ANALYSIS OF THE CONTEMPORARY URBAN ECOSYSTEM: AN APPRAISAL OF HONG KONG'S FUTURE

Richard L. Meier

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EXPLANATION OF METHOD

New approaches are needed for creating simple models of a metropolitan community which at the same time promise to provide a more comprehensive description. Models achieve simplicity by pushing the complexity back to a field of study that has been rather thoroughly pursued and elegantly condensed. Newcomers can then find their way quickly to the frontier where new findings are discovered and reported. Thus the urban economy can only be understood in terms of the general principles of micro- and macro-economic theory as previously elaborated; urban geography is comprehended according to techniques for observing phenomena, such as transport and location, strongly determined by spatial relations; urban sociology is forced to refer to holistic principles elucidated in demography, social structure, social organization, and social pathology; and urban politics depend upon prior generalizations regarding the use of power in human relationships. An executive, a planner, or a doctor responsible for welfare in a city finds that each approach excludes so many significant phenomena from consideration that a corrective is sought.

A living systems model promises just such an overview. From the time of Aristotle until the 1920's an organismic analogy for a society, or a city with its dependent territory, was a favorite for those who endeavored to be wise advice-givers. The organismic model

failed when the component populations of an urban society exhibited many wills simultaneously, so that action was rarely coordinated -- although it was often interrelated.[1] Thus a contemporary living systems model must fall back upon outside-of-the-skin biology with its greater indeterminacy for a suitable framework.

Indeed, it can be argued that a city is organized in a manner that is not merely similar to the ecological community, it is a true member of that class of phenomena -- albeit in an advanced, highly elaborated form. Therefore the generalizations and laws applying to community as a level of organization in ecological theory must also apply to cities.[2] It follows that studies of natural communities, or synthesized communities (as in agriculture and animal husbandry) will generate useful predictions (hypotheses) regarding communities in which the biomass is predominantly human. Such predictions could not otherwise be achieved without conducting experiments that were risky for member populations within the community itself. Thus ecological models are most useful because they permit the acquisition and organization of information for positive improvement of viability in much the same way it is accumulated in medicine -- systematic observation backed by controlled experiments, most often on simple homologues, dealing with a few variables at a time. However, the rigor of this analysis would fail to be communicated were it not for the fact that the teaching of ecology, formal and informal, has recently become as common as economics, sociology, or political science. The ideas can be transmitted to advisors and decision makers in ecological language now, whereas even a half decade ago this would have been possible in only one or two departments of government.[3]

Some appropriate definitions are in order at the start of an attempt to conform to systematic presentation: A community is made up of a cluster of interdependent populations interacting and exchanging with a physical environment. The boundary of a community -- the semi-permeable barrier that separates it from others and makes it possible to assign membership of individuals with minimal disagreement among observers -- is an edge or line (physically identifiable or abstract, as in law) that accommodates a much lower intensity of transactions and continuing relationships. The environment is composed of materials and resources necessary for the survival of the constituent populations as well as the forms and signs imposed upon it that serve to guide the behavior of the individuals and groups. The effective observer of a human community becomes a participant in it, whether he likes it or not. In order to acquire information rapidly he must place himself in busy sites and play an interactive role, thereby taking a risk of modifying some of the relationships likely to be of greatest interest. Naturalists and anthropologists are investigators of community who are particularly alert to the care that must be taken; an urbanist must take similar precautions when contacting the elite of a city.

There are dimensions to a community which are correlated with the appearance of organizational levels observed within it. Population sizes, territorial limits, energy consumption, and materials processing also explain a great deal. Perhaps the most important feature of living systems analysis is the quantitative description of the internal dynamics or life processes. These

include births, deaths, fate of migrants, formation of households and larger organizations, imports, exports, the accumulation of internal stocks, energy flows, and all the cyclical relationships that develop between them. Finally there is a history which traces the introduction and evolutionary course of the respective species (genotypes), the initiation and transformation of organizations, the redistribution of life spaces, the irreparable damage left from catastrophes, the depletion of essential resources, and so on.

A city records a huge amount of information about all of these matters. The problem of achieving a manageable overview is that of filling in the gaps and condensing the data. Even that is not enough, however, so the system description must take advantage of the fact that an educated reader has had experience with cities and would not be surprised by most of the assertions. What is most valuable for the policy formulator and the decision maker, as well as the scholar, is to have a knowledgeable person pick out those features that may be expected to have repercussions for the urban community in the future. They prefer specific forecasts of the local systemic trends that could lead to pollution, famine, epidemic, energy crises, or other grave injuries on one hand and the kind of intervention that increases the capacity to cope with the stresses imposed by the environment and by competitors.

If there is evidence that the forecast may be faulty (usually contraindications appear months or years before an urban ecosystem experiences a severe change) it becomes necessary to scrutinize the relevant details. Until then it is necessary to pick out the highlights

and the surprises. The obsolescence of much of the data drawn upon by the study can be overcome by using informed current estimates and short range projections. Any marked change in the dimensions from what had been expected quickly alerts the user to the fact that an error has been made in measurement, in estimation, in inference, or in the construction of the model.

DIMENSIONS

In Planning for an Urban World, when endeavoring to envisage a world population at steady state, with a predominant share of the people finding it necessary to reside in cities in order to live at a level above subsistence, I was forced to consider the city as a habitat for machines as well as for living things.[4] Machines are continuously filling niches previously occupied by humans, animals, and even plants; this process needs to accelerate as human population expands and natural resources become depleted.[5] Thus the urban ecosystem fits the following paradigm:

Physical Environment	Organic Environment
Stationary Machines	Plants
Mobile Machines & Vehicles	Animals
Automata	Humans

Hong Kong, among all existing metropolises in the world, allows one to obtain much more exact counts of the respective populations and fair estimates of the current rates of change. The reason is that the political boundary drawn around the Crown Colony encloses

very little rural hinterland and allows exceedingly little overspill into adjacent territories. Hong Kong's population is 98-99% pure metropolitan! It is not distributed over suburbs, exurbs, and satellites in an undefinable manner, as is the case for most other metropolises. Macao, for example, has an identity of its own, gaining no more sustenance from Hong Kong than would a small city several hours distant from a true metropolis anywhere else in the world. The Kwangtung province of China has a common language, but it also has a political system that is utterly alien; China is quite strict about maintaining control over flows at the boundary. Thus Hong Kong operates very much like a self-sustaining city state. Most of the statistics collecting apparatus was set up by British civil servants, so the data are as reliable as any that are available for cities. It represents a better case for ecosystem assessment than Singapore, partly because it is twice as large but also because it has a history with fewer discontinuities, so one is allowed to press inferences from ecological relationships a bit further in Hong Kong than elsewhere.

The notable populations introduced in the paradigm have been estimated for Hong Kong and are presented in Table One. Attempts were made also to estimate annual rates of change for the mid-decade period, but these trends are often more uncertain or variable. Inspection of Table 1 shows that, although a great deal of publicity is given to the rate of increase of human population, there should be a great deal more concern for the growth in numbers of vehicles (each of which requires as much

TABLE 1

POPULATION ESTIMATES: HONG KONG ECOSYSTEM (1974)

Stationary Machines		Trend
Electric Motors (air conditioners, pumps, clocks, industrial)	700,000	+11%/yr.[a]
Engines	30,000	+5%
Electric Generators	100	+10%
Mobile Machines & Vehicles		
Watches	500,000	+20%[b]
Vehicles	285,000	+9%
Autos	135,000	+7%
Trucks & Buses	40,000	+5%
Bicycles	150,000	?
Motorcycles	25,000	+18%
Ships	10,000	+5%
Automata		
Minicomputers[c]	100	+30%
Computer Centers[d]	1-200	

Plants		Trend
Trees	2-3,000,000[e]	+5%/yr.
Brush and Grass		?
Vegetables and Rice[f]		-2%
Animals		
Pigs	400,000	+10% in biomass
Poultry	6,000,000	
Cattle	10,000	
Fin Fish	10,000,000	
Shellfish	10,000,000	
Dogs	100,000	
Cats	50,000	
Birds	50,000	
Wildlife (mostly fish and birds)		
Humans		
Census	4,250,000	+1.4%
Refugees[h]	100,000	+15%
Tourists	15,000	+10%

a. Electric power use was increasing 12% per year up to the energy crisis.
b. Estimate from observations on the street and in the field
c. Estimate obtained from the Universities Joint Computer Centre.
d. Automata are sophisticated circuits controlling the machines; computer centers have much greater capacity, but their jobs are still mostly routine.
e. Assumes forest averages 70 trees per acre, with more in banana and fruit orchards, a few in residential zones. A tree is at least 20 ft. high or 1 ft. girth.
f. Increase in output due to faster rotation; acreage has been reduced recently.
g. Listed in approximate order of contribution to biomass.
h. Many are illegal, so perhaps underestimated; a new wave has appeared since 1972.

concrete platform for its "habitat" as 20-30 persons in a re-settlement unit). Crowding caused by the growth of vehicle numbers is much more imminent.[6] The even more rapid growth in electric motors requires the kind of attention to energy supply that has been accorded the subject only since the "energy shock of 1973-4."

An overall judgment of this community of humans and their artifacts arising from the population magnitudes and their trends is that Hong Kong is being stimulated to undertake extraordinary development. The growth of the respective populations could hardly be expected to stay in balance. Stated in still another way, the human population is very busy constructing and arranging a habitat convenient to itself, but in so doing it must draw increasingly heavily from the rest of the world for nourishment in the form of energy (food and fuel) and materials of construction. This developmental pattern is typical of a speeded up process of modernization in the twentieth century. However, with all the competing cities following much the same pattern as they move toward the twenty-first century, the physically limited supplies will not allow such a strategy to persist. The same kind of accelerated growth would occur in the natural world if, say, a forest were to be given much more fertilizer and a steadier supply of water, so that it became greener, supporting more insects. The latter, combined with more seeds and fruits, supported more birds. More leafy materials permit a greater population of mammals, and the presence of both birds and animals allows a much larger population of predators, such as man, to survive. If that extra fertilizer and water were to be shared with other forests the overall growth of biomass would be diminished, but not necessarily totally halted.

One consequence of this agglomeration of human habitat is the increase in the number of associations. Meta-stable groups are formed from the interdependence of individuals drawn from the respective populations; these groups have an address in the city, they respond to inquiries and transmit messages; they transact in many ways as would individuals. Households are groups of human beings, but they frequently have a pet, several electric motors, a clock and a watch or two, several plants and sometimes a tree or two. Enterprises and voluntary associations are, of course, legally recognized as corporate units, substituting in many instances for persons. Those engaged in market-related activities are, characteristically enough for Hong Kong, more completely enumerated and recorded than the religious, cultural, sports, and friendship groups. Nevertheless, due to a history of trouble with secret societies, the listing is more comprehensive than in most Western countries. At their present rate of growth it appears that human associations will require a larger share of the living space in the future. That means more office blocks and neighborhood meeting space (restaurants, cafes, tea shops, church parlors, temple grounds, playgrounds, community centers, resorts) than dwelling space.

THE SEARCH FOR COMPETITIVE ADVANTAGE

It is difficult to determine whether Hong Kong is moving into a basic imbalance with respect to the ecosystem as a whole. The metropolis of Hong Kong floats on a system of worldwide exchanges rather than a resource base in a hinterland, as is most common for other metropolises. Over the last several decades, and in prospect for at least one more, world trade has been expedited by improved

TABLE 2

HOUSEHOLDS AND ORGANIZATIONS

Domestic Units[a]	740,000	+3%
Companies[b]	37,000	+13%
Manufacturing Employers[c]	31,000	+10%
Voluntary Organizations[d]	30,000	10-15%

a. The growth in domestic units seems to be at the rate of 4-5% per year, but the rate of withdrawal from use appears to be 1-2%. After 1976, with the accelerated building of the new towns, both figures are expected to increase.
b. The disappearance rate for companies is extremely irregular, reflecting levels of stress in the business environment. Most firms disappear through amalgamation (a kind of predation?), with the survivor firm gradually integrating the activities of the separate predecessors.
c. The method of collecting statistics for the annual report of the Government has changed recently so that unregistered employers are now also counted, therefore the rate of growth of units is presently quite uncertain.
d. The number of registered societies is obviously an underestimate. The Chinese, as an ethnic group, are known to create many associations; increasing ease of contact in Hong Kong city life is expected to increase the number and the variety of these organizations.

transport technologies and new multinational institutions. Hong Kong is no longer merely an entrepot for China; its residents are able to trade their services for goods at a rate much closer to that obtained by Japan, Europe, and the United States. This is accomplished by extending the diversity of its skills, and incorporating new activities into the community that connect with others elsewhere so as to result in enhanced rewards to both parties; each change represents an adaptation to new opportunities and an investment in internal reserves and buffer stocks or repertories. The stepwise acquisition of new activities by the city during its relatively brief history illustrates this process.

Hong Kong was created by the British as a locale for expediting the flow of trade with China -- households and firms specializing in tea, opium, silver, shipbuilding, and banking settled there from 1840 onward. Trade moved irregularly, taking advantage of intermittent booms to establish a broader base until the 1930's, when textile and garment manufacturing were introduced by Japanese and Chinese entrepreneurial groups to circumvent the Imperial Preference Agreement in order to capture some of the markets supplied by Lancashire mills. Before World War II a rubber shoe industry was superimposed upon them and electric flashlight production had also become established, but little else.

Many of these original activities have now been displaced, while a few have been transformed.[7] Opium traffickers are vigorously hunted but still are present, the silver trade has been replaced with gold, while shipbuilding and repair have advanced to shipbreaking and rolling the salvaged steel into plates, bars, and rods. Tea blending is giving way to coffee, but quite grudgingly. Banking and brokering have found rich new opportunities for gathering financial resources;

one result is an expansion of the surface and volume of the reconstructed environment. The textile weaving and the shoemakers reached a plateau in the early 1960's, but the garment creators have fitted their wares to the world fashions so well that they continue to prosper.

Artisans who were fabricating colored paper for Chinese festivities took on sheet plastics and found a world market for plastic flowers, so that in the 1950's they farmed out the orders to a cottage industry for the population floating in the small harbors and the women in peripheral settlements. Upon this base was built a much larger plastic toy industry in the 1960's; by adding clockwork, electric, and electronic mechanisms it became a world leader in the 1970's. Manufacture of cheap transistor radios was taken up about 1960, but in 1965 the production of high precision microcircuits was adapted to Hong Kong conditions. These sub-assemblies for instruments and computers were produced so well and so cheaply that they became a principal Hong Kong industry within a few years; soon they became equally established in Seoul, Taipei, and Kaohsiung and the interchange of these products between them has become a striking phenomenon in the air freight industry. The fabrication of knitted goods in the early 1960's led Hong Kong enterprisers onto wigs -- a supergrowth industry that collapsed in 1970 -- and then into high style knitted gowns that were more profitable for both the enterprisers and the workers.[8]

Printing is an industry that has been around to some degree for a long time, but high quality printing for export has now been added, and magazines and books are produced in ever larger quantities.

Other precision industries, such as watch making and camera manufacture have also been showing some remarkable increases. Soon to come are oil refining, the synthesis of plastics raw materials, fiber manufacture, and desalinated water; in each of them the production is carried out by stationary machinery supervised by automata which in turn are managed by a few technical workers and executives. The accession of these major facilities was in each instance demonstrated to fit a niche that had been created by the establishment of the predecessor activities.[9]

Note that in this discussion the successive rise and fall of activities has been reported. Activities that are not contributing to the survival and maintenance of the populations in the community are soon abandoned in favor of others that appear more promising. In general, Hong Kong is installing activities that require more energy, more machines, and better trained people to take the place of the waning activities. An approach to some kind of a climax condition will depend not only upon the discovery of a balanced, integrated set of activities, but also upon the achievement of relative stability in the rest of the world. Therefore those people in the community who watch over the boundaries and pick up the influences (information) transmitted across them must be very alert and must communicate much more. It is not surprising that a steadily increasing part of the human effort is being spent upon communications. Paper work is the creeping disease of an established organization, whether in the manufacturing sector or in Government, even in a community ostensibly dedicated to "laissez faire."[10]

The statistics for clearly separating the white collar communications-based jobs from the production labor are not available, since manufacturing employment reflects the total jobs reported by a firm

if its predominant activity was a secondary form of production. Hong Kong has a long way to go to catch up with Western societies, but it, too, is becoming a white collar, service-oriented community. Thus far only the dullest work of the clerks and accountants has been replaced by electronic data processing -- the next stage in the normal succession of activities in a modern community. Software utilized up to the present in Hong Kong cannot be regarded to have achieved the status of automata, with the few exceptions noted in Table 1. Recently however, an increasing number of reasonably sophisticated automatic reservations and inventory management systems have been instituted. The next stage in the succession will appear shortly when automata are assigned the operation of equipment in office buildings and the control of trains and buses in the mass transit system. Interestingly, the important criterion for automation in Hong Kong, as elsewhere, is not to save labor (unless human specialists are exceedingly scarce) but for the minimization of errors, accidents, and some kinds of negligence and crime within the metropolitan community. Automation will reduce fatigue, which often also means a work week reduced from the present 46-60 hours to the more typical 33-40 hours practised elsewhere. But the advanced automatic control systems also require huge quantities of information in order to assure stability over the long run, therefore many more humans are put to work obtaining the data, editing it, and coding it for the machine. Altogether these are more interesting and varied jobs than routine paper shuffling, because most of the data are obtained from other human beings, and much of the remainder requires non-routine inspection of the environment.

An urban community is assured of survival at its present standards of existence if it can export products and services of continuously increasing quality. In the future, quality will no longer depend upon the richness of the materials employed or the luxuriousness of the features displayed, but mostly upon the precision (i.e. absence of error) with which it fits the requirements.

THE STRESSES OF GROWTH AND CHANGE

Whenever a community undergoes rapid growth it should expect that some kind of price must be paid. Different components grow at their own rates, and some of the apparent imbalances that result have already been highlighted. The identification of these differentials is a worthwhile enterprise. The respective growth rates have been estimated by making deductions from various annual reports of Hong Kong agencies. The official physical dimensions for Hong Kong have remained constant since 1861, yet the land surface is increasing about 0.2% per year due to reclamation from the sea. The human population is growing about 1.8% per year (counting refugees), and the number of vehicular trips by about 3%. The number of dwelling units is expanding by about 3%, as are the number of school places and the number of jobs. The amount of roadway is lengthening by about 4%, the amount of income available for consumption (in real terms) 5-8%, the amount of water consumed 8-9%, vehicles licensed 8-9%, solid waste produced 10-12%, and electric power generated about the same. The number of telephones installed advances by 13-15%, but the number of telephone calls placed is going up at a rate of 15-17%. The value of checks cleared is multiplying at a rate of 20-30% per year, while the additions to capital stock are more variable at 10-35% per

year. Each of these rates represents a different way of looking at internal growth: those mentioned earlier are more primitive and structural in nature; the intermediate ones involve transfers of consumer goods with a marked style, quality, or informational component; while the last mentioned measure transactions which have purely symbolic value with minimal demands upon space, so that they exhibit little friction with the environment.

A few indicators of the localized ill effects imposed by the milieu upon its resident populations can be found within the current reports. Tuberculosis is still a big killer in Hong Kong, but the rates are dropping by 3-5% per year. Measles and chicken pox are episodic, but also show a major long term decline. Traffic casualty rates are falling 1-2% per year based upon potential victims, about 9% based upon the population of vehicles. Overall crime reported showed a marked jump in 1973 (16%) but this indicated much more a willingness to record crimes that could not be traced to perpetrators as well as a redefinition of crimes against public order, such as littering public places. A noticeable increase in violent crime, particularly on the part of the growing population of juveniles, led to a special campaign with the slogan "Fight Violent Crime!" An increase in the number of crimes against property and the processes of exchange (e.g. theft, fraud, forgery, corruption) reflects not only the vast increase in opportunity due to the extraordinary growth in securities transactions, but also increasing attention by the authorities concerning the corruption issue.

Data like these indicators demonstrate rather uniformly that the individual and the family are becoming more secure against private disaster despite the increasing intensity of public interactions

and an enhanced temptation for criminals. In part this improvement may be due to cooperation taking the form of public associations which allow people to defend themselves against sources of insecurity. Thus the Hong Kong of 1974 had significantly fewer bad things happening than the Hong Kong of 1973, and the trend promises to continue. Such a conclusion goes against the perceptions of the people themselves, even the educated stratum, because the mass media, particularly television, have taken up crusades against crime, accidents, and pollution, so the number of incidents reaching the attention of the public exaggerates their prevalence. Very likely this increase in concern, which often changes to cynicism, is one of the necessary prices people must pay for enhanced communication.

Because Hong Kong's population densities set the world's record (still up to 400,000 persons per square mile, or 1600 per acre, with hundreds of thousands of households limited to 25 square feet per capita -- 2.5 square meters -- or less) they have caused architects and town planners to search for ill effects due to crowding. Studies on mammals had long ago demonstrated that crowding caused serious disorders leading to neglect of infants, resorption of the fetus, infertility, cannibalism, and related phenomena. The health and activity reports already reviewed give no confirmation of these expectations. However, one argument commonly made is that the stresses may have been internalized, so that they may later release into the urban ecosystem some kind of collective frenzy that could gravely injure, perhaps destroy, the community. Historic examples of self-destruction in cities have been cited, starting from the days of imperial Rome and continuing into the mid-twentieth century.

It is not surprising then that in the social scientist's attempts to get at levels of emotional strain Hong Kong conditions have been studied more intensively than those of any other metropolis.[11] Moreover, smaller comparative studies were conducted in metropolises which contained Chinese along with other ethnic groups (Thai, Malay, Indian) in crowded districts. Mitchell started his major investigation by identifying indicators of strain -- worry, personal unhappiness, low self-esteem, ill health, emotional instability, hostility, withdrawal from family roles, withdrawal from work roles, and deprivation of access to social services. Although almost all of these reports (taken by interviewers proficient in the same dialect over an extended visit with adults) intercorrelated at the individual and the household level, none of the metropolitan areas studied could be shown to be clearly superior or inferior to Hong Kong. The latter contained a greater proportion of unhappy people and people who complained of ill health, but the hypochondriac character (recall that morbidity rates, except for tuberculosis, are low, and all are declining) is explained by the fact that at that time(1968) Hong Kong also contained the greatest downward intergenerational mobility (subjectively interpreted) among all the comparable Asian cities. The wide scale loss of status may be attributed to the very high proportion of refugees together with the frequency of being employed in a "dead end" job. However, few Hong Kong people felt "exploited" then, despite the fact that 60% of them were hired on a seven day week, usually with a ten hour work day. Conditions like these also explain why Hong Kong people were most likely to feel tired at work. They were also often disturbed at work by things that happened at home, but not vice versa.

Extraordinarily dense Hong Kong housing is not statistically associated with unusual levels of emotional strain, even down to a median floor space in resettlement housing of 23-26 square feet per person. Analysis of the separate breakdowns provided by the survey persuade one to believe that government policies for the construction and management of subsidized housing were consonant with user preferences. Although these major programs were aimed at preventing destructive fires and epidemics, as well as opening up accessible land for more intensive use, they have not measurably increased levels of mental strain.

Despite the immediate relevance to ecological arguments of this attempt to elucidate the earliest possible traces of stress, few specific forecasts of those who knew the subject best have been borne out. For example, without investigating the data Mitchell speculated that strains might appear on the crowded street if they did not show up in tightly organized workplaces or households.[12] That possibility has obviously not been borne out. Nor was the intuitive guess that the transition to a six day week would result in malaise. Furthermore it must be noted that indicators of mental strain are very sensitive to security of employment and to the threat of political instability. When the business and political climates are rosy, as during the first three quarters of 1973, there should be a noticeable improvement in happiness as reflected by interview techniques.[14] These qualifiers about social surveys of mental health are introduced primarily to discourage their use for program development; their outstanding value in this instance was a strong disconfirmation of the "worst case hypothesis" which until the work was done sounded only too credible.

The conclusions to be derived from the sum of the evidence is that the Hong Kong habitat is presently favorable for man, animals, and some plants, more so than almost anywhere else in Asia. These conditions are encouraging a proliferation of growth together with the emergence of higher levels of organization. Local residents resist such conclusions; professional opinions voiced elsewhere also do not agree. Therefore I have sought a number of corroboratory tests. Migrants change their home environment for a better one. A local example is the moving of the water people from their boats and isolated houses-on-posts in tidewater villages. Jobs in factories and apartments in a tightly packed settlement have brought more than half of them into the metropolis over the past fifteen years. Apparently they prefer that life to the uncertainties of fishing and the ties to a folk community with a long tradition. Almost all have the opportunity to move back again, but they are sticking it out in the heart of Hong Kong or its high density appendages. The fisherman's life is much better now that dieselization allows him to go out in all seasons, and the price is up, but their number continues to dwindle while the Koreans and the Taiwanese expand.[15]

Similarly an increasing net flow is observed from China into Hong Kong, much of it moderately well-informed because relatives outside provided contacts both before and after migration. Moreover, the flow to the United States, Canada, and the United Kingdom tends to select the locales in those countries that most resemble Hong Kong, even though jobs for bilingual Chinese are readily available in more thinly populated locations. Hundreds of thousands of individual

choices of residence have been made over the past decade, and the great majority show a clear preference for Hong Kong-like communities, as compared to a variety of others.

These are personal and small group decisions made by people who are marginal to communities, and presumably more sensitive to the stresses than the mass, because it is the overstressed (or understimulated -- a stress of another sort) who seek to escape. The totality of evidence, therefore, seems to argue that the quality of life in Hong Kong grades from average to good as compared to all the real alternatives open to human members of the community, even though it may be seriously flawed as compared to an ideal version of city life.

ALTERNATIVE PATHWAYS INTO THE FUTURE

The fundamental environmental issue facing Hong Kong as a community is not the relative goodness or badness at present, or even the threatened levels of pollution. It is the need to find a relatively painless path to a climax condition that exhibits zero population growth and zero energy utilization growth, together with flexible water usage and raw materials requirement. Because it is only a speck on the shoreline of China, it has little control over its destiny, and therefore pathways that offer least resistance to outside forces must be considered. Three very different kinds of alternatives will be explored here, but a review of parallels in recent history will suggest a number of others.[16]

First the important non-future should be noted. The recent remarkable growth cannot continue very long in the path it has taken.

Curiously, most people in Hong Kong are acting as if it will. The commentary in the newspapers tends to confirm them in this habit. The fallacies in this way of thinking have already been reviewed.

1. Goal-Directed Projection into the Future. This is the kind of future that a society can plan for and then proceed to implement. For many societies, if they can construct a realistic plan, this would be the most likely pathway; however, Hong Kong's political situation reduces the capacity to plan effectively. Yet, at the moment, this future can be better defined than any other because it is continuous from the present and the recent past.

The simplest, most ecologically sound program for the community of Hong Kong presumes that the boundaries (which are virtually undefended) will remain stable and that the lease for the New Territories can be renegotiated on much the same terms as at present. Immigration would be balanced by emigration.

The continuing investments in education make it likely that another 40% of the population will accept birth control as rapidly as the last 40% (requiring perhaps twelve years). Thus the one to two child family becomes the norm and only unusual households bring the reproduction of the human population up to or somewhat beyond replacement levels. Under these circumstances the population will grow older, with the average age shifting from less than twenty at the present time to about thirty five a generation from now. The total population of Hong Kong would level off at a figure close to six million.

As a part of this projection it is judged that the dependent pig and poultry populations would by then have reached a somewhat

higher level than at present, mainly because they can be fed on the wastes of the city and the byproducts of the food processing industries, with supplements drawn from the cheapest rough grains on the world market.

The major population expansion is to be expected in fish, as an outgrowth of the borrowing of mariculture techniques from Japan and Hawaii. Floating ponds allow the recycling of human and animal wastes back to the pigs and the domesticated fish, instead of the present disposal into the tidal currents. These innovations are proceeding in nearby Taiwan.[17]

Under climax conditions rice growing should virtually disappear, but Hong Kong would be almost entirely self-sufficient in vegetables. The steep hill and mountain sides would be largely reforested, some of them becoming already quite dense and park-like a human generation hence. The mountain tops would support new and more digestible grasses, fertilized to increase the rate of production. Thus much more grazing would be carried out, but in a way that seldom detracts from the enjoyment of people on holiday, since the same peak areas are very precious for recreational uses.

The big stationary machines -- oil refineries, petrochemicals, plastics, and fiber production, steel mills, and shipyards -- are due to be installed in Hong Kong. Then its industry will become far more vertically integrated than now, but still less so than Japan, Korea, or Taiwan. Many intermediate products will still be shipped out and others quite similar will be imported. In this future Hong Kong must remain a very open system with worldwide relationships. The big machines require energy, but that energy is already spent elsewhere on the globe for intermediates now used by Hong Kong,

so their energy demand represents merely a displacement of "dirty industries" from Japan and the Common Market to outlying islands around Hong Kong. There the dirt is either prevented by more modern design or it is segregated so that the living populations are not much affected. The Japanese are even willing to design synthetic islands; they become economic if land price continues to escalate. The expense of the fuel will assure that a high level of energy economy is practised in manufacturing.

The automotive vehicle population must come under control well within a decade. As the annual increment dwindles to zero the diversity will increase, much as has already occurred in construction machines, vans, and in shipping. Private automobiles can be displaced by increasing the personalized transport services, such as dial-a-ride. Fortunately the era of the universality of the telephone is virtually upon Hong Kong. Its micro-electronics industry will soon be capable of producing a portable telephone that would allow one to quickly obtain a ride from any origin to any destination at a price less than is paid for the same trip by automobile.

Bicycle populations will vastly increase in the new towns and environs, being assigned in many instances a separate network of lanes, following upon precedents now being established elsewhere in the world. The cycle population will also become quite diverse in order to fit the needs of older people.

The automata in this future will be largely invisible and embedded in the newest industries and services. If half of the new equipment in America will incorporate sophisticated automatic

control systems by 1975 (a Business Week estimate) then the same level of use should come to Hong Kong ten or fifteen years later. Their introduction could save twenty to forty per cent of the energy and materials required per unit of output. A large share of the saving would be due to the expediting of round-the-clock organization which allows Hong Kong to be continuously "on line" by means of communication satellite with America, Japan, and Europe.

The constructed physical environment must keep on growing much longer than the populations. In large part this is due to the unfulfilled demand for construction in this metropolis, but it is also needed to add flexibility to the economy, allowing it to adjust quickly to exigencies and opportunities in world trade. Thus a population of six million is likely to demand living space for itself and its organizaitons at least three times the present floor and road area and perhaps four times the enclosed volume. One of the significant reasons is the growing body size of the resident Chinese that is attributed to improved diet. A variety of water borne structures is likely to be added a decade or two hence. The new structure must be designed for minimal air conditioning and maximal natural ventilation in order to save energy and gain flexibility of use under varying conditions of world supply.

Henceforth the emphasis everywhere must be on improved fit between the respective populations and the constructed physical environment. The engine and chassis of a vehicle may be quite standard, but the body and the auxiliary equipment will be increasingly adapted to the function it serves. Thus, in very little time, the body may change to fit a completely new function. Containerization

starts with a standard exterior and introduces new liners and internal supports to handle many different cargoes. These approaches complement each other.

Similarly, the price structure for services, such as water and power supply, must be made still more variable so that real economies can be achieved during periods of regional or world scarcity that inevitably mean scarcity for Hong Kong. Thus if the world food situation becomes serious (less likely than presently publicized in the newspapers, but still a very real possibility) the pig and poultry populations of Hong Kong will suffer, the banquets will depend upon to-fu and textured protein substitute materials. Rice would give place to bread, noodles, and cornmeal pasties. In general it is much more economical for a harbor metropolis to invest in flexibility than in large buffer stocks.

2. Rupture of the Boundary with China. This is an apocalyptic future that presumes temporary breakdowns of public order in China equal to or more severe than The Cultural Revolution. Then poor refugees will come crowding into Hong Kong at the same time that a large share of the cosmopolitan population, and the financial resources they control (led by the tiny minority holding passports) would flee to safer cities. The population could very easily double, and the standard of living fall back to subsistence for a while.

Population pressures are so great in Kwangtung, Fukien, and the provinces to the West that, once economic development was resumed, the conurbation of Canton should grow to a size larger than greater Tokyo. The number would at least be in the range of 30-50,000,000 people, but probably even larger. The land forms require it to be

polycentric, so that an enlarged Hong Kong might play a very significant role in initiating the enterprises and managing the technology as well as offering an opening to the world. Hong Kong might play the same role for the new Canton that Yokohama-Kawasaki did for Tokyo, because Canton would almost certainly remain the center of political administration and be backed with the military police power. The small scale manufacturing that still employs much of the labor force of Hong Kong would move onto new estates not yet populated.

The risks of further breakdowns along this pathway are very high. There may be repeated famines and revolutions in China until population distributions again come into rough balance with food production and with the capacity to distribute imports from the outside world. (The transport system of China does not allow it to depend upon food surpluses in America and Australia the way that India and Java can.) However, due to its high quality harbor and docking facilities, and the great distance from the famine belt, the Canton conurbation should be better off than any other part of China.

During a period of hard times and disorganization in China the conurbation of Canton should remain a center of stability and become a base from which political power over a large hinterland could be exercised. Whatever is left of the indentity of Hong Kong would play an important part in that renaissance.

3. A Quasi-Independent City State. The accelerated decline of the United Kingdom's share of international trade makes it possible that it might divest the last traces of Empire in the foreseeable future.

Then Hong Kong would be forced to pursue a course somewhere between that of Singapore and the future Taiwan. Like Macao, it would have to take orders from Peking, but as long as the yield in foreign exchange is high there may be very little interference. Nevertheless, the demands upon its ecosystem would be much more dependent upon Marxist philosophies expounded in Peking than the Western ideas increasingly propagated in Hong Kong now. Short run interests of an aggressively developing economy, separated by a more permeable boundary, would predominate over the progressive evolution toward a steady state propounded here.

As a result the carrying capacity for biomass would be significantly reduced for a long time to come. The ability to adjust to shocks arising from political and environmental shifts would be judged from the point of view of the survival of the collective unit, and much less that of individual welfare. A biologist would recognize that such a policy is analogous to a concern with the survival of the sub-species, or the gene complexes, rather than the size of the respective cohorts. Both emphases are common, and neither can be claimed to be superior to the other.

CONCLUSIONS

Hong Kong's urban ecosystem is most unique in that it produces better data about the functioning of the complete metropolis.

The information available shows clearly a community in the midst of exponential growth. A continuation of present differential growth will soon exert intolerable stresses. Already in 1974 some of the forces that should cause this growth to level off and integrate

were noticeable, but most of the essential policies have yet to be formulated and put into effect.

Three very different kinds of futures were explored. The one that can be planned by present leaders could lead to a steady state in population, energy use, and water consumption in perhaps a dozen years, although the growth in the constructed physical environment would continue for decades. Rupture of the boundary with China would probably be accompanied by major disasters, from which Hong Kong would recover as an integral part of a Greater Canton conurbation. The third involves increased permeability of the boundary. Then Hong Kong's environmental philosophy must more closely approximate the Marxist-Leninist viewpoint held in Peking at the time. It is expected that this thinking will place less emphasis on maximizing the carrying capacity of the environment, and more on the survival of the collective.

FOOTNOTES

[1]The Chicago School of urban sociology emphasized what almost every city dweller who took pains to observe his milieu already knew -- a rapidly growing metropolis fostered a disjointed, pluralistic society. Louis Wirth is often given credit for expounding this argument systematically, but a careful reading of his selected work edited by A.J. Reiss, On Cities and Social Life, (Chicago: Phoenix, 1964), yields no succinct definition that remains valid today. Concepts of order and organization applicable to cities are still undergoing rapid change, perhaps because the sources of the problems that are faced collectively are also shifting. Also cf. S.S. Guterman, "In Defense of Wirth's 'Urbanism as a Way of Life,'" American Journal of Sociology 74, 1969, 492-9.

[2]Theory building in biological systems rarely depends upon analogy; it strives to reach generalizations about living systems that are homologous -- in practice this means that they should apply to all members of a class emerging at a specific stage of evolution. That argument is best summarized by James G. Miller, Behavioral Science 10, 1965, 193-237 (Basic Concepts); ibid 16, 1971, 277-301 (Structure and Process). A subsequent formulation of methodology directly applicable to the social sciences was published later by C.A. Laszlo, M.D. Levine, and J.H. Milsum, "A General Systems Framework for Social Systems," ibid 19, 1974, 79-92. It succinctly defines the intellectual frame within which this paper is conceived, but not its style. The transition from natural to urban systems is very elegantly treated by Amos H. Hawley, "Ecology and Population," Science 179, 1973, 1196-1201.

[3]The developmental policy consequences of ecological arguments are rarely taken up in a holistic fashion, but a good beginning is found in Eugene P. Odum, "The Strategy of Eco-system Development." Science 164, 1969, 262-70.

[4]Richard L. Meier, Planning for an Urban World: The Design of Resource-Conserving Cities, (Cambridge, Mass.: M.I.T. Press, 1974), in press.

[5]The initial insight occurred when Ikumi Hoshino was enquiring into the loss of population from the most densely settled ward in Tokyo. All indicators suggested that it remained as crowded as ever. Then we discovered that the minimum parking space on private property, as required by a law that was strictly enforced, equalled the average

living space of a resident human being, and that for every person who had moved out a vehicle had been moved in. R.L. Meier and Ikumi Hoshino, "Adjustments to Metropolitan Growth in an Inner Tokyo Ward," Journal of the American Institute of Planners 34, July 1968, 210-222.

[6]Vehicular population growth in Hong Kong already seems to be slackening -- a trend that is attributed more to administrative measures than to increases in the cost of fuel. The cost of the operating license was doubled, and the queue for obtaining a driver's license was allowed to lengthen to six months. Parking charges are brought up to a level that is felt, even though they are still less than the charge that would meet the current land rents. Traffic law enforcement has been noticeably tightened. An excise tax on passenger cars exists, but until now has not been high enough to act as a serious deterrent.

[7]S.G. Davis, Hong Kong in its geographical setting. (London: Collins, 1949); G.B. Endacott, Government and People in Hong Kong, (Hong Kong: Hong Kong University Press, 1964)which describes government actions; T.N. Chiu, The Port of Hong Kong, (Hong Kong: Hong Kong University Press, 1973) which emphasizes the responses in port development and administration that made continued industrial growth possible.

[8]Much of this information needed to be gleaned from issues of the Far East Economic Review, but they rarely rise above the news and comment upon it. The business news sections in the newspapers sometimes contain more comprehensive reports. A useful partial summary with time series was produced by the Hong Kong Trade Development Council, Industrial Investment, Hong Kong 1973-4 (1973).

[9]The principles of ecological succession are very much discussed in America, but are virtually ignored in Europe, perhaps because intervention by man over the course of recent natural history has been so common there that few instances exist where successional changes can be clearly identified (a complaint heard here in Hong Kong as well). The activities referred to here are represented by a category of machines, identifiable by name and function, around which human and vehicular movements are organized. The successor industries may not have more numerous machines than those they displaced but they do tend to organize more people, vehicles, and other stationary machines. Thus activities have been emphasized, rather than the populations of the respective "species" of machines. Most of the specific information on activity has been winnowed from the annual reports of the colony, the latest of which was Hong Kong 1974, Report for the Year 1973, Hong Kong Government Press, 1974. Although the government is quite secretive about its operations, particularly when judged by the top civil servants to be relevant to policy considerations, it is quite fulsome when claiming credit for progress. Since the additions of new activities are normally defined as progress, they are quite comprehensively reported.

[10]The extent to which laissez faire ideology affects administration and policy is striking. It comes out most clearly in Keith Hopkins, editor, Hong Kong, The Industrial Colony,(Hong Kong, Oxford University Press, 1971).

[11]Robert Edward Mitchell, Levels of Emotional Strain in Southeast Asian Cities, two volumes, (Taipei: Orient Cultural Service, 1972).

[12]Robert Edward Mitchell, "Some Social Implications of High Density Housing," American Sociological Review 36, February 1971, 18-29.

[13]Robert Edward Mitchell, personal communication, December 1968.

[14]These deductions follow from the studies upon happiness, particularly those which demonstrate a close relationship between the degree of social participation and happiness. During periods of improving employment prospects participation and opportunity obviously increase and are, on the whole, more rewarding. Derek L. Phillips, "Social Participation and Happiness," American Journal of Sociology 72, March 1967, 479-88. Although the original studies were carried out on an American sample, parallel investigations undertaken elsewhere in the world indicate that the relationship is quite general.

[15]The best current indicators are obtained from the annual reports on fisheries in which estimates of those actively engaged in fishing occur periodically. The total has dropped from 70,000 in 1965 to 46,000 in 1973. Moreover, an important share of the water-people still fishing have moved into flats in harbor towns, some of them involuntarily in the course of cleanup programs. The number of vessels has been reduced to 5600, not all of which are used as residences. This represents a huge reduction from the 150,000 to 200,000 estimated to live in that manner after World War II. The hurdles that they needed to overcome are described by E.N. Anderson in his monograph The Floating World of Castle Peak Bay, (Washington: American Anthropological Association, 1970). Crowding was the least of their worries.

[16]An admirable paper analyzing the possible political futures for Hong Kong was published by Prof. P.B. Harris, "The International Future of Hong Kong," International Affairs 48, January 1972, 60-71. It is unusual that the conclusions should remain valid after the cessation of the American participation in the Viet Nam War, the Nixon shock, and the Kissinger miracles. The passage of time has allowed only a slight sharpening of the alternatives which he was able to perceive.

[17]The Taiwanese are said to combine night soil from Taichung with pig wastes to produce by means of a sequence of three ponds a

continuous crop of proteinaceous green algae, mainly Chlorella. This product can be added to the swill, supplying some of the calories and a large share of the protein required for raising pigs. (Private communication from Michael G. McGarry, September, 1971, supplemented by Taiwanese descriptions at the International Seminar on Land Reform in Relation to Industrial Development, Taipei, December, 1973.)