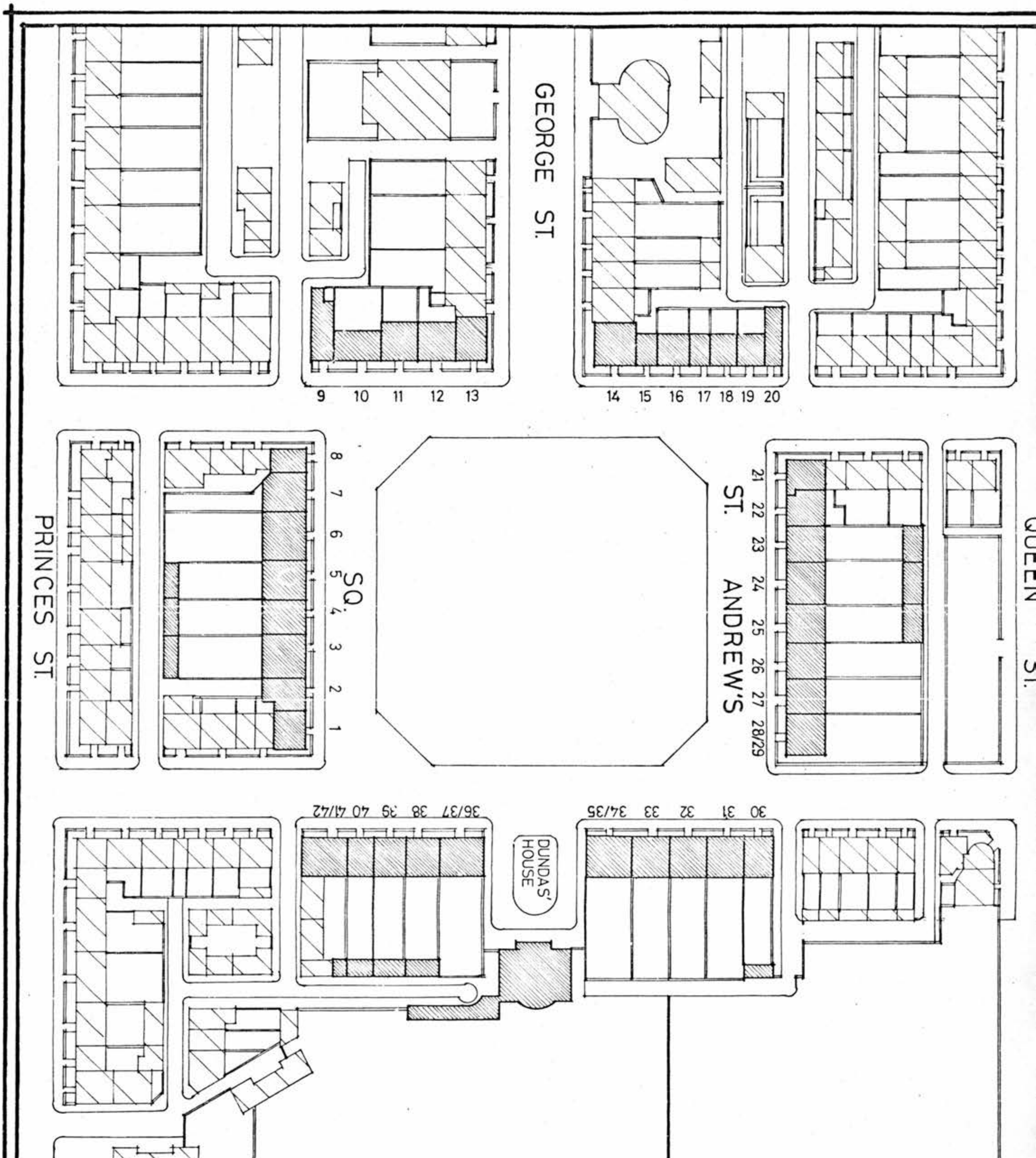

OCIETY OF SCOTLAND
BIBLE HOUSE

ST. ANDREW SQUARE

NORTH SIDE

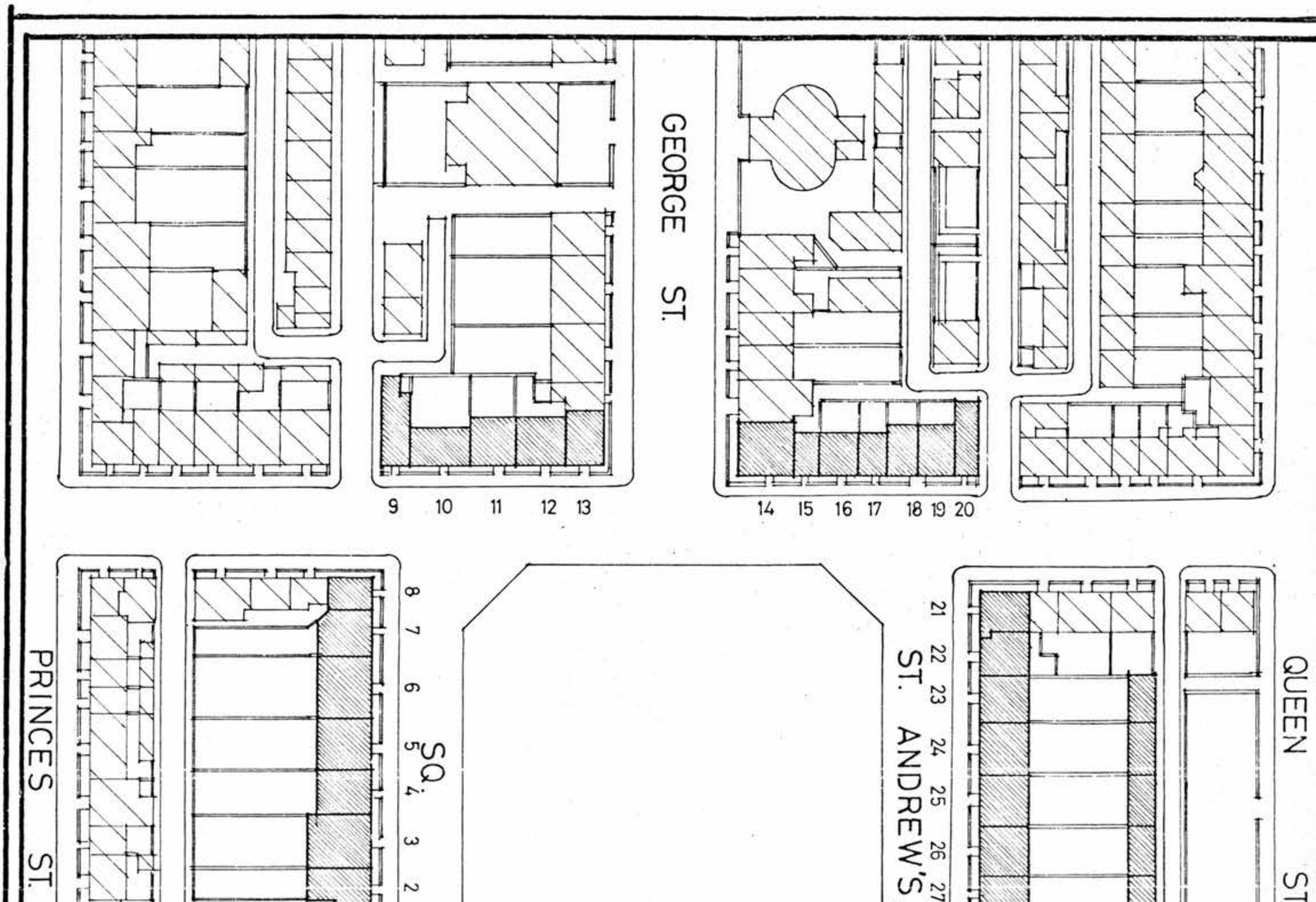
M A P S

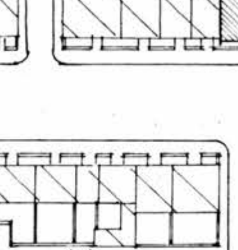
(Maps 1 – 3 in folder inside back cover)



MAP 4-A
ST. ANDREW'S SQUARE - 1784

SCALE: APPROXIMATELY 1": 380m

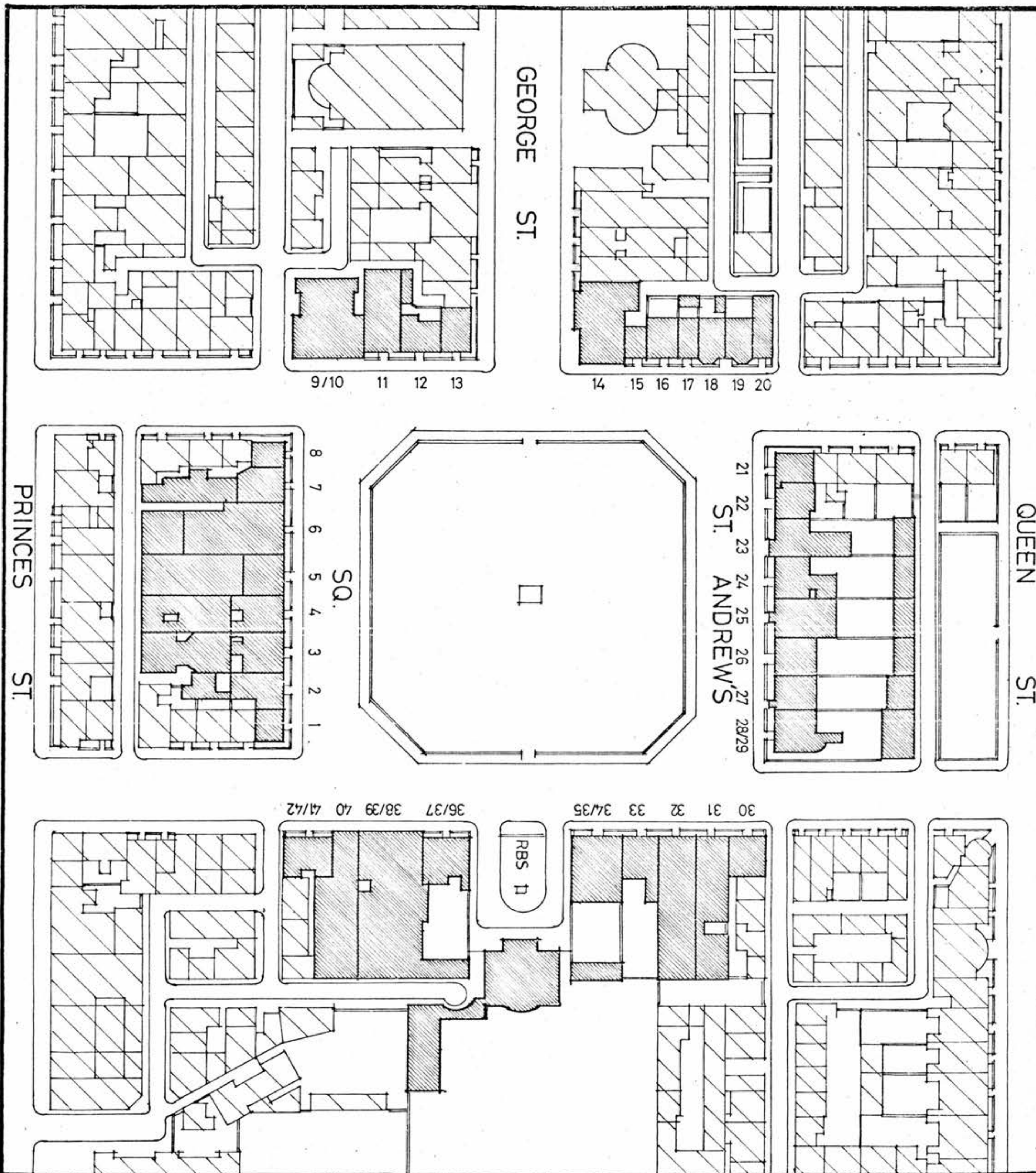




MAP 4-B
ST. ANDREW'S SQUARE – 1817

SCALE: APPROXIMATELY 1": 380m

0 0.5 1 2

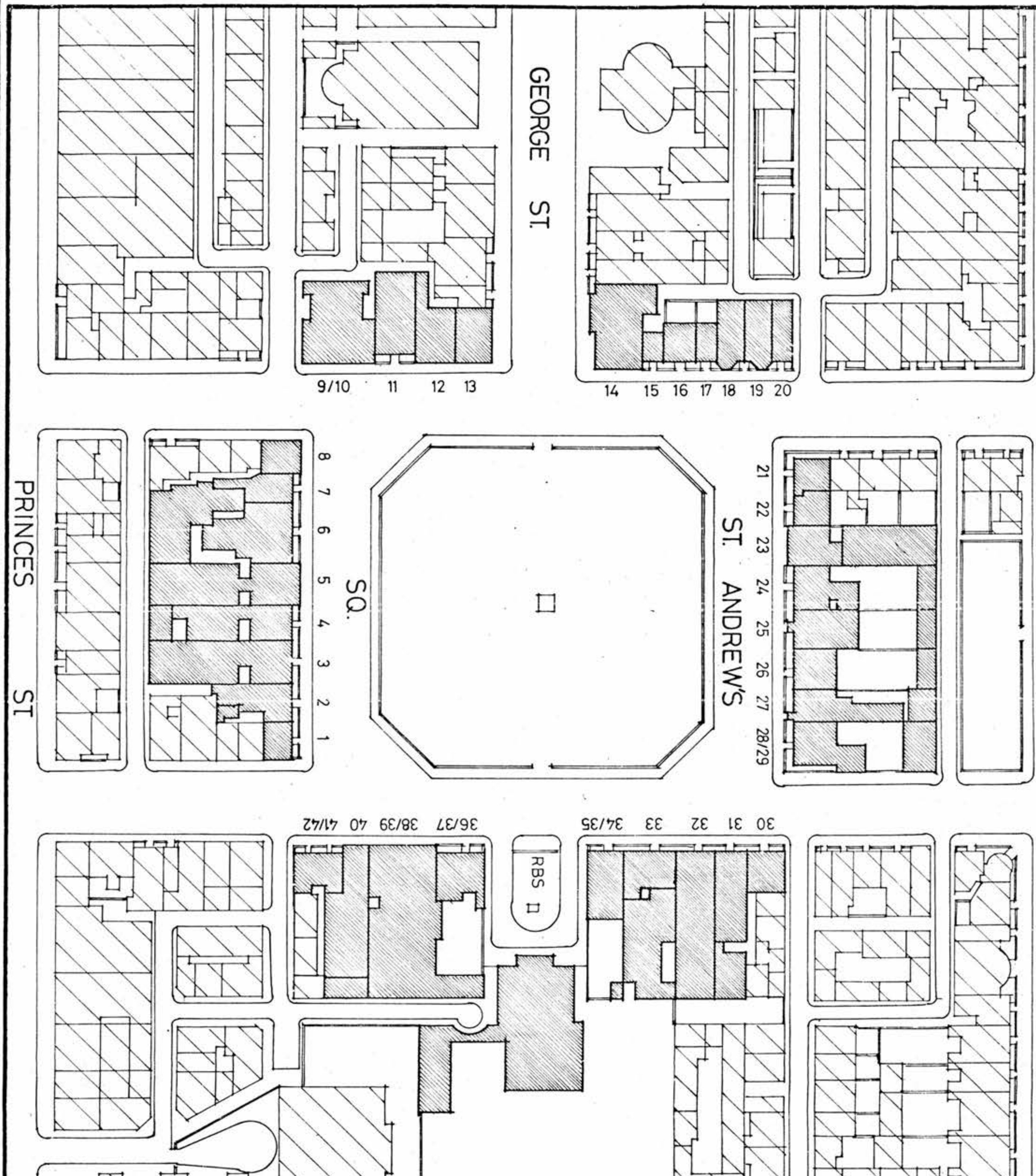


MAP 4-C

ST. ANDREW'S SQUARE - 1854

SCALE: APPROXIMATELY 1": 380 m

0 0.5 1 2

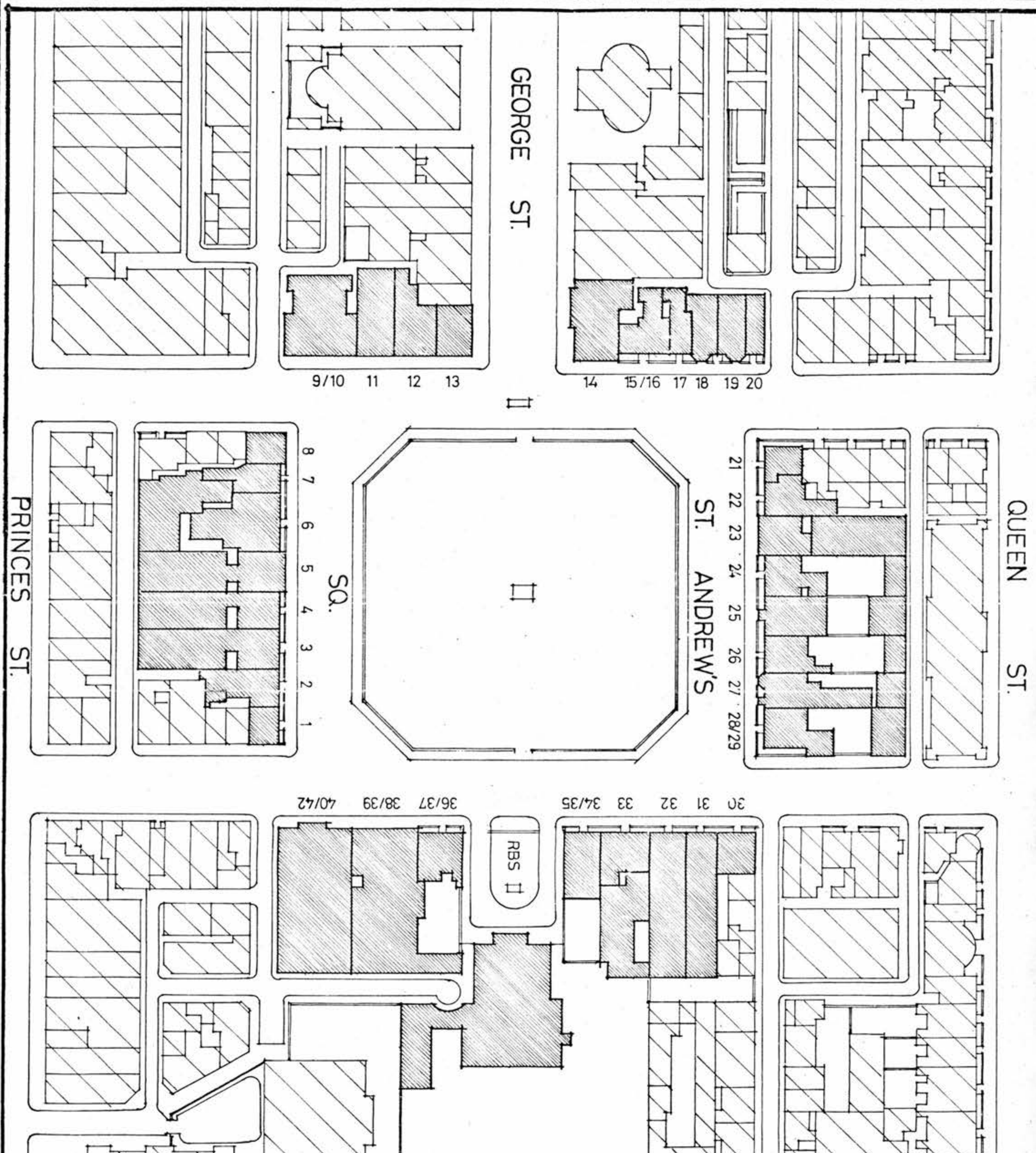


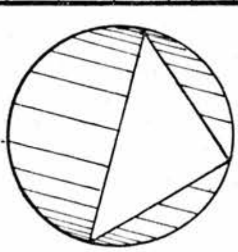
MAP 4-D

ST. ANDREW'S SQUARE - 1881

SCALE: APPROXIMATELY 1": 380m

0 0.5 1 2



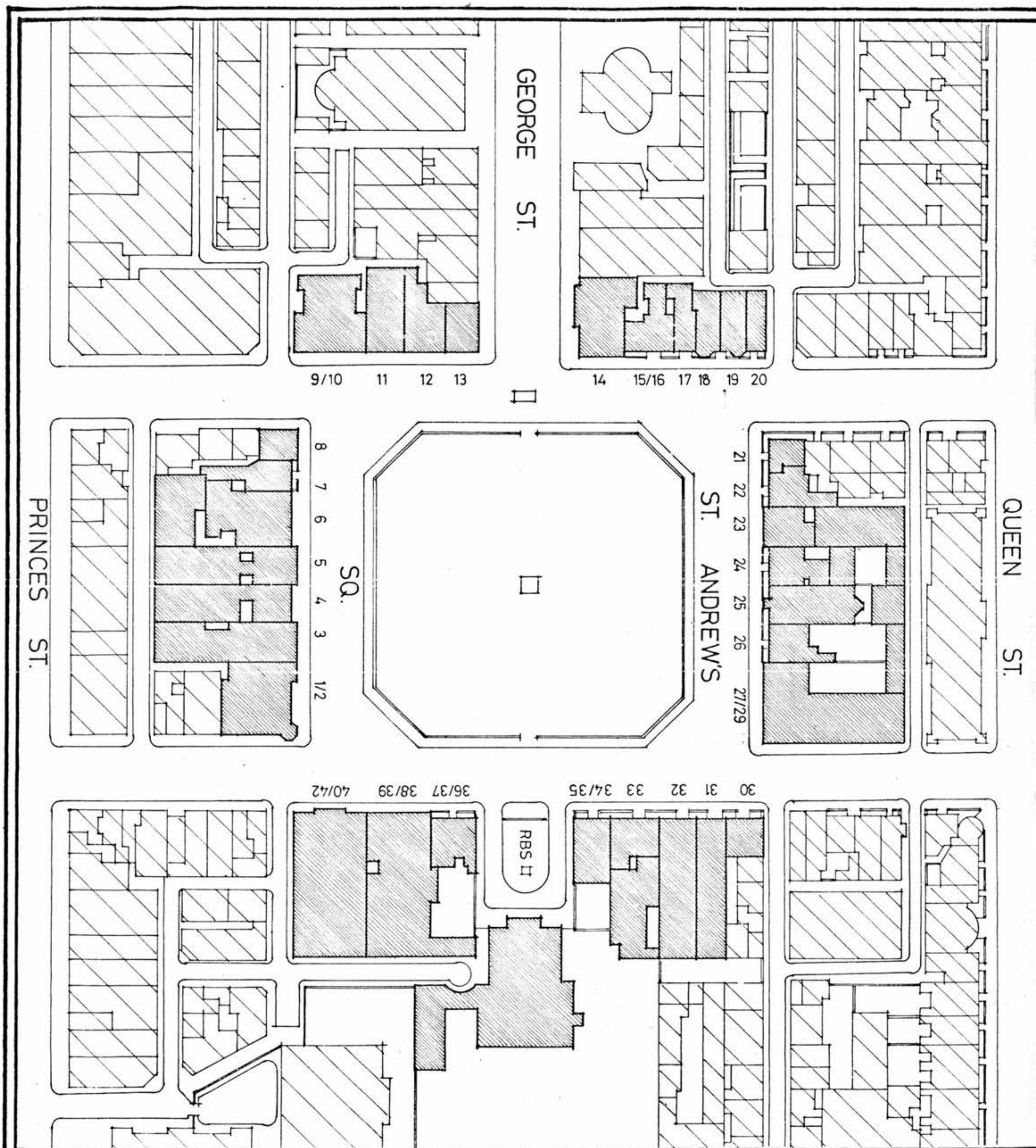


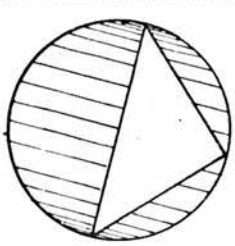
MAP 4-E

ST. ANDREW'S SQUARE - 1892

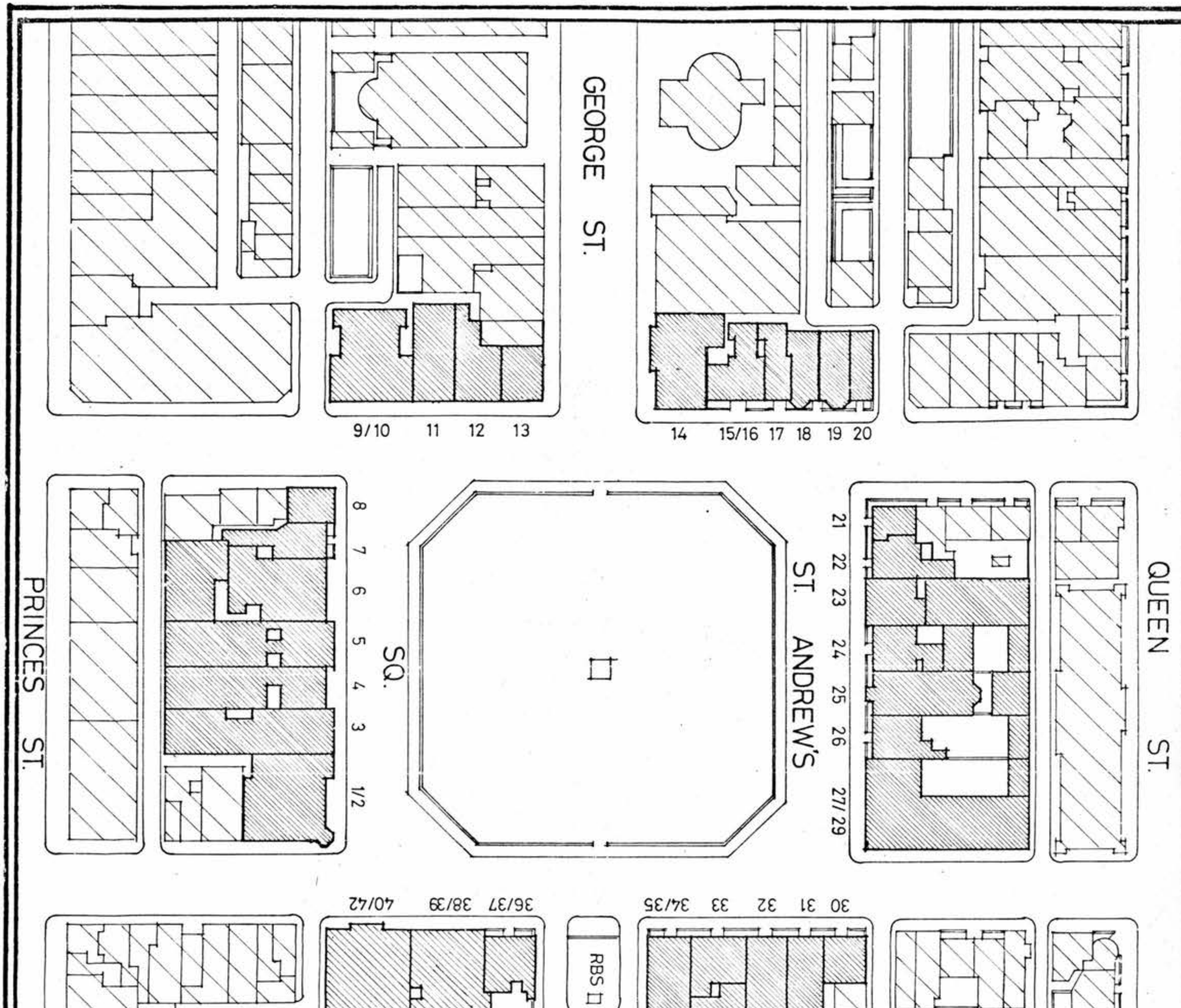
SCALE: APPROXIMATELY 1": 380 m

0 0.5 1 2





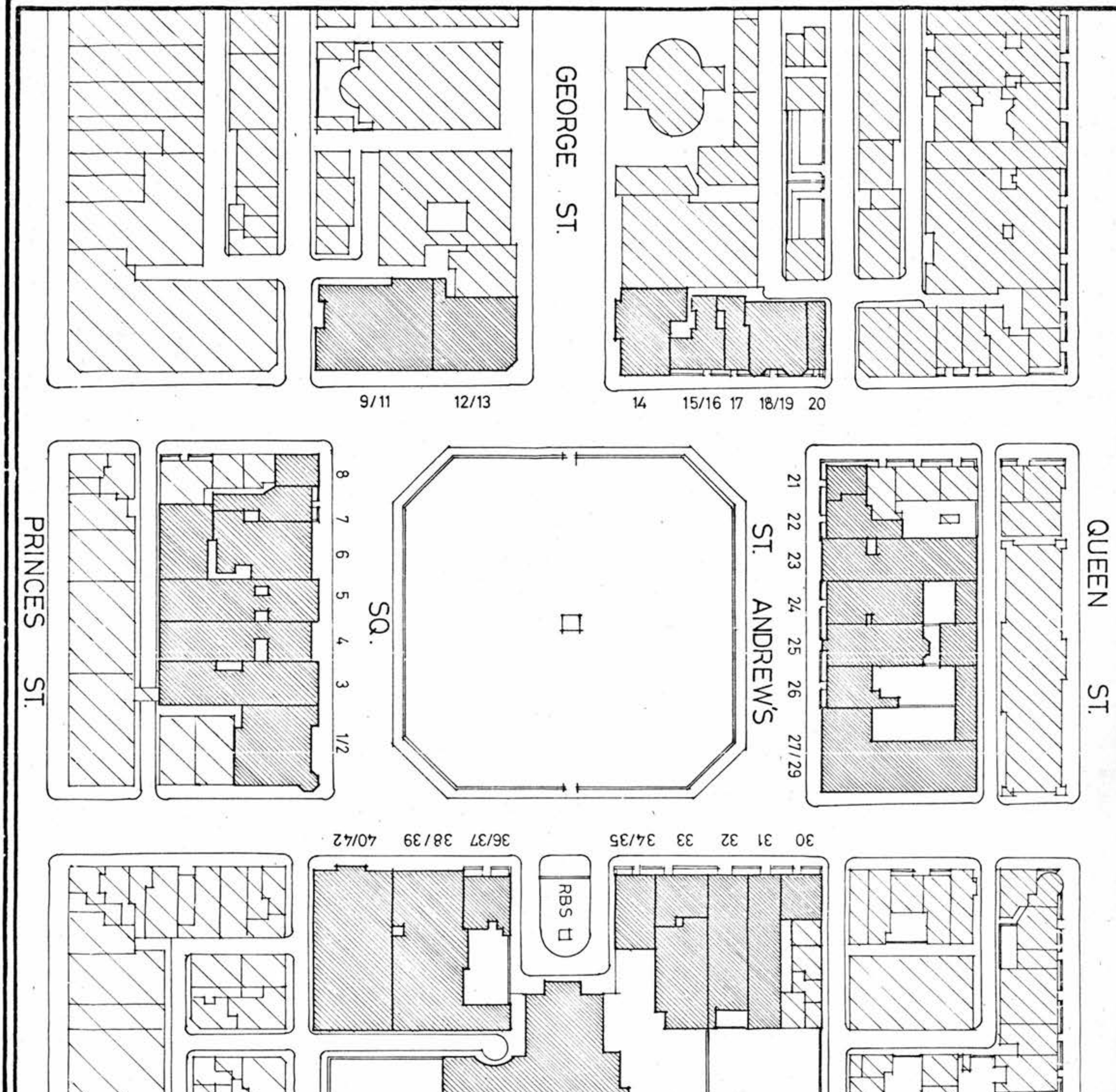
MAP 4-F
ST. ANDREW'S SQUARE - 1914
SCALE: APPROXIMATELY 1":380m
0 0.5 1 2

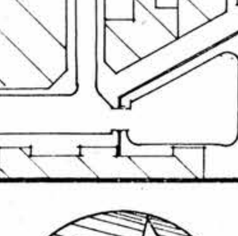


MAP 4-G
ST. ANDREW'S SQUARE - 1932

SCALE: APPROXIMATELY 1": 380 m

0 0.5 1 2

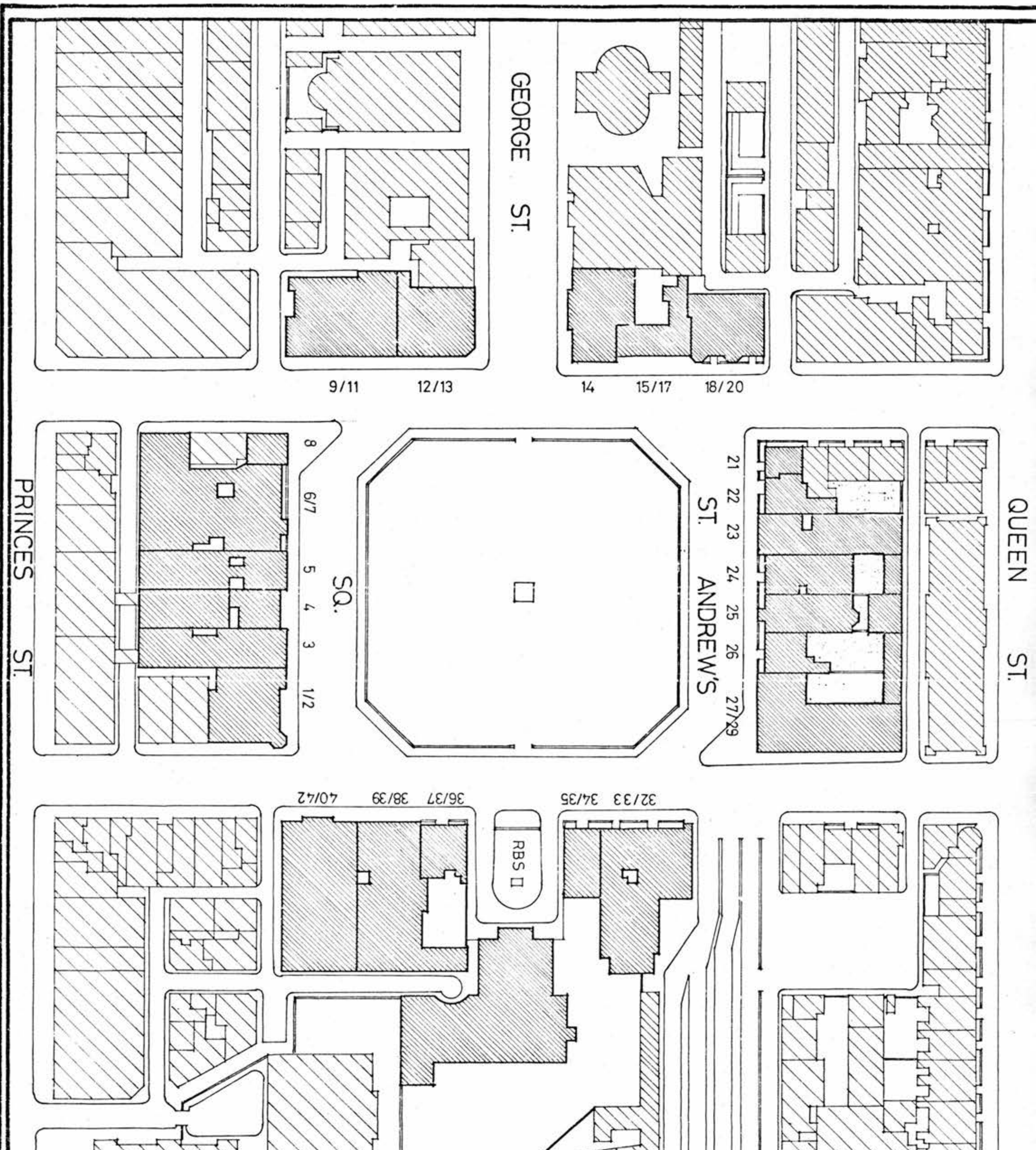




MAP 4-H
ST. ANDREW'S SQUARE – 1952

SCALE: APPROXIMATELY 1":380 m

0 0.5 1 2



MAP 4-I
ST. ANDREW'S SQUARE - 1970
SCALE: APPROXIMATELY 1:380m
0 0.5 1 2

P O S T S C R I P T

P.1 INTRODUCTION

1.01 The purpose of this postscript is to provide additional clarification which discussion at the oral examination indicated as desirable, in relation to a number of points in the main body of the dissertation. In particular, these points were:

1) the inclusion of three tables similar to Table 2.1 (C2) which categorize the characteristics of the physical factors, the use and the user;
2) a note on the description of the technological factors examined in chapter 2;
3) an explanation of the operation of the network of factors influencing the life-span of any item of stock (Figure 2.2); and
4) a brief note on the theoretical and practical basis for the selection of the particular operational factors chosen for analysis in Chapters 7 and 8.

P.2 THE CHARACTERISTICS OF THE PHYSICAL, USE AND USER FACTORS

1.02 Page 16 of the main text introduced four broad categories of factors which influence the life-span of the existing stock or urban buildings. They are:

1) the external or operational factors;
2) the internal or physical factors;
3) the use; and
4) the user.

In sections 2.3 to 2.6 (C2) of the main text, each of these categories was briefly discussed. The following three tables should be read with reference to the appropriate section.

TABLE 2.2 THE CHARACTERISTICS OF THE PHYSICAL FACTORS WHICH AFFECT THE LIFE-SPAN OF ITEMS OF THE EXISTING STOCK

FACTOR	CHARACTERISTICS
I. SPACES AND THEIR DEFINING ELEMENTS A major factor determining the range of possible uses of a given item of stock is the character of the existing spaces within any item of stock, the elements of the fabric forming them, and the space occupied by the entire item.	1. Dimensions of internal spaces. 2. Dimensions of the space occupied by the entire item. 3. Materials used to form the fabric and the state of repair of those materials.
II. STRUCTURE An important constraint on the range of alternative uses of any item of stock is the load-bearing structural elements, which may be difficult, if not impossible, to relocate or alter in the course of adaptation.	1. Live and dead loading capacity of the structure and the type of structural system. 2. Dimensions governed by the structural elements. 3. Materials used to form the structural elements and the state of repair of those materials.

III. SERVICES Another important constraint on the range of alternative uses of any item of stock is the services contained within that item.	1. The type of services contained, their capacity and distribution. 2. Whether the services are artifical (e.g. electric light) or natural (e.g. natural light). 3. The state of repair of the service systems and the level of amenity which they provide.
IV. ACCESS A fourth major constraint on the range of alternative uses of any item of stock is the access to the spaces contained within the stock, to the stock from the external environment, and to the spaces, structure and services for maintenance and adaptive purposes.	1. The capacity, distribution and number of points of access for the purposes of everyday movement. 2. Ease of access to the spaces, structure and services for the purposes of maintenance and adaptation.

P.2.1 A NOTE ON THE DISTINCTION BETWEEN USE AND USER

1.03 In the main text it was stated that the use of an item of stock was a convenient 'label' by which to identify a related set of activities. Further that the characteristics of a use, or its functional requirements, may be described in terms of the aggregation of the functional requirements of the activities which make-up that use. It was also stated, in the main text, that a user of an item of stock was the person or organization which was engaged in those activities. Both the use and the users of an item of stock are influenced by the operational factors.

For example, the operational factors operating at a particular location may determine that the only viable use for an item of stock is an 'office' and thus confine the range of users to 'office' users. If the item of stock is found to contain appropriate physical characteristics in order to accommodate the functional requirements of a particular use (which are, of course, influenced by a particular user) then that item of stock is likely to remain useful.

1.04 A user of an item of stock will, however, influence the life-span of that item, in ways other than determining the particular functional requirements of his use. This will depend upon his type, which influences his perception of the match or mismatch between functional requirements, operational factors and physical characteristics. For example, a 'user' of an item of stock may be its owner who utilizes that item solely as an economic investment. Thus, this user will be concerned with the return on investment that that item realizes in relation to another item of stock, possibly on the same site. On the other hand, the 'user' of that item might be its occupier, in which case he will be concerned with both the functional and economic satisfaction derived from that item of stock. Thus, both the functional requirements of a 'use' and the perception of the 'user' of an item of stock will influence its life-span. (Also see pp 42-49 in main text.)

TABLE 2.3 THE CHARACTERISTICS OF THE USE FACTOR AFFECTING THE LIFE-SPAN OF THE EXISTING STOCK

FACTOR	CHARACTERISTICS
I. USE The functional requirements of a use are a major factor influencing the life-span of items of the existing stock due to the need for a match between those requirements and the physical characteristics of an item of stock to occur for that item to remain 'useful'.	1. The level of aggregation or abstraction utilized in describing the use. 2. Description of the functional requirements of the use.

TABLE 2.4 THE CHARACTERISTICS OF THE USER FACTOR AFFECTING THE LIFE-SPAN OF THE EXISTING STOCK

FACTOR	CHARACTERISTICS
I. USER A major factor influencing the life-span of an item of stock is the perception of the user of that item which is related to his type.	1. The type of user which may be categorized as: a) owner b) occupier c) owner/occupier d) the public 2. The organization of the user and the size and structure of that organization. 3. The availability of information to the user about the operational, physical and use factors and the utilization of that information.

P.3 A NOTE ON THE DESCRIPTION OF THE TECHNOLOGICAL FACTORS

1.05 It could be argued that the energy system is a part of each of the other three systems (the communication system, the transportation system, and the service system) outlined in Table 2.1 and described in Section 2.3.6 of the main text. Indeed, a view may also be taken that the transportation system is part of both the communication and service systems. For the purpose of this thesis, however, these four inter-related systems have been kept separate. The service system is viewed in terms of the service infrastructure (i.e. electrical, water, gas etc supplies.) The transportation system is concerned with both the transport infrastructure and the mode of transport. The communication system is viewed in terms of the infrastructure utilized for non-proximity exchange of information (i.e. telephones, television etc.) The energy system on the other hand is not considered as a 'system' in the same sense as the three systems above. Rather, it is concerned with the level or amount of energy which is utilized by those three systems and with the overall energy consumption of a given society, itself related to the degree of technological sophistication of that society. (see Mesavoric, M. & Pestal, E. opcit.) This degree of sophistication and the level of energy consumption may also be related to the life-span of the existing stock of buildings. A high energy input is required today to both construct a building (and fabricate the materials used) and maintain and run a building on a day to day basis.

In light of the shrinkage of natural resources required to maintain this high energy imput to the stock, these buildings may be made "useless" in the future.

P.4 THE NETWORK OF THE FACTORS

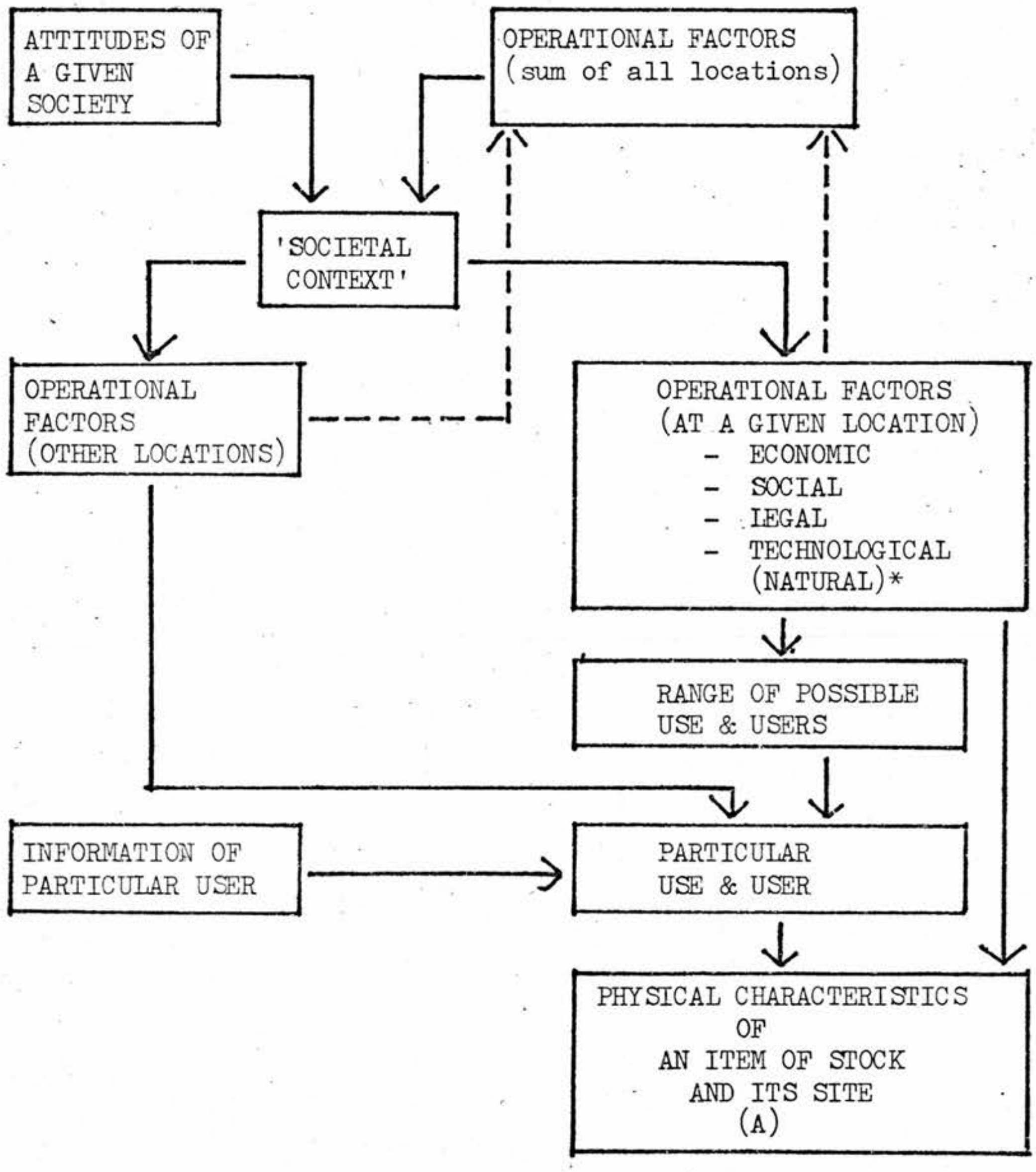
1.06 The usefulness or uselessness of any item of the existing stock is described in terms of the match or mismatch between the four major factors outlined in Chapter 2 (namely, the operational factors, the physical factors, the use and the user.) It was argued in that Chapter that an item of stock would be said to remain 'useful' if a match occurs between the requirements of the use and user of that item of stock, the physical characteristics of that item, and the context in which that item occurs as described by the operational factors. The network illustrating these factors (Figure 2.2) is viewed as a process which changes over time (see Chapter 3.) In order to explain this network more fully, it is necessary to discuss it in terms of stages. (see Figures 2.3 and 2.4 following). The operational factors, which occur at any given location, derive their relative importance and interrelationship on a locational basis. That is, they may be said to be locationally determined. Further, at any given location, the relative importance of the operational factors is influenced by the operational factors at all other locations as well as the attitudes and desires of a given society which has access to those locations. [1]

---

1. As explained in Chapter 2, the natural operational factors are given for any location and may be only marginally influenced by society's actions.

(This may be called the societal context.) The operational factors at any given location, in turn, influence the range of uses and users which may occur at that location. Within this range, the particular uses and users occuring in any item of stock are influenced by the operational factors at that location, the range of possible uses and users, the operational factors at all other locations and the information that the users have about these factors. The physical characteristics of an item of stock and its site are, in turn influenced by the particular use and user of that item and the operational factors occuring at that location. (See Figure 2.3).

FIGURE 2.3 STAGE 1 OF THE NETWORK OF FACTORS AFFECTING THE LIFE-SPAN OF THE EXISTING STOCK



1 ⟶ 2 means 1 influences 2

* see note, bottom of P.7.

1.07 Over time, changes in the attitudes of the given society, the total sum of all locations and the relative importance of the operational factors at those locations will change the relative importance of the operational factors at a given location. This will cause a change in the range of possible uses and users which are viable at that location. When this happens, a particular user will need to evaluate the match or mismatch between his item of stock and his use of that item in light of the new context. (He will also be influenced, of course, by changes in his use of his item of stock, external to its location - for example, a new method of production, growth in his organisation, etc.) This evaluation will be done with the information that is available to the user about the changes occuring at the particular location as well as the changes occuring at all other locations. Assuming that the user remains at the given location, he may decide that:

a) a match between his use of the stock, the physical characteristics of the stock, and the operational factor still occurs, in which case the stock remains useful;

b) a mismatch occurs, in which case the user has the option of:

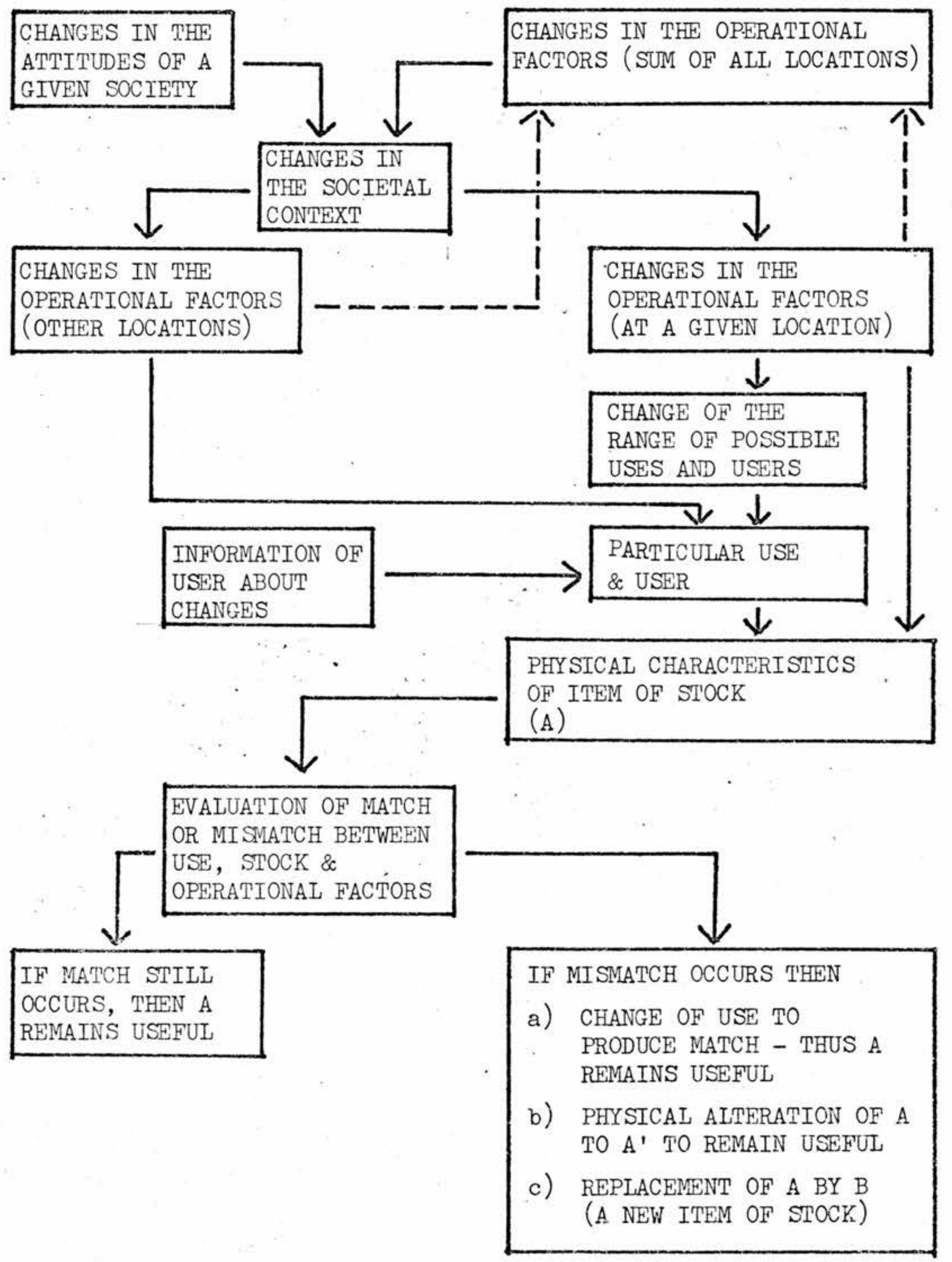
   1) changing the use or method of utilization of the stock so that a match occurs;

   2) physically altering the item of stock so that it becomes useful;

   3) demolishing the item of stock and replacing it by another.

(In reality, of course, the user may alter his use of the item of stock, at the same time physically alter portions of that item while replacing other portions.) (See Figure 2.4).

FIGURE 2.4 STAGE 2 OF THE NETWORK OF THE FACTORS AFFECTING THE LIFE-SPAN OF THE EXISTING STOCK: CHANGES OVER TIME



See notes for table 2.3

1.08 The process through which the network flows may be summarized as follows. The life-span of any item of the existing stock is related to its continued usefulness. This is influenced by the physical characteristics of the item of stock and its site, the use and user of that item of stock and the operational factors occuring at the location of the item. The operational factors at a particular location are in turn influenced by the societal context which is comprised of the sum of the operational factors occuring at all locations and the attitudes of the given society. If an item of stock is to remain useful a match must occur or be made to occur between the use and user of that item, its physical characteristics and the operational factors occuring at the item's location.

P.5 SELECTION OF THE PARTICULAR FACTORS ANALYSED IN CHAPTER 7 and 8

1.09 In order to examine empirically the changes in the networks process, the changes in the attitudes of the given society and the sum of the operational factors at all locations must be taken into account. Unfortunately, not all of the relevant factors are quantifible; for example, changes in the image of the stock (a social operational factor.) Other factors are extremely difficult to quantify due to lack of data or a cumbersome quantity of data, such as changes in the legal factors. Thus the selection of the particular operational factors was made on both a practical and theoretical basis.

a) The change in the size of a population is seen as theoretically important in understanding the life-span of the existing stock because the demand.for stock is based ultimately upon the size of the population. (documented by Stone, PA opcit, Lewis, JP, opcit, and others). The socio-economic composition of that population is also considered to be of importance as it reflects the amount of capital available within that society for building (see Appendix 3 and chapter 8).

b) The importance of the change of use and user to the life-span of the stock, while previously demonstrated by other writers (Frieden, BJ opcit, Justament L, opcit) has been more fully supported by this thesis (see chapters 7 and 8).

c) Certain economic factors, such as value, the amount of capital available for construction, and the wholesale price index have been recognized as important to explaining 'building cycles'. (see Stone, P.A. opcit, Lewis, J.P. opcit and Seeley, I.H. opcit). This thesis has recognized the positive relationship between these cycles and the life-span of the stock (see Chapter 8).

d) Changes of the physical characteristics of items of the stock, either adaptation or replacement, are also important in understanding the life-span of those items. (See Chapters 7 and 8).

e) The amount of labour available to undertake physical alteration or replacement of the stock is also of importance to understanding the life-span of the stock because the capacity of the building industry to undertake either adaptive and/or new construction sets limits on the rate at which the existing stock may be replaced. (See chapter 6).

P.6 CONCLUDING REMARKS

1.10 The life-span of any item of the existing stock of urban buildings is influenced by the changes in the use and user as well as the changes in the operational factors and is related to the item's ability to 'respond' to those changes. This research has exposed some of the popular fallacies regarding the dependence of the life-span of an item of stock on the durability of the materials used in that item. It has shown that the changes in the non-physical factors (the use, user and operational factors) influence that life-span more strongly than the physical deterioration of an item of stock. The research has also exposed the weakness in the argument that 'loose-fit' may necessarily mean 'long-life'. Rather, while the ability of an item of stock to contain a sequential number of uses may contribute to prolonging the life-span of that item, it will not be possible without a 'tight-fit' between the operational factors, the use and user and that item of stock. Further, the research has shown that designing physical adaptability into a building will not necessarily increase its life-span even though it may make the utilization of that item of stock more efficient. Rather, it is the ability of an item of stock to adapt to the changes in the use, user and operational factors which will allow its life-span to be prolonged.

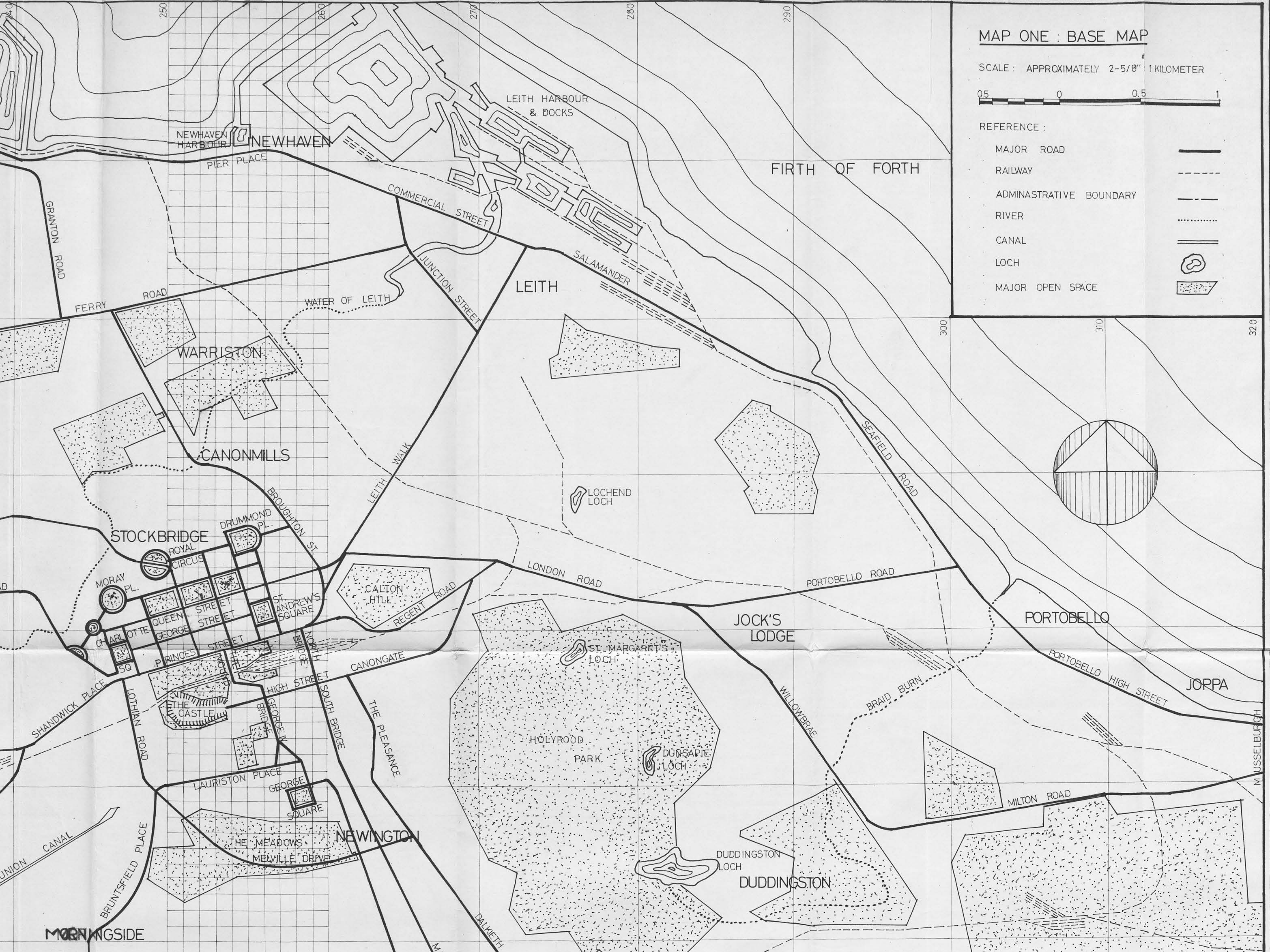

MAP THREE:
PRINCIPAL USE OF
STOCK 1860-1970
SCALE:
APPROX. 2-5/8":1KILOMETER
0.3
0
0.5
REFERENCE:
SINGLE FAMILY HOUSING
MULTI FAMILY HOUSING
COMMERCIAL
EDUCATIONAL
HEALTH CARE
LIGHT INDUSTRIAL
SINGE FAMILY CONVERTED TO MULTI FAMILY HOUSING
SINGLE FAMILY CONVERTED TO MULTI FAMILY HOUSING / COMMERCIAL
GRANTON HARBOUR
GRANTON
NEWHAVEN HARBOUR
250
260
270
770
760
750
740
730
720
710
GRANTON ROAD
COMMERCIAL STREET
FERRY ROAD
WATER OF LEITH
JUNCTION STREET
LEITH WALK
LOCHEND LOCH
COMELY BANK
STOCKBRIDGE
MORAY PL.
QUEENSFERRY ROAD
CHARLOTTE SQ.
LONDON ROAD
CALTON HILL
REGENT ROAD
CANONGATE
WATER OF LEITH
SHANDWICK PLACE
LOTHAIN ROAD
THE PLEASANCE
HOLYROOD PARK
DALRY ROAD
UNION CANAL
BRUNTSFIELD PLACE
NEWINGTON
MORNINGSIDE
DALKIETH ROAD
MAYFIELD GARDENS
MAYFIELD ROAD

710
700
690
680
COMISTON ROAD
LIBERTON
LIBERTON BRAE
BIGGAR ROAD

MAP TWO:
GROWTH OF
URBAN AREA
SCALE:
APPROX. 2-5/8": 1 KILOMETE
0.3 0 0.5
REFERENCE:
PRE 1450
1450 – 1515
1515 – 1625
1625 – 1750
1750 – 1800
1800 – 1825
1825 – 1850
1850 – 1875
1875 – 1900
1900 – 1925
1925 – 1950
1950 – 1975
GRANTON HARBOUR
GRANTON
NEWHAVEN HARBOUR
COMMERCIAL STREET
GRANTON ROAD
FERRY ROAD
WATER OF LEITH
JUNCTION STREET
LEITH WALK
LOCHEND LOCH
COMELY BANK
STOCKBRIDGE
MORAY PL.
QUEENSFERRY ROAD
CHARLOTTE SQ.
CALTON HILL
REGENT ROAD
LONDON ROAD
CANONGATE
ST. MARGARET'S LOCH
WATER OF LEITH
SHANDWICK PLACE
LOTHIAN ROAD
THE PLEASANCE
HOLYROOD PARK
DALRY ROAD
UNION CANAL
BRUNTSFIELD PLACE
NEWINGTON
MORNINGSIDE
DALKEITH ROAD
MAYFIELD GARDENS
MAYFIELD ROAD
250
260
270
770
760
750
740
730
720
710


MORNINGSIDE
DALKEITH ROAD
MAYFIELD GARDENS
MAYFIELD ROAD
COMISTON ROAD
LIBERTON
LIBERTON BRAE
BIGGAR ROAD
720
710
700
690
680


190
200
210
220
230
240
250
260
770
760
750
740
730
720
FIRTH OF FORTH
GRANTON HARBOUR
GRANTON
NEWHAVEN HARBOUR
NEWHAVEN
PIER PLACE
CRAMOND
GRANTON ROAD
CRAMOND ROAD
GRANTON ROAD
DAVIDSON'S MAINS
FERRY ROAD
WATER
WARRISTON
QUEENSFERRY
QUEENSFERRY ROAD
TELFORD ROAD
CANONMILLS
BROUGHTON ST.
DRUMMOND PL.
STOCKBRIDGE
ROYAL CIRCUS
CRAIGLEITH QUARRY
COMELY BANK
MORAY PL.
QUEENSFERRY ROAD
QUEEN STREET
GEORGE STREET
ST. ANDREW'S SQUARE
CHARLOTTE SQ
PRINCES STREET
NORTH BRIDGE
MURRAYFIELD
HIGH STREET
THE CASTLE
GEORGE IV BRIDGE
LOTHIAN ROAD
SHANDWICK PLACE
WATER OF LEITH
CORSTORPHINE ROAD
GLASGOW/STIRLING
LAURISTON PLACE
GEORGE SQUARE
THE MEADOWS
MELVILLE DRIVE
DALRY ROAD
UNION CANAL
BRUNTSFIELD PLACE
MORNINGSIDE



MAP ONE : BASE MAP
SCALE : APPROXIMATELY 2-5/8" : 1 KILOMETER
0.5
0
0.5
1
REFERENCE :
MAJOR ROAD
RAILWAY
ADMINASTRATIVE BOUNDARY
RIVER
CANAL
LOCH
MAJOR OPEN SPACE
250
260
270
280
290
300
310
320
FIRTH OF FORTH
LEITH HARBOUR & DOCKS
NEWHAVEN HARBOUR
NEWHAVEN
PIER PLACE
COMMERCIAL STREET
SALAMANDER
GRANTON ROAD
FERRY ROAD
WATER OF LEITH
JUNCTION STREET
LEITH
WARRISTON
CANONMILLS
LEITH WALK
SEAFIELD ROAD
LOCHEND LOCH
BROUGHTON ST.
DRUMMOND PL.
STOCKBRIDGE
ROYAL CIRCUS
MORAY PL.
QUEEN STREET
GEORGE STREET
CHARLOTTE SQ
PRINCES STREET
ST. ANDREW'S SQUARE
CALTON HILL
REGENT ROAD
LONDON ROAD
PORTOBELLO ROAD
PORTOBELLO
JOCK'S LODGE
PORTOBELLO HIGH STREET
JOPPA
NORTH BRIDGE
CANONGATE
HIGH STREET
ST. MARGARET'S LOCH
WILLOWBRAE
BRAID BURN
SHANDWICK PLACE
THE CASTLE
LOTHIAN ROAD
GEORGE IV BRIDGE
SOUTH BRIDGE
THE PLEASANCE
HOLYROOD PARK
DUNSAPIE LOCH
MUSSELBURGH
MILTON ROAD
LAURISTON PLACE
GEORGE SQUARE
NEWINGTON
THE MEADOWS
MELVILLE DRIVE
UNION CANAL
BRUNTSFIELD PLACE
DUDDINGSTON LOCH
DUDDINGSTON
DALKEITH
MORNINGSIDE


LAURISTON PLACE
GEORGE SQUARE
UNION CANAL
BRUNTSFIELD PLACE
THE MEADOWS
MELVILLE DRIVE
NEWINGTON
DUDDINGSTON LOCH
DUDDINGSTON
MILTON ROAD
MORNINGSIDE
DALKEITH ROAD
MAYFIELD ROAD
MAYFIELD GARDENS
GRANGE
CRAIGMILLAR
BLACKFORD HILL
COMISTON ROAD
LIBERTON
LIBERTON BRAE
BAIRD HILLS
GILMERTON ROAD
GILMERTON
FAIRMILEHEAD
FROGSTON ROAD
BIGGAR ROAD
MORTONHOUSE MAINS
DALKEITH
ESKBANK

730
720
710
700
690
680
670
CALDER
LARNARK
SQUARE
THE MEADOWS
MELVILLE DRIVE
DALRY ROAD
UNION CANAL
BRUNTSFIELD PLACE
MORNINGSIDE
GRANGE
DALRY
BROOMHOUSE ROAD
CALDER ROAD
SIGHTHILL
UNION CANAL
BLACKFORD HILL
COMISTON ROAD
LARNARK ROAD
BAIRD HILLS
COLINTON
WATER OF LEITH
JUNIPER GREEN
FAIRMILEHEAD
FROGSTON ROAD
BIGGAR ROAD
MORTONHOUSE MAINS
TORDUFF RESERVOIR