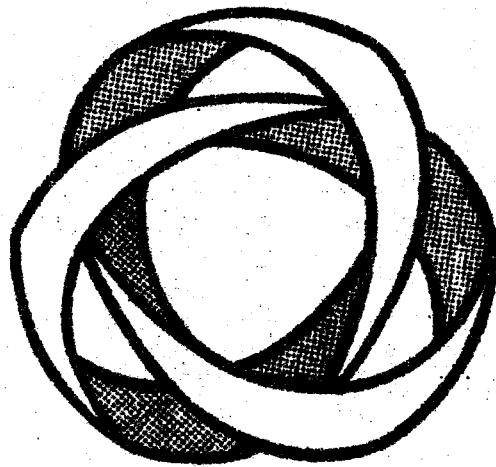


**ECOLOGICAL SOCIETY
OF
AUSTRALIA**



**THE CITY
AS A
LIFE SYSTEM**

UNIVERSITY OF NEW SOUTH WALES

12th - 13th August

1972

OBJECTIVES

For most ecologists, ecology is in essence a man-oriented discipline. Yet our understanding of ecology derives from work which has not involved man as a subject species. How relevant are ecological concepts to the facts and to the needs of human communities? By presenting a functional, quantitative analysis of a modern city viewed as a life system, the ESA hopes to stimulate public and professional interest in an ecological appreciation of problems of environmental quality in modern industrial societies.

In today's industrialized societies, most people live, work, play, and die within the confines of urban systems. An ecological appreciation of this fact demands answer to the following questions:

- how does the physical environment influence the location, structure, function, and evolution of the city system?
- what are the major components of the system? How are they linked?
- what are the main inputs and outputs associated with flows of mass/energy through the system? Can the major processes be quantified?
- what are the controls of the system? How do they operate? Can one define an objective function for the urban system? How could such a function be achieved?
- how did the urban system evolve? Where is it going?

PROGRAMME

Saturday, 12th August, 1972: 9.30 a.m. - 5.00 p.m.

1. INTRODUCTION: 9.30-9.55:

Dr. P.W. Geier, President, E.S.A.

2. NATURAL ENVIRONMENT:

2.1 *The Bioclimatic Setting*: 9.55-10.20:

Professor E.A. Fitzpatrick and Mr. J. Armstrong, U.N.S.W.

The climate of the Sydney Region is described in terms of those weather elements of primary interest from the viewpoint of life in an urban system. Spatial distribution of these elements strongly reflects the influence of meso-scale circulation and energy exchange patterns generated by topographic configuration and thermal contrasts of land and sea. The extent to which urbanization itself has modified the local climate is also examined.

Recognizing that the responses of organisms, including man, to weather variables are seldom induced by singular elements, a characterization of the climatic environment in terms of associations of elements identifiable as weather types is attempted. Using long-term data for representative stations the incidence and persistence of weather types throughout the year is assessed.

2.2 *Structure, Terrain and Soils*: 10.20-10.45:

Drs. T.R. Healy and J. Corbett, U.N.S.W.

The lithological basis, major structural features and relevant geological history affecting the contemporary physiography of the Sydney Region will be briefly outlined. This will be followed by a terrain analysis incorporating investigation of the morphometric relationships between parameters representing slope, relief and drainage; and stressing the multivariate nature of the terrain.

The control by parent material, landforms and time and the role of climate on the genesis and morphology of the soils in the Sydney Region will be discussed. A map of Great Soil Groups based on parent material divisions, but including some of the soils reflecting forms and time, will be presented.

MORNING TEA: 10.45 - 11.15

2.3 *Vegetation*: 11.15-11.40:

Dr. J.P. Burrell, U.N.S.W.

The probable original vegetation of the Sydney area will be outlined with particular reference to geology, topography and soils. The discussion will consider the changes in vegetation type and biomass, and likely changes in soil nutrient status, which have occurred with the imposition upon the landscape of a European urban cultural pattern of city parks, suburban gardens and support market gardens.

2.4 *The Past and Present Fauna*: 11.40-12.05

Dr. H.F. Recher, Australian Museum.

A discussion of the fauna of the Sydney Region as it probably was in 1788 and as it is in 1972. Emphasis will be placed on vertebrates and the changes in vegetation and habitat structure which have caused a change in the numbers and amounts of birds, mammals and reptiles in the Sydney Region. The effect of introduced birds and mammals and the possible effect of introduced disease on native marsupials will be considered.

GENERAL DISCUSSION : 12.05-12.30

LUNCH: 12.30 - 1.30

A light lunch and liquid refreshment will be available, at cost, in the Common Room on the sixth floor of the Bio-Sciences building on campus.

3. STRUCTURE IN THE CITY SYSTEM:

3.1 *Conceptual Models*: 1.30-1.55:

Dr. M.T. Daly, Macquarie University

Two "classical" conceptual models of the internal structure of the city and their usefulness are partially illustrated by examples of studies in Sydney. The abstract and simplified base of these models has stimulated new approaches to conceptualizing city growth processes and these are discussed.

3.2 *Quantitative Models for Urban Systems*: 1.55-2.20:

Drs. G.M. Folie and R.F. Warner, and Mr. D.T. Howell, UNSW.

A review is made of various quantitative models used in the analysis, design and planning of urban systems and subsystems. It is emphasized that quantitative models are developed by processes of simplification and idealization. It follows that any quantitative model is, at best, a partial representation of the real-world system. This fact has to be borne in mind, both in the use of models for problem solving and in the evaluation of model adequacy.

A classification of quantitative models as either static or dynamic is made. A further, but rather arbitrary, classification is made under the headings of descriptive, predictive and pre-scriptive.

Examples of urban system models are discussed.

GENERAL DISCUSSION: 2.20 - 2.45

AFTERNOON TEA: 2.45 - 3.15

4. FUNCTION IN THE CITY SYSTEM:

4.1 *An Analysis of Energy Flow in the Sydney Region*: 3.15-3.40:

Drs. J.D. Kalma, A. Aston, and R.J. Millington, C.S.I.R.O.

This study will provide a framework for discussion of energy flow in the Sydney Region, by analyzing firstly consumption of primary energy in Australia and secondly consumption of energy in New South Wales by consumption sector. In these analyses, population, the value of the production and gross national product (or components thereof) will be related to energy consumption and international comparisons made. Time trends in energy consumption will be analysed and a review of published predictions of energy use will be presented.

We intend to present an energy balance for the Sydney region and we shall discuss energy consumption by industrial, commercial, domestic and public sections of the society. Our overall aim will be to link energy consumption in the Sydney Region to demographic, economic and geographic factors. Much unpublished material provided by the population census and the 1968/69 integrated economic census will be used to provide a better understanding of the inter-relationships. A detailed study is made of energy consumption in the Prospect County Council region and some preliminary results will be presented in this paper.

4.2 *The Role of Meteorology in the Urban Planning of Adelaide:* 3.40-4.05:
Professor P. Schwerdtfeger, Flinder University.

The proper planning of a developing metropolis requires detailed meteorological and climatological information which has hitherto not been available for Australian cities. While the topographies of Sydney and Melbourne appear to call for very substantial and expensive networks of monitoring instrumentation, the relatively simple face of Adelaide is ideal for a pilot study. At the same time, Adelaide shows a surprising anisotropy of meteorological characteristics with over 5°C temperature and major wind parameter variations between various suburban locations at similar altitudes being common at any time of the day. The airflow shows a complex dependence on combined effects of the geostrophic wind, sea-breeze and gullywind, with both cancellation and reinforcement being observed. With even cities such as Adelaide being seriously affected by atmospheric pollution, it is clear that urban complexes have the choice of either controlling both the times and places at which combustion might be permitted, or applying stern emission controls coupled with regional fuel policies. It is quite certain that the former approach is financially more realistic.

4.3 *The Acquisition, Consumption and Elimination of Water by the Sydney Urban System:* 4.05-4.30:
Dr. F.C. Bell, U.N.S.W.

Several types of system structure may be postulated for analyses of the water function in the context of an "urban ecosystem". For this study the components of the adopted system are based mainly on the mode of consumption or disposal (e.g. domestic, industrial, stormwater drainage etc.) but some attempt is also made to account for regional or spatial variations within the system. Spatial boundaries relevant to the water function within the Sydney system are identified and discussed.

An attempt is made to use the above theoretical water function to study the potential consequences of:

- (a) increasing population densities,
- (b) expanding spatial boundaries, and
- (c) changing modes of consumption.

Some suggestions for increasing the efficiency of water consumption within the Sydney system are examined quantitatively by similar analyses.

GENERAL DISCUSSION: 4.30 - 5.00

Sunday, 13th August, 1972: 9.30 a.m. - 5.00 p.m.

4.4 *Nutrients and Materials Balance of a City:* 9.30-9.55:
Drs. R.J. Millington, J.D. Kalma and A.R. Aston, C.S.I.R.O.

In contrast to so-called natural ecosystems, the city presents in general, a non-recycling, exploitive system, in an unsteady state. Stability, coupled with use and re-use with no long-term total growth in the biomass is characteristic of almost all but urbanized human society. The consequences of these contrasting patterns of ecosystems will be discussed. The food-chain concept and its parallel in urban society with multiple handling (transfers), storage and processing will be examined, and an analysis of the relation of urban area to food production and water requirement will be attempted.

4.5 *Manufactures:* 9.55-10.20:
Mr. A.D. Winter, Plant Location International.

This paper attempts to explore the role of the manufacturing sector in the Sydney economy and to indicate the linkages between manufacturing and other sectors of the economy.

The role and importance of manufacturing in the city system are discussed and the interaction of manufacturing with the other sectors of the metropolitan economy - wholesale, office functions, retailing and primary industry are explored.

The paper then goes on to examine the demands by manufacturing on the resources of the city and the constraints both economic and physical phenomena which tend to limit the development and operation of the manufacturing system. The manufacturing system within Sydney is also constrained by competitive elements operating externally to the city and the effect of such competition from other areas will be examined. The problems faced by manufacturers in establishing in Sydney and in continuing existing operations are critically reviewed.

4.6 *Transport and the Urban Environment:* 10.20-10.45:
Messrs. N.F. Clark and T. Patton, Melbourne University.

Modern cities can be distinguished from earlier forms of human settlements by a high degree of specialisation of economic and social activity on separate areas of land. This spatial separation of activity generates inevitable demands for movements by persons.

In the paper a quantitative framework is presented for discussion of the control of the environmental impact of urban travel. The nature of urban structural organisation is discussed and its relationship to the total demand for travel in person miles per year is assessed. The thermal and noxious pollution rates of various modes of transport per person mile of travel are compared.

There is an apparent psychological need of persons for movement and it is believed that this can be expressed in terms of a minimum time of travel per day, from consideration of persons' time budgets. The wide availability of urban transport systems and recent technological changes in transport have had the effect of increasing the total miles of travel per person per day and have also caused a shift to modes of travel with higher rates of thermal and noxious pollution.

MORNING TEA: 10.45-11.15

4.7 *The Spatial Distribution of Sydney's Workforce: 11.15-11.40*
Mr. R.T.M. Whipple, Sydney University.

The availability of journey to work data showing the day time distribution of the work force by industrial class affords the opportunity of probing the spatial structure of metropolitan productive activities.

In conjunction with the 1961 Census of Population, the Commonwealth Statistician collected information on the location of employment within the Sydney area. The results of a 10% sample of house-holders' returns on this topic were published by the State Planning Authority in 1964.

Similar data was collected at the 1966 Census: this has not been published but some tabulations have been prepared and can be made available. Pending the outcome of enquiries as to its suitability, the following outline relates only to the 1961 data. Should it transpire that the 1966 data is amenable to analysis, then it will be included and the scope of the paper may be quite different.

For 64 destination zones, information has been published on the number employed in 51 industrial classes. For the 41 Local Government Areas, an origin-destination matrix also was published for total employment alone.

Both of these tabulations will be subjected to a series of analyses aimed at identifying groups of destination zones having the most similar workforce profiles and commuting areas.

Subject to limitations inherent in the data, it is hoped that the analysis may throw some light on the internal structure of the Sydney area. However, these aims may not be wholly achieved as the relatively large size of the areas acts as a high to medium scale spatial filter.

4.8 *Communication in the Urban System: 11.40-12.05:*
Mr. D. Wilmoth, Sydney University.

Basic to most definitions of the city and reasons for its existence is the idea of interpersonal communication. The city facilitates and expresses human inter-action. It is itself a communication system, a vast network of interdependent information flows. These flows are the movement of goods, energy and people.

This paper outlines two partial approaches to investigating the impact of communication on urban functional and spatial structure - the structure of existing information flows, and the influence of communication on the location of offices.

No comprehensive model of the influence of communication on urban structure exists, but it is hoped that a dual approach of the analysis of activity location and of the flows that connect such activities will be useful.

GENERAL DISCUSSION: 12.05 - 12.30.

LUNCH: 12.30 - 1.30

A light lunch and liquid refreshment will be available, at cost, in the Common Room on the sixth floor of the Bio-Sciences building on campus.

5. CONTROL IN THE CITY SYSTEM:

5.1 *Economic Controls*: 1.30-1.55:

Dr. J. Paterson, John Paterson Urban Systems Pty. Ltd.

A city represents a major investment of social capital in buildings and public infrastructure, and of cultural 'capital' in the forms of habitual patterns of behaviour and effective associations. Public sector planning may lead, or lag, the process of change; commonly public interaction is unco-ordinated, and its unintended consequences outweigh intended effects. While public sector planning represents an ill-defined control on virtually all 'natural' cities, the maximising behaviour of households and firms causes rapid and highly systematic changes in urban activity patterns and built form, in response to external stimuli or environmental changes.

External or environmental change can take the form of changes in real incomes, in the distribution of income, in consumption and production technology, in tastes, and in institutional arrangements at State or Federal level. At the level of the household or firm, maximising behaviour leads to a constant process of adjustment in household or business location, in demand for space, and in patterns of activity, which conforms well with the predictions of economic theory.

At the macroscopic level, however, the process of adaption is very complex, principally because of the longevity of buildings and infrastructure. The slow adaptation of the capital stock is very inefficient in terms of static equilibrium criteria, but it leads to adaptation in activity patterns which can be dynamically efficient. Because the time lags of response range so widely among the various systems which constitute an urban community, uncertainty is high and the final equilibrium after an initial disturbance is practically unpredictable.

5.2 *Legal and Political Controls*: 1.55-2.20:

Mr. G. Clarke, Urban Systems Corporation.

As we gradually evolve more precise scientific knowledge of the ecological impact of urban development, we naturally wish to employ the knowledge in the increasingly selfconscious management and control of urban systems.

This paper therefore presents an outline of a descriptive model, empirically derived, of the processes by which changes typically occur, or are introduced, in the structure of environmental controls. Current widespread concern with the nature and the mechanics of 'controls' implies a concern with a dialectic of stability and change not merely in the physical environment itself, but also in the nature of social and political attitudes, interests and ideas concerning the environment, and in the legal and administrative control mechanisms which derive from the competitive struggles of those attitudes, interests and ideas. The model is particularly concerned with the generation, communication and politicization of ideas in an increasingly knowledgeable society, and the degrees of scientific knowledge, social consensus and/or political power required for their effective legal and administrative implementation.

GENERAL DISCUSSION: 2.20-2.45

AFTERNOON TEA: 2.45-3.15

6. EVOLUTION IN THE CITY SYSTEM:

6.1 *Preliminary Phenomenological Equations of the City System:* 3.15-3.40: Mr. J.M.A. Chappell, A.N.U.

When regarding the city as a life system a conspicuous problem arises over the matter of systematically relating flows of physical energy to socio-economic interactions within the city. This is an important problem because it is the outcomes of these interactions which influence evolution of a city and change its energetics. In addition such interactions are themselves influenced by the pattern of energy flows and hence, the problem concerns a system of inter-dependent variables.

The central difficulty concerns the finding of functional relationships between the set of partitionings of energy usage, such as manufacturing, service and domestic, say, and the set of social categories such as administration, employer, professional, and worker. A relationship is seen between these two sets in terms of energy transfers where energy is partitioned into 'potential' energy, on one hand, and 'kinetic' energy. A city may then be modelled as a system comprised of several phases, such as industrial/financial/domestic, where the relationships between these are functions of (i) relative magnitudes of energy terms for each phase, and (ii) associated 'latent energy' of phase change. A set of phenomenological equations are developed, and their consequences compared with simple anatomical data from selected cities.

6.2 *A Working Model of the City System:* 3.40-4.05: Drs. J.F. Brotchie, R. Sharpe and P. Ahern, C.S.I.R.O.

The paper describes a mathematical model for use in a systems approach to urban planning. The model has the capability of allocating residential, industrial, commercial, recreational, conservation, and life supporting activities to potentially suitable spaces within the environment, so as to maximise the merit of the solution in terms of predefined goals. Activities may be allocated both spatially and in time, so that optimal times of development and re-development may be determined.

The model is specialized to the urban level by the inclusion of submodels for traffic flows, service costs, land value prediction and accessibility analysis. It may be calibrated to a particular city at the data level. It is physically a computer program and is housed in the CDC 6600 system, and accessed by remote terminal. The use of the model takes various forms, e.g. as: (a) a means of comprehensively evaluating various land use plans, (b) a guide to the improvement of these plans, (c) a testing facility for evaluating other decisions on transport networks, zonings, (d) a tool for allowing non-quantifiable factors to be weighted and included, (e) a facility for allowing community opinions to be entered and the consequences fed back in an interactive planning process. An example is presented.

7. PANEL DISCUSSION: 4.30 onwards.

Panel members will include Dr. R.J. Millington, Professor A.J. Rose, Professor P. Schwerdtfeger, Professor R.O. Slatyer and Mr. A.D. Winter.

PUBLICATION

The papers presented at this Symposium will be published as Vol. 7 of the Proceedings of the Ecological Society of Australia. Further enquiries should be sent to the Hon. Treasurer, ESA, P.O. Box 1564, CANBERRA. A.C.T. 2601.